

B-52G FLIGHT MANUAL

USAF SERIES AIRCRAFT

F34601-79-D-3131
F34601-81-D-0326

CHANGE

NOTICE

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Commanders are responsible for bringing this publication to the attention of all Air Force personnel cleared for operation of subject aircraft.

This publication replaces Safety Supplement -310. See Technical Order Index T.O. 0-1-1-2 for current status of Flight Manuals, Safety and Operational Supplements, and Flight Crew Checklists.

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1 JANUARY 1975

CHANGE 26 — 15 MARCH 1982

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LIST OF EFFECTIVE PAGES

INSERT LATEST CHANGED PAGES. DESTROY SUPERSEDED PAGES.

NOTE: The portion of the text affected by the changes is indicated by a vertical line in the outer margins of the page. Changes to illustrations are indicated by miniature pointing hands. Changes to wiring diagrams are indicated by shaded areas.

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STATUS OF SAFETY AND OPERATIONAL SUPPLEMENTS

This supplement status page is based on information available to the manual editor as of the date of this publication. The information may not be current as it must be updated by any subsequent supplement status pages and by reference to T.O. 0-1-1-2.

SUPPLEMENTS IN THIS CHANGE

NUMBER	DATE	SHORT TITLE	SECTION AFFECTED
S-297	15 Jan 80	Crosswind Crab Button	Rescinded
SS-299	17 Sep 80	Downward Seat Linkage Inter- ference (Interim)	Rescinded
SS-307	11 Aug 81	RCD Closure (Interim)	VIII
S-309	3 Feb 82	Rescind Crosswind Crab Button	Rescinded

OUTSTANDING SUPPLEMENTS

NUMBER	DATE	SHORT TITLE	SECTION AFFECTED
S-308	11 Sep 81	Angle of Attack Chart	

[illegible]

LIST OF ILLUSTRATIONS — Titles included in alphabetical index

Before operating the B-52G read the following pages carefully!

SCOPE. This manual provides you with a general knowledge of the aircraft, its characteristics, and specific normal and emergency operating procedures. Your flying experience is recognized; therefore, basic flight principles are avoided.

SUPPLEMENTARY MANUALS. This manual must be used with one or more of the following supplementary manuals to obtain all the information necessary for safe and efficient operation of the B-52G aircraft. These manuals have been separated from this manual for your convenience in handling information which may be classified, applicable only to certain aircraft configurations, or used only by certain crew members.

T.O. 1B-52G-1-1	Flight Manual - Appendix 1, Performance Data - B-52G
T.O. 1B-52G-1-5	Gunner's Manual - Inflight Operation, ASG-15 Fire Control System - B-52G
T.O. 1B-52G-1-6-1	Radar Navigator's/Navigator's Manual - Inflight Operation, AN/ASQ-38 Weapons Control System - Offensive, B-52G and H
T.O. 1B-52G-1-6-2	Radar Navigator's/Navigator's Manual - Inflight Malfunction Isolation and Correction Procedures - AN/ASQ-38 Weapons Control System - Offensive, B-52G and H
T.O. 1B-52D-1-2	Electronic Warfare Officer's Manual - Inflight Operation - B-52D, G, and H (SECRET) (Title Unclassified)
T.O. 1B-52D-25-1	Nuclear Bomb Delivery Technical Manual - Basic Information (SECRET RESTRICTED DATA) (Title Unclassified)
T.O. 1B-52D-25-2	Nuclear Bomb Delivery Technical Manual - Bomb Operating Procedures (SECRET RESTRICTED DATA) (Title Unclassified)
T.O. 1B-52D-25-3	Nuclear Bomb Delivery Technical Manual - Ballistics (CONFIDENTIAL-FORMERLY RESTRICTED DATA) (Title Unclassified)
T.O. 1B-52G-30-2	Aircrew Weapon Delivery Technical Manual B-52/AGM-69A
T.O. 1B-52D-34-2-1	Aircrew Weapons Delivery Manual, (Nonnuclear) (Description and Procedures) - B-52D, G, and H
T.O. 1B-52D-34-2-2	Aircrew Weapons Delivery Manual, (Nonnuclear) (Ballistics) - B-52D, G, and H
T.O. 1-1C-1	Flight Manual - Basic Flight Crew Air Refueling Procedures
T.O. 1-1C-1-15	Flight Manual B-52G/H - Flight Crew Air Refueling Procedures with KC-135, Supplement XV

SOUND JUDGMENT. Instructions in this manual are for a crew inexperienced in the operation of this aircraft. This manual provides the best possible operating instructions under most circumstances, but it is a poor substitute for sound judgment. Multiple emergencies, adverse weather, terrain, etc may require modification of the procedures.

PERMISSIBLE OPERATIONS. The Flight Manual takes a "positive approach" and normally states only what you can do. Unusual operations or configurations are prohibited unless specifically covered herein. Clearance from the using command must be obtained before any questionable operation, which is not specifically permitted in this manual, is attempted. Before granting the clearance the using command may request coordination or engineering assistance/approval from Oklahoma City ALC. Request should be made through the Flight Manual Manager.

STANDARDIZATION AND ARRANGEMENT. Standardization assures that the scope and arrangement of all Flight Manuals are identical. The manual is divided into nine fairly independent sections to simplify reading it straight through or using it as a reference manual.

SAFETY AND OPERATIONAL SUPPLEMENTS Aircraft information involving flight crew safety will be promptly forwarded to you by Safety Supplements issued against this basic Flight Manual. Safety Supplements covering loss of life will get to you in 48 hours by TWX (called Interim Safety Supplements) and those concerning serious damage to equipment within 10 days by mail (in a formal printed form). Operational information not involving safety but of an urgent nature will be forwarded to you by Operational Supplements issued against this basic Flight Manual. These will be forwarded by TWX (interim) or by mail (formal), depending on the urgency of the information. Interim supplements are normally replaced by formal printed supplements at an early date. Formal printed supplements are identified by red letters "SS" for safety supplements and black letters "OS" for operational supplements printed around the borders of the pages. The currency of safety and operational supplements affecting your aircraft and Flight Manual can be determined by referring to the Monthly Index of Bomber Aircraft Safety Supplements (T.O. 0-1-1-2). The title block of each supplement and the title page of this manual should also be checked to determine the effect they may have on existing supplements. You must remain constantly aware of the status of all supplements—current supplements must be complied with, but there is no point in restricting your operation by complying with a replaced or rescinded supplement. As a further aid, supplement summaries are included in this manual following the A pages for both safety and operational supplements; however, these summaries can be only as current as this manual. Safety and Operational Supplements will be filed in accordance with Section IV of the Air Force Technical Order System, T.O. 00-5-2.

CHECKLISTS. The Flight Manual contains only amplified checklists. Abbreviated checklists have been issued as separate technical orders. See the back of the title page for T.O. number and date of your latest checklist. Line items in the Flight Manual and checklists are identical with respect to arrangement and item number. Whenever a Safety or Operational Supplement affects the abbreviated checklist, write in the applicable change on the affected checklist page. As soon as possible, a new checklist page incorporating the supplement will be issued. This will keep hand-written entries of Safety and Operational Supplement information in your checklist to a minimum.

HOW TO GET PERSONAL COPIES. Each flight crew member is entitled to personal copies of the Flight Manual, Safety and Operational Supplements, and Checklists. The required quantities should be ordered before you need them to assure their prompt receipt. Check with your supply personnel—it is their job to fulfill your Technical Order requests. Basically, you must order the required quantities on the Numerical Index and Requirement Table, Bomber Aircraft Technical Orders (T.O. 0-1-1-2). Technical Orders 00-5-1 and 00-5-2 give detailed information for properly ordering these publications. Make sure a system is established at your base to deliver these publications to the flight crews immediately upon receipt.

FLIGHT MANUAL AND CHECKLIST BINDERS. Loose leaf binders are available for use with your manual. These are obtained through local purchase procedures and are listed in the Federal Supply Schedule (FSC Group 75, Office Supplies, Part I). Binders are also available for carrying your abbreviated checklist. These binders contain plastic envelopes into which individual checklist pages are inserted. They are available in three capacities and are obtained through normal Air Force supply under the following stock list numbers: 7510-766-4269, and -4270 for 15, 25, and 40 envelope binders respectively. Check with your supply personnel for assistance in securing these items. Normally, a checklist will be contained in one binder but if not feasible, additional binders may be used as required.

WARNINGS, CAUTIONS AND NOTES. The following definitions apply to "Warnings," "Cautions," and "Notes" found throughout the manual.

WARNING

Operating procedures, techniques, etc, which could result in personal injury or loss of life if not carefully followed.

CAUTION

Operating procedures, techniques, etc, which could result in damage to equipment if not carefully followed.

NOTE

An operating procedure, technique, etc, which is considered essential to emphasize.

SHALL, WILL, SHOULD, AND MAY. The following definitions apply to the words "shall," "will," "should," and "may."

SHALL or WILL

The instructions or procedures prefaced by "shall" or "will" are mandatory.

SHOULD

Normally used to indicate a preferred but non-mandatory method of accomplishment.

MAY

An acceptable or suggested means of accomplishment.

CHANGE SYMBOLS. Changes to existing material and addition of new material are indicated by one of three types of symbols determined by the nature of the material affected. Text material utilizes a vertical line in the margin adjacent to the affected area. Photographs and line drawings use a miniature pointing hand to highlight the affected area. New illustrations (figures) utilize a vertical line in the outer margin of the page. Diagrams and schematics utilize a grey tone (screening) to highlight the affected area. Change symbols are not used for blank space resulting from deletions, indexes and tabular data where changes cannot be identified, relocation of material, or correction of minor inaccuracies unless such correction changes the meaning.

YOUR RESPONSIBILITY — TO LET US KNOW. Every effort is made to keep the Flight Manual current. Review conferences with operating personnel and a constant review of accident and flight test reports assure inclusion of the latest data in the manual. However, we cannot correct an error unless we know of its existence. In this regard, it is essential that you do your part. Comments, corrections, and questions regarding this manual, supplementary manuals, checklists, or any phase of the Flight Manual program are welcomed. These should be forwarded to your local standardization/evaluation unit and routed as directed by AFR 60-9 to the Flight Manual Manager, Oklahoma City ALC/MMSRKE, Tinker AFB, Oklahoma 73145.

Aircraft Coding

The information contained in this manual covers all B-52G aircraft. Code symbols are used to distinguish information related to one aircraft or group of aircraft from that which is applicable to the other aircraft. When code symbols appear by a paragraph or illustration, the information applies only to the aircraft represented by the code symbols. Where no code symbols appear on a paragraph or illustration, the information is applicable to all aircraft.

● **AIRCRAFT UNIT CODING** **W173** ▶. Unit coding permits reference to individual aircraft or to a continuous series of aircraft. Symbol ▶ means "thru" or "on." Example:

W173 ▶ **W180** Aircraft AF57-6468 thru AF57-6475

W181 Aircraft AF57-6476 and on

● **AIRCRAFT GROUP CODING** **B-52 1**. This coding applies to a selected group of aircraft which have a common modification in that group which is no longer identified by TCTO number. Group **B-52 1** applies to a modification of the nonnuclear weapon bombing system. Refer to T.O. 1B-52D-34-2-1 for information on this configuration. Aircraft in this group are identified below by **1** following the aircraft serial number.

Symbol AF Serial No.

W173 57-6468	W205 57-6500	W237 58-169	W269 58-201	W301 58-233	W333 59-2570
W174 57-6469	W206 57-6501 1	W238 58-170	W270 58-202	W302 58-234	W334 59-2571
W175 57-6470	W207 57-6502	W239 58-171	W271 58-203	W303 58-235	W335 59-2572
W176 57-6471	W208 57-6503 1	W240 58-172	W272 58-204	W304 58-236	W336 59-2573
W177 57-6472	W209 57-6504	W241 58-173 1	W273 58-205	W305 58-237	W337 59-2574
W178 57-6473	W210 57-6505	W242 58-174 1	W274 58-206	W306 58-238	W338 59-2575
W179 57-6474	W211 57-6506 1	W243 58-175 1	W275 58-207 1	W307 58-239	W339 59-2576
W180 57-6475	W212 57-6507	W244 58-176 1	W276 58-208	W308 58-240	W340 59-2577
W181 57-6476	W213 57-6508 1	W245 58-177	W277 58-209	W309 58-241	W341 59-2578
W182 57-6477	W214 57-6509	W246 58-178 1	W278 58-210	W310 58-242	W342 59-2579
W183 57-6478 1	W215 57-6510 1	W247 58-179	W279 58-211	W311 58-243	W343 59-2580
W184 57-6479	W216 57-6511	W248 58-180	W280 58-212	W312 58-244	W344 59-2581
W185 57-6480	W217 57-6512	W249 58-181 1	W281 58-213	W313 58-245	W345 59-2582
W186 57-6481	W218 57-6513 1	W250 58-182	W282 58-214 1	W314 58-246	W346 59-2583
W187 57-6482 1	W219 57-6514	W251 58-183	W283 58-215	W315 58-247	W347 59-2584 1
W188 57-6483	W220 57-6515	W252 58-184	W284 58-216	W316 58-248	W348 59-2585
W189 57-6484	W221 57-6516 1	W253 58-185	W285 58-217 1	W317 58-249	W349 59-2586
W190 57-6485	W222 57-6517	W254 58-186	W286 58-218	W318 58-250	W350 59-2587
W191 57-6486	W223 57-6518	W255 58-187	W287 58-219	W319 58-251	W351 59-2588
W192 57-6487	W224 57-6519	W256 58-188	W288 58-220 1	W320 58-252	W352 59-2589
W193 57-6488	W225 57-6520 1	W257 58-189	W289 58-221	W321 58-253	W353 59-2590 1
W194 57-6489	W226 58-158 1	W258 58-190	W290 58-222 1	W322 58-254	W354 59-2591
W195 57-6490	W227 58-159	W259 58-191 1	W291 58-223	W323 58-255	W355 59-2592
W196 57-6491	W228 58-160	W260 58-192 1	W292 58-224	W324 58-256	W356 59-2593
W197 57-6492	W229 58-161	W261 58-193	W293 58-225	W325 58-257	W357 59-2594
W198 57-6493	W230 58-162	W262 58-194 1	W294 58-226	W326 58-258	W358 59-2595
W199 57-6494	W231 58-163 1	W263 58-195	W295 58-227	W327 59-2564	W359 59-2596
W200 57-6495	W232 58-164 1	W264 58-196	W296 58-228	W328 59-2565	W360 59-2597
W201 57-6496	W233 58-165	W265 58-197	W297 58-229	W329 59-2566	W361 59-2598
W202 57-6497	W234 58-166	W266 58-198	W298 58-230	W330 59-2567	W362 59-2599
W203 57-6498	W235 58-167	W267 58-199	W299 58-231 1	W331 59-2568	W363 59-2600
W204 57-6499	W236 58-168	W268 58-200	W300 58-232	W332 59-2569	W364 59-2601
					W365 59-2602

Personnel Coding

Where necessary to distinguish between crewmembers, the following code letters will be used:

(P)	Pilot	(EW)	EW Officer
(CP)	Copilot	(IP)	Instructor Pilot
(N)	Navigator	(IN)	Instructor Navigator
(G)	Gunner	(DI)	Defense Instructor
(RN)	Radar Navigator	(GC)	Ground Crew
(10th)	Tenth Man		

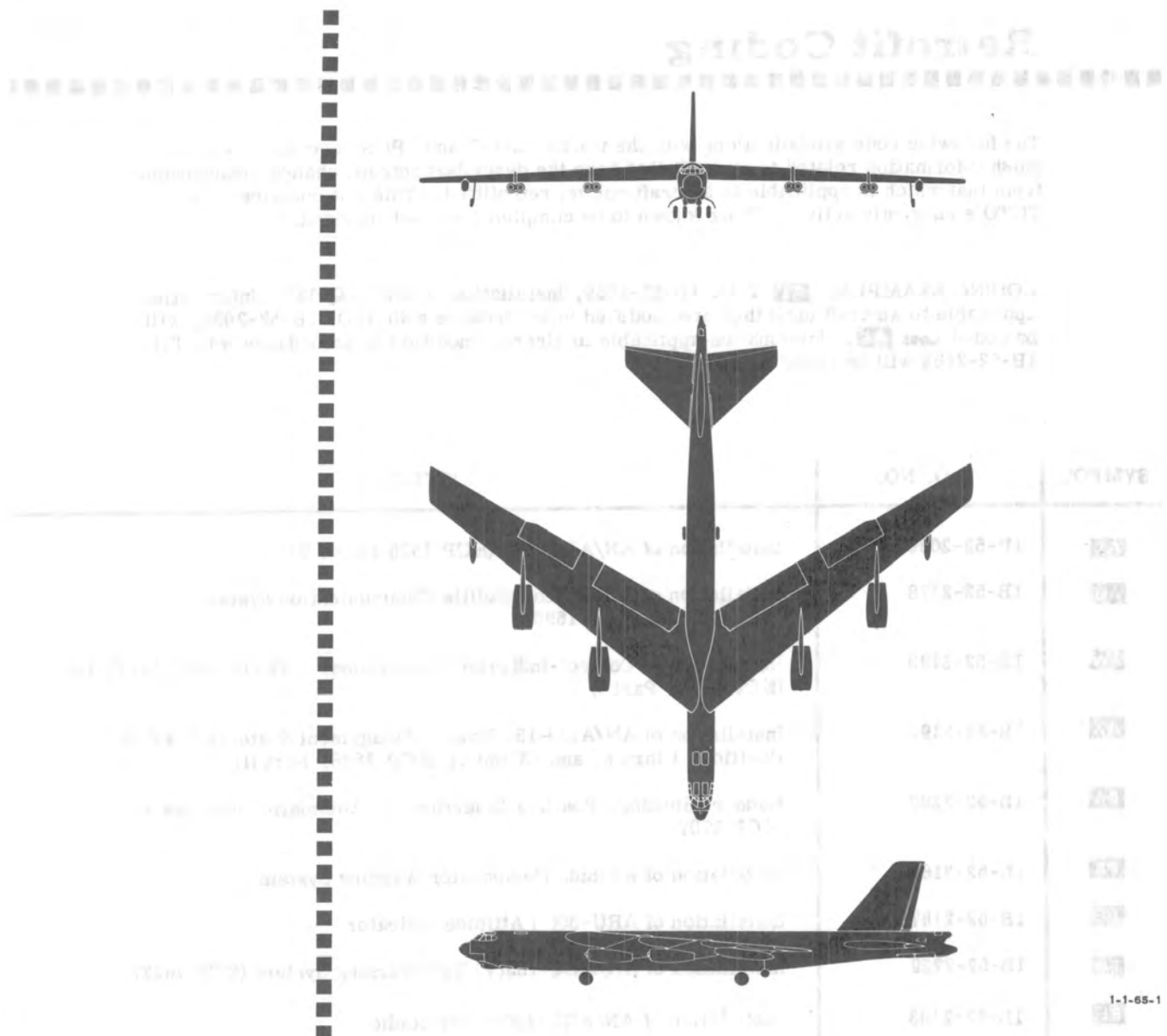
The amplified checklist describes in detail the steps to be completed. Each major part of multi-crewmember checklists has been assigned to a crewmember to be read by him, and to be accomplished by others in the crew. When necessary to show which crewmember will accomplish certain steps, the normal crew coding is used and the code letters will appear after the response to each step. Where a dash (-) is used in crew coding, such as P-CP, P-CP-RN, or any combination of crewmembers, each crewmember will accomplish the step. Where a slash (/) is used, such as P/CP, either crewmember will accomplish the step. A verbal response will be given by the crewmember(s) performing the action. There are exceptions to the verbal response as some of the checklists are to be accomplished silently. When a single crewmember is responsible for a checklist and accomplishment of all items, no crew coding will appear.

Retrofit Coding

The following code symbols along with the words "Less" and "Plus" are used to distinguish information related to aircraft that have the described retrofit change incorporated from that which is applicable to aircraft not yet retrofitted. This list contains only TCTO's currently active. Those known to be completed are not included.

CODING EXAMPLE: **AL** T.O. 1B-52-2039, Installation of AN/ALQ-122. Information applicable to aircraft until they are modified in accordance with T.O. 1B-52-2039, will be coded **Less AL**. Information applicable to aircraft modified in accordance with T.O. 1B-52-2039 will be coded **AL**.

SYMBOL	T. O. NO.	TITLE
AL	1B-52-2039	Installation of AN/ALQ-122 (ECP 1525 Phase II)
AU	1B-52-2178	Installation of Air Force Satellite Communication System (AFSATCOM) (ECP 1596)
AW	1B-52-2190	Installation of Control-Indicator Programmer (CIP) C-10130/ALQ-155 (ECP 1666, Part I)
AX	1B-52-2192	Installation of AN/ALQ-155 Power Management Systems in ECM Positions 1 thru 8, and 13 and 14 (ECP 1666, Part II)
BA	1B-52-2200	Rudder Limiting, Positive Detection and Automatic Shutdown (ECP 1707)
BB	1B-52-2161	Installation of Attitude Comparator Warning System
BC	1B-52-2187	Installation of ARU-30() Attitude Indicator
BG	1B-52-2229	Installation of AN/ALQ-153(V) Tail Warning System (ECP 1652)
BL	1B-52-2193	Installation of AN/ARC-190(V) HF Radio



The **B-52G** Stratofortress



Description

section I

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ITEM	B-52D	B-52F	B-52G	B-52H
J-57-P-19W OR -29WA ENGINES	✓			
J-57-P-43W, -43WA, OR -43WB ENGINES		✓		
J-57-P-43WB ENGINES			✓	
TF33-P-3 ENGINES				✓
PNEUMATIC-DRIVEN ALTERNATOR PACKS	✓			
ENGINE-DRIVEN A-C GENERATORS		✓	✓	✓
PNEUMATIC-DRIVEN HYDRAULIC PACKS	✓	✓		
ENGINE-DRIVEN HYDRAULIC PUMPS			✓	✓
LATERAL CONTROL BY SPOILERS AND AILERONS	✓	✓		
LATERAL CONTROL BY SPOILERS ONLY			✓	✓
JETTISONABLE EXTERNAL TANKS – 3000 GALLONS	✓	✓		
FIXED EXTERNAL TANKS – 700 GALLONS			✓	✓
AUXILIARY TANK FUEL TRANSFER TO MAIN TANK	✓	✓		
AUXILIARY TANK FUEL FEED DIRECTLY TO ENGINES			✓	✓
TALL VERTICAL TAIL	✓	✓		
SHORT VERTICAL TAIL			✓	✓
OCCUPIED TAIL COMPARTMENT	✓	✓		
REMOTELY-OPERATED TAIL TURRET			✓	✓
AGM-69A CAPABILITY			✓	✓
EXTERNAL STORES (CONVENTIONAL MUNITIONS RACKS)	✓	✓		
HI-DENSITY BOMBING SYSTEM	✓			
POWERED RUDDER/ELEVATOR SYSTEM			✓	✓
STABILITY AUGMENTATION SYSTEM (SAS)			✓	✓
ELECTRO-OPTICAL VIEWING SYSTEM (EVS) (AN/ASQ-151)			✓	✓
EXTENSION OF AFT FUSELAGE AND PHASE VI ECM			✓	✓
SATELLITE COMMUNICATION SYSTEM (AFSATCOM) AU			✓	✓

■■■■■■■■■■ Main Differences Table

Figure 1-1.

THE AIRCRAFT

The Boeing B-52G "Stratofortress" aircraft is of the land-based heavy bombardment class designed for long range flight at high speed and altitude. The tactical mission is the destruction of surface objectives by bombs and missiles. The aircraft accommodates a basic crew of six men: a pilot, copilot, radar navigator, navigator, EW officer, and gunner. The instructor crew (in addition to the crewmembers named above) includes an instructor pilot, instructor navigator, and defense instructor. Provisions have been installed to carry and launch a maximum of 20 AGM-69A SRAM (Short Range Attack Missile) rocket-powered air-to-ground missiles in combination with a multiple carriage clip-in bomb load. Lesser numbers of AGM-69A missiles may be carried when configured with other internal bomb loads.

SPECIAL FEATURES

The aircraft is characterized by swept wings, and empennage, four underslung nacelles housing eight turbojet engines, a quadricycle main landing gear, and a tip gear near each outboard engine nacelle. Engine bleed air provides the air supply for air conditioning and anti-icing. Cartridge starters are installed to provide for engine starts without assistance from an auxiliary air cart or auxiliary electrical power cart. Primary electrical power is 205-volt ac and is provided by four engine-driven generators. Hydraulic pressure is supplied by six engine-driven hydraulic pumps and two electric motor-driven hydraulic pumps. Primary pitch and yaw control is maintained by hydraulically actuated rudder and elevators. Lateral control is maintained by operation of hydraulically actuated spoilers. By varying the method of control, these same spoilers serve as airbrakes. The entire horizontal stabilizer is moved by a hydraulic mechanism to provide pitch trim. A steering and crosswind crab system provides steering of the forward main landing gear and also properly positions both forward and rear main landing gear for crosswind landings. A hydraulically driven, revolver-type launcher installation in the aft bomb bay provides umbilical and ejector rack connections for eight AGM-69A missiles. Twelve additional missiles are carried externally on two pylons, one pylon under each wing. The AGM-69A missiles may be launched automatically or manually by the navigator using computer stored target data or inflight

selected targets. AGM-69A equipment interfaces with the AN/ASQ-38BNS, AN/APN-150 radar altimeter, and the aircraft electrical, bleed air, and body hydraulic systems. Primary AGM-69A system control, monitor, and launch is accomplished from the navigator's station. Bomb status and control and jettison control are provided at the radar navigator's station. An AGM-69A selective jettison capability is available to the radar navigator and navigator. Either jettison control may be used for a normal computer controlled or emergency mode safe jettison of AGM-69A missiles. The pilot is provided an ejector unlock control (cooperative with EW officer), SAF prearm (cooperative with RN), a launcher hydraulic system selection, and a jettison control. The EW officer is provided a cooperative ejector lock-unlock switch. For additional information regarding operation with AGM-69A missiles installed, refer to T.O. 1B-52G-30-2. An electro-optical viewing system (EVS) is installed to provide pilots and navigators with a visual presentation of the area ahead of the aircraft during both day and night missions. On aircraft AU, an Air Force Satellite Communications System (AFSATCOM) terminal is installed and is a half-duplex UHF terminal providing communications in both line-of-sight (LOS) and satellite modes. The gunner has the additional duties of operating this system in conjunction with the pilot. The aircraft is painted with a white undercoating and three-color camouflage paint added to the sides and upper surfaces of the airframe.

DIMENSIONS

Wing Span	185 feet
Fuselage Length	160 feet 11 inches
Height	
To top of fin	40 feet 8 inches
Fin folded	21 feet 6 inches
Tread	
Centerline outboard main tires	11 feet 4 inches
Centerline tip gear to tip gear	148 feet 5 inches

For aircraft turning radius and minimum ground clearance, see figure 2-3.

GROSS WEIGHT

The aircraft is in the 400,000-pound gross weight class. For specific weight and loading information, see "Weight Limitations," Section V.

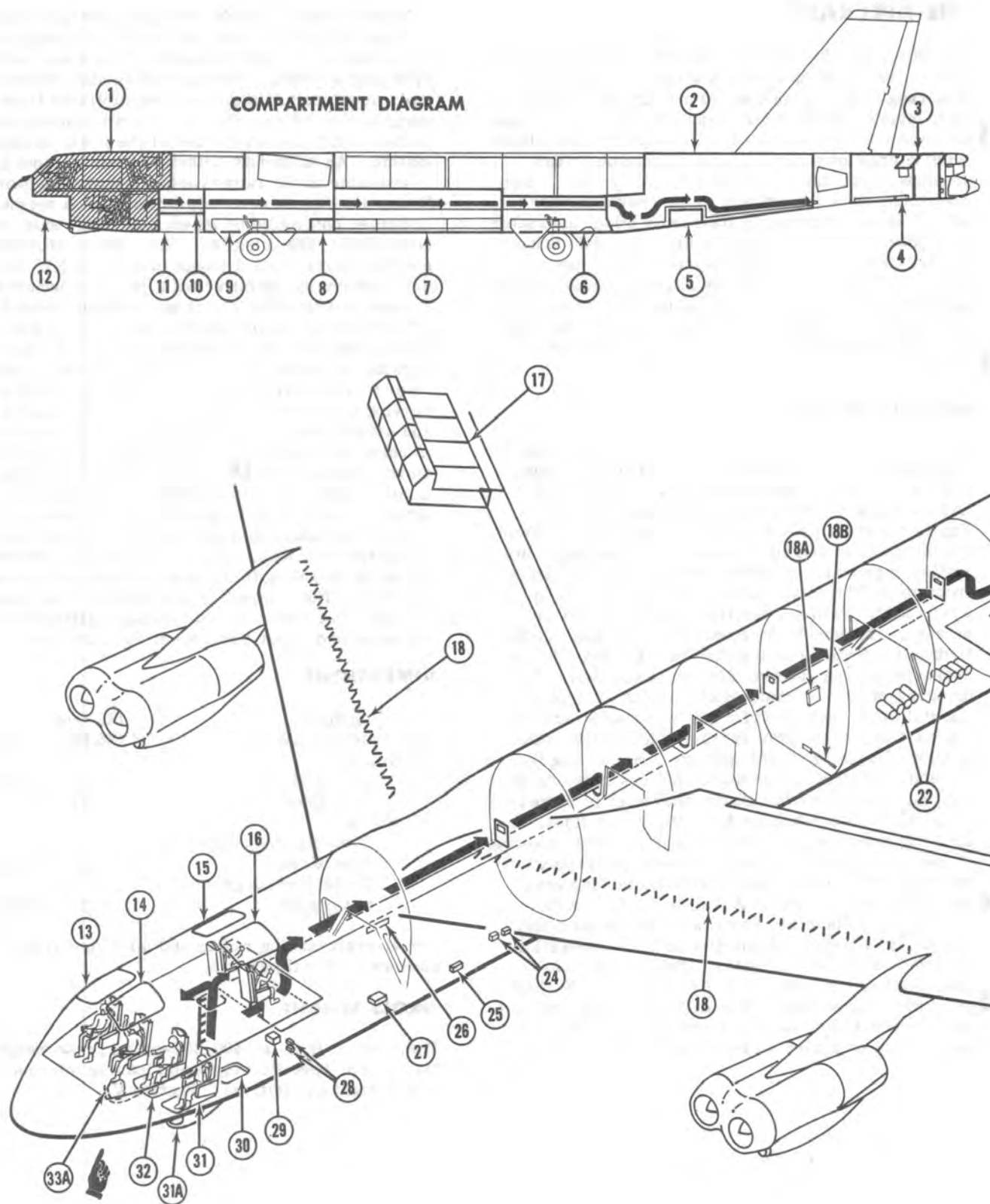
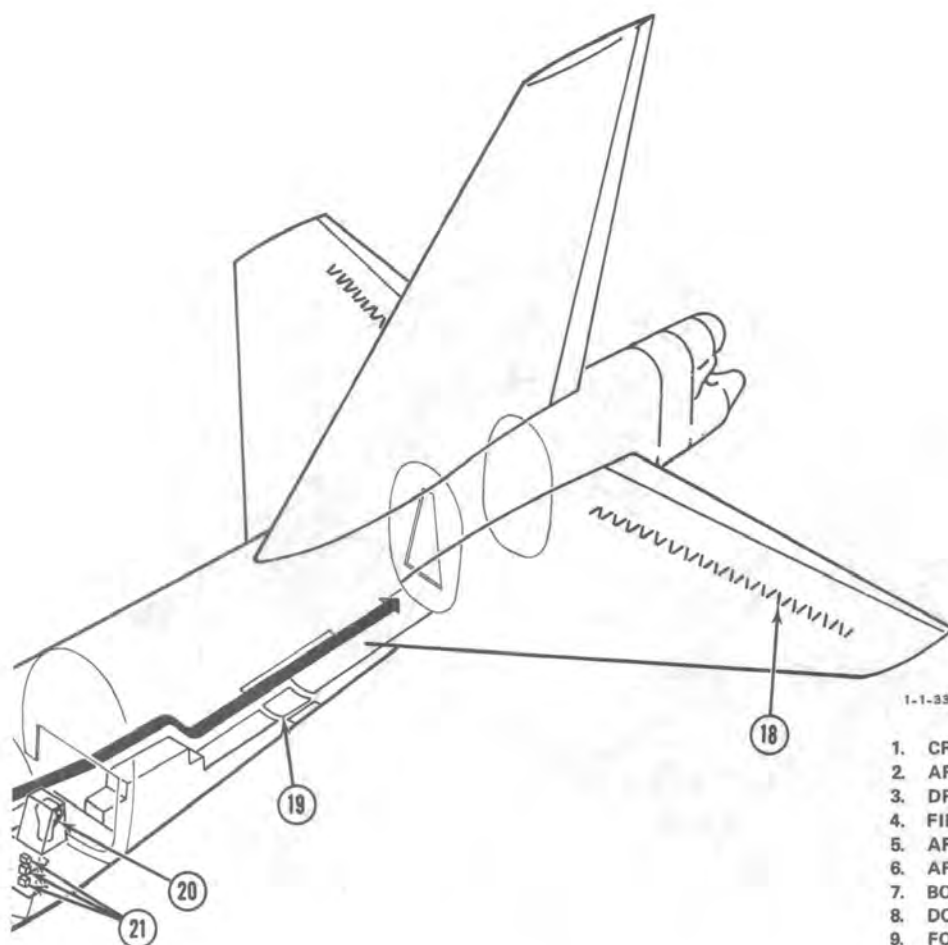


Figure 1-2 (Sheet 1 of 4).



1-1-33

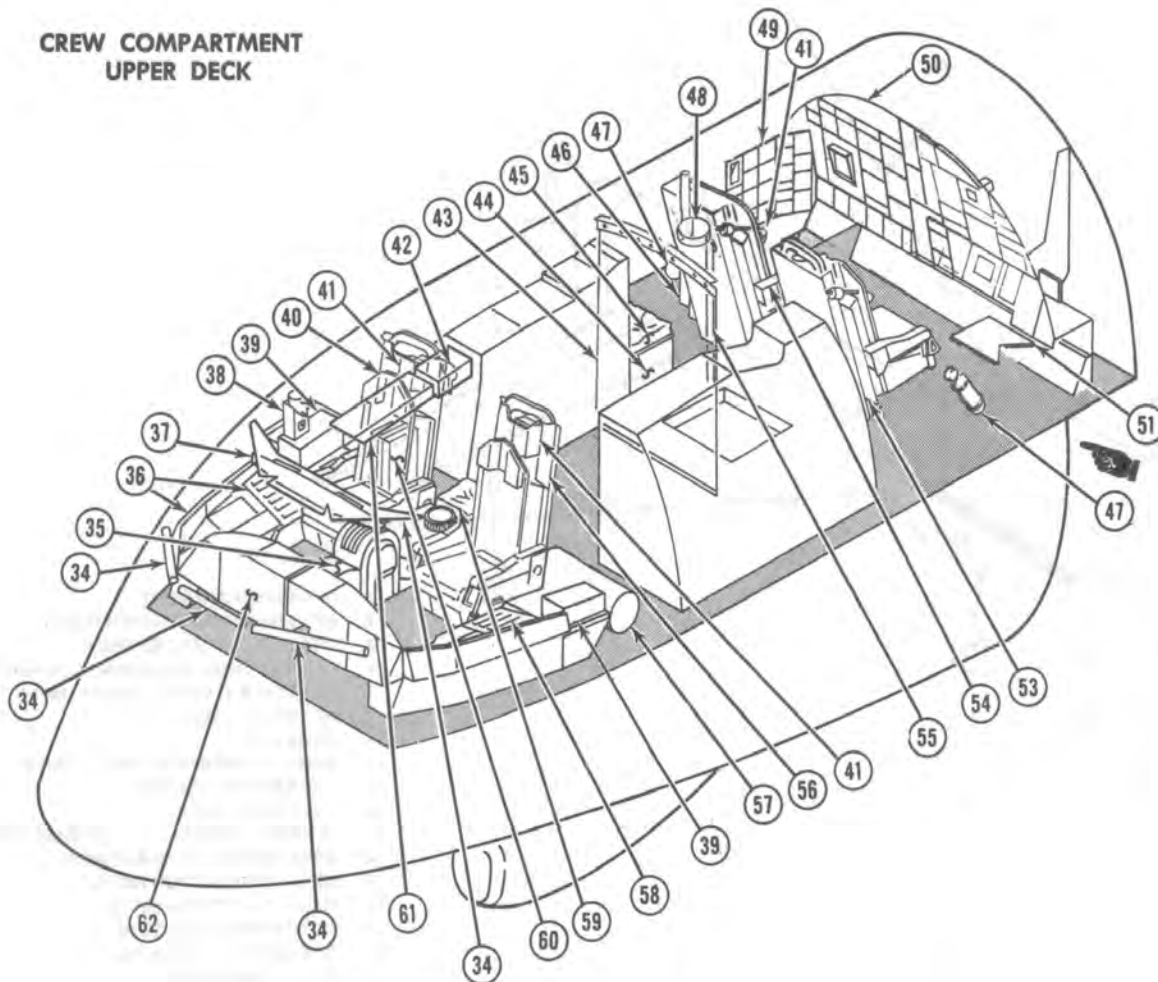
1. CREW COMPARTMENT
2. AFT EQUIPMENT COMPARTMENT
3. DRAG CHUTE COMPARTMENT
4. FIRE CONTROL EQUIPMENT COMPARTMENT
5. AFT ECM ANTENNA COMPARTMENT
6. AFT WHEEL WELL
7. BOMB BAY
8. DOPPLER ANTENNA COMPARTMENT
9. FORWARD WHEEL WELL
10. EQUIPMENT DECK
11. FORWARD ECM RADOME COMPARTMENT
12. NOSE RADOME COMPARTMENT
13. COPILOT'S EJECTION HATCH
14. PILOT'S EJECTION HATCH
15. EW OFFICER'S EJECTION HATCH
16. GUNNER'S EJECTION HATCH
17. CHAFF DISPENSERS
18. VORTEX GENERATORS
- 18A. AGM-69A SAFEING PINS AND STREAMER STOWAGE
- 18B. AGM-69A GROUND SAFETY PIN INSTALLATION AND REMOVAL TOOLS STOWAGE
19. AFT EQUIPMENT COMPARTMENT HATCH
20. STRIKE CAMERA
21. AFT TRANSFORMER RECTIFIER UNITS (3)
22. STARTER CARTRIDGE STOWAGE
23. (DELETED)
24. FORWARD TRANSFORMER RECTIFIER UNITS (2)
25. TRANSFORMER RECTIFIER UNIT (1)
26. EXTERNAL POWER RECEPTACLES
27. AFT BATTERY
28. FORWARD TRANSFORMER RECTIFIER UNITS (2)
29. FORWARD BATTERY
30. MAIN ENTRY DOOR
31. RADAR NAVIGATOR EJECTION HATCH
- 31A. EVS STV TURRET
32. NAVIGATOR EJECTION HATCH
33. (DELETED)
- 33A. EVS FLIR TURRET

 PRESSURIZED COMPARTMENT
 CREW MOVEMENT

General Arrangement Diagram (Typical)

Figure 1-2 (Sheet 2 of 4).

**CREW COMPARTMENT
UPPER DECK**

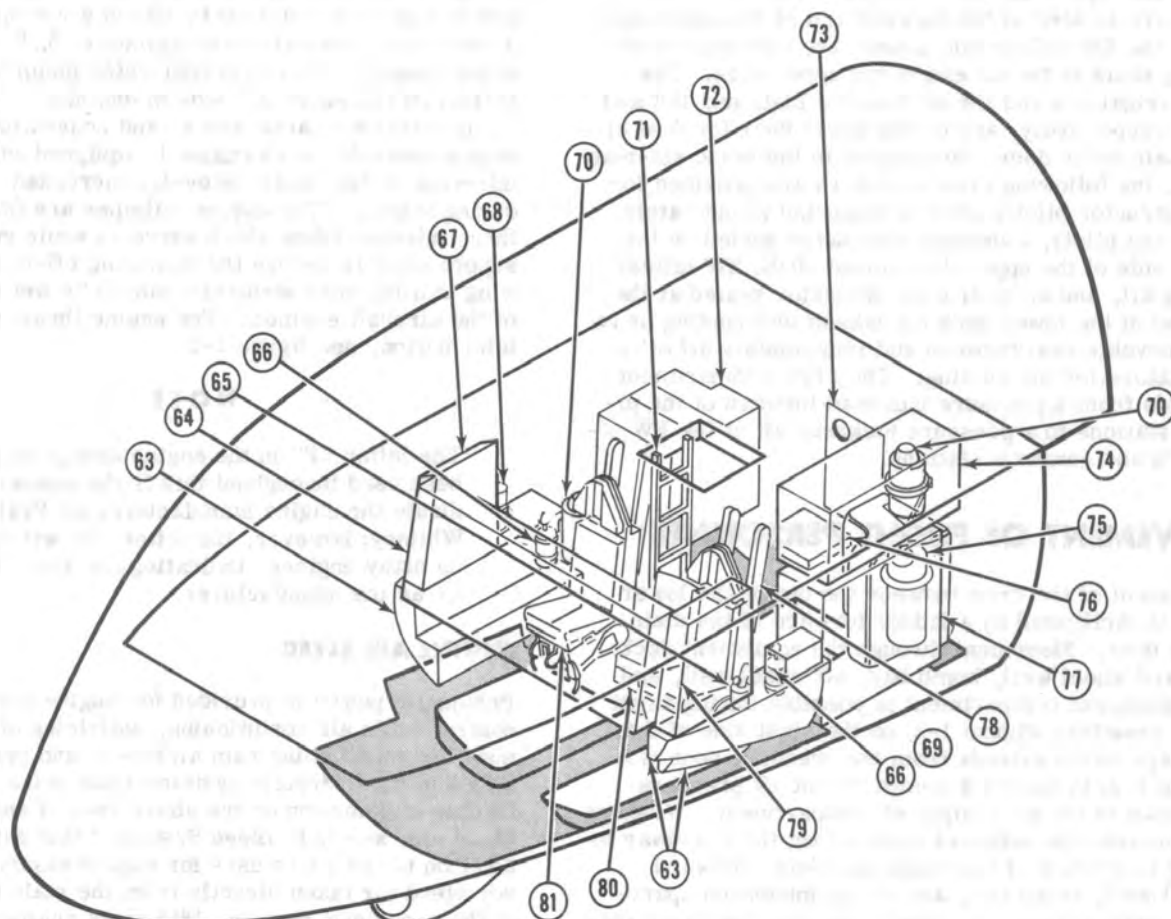


1-1-34

- 34. THERMAL CURTAIN
- 35. AISLE STAND
- 36. COPILOT'S SIDE PANEL
- 37. EYEBROW INSTRUMENT PANEL
- 38. HOT CUP
- 39. FOOD AND DATA BOX
- 40. COPILOT'S SEAT
- 41. STATION URINAL
- 42. SIGNAL LIGHT
- 43. NIGHT FLYING CURTAIN
- 44. TOILET
- 45. DEFENSE INSTRUCTOR'S SEAT
- 46. FOOD STOWAGE BOX
- 47. OXYGEN BOTTLE

- 48. PERISCOPIC SEXTANT MOUNT
- 49. EW OFFICER'S SIDE PANEL
- 50. DEFENSE STATION INSTRUMENT PANEL
- 51. GUNNER'S PULLOUT TABLE
- 52. (DELETED)
- 53. GUNNER'S SEAT
- 54. EW OFFICER'S SEAT
- 55. STANCHION
- 56. PILOT'S SEAT
- 57. MATTRESS STOWAGE
- 58. PILOT'S SIDE PANEL
- 59. INSTRUCTOR PILOT'S SEAT
- 60. PERISCOPIC SEXTANT CARRYING CASE
- 61. PILOTS' OVERHEAD PANEL
- 62. PILOTS' INSTRUMENT PANEL

Figure 1-2 (Sheet 3 of 4).



1-1-34-1

CREW COMPARTMENT LOWER DECK

- 63. MISCELLANEOUS EQUIPMENT SHELF
- 64. NAVIGATORS' INSTRUMENT PANEL
- 65. STATION URINAL
- 66. OXYGEN BOTTLE
- 67. NAVIGATOR'S SIDE PANEL
- 68. HOT CUP
- 69. FOOD STOWAGE BOX
- 70. DRINKING WATER CONTAINER
- 71. LADDER
- 72. REMOTE MODULES RACK

- 73. PRESSURE BULKHEAD DOOR
- 74. ELECTRONIC EQUIPMENT RACK
- 75. CENTRAL URINAL
- 76. INSTRUCTOR NAVIGATOR'S TAKEOFF-LANDING SEAT
- 77. POWER SUPPLY RACK
- 78. RADAR NAVIGATOR'S SEAT
- 79. RADAR NAVIGATOR'S SIDE PANEL
- 80. INSTRUCTOR NAVIGATOR'S DUTY SEAT
- 81. NAVIGATOR'S SEAT

General Arrangement Diagram (Typical)

Figure 1-2 (Sheet 4 of 4).

INTERIOR ARRANGEMENT

All crew members perform their normal crew duties in the crew compartment. This compartment is divided into upper and lower decks. The pilots' stations are located at the forward end of the upper deck while the EW officer and gunner are stationed in aft-facing seats at the aft end of the upper deck. The radar navigator's and the navigator's stations, left and right respectively, are on the lower deck forward of the main entry door. In addition to the basic six-man crew, the following crew members are provided for: an instructor pilot seated between and immediately aft of the pilots, a defense instructor seated on the right side of the upper deck ahead of the EW officer facing aft, and an instructor navigator seated at the aft end of the lower deck for takeoff and landing or on a removable seat between and immediately aft of the navigators for instructing. The crew compartment extends from a pressure bulkhead forward of the pilots' stations to a pressure bulkhead aft of the EW officer's and gunner's stations.

MOVEMENT OF FLIGHT PERSONNEL

Movement of the crew between the upper and lower deck is facilitated by a ladder forward of the main entry door. Movement through the equipment deck, forward wheel well, bomb bay, aft wheel well, and aft equipment compartment is possible during flight via a crawlway (figure 1-2) on the right side of the fuselage which extends from the pressure door (73, figure 1-2) in the crew compartment aft pressure bulkhead to the aft equipment compartment. Windows are provided in bulkhead doors along the crawlway to allow inspection of the equipment deck, forward wheel well, bomb bay, and aft equipment compartment during flight. Access to the unpressurized portion of the fuselage is not generally required for normal flight operations and will be avoided, particularly at high altitudes since the crew compartment must be depressurized. An inflight emergency may require such movement.

ENGINES

Eight Pratt & Whitney Model J-57-P-43WB Turbo Wasp engines (figure 1-3) are used to power the aircraft. The engines are trimmed per "flat rated" engine trim procedures allowing them to maintain constant wet rated thrust over a wide range of temperature (OAT) conditions by manipulation of the throttles according to the required EPR indication. The engines are mounted in pairs, in four nacelles suspended below the wings, and are numbered in the conventional manner from left to right 1 thru 8. The nacelles are also numbered in this manner with engines 1 and 2 in No. 1 nacelle, engines 3 and 4 in No. 2 nacelle, engines 5 and 6 in No. 3 nacelle, and engines 7 and 8 in No. 4 nacelle. The engines are identical with exception of the installation of engine-mounted accessories. An electrically controlled air-drive starter is installed on the lower side of each

engine. All engines have cartridge start capability. An engine-driven hydraulic pump is installed on the lower right side of engines 1, 3, 4, 5, 6, and 7. A 70/90 KVA (brushless) a-c generator is installed on the lower left side of engines 1, 3, 5, and 7. Generator rpm is maintained by use of a constant speed drive which is installed on engines 1, 3, 5, and 7. A dual capacity engine-driven water pump is installed on the lower left side of engines 2, 4, 6, and 8. In addition to accessories and conventional jet engine controls, each engine is equipped with a water injection system which provides increased thrust during takeoff. The engine tailpipes are fitted with three internal lobes which serve as sonic vibration suppressors to reduce the damaging effect on the wing trailing edge structure caused by wet operation of the aircraft engines. For engine thrust rating information, see figure 1-3.

NOTE

The letter "P" in the engine designation has been used throughout this flight manual to indicate the engine manufacturer as Pratt & Whitney; however, the letter "F" will be found on many engines, indicating the Ford Motor Co as the manufacturer.

ENGINE AIR BLEED

Pneumatic power is provided for engine starting, control cabin air conditioning, anti-icing of the left wing air conditioning ram air scoop, and pressurization of the hydraulic systems reservoirs. For further information on the above uses of engine bleed air, see "Air Bleed System," this section. In addition to the above uses for high pressure compressor bleed air taken directly from the main manifold of the pneumatic system, 16th stage engine bleed air is also used for pressurization of the constant speed generator drives and the integral oil tank for each drive, operation of the engine bleed valve actuators to allow bleeding of the 9th stage low compressor pressure (for prevention of hung starts and engine stall), and anti-icing of engine nacelle cowls, inlet guide vanes, nose domes, and inlet pitot tubes for the engine pressure ratio (EPR) transducers. Bleed air obtained from the body manifold is regulated for pressurization of the AGM-69A environmental system air ducts. Right body manifold bleed air is used for anti-icing of the AGM-69A ram air scoop located in the leading edge of the right wing.

ENGINE FUEL CONTROL SYSTEM

An engine fuel control system (figure 1-5) on each engine automatically provides optimum engine performance for any throttle setting. This system makes it unnecessary to make throttle adjustments to compensate for variations in inlet temperature, altitude, or airspeed. Fuel from the tanks is routed through the fuel supply system to fuel control units which meter fuel to each engine. The throttle provides basic engine power control and operates through the fuel control unit to position a throttle valve. En-

engine fuel from the fuel supply system is also controlled by an electrically operated firewall fuel shutoff valve. Power to open this valve is supplied by the fire shutoff switch when the throttles are moved from CLOSED. This allows fuel under boost pump pressure to reach a two-stage engine-driven fuel pump. A bypass valve is provided to allow fuel to bypass the first pump stage in the event of failure. Output from the pump is delivered to the fuel control unit.

Fuel Control Unit

The fuel control unit is of the hydromechanical type and provides a means of obtaining optimum engine performance at any power setting. This unit contains pressure, speed, and temperature sensing servos and a speed setting governor which act in conjunction with the throttle to position the throttle valve. Fuel pressure at the throttle valve is maintained by a pressure regulator which bypasses fuel to the inter-stage area of the fuel pump. The amount of fuel metered to the engine by the throttle valve is determined by a combination of compressor discharge pressure, engine inlet temperature, engine rpm, water pressure, and throttle position. A minimum pressure and shutoff valve downstream from the throttle valve is opened by metered fuel pressure from the throttle valve. When the throttle is closed, a pilot valve is opened which allows high pressure fuel to close the minimum pressure and shutoff valve. A flowmeter transmitter, flowmeter, and total fuel flow indicator are also provided. Metered fuel under pressure flows to the primary discharge nozzles and, when fuel pressure is sufficient, a pressurizing valve is opened which allows fuel to flow to the main discharge nozzles. A fuel pressurizing and dump valve which is held closed by fuel pressure is opened by return spring pressure when the throttle is moved to CLOSED position shutting off fuel pressure to the valve. The opening of this valve as fuel pressure drops allows fuel to drain from the fuel manifolds.

Engine Fuel Control System Controls

THROTTLES. Eight throttles (11, figure 1-13) on the aisle stand control the firewall fuel shutoff valves and throttle valves. In addition to these functions, the throttles control water injection. The throttle quadrant is marked CLOSED--IDLE--OPEN. In CLOSED position, essential d-c power is supplied to close the firewall fuel shutoff valves. Advancing the throttles out of CLOSED position provides power to open the firewall fuel shutoff valves provided the fire shutoff switches have not been pulled (figure 1-4). At the same time, provided the engine starter switch is in START, essential d-c power is supplied to the engine ignition circuit. With the throttles advanced approximately 18° from CLOSED, the pilot valves are

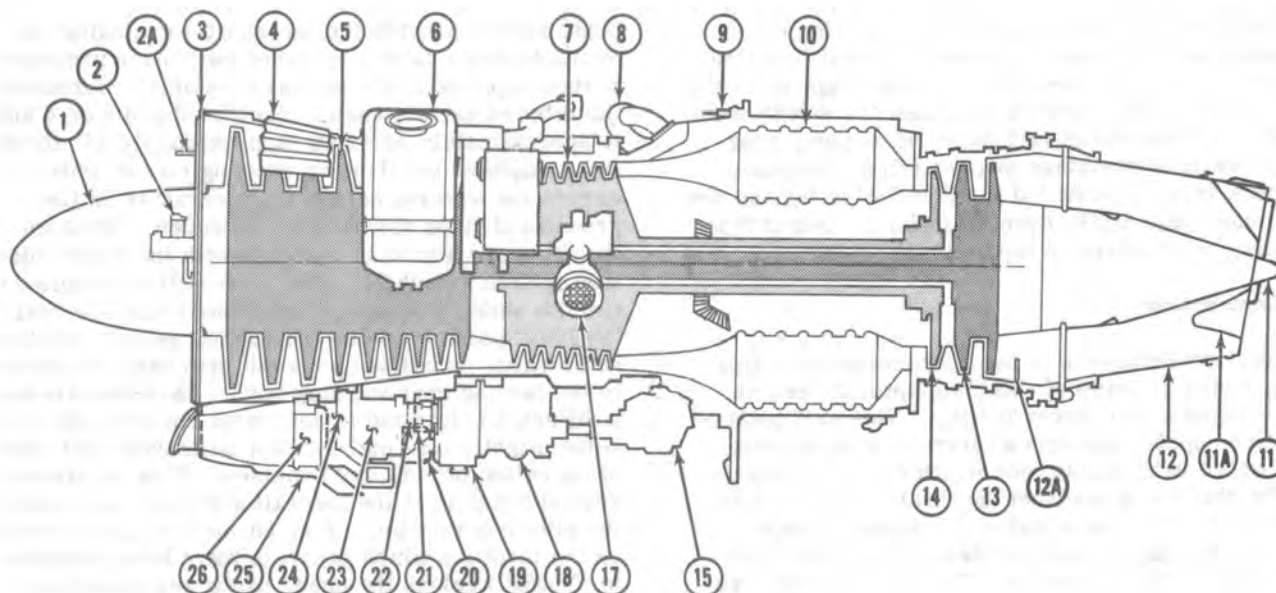
positioned to provide fuel pressure for closing the manifold drain valves; metered fuel under pressure is then supplied to the primary manifold. Advancing the inboard nacelle engine throttles 3 and 5 or 4 and 6 to approximately 88° rpm (approximately 74° throttle) completes the flaps up warning circuit which sounds the warning horn if the aircraft is on the ground and flaps are not fully extended. When the throttles are advanced to OPEN with the water injection system switch ON, TR power will be supplied to provide water injection. Retarding a throttle near the IDLE position, when the landing gear is not down and locked, completes a circuit providing TR power to the landing gear warning horn. Each throttle has a different height and is separated from the others by being slightly bent outboard for selectivity and ease of operation of individual engines. This facilitates ground handling of the aircraft and power settings at the pilot's discretion. A mechanical stop is provided on the throttles which prevents their being retarded to CLOSED unless the upper knobs are raised approximately 1/4 inch. An individual smaller throttle lever and knob is integrally connected to each large throttle to serve as a one-hand multiple grip for operation of the eight engines simultaneously. These are located aft of the large throttles and are spaced close together for convenience of use by the pilots.

THROTTLE BRAKE LEVER. A throttle brake lever (12, figure 1-13) on the aisle stand to the right of the throttles is used to adjust the amount of force necessary to move the throttles. When in OFF (aft) position, the throttle brake is released. Moving the throttle brake lever in the INCREASE (forward) direction increases throttle friction.

ENGINE FIRE SHUTOFF SWITCHES. Eight engine fire shutoff switches are provided for shutoff of fuel and are located on the pilots' instrument panel. Each switch closes a corresponding engine firewall fuel shutoff valve when pulled out to the FIRE SHUTOFF position regardless of throttle position. For a complete description of these switches, see "Emergency Equipment," this section.

Engine Fuel Control System Indicators

FUEL FLOWMETER. Fuel flow to the engine is shown by eight fuel flowmeters (31, figure 15) on the pilots' instrument panel. These indicators read in pounds per hour and operate on TR power. A circuit breaker for the fuel flow indicators, marked "Flow Ind D-C Pwr," is located on the "Fuel Miscellaneous" portion of the right load central circuit breaker panel.



7-1-20

TYPE J-57-P-43WB

- | | | |
|--------------------------------|-----------------------------------|------------------------------------|
| 1. NOSE DOME | 9. FIRE DETECTOR | 17. SURGE BLEED VALVE |
| 2. SURGE BLEED VALVE GOVERNOR | 10. BURNER CANS | 18. FUEL CONTROL UNIT |
| 2A. EPR PROBE (INLET PRESSURE) | 11. EXHAUST CONE | 19. ACCESSORY DRIVE CASE |
| 3. NOSE COWL SEAT | 11A. SONIC VIBRATION SUPPRESSORS | 20. STARTER |
| 4. IGNITION UNITS | 12. TAILPIPE | 21. ENGINE-DRIVEN HYDRAULIC PUMP |
| 5. LOW PRESSURE COMPRESSOR | 12A. EPR PROBE (EXHAUST PRESSURE) | 22. ENGINE-DRIVEN WATER PUMP |
| 6. OIL TANK, ENGINE | 13. 2ND AND 3RD STAGE TURBINES | 23. CONSTANT SPEED DRIVE UNIT |
| 7. HIGH PRESSURE COMPRESSOR | 14. 1ST STAGE TURBINE | 24. A-C GENERATOR |
| 8. BLEED AIR DUCT | 15. ACCESSORY DRIVE | 25. OIL COOLER, ENGINE |
| | 16. (Deleted) | 26. OIL COOLER, GENERATOR CS DRIVE |

ENGINE DRIVEN ACCESSORIES

ENGINE NO.	1	2	3	4	5	6	7	8
HYDRAULIC PUMP	✓		✓	✓	✓	✓	✓	
WATER PUMP		✓		✓		✓		✓
A C GENERATOR & CONSTANT SPEED DRIVE	✓		✓		✓		✓	

ENGINES	THRUST IN POUNDS AT SEA LEVEL NACA STANDARD DAY			MATERIAL
	TAKEOFF RATED THRUST WITH WATER INJECTION	MILITARY RATED THRUST (NO WATER)	NORMAL RATED THRUST	
J-57-P-43WB	13,750	11,200	9,500	TITANIUM
J-57-P-43WB engines are flat rated to develop "wet" takeoff thrust at sea level conditions other than an NACA standard day.				

The Engine

Figure 1-3.

TOTAL FUEL FLOW INDICATOR. A total fuel flow indicator (39, figure 1-15) is located on the pilots' instrument panel. This instrument uses 115-volt a-c power to electrically add the flow rates indicated on the eight individual fuel flowmeters. On aircraft **W173** **W356**, the totalizer indication is accurate within ± 7 to ± 3 percent when all engines are operating. On

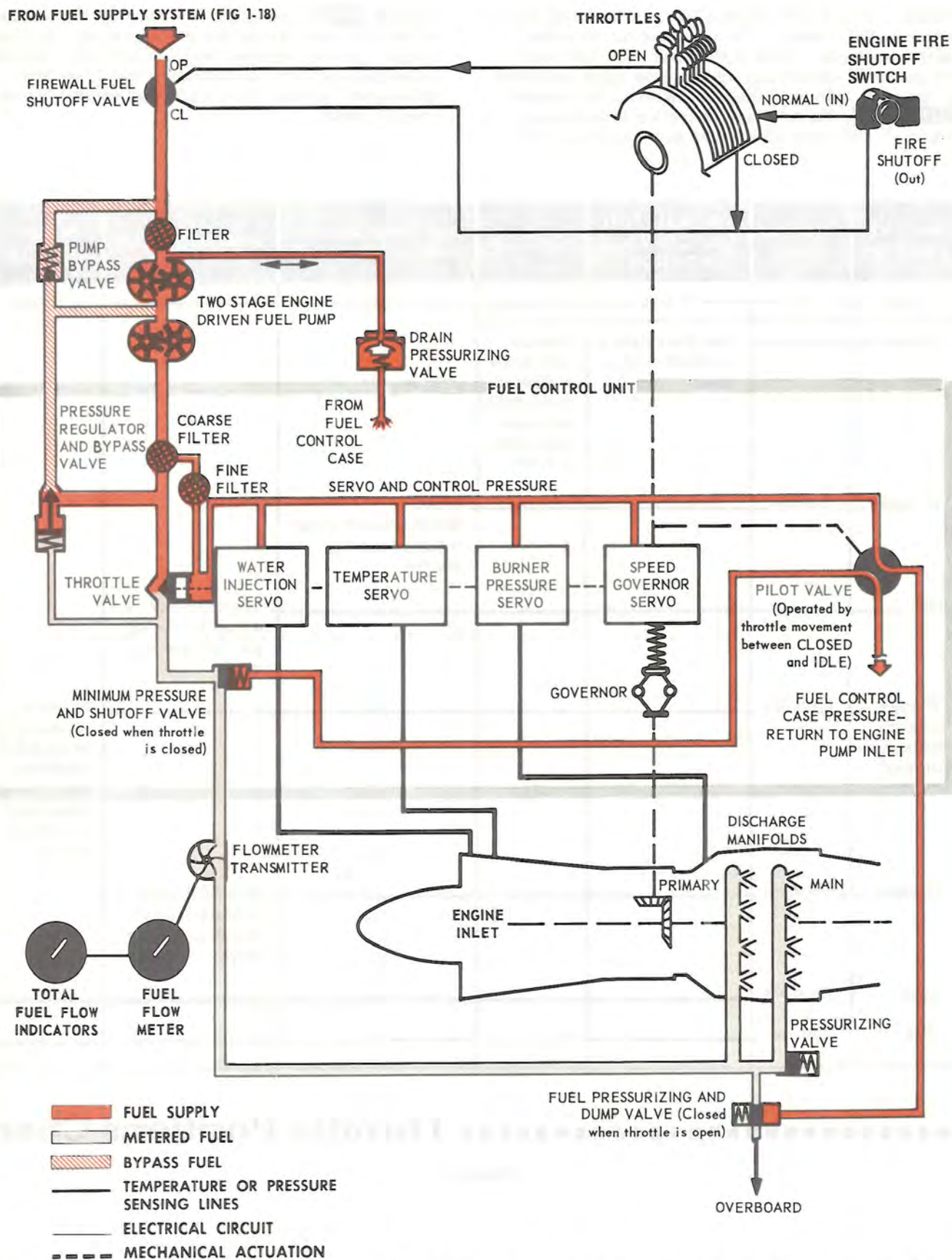
aircraft **W357**, the totalizer indication is accurate within $\pm 3\%$ when all engines are operating. A circuit breaker for the fuel flow totalizer indicator, marked "Flow Ind A-C Pwr" is located on the "Fuel Miscellaneous" portion of the right load central circuit breaker panel.

THROTTLES POSITION	PERCENT RPM	FIREWALL FUEL SHUTOFF VALVE POSITION	IGNITION	FUEL PRESSURIZING AND DUMP VALVE	WARNING HORN	WATER INJECTION
CLOSED	0%	CLOSED	Not Available	Open		Inactive
Advanced		Open unless engine fire shutoff switch is pulled.	Available when throttle is advanced from CLOSED with engine starter switch in START.			
18° approx	(Starting)			Closed. Metered fuel under pressure is supplied to primary manifold.		
IDLE					Energized if throttle is retarded when landing gear is not down and locked.	
70° approx – advancing (65° approx – retarding)	86% to 88%					Initiated (deactivated by retarding throttle) provided the water injection system switch is in the ON position.
74° approx	88% approx				Energized if airplane is on the ground and the flaps are not fully extended.	
Cruise	85% to 97%					
OPEN	102% max.					

Throttle Positions Chart

Figure 1-4.

FROM FUEL SUPPLY SYSTEM (FIG 1-18)



Engine Fuel Control System

Figure 1-5.

WATER INJECTION SYSTEM

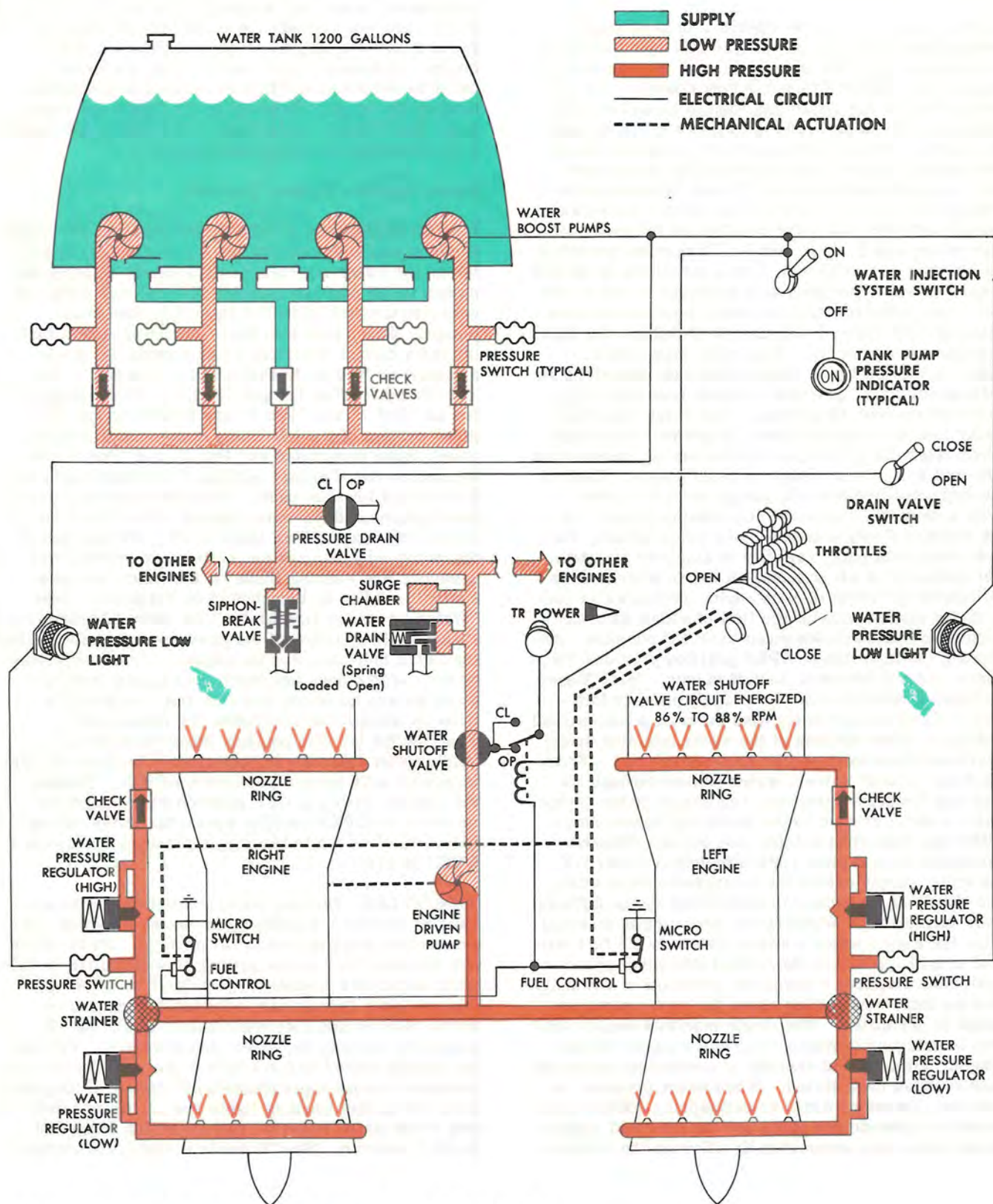
A water injection system (figure 1-6) is provided which allows water to be sprayed into both the engine compressor air inlet and the diffuser section of each engine for increased thrust during takeoff. The primary effect of the water injection is to cool the air, increasing the density and the mass airflow through the engine. The increased airflow, coupled with an automatic increase in fuel flow during water injection, provides added thrust. Water injection is accomplished by four dual capacity engine-driven water pumps installed within the nacelles on the lower left side of engines 2, 4, 6, and 8. Each pump provides the engines of that nacelle with a rated flow of 40,000 pounds of water per hour at a pressure of 385 to 440 psi. The added thrust from water injection is eliminated on both engines of a nacelle if failure of a high pressure pump occurs. The water supply tank, which is located in the forward body section aft of the defense stations, provides a usable capacity of approximately 1200 US gallons. The single manifold water injection supply system is pressurized at approximately 25 psi by four tank-mounted, submerged, 205-volt a-c, electric-driven boost pumps. Each of the tank-mounted electric pumps receives power from a separate electrical distribution circuit. In the event of a single tank booster pump failure, the remaining tank pump capacity is ample to maintain wet operation of all engines. A water shutoff valve is located upstream of each engine-driven water injection pump to restrict the flow of water until the engine throttles are advanced to OPEN position. Advancing the throttles to OPEN position provides TR power to open the water shutoff valves. (See "Water Injection System Switch" for circuit breaker location.) Throttle movement also actuates a mechanical linkage to allow opening of the water injection speed reset servos of each engine fuel control unit. From the water shutoff valves, water passes through the high and low water pressure regulators of the engine water control system to the discharge nozzle rings within the compressor inlet case and the diffuser section of each engine; approximately one-third of the water supply enters the compressor inlet while two-thirds of the supply is distributed by the diffuser case nozzle ring. Water under pressure is directed from the engine water control system to the fuel control unit to reposition the control maximum speed limit (this requires a minimum pressure of 150 psi); thus an increased setting above the usual maximum speed is permitted. The single manifold supply system is designed to exhaust the water supply during takeoff, allowing 110 seconds of continuous maximum takeoff rated (wet) thrust. When water pressure is lowered, the water drain valves (spring-loaded open) at each engine-driven pump and the manifold siphon-break valve open automatically allowing the remain-

ing water to drain overboard. Pressure switches illuminate pressure low warning lights on the control panel when low pressure is sensed before entering the high and low water pressure regulators of each engine. Similarly, upon pressurizing the system, the pilot determines that the engines are producing desired wet engine thrust by an all-lights-out condition. See "Water Limitations," Section V, and figure 1-55 for water servicing information.

Water Injection System Controls

WATER INJECTION SYSTEM SWITCH. An ON--OFF water injection system switch (4, figure 1-7) is located on the water injection control panel. Placing the switch in ON position supplies 205-volt a-c power to energize the tank-mounted water injection boost pumps. Water injection boost pump and water shutoff valve circuit breakers which control TR power are marked "Water Injection Pump Control," "Pod 1," "Pod 2," "Pod 3," and "Pod 4." Those designated as "Pod 1" and "Pod 2" are located on the "Engine" portion of the left load central circuit breaker panel; those designated as "Pod 3" and "Pod 4" are located on the "Engine" portion of the right load central circuit breaker panel. Both the water injection boost pumps and the water shutoff valves are controlled by relays within this circuit. ON position of the water injection system switch also permits the pressure low warning lights on the water injection control panel to be illuminated by TR power. (See "Water Pressure Low Lights" for circuit breaker location.) Illumination of the pressure low amber warning lights indicates that the engines are not receiving water. Water does not reach the engines until the throttles are advanced to OPEN position at which time the amber warning lights are extinguished. From OPEN throttle position (approximately 86% rpm), water injection is continuously initiated as rpm increases with increased throttle setting. Turning the system switch to OFF position while the drain switch is in OPEN position allows the water shutoff valves to close while the engine throttles remain in OPEN position.

THROTTLES. Opening water shutoff valves by advancing throttles depends on the water injection system switch being placed in ON position. As throttles are advanced to a power setting of approximately 86% rpm, which will initiate water injection, a power control lever linkage cam actuates a microswitch within each engine fuel control unit to provide TR power for opening the water shutoff valves. The water shutoff valves will not open if the throttles are not advanced beyond approximately 86% rpm or if the pressure low amber warning lights are not illuminated due to the water injection system switch being left in OFF position. (See "Water Injection System Indica-



▶ WATER INJECTION SHUTOFF VALVE CONTROL CIRCUIT BREAKERS.
 POWER FOR: POD 1 AND 2 FROM LEFT FWD D-C POWER BOX;
 POD 3 AND 4 FROM RIGHT FWD D-C POWER BOX.

Water Injection System (Typical)

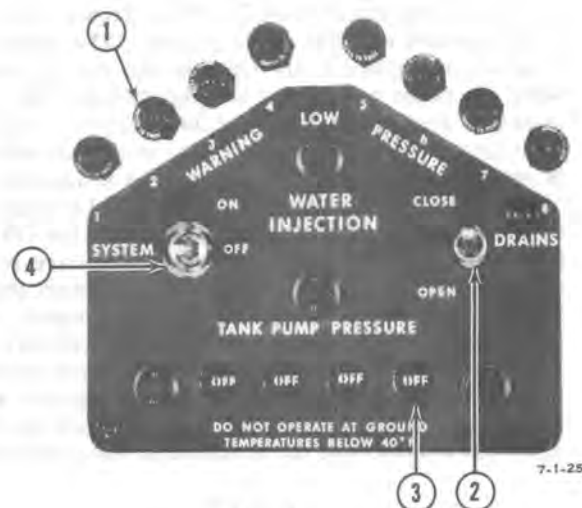
Figure 1-6.

tors" for circuit breaker location.) Throttle movement also actuates a mechanical linkage which will allow pressurization of the water injection speed reset servo of each engine fuel control unit. When either of the throttles which control the engines of a nacelle is advanced to OPEN position with the water injection system switch placed in ON position, electrical contact will be established for opening the water shutoff valve which controls the water supply to both engines. Operation of the water shutoff valve motor is assured by having control of the circuit with either throttle, however, water will not be supplied to either engine if the right engine is not operated at an rpm which will allow the engine-driven water pump to pressurize both engine water manifolds within that nacelle. Beyond the OPEN throttle position, continuous operation with added thrust is obtained as the throttles are advanced to the maximum throttle stop position. Regardless of throttle position, the water shutoff valves will close when the water injection system switch is placed in OFF position. With the water injection system switch in ON position, closing the water shutoff valves may be accomplished by retarding the throttles approximately 5° below the value at which the throttles are set for opening the valves.

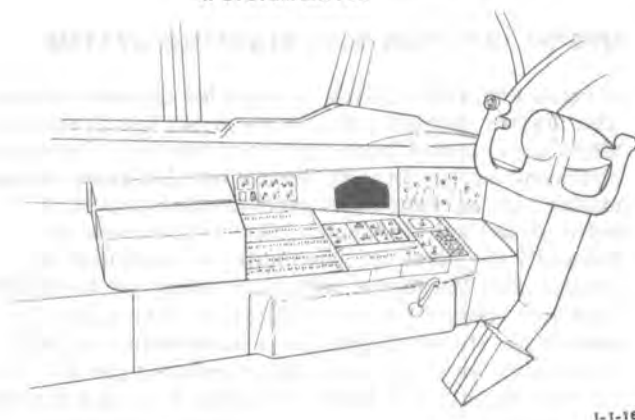
WATER INJECTION DRAIN VALVE SWITCH. An OPEN--CLOSE drain valve switch (2, figure 1-7) is located on the water injection control panel. When in the OPEN position, TR power is supplied to open the motor-operated manifold drain valve. The drain valve circuit breaker marked "Tank Drain Valve" is located on the "Engine" portion of the left load central circuit breaker panel. In CLOSE position, the drain valve remains closed. Either during flight or while on the ground, the water drainage rate is increased substantially by turning the system switch ON to provide pressure from the electric boost pumps. Ordinarily a decrease in the period of maximum wet rated thrust is not desirable, but the time duration of 110 seconds of water injection may be decreased by placing the water injection drain valve switch in OPEN position while water injection is being initiated. Sixteen minutes is required for pressure draining a full tank of water with the water injection system switch in ON position. Water should not be pressure drained during flight. Additional time required to gravity drain residual water from the tank and lines is approximately 3 minutes.

Water Injection System Indicators

WATER PRESSURE LOW LIGHTS. Eight amber water pressure low indicating lights (1, figure 1-7) located on the water injection control panel are controlled by pressure switches located immediately downstream of the engine-mounted water injection pumps. Illumination of the amber warning lights is due to low pressure and indicates that the engines are not receiving water. Low water pressure will cause the lights to illuminate when the water injection sys-



1. WATER PRESSURE LOW LIGHTS
2. DRAIN VALVE SWITCH
3. TANK PUMP PRESSURE INDICATORS
4. SYSTEM SWITCH



Water Injection Panel

Figure 1-7.

tem switch is in ON position or has been in ON position subsequent to opening the water injection drain valve. Placing the water injection system switch to OFF position will not turn the lights out unless the water injection drain valve switch is placed in OPEN position. TR power is supplied to the water pressure low lights through a circuit breaker marked "Water Inj Press Ind" on the "Engine" portion of the left load central circuit breaker panel.

TANK PUMP PRESSURE INDICATORS. Four individual two-position window-type tank pump pressure indicators with ON and OFF window tabs (3, figure 1-7) are located on the water injection control panel. The indicators, which normally remain in the OFF position, are separately controlled by four pressure

switches located immediately downstream from the tank-mounted electric boost pumps. The indicator tabs are energized to the ON position by TR power when the boost pumps are in operation and the water injection system switch is in ON position. The control circuit breaker for the water pressure indicators is marked "Water Inj Press Ind" and is located on the "Engine" portion of the left load central circuit breaker panel. The tabs will remain in the ON position, indicating the electric boost pumps are in operation, during the time required to exhaust the water supply. As the water supply is exhausted, the tabs will move to OFF position due to pressure switch control. The four submerged boost pumps may be checked individually by observing that all four indicator tabs move from OFF to ON when the water injection system switch is placed in ON position.

NOTE

The water injection system indicators do not show the total quantity of water available for injection.

ENGINE IGNITION AND STARTING SYSTEM

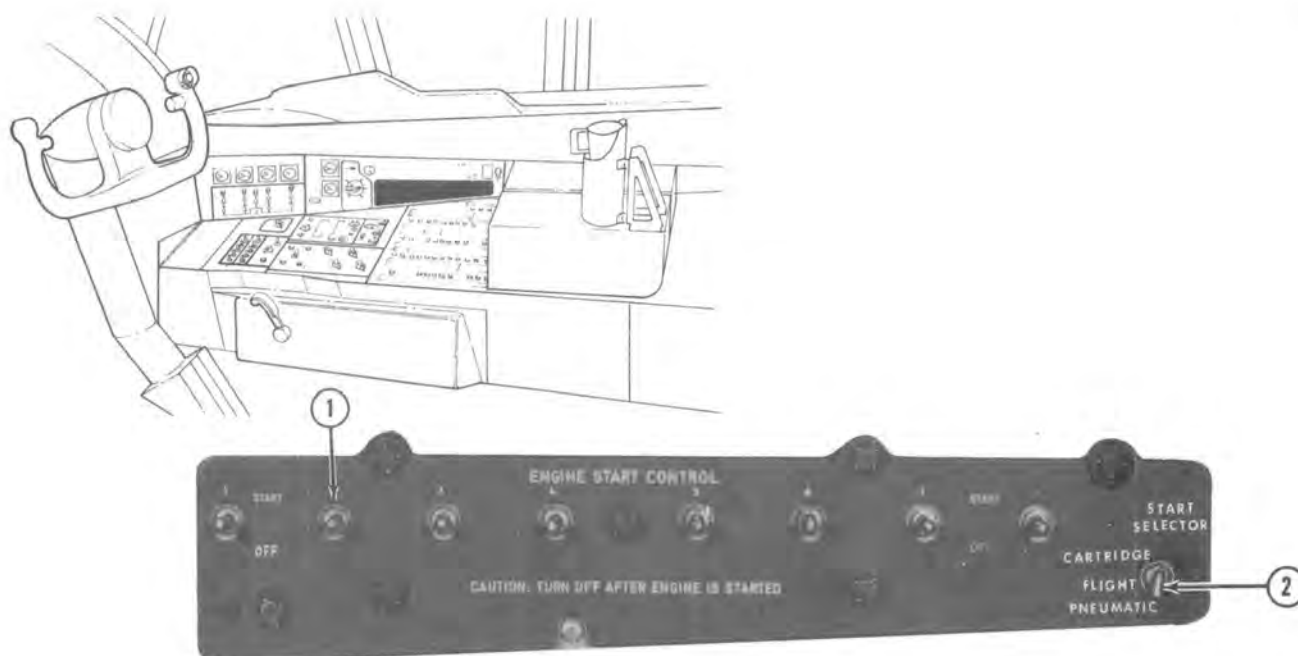
A turbine-driven starter is provided on each engine. The starter turbine may utilize either low pressure bleed air obtained from a ground source or from an operating engine through the air bleed system or may utilize high pressure gas generated by burning a solid propellant cartridge. Starter operation is basically the same for pneumatic or cartridge operation with the major difference being the temperature and pressure of the two gases. The bleed air enters the starter turbine at a temperature of 500° F or less, while the cartridge-produced gas enters at a temperature in excess of 2100° F. Each starter unit consists of a turbine, gear train, overrunning clutch with a speed sensing device, and an overspeed disengagement mechanism with shear pin. In addition, the cartridge starter has a breech chamber with breech cap and locking handle, a two-stage pressure relief valve, an aerodynamic brake, and the necessary electrical components for cartridge ignition and starter control. The cartridge cannot be ignited unless the breech is properly installed and the lock handle is in the proper position. The two-stage pressure relief valve maintains proper operating pressure and, in case of malfunction, relieves pressure to safe limits. As engine rpm exceeds starter rpm, the overrunning (sprag-type) clutch releases to prevent the starter turbine from being driven to an overspeed condition. Should the overrunning clutch not release, the overspeed disengagement mechanism will isolate the starter turbine from the starter gear train. An aerodynamic brake is attached to the starter turbine to prevent turbine overspeed. When starting with compressed air, a centrifugal switch monitors rpm at the starter mounting pad and, as a specified rpm is reached, breaks the circuit to the starter control valve solenoid, allowing the valve to close and shut off the starter air supply. Each starter is geared to the high pressure compressor of the engine on which it is installed.

Since the primary purpose of the cartridge-pneumatic starter is to provide for operation without need for auxiliary air and electrical power supply, provision (22, figure 1-2) has been made to carry eight spare cartridges in the aircraft. Since all eight engines have cartridge-pneumatic starters, provisions are made in the electrical supply system for cartridge starting all engines simultaneously to accomplish a "quick-start." These provisions also include the capability to start all engines from a single battery in the event of failure of one. The switching of the start functions to the good battery is automatic and cannot be controlled by the pilot. Engine start and start bus control circuit breakers are on the left and right load control circuit breaker panels.

Engine ignition is accomplished by spark ignitors located in the combustion chambers of each engine. Ignition is under control of eight starter switches, a start selector switch, and the throttles. These controls may be used to obtain starts on the ground in any combination of engines from single to all, either pneumatic or cartridge. In flight, these controls are used for all combinations of air starts. Power for ignition is essential d-c power supplied through eight circuit breakers marked "Ignition" on the "Engine" portions of the left and right load central circuit breaker panels. Outboard engine circuit breakers are on the left load central circuit breaker panel and supply power from the left essential d-c start bus. Inboard engine circuit breakers are on the right load central and supply power from the right essential d-c start bus. Under battery only operation, these start buses will be automatically connected to the good battery if one were to fail.

Engine Ignition and Starting System Controls

START SELECTOR SWITCH. A start selector switch (2, figure 1-8) having CARTRIDGE--FLIGHT--PNEUMATIC positions is located on the copilot's side panel. The switch is locked in center FLIGHT position and must be pulled out before moving to either CARTRIDGE or PNEUMATIC position. The position of this switch determines whether ignition only or both starter and ignition are provided when the starter switch is operated. In momentary CARTRIDGE position, the circuits are completed for firing of starter cartridges on engines selected by the individual engine starter switches. If a starter switch is in START position, positioning of this selector switch to CARTRIDGE position will fire the cartridge for that selected engine. In FLIGHT position, only power for engine ignition will be provided to the engine(s) for which the starter switch is in START. The starters will be inoperable. In PNEUMATIC position, power is supplied to open the starter air valve on the engine having the starter switch in START. Ignition power is also directed to that engine.



1. STARTER SWITCHES
2. START SELECTOR SWITCH

Engine Ignition and Starter Controls

Figure 1-8.

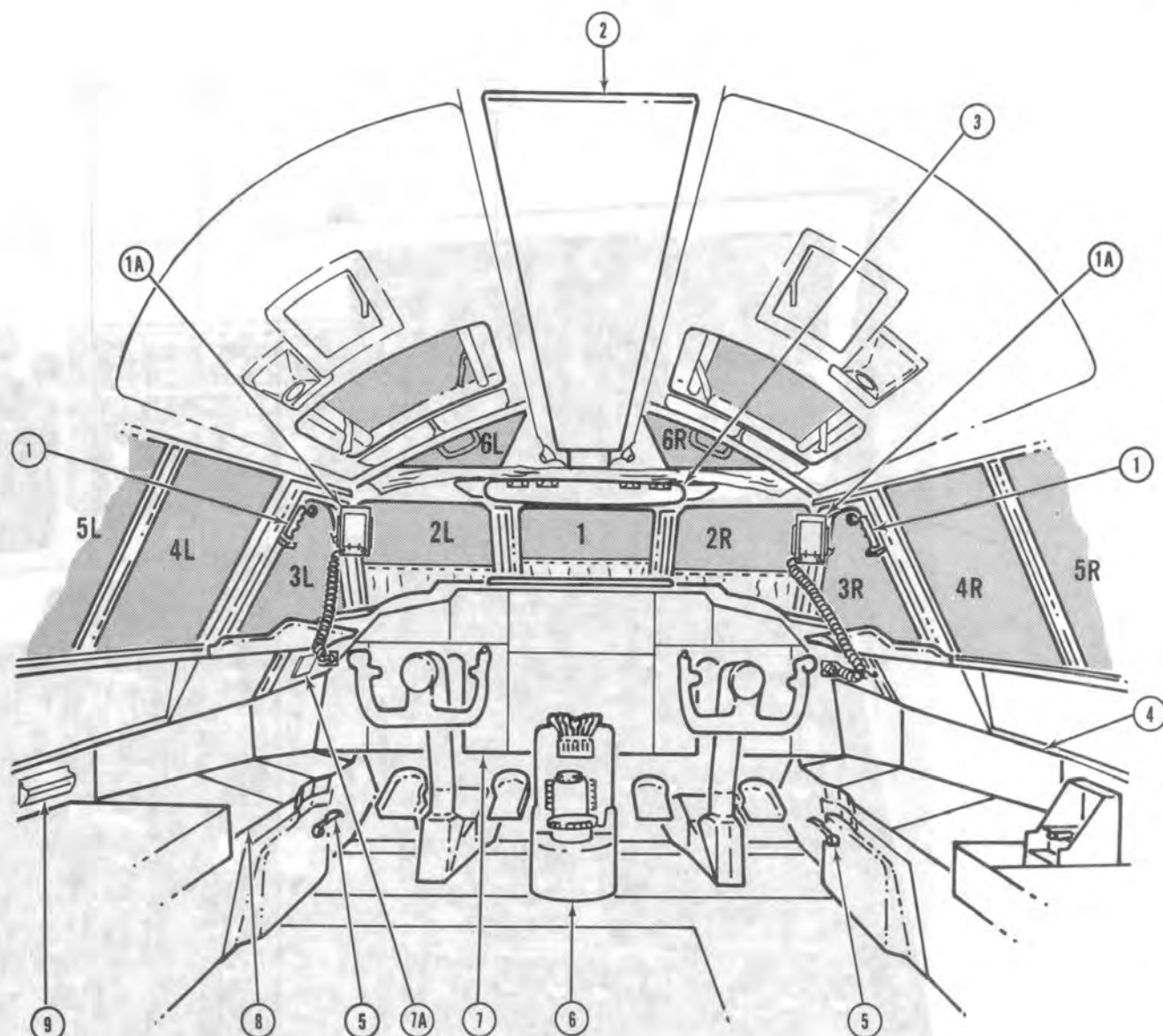
STARTER SWITCH. Eight START--OFF starter switches (1, figure 1-8) are provided on the copilot's side panel. These switches select the engine(s) for which a starting function is desired. The desired functions are determined by use of the start selector switch in accordance with the starting mode desired: pneumatic, cartridge, or inflight. For pneumatic starting, when the starter switch is in START, the starter air valve is opened and ignition power is directed to that engine. For cartridge starting, power is available to fire the cartridge for that engine. For inflight starting, only ignition is directed to that engine.

THROTTLES. Eight throttles (11, figure 1-13) on the aisle stand control engine ignition. See figure

1-4 for other functions. Advancing a throttle out of CLOSED position will supply essential d-c power for ignition to that engine if the starter switch is in START. Returning the throttle to closed cuts off ignition power.

Engine Ignition and Starting System Indicators

STARTER-SWITCH-NOT-OFF CAUTION LIGHT. An amber starter-switch-not-off caution light located above the engine start control panel or on the a-c control panel (11, figure 1-22) is marked "Starter Not Off." The light illuminates by right essential power when a starter switch is left in START position.



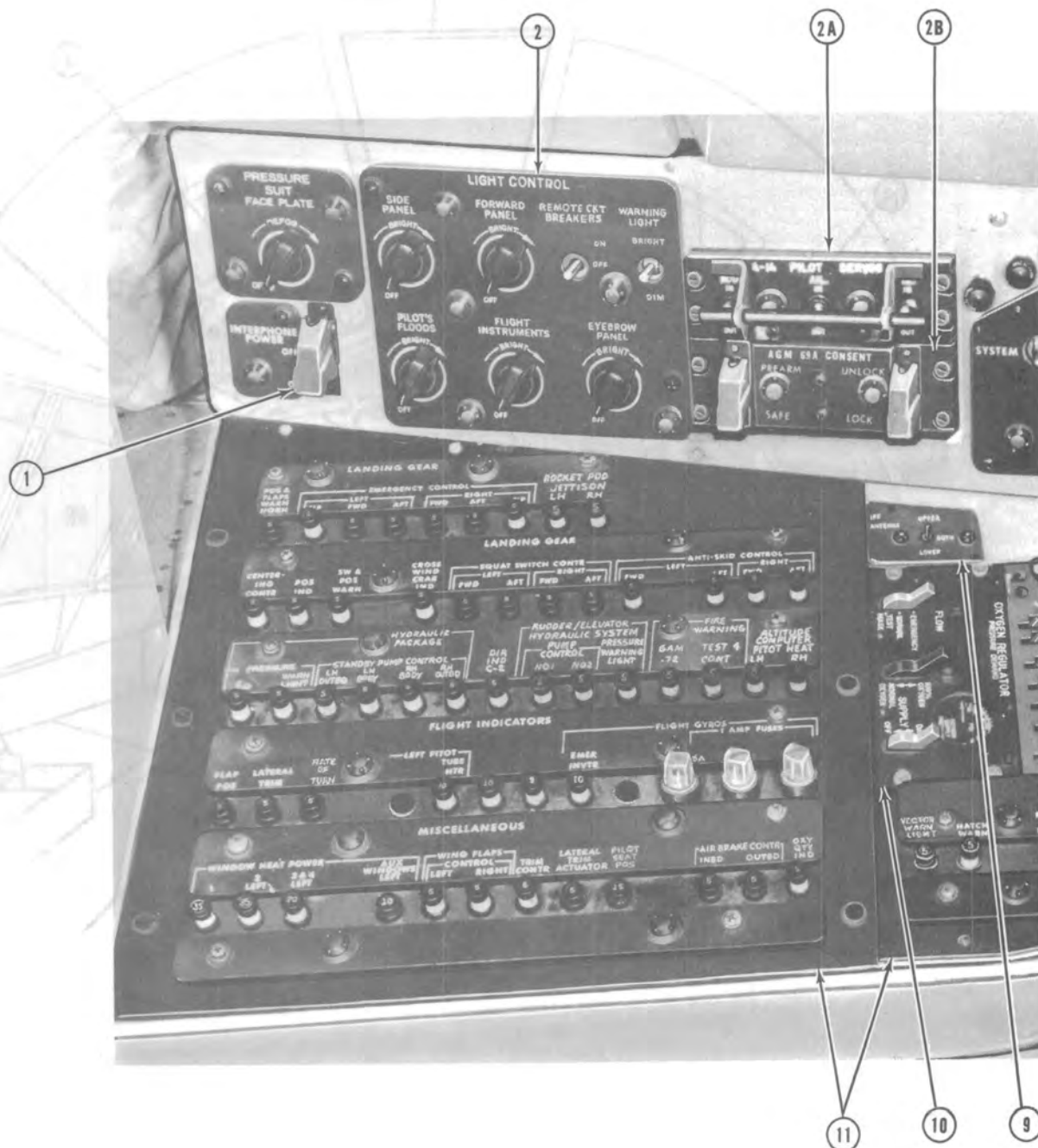
- | | |
|------------------------------------|--|
| 1. SLIDING WINDOW HANDLE | 6. AISLE STAND |
| 1A. CHART HOLDER | 7. PILOTS' INSTRUMENT PANEL |
| 2. OVERHEAD PANEL | 7A. ALTIMETER CORRECTION CARD AND HOLDER |
| 3. EYEBROW INSTRUMENT PANEL | 8. PILOT'S SIDE PANEL |
| 4. COPILOT'S SIDE PANEL | 9. PILOT'S READINESS SWITCH ASSEMBLY |
| 5. CONTROL COLUMN DISCONNECT LEVER | |

NOTE

WINDOW NUMBERS 6L AND 6R NOT ANTI-ICED.

Pilots' Station (Typical)

Figure 1-9.



1. INTERPHONE POWER SWITCH
2. PILOT'S LIGHTING PANEL
- 2A. SERVOS CUTOFF SWITCH PANEL
- 2B. AGM-69A CONSENT PANEL
3. WATER INJECTION PANEL
4. HYDRAULIC CONTROL PANEL
5. FLARE EJECTOR PANEL

- 5A. AIR OUTLET KNOB
6. PILOT'S INTERPHONE PANEL
7. (Deleted)
8. IFF CONTROL PANEL
9. IFF ANTENNA SWITCH PANEL
10. PILOT'S OXYGEN REGULATOR
11. PILOT'S CIRCUIT BREAKER PANEL

Figure 1-10 (Sheet 1 of 2)



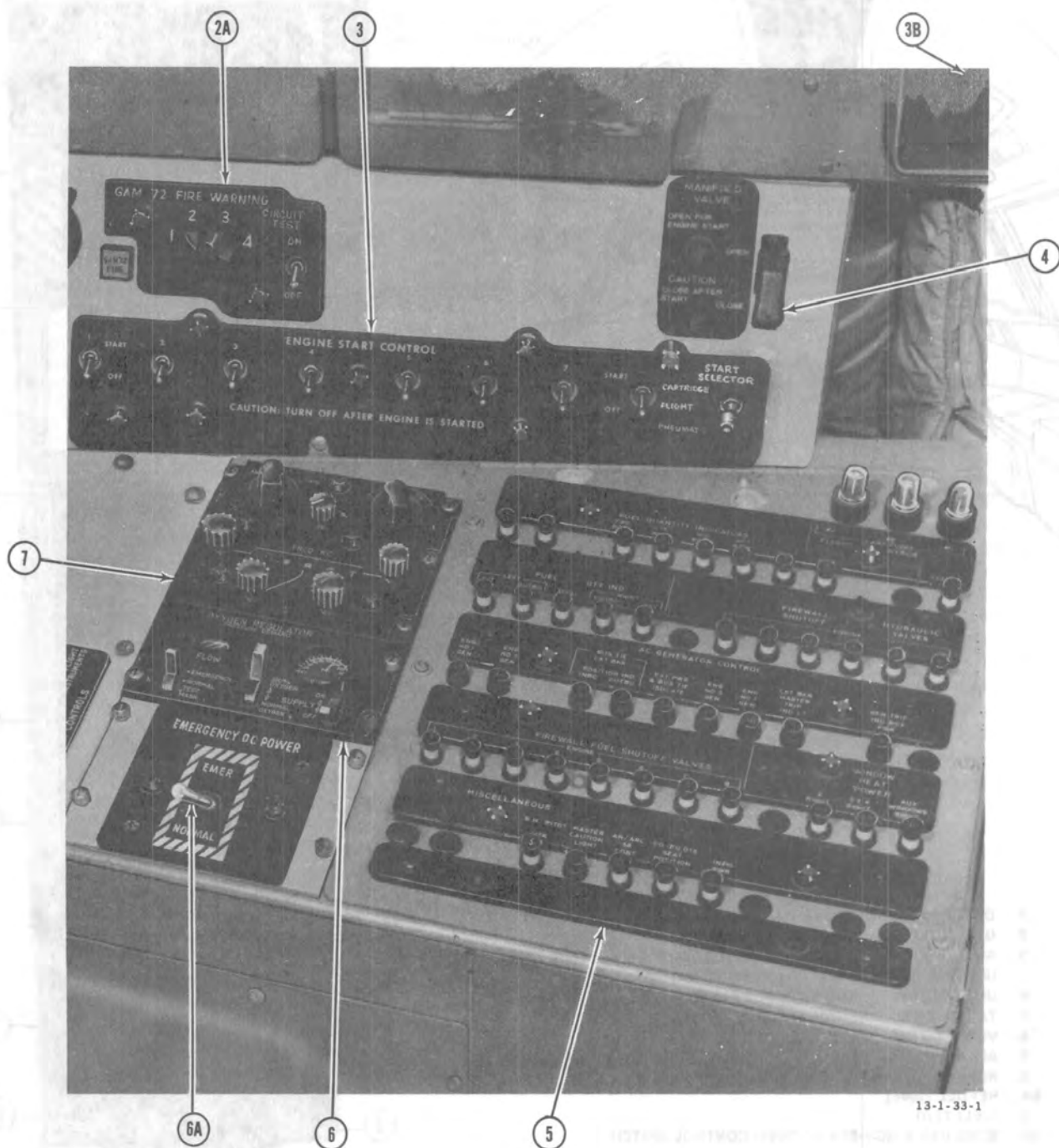
Change 3 1-23



- 1. A-C CONTROL PANEL
- 2. MANIFOLD TEMPERATURE GAGE
- 2A. GAM-72 FIRE WARNING PANEL (INOPERATIVE)
- 3. ENGINE IGNITION AND STARTER CONTROLS PANEL

- 3B. FUEL SYSTEM CHECKOUT PANEL
- 4. MANIFOLD VALVE SWITCH
- 5. COPILOT'S CIRCUIT BREAKER PANEL
- 6. COPILOT'S OXYGEN REGULATOR

Figure 1-11 (Sheet 1 of 2).

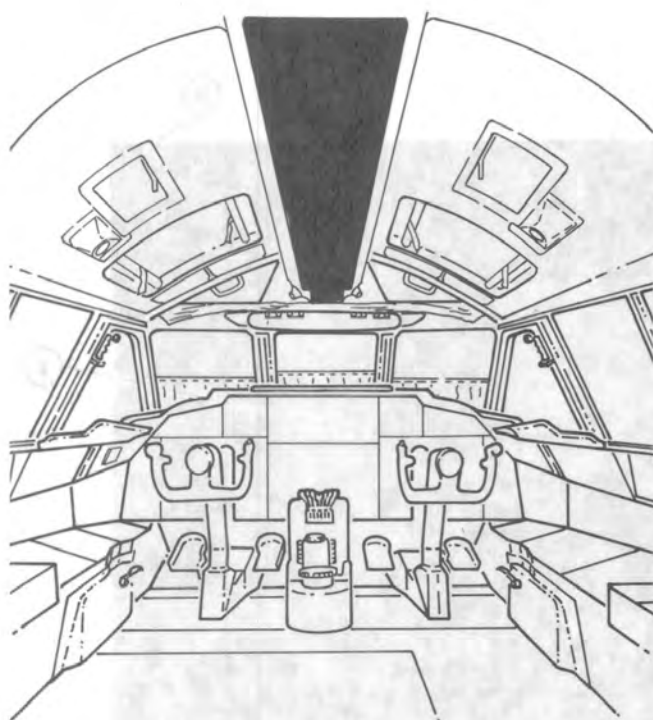


- 6A. EMERGENCY D-C POWER SWITCH
 7. LIAISON RADIO CONTROL PANEL
 8. COPILOT'S LIGHTING PANEL
 9. COPILOT'S INTERPHONE PANEL

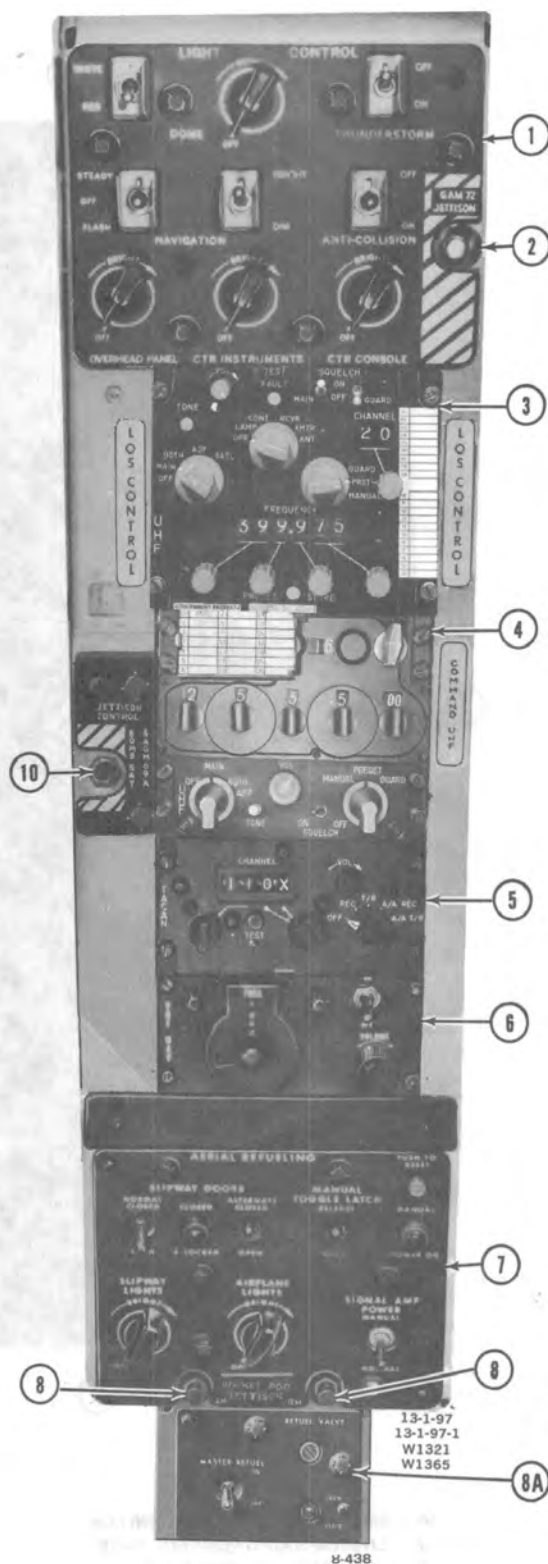
- 9A. CABIN TEMPERATURE SELECTOR SWITCH
 10. D-C CONTROL PANEL
 11. AIR OUTLET KNOB

Copilot's Side Panel

Figure 1-11 (Sheet 2 of 2).



1. OVERHEAD LIGHTING PANEL
2. GAM-72 (LAUNCH GEAR) JETTISON SWITCH
3. AUXILIARY UHF COMMAND RADIO CONTROL PANEL **Less AU**
4. UHF LINE-OF-SIGHT (LOS) RADIO CONTROL PANEL **AU**
5. TACAN RADIO CONTROL PANEL
6. VOR CONTROL PANEL
7. AIR REFUELING PANEL
8. ROCKET POD JETTISON SWITCH (INOPERATIVE)
- 8A. REFUEL PANEL
9. (DELETED)
10. BOMB BAY & AGM-69A JETTISON CONTROL SWITCH



Overhead Panel (Typical)

All data on pages 1-27 and 1-28 (Deleted)

Figure 1-12.

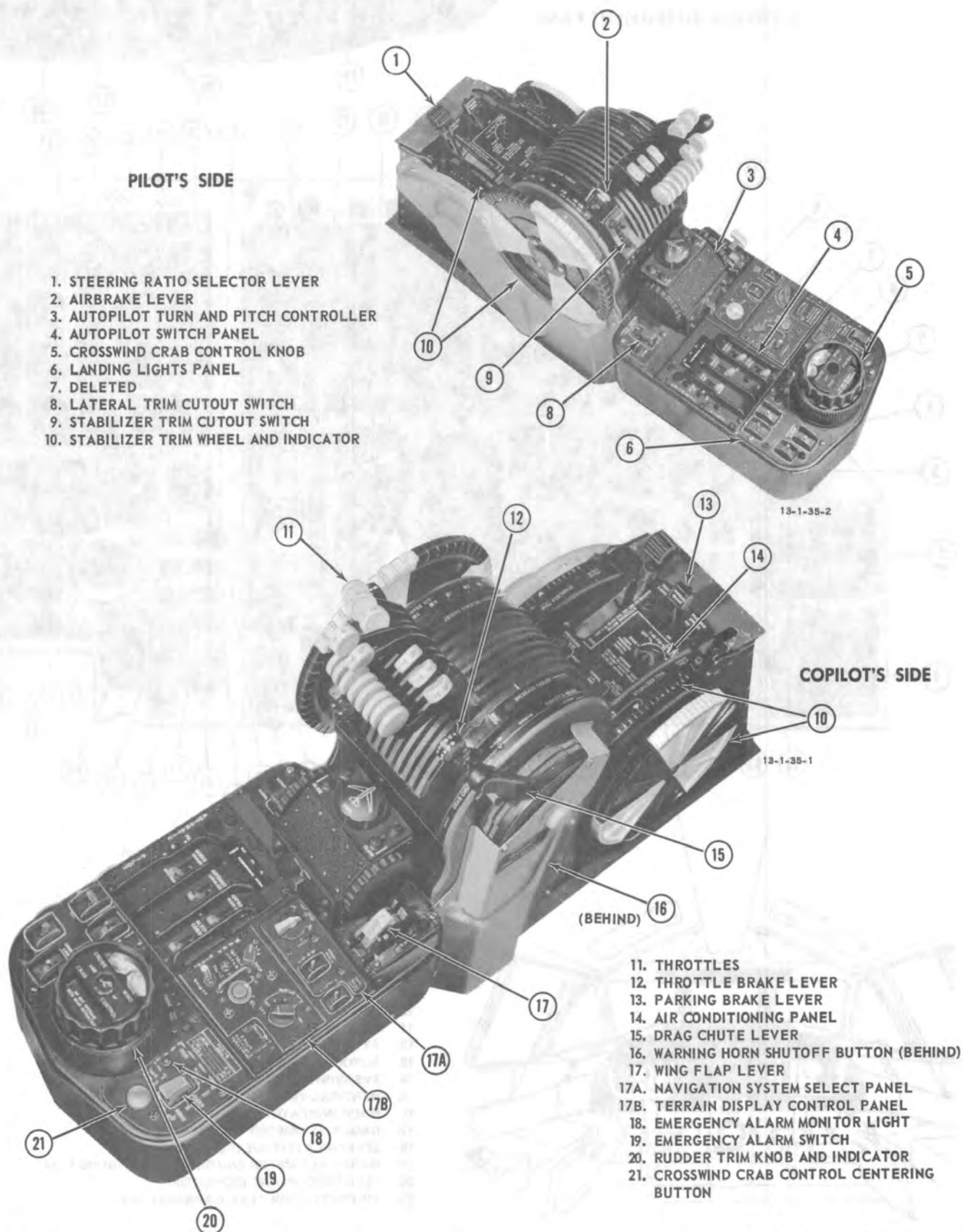
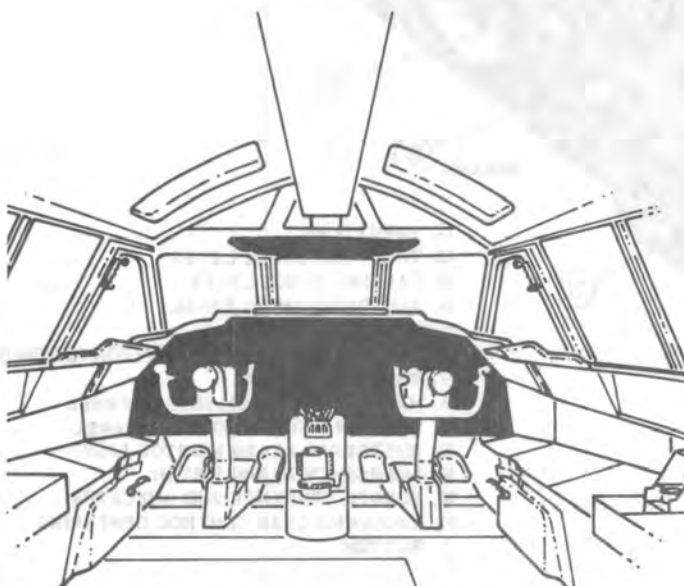
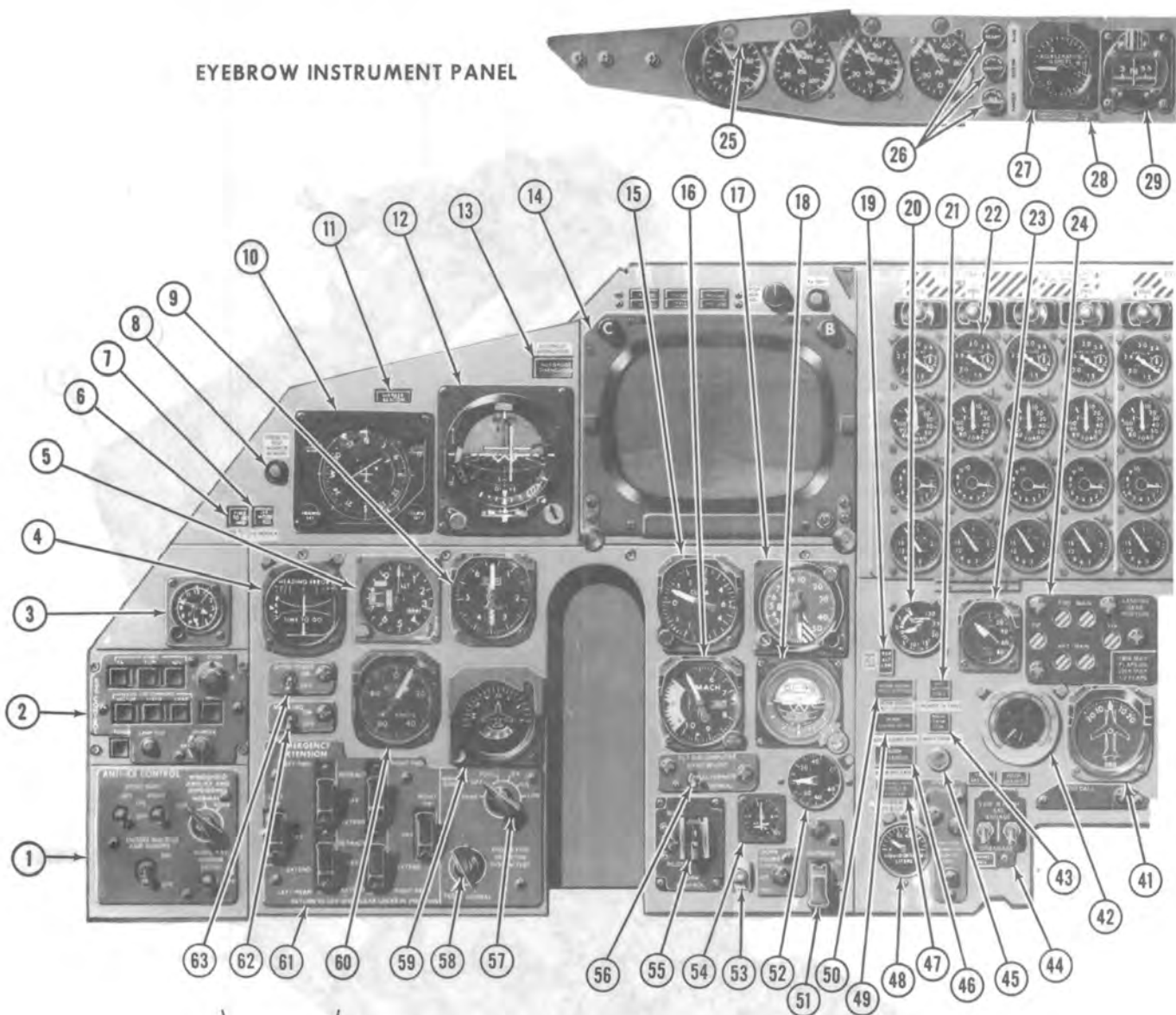


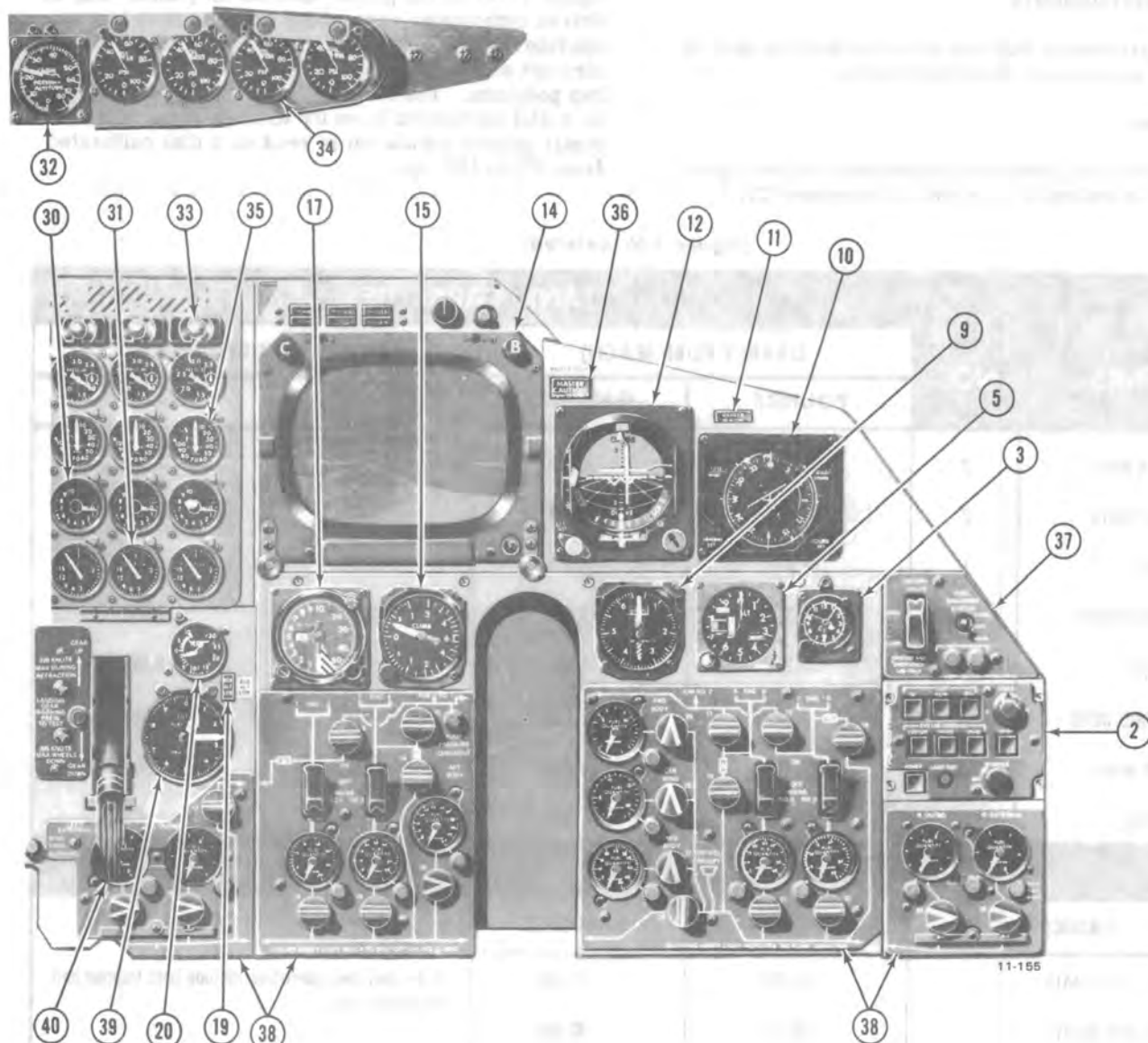
Figure 1-13.
(Figure 1-14 deleted)

EYEBROW INSTRUMENT PANEL



1. ANTI-ICE CONTROL PANEL (FIGURE 4-7)
2. EVS CONTROL PANEL (FIGURE 4-68)
3. CLOCK
4. FLIGHT COMMAND INDICATOR
5. ALTIMETER
6. TIME-TO-GO LIGHT
7. IFF MODE 4 LIGHT
8. MARKER BEACON LIGHT TEST SWITCH
9. INDICATED AIRSPEED INDICATOR
10. HORIZONTAL SITUATION INDICATOR (FIGURE 4-31)
11. MARKER BEACON LIGHT
12. ATTITUDE - DIRECTOR INDICATOR (FIGURE 1-47)
13. AUTOPILOT DISENGAGED LIGHT
14. EVS MONITOR (FIGURE 4-67)
15. VERTICAL VELOCITY INDICATOR
16. MACH INDICATOR
17. RADAR ALTIMETER (FIGURE 4-15)
18. STANDBY ATTITUDE INDICATOR **BC**
19. RADAR ALTIMETER CAUTION LIGHT (FIGURE 4-15)
20. CLEARANCE PLANE INDICATOR
21. TIP PROTECTION GEAR WARNING LIGHT

Figure 1-15 (Sheet 1 of 2) .



- 22. ENGINE PRESSURE RATIO GAGES
- 23. WING FLAP POSITION INDICATOR
- 24. LANDING GEAR POSITION INDICATORS PANEL (FIGURE 1-40)
- 25. LOW OIL PRESSURE WARNING LIGHTS
- 26. AIR REFUELING LIGHTS
- 27. ACCELEROMETER
- 28. MAGNETIC STANDBY COMPASS CORRECTION CARD
- 29. MAGNETIC STANDBY COMPASS
- 30. EXHAUST GAS TEMPERATURE GAGE
- 31. FUEL FLOWMETERS
- 32. CABIN ALTIMETER
- 33. ENGINE FIRE SHUTOFF SWITCHES
- 34. OIL PRESSURE GAGES
- 35. TACHOMETERS
- 36. MASTER CAUTION LIGHT
- 37. FUEL SCAVENGE SYSTEM PANEL (FIGURE 1-19)
- 38. FUEL SYSTEM MANAGEMENT PANELS (FIGURE 1-19)
- 39. TOTAL FUEL FLOW INDICATOR
- 40. LANDING GEAR LEVER
- 41. CROSSWIND CRAB POSITION INDICATOR
- 42. TOTAL FUEL QUANTITY INDICATOR

- 43. MAIN TANKS LOW WARNING LIGHT
- 44. SAS CONTROL PANEL (FIGURE 4-27A)
- 45. STORES JETTISONED LIGHT
- 46. BOMB RELEASED LIGHT
- 47. HATCHES WARNING LIGHT
- 48. TOTAL OXYGEN QUANTITY GAGE
- 49. BOMB DOORS OPEN LIGHT
- 50. BOMB DOORS NOT LATCHED LIGHT
- 51. ANTISKID SWITCH
- 52. OUTSIDE AIR TEMPERATURE GAGE
- 53. BOMB DOORS SWITCH
- 54. LATERAL TRIM INDICATOR
- 55. AUTOPILOT TURN CONTROL SELECTOR SWITCH
- 56. FLIGHT DIRECTOR COMPUTER GYRO SELECTOR SWITCH
- 57. WINDSHIELD WIPER SWITCH
- 58. ENGINE FIRE DETECTOR SYSTEM TEST SWITCH
- 59. HEADING INDICATOR (GYRO)
- 60. TRUE AIRSPEED INDICATOR
- 61. LANDING GEAR CONTROLS PANEL (FIGURE 1-40)
- 62. MACH INDICATOR SWITCH
- 63. GYRO POWER SWITCH

■■■■■■■■■■ Pilots' Instrument Panel (Typical) ■■■■■■■■■■

Figure 1-15 (Sheet 2 of 2).

ENGINE INSTRUMENTS

Engine instruments that are not described as part of an engine system are described below.

Tachometers

Speed of the high pressure compressor rotor in percent rpm is indicated by eight tachometers (35,

figure 1-15) on the pilots' instrument panel. Engine-driven tachometer generators supply power to operate the indicators which are independent of the aircraft electrical system. Each instrument has two pointers. The larger pointer indication is read on a dial calibrated from 0% to 100% rpm. The small pointer indication is read on a dial calibrated from 0% to 10% rpm.

(Figure 1-16 deleted)

TANKS		NO.	TANK CAPACITIES			
			USABLE FUEL (EACH)		FULLY SERVICED (EACH)	
			POUNDS	GALLONS	POUNDS	GALLONS
NO. 1 & 4 MAIN	2		31,843	4,899	31,883	4,905
NO. 2 & 3 MAIN	2		44,259	6,809	44,421	6,834
MID BODY	1		46,410	7,140	46,501	7,154
FORWARD BODY	1		13,319	2,049	13,345	2,053
AFT BODY	1		55,192	8,491	55,237	8,498
OUTBOARD WING	2		7,495	1,153	7,540	1,160
CENTER WING	1		20,982	3,228	21,060	3,240
EXTERNAL	2		4,550	700	4,583	705
USABLE FUEL TOTALS			NOTES			
TANKS			POUNDS	GALLONS	Fully serviced quantities include both trapped and drainable fuel. The tanks will have the quantities shown under conditions of ICAO standard day with fuel density of 6.5 pounds per gallon.	
NO. 1, 2, 3 & 4 MAIN			152,204	23,416		
MAINS & MID BODY			198,614	30,556		
MAINS, MID BODY, FORWARD BODY & AFT BODY			267,125	41,096		
MAINS, ALL BODY, OUTBOARD WING & CENTER WING			303,097	46,630		
ALL TANKS			312,197	48,030	NOTE See data supplied in Section V, OPERATING LIMITATIONS to determine fuel loading.	

Fuel Quantity Data

Figure 1-17.

Exhaust Gas Temperature Gages

Exhaust gas temperature of each engine is indicated by eight gages (30, figure 1-15) on the pilots' instrument panel. These gages are calibrated in degrees centigrade and indicate the temperature of the exhaust gases of each engine. Engine thermocouples supply power to operate the gages which are independent of the aircraft electrical power system.

Engine Pressure Ratio (EPR) Gages

An engine pressure ratio (EPR) gage (figure 1-15) for each engine is located on the pilots' instrument panel. These gages indicate the ratio of engine inlet to exhaust pressures which is used as a measure of engine thrust. The engine inlet and exhaust indications are compared by a computer-transmitter which electrically transmits an indication to the engine pressure ratio gage. The computer-transmitter operates on 118-volt single-phase a-c power obtained from the aircraft electrical system. Pressure ratio gage circuit breakers marked "Press Ratio Ind," "Pod 1," "Pod 2," "Pod 3," and "Pod 4" are located on the "Engine" portion of the right load central circuit breaker panel.

NOTE

To more readily identify a malfunctioning engine, a yellow vertical stripe is painted between the left-hand and right-hand bank of engine instruments (engines 4 and 5).

Oil Pressure Gages

Engine oil pressure is indicated by eight oil pressure gages (34, figure 1-15) located on the eyebrow instrument panel. These gages operate on 28-volt a-c power supplied through pressure transmitters in each engine oil system. A single circuit breaker for the eight oil pressure gages marked "Oil Press Ind" is located on the "Engine" portion of the right load central circuit breaker panel.

NOTE

- If the oil pressure circuit breaker has popped, oil pressure indicators are inoperative.
- Oil pressure will have a tendency to follow the throttle due to the type of oil pressure relief valve installed. This condition is normal provided the oil pressure stabilizes between the minimum and maximum limits.

Low Oil Pressure Warning Lights

Engine low oil pressure is indicated by eight amber oil pressure warning lights (25, figure 1-15) located over each oil pressure gage on the eyebrow instrument panel. A pressure switch is installed on each engine that will extinguish the light when an increasing oil pressure reaches 37 (± 2) psi and will illuminate the light when a decreasing oil pressure reaches to 37 (± 2) psi. These lights will complement the oil

pressure indicating system to provide a crosscheck to establish if a malfunction is occurring in the oil pressure indicating system or in the engine. All lights have a press-to-test feature and have provisions for manually dimming or shading. The low oil pressure warning lights operate on TR power and are controlled by a circuit breaker marked "Oil Press Warning" on the "Engine" portion of the right load central circuit breaker panel.

OIL SUPPLY SYSTEMS

Each engine is provided with an integral oil system which includes an oil tank with a minimum usable capacity of 6.8 gallons and a total capacity of 8.75 gallons. From the tank, oil is supplied to gear-type engine-driven oil pressure pumps which supply the engine bearings and accessory drives in the various engine compartments. Scavenge pumps remove oil from the engine compartments, route it through an oil cooler, and return it to the tank for reuse. Cooling air is provided by ram air in flight; while on the ground, engine bleed air is provided by actuation of the landing gear squat switch relays. Actuation of the squat switch permits high pressure compressor bleed air to enter an ejector in the aft portion of the oil cooler ducting, thus inducing a flow of air through the cooler. Oil temperature is governed by a thermostatic control valve which is an integral part of the oil cooler. When the oil supply is exhausted, approximately 1 to 1 1/2 gallons of oil remain trapped in the lines and oil cooler. No manual controls are provided for the engine oil system. For oil servicing information, see figure 1-55.

FUEL SUPPLY SYSTEM

The fuel supply system (figure 1-18) is designed so that the engines receive fuel from the nearest of four main tanks or by pressure override from a main manifold. The main manifold can be pressurized by any auxiliary tank or tanks. The main tanks are integral wing tanks ("wet wing"); each tank has four boost pumps and normally supplies two engines. No. 1 main tank furnishes fuel for engines 1 and 2, No. 2 main for engines 3 and 4, No. 3 main for engines 5 and 6, and No. 4 main for engines 7 and 8. The auxiliary tanks include two outboard wing tanks which are integral wing tanks, an integral center wing tank, three body tanks, and two nonjettisonable external tanks. Normally the main manifold is used for directing auxiliary tank fuel to the engines. The main manifold is separated from the refuel manifold by the main refuel valve. During a refueling operation, the main manifold is used to direct fuel to the desired tanks. (See "Air Refueling System" and "Single Point Ground Refueling System," Section IV.) The main manifold may also be used to transfer fuel from auxiliary tanks to main tanks. A crossfeed manifold is provided which makes it possible to interconnect the fuel feed systems of each nacelle. Auxiliary fuel should be fed directly to the engines. While auxiliary fuel is being used, main tank boost pump switches are ON. The boost pumps in the auxiliary tanks are of

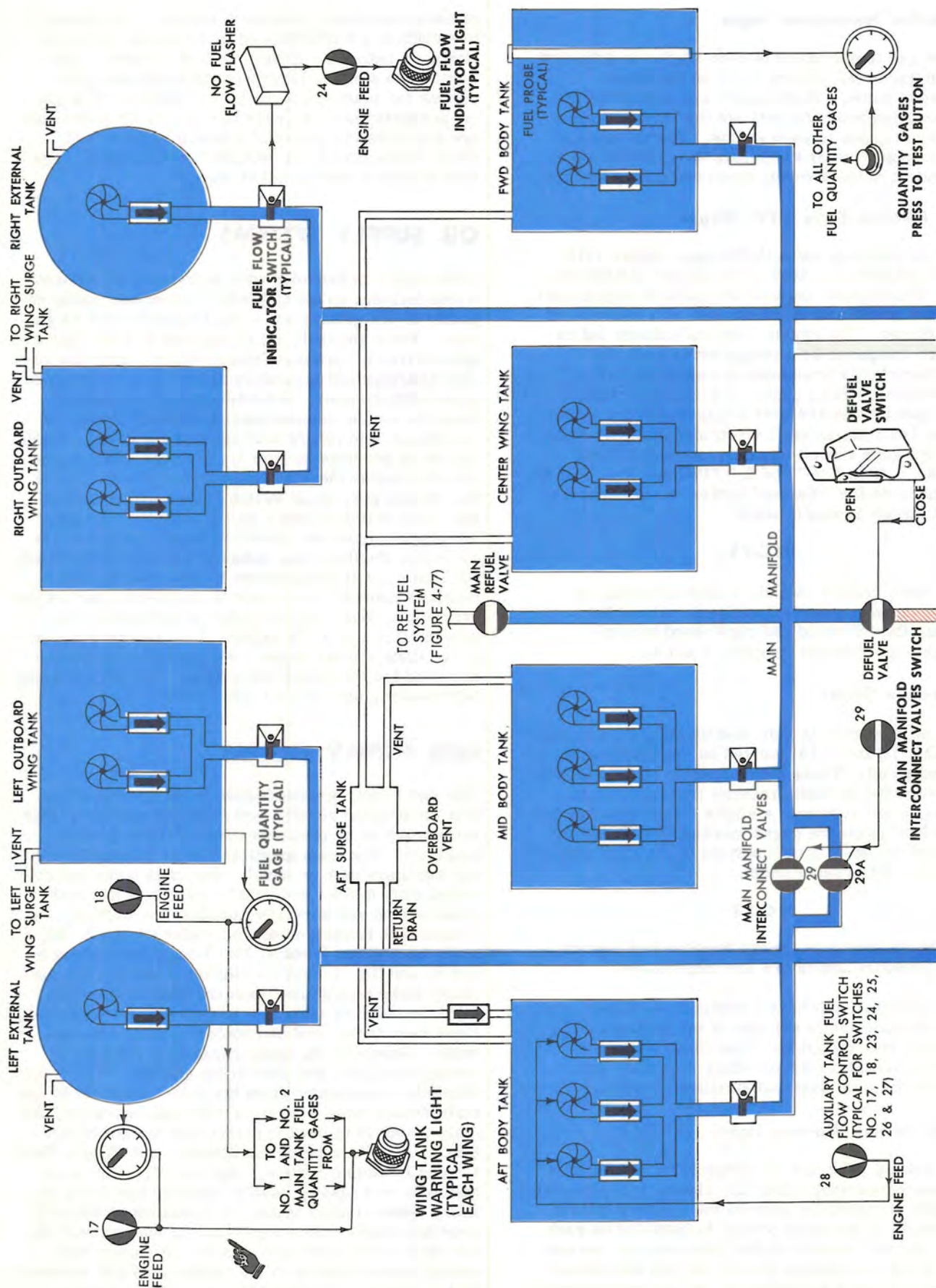
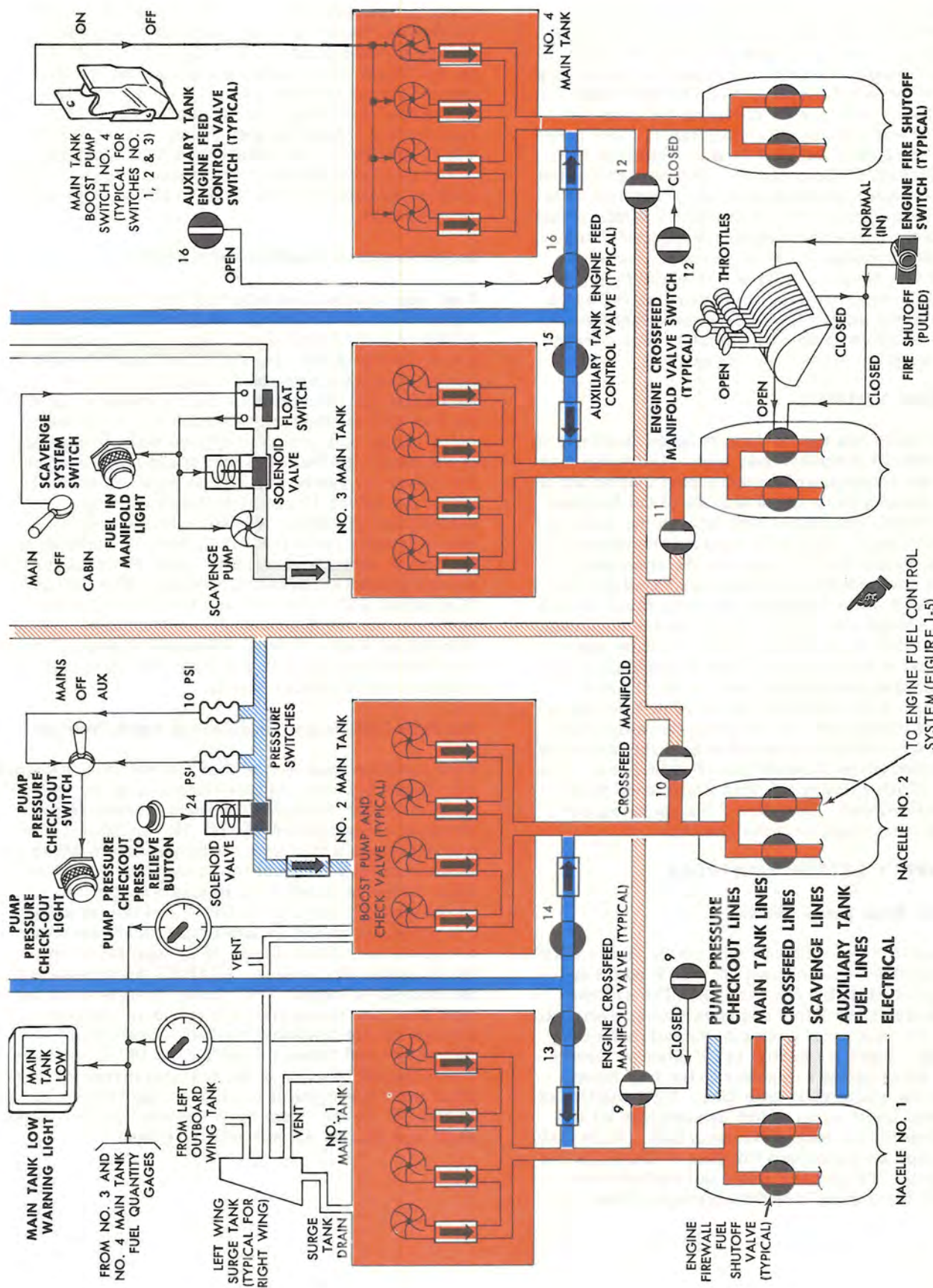


Figure 1-18 (Sheet 1 of 2).



higher capacity than the boost pumps in the main tanks thus allowing a pressure override condition to exist. When an auxiliary tank runs dry, the main tank boost pumps take over fuel supply to the engines with no interruption in fuel flow. The fuel system panel (figure 1-19) is used to control fuel flow for engine feed and air refueling operations. This panel indicates the flow of fuel obtained by selecting different positions of the controls. The majority of the fuel system controls are numbered to simplify their identification (figure 7-1). The control numbers that appear on the fuel system panel correspond to the control identification numbers that appear in this manual. The main manifold is scavenged by utilizing a float switch, a solenoid-operated valve, and a scavenge pump which directs scavenged fuel from the main manifold to No. 3 main tank. For correct fuel specification grade, see figure 1-55.

FUEL TANK VENTING

Body fuel tanks are vented through three manifolds to a surge tank aft of the aft body tank. The surge tank opens to the atmosphere through a port located aft of the rear wheel well on the underside of the fuselage and also routes fuel discharged through the vents to the aft body tank. Body tank cavities are vented through a manifold which opens to the atmosphere through a port located aft of the rear wheel well on the underside of the fuselage. Internal tanks in each wing are vented with a single vent line for each tank. The three lines in each wing drain to a wing surge tank located in each wingtip. The surge tanks route fuel discharged through the vents to No. 1 and 4 main tanks. Each external tank is vented through a single line which opens to the atmosphere through a port located on the aft outboard side of the tank strut. The vent system is designed for JP-4 fuel only. See "Rate of Climb Limitations with Emergency Fuel (Aviation Gasoline)," Section V, for operating restrictions when using aviation gasoline.

FUEL SUPPLY SYSTEM CONTROLS

Main Tank Boost Pump Switches

Four main tank boost pump switches (3, figure 1-19) on the fuel system panel have ON--OFF positions and are guarded in the ON position. The switches are numbered from 1 to 4 and each switch electrically controls the four boost pumps in the corresponding main tank. Placing a switch in ON position directs 205-volt three-phase a-c power to the four boost pumps in the respective main tank. OFF position of a main tank boost pump switch deenergizes all the boost pumps in the respective main tank. Main tank boost pumps are numbered for ease of identification (figure 7-4). TR control power is supplied to the main tank boost pump switches through circuit

breakers marked "6," "7," "10," and "11" on the "Left Wing Tanks" portion of the left load central circuit breaker panel; "12," "13," "16," and "17" on the "Right Wing Tanks" portion of the left load central circuit breaker panel; "4," "5," "8," and "9" on the "Left Wing Tanks" portion of the right load central circuit breaker panel; and "14," "15," "18," and "19" on the "Right Wing Tanks" portion of the right load central circuit breaker panel. The circuit breakers are bracketed to indicate the applicable tank.

Engine Crossfeed Manifold Valve Switches

Four engine crossfeed manifold valve switches (2, figure 1-19) on the fuel system panel have unmarked OPEN--CLOSED positions. These rotary switches are numbered 9, 10, 11, and 12 and control operation of the engine crossfeed manifold valves of corresponding numbers allowing interconnection of the fuel feed systems of each nacelle. When the white stripe on a switch is aligned with the flow line of the panel, the switch is OPEN and left essential d-c power for valves 9 and 12 or right essential d-c power for valves 10 and 11 is supplied to open the corresponding valves. CLOSED position supplies power to close the valve. D-C power is supplied to the engine cross-feed manifold valve switches through circuit breakers marked "Crossfeed Valves 9" and "Crossfeed Valves 12" on the "Fuel Feed Control" portion of the left load circuit breaker panel and "Crossfeed Valve 10" and "Crossfeed Valve 11" on the "Fuel Feed Control" portion of the right load central circuit breaker panel.

Auxiliary Tank Engine Feed Control Valve Switches

Four auxiliary tank engine feed control valve switches (16, figure 1-19) on the fuel system panel have unmarked OPEN--CLOSED positions. These rotary switches are numbered 13, 14, 15, and 16 and control operation of valves of corresponding numbers to direct auxiliary tank fuel to the engines. When the white stripe on a switch is aligned with the flow line on the panel, the switch is OPEN and left essential d-c power for valves 14 and 15 and right essential d-c power for valves 13 and 16 is supplied to open the corresponding valves. CLOSED position closes the respective valve. D-C power is supplied to the auxiliary tank engine feed control valve switches through circuit breakers marked "Direct Feed Valves 14" and "Direct Feed Valves 15" on the "Fuel Feed Control" portion of the left load circuit breaker panel and "Direct Feed Valves 13" and "Direct Feed Valves 16" on the "Fuel Feed Control" portion of the right load central circuit breaker panel.

Main Manifold Interconnect Valves Switch

A main manifold interconnect valves switch (15, figure 1-19) on the fuel system panel has unmarked OPEN--CLOSED positions. This rotary switch is numbered 29 and controls the operation of main manifold interconnect valves 29 and 29A. When the white stripe on the switch is aligned with the flow line on the panel, the switch is OPEN and left TR power is supplied to open valve 29 and right TR power is supplied to open valve 29A. Opening these valves interconnects the right and left sides of the main manifold. CLOSED position closes the two valves. TR power is supplied to the main manifold interconnect valves switch through circuit breakers marked "Crossfeed Valves 29" on the "Fuel Feed Control" portion of the left load central circuit breaker panel and "Crossfeed Valve 29A" on the "Fuel Feed Control" portion of the right load central circuit breaker panel.

Auxiliary Tank Fuel Flow Control Switches

Eight auxiliary tank fuel flow control switches (16, figure 1-19) on the fuel system panel have unmarked REFUEL--OFF--ENGINE FEED positions. These rotary switches are numbered 17, 18, 23, 24, 25, 26, 27, and 28 and control the flow of fuel to and from the auxiliary tanks. A white arrowhead is painted on top of each switch and the direction the arrow is pointing determines the position of the switch. For ENGINE FEED position, the arrow is pointed away from the tank; for REFUEL position, the arrow is pointed toward the tank; and for OFF position, the arrow is perpendicular to the flow line between tank and main manifold. ENGINE FEED position directs 205-volt three-phase a-c power to the boost pumps in the respective tank. ENGINE FEED position of an external tank switch (17 or 24) will also illuminate the wing tank warning light on that side. REFUEL position causes TR power to energize the fuel level control valves in the respective tank provided the master refuel switch is ON. See "Refuel System," Section IV. OFF position deenergizes the boost pumps and the fuel level control valves in the respective tank. Auxiliary tank boost pumps are numbered for ease of identification (figure 7-4). TR control power is supplied for ENGINE FEED position through circuit breakers on the left load central circuit breaker panel marked "Outbd 2" on the "Left Wing Tanks" portion; "Outbd 20" on the "Right Wing Tanks" portion; and "Fwd 24," "Ctr Wing 25," "Mid 29," "Aft 30," and "Aft 32" on the "Body Tanks" portion and circuit breakers on the right load central circuit breaker panel marked "Ext 1" and "Outbd 3" on the "Left Wing Tanks" portion; "Outbd 21" and "Ext 22" on the "Right Wing

Tanks" portion; and "Fwd 23," "Ctr Wing 26," "Mid 27," "Mid 28," and "Aft 31" on the "Body Tanks" portion. The switches for the left external, left outboard, right outboard and right external tanks (switches 17, 18, 23, and 24 respectively) are equipped with fuel flow control switch locks (20, figure 1-19). Each lock is a pivoting bar with a detent that mates with an extension on the corresponding switch. The lock must be pivoted away from the switch before the switch can be moved from OFF position.

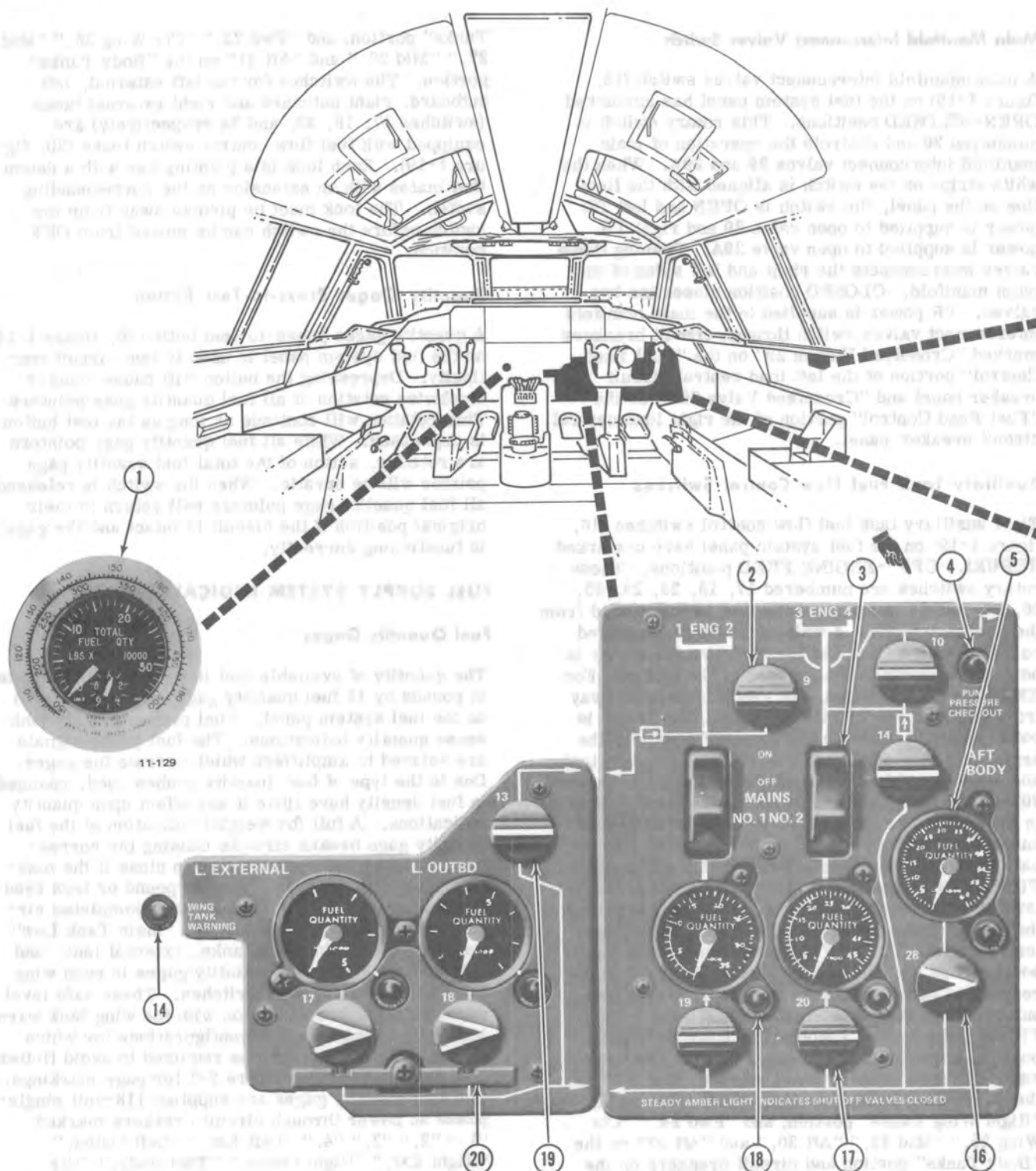
Quantity Gages Press-to-Test Button

A quantity gages press-to-test button (6, figure 1-19) on the fuel system panel is used to test circuit continuity. Depressing the button will cause counter-clockwise rotation of all fuel quantity gage pointers. This rotation will continue as long as the test button is depressed. While all fuel quantity gage pointers are rotating, action of the total fuel quantity gage pointer will be erratic. When the switch is released, all fuel quantity gage pointers will return to their original position if the circuit is intact and the gage is functioning correctly.

FUEL SUPPLY SYSTEM INDICATORS

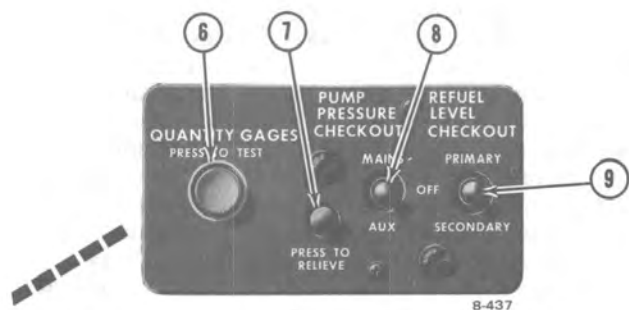
Fuel Quantity Gages

The quantity of available fuel in each tank is indicated in pounds by 12 fuel quantity gages (5, figure 1-19) on the fuel system panel. Fuel probes in each tank sense quantity indications. The fuel probe signals are relayed to amplifiers which operate the gages. Due to the type of fuel quantity probes used, changes in fuel density have little if any effect upon quantity indications. A full (by weight) indication of the fuel quantity gage breaks circuits causing the corresponding fuel level control valve to close if the master refuel switch is ON. A 4000-pound or less reading of a main tank fuel quantity gage completes circuits which supply TR power to a "Main Tank Low" warning light. The main tanks, external tank, and outboard wing tank fuel quantity gages in each wing have internal safe level switches. These safe level switches work in conjunction with the wing tank warning lights to indicate fuel configurations for which airspeed limitations may be required to avoid flutter. (See Section V.) (See figure 5-1 for gage markings.) The fuel quantity gages are supplied 118-volt single-phase ac power through circuit breakers marked "1," "2," "3," "4," "Left Ext," "Left Outbd," "Right Ext," "Right Outbd," "Fwd Body," "Ctr Wing," "Mid Body," and "Aft Body" on the "Fuel Quantity Indicators" portion of the copilot's circuit breaker panel.

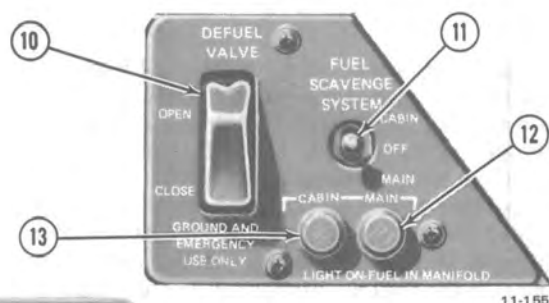


1. TOTAL FUEL QUANTITY GAGE
2. ENGINE CROSSFEED MANIFOLD VALVE SWITCHES (NO. 9 THRU 12)
3. MAIN TANK BOOST PUMP SWITCHES (NO. 1 THRU 4)
4. PUMP PRESSURE CHECKOUT LIGHT
5. FUEL QUANTITY GAGES
6. QUANTITY GAGES PRESS-TO-TEST BUTTON
7. PUMP PRESSURE CHECKOUT PRESS-TO-RELIEVE BUTTON
8. PUMP PRESSURE CHECKOUT SWITCH
9. REFUEL LEVEL CHECKOUT SWITCH
10. DEFUEL VALVE SWITCH
11. SCAVENGE SYSTEM SWITCH
12. FUEL-IN-MAIN-MANIFOLD LIGHT
13. FUEL-IN-CABIN-MANIFOLD LIGHT
14. WING TANK WARNING LIGHTS
15. MAIN MANIFOLD INTERCONNECT VALVES SWITCH (NO. 29)

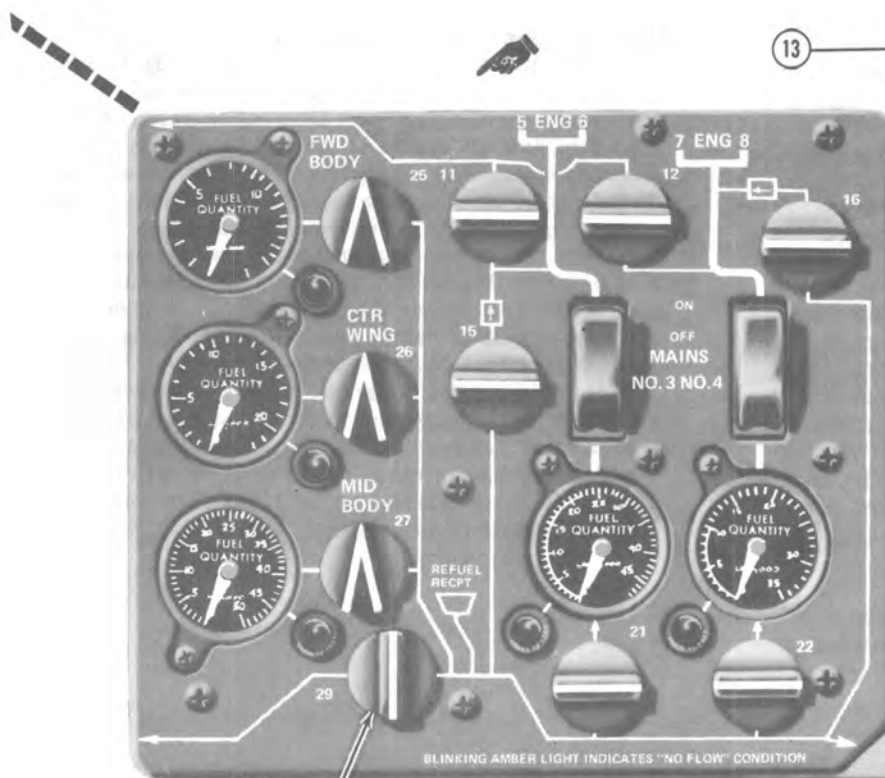
Figure 1-19 (Sheet 1 of 2).



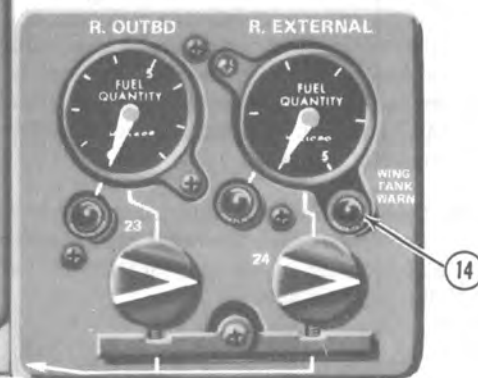
SYSTEM CHECKOUT PANEL



SCAVENGE SYSTEM PANEL



MANAGEMENT PANELS



8-306-1

16. AUXILIARY TANK FUEL FLOW CONTROL SWITCHES (NO. 17, 18, 23 THRU 28)
17. MAIN TANK FUEL LEVEL CONTROL VALVES SWITCHES (NO. 19 THRU 22)
18. FUEL FLOW INDICATOR LIGHTS
19. AUXILIARY TANK ENGINE FEED CONTROL VALVE SWITCHES (NO. 13 THRU 16)
20. FUEL FLOW CONTROL SWITCH LOCKS

■■■■■■■■■■ Fuel System Panels

Figure 1-19 (Sheet 2 of 2).

Total Fuel Quantity Gage

A total fuel quantity gage (1, figure 1-19) is located adjacent to the fuel system panel. The total fuel quantity gage receives its indication by electronic addition of indications of the individual fuel gages. The total fuel quantity gage is supplied 118-volt single-phase a-c power through a circuit breaker marked "Total" on the "Fuel Quantity Indicators" portion of the copilot's circuit breaker panel. A best flare speed indicator dial is installed outside of total fuel quantity gage to allow determination of gross weight and best flare speed directly from the quantity indication. See "Miscellaneous Equipment," Section IV, for additional information on the best flare speed indicator.

NOTE

- If a malfunction causes an individual fuel quantity gage pointer to rotate continuously, the total fuel quantity gage pointer will oscillate over a range equal to the full scale quantity of the malfunctioning individual gage. The pointer of the individual gage may be stopped at zero by pulling the circuit breaker for the gage just before the pointer reaches zero. If the fuel quantity gage for any tank is stopped at any point, this quantity will be the amount reflected for that tank in the reading of the total fuel quantity gage. The total fuel quantity gage will be in error by the amount that the individual quantity gage is in error.
- If an individual fuel quantity gage pointer falls below the zero mark, the total fuel quantity gage may rotate continuously clockwise. Depressing the fuel quantity gage test button will cause counterclockwise rotation of all the gage pointers. The individual gage pointer may be set at zero by pulling the applicable circuit breaker just before the pointer reaches zero and rotation of the total fuel quantity gage pointer will stop.
- There is an allowable tolerance of 3400 pounds between the total fuel quantity gage and the sum of all individual gage fuel quantity gage readings.

Wing Tank Warning Lights

Two amber wing tank warning lights (14, figure 1-19) on the fuel system panel are provided to warn the crew that fuel is being used from the outboard wing tanks out of sequence. The main, external, and outboard wing tank fuel quantity gages for each wing have internal safe level switches. If the fuel quantity indication of either main tank in a wing is above the green band marking on the dial and the fuel quantity indication of the outboard wing tank for the same wing is below safe level, the light will come on and remain on until the fuel quantity indications of both main tanks have reached the green band marking area on the dials. The light will also be illuminated whenever the respective external tank fuel flow control switch is in ENGINE FEED or when the quantity indication for that tank is below the safe level. The wing tank warning lights receive right TR power through a circuit breaker marked "Outbd & Ext Tank Level Warn" on the "Fuel Miscellaneous" portion of the right load central circuit breaker panel.

Fuel Flow Indicator Lights

Twelve amber fuel flow indicator lights (18, figure 1-19) are located on the fuel system panel adjacent to the fuel quantity gages. Those indicator lights adjacent to auxiliary tank gages perform a dual function; 1) indicating no fuel flow from the corresponding tank during fuel feed operations and 2) indicating no fuel flow into the tank during refuel operations. Those indicator lights adjacent to the main tank gages perform only a single function, that of indicating no fuel flow into the tank during refuel operations. See "Refuel System," Section IV, for description of refuel function of the lights. With an auxiliary tank fuel flow control switch in ENGINE FEED position, the boost pumps in the corresponding auxiliary tank supply fuel to the main manifold. As soon as the auxiliary tank runs dry, a flow switch in the line causes the respective fuel flow indicator light to flash, indicating no fuel flow from the tank. The fuel flow indicator lights receive right TR power

(Figure 1-19A deleted)

through a circuit breaker marked "Fuel Manag Ind" on the "Fuel Miscellaneous" portion of the right load central circuit breaker panel.

NOTE

- A fuel flow indicator light may flash intermittently when fuel in an auxiliary tank is at a low level and the aircraft is being maneuvered.
- A fuel flow indicator light may not illuminate when an auxiliary tank fuel flow control switch is in the ENGINE FEED position and the auxiliary tank is empty. See "Fuel System Management," Section VII.

Main Tank Low Warning Light

A red main tank low warning light (43, figure 1-15) is located adjacent to the fuel system panel. A 4000-pound or less indication of any main tank fuel quantity gage causes the main tank low warning light to come on, indicating that the fuel quantity in one or more main fuel tanks is below the 4,000-pound level. Right TR power is supplied to the light through a circuit breaker marked "Main Tank Low Level Warn" on the "Fuel Miscellaneous" portion of the right load central circuit breaker panel.

FUEL CHECKOUT SYSTEM

Fuel pressure gages and warning lights are not provided for each tank. To save weight, a fuel checkout system is provided in the fuel system. This system allows ground pressure checking of each boost pump and each valve in the fuel system. To use the fuel checkout system, fuel under pressure is routed to a pressure switch by positioning various valves. This switch is located in a fuel line between the crossfeed manifold and the No. 2 main tank. The pressure switches will close and supply power to illuminate a pressure checkout light, indicating proper system operation. The fuel checkout system controls and indicators are located on a separate fuel system checkout panel (3B, figure 1-11) on the copilot's side panel.

Pump Pressure Checkout Switch and Light

A pump pressure checkout switch (8, figure 1-19) is used for ground checking of fuel pressure. The switch has MAINS--OFF--AUX positions. MAINS position supplies left TR power to the low pressure side of a pressure switch. When fuel pressure reaches 10 psi, the green pump pressure checkout light (6, figure 1-19) on the fuel-system panel glows. In AUX position, left TR power is supplied to the high pressure side of the pressure switch. When fuel pressure reaches 24 psi, the same pump pressure checkout light glows. OFF position completely deenergizes the pump pressure checkout circuits. TR power is supplied to the pump pressure checkout switch and light through a circuit breaker marked "Grd Chk Out Pump Press" on the "Fuel System" portion of the left load central circuit breaker panel.

Pump Pressure Checkout Press-to-Relieve Button

A pump pressure checkout press-to-relieve button (7, figure 1-19) on the fuel system panel is utilized to relieve the fuel pressure built up by use of the pump pressure checkout switch. Pushing this button causes left TR power to energize and open a solenoid-operated valve to allow fuel pressure to bleed off into No. 2 main tank. TR power is supplied to the pump pressure checkout press-to-relieve button through a circuit breaker marked "Grd Chk Out Refuel Valves" on the "Fuel System" portion of the left load central circuit breaker panel.

FUEL SCAVENGE SYSTEM

A separate scavenge system is provided for the main fuel manifold and the refuel (cabin) manifold. Each system has an a-c powered pump, float switch, and solenoid-operated valve, all under control of a single scavenge switch. The main manifold fuel is directed to the No. 3 main tank and the refuel (cabin) manifold fuel is directed to the No. 2 main tank. The scavenge system controls and indicators are located on the fuel scavenge system panel (figure 1-19) on the copilot's instrument panel above the fuel panels.

Scavenge System Switch

A scavenge system switch (11, figure 1-19) has CABIN--OFF--MAIN positions. MAIN position directs right TR power to a float switch in the scavenge line between the main manifold and No. 3 main tank. If there is fuel in the manifold, the float switch makes a contact which causes the TR power to illuminate the fuel-in-manifold light, open a solenoid shutoff valve, and energize a relay which directs 118-volt single-phase a-c power to the main manifold scavenge pump. The fuel in the manifold is pumped into No. 3 main tank. As soon as the manifold is scavenged, the float switch breaks contact causing the scavenge pump to stop, the solenoid shutoff valve to close, and the fuel-in-manifold light to go out. CABIN position actuates the scavenge operation in the refuel manifold. See "Air Refueling System," Section IV. OFF position completely deenergizes the scavenge circuits in the main and refuel manifolds. TR power is supplied for MAIN position through a circuit breaker marked "Manifold-Fuel Scavenge Control-Main" on the "Fuel Miscellaneous" portion of the right load central circuit breaker panel.

Fuel-in-Manifold Lights

Two amber fuel-in-manifold lights (12 and 13, figure 1-19) indicate when fuel is in either the main or refuel manifolds. The lights are marked "Cabin" and "Main." When the scavenge system switch is placed in MAIN position, the "Main" fuel-in-manifold light will go out as soon as the manifold is scavenged or the scavenge system switch is turned OFF. The "Cabin" fuel-in-manifold light will glow if fuel is in the refuel manifold and the master refuel switch is OFF. On aircraft W173 W259, the light will go out as soon as the manifold is scavenged or the master

refuel switch is turned ON. After scavenging, the light may blink on and off if residual fuel remains in the manifold. On aircraft **W260**, the light will go out as soon as the manifold is scavenged or, with fuel in the refuel manifold and the scavenge system switch OFF, the light will go out if the master refuel switch is returned to ON position. The fuel-in-manifold lights receive right TR power through circuit breakers marked "Manifold Fuel Scavenge Control Cabin" and "Manifold Fuel Scavenge Control Main" on the "Fuel Miscellaneous" portion of the right load central circuit breaker panel.

ELECTRICAL POWER SUPPLY SYSTEMS

Primary and secondary distribution buses supply power to the aircraft. Primary power is supplied by four engine-driven generators. This 205/118-volt three-phase a-c power is used for most heavy loads such as boost pumps and wing flap motors. Single-phase 118-volt a-c power is used for small motors, actuators, heating, and some electronic equipment. Transformers reduce single-phase a-c power to 28 volts for most lighting. Secondary power is 28-volt nominal unregulated dc supplied by transformer-rectifier (TR) units fed from 205-volt three-phase a-c power of the primary system. This TR power is used for control circuits, instruments, small motors, and electronic equipment. Batteries provide an auxiliary source of 24-volt d-c power which is supplied to essential and emergency equipment in case the a-c or TR system fail to function. The batteries also provide power directly to emergency equipment through the forward and aft battery buses. Both ac and dc power is distributed throughout aircraft by buses located in junction boxes and circuit breaker panels. AC and dc power may be obtained for ground operation through external power receptacles. AGM-69A ac power requirements are provided from the aircraft through circuit breakers in the engine No. 1, No. 5, and No. 7 generator power boxes. The ac input power is redistributed within the AGM-69A system through circuit breakers located in an AGM-69A power distribution box installed in the forward wheel well. AGM-69A dc control power and other miscellaneous requirements are supplied from the aircraft forward TR bus. The dc power requirements for AGM-69A are provided from four AGM-69A TR units installed in the forward wheel well with circuit breaker protection in the AGM-69A power distribution box. A nickel-cadmium battery, battery charger, and test panel are installed in the forward wheel well. The battery serves as a source for master control power, essential power, missile electronics back-up power, and ejector rack unlock squib power. For additional information regarding the AGM-69A electrical system, refer to T.O. 1B-52G-30-2.

A-C POWER SYSTEM

The a-c power system (figures 1-20 and 1-21) consists of four engine-driven generators, a flight gyro emergency power inverter, power distribution boxes, a central bus tie, bus tie and generator circuit breakers, power load boxes, and circuit breaker panels.

An a-c control panel (figure 1-22) at the copilot's station provides all the controls and indicators for operation of the system. The gyro power switch on the forward instrument panel controls the flight gyro emergency power inverter.

Generators

The primary a-c power supply is provided through four engine-driven generators located on the left engine of each nacelle, thus the generators are driven by engines 1, 3, 5, and 7.

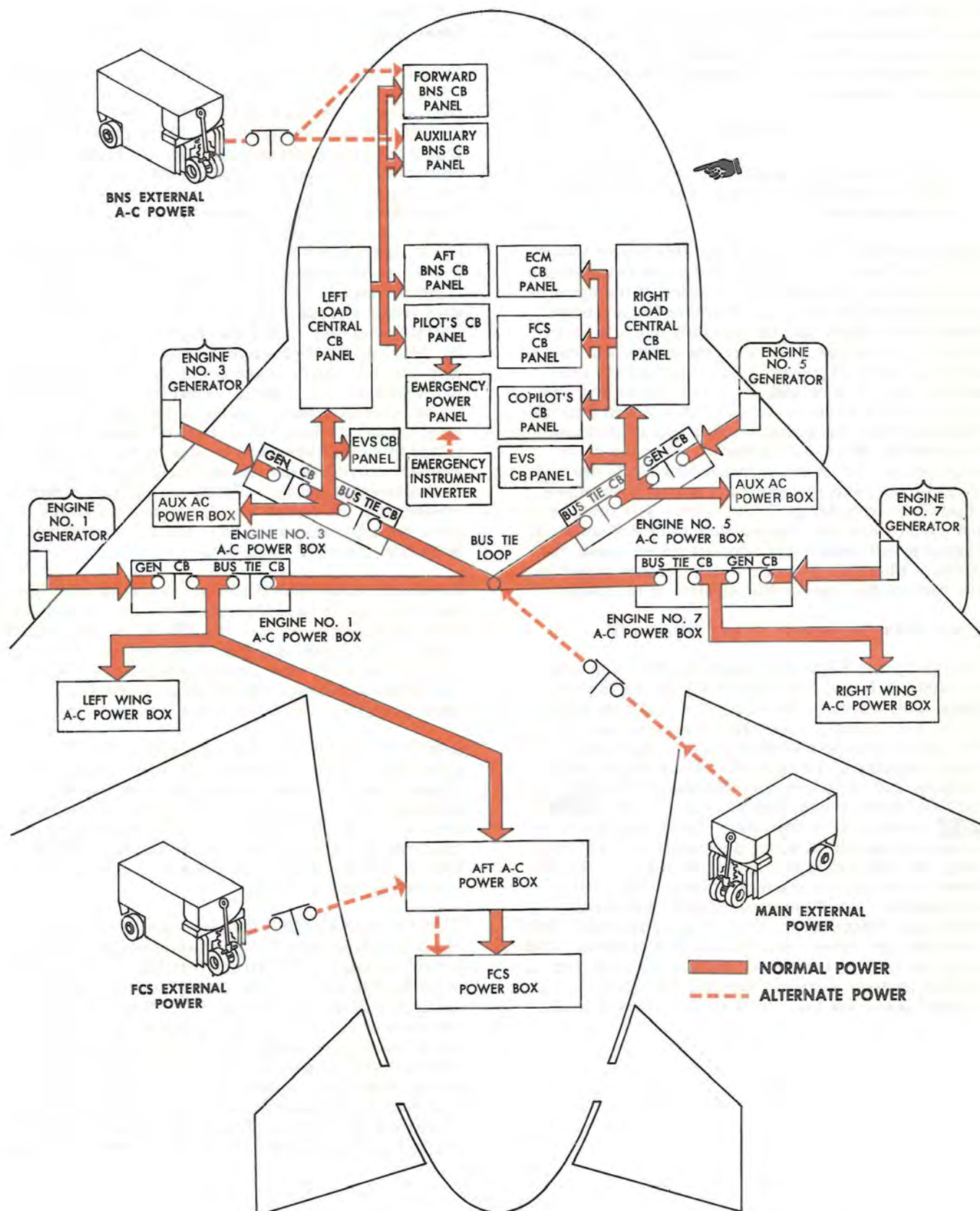
GENERATOR DRIVES. Since certain electronic equipment requires constant frequency ac, a drive is needed to drive the generator at a constant speed throughout the range of various engine speeds. The drive used consists of a hydraulic transmission controlled by an electromechanical governor. The transmission receives its input drive power directly from the engine. By use of a wobble plate pump, the drive adds to or subtracts from the variable input speed of the engine and provides a constant a-c output from the generator of 400 (± 1.5) cycles per second. The minimum generator cut-in speed is approximately 3100 engine rpm. Movement of the governor flyweights controls the action by directing oil pressure to vary the pitch of the wobble plate. The frequency is controlled automatically by the frequency and load controller through the magnetic trim head of the basic speed governor. The drive can manually be disconnected from the engine by use of the decoupler system and will automatically disconnect any time the drive temperature reaches 450°F. The drive can only be reconnected when the aircraft is on the ground and with the engine not operating.

GENERATOR DRIVE OIL SYSTEM. Each generator is provided with an independent oil system which consists of an integral reservoir, oil cooler, oil cooler bypass valve, and two filters. The integral reservoir oil capacity is 4 1/2 to 5 quarts. Bleed air from the compressor 16th stage maintains a pressure of 8 (± 2) psi on the oil system. A regulator valve regulates system pressurization. The oil cooler valve provides a quick warmup for the oil after engine start and maintains oil temperature at the desired level. The drive is protected from foreign matter by the charge filter and scavenge filter. For generator drive oil servicing, see figure 1-55.

Protective Features

Generator protective features are all automatically incorporated in the generator and generator drive systems. Each protective feature may accomplish one or more of the following actions:

1. Isolate the generator by tripping the respective bus tie circuit breaker.
2. Disconnect the generator from its main bus by tripping the respective generator circuit breaker.
3. Throw the drive in full underspeed operation so it will turn at the slowest rate possible for the speed at which the engine is operating.



■■■■■■■■■■ A-C Power Routing (Typical)

Figure 1-20.

4. Provisions for manually decoupling the generator drive from the engine in the event of drive overheat.
5. Automatic thermal decoupling of the generator drive from the engine when generator drive temperature reaches 450°F.

NOTE

A bus tie circuit breaker will close automatically, if not already closed, when its generator shuts down.

SPEED PROTECTION. An under-overspeed switch on a limit governor provides protection from excessively low or high generator speeds. If the speed of the generator drops to a point where the a-c output frequency is below 320 Hz (possibly due to a faulty governor or engine shutdown), the switch will energize the under-overspeed relay, tripping the generator control relay and generator circuit breaker. This will take the generator off the line and thus protect electronic equipment which might be damaged by operation at a low frequency. When the drive overspeeds, the under-overspeed switch is drained of oil by the limit governor and reacts in the same manner as an underspeed condition. The limit governor also causes the transmission to be hydraulically locked in full underdrive (slowest output speed) position. When this happens, the generator cannot be put back on the line for the duration of the flight.

Flight Gyro Emergency Power Inverter

An emergency flight instrument inverter is provided to supply 115-volt three-phase a-c power to primary flight instruments in the event of a complete failure of the a-c system. The inverter supplies power to the pilot's attitude indicator and the pilot's directional indicator. The inverter also supplies single-phase power for instrument lighting of the pilot's attitude-director indicator and, on aircraft **W173** **W219**, to the pilot's altimeter. If the gyro power switch on the pilots' instrument panel is in ON position, the inverter is automatically turned on in the event of complete a-c power failure. For further information, see "Electrical System Emergency Operation," Section III. The inverter is deenergized when the gyro power switch is in OFF position. The inverter utilizes emergency battery power through a circuit breaker marked "Emerg Invtr" on the "Flight Gyros" portion of the pilot's circuit breaker panel.

A-C Power Distribution Boxes, Panels, Fuses and Circuit Breakers

Primary 205-volt a-c power is fed to separate buses within the four generator power boxes which in turn feed power to separate buses within the five power distribution boxes and panels. These power distribution boxes and panels provide power to other panels throughout the aircraft (figure 1-25). See figure 1-20 for a-c power routing. If any generator becomes inoperative, the other generators act as an alternate source to provide power to the faulty generator power distribution box. This is accomplished through automatic features of the generator system. The boxes and panels are supplied power through multi-wire feeders of three or more wires for each phase. The buses in these boxes and panels supply all of the 205-volt three-phase loads and, in addition, furnish 118-volt single-phase power to autotransformers for reduction to 28-volt ac. Distribution circuits for the circuit breaker panels in the crew compartment except the EVS circuit breaker panel are protected by circuit breakers located on the "Power Feeder" portion of the left and right load central circuit breaker panels. Fuses and additional circuit breakers on the circuit breaker panels within the crew compartment are used to protect wiring and individual pieces of equipment.

CURRENT LIMITERS (FUSES). One basic type of fast blow fuse is used throughout the aircraft for fault protection. Six ratings of 10, 20, 30, 40, 50, and 60 amperes are used. Some limiters have an indicator element that protrudes out of the limiter body when the limiter has blown; others show discoloration inside the glass barrel when blown.

INDICATING FUSES. Indicating fuses are used for protection of some lightly loaded three-phase a-c transformers. These fuses protect the transformer windings as well as the aircraft wiring. Such fuses are located on the pilot's, copilot's, right load central, and aft BNS circuit breaker panels. A neon light in the end of the fuse holder will glow when its respective fuse is blown.

CIRCUIT BREAKERS. Standard circuit breakers, ranging in size from 2.5 to 50 amperes, are used to provide protection for aircraft wiring. Although applied specifically for wire protection, they provide some protection for components. These circuit breakers are of the trip-free pushbutton type. Wiring to three-phase loads is protected by three individual circuit breakers, one for each phase. Special circuit breakers are used in conjunction with the bombing navigational system to provide both wire and component protection. These circuit breakers are toggle type and are used in fractional ampere ratings.

Three-phase circuit breakers of this type are used for some BNS components requiring three-phase power. The three-phase breakers will open all three power circuits simultaneously in the event that a short occurs in any one circuit.

A-C Power System Controls

GENERATOR SWITCHES. Four three-position generator switches (2, figure 1-22) on the copilot's a-c control panel are marked ON and OFF at the extreme positions respectively and are spring-loaded to the unmarked neutral position. When the switch is held momentarily in ON position, 24-volt d-c essential battery power closes the generator control relay and generator circuit breakers and energizes the generator field. When the switch is held in OFF position, the same power trips both the generator control relay and the generator circuit breaker and closes the bus tie circuit breaker. The switch receives d-c essential control power through circuit breakers marked "Eng No. 1 Gen," "Eng No. 3 Gen," "Eng No. 5 Gen," and "Eng No. 7 Gen" on the "A-C Generator Control" portion of the copilot's circuit breaker panel.

GENERATOR DRIVE DECOUPLER SWITCHES. Four generator drive decoupler switches (4B, figure 1-22), one for each generator drive, on the a-c control panel are marked DECPL--OFF. The switches are latched in OFF position and are spring-loaded to OFF after being placed to DECPL position. When a switch is placed in DECPL position and the throttle advanced beyond CLOSED, the drive input shaft disconnects from the engine shaft stopping generator output. The generator drive cannot be recoupled during flight. The decoupler switches are supplied right TR power through circuit breakers marked "Eng No. 1 & 3 Gen Dr Decoupler Cont" and "Eng No. 5 & 7 Gen Dr Decoupler Cont" on the "Miscellaneous" portion of the right load central circuit breaker panel.

NOTE

If a generator drive is decoupled during flight, it can only be recoupled while the aircraft is on the ground.

MASTER ISOLATE SWITCH. An isolate switch (6, figure 1-22) on the copilot's a-c control panel is marked "Push to Isolate Central Tie Bus." Pressing the switch energizes the master isolate relay which in turn trips the bus tie circuit breakers, isolating generators from the central bus tie. Holding the generator switches in ON position until the bus tie circuit breakers close will repower the central bus tie.

FREQUENCY AND VOLTAGE SELECTOR SWITCH (GENERATOR SELECTOR SWITCH). A five-position frequency and voltage selector switch (10, figure 1-22) located on the a-c control panel has ENG 1 GEN--ENG 3 GEN--ENG 5 GEN--CENTRAL TIE BUS--ENG 7 GEN positions. The switch provides a means of selecting and reading frequency and voltage of each generator and the central bus tie. By placing the switch in ENG 1 GEN position, the frequency and voltage of the No. 1 generator may be read on the frequency meter and voltmeter provided the generators are isolated. The remaining positions will perform the above operation for their respective generators as marked. When the generators are in parallel, all generator switch positions will read the same as the CENTRAL TIE BUS position.

A-C Power System Indicators

A-C AMMETERS. Four a-c ammeters (1, figure 1-22) located on the a-c control panel provide an indication of output in amperes supplied by each individual generator. The ammeters indicate in the range from 0 to 350 amperes. See figure 5-1 for ammeter markings.

CIRCUIT BREAKER POSITION INDICATORS. Eight three-position tab indicators, one for each generator circuit breaker (3, figure 1-22) and one for each bus tie circuit breaker (4, figure 1-22), are located on the a-c control panel and provide a means of indicating the position of the generator and bus tie circuit breakers. Two positions of the tab indicator are bars and the other is OFF. The bars are white and run vertically and horizontally through the center of the black indicator. OFF position is black and has OFF marked in white across the center of the indicator. When the bar is lined up with the reference line on the a-c control panel, the circuit breaker is closed and power is on the aircraft bus. When the bar is at a right angle to the reference line, the circuit breaker is open and power is isolated from the bus. OFF position indicates the tab indicator is not receiving control power. The generator circuit breaker position indicators receive d-c power through circuit breakers marked "Eng No. 1 Gen," "Eng No. 3 Gen," "Eng No. 5 Gen," and "Eng No. 7 Gen." The bus tie circuit breakers position indicators receive d-c power through circuit breakers marked "Bus Tie Ckt Bkr Position Ind Inbd and Outbd." All these circuit breakers are located on the "AC Generator Control" portion of the copilot's circuit breaker panel.

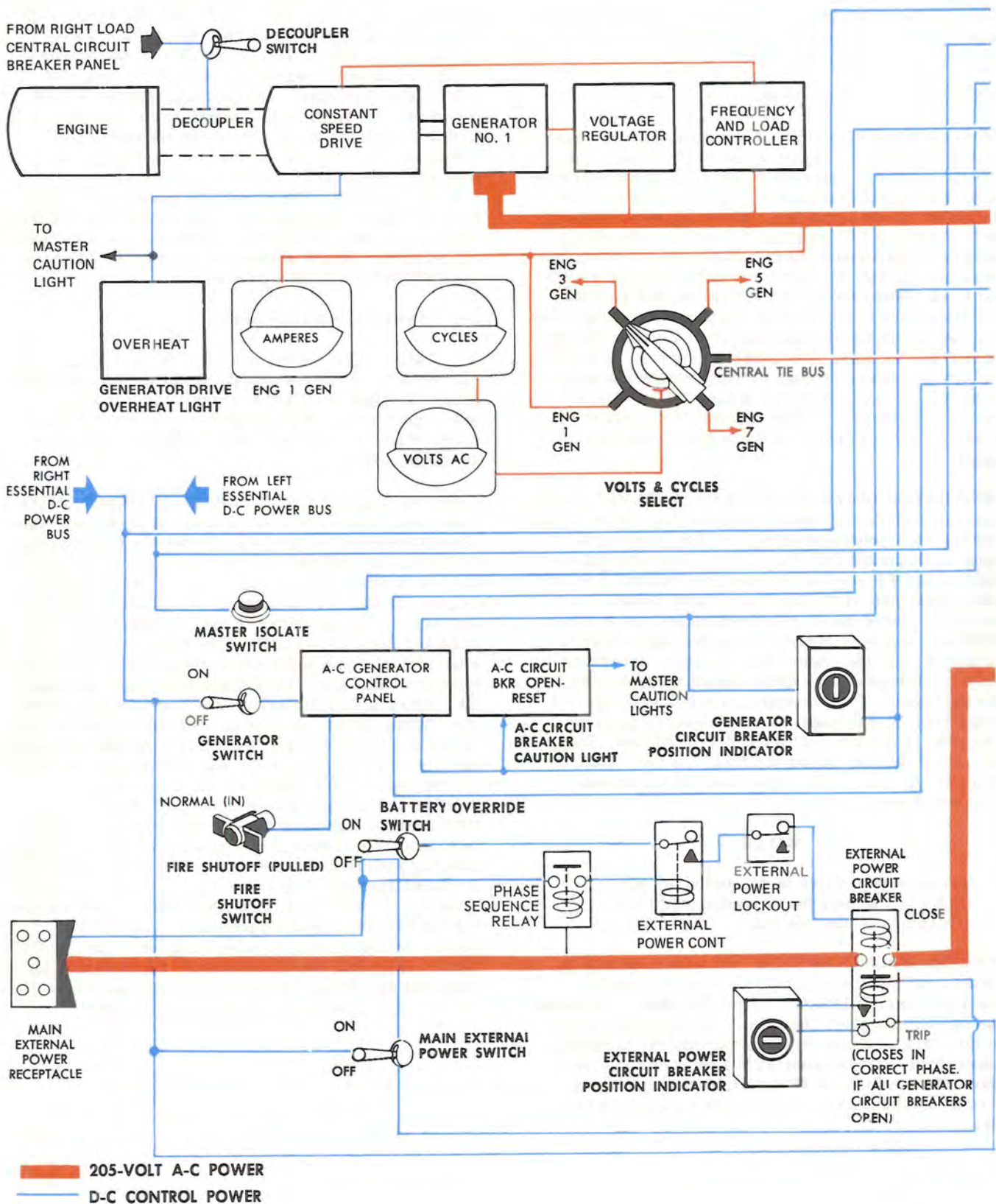
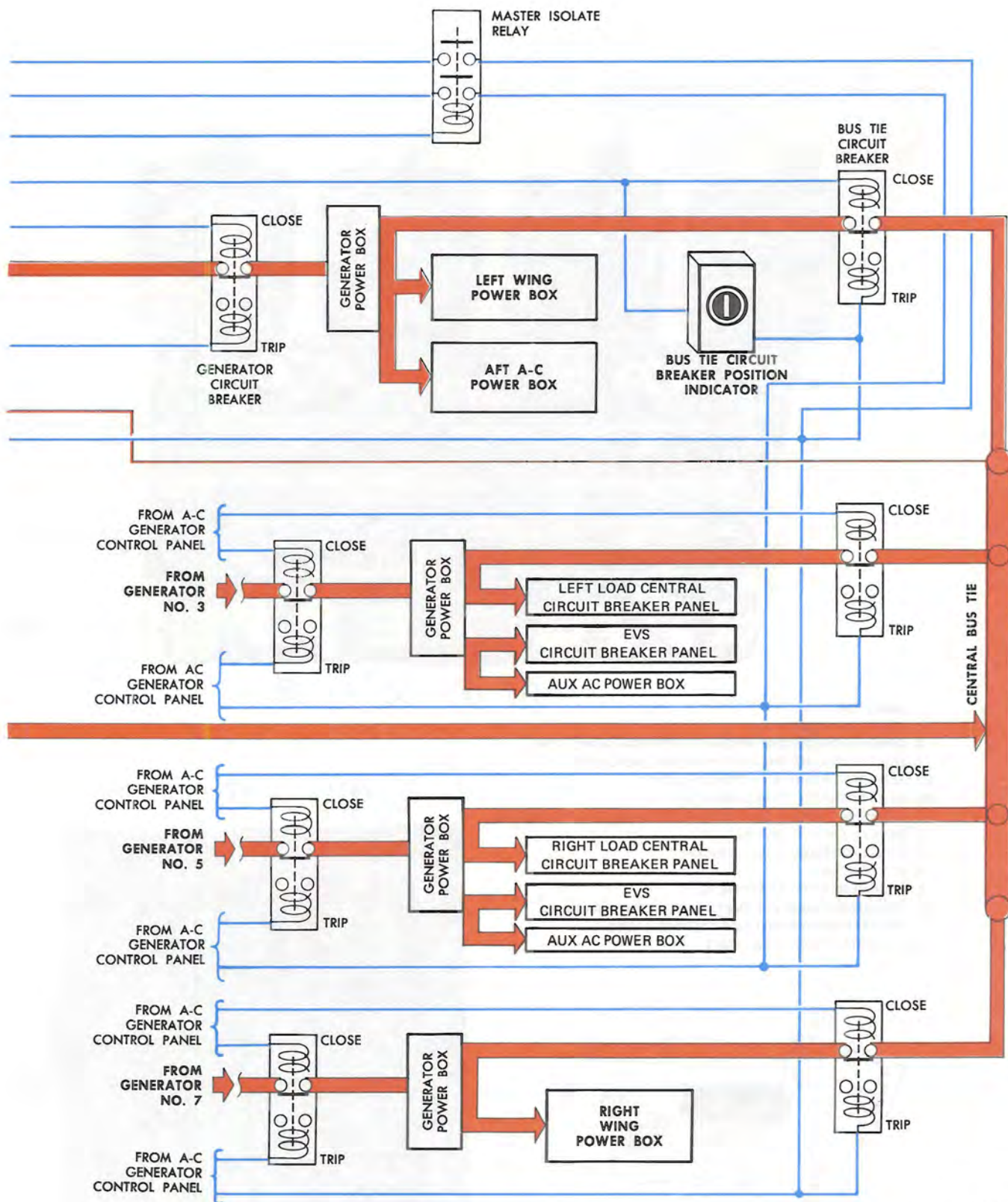


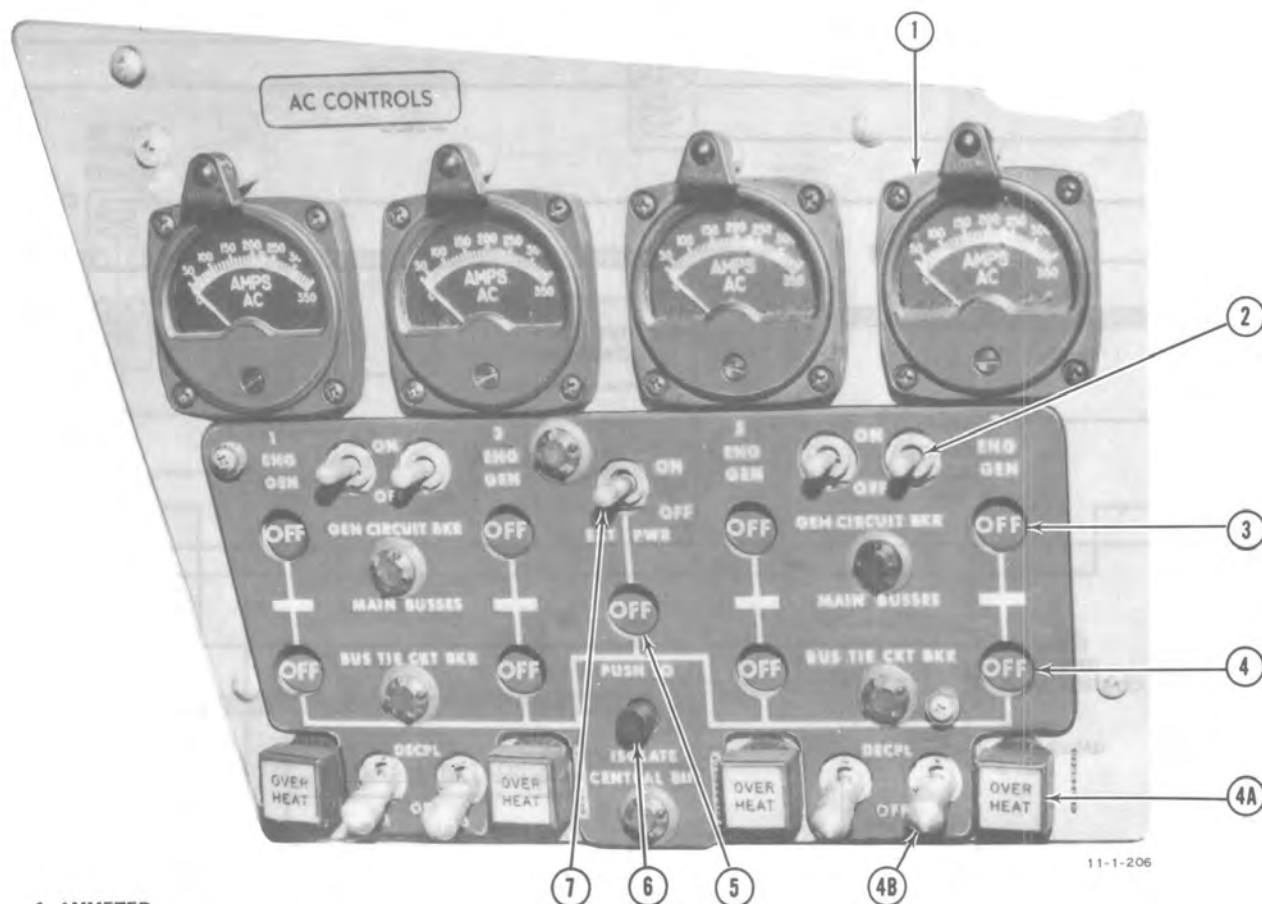
Figure 1-21 (Sheet 1 of 2).



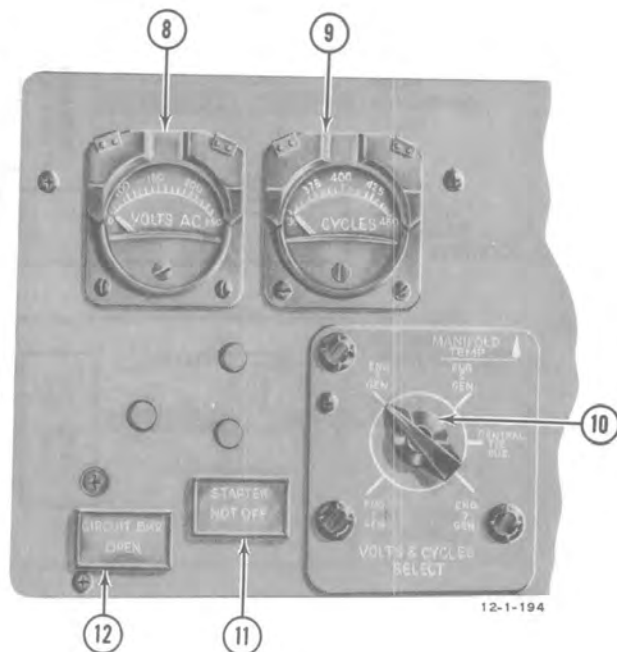
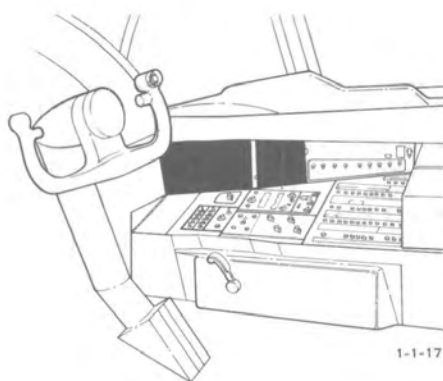
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.....A-C Power System (Typical)

Figure 1-21 (Sheet 2 of 2).



1. AMMETER
2. GENERATOR SWITCH
3. GENERATOR CIRCUIT BREAKER POSITION INDICATOR
4. BUS TIE CIRCUIT BREAKER POSITION INDICATOR
- 4A. GENERATOR DRIVE OVERHEAT LIGHT
- 4B. GENERATOR DECOUPLE SWITCH
5. EXTERNAL POWER CIRCUIT BREAKER POSITION INDICATOR
6. MASTER ISOLATE SWITCH
7. MAIN EXTERNAL POWER SWITCH
8. VOLTMETER
9. FREQUENCY METER (TYPICAL)
10. FREQUENCY AND VOLTMETER SELECTOR SWITCH
11. STARTER-SWITCH-NOT-OFF CAUTION LIGHT
12. A-C CIRCUIT BREAKER LIGHT



A-C Control Panel

Figure 1-22.

Figure 1-23.

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GENERATOR DRIVE OVERHEAT LIGHTS. Four amber generator drive overheat lights (4A, figure 1-22), one for each generator, are marked "Overheat" and are on the a-c control panel. The lights will illuminate when a generator drive temperature reaches $345^{\circ} (\pm 6^{\circ})$ F. The lights will go out when the drive temperature decreases to 300° F (minimum). The drive overheat light signals are also monitored by the master caution light circuit. The drive overheat lights No. 1 & 3 are supplied left TR power from the left forward d-c power box while overheat lights No. 5 & 7 are supplied right TR power from the right forward d-c power box.

A-C CIRCUIT BREAKER LIGHT. A rectangular amber indicator light (12, figure 1-22) with an integral push-to-reset switch is on the a-c control panel. The light, when illuminated, shows black letters "Circuit Bkr Open, Push To Reset" on an amber background. The a-c circuit breaker light serves to caution that one of the generator or bus tie circuit breakers has tripped open. The light will illuminate at the same time any of the generator or bus tie circuit breakers open and will remain on as long as the circuit breaker is open unless it is reset. The light may be reset by pressing the face of the light, at which time it will go out and be ready for additional indication of any circuit breaker which may open. The indication given on the a-c circuit breaker light is also indicated on the master caution light located on the right side of the pilots' instrument panel. See "Emergency Equipment," this section. The a-c circuit breaker light receives d-c essential power through a circuit breaker marked "Master Trip Lt" on the copilot's circuit breaker panel.

FREQUENCY METER. A frequency meter (9, figure 1-22) on the a-c control panel provides a means of reading individual frequencies of the generators and central bus tie. Some frequency meters are calibrated from 350 to 450 cycles per second and some from 380 to 420 cycles per second. For typical frequency meter instrument markings, see figure 5-1.

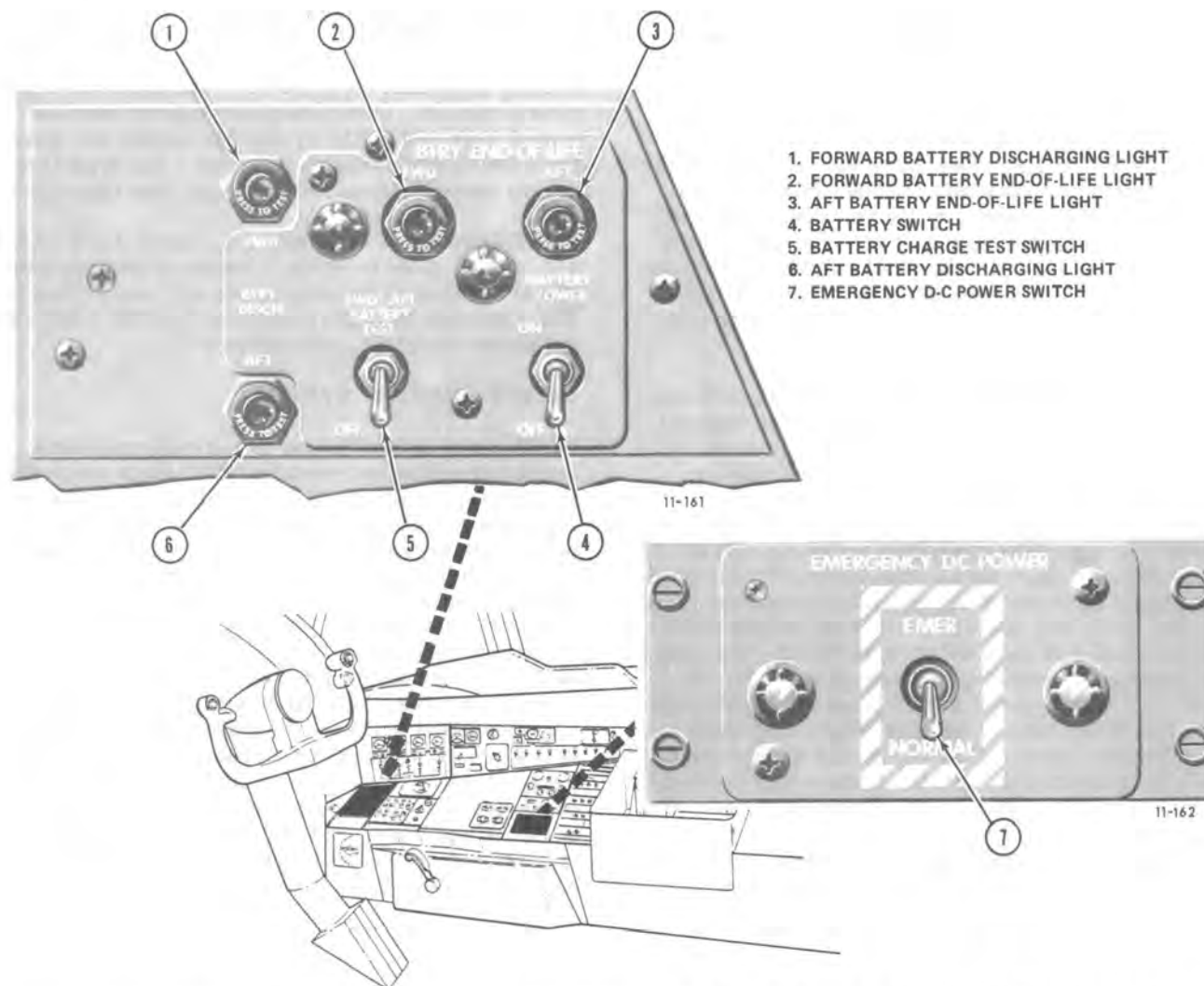
VOLTMETER. A voltmeter (8, figure 1-22) on the a-c control panel provides a means of reading individual voltages of the generators and central bus tie. The voltmeter is calibrated from 0 to 250 volts. For voltmeter markings, see figure 5-1.

DIRECT CURRENT SYSTEM

Direct current (d-c) power is normally provided through transformer-rectifier (TR) units which are supplied a-c power by the generators. Two 24-volt batteries are used as an auxiliary source of d-c power. D-C power is supplied to the various equipment from one of the following buses:

- Aft Battery Bus and Forward Battery Bus
- Emergency Battery Power Bus and Emergency Instrument Power Bus
- Right Essential Bus and Left Essential Bus
- Right TR Bus, Left TR Bus, and Aft TR Bus

The equipment will receive power from one of the buses according to the importance of the equipment (figure 1-23). The two forward TR buses are interconnected and will supply d-c power as long as a-c power is available. In the event of an a-c power failure, d-c power would not be supplied to the TR buses. The left essential and right essential



D-C System Controls

Figure 1-24

buses normally receive TR power but, in the event of an a-c system failure, these buses automatically transfer to battery power provided the battery switch is ON. These buses supply battery power to essential d-c operated equipment which normally received TR d-c power. The aft battery bus and forward battery bus can supply direct battery power to emergency equipment. D-C power is distributed and protected through boxes and panels located throughout the aircraft (figure 1-25).

Batteries

An auxiliary source of d-c power is provided by two 24 volt 22 ampere-hour nickel-cadmium batteries, (27 and 29, figure 1-2) designated as the forward and aft batteries located in the forward wheel well. The batteries have heaters and are capable of satisfactory operation at -40°C (-40°F). The aft battery supplies power directly through fuses and circuit breakers to battery buses located in the aft battery power box, left load central fuse installation, left

load central circuit breaker panel, pilot's circuit breaker panel, and right forward BNS overhead circuit breaker panel. The forward battery supplies power directly through fuses and circuit breakers to battery buses located in the right forward d-c power box, right load central fuse installation, right load central circuit breaker panel, pilot's circuit breaker panel, and aft BNS circuit breaker panel. Essential battery buses are supplied battery power through the left and right essential d-c battery relays when battery switch is ON and TR power is not available. When TR power is available, the right and left d-c TR relays are energized. Should a-c or TR power fail, essential battery bus loads are assured a source of power from the batteries for a short period of time. Loads such as emergency landing gear control, entry light, and jettison power are connected directly to the battery buses (figure 3-19). Loads such as bailout warning and airbrake control are connected so that they may receive power from either the forward or aft battery, depending on the position of the emergency dc power switch (figure 3-19).

Figure 1-24A (Deleted)

The batteries are charged from individual static transformer-rectifiers. The transformer-rectifier unit for the forward battery receives a-c power from engine No. 7 generator bus and that for the aft battery receives a-c power from engine No. 1 generator bus. The TR units will supply charging power for their batteries as long as a-c power is on the respective generator buses.

Transformer-Rectifier Units, Buses, and Circuit Breakers

Direct current power for normal operation is supplied from 28-volt nominal transformer-rectifier (TR) units (21, 24, and 28, figure 1-2) which operate directly from the a-c power boxes and are supplied three-phase 205-volt a-c power from the generators. TR bus voltage is between 23 and 30 volts depending upon load and condition of TR units. Five TR units are located in the forward wheel well area, two in the forward portion, and three in the aft portion. The three remaining TR units are located in the aft equipment compartment. The forward TR units are bused together as are the aft TR units so that partial TR unit failure will not result in a loss of power to any d-c operated equipment. In the event of complete failure of a TR bus, certain a-c loads, such as flaps, fuel, stabilizer trim, etc., may be inoperative because they are controlled by TR power. The output of the forward units is distributed to the left and right forward d-c power boxes and then to the left and right load centrals, pilots, navigators', and ECM circuit breaker panels. The output of the aft units is distributed to the aft d-c power box and then to the gunner's circuit breaker panel.

D-C Power System Controls

BATTERY SWITCH. An ON--OFF battery switch (4, figure 1-24) on the copilot's side panel routes battery power to the essential battery buses. When the battery switch is placed in ON position, battery power is directed to the essential buses through the essential dc battery relays and, when TR power is available, relays are energized to transfer essential buses to TR power. In the "copilot's" circuit breaker panel only, the right and left essential dc buses are normally powered from their respective

battery any time the battery switch is ON. If the battery switch is OFF and TR power is available, they will be powered from the TR buses. When the battery switch is in OFF position, no battery power is available to the essential battery buses. Battery power is supplied directly from each battery to individual (direct) battery buses at all times, regardless of the position of the battery switch.

EMERGENCY D-C POWER SWITCH. An emergency d-c power switch (7, figure 1-24) marked NORMAL--EMER located on the copilot's side panel controls which source of power is connected to the emergency battery power bus and the emergency instrument power bus. When the switch is in NORMAL position, aft battery power is supplied to the emergency battery power bus and left essential power is supplied to the emergency instrument power bus. When the switch is placed to EMERGENCY position, forward battery power is supplied to both buses (figure 1-23). For detail loads on battery switch positions, see "Battery Loads," figure 3-19. Emergency battery power and control is provided through circuit breakers marked "Right Emer Bat Pwr," "Right Emer Instr Pwr," "Emer Bat Pwr Contr," and "Right Emer Instr Contr" on the "D-C Power Feeder" portion of the right load central circuit breaker panel, and "Left Bat Pwr Emer" and "Left Emer Instr Pwr" on the "D-C Power Feeder" portion of the left load central circuit breaker panel.

BATTERY CHARGE TEST SWITCH. A TEST FWD AND AFT--OFF battery charge test switch (5, figure 1-24) on the copilot's side panel provides a means of testing the battery charging circuit. When placed in the TEST FWD AND AFT position, the switch completes the circuit between the battery detector and battery discharging light. To use this switch, the proper battery loads must be on the bus in order for the battery charger to pulse.

INTERPHONE POWER SWITCH. An ON--OFF interphone power switch (1, figure 1-10) on the pilot's side panel, in addition to its normal functions (see "Interphone System," Section IV), controls operation of both battery detectors. ON position energizes both battery detectors and allows the battery discharging lights to function. OFF position deenergizes the battery detectors and battery discharging light circuits.

BATTERY END OF LIFE LIGHTS. Two red end of life lights (2 and 3, figure 1-24), one for each battery, on the copilot's side panel, indicate the approach to and the end of useful battery output. When battery voltage decreases to 22.2 (± 0.1) volts, the respective light will flash at a rate of 45 ($\pm 20/-15$) cycles per minute (a cycle being one complete on and off operation). The light will continue to flash until voltage decreases to 18 (± 0.5) volts at which time the lights will remain on. At this time, the battery is discharged beyond a usable condition. The lights will remain off when voltage is 22.3 or above. With a maximum emergency load of 15 amperes on the battery buses, there is a minimum time of 6 minutes and a maximum of 14 minutes from the time the end of life lights flash on and off until they have a steady illumination. The lights receive battery power through circuit breakers marked "Aft Battery Detector Power" and "Forward Battery Detector Power" in the right forward d-c power box.

BATTERY DISCHARGING LIGHTS. Two amber discharging lights (1 and 6, figure 1-24), one for each battery, on the copilot's side panel indicate when the respective battery is discharging. When the current of a battery flows 0.25 ($\pm 0.75/-0$) ampere or more in the discharge direction, its respective light will illuminate. When the current of a battery flows in the charge direction, its respective light will be out. In addition, the battery discharging lights may be used to give the copilot an indication as to the minimum state of charge of the batteries. A battery discharging light will flash on and off if the battery is more than 70% charged and the charging TR unit is functioning while the interphone power switch is ON, the battery charge test switch is in TEST FWD AND AFT position, and proper bus loads exist. The 70% minimum figure is based on a battery at a temperature of approximately 21° C (70° F). When the battery is colder, the flashing discharging light will indicate a lower minimum state of charge. Press-to-test function of the battery discharging lights normally will not operate unless the interphone power switch is ON. The forward battery discharging light will press to test with the interphone switch OFF if a feedback voltage exists through the battery detector system. The battery discharging lights signals are also monitored by the master caution light controller. See "Master Caution Lights" under "Emergency Equipment," this section.

EXTERNAL ELECTRICAL POWER SYSTEMS

Three external power receptacles are provided for energizing aircraft equipment from an external

source: a main receptacle, a bombing navigational system receptacle, and a gunnery system receptacle.

Main External Power

The main external power (ac) is routed to the central bus tie by means of an external power receptacle (26, figure 1-2) located on the right side of the fuselage adjacent to the forward wheel well. This receptacle has six pins. Three pins take 205-volt three-phase a-c power, two pins are for ground, and one is for 24-volt d-c external power to energize the external power control relay through the phase sequence relay. The external power circuit breaker relay connects the a-c power to the aircraft bus and is closed through actuation of the external power switch on the copilot's a-c control panel. The external power circuit breaker is closed through the open side of the generator circuit breakers. The main external power circuit breaker relay may be tripped by placing the external power switch to OFF position, shutting off the external power cart, pulling the plug, or energizing any generator. The external power circuit receives d-c control power from the right essential bus through a circuit breaker marked "Ext Pwr & Bus Tie Isolate" located on the copilot's circuit breaker panel.

Bombing Navigational System External Power

External power for the bombing navigational system (BNS) is routed to the BNS circuit breaker panel by means of two receptacles (26, figure 1-2) located on the right side of the fuselage adjacent to the forward wheel well just aft of the main external power receptacle. One receptacle is for a-c power and has six pins. Three pins take 205-volt three-phase a-c power, one for ground, one for 24-volt d-c control power to energize the connecting relays through the phase sequence relay, and the remaining pin is not used. A-C power is connected to the BNS circuit breaker panels through the actuation of the BNS external power switch. The other receptacle has three pins, one pin for ground and two to take 24-volt d-c external power for control and power to the BNS circuit breaker panel. If external power is applied to the BNS receptacle while power is applied to the main external receptacle, the BNS external electrical power will automatically isolate the BNS from the aircraft power system.

Fire Control System External Power

External power for the fire control system (FCS) is routed to the aft a-c power shield by means of two

receptacles located aft and adjacent to the right rear wheel well. One receptacle is for a-c power and has six pins. Three pins take 205-volt three-phase a-c power, one is for ground, one is for 24-volt d-c external power to energize the connecting relay, and the remaining pin is not used. The other receptacle is for d-c power and has three pins, two take 24-volt d-c for power and control and one is for ground.

Power is supplied to the FCS circuit breaker panel through the actuation of the external power switch. If FCS external power is applied to the FCS receptacle, all FCS equipment will automatically be isolated from aircraft power. In addition to the gunnery equipment, the domelight, ammunition rack lights, and interphone are supplied external power.

External Electrical Power System Controls

MAIN EXTERNAL POWER SWITCH. A three-position main external power switch (7, figure 1-22) on the a-c control panel is marked ON and OFF at extreme positions respectively and is spring-loaded to the unmarked neutral position. The switch is provided for controlling the main external power system. When placed in ON position momentarily, the external power circuit breaker relay is closed and latched, feeding external power to the aircraft distribution system provided phase sequence is correct and generator circuit breakers are open. When placed in OFF position momentarily, the external power circuit breaker relay is tripped open and external power is removed from the bus. The switch receives d-c control power from the right essential bus through a circuit breaker marked "Ext Pwr & Bus Tie Isolate" located on the copilot's circuit breaker panel.

CAUTION

In order to disconnect external power, the "Ext Pwr & Bus Tie Isolate" circuit breaker on the copilot's circuit breaker panel must be in.

BATTERY OVERRIDE SWITCH. An ON--OFF spring-loaded momentary switch is located in the forward wheel well on the bottom forward end of the left d-c power box. The switch is provided as an emergency means of connecting external power to the aircraft bus when aircraft battery power is unavailable. When placed to the ON position, power is supplied to the switch from pin E of the power cart to close the external power circuit breaker through the interlock circuits. In OFF position, the external power control circuitry is returned to the normal configuration. The external power switch on the copilot's a-c control panel should be used to trip the external power circuit breaker to disconnect external power.

CAUTION

- This switch is not to be used for normal training missions.
- Make certain the "Ext Pwr & Bus Tie Isolate" circuit breaker on the copilot's circuit breaker panel is in when external power is connected to the aircraft bus. This will assure protective circuitry in the event of a circuit fault.

BOMBING NAVIGATION EXTERNAL POWER SWITCH. A two-position ON--OFF switch located on the BNS ground cooling control panel at the radar navigator's station is provided for controlling the bombing navigation external power system. In ON position, the BNS control relay and BNS external power relays are energized feeding power to the BNS equipment provided phase sequence is correct. In OFF position, the system is deenergized and BNS external power is removed from the bus. The switch receives control power from the BNS external power receptacle.

FCS EXTERNAL POWER SWITCH. A two-position ON--OFF switch located on the right side at the gunner's station is provided for controlling the FCS external power system. In ON position, the connecting relays are energized feeding power to the FCS equipment, gunnery compartment domelights, interphone, and spotlights provided the phase sequence is correct. In OFF position, the system is deenergized and FCS external power is removed from the bus. The switch receives control power from the FCS external power receptacle.

Main External Power System Indicator

A three-position tab indicator (5, figure 1-22) located on the a-c control panel provides a means of indication that the main external power circuit breaker relay is closed and main external power is on the bus. Two positions of the tab indicator are bars and the other is OFF. The bars are white and run vertically and horizontally through the center of a black indicator. The OFF indicator is black and has OFF marked in white across the center of the indicator. When the bar is lined up with the reference line on the a-c control panel, the external power circuit breaker is closed and power is on the aircraft bus. When the bar is at a right angle to the reference line on the a-c control panel, the external power circuit breaker relay is open and external power is isolated from the aircraft bus. OFF position indicates the tab indicator is not receiving control power. The indicator receives d-c control power from the right essential bus through a circuit breaker marked "Ext Pwr & Bus Tie Isolate" located on the copilot's circuit breaker panel. No provisions are made for BNS or FCS external power indications.

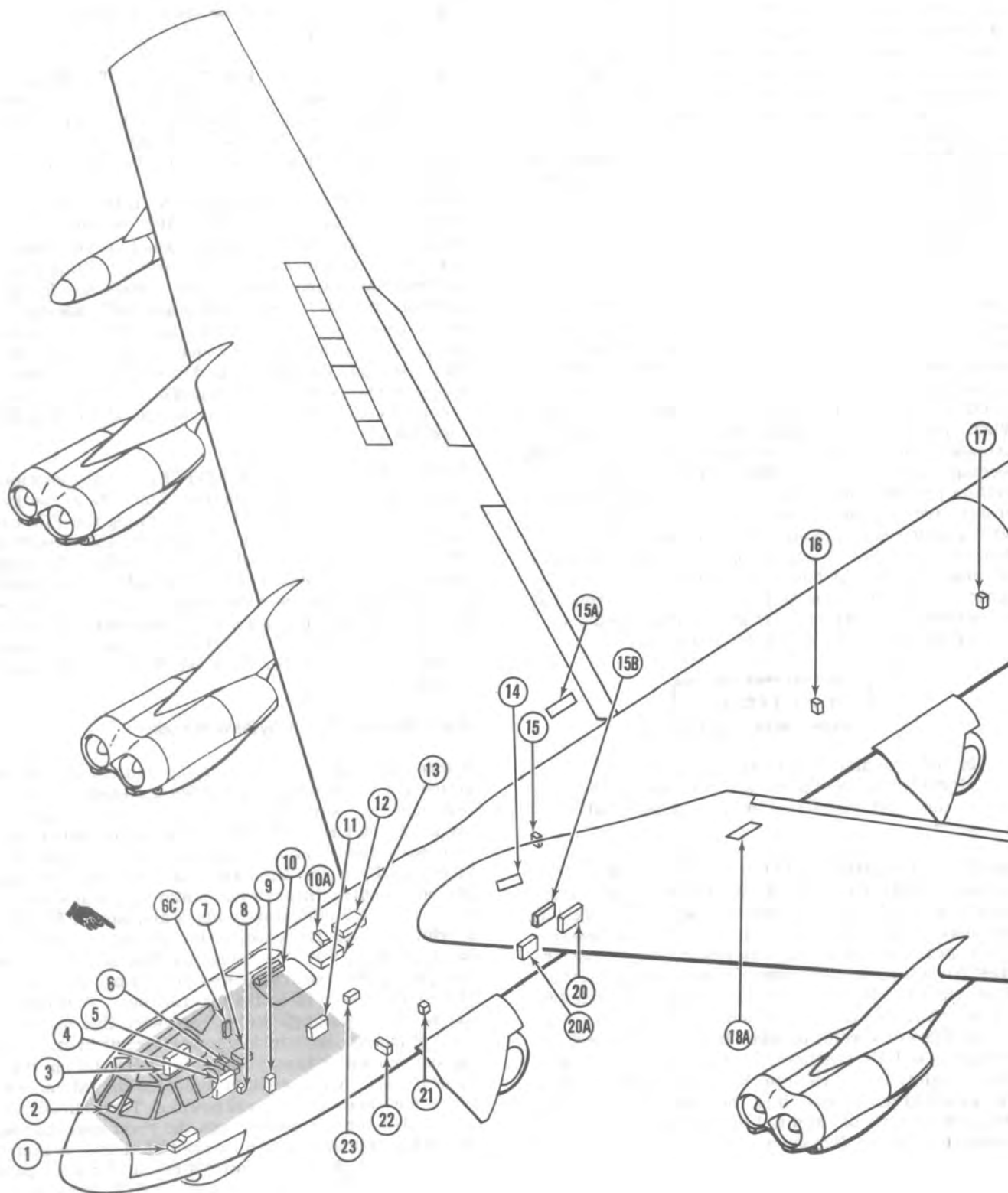
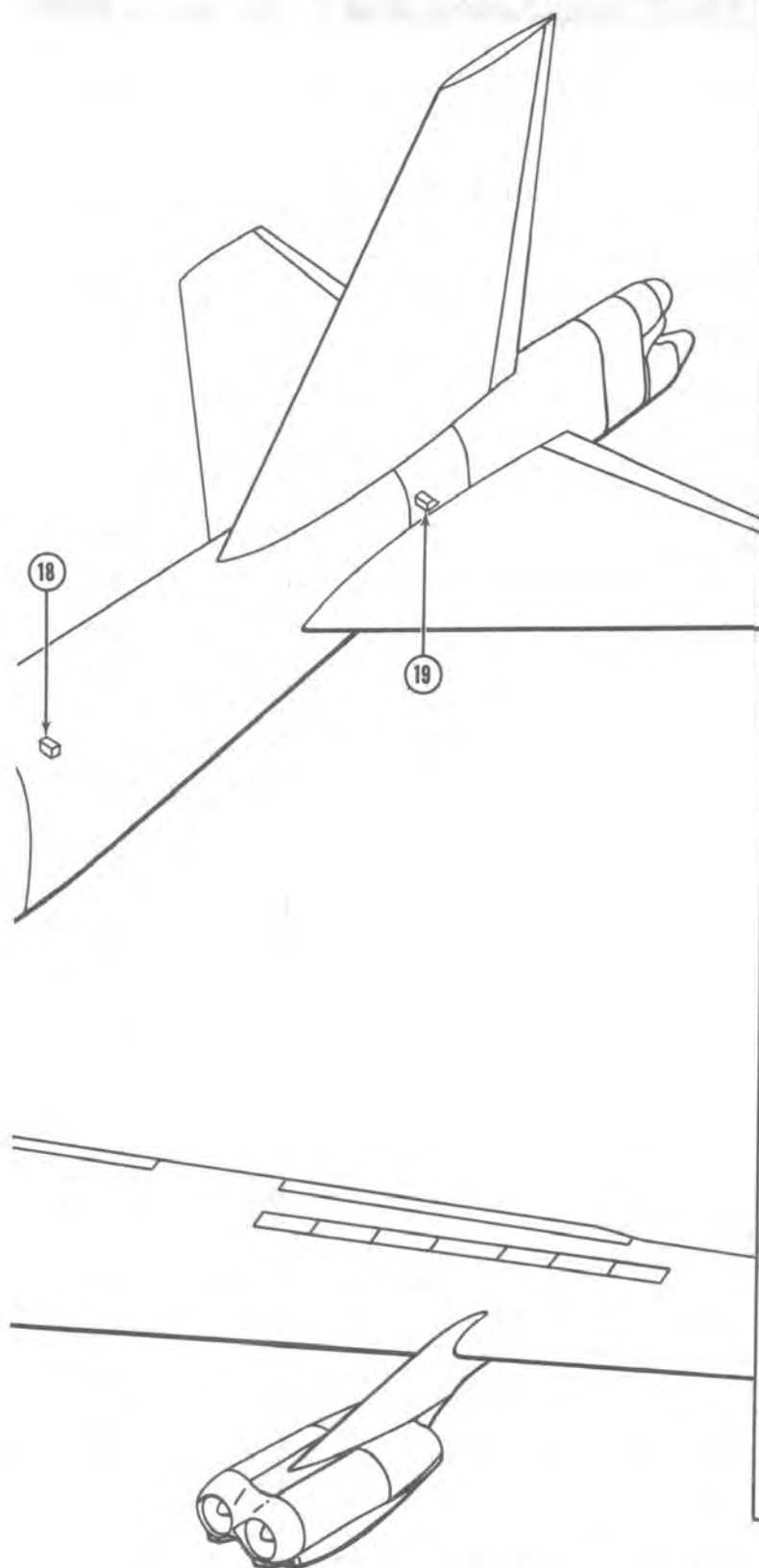


Figure 1-25 (Sheet 1 of 13).



1. PILOT'S CIRCUIT BREAKER PANEL
 2. COPILOT'S CIRCUIT BREAKER PANEL
 3. RIGHT LOAD CENTRAL CIRCUIT BREAKER PANEL
 4. LEFT LOAD CENTRAL CIRCUIT BREAKER PANEL
 5. RIGHT FORWARD BNS CIRCUIT BREAKER
 6. LEFT FORWARD BNS CIRCUIT BREAKER PANEL
 - 6C. EVS CIRCUIT BREAKER PANEL
 7. AFT BNS CIRCUIT BREAKER PANEL
 8. LEFT LOAD CENTRAL FUSE INSTALLATION
 9. AUXILIARY BNS CIRCUIT BREAKER PANEL
 10. ECM CIRCUIT BREAKER PANEL
 - 10A. AUXILIARY AC POWER BOX
 11. FCS CIRCUIT BREAKER PANEL
 12. ENG NO. 5 GENERATOR POWER BOX
 13. ENG NO. 3 GENERATOR POWER BOX
 14. ENG NO. 7 GENERATOR POWER BOX
 15. STATION 694 POWER PANEL
 - 15A. RIGHT WING A-C POWER BOX
 - ★15B. AGM-69A BATTERY POWER BOX
 16. STATION 1028 POWER PANEL
 17. AFT A-C POWER BOX
 18. SECTION 47 D-C POWER PANEL OR AFT D-C POWER BOX
 - 18A. LEFT WING A-C POWER BOX
 19. FCS POWER BOX
 20. ENG NO. 1 GENERATOR POWER BOX
 - ★20A. AGM-69A POWER DISTRIBUTION BOX
 21. AFT BATTERY POWER BOX
 22. LEFT FORWARD D-C POWER BOX
 23. RIGHT FORWARD D-C POWER BOX
- DENOTES READILY ACCESSIBLE PANELS
- ★ REFER TO T.O. 1B-52C-30-2 FOR CIRCUIT BREAKER INFORMATION

Equipment Power Source, Circuit Breaker and Fuse Panel Locations (Typical)

Figure 1-25 (Sheet 2 of 13).

SYSTEM	POWER SOURCE				CONTROL	
	GEN BUS	TR BUS	ESSENTIAL BUS	BATTERY BUS	POWER	CIRCUIT BREAKER PANEL
AIR CONDITIONING						
Bleed Valves Strut No. 3 and Body Crossover	No. 5				A-C	Right Load
Bleed Valves Struts No. 1 and 4		Right			Right TR	Right Load
Bypass Valve Water Separator		Right			Right TR	Right Load
Cabin Control		Right			Right TR	Right Load
Emergency Ram Air	No. 3	Left			Left TR	Auxiliary BNS
Precooler	No. 1				Right TR	Right Load
Shutoff Valve Air Conditioning	No. 5				A-C	Right Load
Temperature Regulator	No. 5				A-C	Right Load
Temperature Mod Valve	No. 3				A-C	★
Free Air Temperature		Left			Left TR	Left Load
ANTI-ICE AND HEAT						
Airscoop Shutoff Valve		Left			Left TR	Left Load
Battery Heater (Aft)	No. 1				A-C	★
Battery Heater (Forward)	No. 5				A-C	★
Camera Heater	No. 1				A-C	★
ECM System 15 Heater	No. 1				Right TR	ECM
ECM System 16 Heater	No. 5				Right TR	ECM
Escape Hatch (Pilot)	No. 3	Left			Left TR	Left Load
Escape Hatch (Copilot)	No. 5	Right			Right TR	Right Load
Pitot Tube Heater (Left and SAS)	No. 3				A-C	P
Pitot Tube Heater (Right and SAS)	No. 5				A-C	CP
Pitot Tube Heaters (Altitude Computer)	No. 3				A-C	P
Pod Control No. 1		Left			Left TR	Left Load
Pod Control No. 2		Left			Left TR	Left Load
Pod Control No. 3		Right			Right TR	Right Load
Pod Control No. 4		Right			Right TR	Right Load
Q-Spring Heater	No. 1				A-C	★
Ram Airscoop (Emergency)	No. 3				A-C	★
Stabilizer Trim Heat	No. 1				A-C	★
Vane Heaters	No. 3				A-C	Auxiliary BNS
Window Relay (Left)		Left			Left TR	Left Load
Window Relay (Right)		Right			Right TR	Right Load
Window Relays (Left Auxiliary)		Left			Left TR	Left Load
Window Relays (Right Auxiliary)		Right			Right TR	Right Load
Window Control Units (Left)	No. 3				A-C	Left Load
Window Control Units (Right)	No. 5				A-C	Right Load
Window Heat Power (No. 1 Left, 2, 3, and 4)	No. 3				A-C	P
Window Heat Power (No. 2, 3, and 4 Right)	No. 5				A-C	CP
Window Heat Power (Left Auxiliary)	No. 3				A-C	P
Window Heat Power (Right Auxiliary)	No. 5				A-C	CP
Weapon Heater Control (Aft)		Right			Right TR	Aft BNS
Weapon Heater Control (Forward)		Left			Left TR	Aft BNS
ELECTRONICS						
AFSATCOM AU						
• R-T (LOS Radio Set AN/ARC-171(V))	No. 3				Left TR	Right Load
• DC No. 1 (SATCOM Control and Modem)		Left				Right Load
• DC No. 2 (Sync Power Supply, Preamplifier, and Relays)		Left				Right Load
• CONTR (Logic) P S and Modem (Printer and Keyboard)	No. 3					Right Load
Automated Offset Unit	No. 3				A-C	Fwd BNS
Altitude Computer	No. 3				A-C	Left Load
Astrocompass	No. 3	Left			Left TR	Auxiliary BNS
Autopilot	No. 3	Left			A-C	Left Load
BNS Right TR Control		Right			Right TR	Right Load

★ Not in pressurized compartment

Figure 1-25 (Sheet 3 of 13).

SYSTEM	POWER SOURCE				CONTROL	
	GEN BUS	TR BUS	ESSENTIAL BUS	BATTERY BUS	POWER	CIRCUIT BREAKER PANEL
ELECTRONICS (Cont)						
BNS A-C Power	No. 3				A-C	Left BNS
BNS Left TR Power and Control		Left			Left TR	Left Load
Chaff Dispenser Deactivate		Right			Right TR	ECM
Doppler Radar (AN/APN-89A)	No. 3	Left			Left TR	Auxiliary BNS
ECM Signal Processor						
• CM-465/ALQ-155(V)	No. 5				A-C	Right Load
ECM System 15 and 16 Blanking		Right			Right TR	ECM
ECM System No. 15						
• Blanking Module		Left			Left TR	ECM
• PD Power		Aft			Aft TR	*
• PR Power		Aft			Aft TR	*
• Receiver and RF Switch	No. 1					*
• Transceiver	No. 1					*
ECM System No. 15 and 16 Indicator Control		Left			Left TR	ECM
ECM System No. 15 and 16 Monitor Control		Left			Left TR	ECM
ECM System No. 16						
• Blanking Module		Left			Left TR	ECM
• PD Power		Right			Right TR	*
• PR Power		Right			Right TR	*
• Receiver and Antenna Switch	No. 5					*
• Transceiver	No. 5					*
ECM Transmitters						
No. 1 ALT-28 Less AX ALQ-155 AX	No. 1	Left			Right TR	*
No. 1 ALT-28 Antenna Selector		Left			Left TR	ECM
No. 2 ALT-28 Less AX ALQ-155 AX	No. 1	Right			Right TR	*
No. 2 ALT-28 Antenna Selector		Left			Left TR	ECM
No. 3 ALT-28 Less AX ALQ-155 AX	No. 3	Right			Right TR	*
No. 4 ALT-28 Less AX ALQ-155 AX	No. 5	Left			Left TR	*
No. 5 ALT-28 Less AX ALQ-155 AX	No. 3	Right			Right TR	*
No. 6 ALT-28 Less AX ALQ-155 AX	No. 5	Left			Left TR	*
No. 7 ALT-28 Less AX ALQ-155 AX	No. 3	Left			Left TR	*
No. 8 ALT-28 Less AX ALQ-155 AX	No. 3	Left			Left TR	*
No. 9 (ALT-16) Less AL (ALT-16A) AL	No. 7	Aft			Aft TR	*
No. 10 (ALT-6B) Less AL (Provisions) AL	No. 7	Aft			Aft TR	*
No. 11 AN/ALT-32	No. 7	Aft			Aft TR	*
No. 12 AN/ALT-32	No. 7	Aft			Aft TR	*
No. 13 (ALT-6B) Less AX ALQ-155 AX	No. 7	Aft			Aft TR	*
No. 14 (ALT-6B) Less AX ALQ-155 AX	No. 7	Aft			Aft TR	*
No. 15 AN/ALQ-117	No. 1					
No. 16 AN/ALQ-117	No. 5					*
No. 20 AN/ALT-32L	No. 5	Right			Right TR	*
No. 21 AN/ALT-16A AL	No. 5	Right			Right TR	*
Fire Control System	No. 1	Left			Left TR	FCS
Glide Slope (AN/ARN-31)	No. 5	Aft			Aft TR	Right Load
IFF	No. 3	Left			Left TR	Left Load
Interphone				Aft	Aft Battery	P
Liaison Radio (AN/ARC-58) Control W181	No. 1	Right			Right TR	CP
Liaison Radio (AN/ARC-65) Control W173 W180 Less B L	No. 1	Aft			Aft TR	*
Liaison Radio (AN/ARC-190) Control W173 W180 B L	No. 1	Aft			Aft TR	*
Marker Beacon (AN/ARN-32)		Aft			Aft TR	*
Monitoring Set (AN/AJM-14)	No. 5	Right			Right TR	Right Load
N-1 Compass	No. 3	Left			Left TR	Aft BNS
ODR Power (AN/ARN-14)		Aft			Aft TR	*
Pressurization-Radar	No. 3	Left			Left TR	Auxiliary BNS

Equipment Power Source, Circuit Breaker and Fuse Panel Locations (Typical)

Figure 1-25 (Sheet 4 of 13).

SYSTEM	POWER SOURCE				CONTROL	
	GEN BUS	TR BUS	ESSENTIAL BUS	BATTERY BUS	POWER	CIRCUIT BREAKER PANEL
ELECTRONICS (Cont)						
Pressurization Kit						
• APR-9 ECM and APN-69	No. 1	Aft			Aft TR	*
• ARC-58 & ECM System 15 W181	No. 1	Aft			Aft TR	*
• ECM System 15 W173 W180	No. 7	Left			Left TR	ECM
• ECM System 16	No. 5	Left			Left TR	ECM
Receivers (ECM)						
ALQ-122 AL	No. 7	Aft			Aft TR	*
AN/ALR-20A	No. 5	Right			Right TR	ECM
AN/ALR-46	No. 5	Right			Right TR	ECM
Radio Command (Auxiliary) Less AU		Right			Right TR	Right Load
Radar Altimeter (AN/APN-150)	No. 1	Aft			Aft TR	*
Radio Command UHF		Aft			Aft	*
Radio Navigator Indicator (AN/ARN-21)	No. 3	Left			Left TR	P
Rate-of-Turn Indicator			Left		Left Ess	P
Rendezvous Beacon (AN/APN-69)	No. 3	Aft			Aft TR	*
Remote Keyer W173 W180		Aft			Aft TR	*
TACAN (AN/ARN-118)	No. 3	Left			Left TR	Left Load
True Heading Computer	No. 3	Left			Left TR	Aft BNS
ELECTRICAL MISCELLANEOUS						
Bailout Warning Control (Forward)				Aft	Aft Battery	P
Bailout Warning Control (Aft)				Forward	Fwd Battery	*
Battery Charging (Aft)	No. 1				A-C	*
Battery Charging (Forward)	No. 7				A-C	*
Battery Detector Power				Forward	Fwd Battery	*
BNS Radar Press	No. 3	Left			Left TR	Auxiliary BNS
BNS Overheat Control		Left			Left TR	Auxiliary BNS
Camera Door and Master Power	No. 1	Right			TR	Aft BNS
ECM Indicator Lights Dimming & Power		Left			Left TR	ECM
Flight Gyro (Pilot)	No. 3	Left			Left TR	P
Control	No. 3				A-C	P
Emergency Inverter			Left		Left Ess	P
Directional Indicator			Left		Left Ess	P
Gyro Power	No. 3				A-C	P
Radio Navigator Indicator			Left		Left Ess	P
Rate-of-Turn			Left		Left Ess	P
Flight Gyro (Copilot)	No. 5	Right			Right TR	CP
Flare Ejector Program Power	No. 5	Right			Right TR	ECM
Flight Loads Recorder	No. 1	Aft			Aft TR	*
Food Warming Oven and Hot Cup (P-CP-EW-G)	No. 5				A-C	Right Load
Food Warming Oven and Hot Cup (BNS)	No. 3				A-C	Aft BNS
Standby Attitude Indicator BC			Left		Left Ess	P

* Not in pressurized compartment

Figure 1-25 (Sheet 5 of 13).

SYSTEM	POWER SOURCE				CONTROL	
	GEN BUS	TR BUS	ESSENTIAL BUS	BATTERY BUS	POWER	CIRCUIT BREAKER PANEL
ELECTRICAL MISCELLANEOUS (Cont)						
Generator Drive Decoupler Switches		Right			Right TR	Right Load
Generator Drive Overheat Lights No. 1 & 3		Left			Left TR	*
Generator Drive Overheat Lights No. 5 & 7		Right			Right TR	*
Generator Control Power 1 and 7			Left		Left Ess	CP
Generator Control Power 3 and 5			Right		Right Ess	CP
Generator Bus Tie Position Indicators 1 and 7			Left		Left Ess	CP
Generator Bus Tie Position Indicators 3 and 5			Right		Right Ess	CP
Generator Trip Indicator Power			Right		Right Ess	CP
Interphone Power				Aft	Aft Battery	P
Manifold Temperature Indicator		Right			TR	Right Load
Oxygen Quantity Indicators	No. 3				A-C	P
Rocket Pod Power (Left)		Left			TR	*
Rocket Pod Power (Right)		Right			TR	*
Rocket Pod Control		Right			Right TR	ECM
Rocket Pod Jettison		Right			Right TR	P
Seat Position (P-N-RN)	No. 3				A-C	P - Aft BNS
Seat Position (CP-EW-G)	No. 5				A-C	CP - FCS
Total Fuel Quantity Recorder	No. 1				A-C	Right Load
TR Units (No. 1 Forward, No. 5, 6, 7 Aft)	No. 1				A-C	*
TR Units (No. 3 Forward)	No. 3				A-C	*
TR Units (No. 4 Forward)	No. 5				A-C	*
TR Units (No. 2, 8 Forward)	No. 7				A-C	*
Windshield Wiper (Pilot)		Left			Left TR	Left Load
Windshield Wiper (Copilot)		Right			Right TR	Right Load
Wing Chaff Power (1, 2, 3, 4)	No. 1	Left			Left TR	*
Wing Chaff Power (5, 6, 7, 8)	No. 7	Right			Right TR	*
Wing Chaff Control		Right			Right TR	ECM
ENGINES						
Engines Pressure Ratio	No. 5				A-C	Right Load
Fire Detectors Outboard			Left		Left Ess	Left Load
Fire Detectors Inboard			Right		Right Ess	Right Load
Firewall Fuel Shutoff Outboard			Left	Forward**	Left Ess/ Fwd Bat**	Left Load
Firewall Fuel Shutoff Inboard			Right	Aft**	Right Ess/ Aft Bat**	Right Load
Fuel Flow Indicators		Right			Right TR	Right Load
Fuel Flow Totalizer	No. 5				A-C	Right Load
Oil Cooler Flaps No. 1, 3, 5, and 7		Left			Left TR	*
Oil Cooler Flaps No. 2, 4, 6, and 8		Right			Right TR	*
Ignition No. 1, 2, 7, and 8			Left	Forward**	Left Ess/ Fwd Bat**	Left Load

** Automatically switches in event of essential bus malfunction

Equipment Power Source, Circuit Breaker and Fuse Panel Locations (Typical)

Figure 1-25 (Sheet 6 of 13).

SYSTEM	POWER SOURCE				CONTROL	
	GEN BUS	TR BUS	ESSENTIAL BUS	BATTERY BUS	POWER	CIRCUIT BREAKER PANEL
ENGINES (Cont)						
Ignition No. 3, 4, 5, and 6			Right	Aft **	Right Ess/ Aft Battery	Right Load
Low Oil Pressure Warning Lights			Left		Right TR	Right Load
Starter No. 4 (Cartridge)		Left			Left Ess	Left Load
Starter No. 6 (Cartridge)			Right		Right Ess	Right Load
Starters No. 1 and 2		Left			Left TR	*
Starters No. 3 and 4			Left		Left Ess	Left Load
Starters No. 5 and 6			Right		Right Ess	Right Load
Starters No. 7 and 8		Right			Right TR	*
Standby Start Power Inboard				Aft		Left Load
Standby Start Power Outboard				Fwd		Right Load
Start Control Aft Bus			Left		Left Ess	Left Load
Start Control Fwd Bus			Right		Right Ess	Right Load
Start Bus Switching			Left		Left Ess	Left Load
Start Bus Switching			Right		Right Ess	Right Load
Start No. 1, 2, 7, and 8			Left		Left Ess	Left Load
Start No. 3, 4, 5, and 6			Right		Right Ess	Right Load
Oil Pressure Indicators	No. 5				A-C	Right Load
Water Injection Pump Control No. 1	No. 1	Left			Left TR	Left Load
Water Injection Pump Control No. 2	No. 5	Left			Left TR	Left Load
Water Injection Pump Control No. 3	No. 3	Right			Right TR	Right Load
Water Injection Pump Control No. 4	No. 7	Right			Right TR	Right Load
Water Injection Indicator Lights		Left			Left TR	Left Load
Water Injection Drain Valve		Left			Left TR	Left Load
Water Injection Shutoff Valve Controls No. 1 and 2		Left			Left TR	Left Load
Water Injection Shutoff Valves No. 3 and 4		Right			Right TR	Right Load

Equipment Power Source, Circuit Breaker and Fuse Panel Locations (Typical)

Figure 1-25 (Sheet 7 of 13).

SYSTEM	POWER SOURCE				CONTROL	
	GEN BUS	TR BUS	ESSENTIAL BUS	BATTERY BUS	POWER	CIRCUIT BREAKER PANEL
EVS						
Copilot's Display	No. 3	Right			Right TR	EVS
Copilot's — Radar Nav Power		Right			Right TR	EVS
EVS Indicator Dimming		Left			Left TR	EVS
FLIR AZ & Elevation		Right			Right TR	EVS
FLIR Control		Right			Right TR	EVS
FLIR ENV Control		Right			Right TR	EVS
FLIR ENV Fan	No. 3				A-C	EVS
FLIR ENV Heater	No. 3				A-C	EVS
FLIR Power	No. 3	Right			Right TR	EVS
FLIR Turret	No. 3	Right			Right TR	EVS
FLIR Window Heater	No. 3				A-C	★
Navigator's Display (Monitor)	No. 5	Left			Left TR	EVS
Pilot's Display (Monitor)	No. 5	Left			Left TR	EVS
Pilot-Navigator Power		Left			Left TR	EVS
Radar Nav Display (Monitor)	No. 3	Right			Right TR	EVS
SCU	No. 3				A-C	EVS
SSG						
STV ENV Control	No. 3	Right			Right TR	EVS
STV ENV Fan	No. 5	Left			Left TR	EVS
STV ENV Heater	No. 5				A-C	EVS
STV Power	No. 5	Left			A-C	EVS
STV Servo AZ & Elevation	No. 5	Left			Left TR	EVS
STV Servo Turret		Left			Left TR	EVS
STV Window Heater	No. 5	Left			Left TR	EVS
VDU	No. 3 & No. 5				A-C	EVS
Window Wash Control		Right			Right TR	EVS
Window Wash Pump	No. 5				A-C	EVS
Window Wash Valves		Right			Right TR	EVS
Window Wash Tank Heater	No. 5				A-C	EVS
FUEL						
Fuel Pumps — Auxiliary						
Tank Pump No.						
Aft Body 30	No. 3	Left			Left TR	Left Load
Aft Body 31	No. 7	Right			Right TR	Right Load
Aft Body 32	No. 1	Left			Left TR	Left Load
Center Wing 25	No. 1	Left			Left TR	Left Load
Center Wing 26	No. 7	Right			Right TR	Right Load
Forward Body 23	No. 3	Right			Right TR	Right Load
Forward Body 24	No. 5	Left			Left TR	Left Load
Left External 1	No. 1	Right			Right TR	Right Load
Left Outboard 2	No. 3	Left			Left TR	Left Load
Left Outboard 3	No. 1	Right			Right TR	Right Load
Mid Body 27	No. 5	Right			Right TR	Right Load
Mid Body 28	No. 7	Right			Right TR	Right Load
Mid Body 29	No. 1	Left			Left TR	Left Load
Right External 22	No. 7	Right			Right TR	Right Load
Right Outboard 20	No. 7	Left			Left TR	Left Load
Right Outboard 21	No. 5	Right			Right TR	Right Load

Equipment Power Source, Circuit Breaker and Fuse Panel Locations (Typical)

Figure 1-25 (Sheet 8 of 13).

SYSTEM		POWER SOURCE				CONTROL	
		GEN BUS	TR BUS	ESSENTIAL BUS	BATTERY BUS	POWER	CIRCUIT BREAKER PANEL
FUEL (Cont)							
Fuel Pump - Main							
Tank	Pump No.						
1	4	No. 1	Right			Right TR	Right Load
1	5	No. 7	Right			Right TR	Right Load
1	6	No. 3	Left			Left TR	Left Load
1	7	No. 5	Left			Left TR	Left Load
2	8	No. 1	Right			Right TR	Right Load
2	9	No. 7	Right			Right TR	Right Load
2	10	No. 3	Left			Left TR	Left Load
2	11	No. 5	Left			Left TR	Left Load
3	12	No. 3	Left			Left TR	Left Load
3	13	No. 5	Left			Left TR	Left Load
3	14	No. 1	Right			Right TR	Right Load
3	15	No. 7	Right			Right TR	Right Load
4	16	No. 3	Left			Left TR	Left Load
4	17	No. 5	Left			Left TR	Left Load
4	18	No. 1	Right			Right TR	Right Load
4	19	No. 7	Right			Right TR	Right Load
Fuel Valves							
No. 9 (Crossfeed)				Left		Left Ess	Left Load
No. 10 (Crossfeed)				Right		Right Ess	Right Load
No. 11 (Crossfeed)				Right		Right Ess	Right Load
No. 12 (Crossfeed)				Left		Left Ess	Left Load
No. 13 (Direct Feed)				Right		Right Ess	Right Load
No. 14 (Direct Feed)				Left		Left Ess	Left Load
No. 15 (Direct Feed)				Left		Left Ess	Left Load
No. 16 (Direct Feed)				Right		Right Ess	Right Load
No. 29 (Main Manifold Interconnect)			Left			Left TR	Left Load
No. 29a (Main Manifold Interconnect)			Right			Right TR	Right Load
No. 30 (Defuel)			Right			Right TR	Right Load
Refuel			Right			Right TR	Right Load
Fuel Miscellaneous							
Air Refueling			Right			Right TR	Right Load
Fuel Flow Indicators		No. 5	Right			Right TR	Right Load
Fuel Quantity Management (Including Fuel Total)		No. 5				A-C	CP
Fuel Tank Warning (Main, Outboard, and External)			Right			Right TR	Right Load
Fuel Manifold Scavenge (Main)		No. 1	Right			Right TR	Right Load
Fuel Manifold Scavenge (Cabin)		No. 5	Right			Right TR	Right Load
Master Fuel Level Control (Left)		No. 1	Right			Right TR	Right Load
Master Fuel Level Control (Right)			Left			Left TR	Left Load
Pump Pressure (Ground Checkout)			Right			Right TR	Right Load
Refuel Valve (Checkout)			Left			Left TR	Left Load
FLIGHT CONTROLS							
Airbrake Control					Aft	Aft Battery	P
Flap Motor Power (Left)		No. 1				A-C	*
Flap Motor Power (Right)		No. 7				A-C	*
Flap Control (Left)			Left			Left TR	P
Flap Control (Right)			Right			Right TR	P
Flap Brake (Left)			Left			Left TR	*
Flap Brake (Right)			Right			Right TR	*
Flap Position Indicator			Left			Left TR	P
Lateral Trim Indicator			Left			Left TR	P

*Not in pressurized compartment

Figure 1-25 (Sheet 9 of 13).

SYSTEM	POWER SOURCE				CONTROL	
	GEN BUS	TR BUS	ESSENTIAL BUS	BATTERY BUS	POWER	CIRCUIT BREAKER PANEL
FLIGHT CONTROLS (Cont)						
Lateral Trim Actuator	No. 3				A-C	P
Stability Augmentation System (SAS)		Left			TR	Left Load
SAS Control	No. 3				A-C	Left Load
SAS Power	No. 1				A-C	*
Stabilizer Trim Actuator		Left			Left TR	P
Trim Control						
HYDRAULICS						
Firewall Hydraulic Shutoff Valves No. 1, 3, and 4			Left		Left Ess	CP
Firewall Hydraulic Shutoff Valves No. 5, 6, and 7			Right		Right Ess	CP
Ground Service Pump (Left)		Left			Left TR	*
Ground Service Pump (Right)		Right			Right TR	*
Powered Rudder/Elevator System						
Pump Power No. 1	No. 1				A-C	*
Pump Power No. 2	No. 7				A-C	*
Pump Control No. 1		Left			TR	Pilot's
Pump Control No. 2		Right			TR	Pilot's
Pressure Warning Light		Left			TR	Pilot's
Hydraulic Ground Cooling Blower	No. 1				A-C	*
Hydraulic Ground Cooling Control		Left			TR	Left Load
Pressure Indicators	No. 3				A-C	P
Pressure Warning Light		Left			Left TR	P
Standby Pump (Left Body)	No. 3	Left			Left TR	P
Standby Pump (Left Outboard)	No. 1	Left			Left TR	P
Standby Pump (Right Body)	No. 1	Right			Right TR	P
Standby Pump (Right Outboard)	No. 7	Right			Right TR	P
LANDING GEAR						
Antiskid Control (Forward)			Left		Left Ess	P
Antiskid Control (Aft)			Right		Right Ess	P
Antiskid Valves (Forward)				Aft	Aft Battery	*
Antiskid Valves (Aft)				Forward	Fwd Battery	*
Centering Control		Right			Right TR	P
Crosswind Crab Indicator		Left			Left TR	P
Emergency Landing Gear Control						
Left Aft				Aft	Aft Battery	P
Left Forward				Forward	Fwd Battery	P
Right Aft				Forward	Fwd Battery	P
Right Forward				Aft	Fwd Battery	P
Normal Landing Gear Control						
Left Aft			Right		Right Ess	Right Load
Left Forward			Left		Left Ess	Left Load
Right Aft			Left		Left Ess	Left Load
Right Forward			Right		Right Ess	Right Load
Tip Gear Control						
Left (Emergency)			Right		Right Ess	P
Right (Emergency)			Left		Left Ess	P
Left (Normal)			Left		Left Ess	Left Load
Right (Normal)			Right		Right Ess	Right Load

Equipment Power Source, Circuit Breaker and Fuse Panel Locations (Typical)

Figure 1-25 (Sheet 10 of 13).

SYSTEM	POWER SOURCE				CONTROL	
	GEN BUS	TR BUS	ESSENTIAL BUS	BATTERY BUS	POWER	CIRCUIT BREAKER PANEL
LANDING GEAR (Cont)						
Squat Switch Control						
Left Aft			Right		Right Ess	P
Left Forward			Left		Left Ess	P
Right Aft			Left		Left Ess	P
Right Forward			Right		Right Ess	P
Position Indicator W173 W249		Right			Right TR	P
Position Indicator W250			Right		Right Ess	P
Position and Flaps Warning Horn		Right			Right TR	P
Position Warning Lights (Main)			Right		Right Ess	P
LIGHTS (EXTERIOR)						
Air Refueling	No. 5	Right			Right TR	Right Load
Anti-Collision	No. 3				A-C	Left Load
Crosswind Taxi and Crosswind Landing	No. 7	Left			Left TR	Left Load
Landing Light Power (Left)	No. 1				A-C	*
Landing Light Power (Right)	No. 7				A-C	*
Landing Light Control	No. 5				A-C	Left Load
Navigation	No. 3				A-C	Left Load
Terrain Clearance	No. 3				A-C	Left Load
Wing Taxi	No. 3	Left			Left TR	Left Load
LIGHTS (INTERIOR)						
Cabin						
Aisle and Spot	No. 3				A-C	Left Load
Dome (P-CP)	No. 5				A-C	Right Load
Dome (BNS and Miscellaneous)	No. 3				A-C	Auxiliary BNS
Dome (EW)	No. 5				A-C	ECM
Dome (Gunner)	No. 5				A-C	FCS
Dome (Bunk)	No. 5				A-C	Right Load
Entry				Aft	Aft	Fwd BNS
Flood (Pilot)	No. 5				A-C	Right Load
Flood (Copilot)	No. 3				A-C	Left Load
Flood (BNS)	No. 3				A-C	Auxiliary BNS
Flood (EW)	No. 5				A-C	ECM
Flood (Gunner)	No. 5				A-C	FCS
Flood Remote (Pilots)	No. 3				A-C	Left Load
Flood Remote (BNS)	No. 3				A-C	Auxiliary BNS
Instrument (Pilot)	No. 3				A-C	Left Load
Instrument (Copilot)	No. 5				A-C	Right Load
Instrument (Emergency) (Emergency Switch NORMAL)			Left		Left Ess	P
Instrument (Emergency) (Emergency Switch EMERGENCY)				Forward	Fwd Battery	P
Panel (Pilot and Overhead)	No. 3				A-C	Left Load
Panel (Copilot)	No. 5				A-C	Right Load
Panel (BNS)	No. 3				A-C	Auxiliary BNS
Panel (EW)	No. 5				A-C	EW

* Not in pressurized compartment

Figure 1-25 (Sheet 11 of 13).

SYSTEM	POWER SOURCE				CONTROL	
	GEN BUS	TR BUS	ESSENTIAL BUS	BATTERY BUS	POWER	CIRCUIT BREAKER PANEL
LIGHTS (INTERIOR) (Cont)						
Panel (Gunner)	No. 5				A-C	FCS
Panel (Pilots' Overhead)	No. 3				A-C	Left Load
Panel (BNS Remote)	No. 3				A-C	Auxiliary BNS
Periscopic Sextant	No. 5				A-C	Right Load
Signal	No. 5				A-C	Right Load
Table (BNS)	No. 3				A-C	Auxiliary BNS
Thunderstorm	No. 3				A-C	Left Load
Walkway (Aft)	No. 1	Left			Left TR	Auxiliary BNS
Walkway (Fwd)	No. 3				A-C	Auxiliary BNS
Walkway (Section 43 R and L)	No. 1 and 7				A-C	*
Dim Control		Left			Left TR	Left Load
Hatch Position Warning		Left			Left TR	Pilots Aux.
Master Caution		Right			Right TR	Copilots
Press-To-Test		Left			Left TR	Left Load
Master Trip			Right		Right Ess	CP

Equipment Power Source, Circuit Breaker and Fuse Panel Locations (Typical)

Figure 1-25 (Sheet 12 of 13).

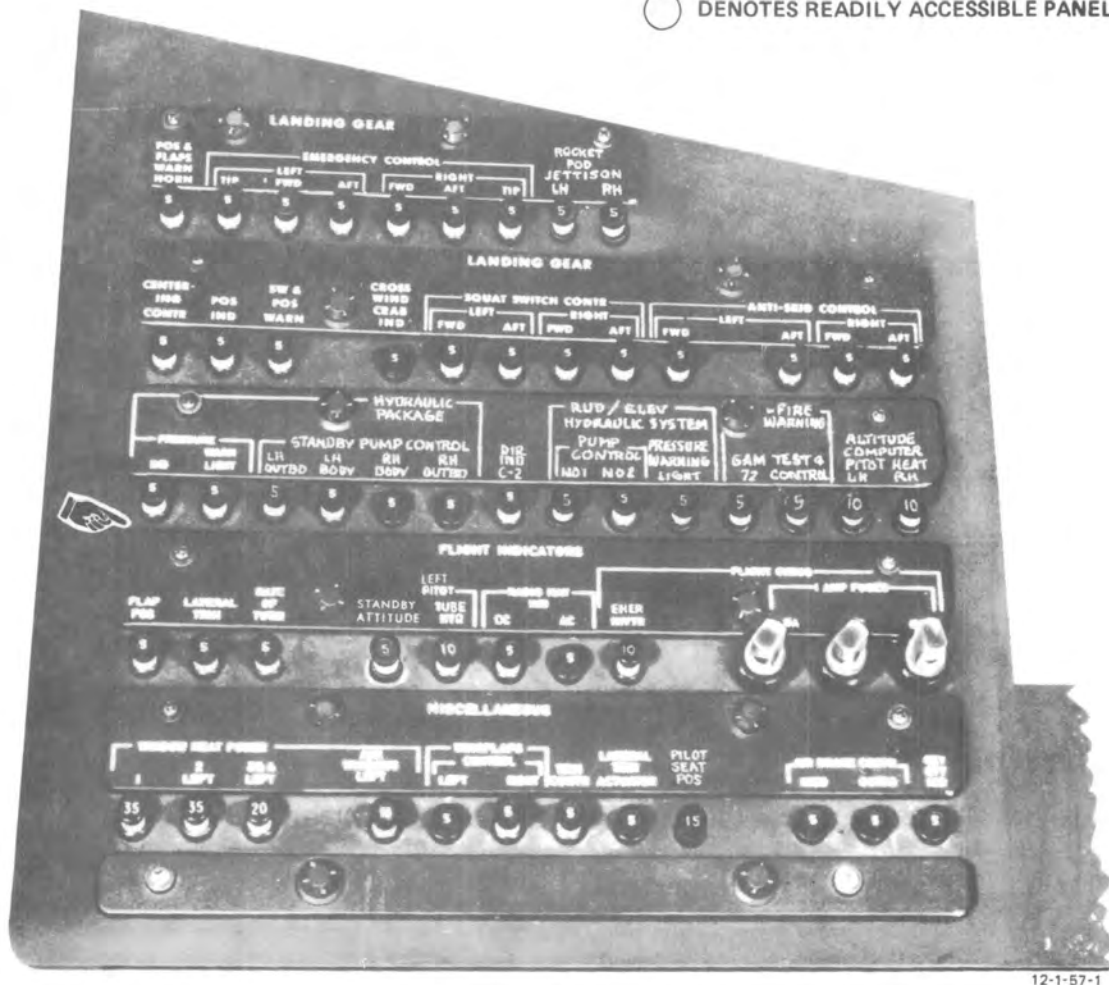
SYSTEM	POWER SOURCE				CONTROL		
	GEN BUS	TR BUS	ESSENTIAL BUS	BATTERY BUS	POWER	CIRCUIT BREAKER PANEL	
MISSILE (AGM-69A)							
Air Cond Compressor	5	Right			Left TR	★	
Air Cond Fans	5				Left TR	★	
Air Cond Heater No. 1	5				Left TR	★	
Air Cond Heater No. 2	5				Left TR	★	
RH Air Scoop Anti-Ice					Left TR	Left Load	
Battery Charger	7					★	
Computer	5				Left TR	★	
Distributor Processor	7				AC	★	
Elex TR No. 1	1				Left TR	★	
Elex TR No. 2	5				Left TR	★	
Elex TR No. 3	7				Left TR	★	
GAM-72 Gear Jettison and AGM-69A		Left		Aft	Aft Battery	P	
Heater and Distributor Power	7				★		
Hydraulic Control (Pump)				Left TR	Left Load		
Hydraulic Pump	1			Left TR	★		
Hydraulic Pump TR	7				★		
IMU	5			Left TR	★		
Ind Dimming	7				★		
Insert Printer	5			Left TR	★		
Launcher Rotation Tool	5			Left TR	★		
Master Power Control					AGM-69A Battery	AGM-69A Battery	★
Power (AGM-69A)	5					★	
Power Supply (AJQ-23) (OTL TR Unit)	5				Left TR	★	
Pylon (LH) AC	5				Left TR	★	
Pylon (RH) AC	5				Left TR	★	
WEAPON SYSTEM							
★Aft Bomb Bay IFI Power		Right	Right		Right TR		
Aft Parachute Static Line Control		Right			Right TR	Aft BNS	
Bomb Door Valve Control					Right Ess	Right Load	
Aft Weapon Release Heater Control		Right			Right TR	Aft BNS	
Bomb Door Hold Open		Left			Left TR	Aft BNS	
Bomb Door Position Indicator		Left			Left TR	Aft BNS	
BNS Timer Door Close		Left			Left TR	Aft BNS	
Emergency Manual Bomb Release (Fwd & Aft)					Aft		
★Forward Bomb Bay IFI Power		Left			Left TR		
Forward Weapon Release Heater Control		Left			Left TR	Aft BNS	
Forward Parachute Static Line Control		Left	Left TR	Aft BNS			
Forward Emergency Bomb Door Valve			Left Ess	Left Load			
Normal Release Bomb Systems		Left	Left TR	Fwd BNS			
Forward/Aft IFC Battery Power			Forward	Fwd Battery	Aft BNS		
Forward IFC TR Power		Left	Left			Aft BNS	
Aft IFC TR Power		Right				Aft BNS	
Coded Switch Set		Right				Aft BNS	
Special Weapon Rack Select		Left			Left TR	Aft BNS	
Weapon Release Indicator Lights		Left			Left TR	Aft BNS	
Bomb Door Control Relays					Right Ess	Right Load	
Jettison Power					Aft	Aft Battery	Fwd BNS
Jettison Control					Aft	Aft Battery	Fwd BNS
Bomb Door Check Valve		Left				Left TR	Aft BNS
★ Source of power depends on position of IFC power select switch.							

Equipment Power Source, Circuit Breaker and Fuse Panel Locations (Typical)

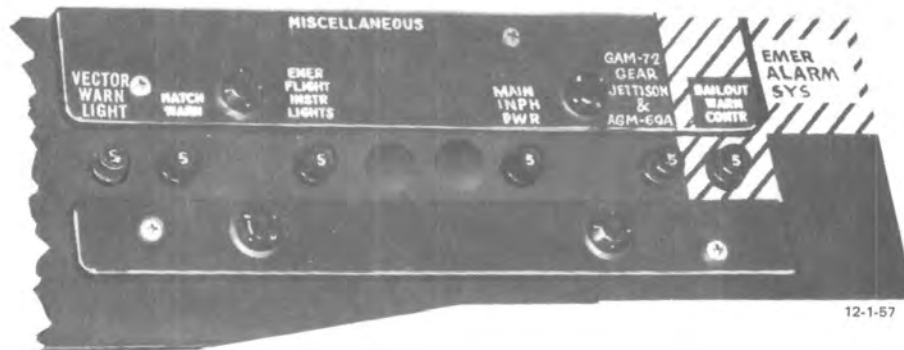
Figure 1-25 (Sheet 13 of 13).

NOTE

○ DENOTES READILY ACCESSIBLE PANELS



12-1-57-1



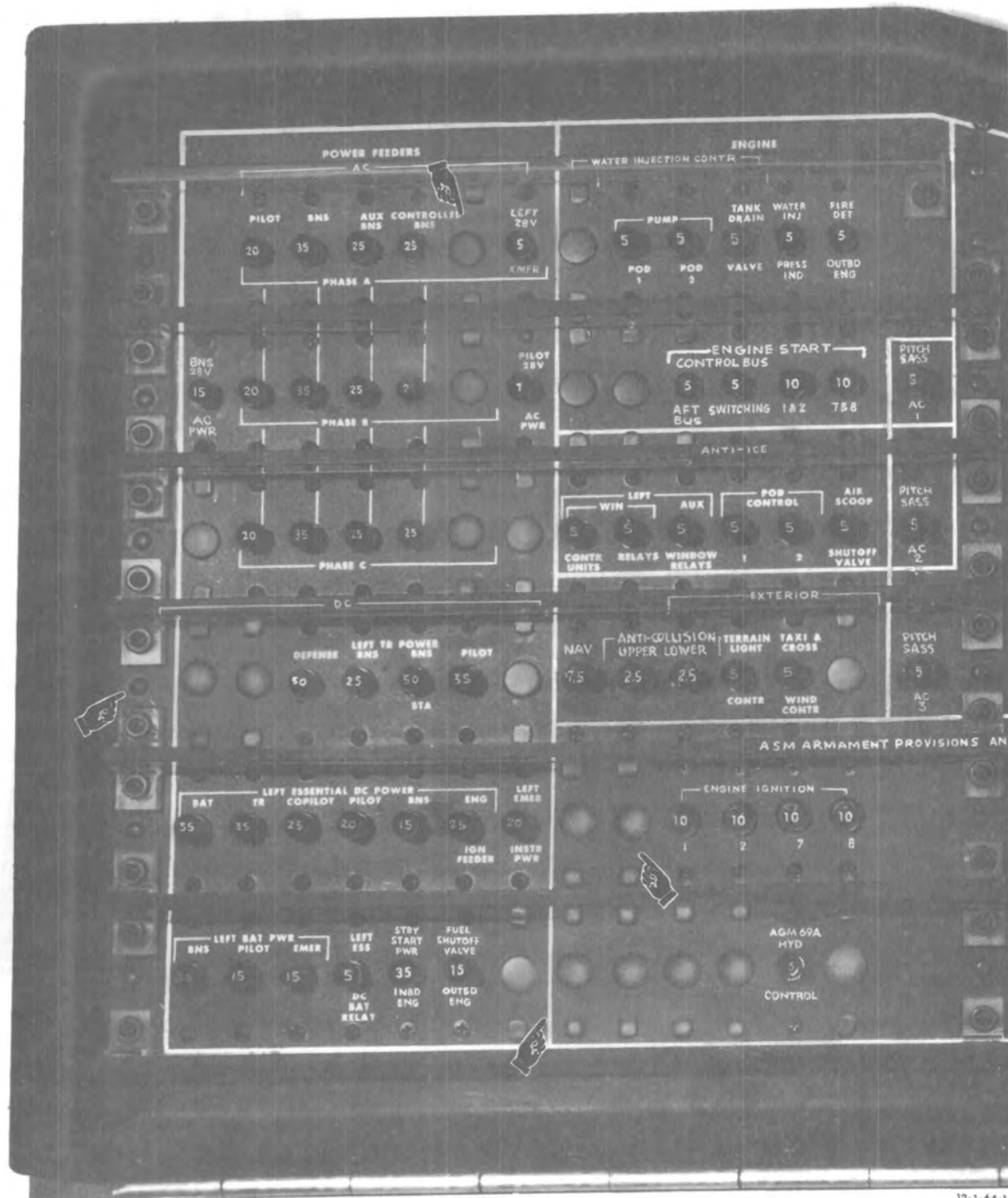
12-1-57

① PILOT'S CIRCUIT BREAKER PANELS (TYPICAL)

Figure 1-26 (Sheet 1 of 12).



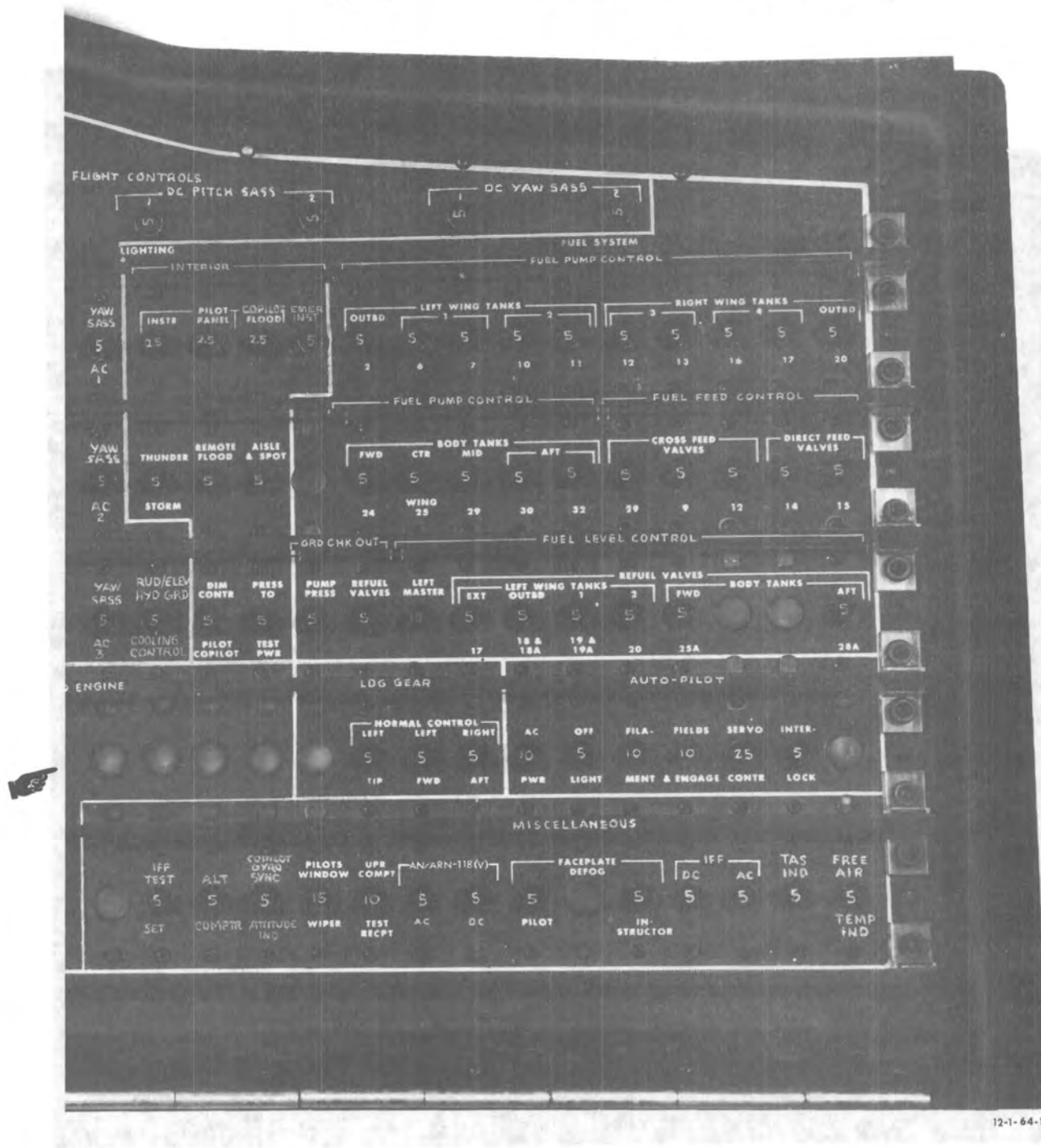
Figure 1-26 (Sheet 2 of 12).



12-1-64-1

Figure 1-26 (Sheet 3 of 12)

④ LEFT LOAD CENTRAL CIRCUIT BREAKER PANEL (TYPICAL)

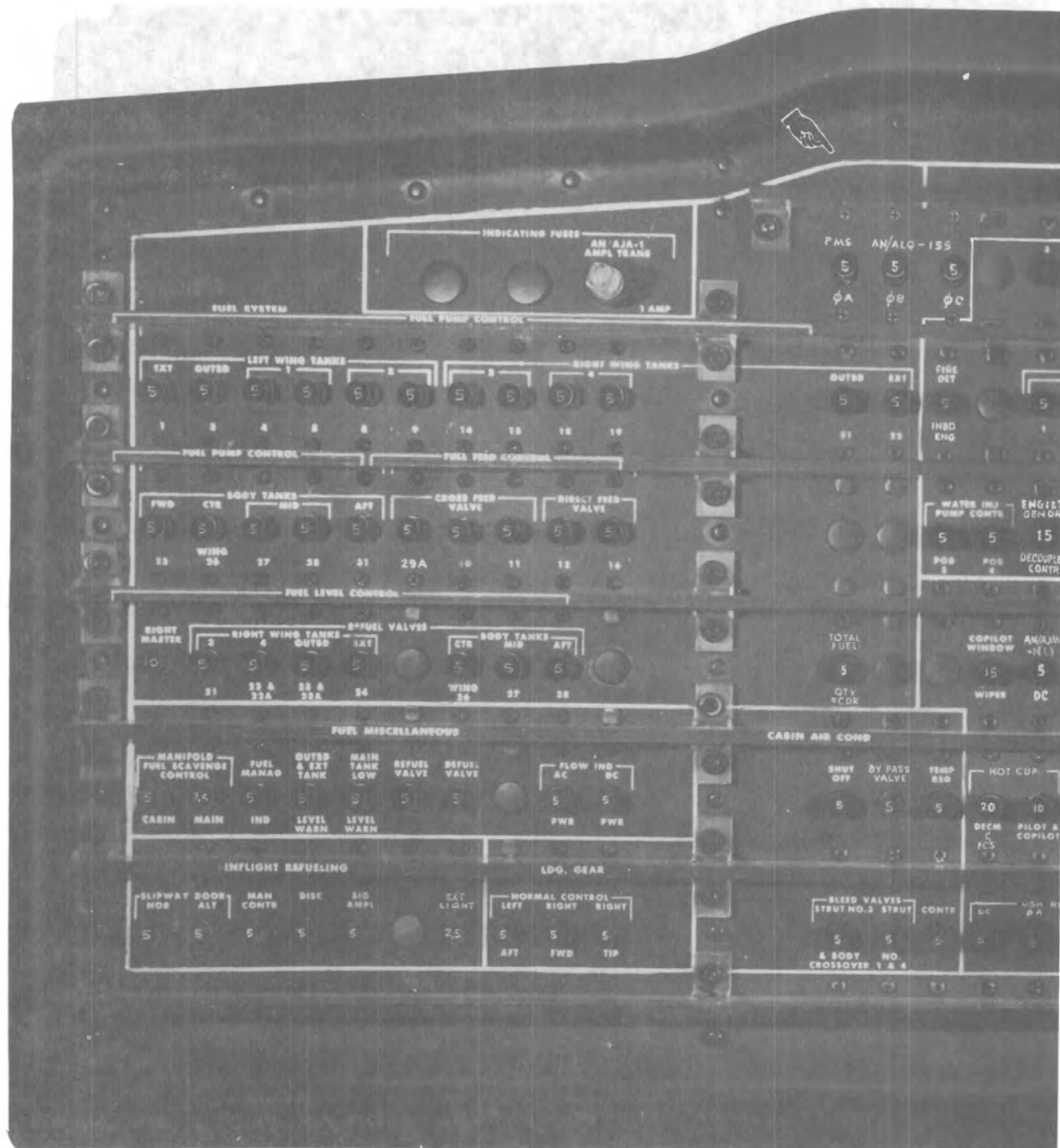


12-1-64-1

Circuit Breaker Panels

Figure 1-26 (Sheet 4 of 12)

③ RIGHT LOAD CENTRAL CIRCUIT BREAKER PANEL (TYPICAL)

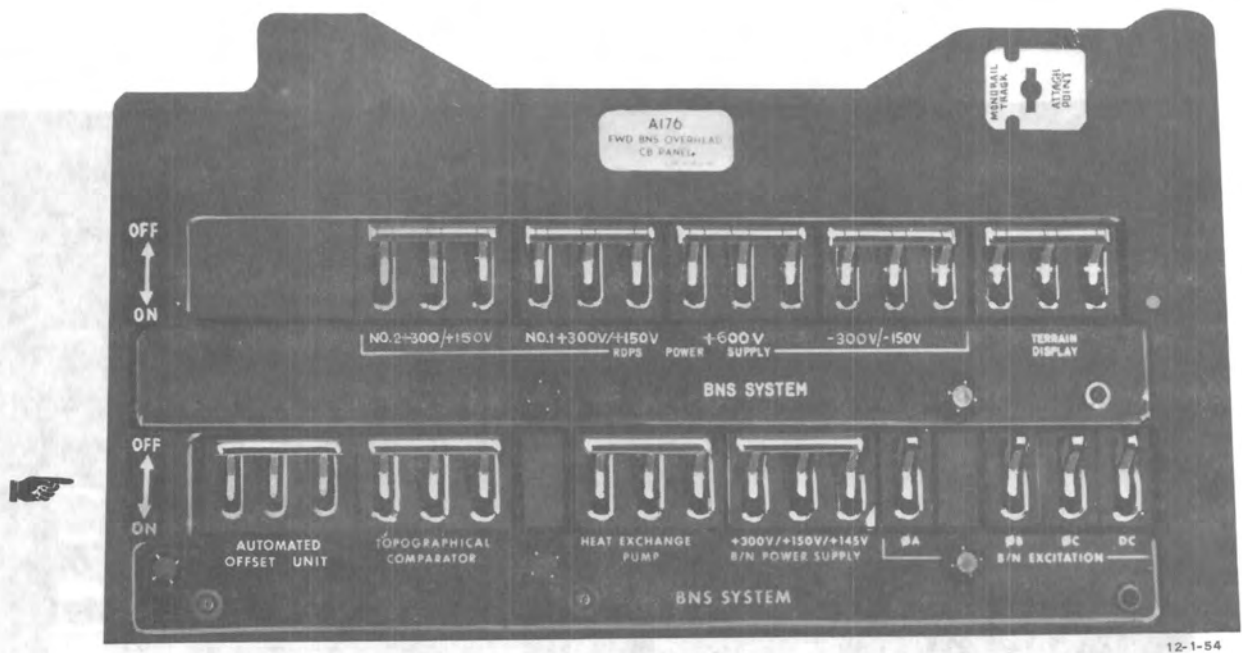


12-1-65-1

Figure 1-26 (Sheet 5 of 12)

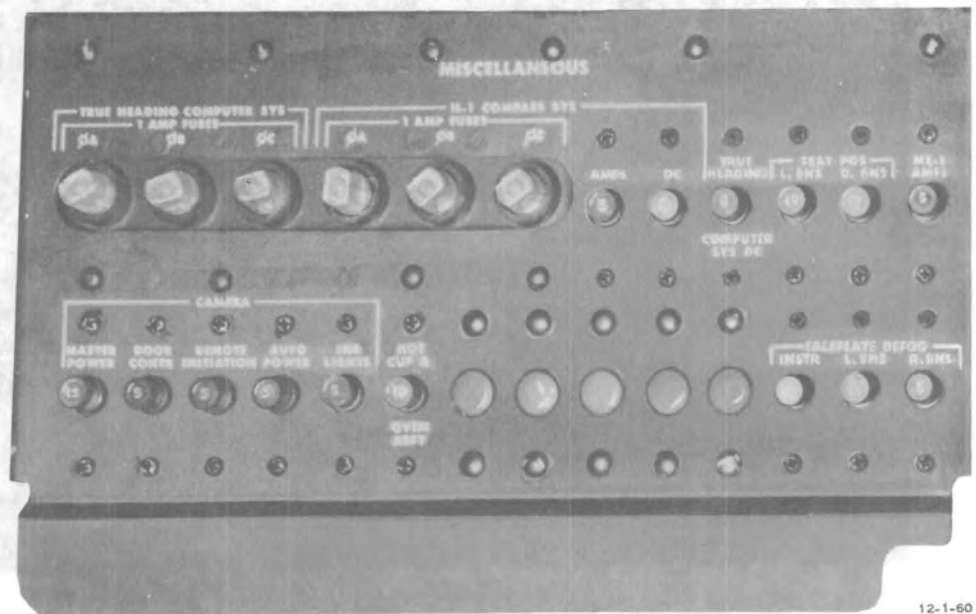
.....Circuit Breaker Panels

Change 18 1-77



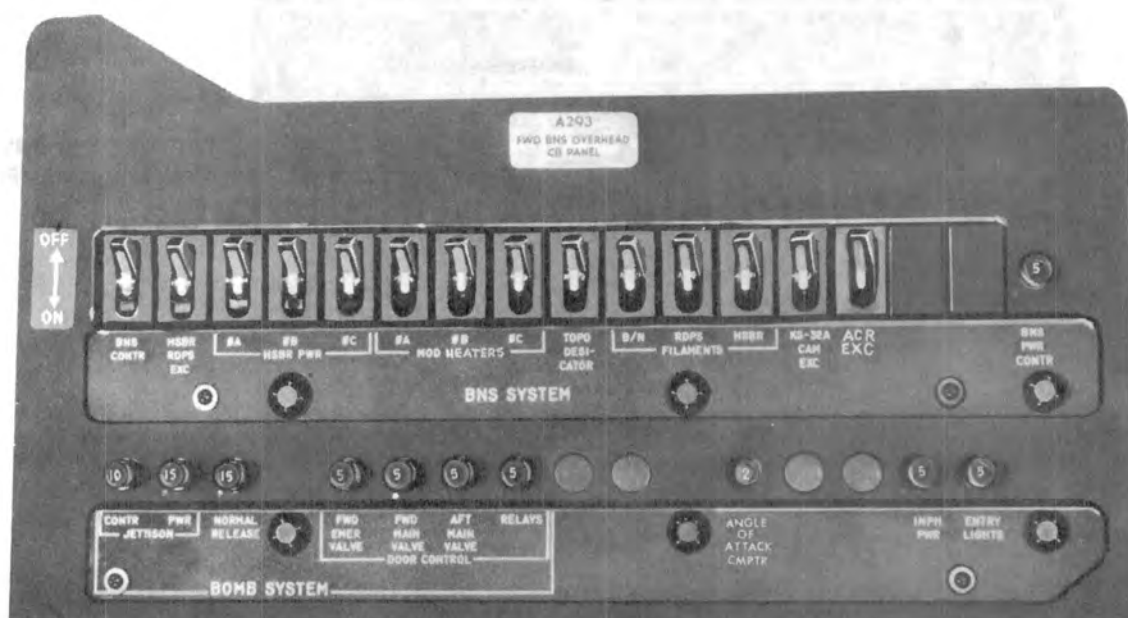
12-1-54

⑥ LEFT FORWARD BNS CIRCUIT BREAKER PANEL (TYPICAL)

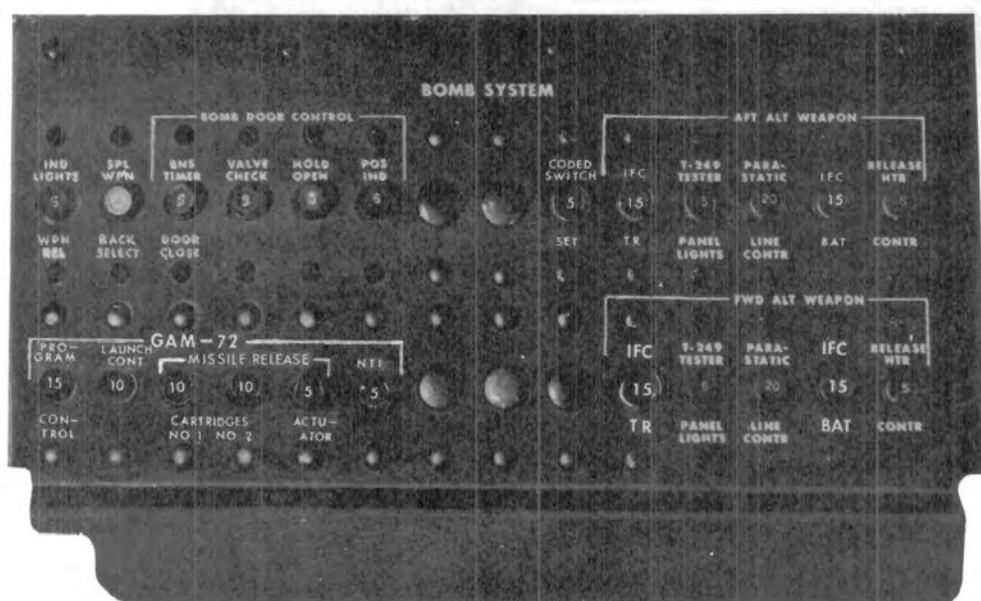


12-1-60

⑦ AFT BNS CIRCUIT BREAKER PANEL (TYPICAL)



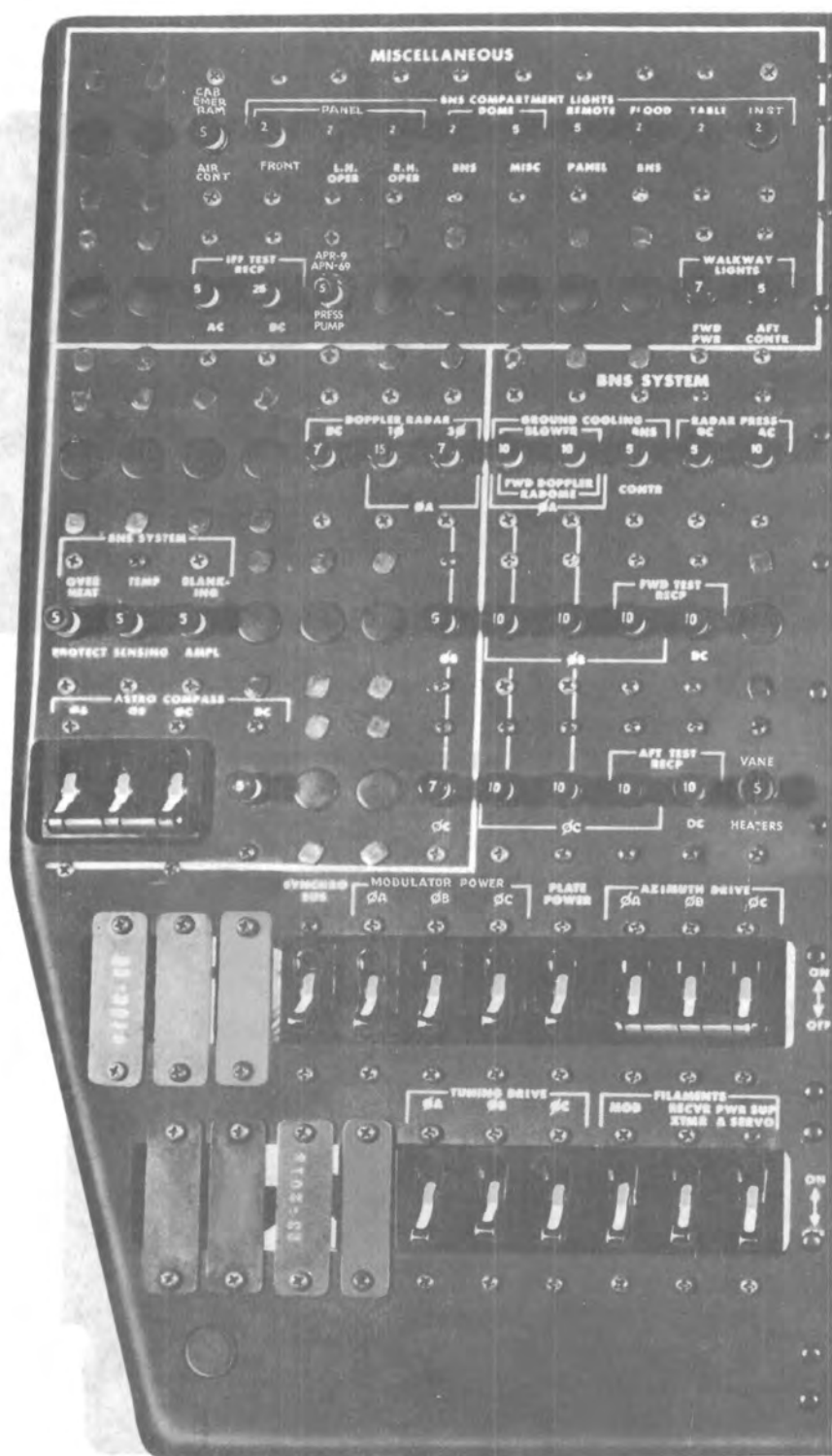
⑤ RIGHT FORWARD BNS CIRCUIT BREAKER PANEL (TYPICAL)



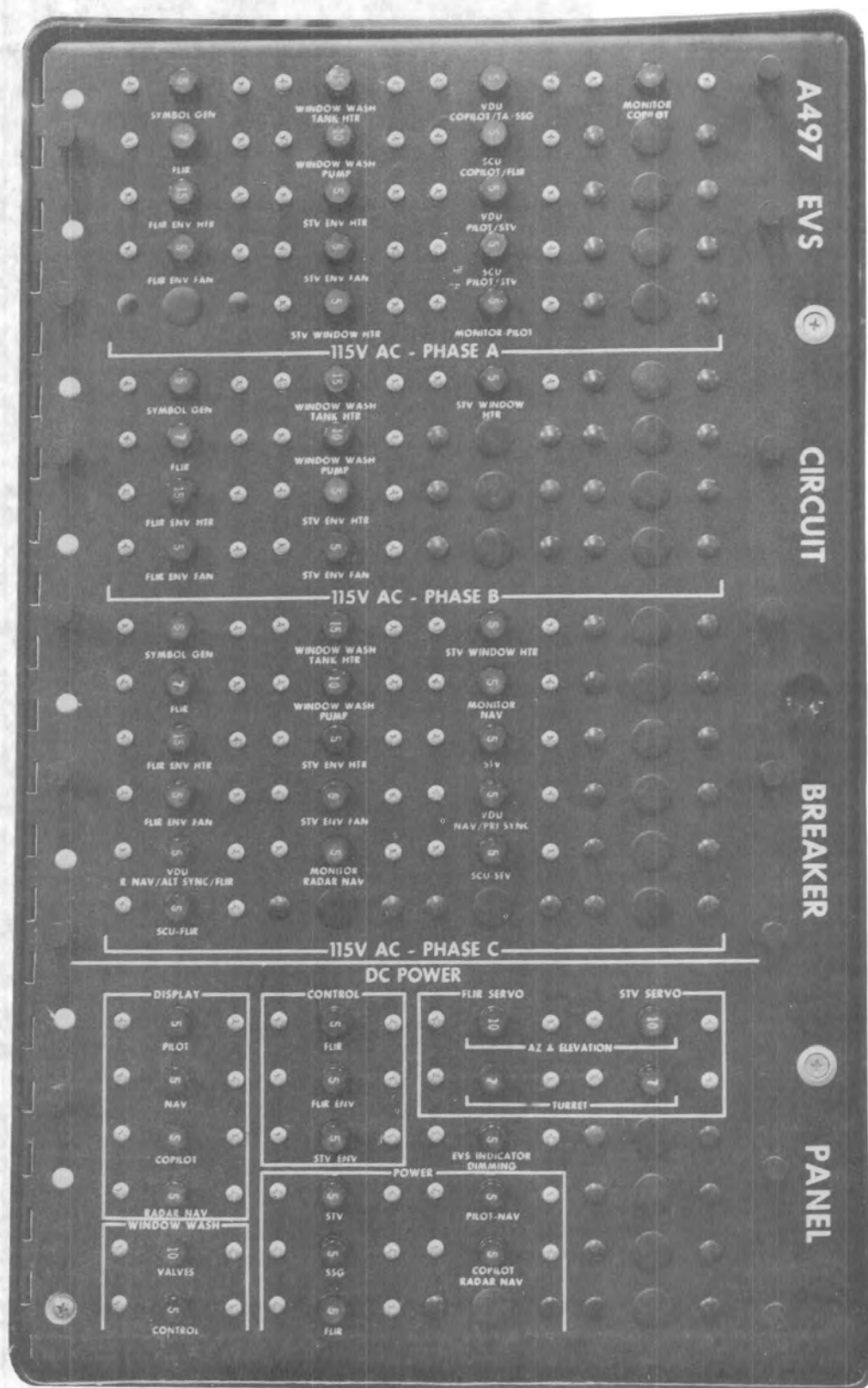
12-1-60

.....Circuit Breaker Panels

Figure 1-26 (Sheet 8 of 12).



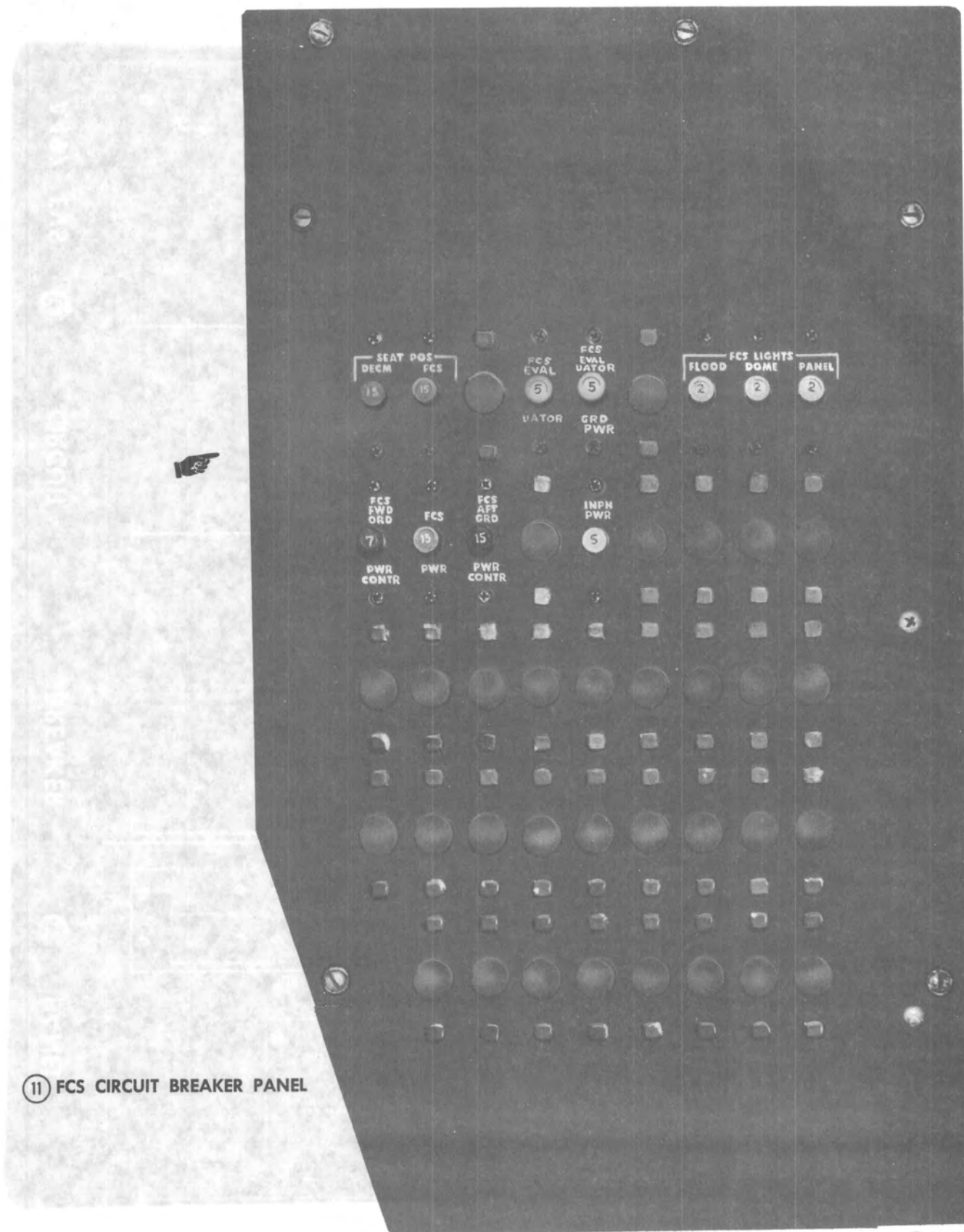
9 AUXILIARY BNS CIRCUIT-BREAKER PANEL (TYPICAL)



6C EVS CIRCUIT BREAKER PANEL (TYPICAL)

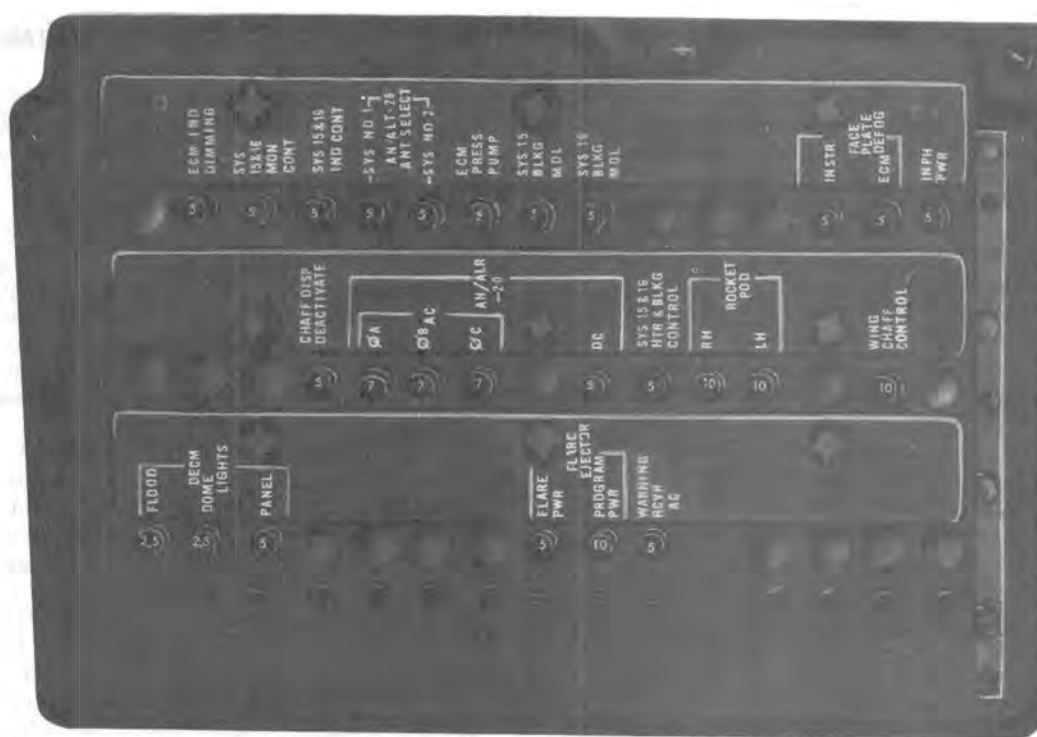
Circuit Breaker Panels

Figure 1-26 (Sheet 10 of 12).



.....Circuit Breaker Panels

Figure 1-26 (Sheet 11 of 12).



(10) ECM CIRCUIT BREAKER PANEL (TYPICAL)

12-1-195

Circuit Breaker Panels

Figure 1-26 (Sheet 12 of 12).

HYDRAULIC POWER SUPPLY SYSTEMS

NOTE

Reference to engine driven pumps/left or right body hydraulic systems providing standby pressure to the rudder/elevator hydraulic systems, should not be misunderstood. Hydraulic pressure provided by the body systems provides a source of power for the auxiliary hydraulic pumps; however, the hydraulic fluid in the body systems is completely separated from that in the rudder/elevator systems. Therefore, if a complete loss of hydraulic fluid occurs in the rudder/elevator systems resulting in the illumination of all four indicator lights, normal body systems pressure will not provide any pressure within the rudder/elevator system and these flight control systems will be inoperative. See "Rudder/Elevator Hydraulic Malfunctions," in Section III.

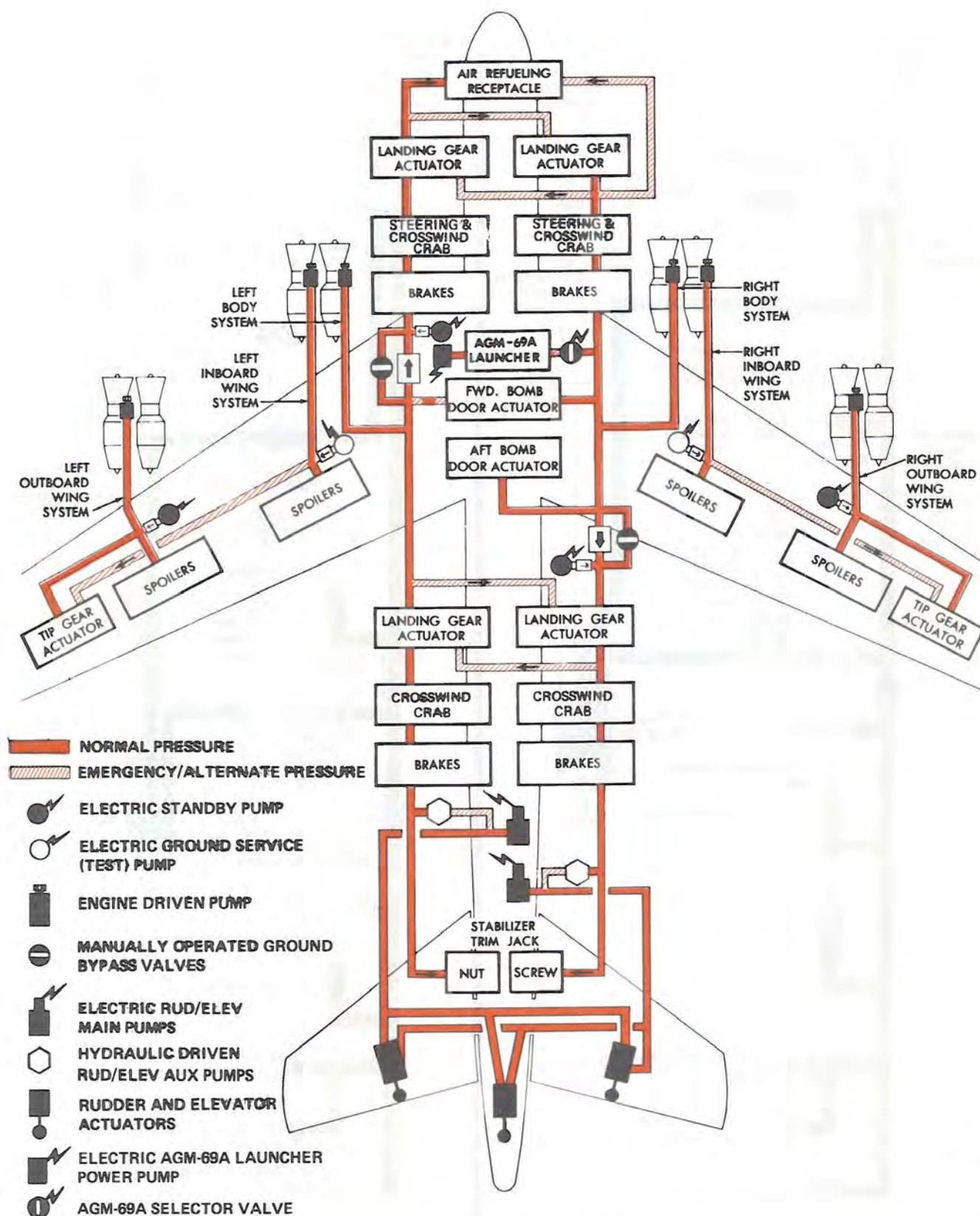
The hydraulic systems of this aircraft differ from a conventional system in decentralization. Instead of the usual single main system, there are six independent engine-driven systems (figure 1-27) consisting of inboard and outboard right and left wing hydraulic systems and right and left body hydraulic systems. In addition there are two electric motor-

driven primary hydraulic systems consisting of main No. 1 and 2 rudder/elevator hydraulic systems (figure 1-28A). Engine-driven pumps, which supply normal pressure to the wing and body systems, are mounted on the right side of engines 1, 3, 4, 5, 6, and 7. Electric motor-driven pumps, which supply normal pressure to the No. 1 and 2 main rudder/elevator hydraulic systems are mounted on the right aft side of the fuselage in the 47 section of the aircraft. Electric motor-driven standby pumps, available for use in all systems except the inboard wing systems, are installed at the left and right wing trailing edge locations and left and right body locations. The right body system standby pump supplies standby pressure to the No. 2 rudder/elevator hydraulic system. Engine-driven pumps 1 and 7 supply normal pressure to the outboard spoilers and tip protection gear. The outboard left and right wing location electric motor-driven pumps supply standby pressure to the outboard spoilers and tip protection gear. The engine-driven pumps on engines 3 and 6 supply normal pressure to the inboard spoilers and provide emergency pressure for extension of the tip protection gear. The engine-driven pumps installed on engines 4 and 5 supply normal pressure to the body systems, standby pressure to the rudder/elevator systems (RUD/ELEV AUX 1 and 2, figure 1-28A).

The left and right body location electric motor-driven pumps provide standby pressure for the essential body systems normally serviced by engines 4 and 5 respectively. The left body system supplies normal pressure to the air refueling system, left forward landing gear, brakes, steering and crosswind crab, left aft landing gear, brakes, crosswind crab, and the stabilizer nut. It also supplies emergency pressure to the right forward landing gear, forward bomb door, right aft landing gear and it supplies standby pressure to the rudder and elevator. The right body system supplies normal pressure to the right forward landing gear, brakes, steering and crosswind crab, forward and aft bomb doors, right aft landing gear, brakes, crosswind crab, and the stabilizer screw. It also supplies emergency pressure to the air refueling system, left forward and left aft landing gear, and it supplies standby pressure to the rudder and elevator. Due to a one-way check valve in each body system, the left body standby pump is able to supply standby pressure only to the air refueling system, left forward landing gear, brakes, steering and crosswind crab, and right forward landing gear. The right body standby pump, in a similar manner, is able to supply standby pressure only to the right aft landing gear, brakes, crosswind crab, stabilizer screw, and left aft landing gear. See "Hydraulic System Operation," Section VII. Pressure can be furnished from either of two engine-driven pumps or a standby pump for operation of the stabilizer, brakes, landing gear, air refueling toggle actuator, and air refueling doors. Pressure can be furnished from either No. 4 or 5 engine-driven pumps for operation of the rudder and elevator in event of failure of the No. 1 and 2 main rudder/elevator system pumps. No standby pump pressure is available to the bomb doors. Reliability of the aircraft hydraulic systems is assured by alternate sources of pressure, providing increased life to vital equipment during either combat or routine missions. AGM-69A launcher rotational drive is accomplished through use of two similar but independent AGM-69A hydraulic systems. See "Carrier Aircraft AGM-69A Hydraulic Systems," this section, for additional information.

ENGINE-DRIVEN HYDRAULIC SYSTEMS

A variable delivery engine-driven pump supplies normal pressure to each wing and body hydraulic system (figure 1-28) and supplies standby pressure to the rudder/elevator hydraulic systems (figure 1-28A). Each pump has a rated flow of 12 gallons per minute at an output pressure of 2800 psi, with cutout pressure at 3000 (± 50), and provides both variable flow and pressure. At cutout pressure, the pumps continue to operate but discontinue delivery; the fluid is bypassed to return. With exception of the inboard spoilers and the aft bomb door actuator, each separate hydraulic power supply system (brakes, steering, landing gear, etc) has either or both emergency and standby alternate sources of pressure. Each electric motor-driven standby pump has a rated flow of 3 gallons per minute at 1300 psi output pressure. The variable delivery standby pumps, which discontinue delivery at a cutout pressure of 3000 (± 50) psi, are controlled by individual switches on the pilot's side panel. According to system demand, a standby pump may run continuously for several hours under emergency conditions. Due to accumulative tolerance buildup in pressure transmitters and pressure gages, engine-driven and standby pump cutout pressures will indicate 3000 (± 250) psi on the hydraulic system pressure gages. A pressure switch is incorporated in each system to control the respective pressure low warning light for that system. The lights, which indicate main pump pressure only, are located on the pilot's side panel. A pressure transmitter in each system located downstream of the system one-way check valve registers system pressure at the hydraulic pressure gage on the pilot's side panel. Oil-air type accumulators, which have attached air gages, are incorporated to provide air preload pressure for accelerating the operation of outboard wing system components and certain body system components. In the brake pressure lines, restrictor valves are located downstream from the accumulators to prevent a momentary drop in pressure. Direct application of pressure is provided to the stabilizer hydraulic motors and the bomb door, landing gear, and air refueling toggle actuators. Where the restrictor valves are located downstream from the accumulator in the brake pressure lines, a thermal relief valve with an opening pressure of 3750



Hydraulic System Locations (Typical)

Figure 1-27

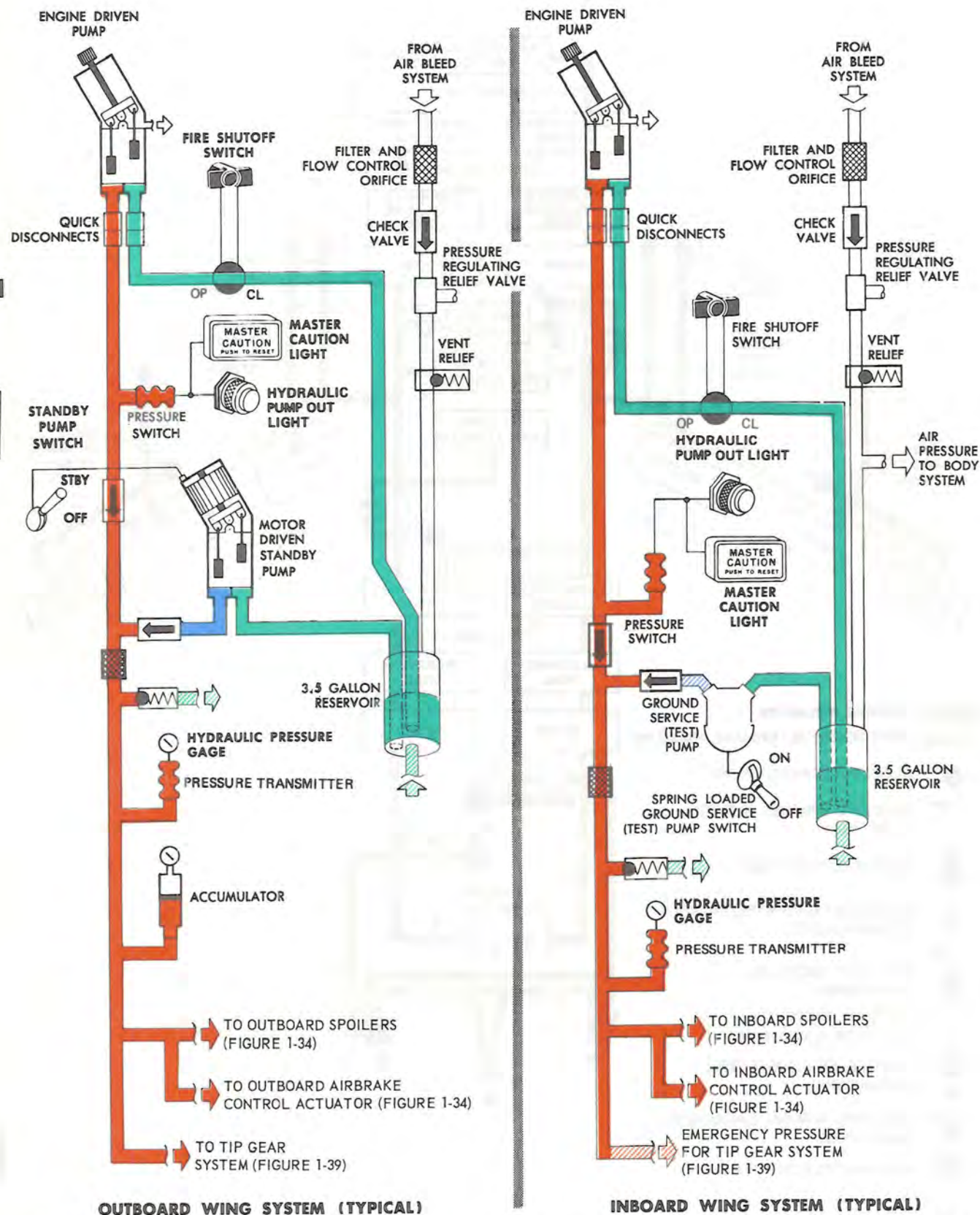
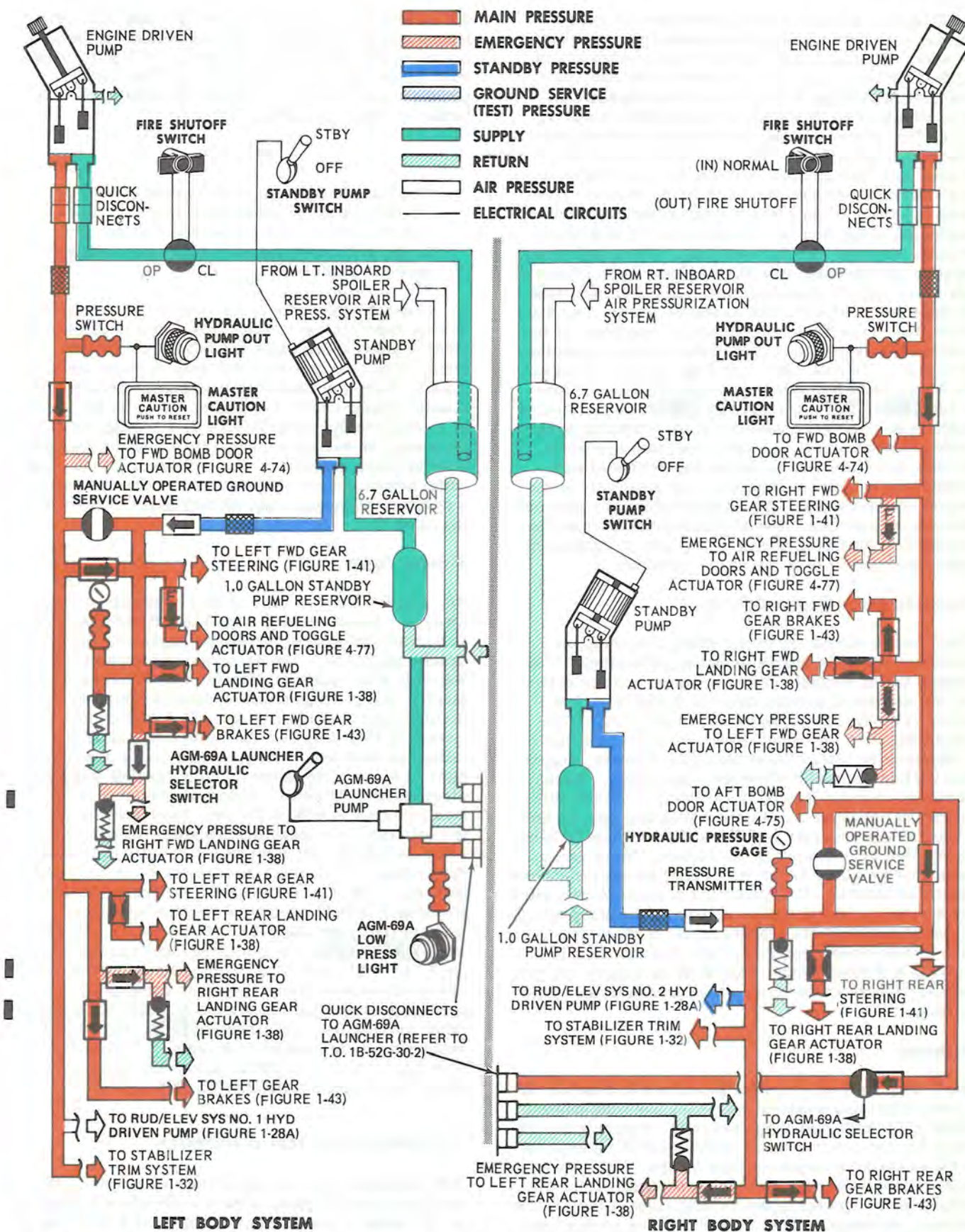


Figure 1-28 (Sheet 1 of 2).



Hydraulic Power Supply Systems (Typical)

Figure 1-28 (Sheet 2 of 2).

(±100) psi is located at each accumulator to relieve excess pressure caused from continuous use of the brakes. Hydraulic fuses of two types, which are installed as a safety feature in certain systems, will automatically close when a break in a downstream line allows more flow than the calibrated rate of a fuse, thus preventing the loss of an excessive quantity of hydraulic fluid. The fuse types consist of Type I and Type II which are similar in performance and differ only in the manner in which they are reset after closing. Type I fuses require that pressures on each side of the fuse be equalized and Type II fuses require reverse flow for resetting. The wheel brake system incorporates two 60 cubic inch Type I fuses in the slave control lines and eight 120 cubic inch Type II fuses in the wheel brake pressure lines. Two 120 cubic inch Type I fuses are installed upstream of the emergency extension control valves of the tip protection gear. Two 60 cubic inch Type I fuses are used in the air refueling pressure actuating lines on aircraft **W173** **W191**. On aircraft **W192**, two 120 cubic inch Type I fuses are used in the air refueling pressure actuating lines. A motor-operated hydraulic shutoff valve is installed in the supply line of each system for control of fluid from the reservoir to the engine-driven pump. The shutoff valves are open and provide a continuous flow of hydraulic fluid when the engine fire shutoff switches on the pilots' instrument panel are pushed in to the normal position.

Hydraulic Pump (Engine-Driven)

Each engine-driven hydraulic pump is a complete packaged unit with engine mounting provisions. The pumps are of variable delivery design and are driven by the engines at a ratio speed of 0.355 of engine rpm. The pumps operate continuously with engine operation, are self-regulating, and react to either continuous or intermittent demands of power, supplying variable flow and pressure accordingly. Each pump has a rated flow of 12 gallons per minute with an output pressure of 2800 psi with pump rpm at 3100. Pump cutout pressure is 3000 (±50) psi. Due to being controlled by operation of the engines, there are no manual-type controls for energizing the engine-driven hydraulic pumps. Cavitation of the pump is prevented by keeping a head of fluid available to the pump by air pressurization of the supply portion of the system. The pumps utilize hydraulic fluid from the supply for cooling and lubrication. Shutoff of the supply will result in damage to the pump while the engine is windmilling.

Reservoir

Each wing hydraulic system includes a 3.5-gallon capacity reservoir which is located in the wing trailing edge. The outboard wing reservoirs supply hydraulic fluid for the electric motor-driven standby pumps as well as the main engine-driven pumps. Main reservoirs for the body system have a capacity of 6.7 gallons and are located in the trailing edge of the inboard wings. All main system reservoirs are pressurized from the air system at 25 to 30 psi operating pressure. Each reservoir is equipped with an internal

100 cubic inch capacity negative "g" tank which will keep a supply available to the pump with fluid held to the top of the tank due to a negative "g" flight attitude. Each reservoir also incorporates a filler neck, strainer, and cap and a window-type sight gage calibrated to show full and refill levels.

NOTE

Fluctuations of the reservoir fluid level near the full mark are normal and may be expected due to pressure and temperature variations in the system air and oil which cause expansion and contraction.

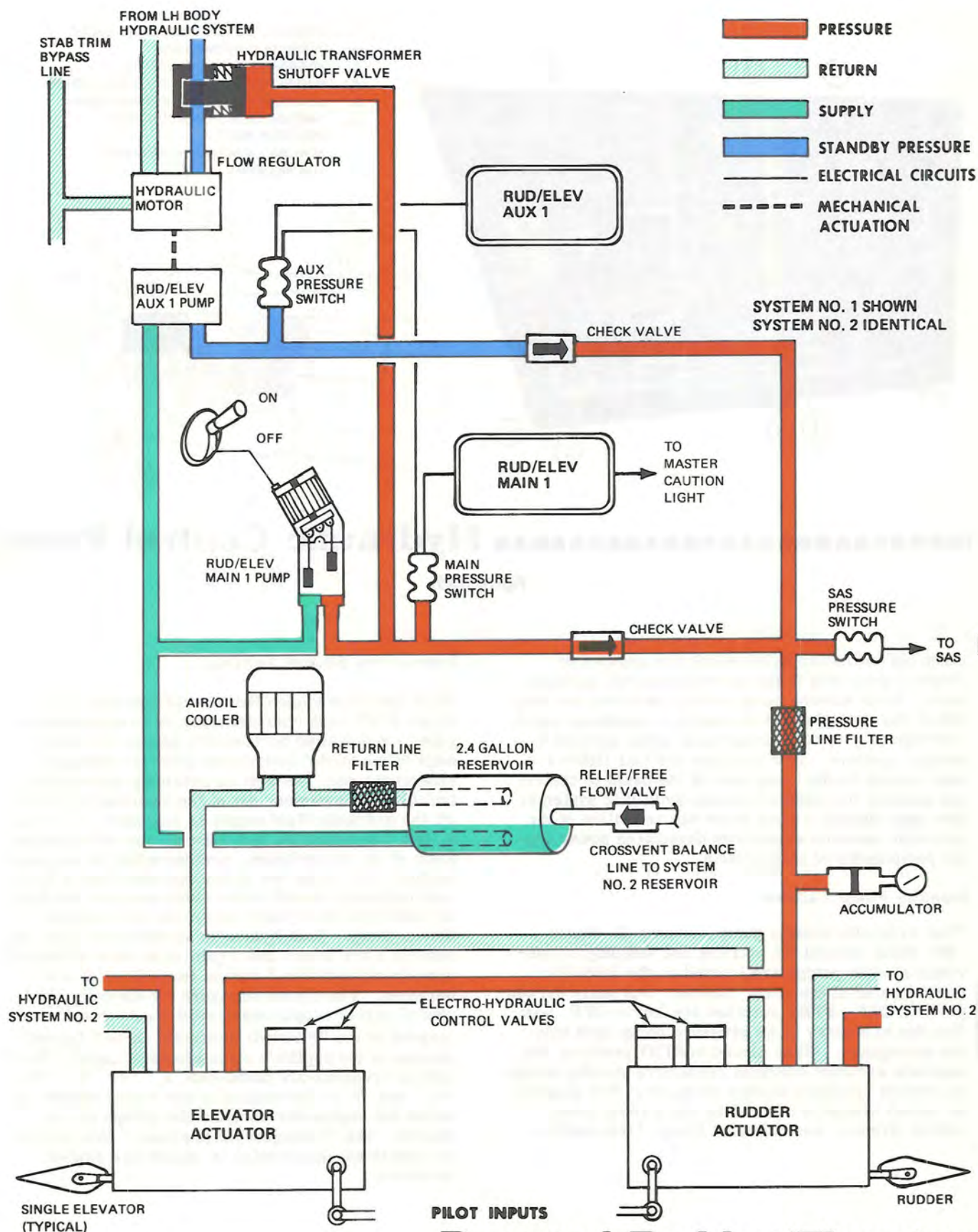
A 1.0-gallon reservoir is installed in the return line of each body system to provide a supply of fluid to the standby pump of the right and left body hydraulic systems. The outboard wing hydraulic system has no standby reservoir; however, the supply lines to the standby pumps hold 0.5 gallon of fluid. In the event of a complete hydraulic failure on one wing, this supply should be enough to extend the tip protection gear. Standby pump reservoirs are equipped with inlet and outlet attach fittings only and are installed at respective left forward and right aft bulkhead locations of the bomb bay.

Standby Pump

The standby pump in each of four hydraulic systems (body and outboard wing) supplies sufficient pressure to operate the system should the engine-driven hydraulic pump fail. The standby pump consists of a 205-volt 400-cycle a-c constant speed continuous duty electric motor coupled with a variable delivery hydraulic pump which has a rated flow of 3 gallons per minute at 1300 psi, decreasing to 1.2 gallons per minute at 2800 psi. The pump and motor are packaged as a complete assembly which is self-cooled and electrically controlled. Cutout pressure of each standby pump is 3000 (±50) psi. Each standby pump is controlled by a manually operated switch and, when energized, will regulate from zero flow to full flow within 0.05 second, decreasing to zero flow at 3000 psi. The circuit breakers located on the "Standby Pump Control" portion of the pilot's circuit breaker panel are controlled by TR power. On aircraft **W173** **W180**, the circuit breakers are numbered "1," "4," "5," and "7" according to the engine number of the engine-driven hydraulic pump providing normal pressure for the system in which the standby pump is installed. On aircraft **W181**, the circuit breakers are designated "LH Outbd," "LH Body," "RH Body," and "RH Outbd" according to the system which the respective standby pump supplies.

HYDRAULIC SYSTEM CONTROLS

The hydraulic system controls are arranged on the hydraulic control panel (figure 1-29) which is located on the forward vertical part of the pilot's side panel. The six individual hydraulic systems are represented on the control panel by six pressure gages and six



Powered Rudder/Elevator Hydraulic System (Typical)

Figure 1-28A.

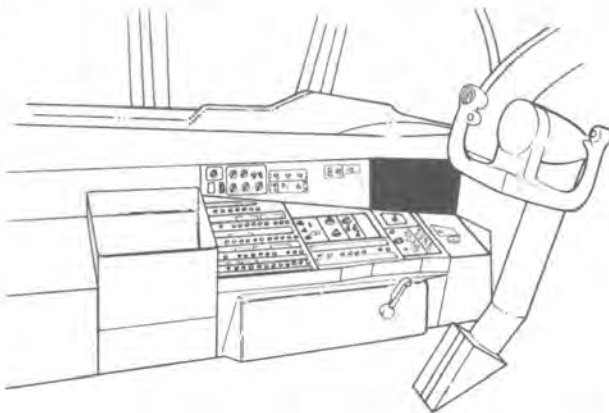
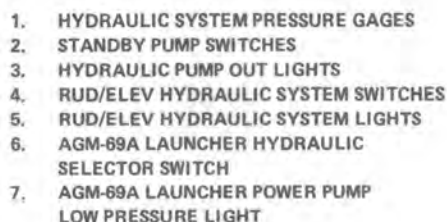


Figure 1-29.

Standby Pump Switches

Engine Fire Shutoff Switches

Eight pull-type engine fire shutoff switches (33, figure 1-15) each corresponding to a respective engine, are installed horizontally across the upper edge of the pilots' instrument panel for inflight emergency use. As well as providing shutoff control of other systems, six of the switches will shut off the hydraulic fluid supply to engines 1, 3, 4, 5, 6, and 7 on which the hydraulic pumps are installed. Each of the six switches, corresponding to the above engines, will close the motor-operated engine fire-wall hydraulic shutoff valve which controls the flow of fluid from the system reservoir to the engine-driven pump. Each hydraulic shutoff valve unit consists of a d-c motor and a gate-type valve which will open or close within 1 second regardless of temperature. The circuit breakers for the hydraulic shutoff valves supply essential d-c power and are located on the "Firewall Hydraulic Shutoff Valves" portion of the copilot's circuit breaker panel. The circuit breakers are numbered "1," "3," "4," "5," "6," and "7" to correspond to the engine number on which the engine-driven hydraulic pumps are installed. See "Emergency Equipment," this section, for additional information on engine fire shutoff switches.

HYDRAULIC SYSTEM INDICATORS

Hydraulic Pressure Gages

Six gages (1, figure 1-29) on the hydraulic control panel indicate pressure of the hydraulic systems. The gages are calibrated from 0 to 4000 psi. The location of each gage on the control panel corresponds to the respective hydraulic system which it serves and which is shown by outline on the control panel. Due to accumulative tolerance buildup in pressure transmitters and pressure gages, engine-driven and standby pump cutout pressures will indicate 3000 (± 250) psi on the hydraulic system pressure gages. In the event an engine-driven pump fails on the left or right body system, the pressure gage will then indicate only pressure trapped in that portion of the system downstream of the one-way check valve. This pressure should dissipate either through normal internal leakage or by operation of a system component located downstream of this one-way check valve. When the standby pump is energized, the gage will then indicate only the pressure supplied to this isolated portion of the system. All six pressure gages are operated by 28-volt a-c power and are controlled by a circuit breaker marked "Ind" located beside the pressure low warning light circuit breaker on the "Pressure" portion of the pilot's circuit breaker panel. See figure 5-1 for hydraulic pressure gage markings.

Engine-Driven Hydraulic Pump Out Lights

Each of the six individual hydraulic systems has an amber pump out indicating light (3, figure 1-29) located on the hydraulic control panel at the pilots' station. Since the lights indicate engine-driven pump pressure only, a light will remain on after failure of a main pump even though (for those systems which have a standby pump) system pressure is restored to normal by the standby pump. Only a return of the affected main pump to proper operation will extinguish the light. Each light is illuminated when system pressure drops to 350 (± 150) psi and goes out when system pressure increases to 700 psi maximum as controlled by pressure switches in the systems. All six pump out indicating lights operate on TR power and are controlled by a circuit breaker marked "Warn Light" located on the "Pressure" portion of the pilot's circuit breaker panel. When a pump out warning light illuminates, a signal is sent to the master caution light controller, resulting in illumination of the master caution light. The master caution light is installed on the forward instrument panel for the convenience of checking different systems by use of a single indicator. There is a separate circuit from each hydraulic system pressure switch to the system pump out light and the master caution light. Even though normal pressure cannot be restored on the particular hydraulic system which has a pump out light illuminated, the master caution light circuit may be reestablished for use as an indicator of other malfunctions by pressing the light button to reset the circuit. The master caution light serves the purpose of providing immediate reference to normal system pressure of the six separate hydraulic systems. See

"Master Caution Light" under "Emergency Equipment," this section, for additional information.

NOTE

During ground operation, the pump out lights may illuminate momentarily when a demand is placed on a hydraulic system and the engine driving the pump for that system is at or near idle.

RUDDER/ELEVATOR HYDRAULIC SYSTEMS

The rudder and elevator flight controls are powered by two independent primary hydraulic systems (figure 1-28A). Each hydraulic system has its own fluid power generation, fluid transmission, supply components, and actuation subsystem. The systems are redundant, in that either is adequate for mission accomplishment in event of failure of the other. Normal hydraulic power is generated by variable displacement hydraulic pumps driven by alternating current electric motors. An auxiliary hydraulic pump (hydraulic transformer) is installed in each of the primary systems to provide standby power capable of supplying adequate hydraulic pressure for system operation in the event of electric motor-driven supply failure. The auxiliary hydraulic pumps are prevented from continuous operation by a shutoff valve that is controlled by hydraulic pressure from the primary system. The left and right hand body hydraulic systems each supply power to one transformer.

Hydraulic Pump (A-C Motor Driven)

A hydraulic power supply is incorporated in each rudder/elevator system as the primary source of hydraulic power. The hydraulic power supply consists of an electric motor-driven pump, an airless self-pressurizing reservoir, and a manifold. The motor pump assembly consists of a variable delivery axial piston 4 gpm hydraulic pump and a three-phase 118/205-volt induction motor. The assembly is rated for continuous duty at 2 gallons per minute to an altitude of 55,000 feet. Rated pump speed is 5625 rpm. Pump cooling oil for each system is routed directly to an air/oil cooler.

Rudder/Elevator Auxiliary Hydraulic Pumps

An auxiliary hydraulic pump is incorporated in each rudder/elevator hydraulic system to provide a standby source of hydraulic power for rudder and elevator actuation. The auxiliary rudder/elevator pump is a transformer type unit consisting of a hydraulic motor with a flow regulator in the inlet port and a hydraulic pump (driven by the hydraulic motor) with a check valve in the outlet port. The auxiliary rudder/elevator hydraulic pumps utilize power from the aircraft left and right hand body hydraulic systems, but maintain fluid isolation between the body hydraulic systems and the rudder/elevator hydraulic system. Each auxiliary rudder/elevator hydraulic pump has a normal output of 2 gallons per minute. Each auxiliary pump delivers zero flow at pump differentials above 2800 psi and delivers flow at pressure

differentials below 2470 psi. A flow regulator is installed in the pressure port of the auxiliary hydraulic pump to limit flow to 3 (± 0.3) gpm.

NOTE

A shutoff valve is installed forward of each auxiliary pump to prevent continuous operation of the pumps from body hydraulic system pressure. These valves are open for auxiliary pump operation when the main pump switches are off. The appropriate valve will also open upon failure of a main pump.

Reservoir

Two reservoirs of approximately 2.4 gallon capacity each are installed for use in the powered rudder/elevator main No. 1 and 2 hydraulic systems. These are "bootstrap" type reservoirs with a reservoir piston loaded to approximately 8 psi by means of a helical spring. With 3000 psi applied to the pressurizing piston, the reservoir outlet pressure will be 38 (± 5) psi. A relief/freeflow valve is installed in each reservoir and the two valves are joined by a reservoir crossvent balance line. The valves are designed to relieve reservoir pressure in excess of 60 (± 5) psi differential and to allow freeflow into the reservoir with a cracking pressure of 5 psi differential maximum.

Ground Cooling Blower

A ground cooling blower is also incorporated to supply cooling air for the oil coolers and hydraulic supply electric motors during ground operation. Exhaust air from the oil coolers and electric motors is ducted overboard. The 205-volt a-c blower is activated when either main hydraulic system switch 1 or 2 is in ON. The blower is deactivated during flight through a landing gear safety switch and cooling air is then supplied to the hydraulic systems from a ram air scoop located in the leading edge of the vertical stabilizer.



Maximum time that rudder/elevator hydraulic systems can be operated without ground blower in operation is 4 minutes.

Rudder/Elevator Main 1 and 2 System Switches

Two rudder/elevator hydraulic system switches (4, figure 1-29) are located on the lower portion of the hydraulic control panel. These switches have ON-OFF positions and in the ON position they energize a-c motor driven pumps located in the 47 section that operate the rudder/elevator main No. 1 and 2 hydraulic systems. ON position of either hydraulic system switch 1 or 2 also activates the ground cooling blower. In the OFF position, power is removed

from the hydraulic pumps. The switches are spring-loaded toggle-type switches and are held in both the ON, OFF positions by detents. Moving the switches from one position to another requires pulling them out of one detent and placing them in the other detent. Left TR power (No. 1) and right TR power (No. 2) is supplied to the switches through circuit breakers marked "Pump Control No. 1, No. 2" on the "Rud/Elev Hydraulic System" portion of the pilot's circuit breaker panel.

Rudder/Elevator Hydraulic System Indicator Lights

Four amber push-to-test indicator lights (5, figure 1-29) located on the hydraulic control panel are available for monitoring the main and auxiliary rudder/elevator hydraulic systems. The lights are decaled "Rud/Elev Main 1 (or 2)" and "Rud/Elev Aux 1 (or 2)" for main rudder/elevator hydraulic systems 1 and 2 and auxiliary rudder/elevator hydraulic systems 1 and 2 respectively. When main hydraulic system switches 1 and 2 are on and the hydraulic system pumps are operating normally, the rud/elev main 1 and 2 lights and the rud/elev aux 1 and 2 lights will be out. If main rudder/elevator hydraulic system pumps 1 and/or 2 fail, their respective lights will illuminate. The aux rudder/elevator lights 1 and/or 2 will remain out indicating that hydraulic pressure is being supplied to systems 1 and/or 2 from the right hand and/or left hand body hydraulic systems. If one or the other aux rudder/elevator lights illuminate, that specific pump has failed. The lights operate on Left TR power through a circuit breaker marked "Pressure Warning Light" on the "Rud/Elev Hydraulic System" portion of the pilot's circuit breaker panel. Whenever a pressure switch senses low pressure, a signal is sent to the light on the hydraulic control panel and, for main hydraulic systems 1 and 2, simultaneously to the master caution light on the pilots' forward instrument panel, illuminating the lights.

NOTE

- Due to system pressure demands when retracting the landing gear and operating stabilizer trim simultaneously, or when throttles are retarded to IDLE and stabilizer trim is actuated, the rudder/elevator auxiliary hydraulic system lights on the hydraulic control panel may blink momentarily.
- The RUD/ELEV AUX 1 and 2 lights receive signals from the same pressure switches as the RUD/ELEV MAIN 1 and 2 lights. When the main pump switches are placed ON and pumps are operating normally all four lights will go out. When main pump switches are OFF, or pumps have failed, the RUD/ELEV AUX lights receive signals from the auxiliary hydraulic system for proper RUD/ELEV AUX light indications. Should a main pump fail the corresponding aux light may come on momentarily, then go out indicating auxiliary system pressure is available.

CARRIER AIRCRAFT AGM-69A HYDRAULIC SYSTEMS

The AGM-69A launcher hydraulic pressure supply system provides hydraulic power for operation of the rotary launcher when the launcher is installed in the bomb bay. The system consists of two similar but independent hydraulic systems. An electric motor-driven hydraulic pump connected to the left body system provides primary hydraulic pressure for normal launcher rotation. Secondary hydraulic

pressure for emergency rotation is provided by the engine number 5 hydraulic pump through a control valve connected to the right body system. Each source of hydraulic pressure is electrically controlled by a three position (ON PRIMARY--OFF--ON RH BODY) toggle switch on the pilot's hydraulic control panel. Placing the AGM-69A launcher switch to the ON PRIMARY position energizes the hydraulic pump relay to provide electrical power to operate the hydraulic launcher power pump. If the launcher power pump fails to supply the required pressure,

the AGM-69A low pressure light will come on. Placing the AGM-69A launcher switch to ON RH BODY energizes and opens an electrically operated control valve to supply secondary hydraulic pressure from the right body hydraulic pressure line. Each AGM-69A hydraulic system contains a pressure, return, and bypass line with quick-disconnect fittings located on the right and left lower longeron for mating with the launcher hydraulic lines (figure 1-28).

Launcher Power Pump

The AGM-69A launcher power pump is the primary source of hydraulic pressure to rotate the launcher and is mounted on the left lower longeron midway in the bomb bay. The launcher power pump receives its fluid supply from the left body hydraulic system return line. The launcher power pump consists of a variable delivery piston type pump powered by a 115/200 volt ac, three-phase, 400 cycle electric motor. The pump is controlled by activating the AGM-69A launcher switch located on the pilot's hydraulic control panel. Placing the switch in the ON PRIMARY position supplies 28 volt dc power from the left TR BUS to energize the hydraulic pump control relay. When energized, this relay closes the three-phase ac circuit from the engine No. 1 generator power box to drive the launcher power pump. The dc circuit breaker is located on the left load central circuit breaker panel and is marked "AGM-69A Hydraulic Control." The ac circuit breakers for the launcher power pump are not accessible in flight.

Secondary Hydraulic Power Supply

A secondary source of hydraulic power to rotate the launcher is provided by a solenoid operated, three-way hydraulic control valve which routes pressure from the right body hydraulic system pressure line to the launcher manifold. Selecting ON RH BODY on the AGM-69A launcher switch located on the pilot's hydraulic control panel supplies 28 volt dc power from the left TR BUS to operate the hydraulic control valve. Circuit breakers are located on the left load central circuit breaker panel. Secondary pressure will be interrupted during operation of either the stabilizer trim system or the bomb door system. During secondary system operation, the ENG 5 (right body) hydraulic pressure gage will indicate available supply pressure.

Launcher Hydraulic Selector Switch

A single toggle switch (6, figure 1-29) on the pilot's hydraulic control panel provides for selection of the launcher power pump or right-hand body hydraulic system pressure to power the rotary launcher. The switch has positions marked ON PRIMARY--OFF--ON RH BODY. With the switch positioned to ON PRIMARY, the AGM-69A hydraulic launcher power pump is powered, and the launcher is operated by this pump. With the switch positioned to ON RH BODY, the power pump is turned off and the launcher operates from the aircraft right-hand body hydraulic system. To preclude interruption of the stabilizer trim system or bomb door operation while operating

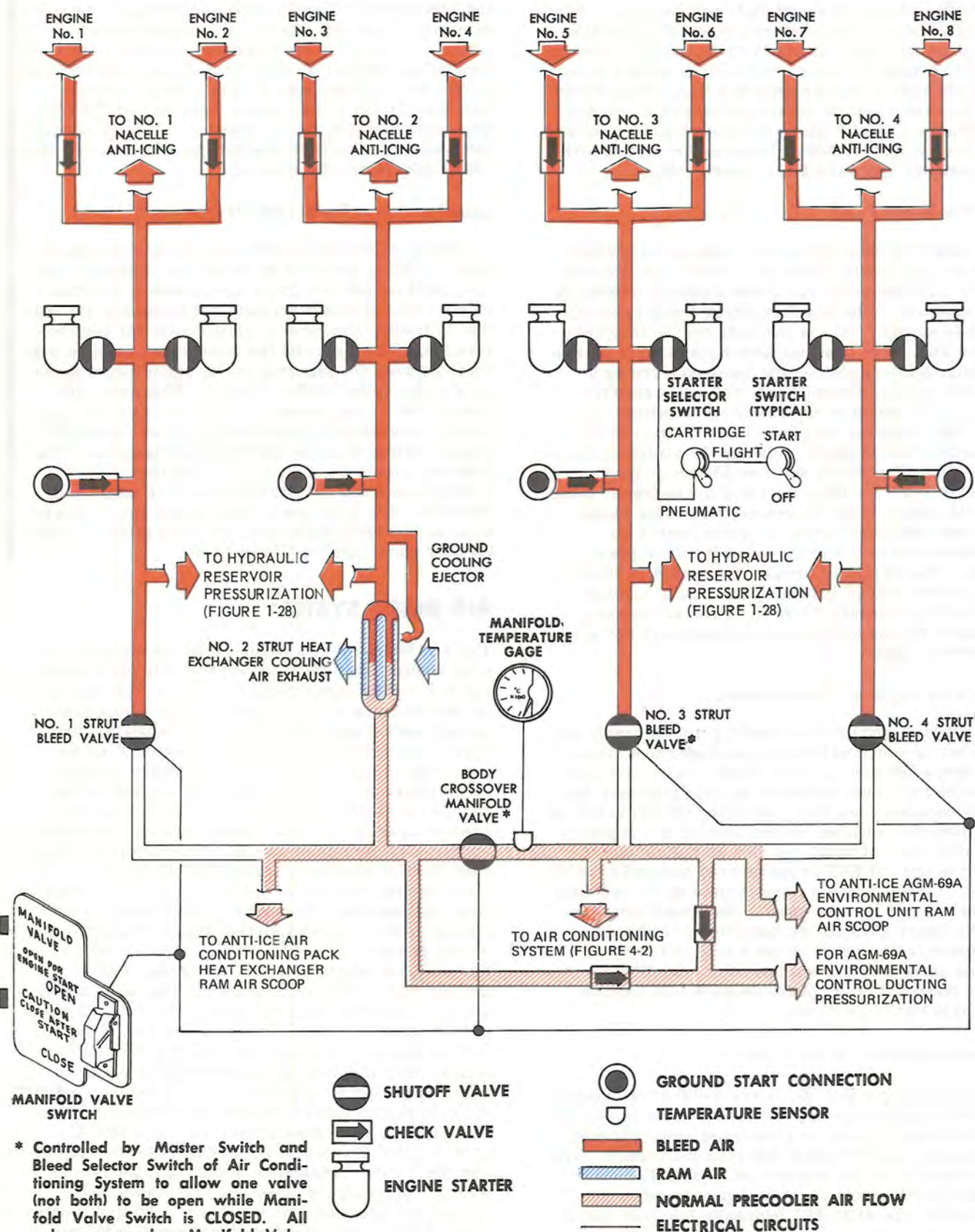
the launcher on the right-hand body system, the secondary launcher control valve is automatically turned off whenever the electrical stabilizer trim buttons are used or an electrical signal is introduced to operate the bomb doors. The control switch is energized by 28 volt dc power from the left TR BUS. The control switch circuit breaker is located on the left load central circuit breaker panel and is marked "AGM-69A Hydraulic Control."

Launcher Power Pump Low Pressure Light

An amber AGM-69A launcher low pressure light (7, figure 1-29) is provided on the pilot's hydraulic control panel to indicate that a low pressure condition exists in the launcher primary hydraulic system and that hydraulic pressure is not adequate for launcher rotation. This light and the master caution light will come on when the launcher power pump output pressure drops below 1300 (± 100) psi. The light will come on for a low pressure condition in the primary system only when the AGM-69A launcher hydraulic control switch is in the ON PRIMARY position. The light will go out when pressure increases to 1500 (± 50) psi or when ON RH BODY or OFF position is selected. The light is energized by 28 volt dc power with the circuit breaker located on the pilot's circuit breaker panel marked "Warn Light."

AIR BLEED SYSTEM

The air bleed system (figure 1-30) incorporates a wing leading edge manifold and controls for collecting and routing high pressure hot air. This air may be obtained either from the final stage compressor of each operating engine or from an auxiliary air source applied to a ground start connection on the underside of each nacelle. The air bleed system is the power source for engine starting and the air source for heating, cooling, and pressurizing the crew compartment. The system is designed so that normal airflow is from the No. 2 nacelle through a ram air heat exchanger (precooler) in the No. 2 strut into the distribution ducting in the wing leading edge and fuselage. A constantly operating ejector system assures coolant airflow through the precooler during ground operations. In the event of failure of the bleed air supply from No. 2 nacelle, either through duct failure or shutdown of engines 3 and 4, emergency airflow may be obtained from No. 3 nacelle by placing the bleed selector switch, (figure 4-3) on the aisle stand, in the EMERG RH INBD position. This air does not pass through a strut mounted precooler and therefore may directly subject the distribution ducting and the air conditioning system to bleed air temperatures of 232° to 399° C (450° to 750° F), depending on engine thrust settings and OAT. The distribution ducting and the routing it follows, particularly along the wing leading edge, are not designed for safe operation at temperatures above 246° C (475° F) when the aircraft is below 25,000 feet. Above 25,000 feet with low OAT conditions, adequate cabin heating may not be available with the bleed selector switch in the NORMAL LH INBD position. This is caused by overcooling of the



Air Bleed System

Figure 1-30.

bleed air by the precooler, with the result that the bleed air temperature may not be high enough to permit adequate cabin heating. In order to minimize this problem, the following instructions apply:

- At altitudes below 25,000 feet, place bleed selector switch in NORMAL LH INBD position.
- At altitudes of 25,000 feet or above, the bleed selector switch may be placed in EMERG RH INBD position.

WARNING

When EMERG RH INBD is selected below 25,000 feet, the manifold temperature gage must be monitored closely since the bleed air is not precooled by a heat exchanger and the duct temperatures will be dependent on engine thrust settings, altitude, and OAT. Since the bleed air is not precooled, the distribution ducting may be subjected to temperatures up to 399° C (750° F) creating a potentially hazardous condition if fuel vapors are present in the wing leading edge and because of excessive temperatures at all of the hot air duct outlets. When the aircraft is below 25,000 feet, an explosive condition can exist in the wing by possible auto-ignition of accumulated fuel vapor in the duct area when the temperatures are above 246° C (475° F). Above 25,000 feet, this explosive condition no longer exists due to the high auto-ignition temperature of fuel vapor at high altitude. A hazardous condition exists at all altitudes at the hot air outlets when combustible materials are stored on or close to the hot air duct outlets. If EMERG RH INBD must be selected, see "Air Bleed System Emergency Operation," Section III, for control of air bleed manifold temperatures.

- The AGM-69A missile environmental control system receives engine bleed air (figure 1-30) from the body manifold for regulated pressurization of the environmental air distribution ducting. Right manifold bleed air is supplied to a valve for anti-icing control of the AGM-69A ram air scoop in the right wing leading edge. For further information on environmental control system and anti-icing, refer to T.O. 1B-52G-30-2.

MANIFOLD VALVE SWITCH

The OPEN--CLOSE manifold valve switch (4, figure 1-11), guarded to the CLOSE position, is located on the copilot's side panel. OPEN position, used primarily for engine starting, provides for airflow from any engine to any other engine by supplying 118-volt single-phase ac to open the motor-driven body crossover manifold and No. 3 strut bleed valves, and TR power to open the normally closed solenoid-operated No. 1 and 4 strut bleed valves. In OPEN position, air conditioning system control of the body crossover manifold and No. 3 strut bleed valves is discontinued. This results in hot bleed air being interconnected between all engines through the body crossover manifold. The guarded CLOSE position restores 118-volt single-phase ac to the air conditioning system controls for management of bleed air source selection and removes TR power from the solenoid-operated No. 1 and 4 strut bleed valves which resume their normally closed positions.

MANIFOLD TEMPERATURE GAGE

The manifold temperature gage (2, figure 1-11) on the copilot's side panel indicates the temperature from 0° to 300° C in the air bleed manifold. The gage is electrically operated by TR power through the "Manifold Air Temp" circuit breaker on the right load central circuit breaker panel through a temperature sensor bulb in the manifold at the air conditioning duct leadoff. See figure 5-1 for gage markings.

FLIGHT CONTROL SYSTEMS

Primary flight control of the aircraft is accomplished by three basic systems; the elevator, rudder, and lateral control systems. The elevators and rudder are moved by hydraulically powered systems. See "Powered Rudder/Elevator System," this section. Lateral control is accomplished by spoilers which are part of a spoiler and airbrake control system. Ailerons are not installed on the aircraft.

RUDDER SYSTEM

(Also see "Powered Rudder/Elevator System," this section).

Directional control and trim are achieved with the rudder system.

Rudder Pedals

The rudder pedals are conventional and are adjustable fore and aft by levers on the inboard side of each pedal. A vertical hinge incorporated into each pedal allows the pedals to be individually folded aft to provide additional leg room.

Rudder Artificial Feel

Rudder feel and centering is provided by a rudder Q-spring in the cable system. This device consists of two bellows chambers attached to fuselage structure. Ram air from the leading edge of the fin enters the two chambers and exerts a pressure directly proportional to indicated airspeed; this pressure exerts a force on a cable which is attached to a Q-spring arm on the rudder torque tube. Tension in the cable tends to keep the Q-spring arm centered, thereby also centering the rudder control system. It also adds a resistance to pilot control force, thus simulating airloads on a conventional rudder system.

Rudder Trim

A ball bearing screw actuator, which is extended or retracted by a cable system attached to the rudder trim knob, moves the rudder torque tube to a new position relative to the Q-spring lever and provides rudder trim. The Q-spring tends to maintain the torque tube in the neutral position as set by adjust-

ment of the trim knob. Movement of the rudder pedals in flight rotates the torque tube causing displacement of the Q-spring lever; however, when use of rudder is discontinued, Q-spring force returns the torque tube to the neutral position. Use of rudder trim will displace the entire rudder control system including the rudder pedals. This displacement moves the rudder by mechanical command input to the rudder actuator.

RUDDER TRIM KNOB AND INDICATOR. The rudder trim knob (20, figure 1-13) on the aisle stand is the only control provided for rudder trim. Rotation of the knob actuates the trim screw and repositions the rudder torque tube to a new neutral trim which is maintained by the Q-spring. The indicator is a mechanical indicator calibrated in units of trim up to a maximum of 12 units nose left and 12 nose right.

ELEVATOR SYSTEM

(Also see "Powered Rudder/Elevator System," this section.)

The control columns transmit control movements through separate control column disconnect mechanisms to the respective right and left forward control cable quadrant, where a pair of cables joins them into a single system. A force switch assembly is contained in each of the control rods located between the control column transverse shaft bellcranks and the forward elevator control quadrants. These switches, although having no effect on the elevator system, provide the pilots with a means of quickly terminating unscheduled stabilizer trim movements that may result from stabilizer or autopilot system

malfunction (except stabilizer trim reversal). For further information on force switch operation, see "Force Switches" under "Stabilizer Trim System," this section. Either or both control columns may be manually disconnected from the cable system and stowed forward against the instrument panel. A connection is provided between the disconnect linkage and the seat ejection system so that the column will be automatically disconnected and stowed during the seat ejection cycle.

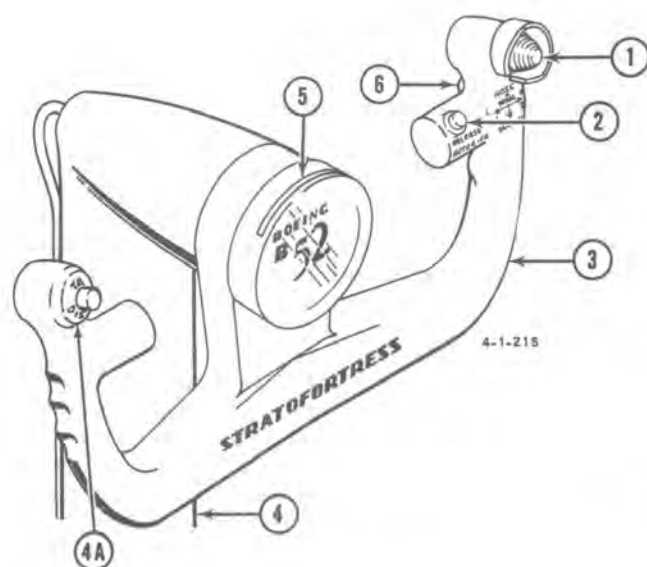
Elevator Artificial Feel

Elevator feel and centering is provided by an elevator Q-spring in the cable system. The Q-spring consists of a single bellows chamber attached to the structure operating in conjunction with a preloaded mechanical spring to provide control centering force in the low speed range. Operation of the elevator control system in either direction from neutral is immediately opposed by the resistance of the Q-spring and the mechanical spring. The mechanical spring provides supplemental artificial feel and a positive

control column neutral position. Pilot effort required to maneuver the aircraft is increased at low airspeeds (providing trim stimulus) and decreased at high airspeeds (providing improved maneuvering capabilities) with positive centering at all airspeeds (increasing trim stability). In the event that Q-spring pressure is lost, this additional spring tension on the elevator system will provide partial feel. Conventional elevator trim is not provided; pitch trim is accomplished by hydraulically moving the entire stabilizer.

Control Columns and Disconnect Levers

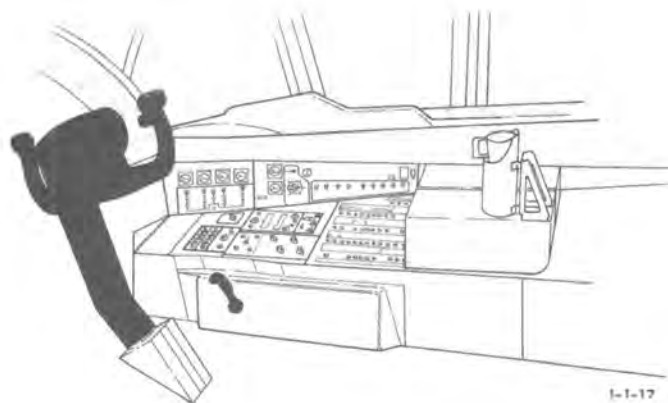
Conventional pilot's and copilot's control columns (4, figure 1-31) are provided which can be manually disconnected from the elevator system by pushing forward and downward on control column disconnect levers (7, figure 1-31). These levers are located near each pilot's outboard armrest and below their respective side panels. When disconnecting a control column, grasp the control wheel, push down on the disconnect lever, and assist the control column into its



NOTE

COPLOT'S CONTROL COLUMN
AND DISCONNECT LEVER
SHOWN — PILOT'S OPPOSITE

1. STABILIZER AND LATERAL TRIM BUTTON
2. AUTOPILOT AND AIR REFUELING (IFR) BOOM RELEASE BUTTON
3. CONTROL WHEEL
4. CONTROL COLUMN
- 4A. EVS NFOV SELECT SWITCH
5. FLIGHT DATA CARDHOLDER
6. INTERPHONE-MIKE TRIGGER SWITCH
7. DISCONNECT LEVER



Control Column and Disconnect Lever

Figure 1-31.

stowed position since the columns tend to remain in position when manually disconnected. Reconnection of control columns after depressing disconnect lever is dependent on column being cycled through stowed detent or disconnect lever being pulled up before being reconnected.

WARNING

Whenever either control column is disengaged and subsequently reengaged in flight, positive engagement will be confirmed by holding the other column rigid near neutral while applying a push/pull force to the column being engaged. This may be accomplished with the autopilot operating provided care is taken not to displace either column sufficiently to cause force switch disengagement.

NOTE

After ejection sequence has been initiated, control column can be reengaged by pulling disengage lever up as far as possible and holding until the control column is pulled aft and engagement occurs.

WARNING

When the column has been reengaged after ejection sequence has been initiated, the column must be manually stowed for subsequent ejection.

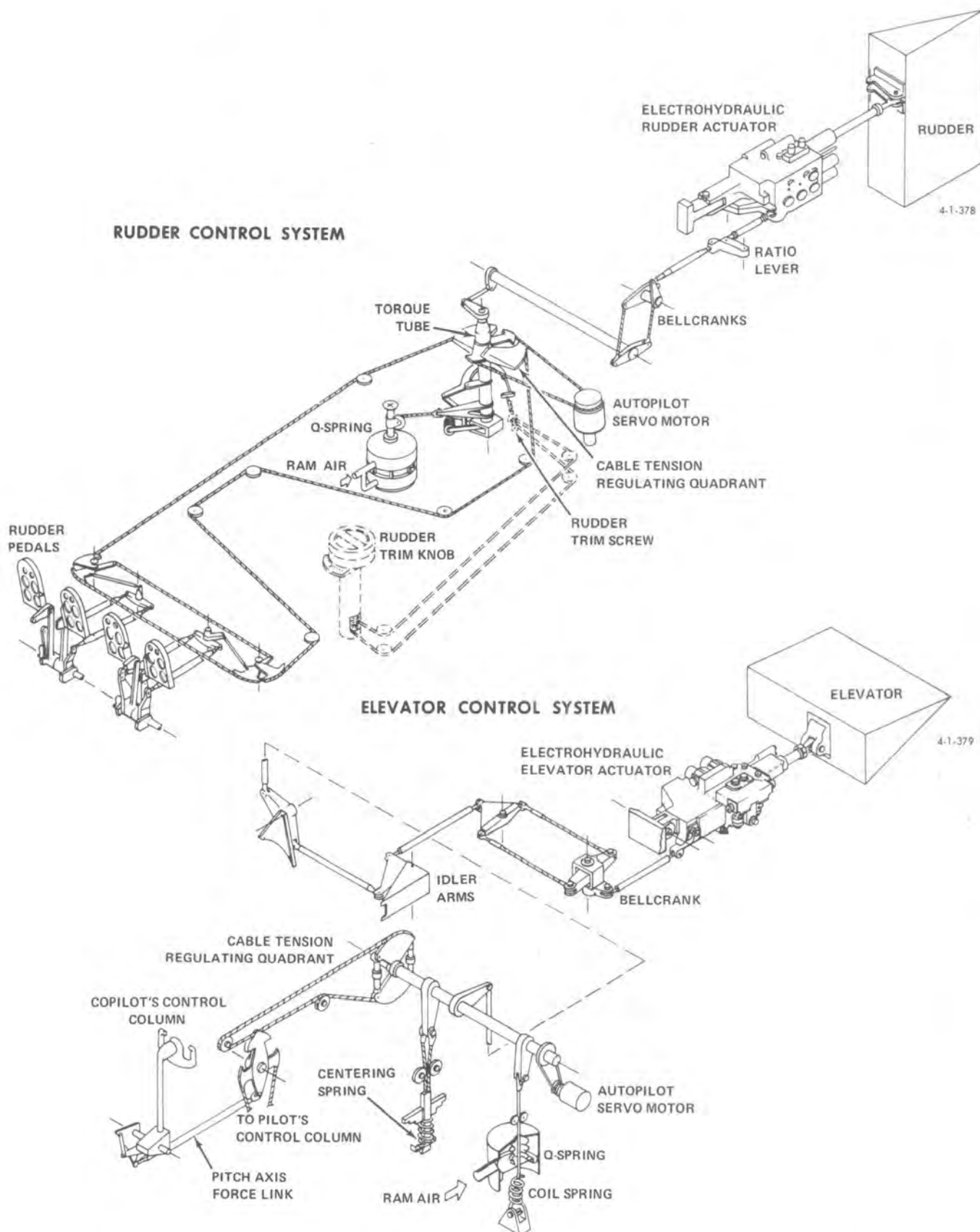
POWERED RUDDER/ELEVATOR SYSTEM

A hydraulically powered rudder/elevator system (figure 1-31A) is installed in the aircraft in conjunction with a yaw and pitch stability augmentation system (SAS) which provides dutch roll damping, reduced structural loads, and controllability in turbulence. For further information on the SAS, see "Stability

Augmentation System," Section IV. Any commands applied to the rudder hydraulic actuator by the autopilot are applied in parallel (i.e., the rudder pedals are displaced when the rudder is displaced.) SAS commands applied to the rudder hydraulic actuator are applied in series with pilot inputs (i.e., the rudder pedals do not reflect rudder movement due to SAS inputs.) The maximum rudder deflection is limited to $\pm 19^\circ$ for mechanical control inputs and $\pm 10^\circ$ for SAS inputs. Two elevator actuators are incorporated in the pitch axis control system to provide an irreversible actuation system. The elevator actuators position the elevators in response to mechanical control inputs transmitted to each actuator from the control column or autopilot pitch axis and by electrical signals transmitted to each actuator from the SAS. Autopilot commands are applied to the actuators in parallel with pilot inputs (i.e., the control column is displaced when the elevators are displaced). SAS commands are applied to the actuators in series with pilot inputs (i.e., the control column does not reflect elevator movement due to SAS inputs). The maximum elevator deflection is $\pm 19^\circ$ for mechanical control inputs and approximately $\pm 5^\circ$ for SAS inputs. For further information on component parts of the powered rudder/elevator system, see "Hydraulic Power Supply Systems," this section. For further information on the electronic portion of the powered rudder/elevator system, see "Stability Augmentation System," Section IV.

Rudder and Elevator Actuators

The rudder is powered by a single actuator while the elevator is powered by two actuators (one each for the right and left surfaces, operating independently of one another, figure 1-31A). The rudder and elevator actuators are dual tandem type units with each of the two cylinders utilizing power from one of the two rudder/elevator hydraulic systems. The actuators position the rudder and elevators in response to pilot and/or electrical input commands. Each of the actuators also incorporate two "load limit" devices, one per piston and cylinder assembly, to permit control surface "blow down" to preclude inadvertent structural damage due to the added power of the system. It should be noted that the stability augmentation system and mechanical command ability is fully



■■■■■■■■■■ Powered Rudder/Elevator System

Figure 1-31A.

operational in the event of one complete hydraulic system failure. The only degradation in performance noted is a lower "blow down" speed, which decreases authority in some flight conditions. This is due to the fact that only half power is available. Snubbing is provided in the last three degrees of rudder and elevator travel. Each actuator package consists of two shutoff valves, four filters, and two position transducers. Each rudder and elevator actuator also employs two electrohydraulic control valves. These electrohydraulic flow control valves are controlled by electrical inputs. Each unit meters hydraulic fluid flow to an auxiliary servo actuator in response to an electrical signal. For further information, see "Stability Augmentation System," Section IV.

STABILIZER TRIM SYSTEM

Pitch trim of the aircraft is provided by the stabilizer trim system (figure 1-32). The leading edge of the stabilizer is raised and lowered by a jackscrew driven by two hydraulic motors. One of the motors drives the screw and the other drives the nut. The motor driving the screw is supplied with pressure from the right body hydraulic system while the left body hydraulic system supplies the motor driving the nut. The hydraulic pressure to the motors is metered by valves which are controlled by the cable system or a parallel electric trim control system through a followup system. The mechanical followup system automatically returns the metering valves to the closed position when the stabilizer reaches the position called for by the cable system, the electric trim control system, or the autopilot. When engaged, the autopilot provides stabilizer trim through the followup system. An alternate source of hydraulic pressure for the upper hydraulic motor (which drives the screw) is furnished by the right body standby pump. No standby pump is provided for the lower hydraulic motor (which drives the nut). Stabilizer speed is approximately four units every 10 seconds with both left and right body hydraulic systems operating and engines at idle and six units every 10 seconds with engines operating at 82% rpm and above. When operated only on standby pressure, this speed is reduced to approximately one unit every 10 seconds. Trim position creeping, due to airloads on the stabilizer when the hydraulic system is unpressurized, is prevented by a hydraulically released brake on each hydraulic motor drive. This brake is completely released when hydraulic pressure is above 1000 psi. The electrical input into the followup system is equivalent to approximately seven units of stabilizer travel every 10 seconds. Pitch trim is not

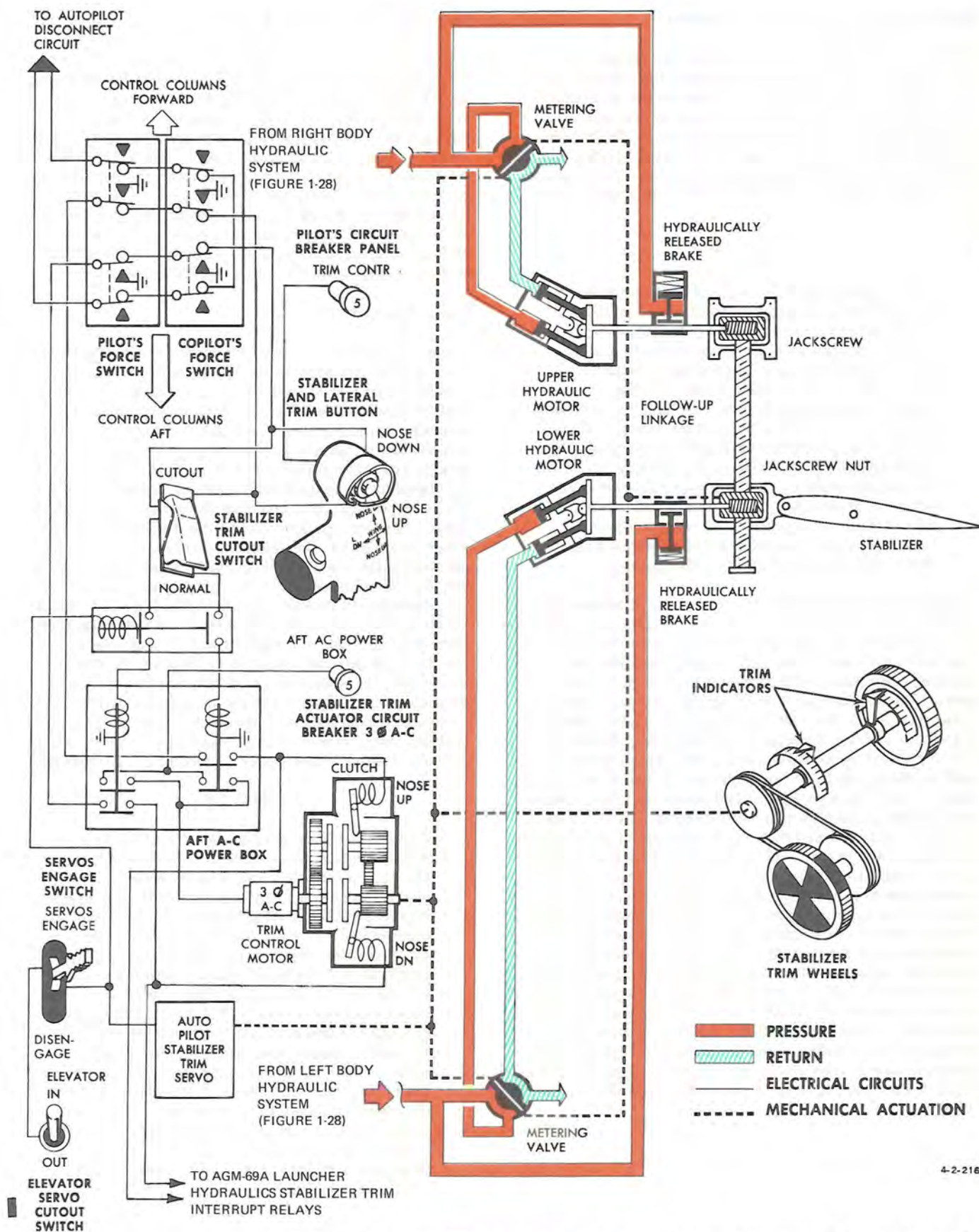
automatically adjusted when the wing flaps are raised and lowered. An automatically operated heating element is installed in each followup screw to prevent icing of the screw threads. For operating limitations of the stabilizer trim system, see "System Limitations", Section V. AGM-69A launcher operation in the secondary mode places a high demand on the right body hydraulics system. To insure a continuous hydraulic supply for bomb door operation and/or for stabilizer trim screw operation, trim change electrical inputs in both the noseup and nose-down directions are paralleled to AGM-69A hydraulic interrupt relays. Operation of either interrupt relay will result in interruption of the launcher hydraulic drive for the duration of the trim change and/or bomb door operation.

NOTE

If heater elements are not installed or are inoperative, the stabilizer trim system may become inoperative under certain conditions of temperature and humidity. This inoperative condition could be caused by frost or ice buildup on the followup screws which may jam the screws and prevent stabilizer operation either manually or electrically until the frost or ice is melted. Operation without heaters after cold soak at altitude may result in a reduced operation rate electrically and sponginess in the operation of the manual trim wheel.

Stabilizer Trim Wheels and Indicators

Manual control of the stabilizer trim metering valve is provided by rotation of the stabilizer trim wheels (10, figure 1-13) on the aisle stand. The pilot's trim wheel is attached to the throttle shaft and operates through a chain sprocket linkage to move a trim indicator located forward and inboard of the wheel. The copilot's trim wheel and trim indicator are located opposite to the pilot's trim indicator. The indicators are calibrated in units of stabilizer leading edge movement from nine units "Aircraft Nose Dn" to four units "Aircraft Nose Up" with one unit equaling 1 degree of stabilizer travel. Any trim accomplished using the electric trim control system will feed back through the cable system rotating the manual trim wheels and indicators. The manual trim wheels can be used to override the electric trim control system or autopilot trim system. The trim wheel face and periphery is painted in alternate black and white segments as a visual aid and reminder when the electric trim control system is being used.



Stabilizer Trim System (Typical)

Figure 1-32.

Stabilizer and Lateral Trim Buttons

Stabilizer and lateral trim buttons (1, figure 1-31) are located on the outboard grips of the pilots' control wheels. Guards are provided on the wheels at the stabilizer trim switch housings to prevent inadvertent actuation of the trim switches. To initiate electrical control of the stabilizer trim, either the NOSE UP or NOSE DN position is used. The buttons are spring-loaded to an unmarked center OFF position.

NOTE

The spring-loaded feature of the stabilizer trim switch should not be relied on to return the switch to neutral. The pilot should manually return the switch to neutral with a positive thumb movement each time it is used. To aid in recognizing a malfunctioning electrical trim system before reaching an extreme out-of-trim condition, the trim switch will be actuated in short intermittent bursts when used during flight. Due to the possibility of the switch sticking, care should also be taken to avoid inadvertent actuation of the switch when flying on autopilot. A runaway trim condition would result if a trim switch was stuck and the autopilot was disengaged.

Actuation of the stabilizer trim button produces the following visible results: 1) nose up trim moves the trim indicator aft toward "Aircraft Nose Up," the manual trim wheel rotates aft, and the stabilizer leading edge moves down; and conversely 2) nose down trim moves the trim indicator forward toward "Aircraft Nose Dn," the manual trim wheel rotates forward, and the stabilizer leading edge moves up. Moving a button to either trim position closes a circuit to supply left TR power to one of two power relays. These relays will switch 205-volt three-phase a-c power to operate the trim control motor. The trim control circuit breaker is marked "Trim Contr" and is located on the "Miscellaneous" portion of the pilot's circuit breaker panel. Positioning a button to a trim position will also supply TR power to the respective nose up or nose down clutch solenoid in the trim actuator. The stabilizer trim function of the stabilizer and lateral trim buttons is inoperative when the autopilot elevator servo cutout switch is positioned to IN and the autopilot servos engage switch is positioned to ENGAGE. This is accomplished by electrically disconnecting the control circuits between the trim buttons and the actuator clutches and power relays. For operating limitations of the stabilizer trim system, see "System Limitations," Section V.

Stabilizer Trim Cutout Switch

A guarded CUTOFF--NORMAL stabilizer trim cutout switch (9, figure 1-13) on the aisle stand is provided to disconnect the d-c control circuits between the trim buttons and the clutch solenoids in the trim actuator and between the trim buttons and the a-c power relays. When this switch is in CUTOFF (guard up) position, the circuits are broken and the stabilizer trim cannot be operated electrically. For normal electrical control of stabilizer trim, this switch must be in NORMAL (guard down) position. Manual control of stabilizer trim is not affected by the cutout switch in either CUTOFF or NORMAL position.

Force Switches

Force switches are installed within the control column linkage to provide the pilots with an effective means of immediate interruption of unscheduled stabilizer trim movement (except for stabilizer trim reversal as noted below). A pilot's natural reaction in responding to an aircraft pitch movement with an opposing control column force is utilized. When such an opposing force on either control column reaches 24 to 36 pounds, two microswitches are actuated to open. One switch disengages the autopilot and the other deactivates the stabilizer trim in the unscheduled direction only. Electrically controlled trim opposing the unscheduled trim movement continues to be available by means of trim buttons unless deactivated by the trim cutout switch or circuit breakers. Note that as control column force is reduced below the 24 to 36 pounds required to actuate the microswitches, the switches close and restore any unscheduled stabilizer trim not originally caused by the autopilot which will not reengage. For further information, see "Force Switch Operation" under "Flight Control System Emergency Operation," Section III.

NOTE

Certain malfunctions within the aircraft electrical system can create a condition wherein the stabilizer trim motor may drive in the opposite direction to the input signal commanded by the stabilizer trim button. In the event of such stabilizer trim motor reversal, the pilot's natural reaction in responding to an aircraft pitch movement with an opposing control column force will not interrupt driving of the reversed trim motor. The force switches interrupt the power to the trim motor clutch on the side opposite that required for proper trim direction. In the reversed motor situation, the correct clutch is engaged but the direction of rotation is reversed. Stabilizer trim reversal can be interrupted by repositioning the trim button to neutral or by actuating the stabilizer trim cutout switch to the CUTOFF position.

LATERAL CONTROL SYSTEM

Lateral control of the aircraft is provided by the spoiler, spoiler trim, and airbrake control system. Rotation of the control wheels actuates hydraulically operated spoilers located on the upper surface of each wing just aft of the rear spar. Raising the spoilers interrupts the flow of air over the wing, causing a reduction in lift and an increase in drag. Information on the operation of the lateral control system is presented under "Spoiler and Airbrake System," this section.

Control Wheels

Dual control wheels (3, figure 1-31) are provided for the pilots. Each wheel has, on its outboard handgrip, a stabilizer and lateral trim button, an autopilot and air refueling (IFR) boom release button, and an interphone-mike trigger switch. Each wheel has, on

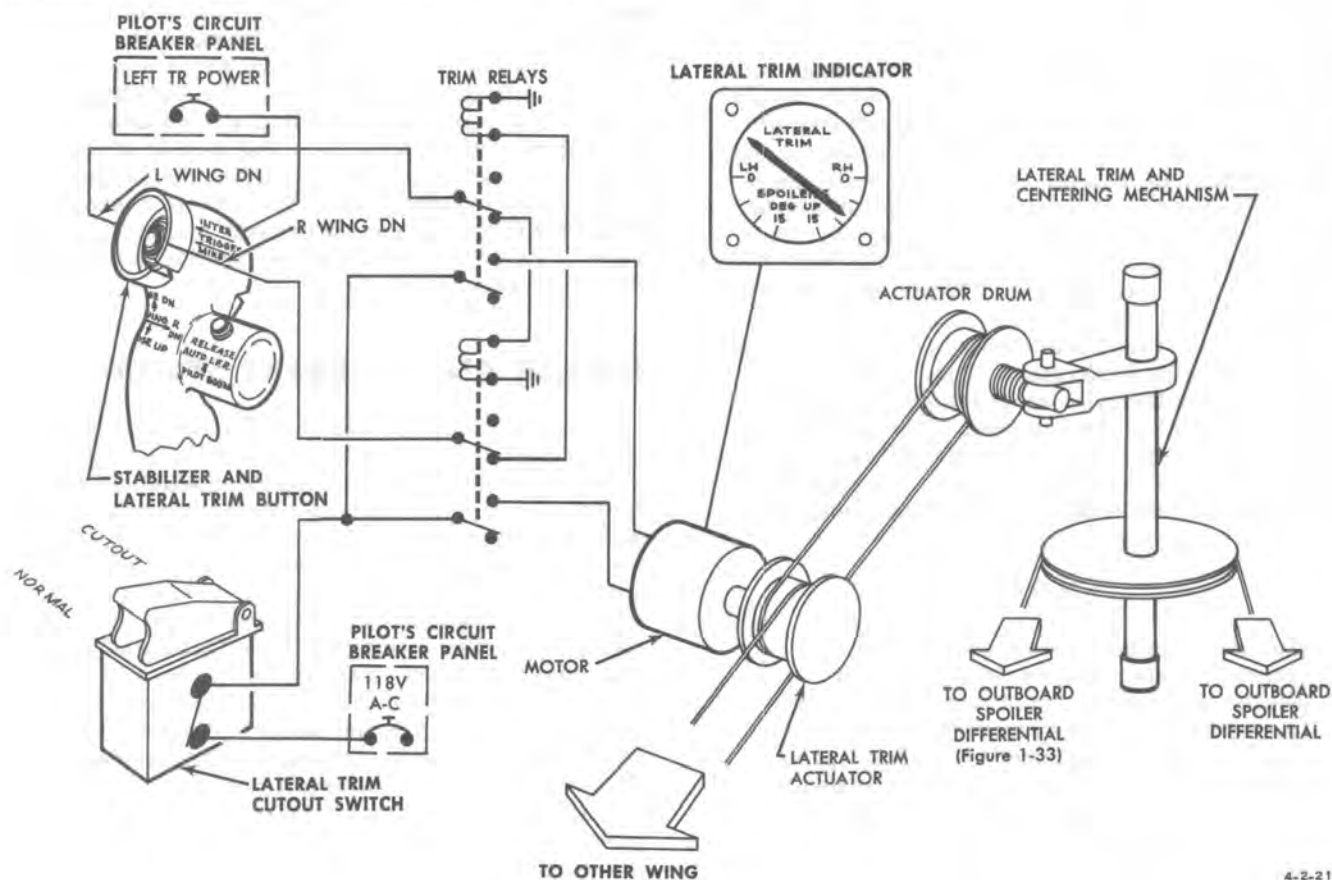
its inboard handgrip, an EVS NFOV (narrow field of view) select switch. A flight data card can be placed in a slot (5, figure 1-31) in front of the medallion on the pilot's and copilot's control wheels.

NOTE

The control wheels are not disconnected from the lateral controls when the control columns are disconnected.

LATERAL TRIM SYSTEM

An electrically controlled lateral trim system (figure 1-33) provides a means of obtaining lateral trim (lateral control neutral position). Lateral trim buttons on the control wheels control a single centrally loca-



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Lateral Trim System

Figure 1-33.

ted electrical trim actuator which is cable-connected to an actuator drum on the spoiler centering mechanism in each wing. Rotation of the actuator drum re-locates the neutral position for each centering mechanism which in turn tends to hold the entire lateral control system in a new position. Maximum displacement of the neutral position is equivalent to approximately 20° of rotation to left and right of the zero control wheel position. Limit switches which are incorporated within the electrical trim actuator prevent the actuator from exceeding its maximum allowable travel. The effect of lateral trim will be modified as airbrakes are applied, making readjustment of lateral trim necessary.

Stabilizer and Lateral Trim Buttons

Lateral trim control is provided by a stabilizer and lateral trim button (1, figure 1-31) on the outboard handgrip of each control wheel. These buttons have L WING DN--R WING DN--NOSE DOWN--NOSE UP--OFF positions and are spring-loaded to OFF position. Only the first two positions and the unmarked center OFF position affect the lateral trim. The other two trim positions control stabilizer trim. When moved sideways to the L WING DN or R WING DN position, the buttons close contacts to supply TR power to one of two lateral trim relays. This relay, when energized, will close contacts to supply 118-volt single-phase a-c power to the lateral trim actuator. The lateral trim circuit breaker is marked "Lateral Trim Actuator" and is located on the "Miscellaneous" portion of the pilot's circuit breaker panel. The d-c control circuit to each trim relay is closed only when the other relay is deenergized; thus, when one pilot is trimming the lateral control system, the other pilot's trim circuit is disconnected. The trim buttons energize either the stabilizer or the lateral trim circuits but not both at the same time. The stabilizer trim function of the buttons is described under "Stabilizer Trim System," this section.

NOTE

Use of a trim button does not position the control wheels. Lateral trim is accomplished by coordination of trim button actuation with control wheel movement. As lateral trim is accomplished, centering spring loads are relieved when a neutral position is established for the lateral control centering mechanism of each wing. The neutral trim position, as provided by rotation of the lateral trim actuator drum, will allow the aircraft lateral attitude to remain as positioned by the control wheels after a stable trimmed condition has been established.

Lateral Trim Cutout Switch

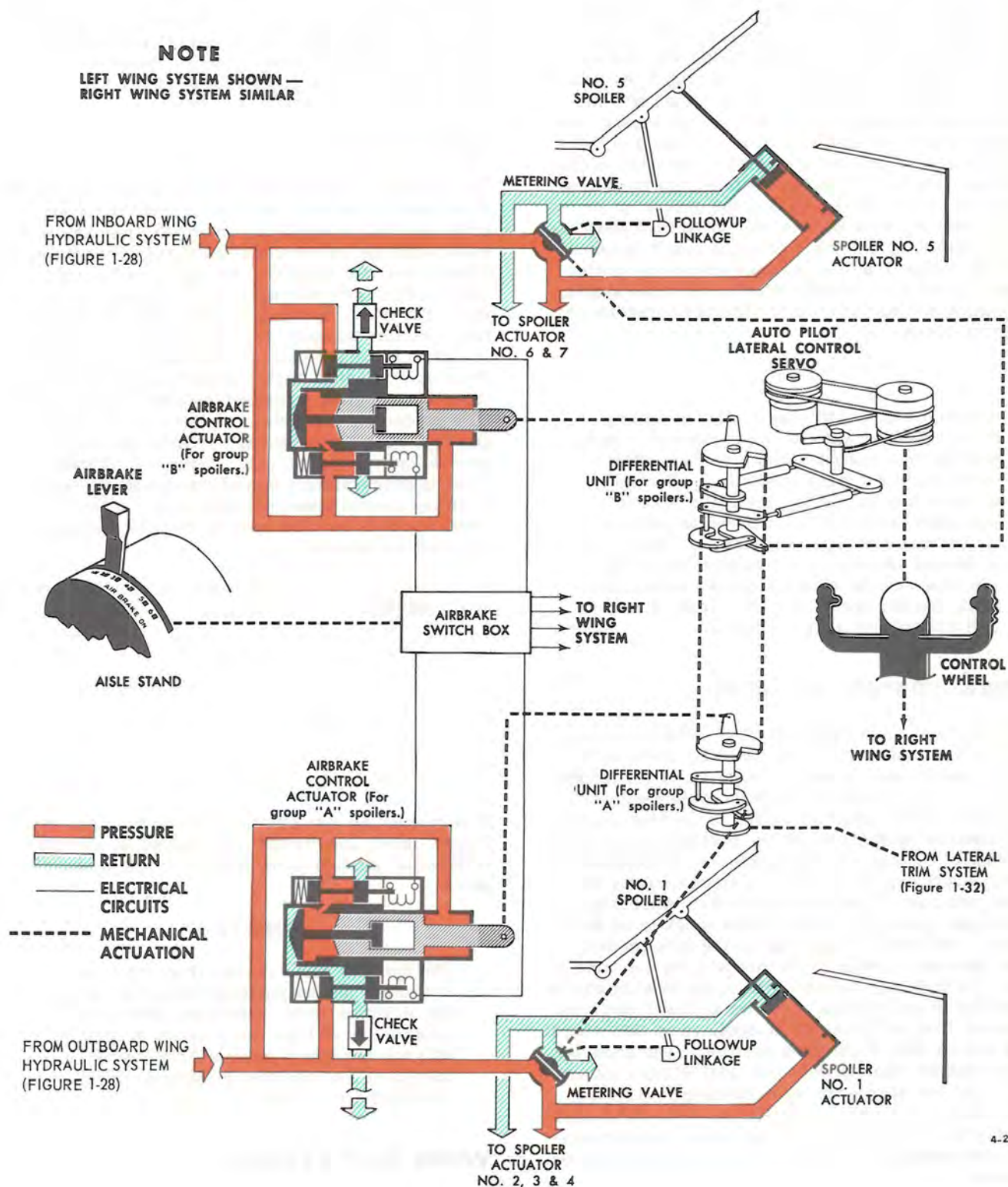
The 118-volt single-phase a-c circuit for the lateral trim actuator can be disconnected by actuating a CUTOUT--NORMAL guarded switch (8, figure 1-13) on the left side of the aisle stand. When the switch is in CUTOUT (guard up) position, the circuit is broken and lateral trim is inoperative. This switch must be in NORMAL (guard down) position before lateral trim can be accomplished.

Lateral Trim Indicator

A single lateral trim indicator (54, figure 1-15) is located on the forward instrument panel in front of the pilot. The indicator provides an indication of input trim which is comparative with spoiler position. Spoiler position does not necessarily correspond to indicated trim which is electrically positioned by the lateral trim actuator shaft. As much as 3° of trim indication may be necessary to compensate for tolerances in the lateral control system. The indicator is calibrated in degrees of spoiler position from 0° to 15° spoiler up with a separate scale for left and right spoilers. The indicator pointer is a single needle pointed at both ends and will indicate on either scale. The pointer is electrically connected to a position transmitter on the lateral trim actuator shaft. The indicator utilizes TR power through a circuit breaker marked "Lateral Trim" on the "Flight Indicators" portion of the pilot's circuit breaker panel.

SPOILER AND AIRBRAKE SYSTEM

Lateral control and airbrake action are provided by a spoiler and airbrake system (figure 1-34). Each wing is provided with seven spoilers which perform a dual function. When the control wheel is rotated, the spoilers are actuated to provide lateral control. In addition, when the airbrake lever is actuated, the spoilers are raised symmetrically to act as airbrakes. The spoilers are numbered from left to right, No. 1 thru 7 being on the left wing and 8 thru 14 on the right wing. Each of the 14 spoilers has a separate hydraulic actuator. On each wing, the four outboard spoilers are mechanically linked to operate as a unit and are called group A. The three inboard spoilers are also mechanically linked to operate as a unit and are called group B. Group A spoilers are powered by the outboard wing hydraulic system (hydraulic pumps on engines 1 and 7); group B spoilers are powered by the inboard wing hydraulic system (hydraulic pumps on engines 3 and 6). Hydraulic pressure is metered by four metering valves, one for each group of spoilers. The four metering valves



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Spoiler and Airbrake System

Figure 1-34.

are controlled through four differential mechanisms, one for each valve, which allow the metering valves to be operated by either airbrake control, lateral control (including lateral trim), or both simultaneously. When lateral control and airbrake control mechanisms are used simultaneously, the differential mechanisms in one wing will be moved the total amount called for by both control systems and the spoilers will respond to the total control signal. At the same time, the differential mechanisms in the opposite wing will receive control movements in the opposite direction. The net result is that the output movement of the differentials is the difference between opposing input signals; the spoilers respond to the difference in the two. This will result in cancellation of airbrake action in cases where the spoiler signal equals or is greater than the airbrake signal, permitting the lateral control system to override the airbrake system.

NOTE

Above 250 knots IAS, the spoiler actuators do not have sufficient force to raise the spoilers full up. Adequate roll control is still available under these conditions. Because of this force limitation, the roll response with wheel position is not the same with airbrakes up as with zero airbrakes. In the area of spoiler blowdown, a dead area exists but, when the control wheel is rotated beyond this area, spoiler control will be regained and roll control will still be obtained.

LATERAL CONTROL ACTUATION

Spoiler action for lateral control is initiated by control wheel rotation which mechanically opens hydraulic metering valves to supply pressure to the spoiler actuators. A mechanical followup system automatically returns the metering valves to the closed position when the spoilers reach the position called for by the control wheels or by the autopilot, if engaged. The spoilers are full up (60°) at approximately 80° of wheel rotation. Rotation of the control wheels will cause both metering valves in both wings to be displaced. All spoilers will rise on the wing toward which the control wheel is turned and, at the same time, the metering valves in the opposite wing will be displaced in the opposite direction to lower spoilers. This will have no effect on the spoilers on this wing if they are already in the down position. The metering valves permit this control movement without bottoming. Two overtravel spring cartridges located in each wing allow continued operation of the remainder of the system should a metering valve, followup system, differential mechanism, or trim mechanism be jammed.

AIRBRAKE ACTUATION

Use of the spoilers as airbrakes is controlled by an airbrake lever which electrically controls solenoid valves in airbrake control actuators at each spoiler

differential unit. The airbrake control actuators reset the spoiler differential units to open the spoiler metering valves. The metering valves are opened in pairs so that the outboard spoilers move as a unit and the inboard spoilers move as a unit, providing symmetrical airbrake action. Control for the airbrakes is available on emergency battery power.

AIRBRAKE LEVER

The airbrake lever (2, figure 1-13) on the pilot's side of the aisle stand operates six contacts in the airbrake switch box supplying emergency battery power to the solenoid valves at the hydraulic control units. These units mechanically open the metering valves which direct hydraulic pressure to actuate the spoilers. The lever has an OFF position and six operating positions marked 1--2--3--4--5--6. Detents are provided at OFF and at positions 2, 4, and 6. Position 1, marked "AR," is used primarily for air refueling and gives increased roll rate authority. OFF position of the airbrake lever deenergizes the airbrake control circuits and permits the spoilers to provide lateral control only. When the airbrake lever is progressively moved through its full range (with the control wheel in neutral), the outboard spoiler and the inboard spoilers will be operated alternately as follows:

LEVER POSITION	OUTBOARD SPOILERS	INBOARD SPOILERS
OFF	0°	0°
1	10°	0°
2	10°	20°
3	40°	20°
4	40°	40°
5	50°	40°
6	50°	60°

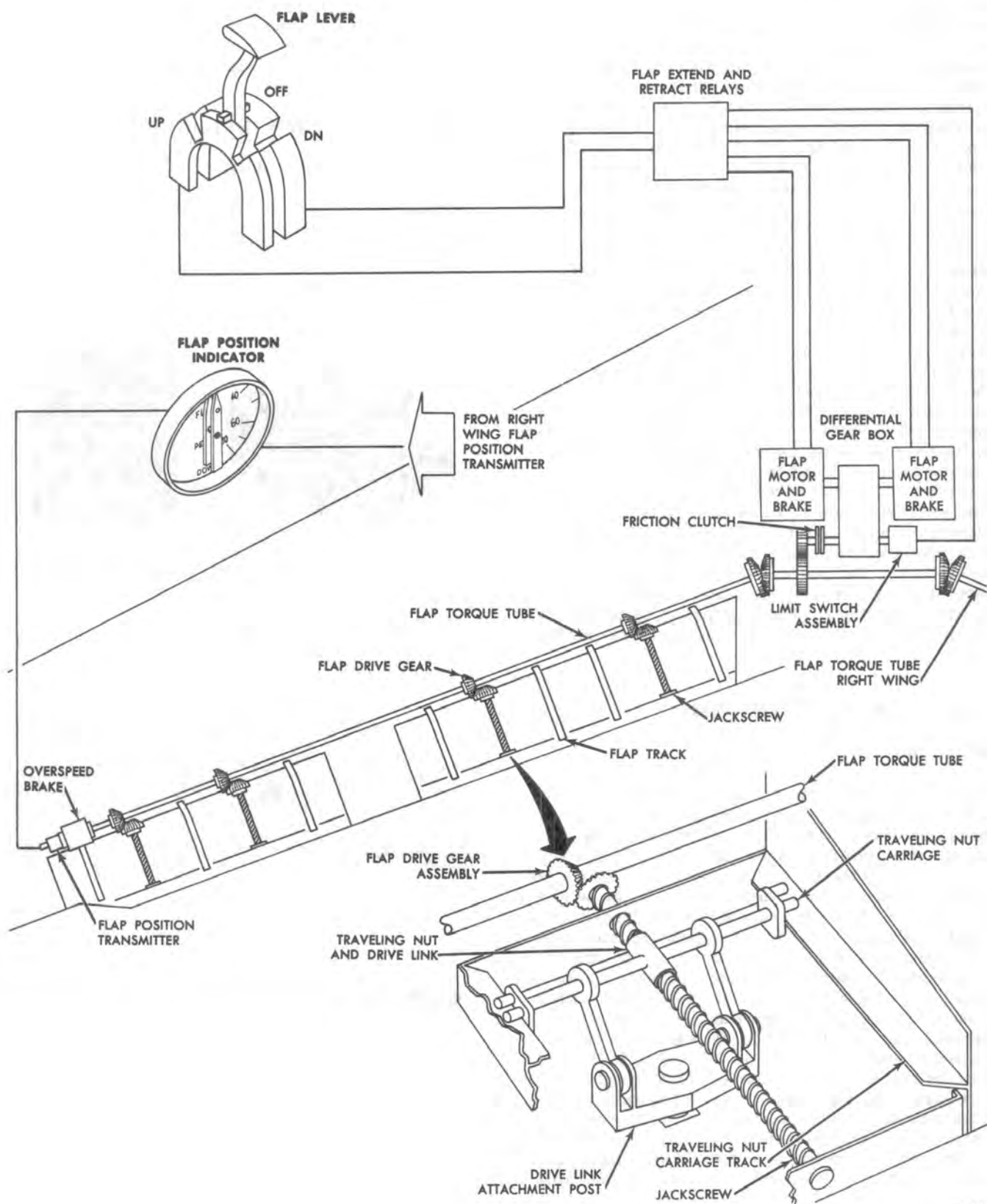
Two controlling circuit breakers marked "Air Brake Contr" "Inbd" and "Outbd" are located on the "Miscellaneous" portion of the pilot's circuit breaker panel.

NOTE

The spoilers move rapidly from one position to another as new positions are selected by the airbrake lever. Gradually moving the airbrake lever from one position to another will not result in a reduced rate of spoiler movement nor can they be stopped in any intermediate position.

WING FLAP SYSTEM

The wing flap system includes four separate wing flap sections. The flaps are of the Fowler type with high lift-drag ratio resulting in shortened takeoffs and reduced landing speeds. All four flap sections are simultaneously driven by a single power unit located in



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Wing Flap System

Figure 1-35.

the fuselage aft of the center section rear spar (figure 1-35). The power unit consists of two 205-volt three-phase a-c motors joined by differential gearing. Each motor is provided with an electrically released brake which will be released only when the motor is energized and putting out torque. A flap torque tube driven by the power unit extends out each wing on the aft side of the rear spar. This torque tube drives two jackscrews in each flap section to extend or retract flaps. During the first 37 1/2% of extension, the flaps rotate downward 35° with little rearward movement. For the remainder of the extension, the flaps move rearward only. Most of the drag increase occurs during the first 20% of the flap motion. This initial 20% rotates the flaps down 29° in approximately 12 seconds, leaving only 6° of rotation in the remaining 80% of flap extension. The flaps are electrically controlled by a single flap lever. No emergency control system is provided for the flaps; however, should one of the two motors in the power unit be rendered inoperative, the remaining motor will extend or retract the flaps in approximately 120 seconds. An overspeed brake mechanism located at the outboard end of each flap torque tube functions automatically to modulate rate of flap movement in case of excessive rpm of the flap drive. Such excessive rpm would be induced by the slipstream acting to "drive" a flap section or sections which had been rendered "free" because of a broken torque tube. The overspeed brake limits the movement to a rate that will not cause damage to the free section or sections. For information on the aerodynamic characteristics of the wing flaps, see Section VI.

WING FLAP SYSTEM CONTROLS

Wing Flap Lever

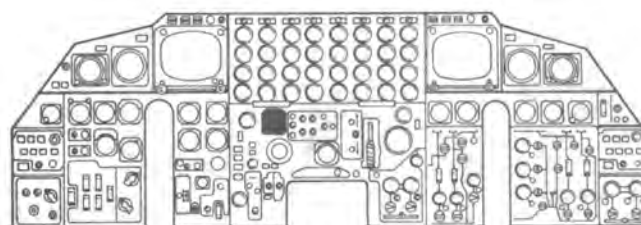
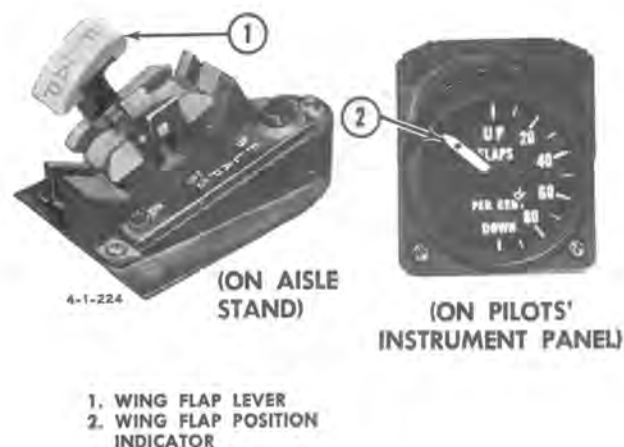
Control of the wing flaps is accomplished by moving a lever (1, figure 1-36) with an airfoil-type knob on a detent quadrant located on the right side of the aisle stand. This lever provides UP--OFF--DN positions with detents at the UP and DN positions. This lever must be pulled up out of detent before it can be moved from either UP or DN position. An OFF position is located on either side of a spring-loaded latch-type stop which is in the middle of the detent quadrant. Depressing the latch toward the flap lever allows the flap lever to be moved from OFF position on either side of the latch to the opposite detent. When the lever is placed in the UP or DN position, a circuit is closed to supply TR power to left and right flap extend or retract relays. These relays introduce 205-volt three-phase a-c power to operate both flap motors simultaneously, causing the flaps to extend or retract fully in approximately 60 seconds. Two flap control circuit breakers marked "Wing Flaps Control," "Left," and "Right" are located on the "Mis-

cellaneous" portion of the pilot's circuit breaker panel. Limit switches provide protection for both extension and retraction operations. When the lever is in OFF position, the circuits are deenergized and the wing flaps are held in their last position.

WING FLAP SYSTEM INDICATORS

Wing Flap Position Indicator

A dual wing flap position indicator (2, figure 1-36) is provided on the pilots' instrument panel. This indicator reads from 0% to 100% of wing flap travel. The indicator transmitters, which are controlled by TR



Wing Flap System Controls

Figure 1-36.

power, are located in the overspeed brakes on the outboard ends of each torque tube. A position circuit breaker for the transmitter circuit marked "Flap Pos" is located on the "Flight Indicators" portion of the pilot's circuit breaker panel. The dual indicating system is provided to show any difference in position of the left and right wing flap sections such as would result from a broken flap torque tube. The top needle in the indicator has a hole in it, is marked "R," and indicates the position of the right wing flaps. The bottom needle is marked "L" and indicates the position of the left flaps.

Wing Flaps Up Warning Signal

The wing flaps up warning signal is sounded by the landing gear warning horn. The signal will sound only when the aircraft is on the ground, throttles for engines 3 and 5 or 4 and 6 are at or beyond approximately 88% rpm, and flaps are not fully extended. The horn is actuated by a series circuit energized by TR power through the horn, throttles for engines 3 and 5 or 4 and 6, a landing gear squat switch, and through the flap warning horn switch. Engines 1, 2, 7, and 8 are not included in this circuit. A landing gear and flaps warning horn circuit breaker marked "Pos & Flaps Warn Horn" is located on the "Landing Gear" portion of the pilot's circuit breaker panel. When the flaps warning horn is energized, a signal is also sent to the master caution light to cause it to illuminate. See "Master Caution Light" under "Emergency Equipment," this section, for additional information.

LANDING GEAR SYSTEM

The landing gear system is a composite of the main landing gear system and the tip gear system. The dual wheel main landing gear are in a quadricycle arrangement with two side-by-side forward and two side-by-side rear. The left forward and left rear gear retract forward into fuselage wheel wells while the right forward and right rear gear retract aft into fuselage wheel wells. The tip gear are located between the outboard engine strut and the external tank strut and retract inboard and slightly forward into each wing. The function of the tip gear is to prevent damage to the wingtips during abnormal ground maneuvers and/or high gross weight conditions. Normally the tip gear tires contact the ground only under maximum weight conditions. All landing gear are hydraulically actuated through electrically operated valves. Retraction and extension of each landing gear is accomplished by its hydraulic actuator with pressure supplied from the right and left body hydraulic systems. A single mechanical lock on the main landing gear drag strut locks the main landing gear in either the extended or the retracted position.

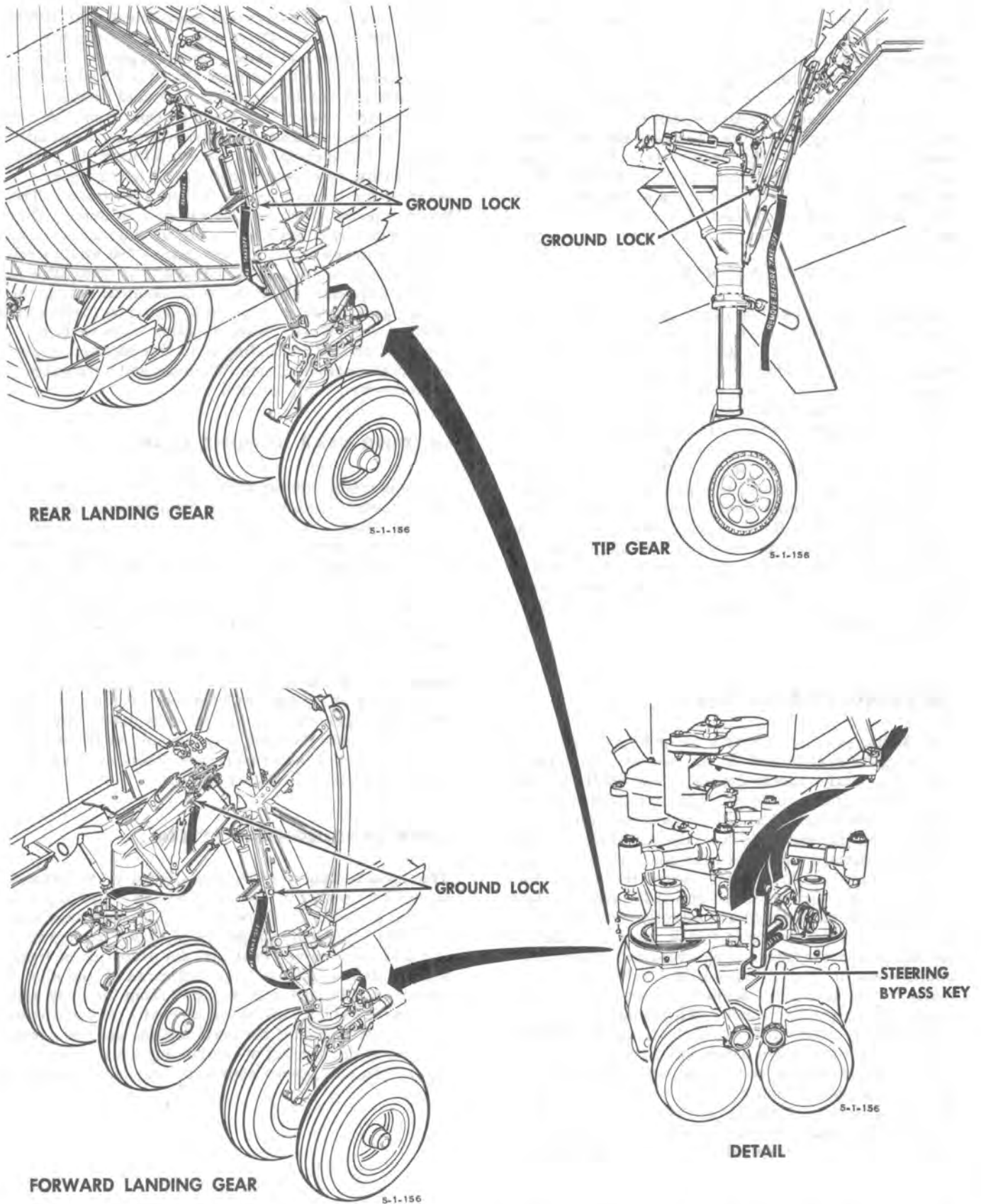
Oleo safety switches prevent inadvertent gear retraction on the ground. There are no provisions for overriding these switches in an emergency. The landing gear is fully retracted in 10 to 15 seconds or extended in 15 to 20 seconds. For cold weather retraction time, see "Cold Weather Operation," Section IX. The main landing gear doors are mechanically linked to the main landing gear and follow the cycle of operation selected by the normal landing gear lever or the landing gear emergency switches. The tip gear doors, however, are in two sections. The strut section is connected to the tip gear and follows the cycle of operation for the gear. The wheel well section is hydraulically actuated and is controlled for proper sequence operation by mechanical linkage in the tip gear system. For information on landing gear brakes, see "Wheel Brake System," this section. For information on landing gear steering and crosswind crab operation, see "Steering and Crosswind Crab System," this section.

LANDING GEAR GROUND LOCKS

Three pairs of landing gear ground locks (figure 1-37) prevent retraction of the landing gear on the ground. Each ground lock is a pin-type lock with a red warning streamer attached. The tip gear locks are the smallest of the two types. The front main gear locks have the ground lockpin on one end of the streamer and a two-pin steering valve bypass key on the other end. Most rear main gear also have bypass key facilities for use by maintenance when towing from the rear is required. The ground lockpins are inserted in each main landing gear drag strut and each tip gear side brace. The locks are stowed in "Landing Gear Lock" containers which are located beneath the BNS power supply modules rack in the aft end of the crew compartment on the left side of the aircraft (figure 4-63).

MAIN LANDING GEAR SYSTEM

The main landing gear system (figure 1-38) utilizes power for operation from the left and right body hydraulic systems which receive main pump pressure from the engine-driven pumps installed on engines 4 and 5 respectively. Pressure for actuation of front and aft landing gear which are located on one side of the aircraft is normally supplied from the body system on that same side of the aircraft. Normal extension or retraction of the main landing gear is accomplished by positioning of the landing gear control lever. An emergency source of pressure is provided



■■■■■■■■■■ Landing Gear Ground Locks (Typical)

which allows separate control of the landing gear by individual switches. Emergency pressure is provided by connecting the pressure sources of the body systems to solenoid-operated control valves which are installed on the opposite side of the aircraft. Each main landing gear may be actuated by either of two solenoid-operated control valves, one of which is supplied with normal system pressure and the other with emergency system pressure. Although separate switches are used for emergency actuation, the emergency system pressure sources of the left front and aft landing gear are the same as the normal system pressure sources of the right front and aft landing gear. Similarly, the emergency system pressure sources of the right front and aft landing gear are the same as the normal system pressure sources of the left front and aft landing gear. Each of the body systems is equipped with an electric standby pump which is energized by a separate standby pump switch. Standby pump pressure may be supplied as an alternate source of normal system pressure when the engine-driven pumps are not operating or not providing sufficient normal pressure. Standby pump pressure may be used for actuating the front or aft pair of landing gears separately from the other pair when the engine-driven pumps are not operating. Due to the location of a check valve, pressure from the left body system standby pump is not supplied to the aft landing gear. Similarly, pressure is not supplied to the forward gear from the right body system standby pump. When the landing gear control lever is positioned, pressure from the left body system standby pump will actuate the forward landing gear through the left normal pressure control valve and the right emergency pressure control valve; pressure from the right body system standby pump will actuate the rear landing gear through the right normal pressure control valve and the left emergency pressure control valve. The normal gear up circuit supplies power to the crosswind crab centering motor through centering switches to insure centering of the main landing gear prior to retraction. This circuit also includes oleo safety switches which prevent inadvertent retraction when either the left front or right rear main landing gear is on the ground and the oleo strut is compressed more than 0.75 inch. A gear up lock switch deenergizes the circuits when the gear is up and locked. After being unlocked by hydraulic pressure, the landing gear will free fall almost to the down and locked position; therefore, a position switch is included in the circuit. This switch keeps the circuit energized until landing gear reaches the full down and locked position. The emergency gear up circuits include oleo safety switches to prevent retraction when either the right front or left rear main landing gear are on the ground. Actuation of emergency landing gear switches does not automatically center the landing gear. Each landing gear emergency retract or extend circuit remains energized until the individual emergency switches are placed in OFF position.

LANDING GEAR OLEO SAFETY SWITCHES

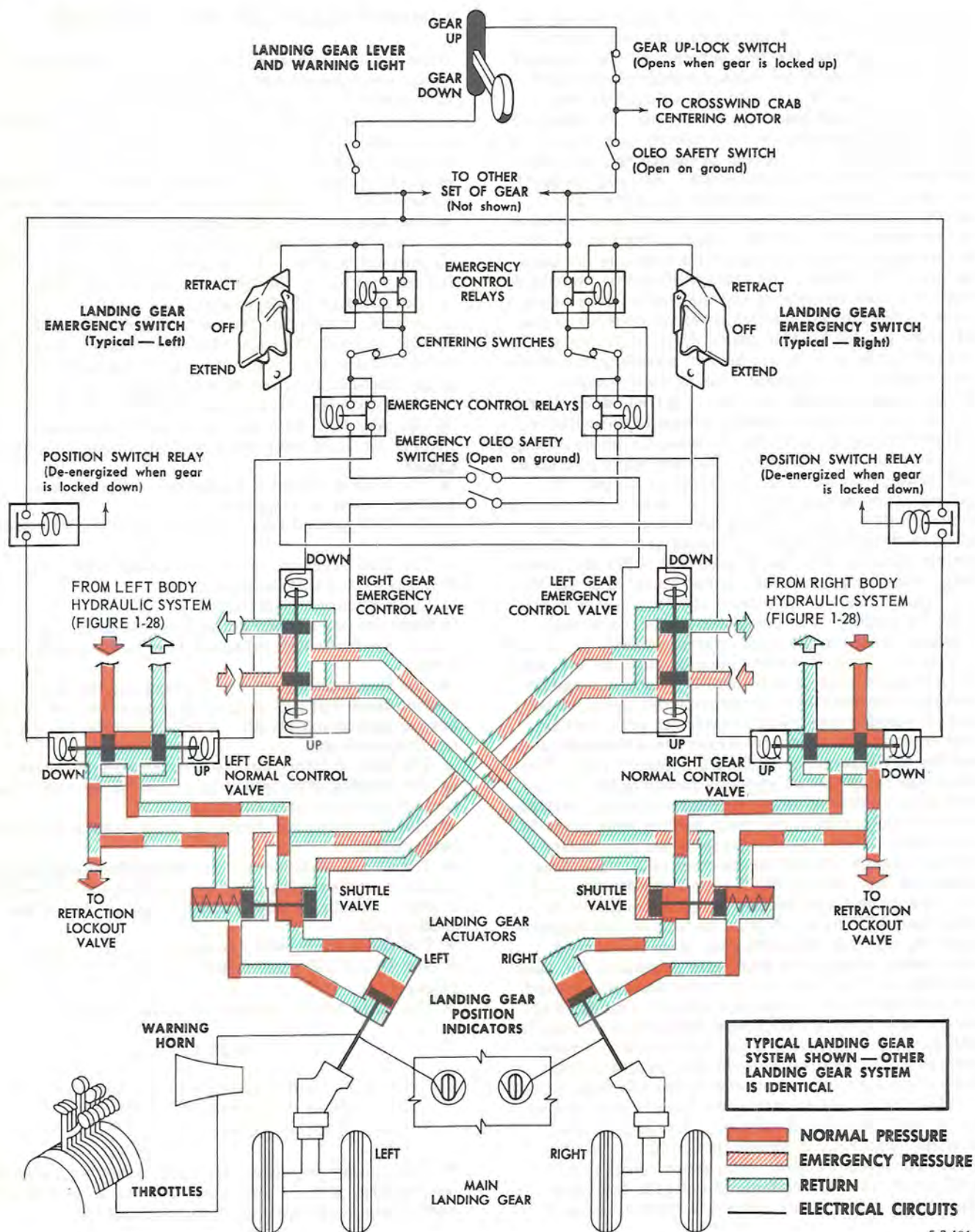
When the aircraft is on the ground, the landing gear struts are compressed actuating the oleo safety switches. The oleo safety switches are also actuated in flight when the gear is extended and crabbed to an angle equal to or exceeding 14° through any combination of crosswind crab setting and rudder pedal movement. The following systems are affected by actuation of the landing gear oleo safety switches.

- The anti-ice airscoop heater for the rudder and elevator Q-spring inlet and the air conditioning scoop lip anti-ice shutoff valve will not be energized, causing ice to form on the lip under icing conditions.
- The AN/ALE-20 flare ejection circuit will become de-armed, preventing flares from being ejected.
- The AN/ALE-25 rocket firing circuits will become de-armed and the rocket pod jettison circuits will become inoperative, preventing rockets from being fired or pods from being jettisoned.
- The AN/ARC-58 radio will receive additional cooling air from the ground cooling system blowers **W181**.
- The rudder/elevator hydraulic system ground cooling blower will operate.
- The BNS ground cooling system blowers will operate.
- The BNS overheat system automatic shutdown thermal switch will become armed.
- Cabin pressure will dump.
- High pressure bleed air is directed to the oil cooler ejector which induces a flow of air through the cooler.
- The flap warning horn will sound and the master caution light will illuminate if the throttles are at or beyond approximately 45° of travel and the flaps are not fully extended.
- The ground interphone panels become operative.
- The landing gear cannot be retracted by either the normal or emergency controls.
- The strike camera heater control system becomes inoperative.
- The antiskid valves will be deenergized and application of brakes prior to landing will result in locked brakes. Normal braking may be applied during the landing roll.
- The flight loads data recorder will not record.
- The EVS FLIR window anti-icing system becomes inoperative.
- The ECM heater system becomes inoperative.

NOTE

When the landing gear oleos are extended after takeoff, the operation of the above systems will be reversed.

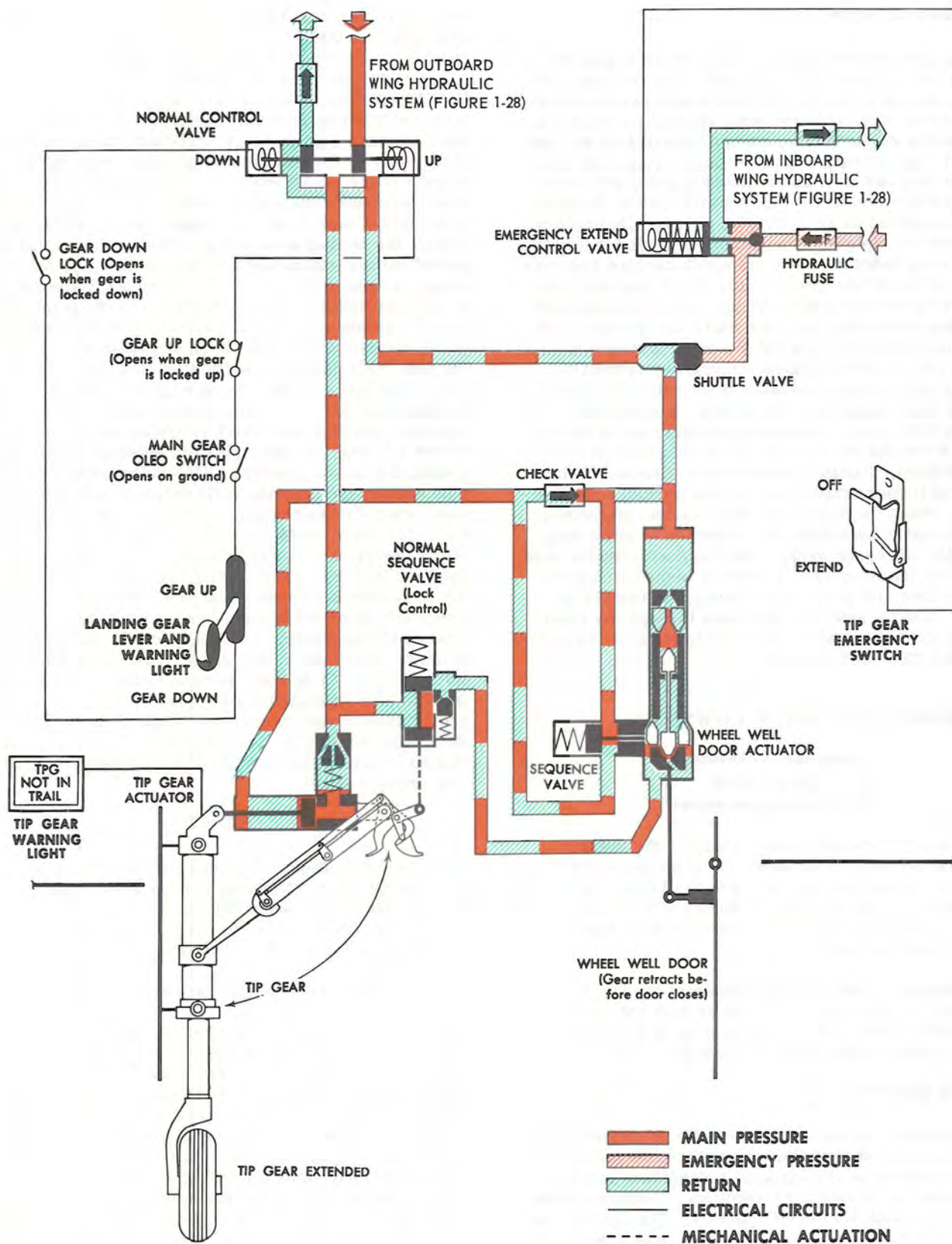
- If the safety switches have been cycled by a takeoff and landing, Mode 4 codes will zeroize if the Mode 4 code switch is not placed in HOLD position.



5-2-164

Main Landing Gear System (Typical)

Figure 1-38.



5-2-167

Tip Gear System (Typical)

Figure 1-39.

TIP GEAR SYSTEM

The tip gear system (figure 1-39) for each gear receives normal hydraulic pressure from the outboard wing hydraulic system. Normal system pressure to the left and right outboard wing hydraulic systems is supplied by engine-driven pumps installed on engines 1 and 7 respectively. Each outboard wing hydraulic system includes an electric standby pump which provides an alternate source of normal system pressure when energized by an individual switch. Emergency pressure for tip gear extension is provided by the inboard wing hydraulic systems which receive pressure from engine-driven pumps installed on engines 3 and 6. Emergency tip gear extension is accomplished by actuating individual switches which are grouped with the emergency switches for the main landing gear. There are no provisions for emergency retraction. The tip gear system operates in an indirect manner. In gear down operation, the normal landing gear lever actuates switches which energize the down circuit. When the solenoid in the normal control valve is energized, hydraulic pressure is directed to the wheel well door actuator and to the normal sequence valve. When the wheel well door opens, mechanical linkage opens the normal sequence valve permitting hydraulic pressure to enter the tip gear actuator thus extending the tip gear. A reverse sequence insures proper door and gear timing during the retraction cycle. The tip gear circuits pass through the main landing gear oleo safety switches to prevent inadvertent retraction on the ground.

LANDING GEAR SYSTEM CONTROLS

CAUTION

- During retraction or extension of the landing gear by either the normal or emergency system, do not change the position of the control handle or the emergency switch while the gear is in motion since this procedure may rupture a hydraulic line.
- During retraction or extension of the landing gear by one system, do not actuate the other system while the gear is in motion since this procedure may rupture a hydraulic line.

Landing Gear Lever

A landing gear lever (4, figure 1-40) is located on the pilots' instrument panel ahead of the aisle stand. The lever handle is in the shape of a miniature landing gear wheel to facilitate recognition. Positions of the lever are GEAR UP--GEAR DOWN. The landing gear lever is held by a spring-loaded pawl and a detent on the inside end of the lever making it necessary to pull out on the handle approximately 1/4 inch to move the

lever from one position to the other. In changing positions of the landing gear lever, the pawl travels the lever quadrant surface which has detents at each end for engaging the pawl in the GEAR UP or GEAR DOWN position. The quadrant has a safety stop at a midpoint position between the detents. The safety stop provides a positive GEAR DOWN latched position if the pawl on the landing gear control lever fails to remain in the GEAR DOWN position detent. The lever quadrant with visible detents at each end is located on the face of the instrument panel and, in addition, the landing gear control lever, which must be pulled out approximately 1/2 inch in changing positions, is held in GEAR UP and GEAR DOWN positions by an overcenter spring. Movement of the lever actuates a group of switches which control the solenoids of the control valves and the first motion of the landing gear hydraulic actuator will unlock the locks for gear actuation in either the up or down position. The landing gear lever is mechanically linked to a steering ratio selector unit which prevents movement to GEAR UP until the steering ratio selector lever is in TAKEOFF LAND position. This mechanical linkage also adjusts the steering ratio selector unit to zero ratio when the landing gear lever is moved to GEAR UP. The GEAR DOWN position of the landing gear lever energizes the landing light and crosswind landing light circuits. The landing gear lever controls TR power for all warning and indicator systems and essential power for normal landing gear control including the tip gears. Landing gear circuit breakers marked "Left Fwd," "Right Aft," and "Left Tip" are located on the "Ldg Gear Normal Control" portion of the left load central circuit breaker panel. Landing gear circuit breakers marked "Right Fwd," "Left Aft," and "Right Tip" are located on the "Ldg Gear Normal Control" portion of the right load central circuit breaker panel.

NOTE

The effort required to operate the landing gear lever is increased if the rudder pedals are not in neutral. This increase in operating effort is caused by the requirement to displace the steering system.

Landing Gear Emergency Switches

There are six guarded switches (1, figure 1-40) on the left side of the pilots' instrument panel which are used for emergency actuation of the landing gear. Four switches, one for each main landing gear, have EXTEND--OFF--RETRACT positions. The other two switches, one for each tip gear, have only EXTEND--OFF positions since there are no emergency retraction provisions for the tip gear. The switch guards are spring-loaded and are designed to return the switches from other positions to the OFF position when the guards are closed. The emergency switches control forward direct battery power for the left forward and right aft main landing gear and aft direct

tion itself so that trapped hydraulic fluid is returned to the reservoir. With normal pressure relieved, the emergency pressure will reposition the shuttle valve allowing emergency pressure to actuate the main gears. The tip gear emergency extend system will override the normal system hydraulically provided a normal system retract signal is not present. Actuation of the emergency landing gear switches does not automatically center the landing gear. The normal landing gear retract and extend circuits are deenergized by a lock switch when the landing gears are actuated to either extreme position. Emergency retract and extend circuits are energized until the emergency switches are returned to OFF position. Due to actuation of the main landing gear oleo squat switches by the weight of the aircraft, either the normal or the emergency retract circuits cannot be energized for retraction when the aircraft is on the ground. Landing gear actuation is provided by individual emergency switches when certain gear have failed to actuate after placing the main landing gear control lever in the desired position. Emergency control circuit breakers marked "Left - Tip, Fwd and Aft" and "Right - Fwd, Aft and Tip" are located on the "Landing Gear" portion of the pilot's circuit breaker panel.

LANDING GEAR SYSTEM INDICATORS

Landing Gear Position Indicators

Six tab-window type landing gear position indicators (2, figure 1-40) in the lower center of the pilots' instrument panel indicate landing gear position. Each tab indicator has three visual indicators to register landing gear position. When the landing gear is up and locked, the word UP appears in the tab window. A gear in an intermediate position or when there is no d-c power on the aircraft is indicated by slanting alternate black and ivory stripes. The appearance of a wheel symbol indicates a gear down and locked. The indicators operate on TR power on aircraft **W173** **W249** and right essential power on aircraft **W250**. A circuit breaker for the position indicators marked "Pos Ind" is located on the "Landing Gear" portion of the pilot's circuit breaker panel.

Landing Gear (and Lever Position) Warning Light

A light red landing gear warning light (3, figure 1-40) in the end of the landing gear lever warns of incorrect landing gear position. When gear actuation is taking place and the landing gear position does not agree with the landing gear lever position, the landing gear warning horn is blowing, or when the landing gear lever is not in the detent, the red light in the landing gear lever illuminates. As soon as the landing gear is locked in the selected position, the red light goes out provided the warning horn is not blowing. The warning light circuit is deenergized to allow the warning light to go out when the landing gear lever pawl, which is retracted by a control lever spring, is fully seated in the lever quadrant detents.

A landing gear warning light test button (5, figure 1-40) is located near the landing gear lever on the instrument panel. The landing gear warning light will be illuminated when this button is depressed. A circuit breaker which provides right essential d-c power for the landing gear warning light marked "SW & Pos Warn" is located on the "Landing Gear" portion of the pilot's circuit breaker panel.

NOTE

Flight at high indicated airspeeds and Mach numbers may produce enough wing twist to cause the tip protection gear doors to gap open. This will cause the landing gear warning light to go on and cause an intermediate tip gear signal to appear. Reduction of air speed will correct this situation. However, flight may be continued under these conditions without affecting normal operation of the aircraft.

Tip Protection Gear Caution Light

An amber word caution light (21, figure 1-15) marked "TPG Not in Trail" located on the copilot's side of the instrument panel adjacent to the landing gear lever detects reversal of the tip protection gear. This light and the master caution light will illuminate if either tip gear casters more than 60° either side of the trail aft position. The light operates on TR power on aircraft **W173** **W249** and right essential power on aircraft **W250**. A circuit breaker for the light marked "Pos Ind" is located on the "Landing Gear" portion of the pilot's circuit breaker panel.

Landing Gear Warning Horn and Shutoff Buttons

The landing gear warning horn is flush-mounted on the upper aisle dome light mounting plate. The horn sounds a warning when any throttle is retarded below a position 2.25° to 7.5° above IDLE position while any one landing gear is not down and locked. A warning horn shutoff button (16, figure 1-13), which is used to silence the horn, is located on the copilot's side of the aisle stand. Provided a gear has not locked, the horn, which operates on TR power, will sound again when another throttle is retarded. A circuit breaker for the landing gear warning horn marked "Pos & Flaps Warn Horn" is located on the "Landing Gear" portion of the pilot's circuit breaker panel.

NOTE

When all throttles have been retarded and the shutoff button has been used to silence the warning horn, a throttle must be advanced to reactivate the warning horn system. This is necessary to insure proper warning horn operation for an unsafe gear condition.

STEERING AND CROSSWIND CRAB SYSTEMS

A means of steering the aircraft on the ground and of presetting the crab angle of the landing gear during crosswind landings and takeoffs is furnished by two separate yet integrated systems known as the steering and the crosswind crab system (figure 1-41). The steering system and crosswind crab system are integrated through mechanical and cable linkage to a differential coordinating unit. Cable and mechanical linkage from this unit operate steering metering valves on both forward and rear main gear. The steering metering valves meter hydraulic pressure to the actuating cylinders which position each forward gear for steering or all four gear for crosswind crab.

NOTE

Actuation of the crosswind crab system sets up a new neutral position for steering which does not affect the turning angle available with the takeoff and landing steering ratio but limits the turning angle available with the taxi steering ratio. With crosswind crab set and the steering ratio selector in TAXI, the available turning angle of the forward gear relative to the new neutral is 55° in the direction of the crab setting and 55° minus the crab setting in the direction opposite the crab setting. See figure 1-42A.

STEERING SYSTEM

The forward main landing gear are steered by hydraulic pressure controlled by movement of the rudder pedals. The left forward gear uses pressure from the left body hydraulic systems and the right forward gear uses pressure from the right body hydraulic system. Emergency source of hydraulic pressure is not available for steering; however, under certain conditions, standby pressure can be used. See "Landing with One Forward Gear Steering Failure," Section III. In the event of steering failure on one front gear, it will trail the other front gear which has steering available. Steering is accomplished when the rudder pedals move mechanical and cable linkage through a ratio selector unit and a differential coordinating unit to the metering valves which hydraulically position the forward main gear. The steering ratio selector unit mechanically limits steering angles for two conditions. A taxi ratio allows the forward gear to be turned to a maximum angle of 55° right or left of a center position with full rudder pedal travel. The second ratio is used for takeoff and landing and restricts the turning angle to

approximately 12° right or left of center. The differential coordinating unit has three main components; a forward drum, a jackscrew, and a rear drum. All three are interconnected. Rudder pedal movement for steering mechanically moves the forward drum in an amount determined by the ratio selector. Movement of the forward drum moves the rear drum through linkage to mechanically operate the steering metering valves on each of the forward main gear. These valves meter hydraulic pressure to the actuating cylinders to position the gear as desired. During forward towing operations, a valve between the steering actuating cylinders on each forward gear must be opened by a steering bypass key (figure 1-37) to bleed pressure. This is to prevent damage caused by hydraulic locking of the pistons in the actuating cylinders. On most aircraft, this valve was also incorporated on the rear gear so that towing from the rear could be accomplished. Each bypass key has a two-pin arrangement. The bypass keys for the forward gear are attached to the ground lock streamers. When the key is inserted into the steering metering valve receptacle, one pin secures the key in place and the other moves the bypass valve to bleed pressure. Centering springs are provided near each steering valve which only assist in returning the gear and rudder pedals to neutral whenever pressure on the rudder pedals is removed.

NOTE

For maximum steering and rudder control, no rudder trim should be used. The maximum steering angle is reduced when rudder trim in the opposite direction is used. For example, steering to the left is reduced when nose right trim is introduced. The steering angle is reduced proportionally to the amount of trim used to displace the rudder pedals.

Steering Ratio Selector Lever

A steering ratio selector lever (4, figure 1-42) on the left forward end of the aisle stand is used to select one of two steering ratios. The two ratios are TAXI -- TAKEOFF LAND which allow steering of up to 55° and approximately 12° respectively. To move the lever from either one of these positions, a knob on the lever must be pulled up to free the lever from a detent position. When the lever is moved from one position to the other, it mechanically adjusts the steering ratio selector unit to limit the angles of turn available. The ratio selector lever is mechanically linked to the landing gear lever. This is done to prevent moving the landing gear lever up unless the ratio selector lever is in TAKEOFF LAND and to prevent moving the ratio selector lever while the landing gear

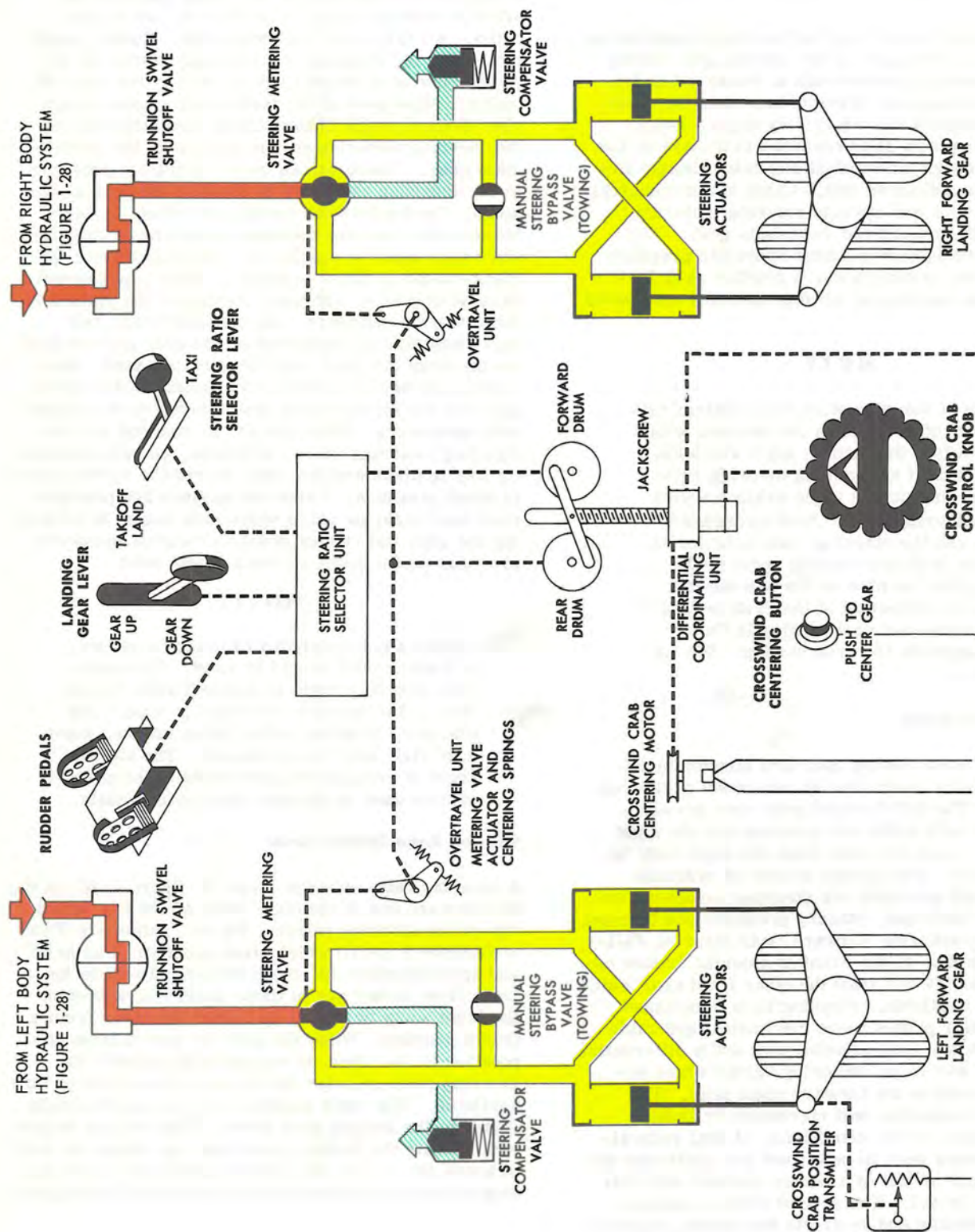


Figure 1-41 (Sheet 1 of 2)

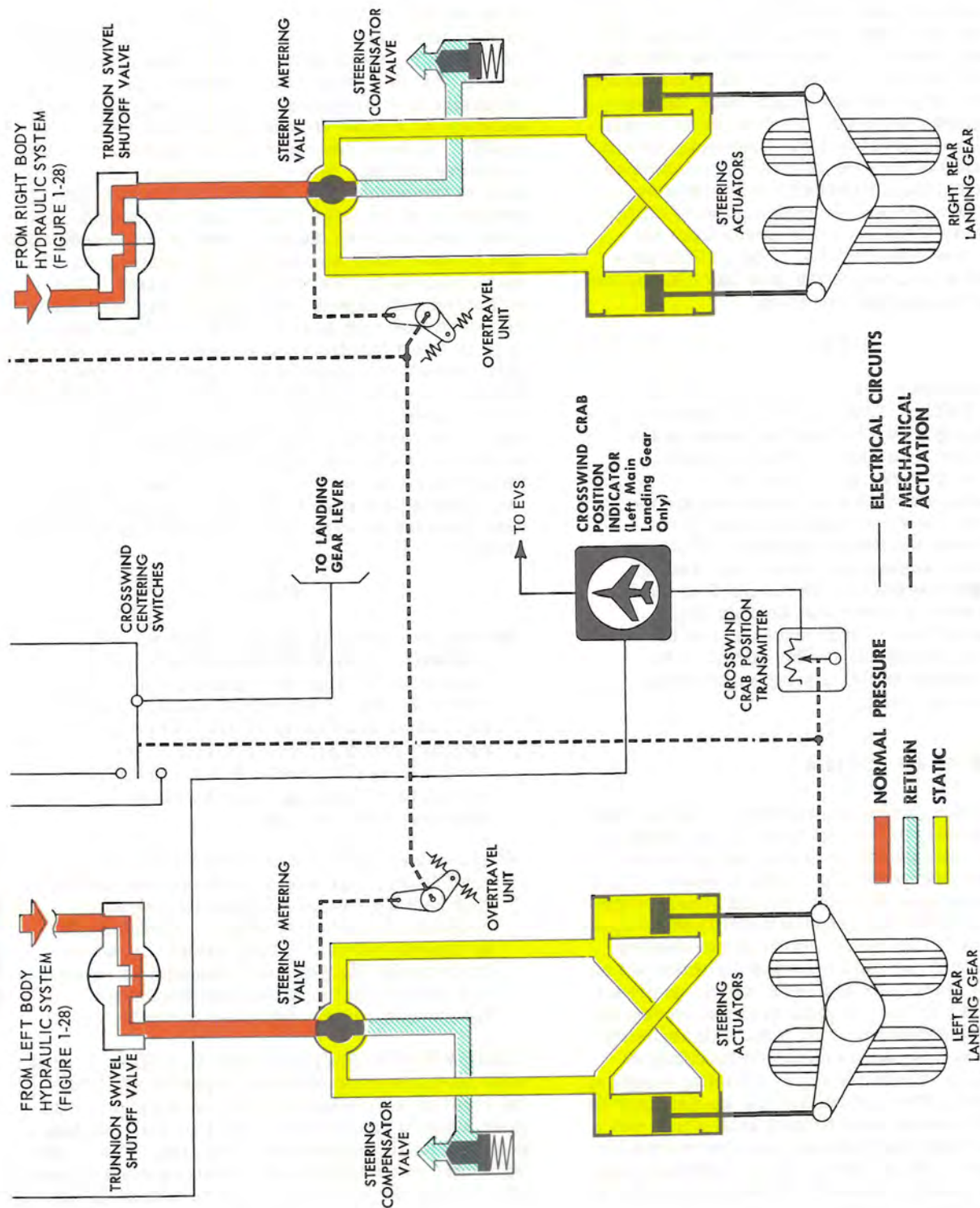


Figure 1-41 (Sheet 2 of 2)

Steering and Crosswind Crab System (Typical)

are retracted. When the landing gear lever is moved to GEAR UP, the linkage will adjust the steering ratio selector unit to a zero steering ratio. This prevents any actuation of the steering metering valves by rudder pedal movement and returns the steering control system to center. Since normally the landing gear lever will be positioned before using the emergency landing gear switches, the ratio selector will usually be adjusted accordingly. Centering cams in each gear maintain the gear at centered position as soon as oleos are fully extended. A trunnion swivel shutoff valve is on each main gear and shuts off hydraulic pressure to the steering valves when the landing gear have retracted 38° to 60°. This prevents steering action before the gear has cleared the wheel well during landing extension.

NOTE

With the steering ratio selector lever in either the TAXI or TAKEOFF LAND position, the landing gear will follow the rudder pedal displacement by a predetermined amount. Moving the selector lever from one to the other position will be met by increasing resistance as the rudder displacement is increased from the neutral position. This is the result of attempting to steer the landing gear to the new position as required by the steering ratio selector unit through use of the selector lever. This condition can be avoided by placing the rudder pedals in the neutral position before moving the steering ratio selector lever.

CROSSWIND CRAB SYSTEM

A crosswind crab system is provided on this aircraft to facilitate making crosswind landings and takeoffs and to reduce the hazards of crosswind conditions. The crosswind crab system provides a means of turning all four main gear to align with the runway while the aircraft is flown in a wings-level attitude compensating for drift. This system utilizes the steering actuators on the front main gear and a similar set on the rear main gear. The landing gear can be preset and turned up to 20° left or right of center during the approach. The maximum of 20° crab will accommodate landings in crosswinds up to and including 43 knots blowing 90° to the runway at a landing weight of 270,000 pounds. The direction of the landing gear is preset by a crosswind crab control knob which mechanically operates the steering metering valves on each main gear. These valves meter hydraulic pressure to the actuating cylinders to position the gear as desired. The crosswind crab system is automatically centered when the landing gear lever is moved to the GEAR UP position. On the ground after landing, the gear is quickly centered by a pilot-operated centering button or by turning the crosswind crab control knob to center. Crab position of the aft gear is fed to the EVS for positioning the STV and FLIR sensors.

Crosswind Crab System Controls

CROSSWIND CRAB CONTROL KNOB. The crosswind crab control knob (2, figure 1-42) is recessed in the rudder trim control knob on the aft end of the aisle stand. The control has an indicator in the form of a miniature aircraft which points to a degree scale to indicate the amount of nose left or right trim selected. To move the control, it is necessary to lift up before turning. When the crosswind crab control knob is turned for trim, cable linkage moves the jackscrew at the differential coordinating unit. The jackscrew positions the rear drum of the coordinating unit to move cable and mechanical linkage to operate the forward gear steering metering valves. The jackscrew also moves cable and mechanical linkage to operate the rear gear steering metering valves. It is to be noted that the rear main gear can be steered only through movement of the jackscrew of the coordinating unit while the forward main gear are steered by movement of the rear drum of the coordinating unit. The rear drum can be moved both by the jackscrew for crosswind crab and by the forward drum of the coordinating unit for steering by the rudder pedals. This action allows steering of the forward gear even when the forward gear are preset for crosswind crab.

NOTE

- When the main landing gear are extended and crabbed in flight to an angle equal to or exceeding 14° through any combination of crosswind crab setting and rudder pedal movement, the landing gear safety switch will be actuated causing certain aircraft systems to start operating or to shut down. For further information, see "Landing Gear Oleo Safety Switches," this section.
- The control knob can be turned while the aircraft is on the ground with responding control knob indicator movement without hydraulic pressure or electrical power. Therefore, if an unobserved crab setting exists, upon aircraft taxiing the gear will immediately actuate to a left or right crab position resulting in the aircraft rapidly departing centerline.

CROSSWIND CRAB CENTERING BUTTON. A crosswind crab centering button (3, figure 1-42) located to the right of the crosswind crab control knob on the aisle stand is used to center all four main landing gear from a turned position to neutral. The crosswind crab centering button controls an electric motor which turns the jackscrew in the coordinating unit in the desired direction to center all four gear. When the left rear gear is centered, power to the motor is interrupted causing all centering action to stop. The centering button, a push-type switch that is spring-loaded to OFF position, is supplied TR power. The centering switch circuit breaker marked "Centering Contr" is located on the "Landing Gear" portion of the pilot's circuit breaker panel. The direction of

the motor is governed by two cam-actuated centering switches on the left rear main landing gear. When either of these switches is actuated by the cam and the centering button is pushed, the circuit is energized to operate the centering motor.

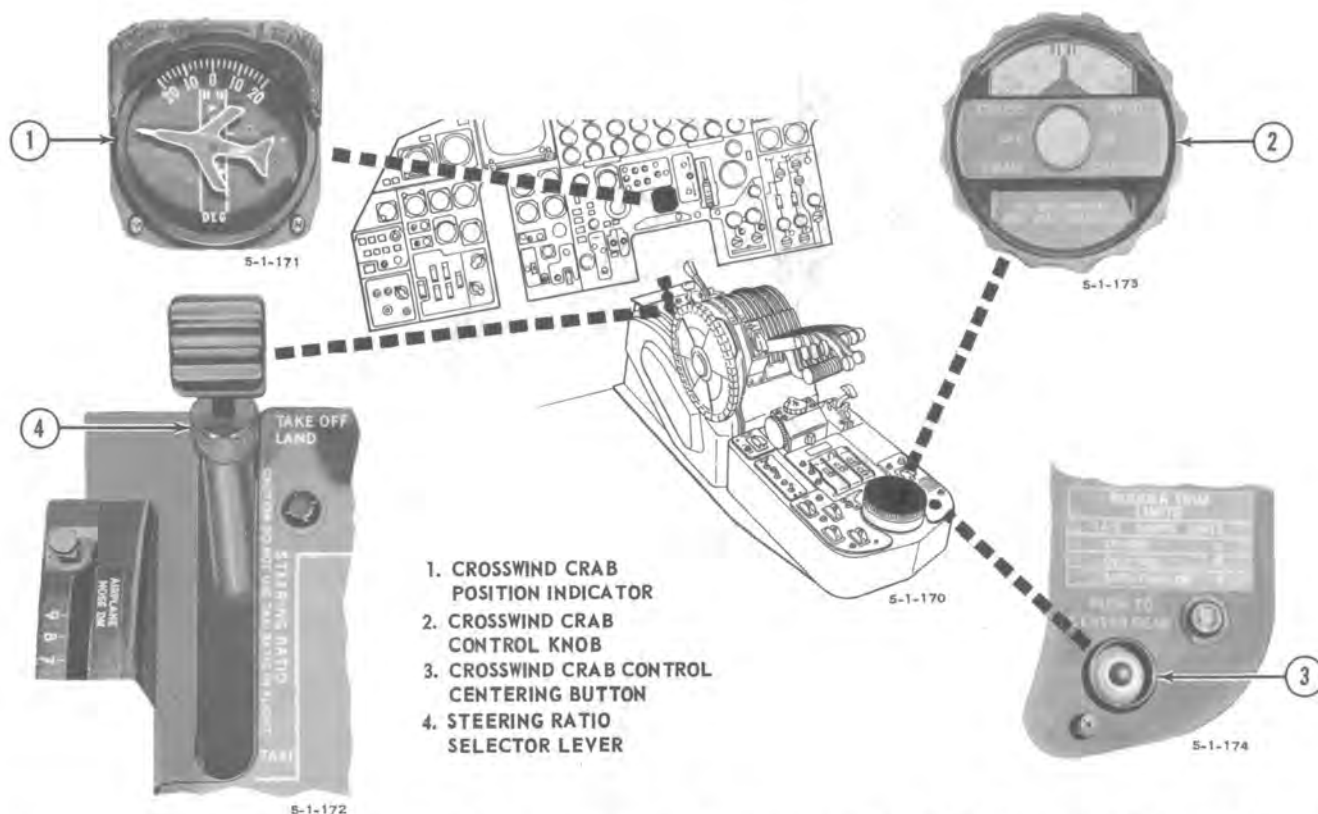
Crosswind Crab System Indicators

CROSSWIND CRAB POSITION INDICATOR. The indicator (1, figure 1-42) is centrally located on the lower part of the pilots' instrument panel and shows in a relative plan view presentation the amount in degrees that the landing gear is turned to compensate for aircraft crab during crosswind conditions. The indicator is an electrically operated instrument and receives power from the TR bus which is carried through two position transmitters, one on the left forward gear and one on the left rear gear. The circuit breaker for the position indicator marked "Crosswind Crab, Ind" is located on the "Landing

Gear" portion of the pilot's circuit breaker panel. The indicator has a diagram marked with a miniature runway and a scale calibrated from 0° to 20° both right and left. Two movable pointers, mounted one above the other, indicate the degree of turn. The lower pointer, a simple needle, indicates the forward gear, and the upper pointer, in the form of a miniature aircraft, indicates the rear gear. Since the gear position is in the opposite direction from that indicated by the pointers, it is always considered that the aircraft is being turned into the wind at an angle to the runway. When the aircraft is steered, the lower pointer will move in a direction opposite that of the turn and the upper pointer will remain in the position of the crab angle.

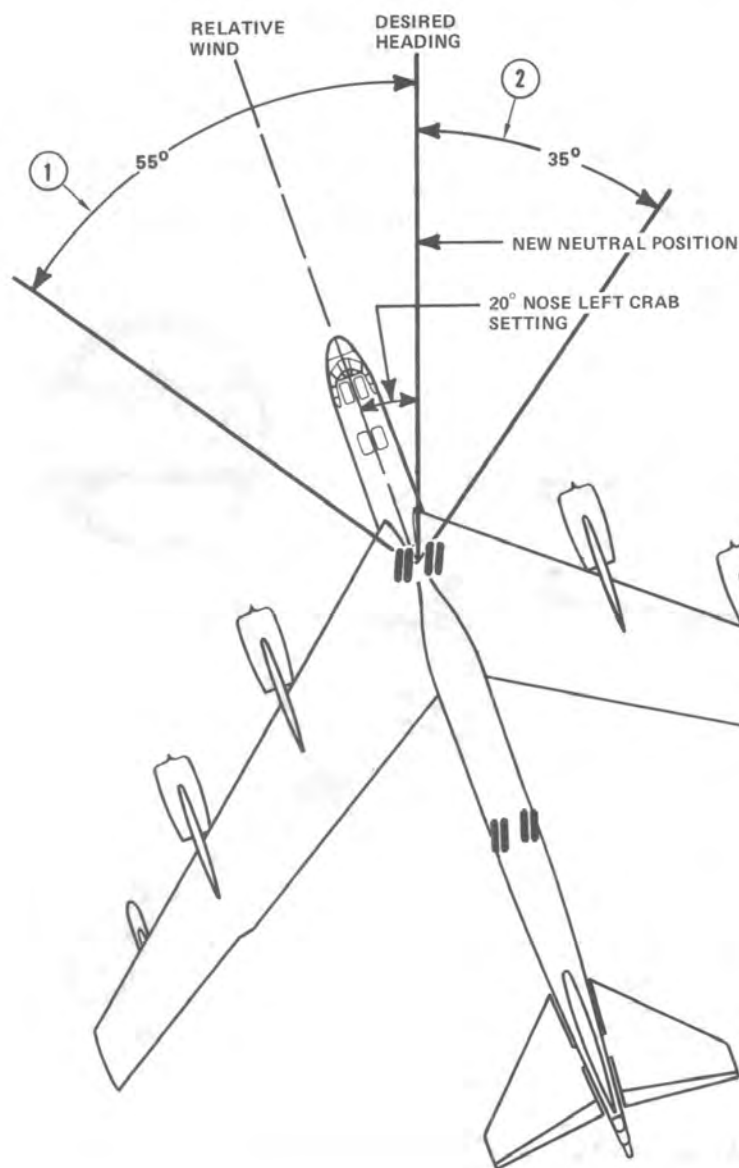
NOTE

After crosswind crab has been set, both pointers of the crosswind crab indicator should match crab angle within 2°.



Steering and Crosswind Crab Controls

Figure 1-42.

**REMARKS:**

Crab setting refers to direction of the nose of the aircraft relative to desired heading.

CONDITIONS:

- Aircraft taxiing with 20° nose left crosswind crab setting.
- Steering ratio lever in TAXI.

- 1 Turning angle available in direction of crab setting is 55° from new neutral position.
- 2 Turning angle available in direction opposite crab setting is 35° (55° minus 20°) from new neutral position.

Turning Angles Available With Maximum Crosswind Crab Setting

Figure 1-42A

WHEEL BRAKE SYSTEM

Each wheel of the main landing gear has hydraulic brakes. The brakes are of the segmented rotor multiple disc type, utilizing cerametallic brake linings. Braking is accomplished by toe pressure on any or all of the rudder pedals. No differential braking is provided. An antiskid system to automatically detect and correct a skid condition is on each wheel of the main landing gear. Parking brakes are also provided.

WHEEL BRAKE HYDRAULIC PRESSURE

Each main landing gear has an individual brake system as shown in figure 1-43. Brake pressure for the front and rear gear on the right side is supplied by the right body system and pressure for the front and rear gear on the left side is supplied by the left body system. There is an accumulator for each main gear brake system, one located in each wheel well. There is a pressure gage on each accumulator which gives brake system pressure or air preload if the brake system is bled down. The two forward main gear brakes are actuated simultaneously and the two rear main gear brakes are slaved to the forward brake systems. This provides equal braking on all four main gear. Brake application pressure is supplied to each aft main landing gear by individual slave pressure-operated metering valves. Both aft brake slave metering valves are normally supplied with slave pressure from the left body hydraulic system; however, an alternate source of slave pressure is supplied to both valves from the right body hydraulic system. Slave pressure from either body system will open the slave metering valves of both aft gear to permit brake application from pressure supplied by the body system which corresponds with the side on which the gear is located. Toe pressure on the rudder pedals is transmitted to two main metering valves through mechanical linkages and a spring system of feel and return springs. The feel springs absorb linkage travel and hold spring tension on the metering valves. The return springs return and hold the metering valves in the off position. A retraction lockout cylinder is connected to each spring cartridge assembly, which contains a retraction lockout spring and a return spring, to limit the amount of brake pressure than can be applied to stop wheel rotation during gear retraction. This reduced braking pressure, which amounts to approximately one-fourth normal braking pressure, is for the purpose of preventing undue stresses on the retraction mechanism by a sudden braking of the wheels. Hydraulic pressure from the main metering valves is used for two purposes; one is brake actuation on each wheel of the

forward main gear and the other is hydraulic actuation of the two slave metering valves, one for each rear main gear. Pressure is supplied to the two slave metering valves through the normal slave line or the alternate slave line. Differential pressure in the normal slave line holds a control valve in the alternate slave line closed. The alternate slave line control valve will open if the pressure in the normal slave line becomes appreciably less than the pressure in the alternate slave line. Either slave line pressure can enter the two slave metering valves through a shuttle valve on each metering valve. The shuttle valve positions according to pressure differential. Hydraulic pressure to the brakes is further controlled by an antiskid system.

ANTISKID SYSTEM

The antiskid system consists of a skid detector on each main gear wheel, a dual antiskid valve for each gear, a relay unit for each main gear, and an antiskid switch. The antiskid system is supplied with essential d-c power from each main gear antiskid shield. Antiskid control circuit breakers marked "Left Fwd," "Left Aft," "Right Fwd," and "Right Aft" are located on the "Landing Gear" portion of the pilot's circuit breaker panel. The dual antiskid valve is electrically actuated through relays from a skid detector unit on each wheel. This valve is spring-loaded to the open position to allow pressure to reach the brakes. When any wheel is in a skid condition, a signal is transmitted by the skid detector unit through the relay unit to actuate the valve. The dual antiskid valve is then positioned to shut off pressure to the brake and opens a port to the return line releasing the brake pressure on that wheel. At the end of the skid signal, following a very short time delay, brake pressure is again restored to the wheel. If the skid continues until wheel rotation stops, a locked wheel signal is transmitted through an additional relay to release brake pressure from that wheel. Upon brake pressure release, the wheel is free to rotate and again starts to accelerate. After a short time delay to permit the wheel to reach nonskid speed, the brake pressure is again restored to the wheel. For further information, see "Landing Gear Safety Switches," this section.

NOTE

A skid or locked wheel condition on any one wheel does not affect braking on any other wheel.

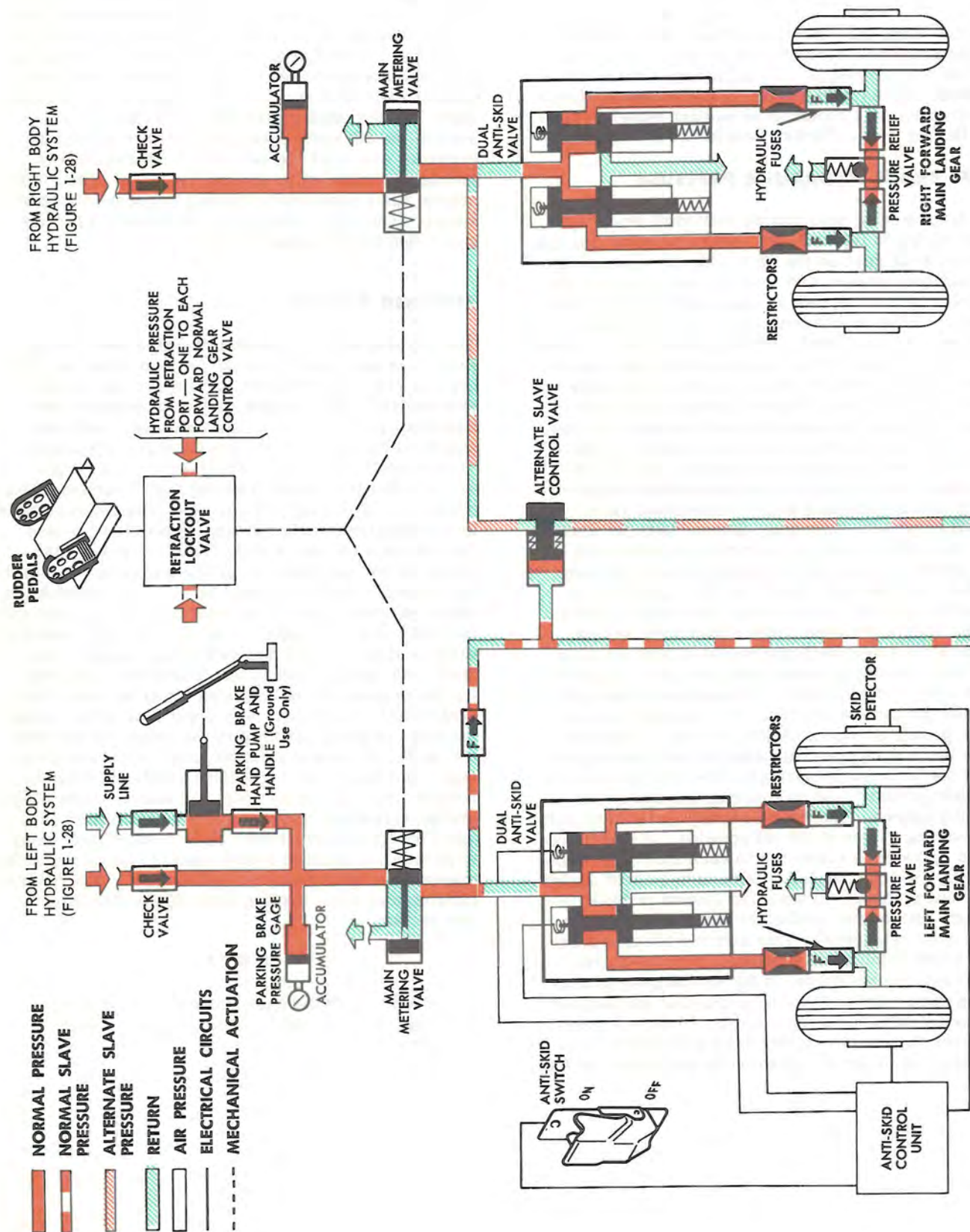


Figure 1-43 (Sheet 1 of 2).

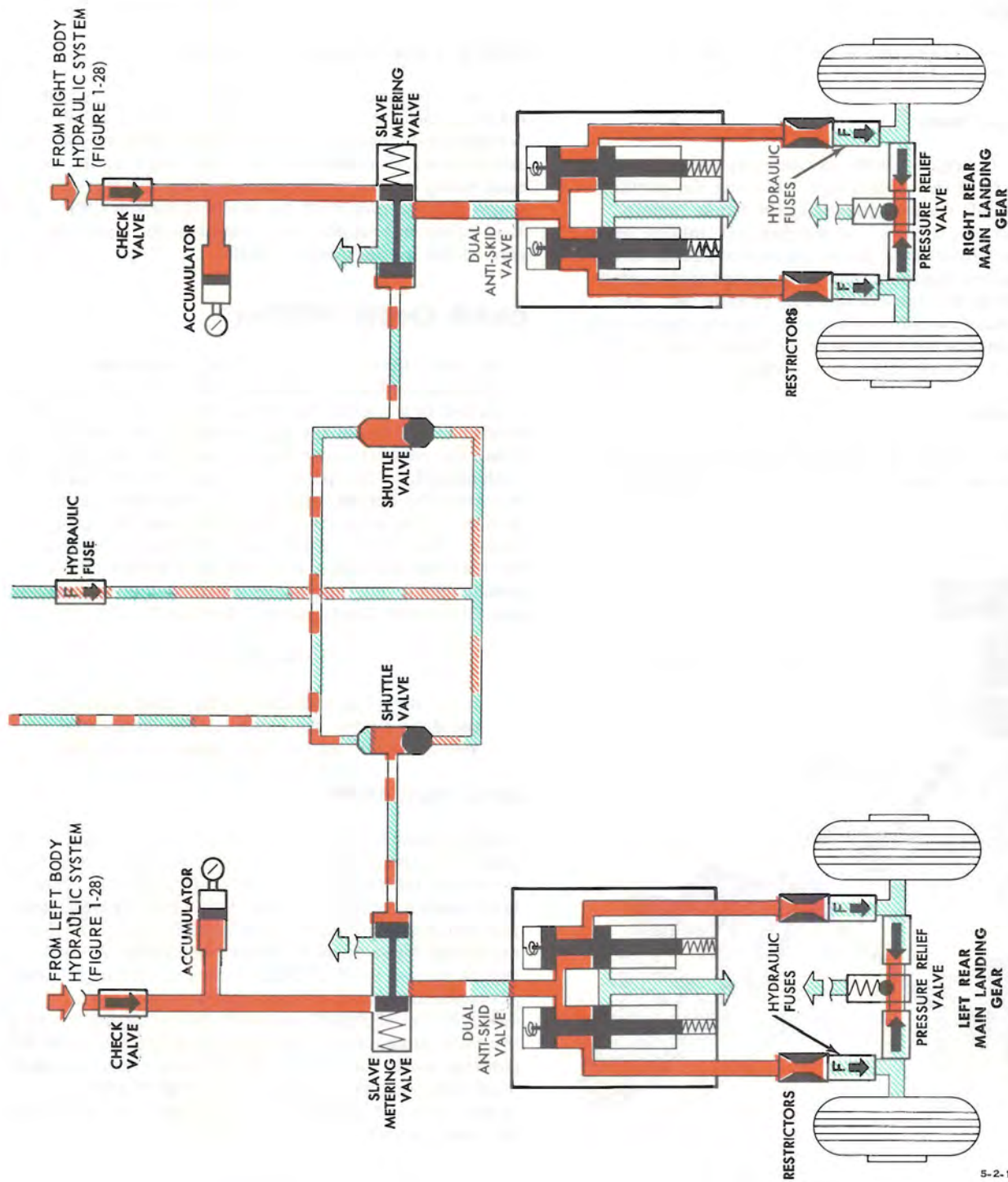


Figure 1-43(Sheet 2 of 2).

Wheel Brake System

WHEEL BRAKE SYSTEM CONTROLS

Rudder Pedals

Toe pressure on any one of the four rudder pedals will actuate the wheel brakes.

Parking Brake Lever

This lever (2, figure 1-44) is centrally located on the forward side of the aisle stand. Moving the parking brake lever aft while depressing the brake pedals sets the parking brakes. A mechanical linkage from the parking brake lever locks the brake pedals in a brakes-applied position. As long as hydraulic pressure is available, the brakes will remain on. The parking brake may be released by merely depressing the brake pedals until the parking brake lever releases, then release the brake pedals.

Antiskid Switch

The antiskid switch (1, figure 1-44) is on the pilots' instrument panel below and to the left of the landing

gear lever. The switch has two positions, ON--OFF, and is guarded to the ON position. When the switch is ON, the antiskid system is in operation.

Parking Brake Hydraulic Hand Pump

The parking brake hydraulic hand pump is a ground handling facility, used to charge the left front gear accumulator pressure during towing operations. Approximately 70 double strokes are required on the hand pump to charge the accumulator for one or two brake applications with the antiskid switch OFF. The hand pump and handle are located on the right-hand side of the forward wheel well.

DRAG CHUTE SYSTEM

A 44-foot ribbon-type drag chute is provided for deceleration during the landing roll. The parachute is installed in a compartment (3, figure 1-2) aft of the rudder in the top of the tail section of the fuselage. When the compartment door is opened, the drag chute is deployed. The opening door pulls the ripcord and releases the spring-loaded pilot chute into the slipstream. The pilot chute then pulls out the main drag chute. The risers of the main chute are attached to the aircraft through a terminal held by the jettison mechanism. For operating limits of the drag chute, see "Airspeed Limitations," Section V.

NOTE

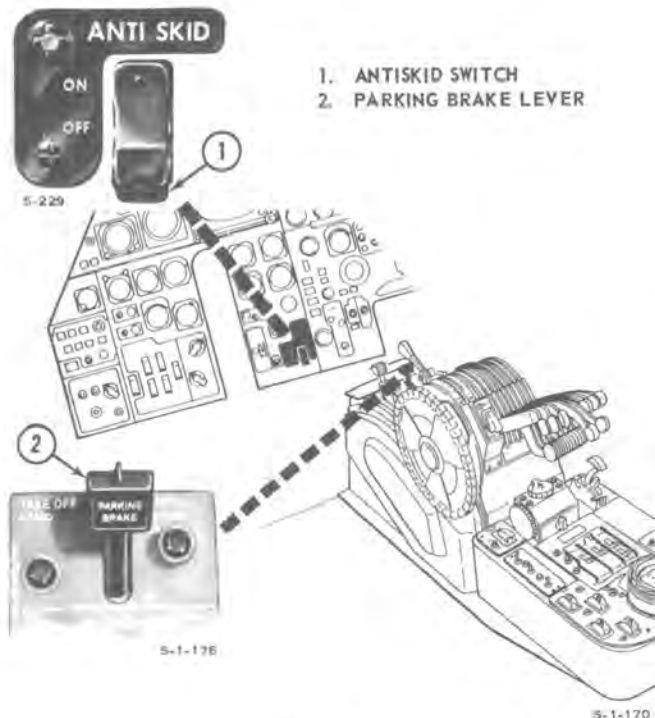
If the door opens accidentally, thus deploying the drag chute, the chute will be jettisoned automatically by the drag chute mechanism.

DRAG CHUTE LEVER

A drag chute lever (15, figure 1-13) is located on the copilot's side of the aisle stand. Positions of the lever are DEPLOY--LOCKED--JETTISON. This lever manually operates the drag chute release and jettison mechanisms through a cable system. Normally the lever must be moved to DEPLOY before it can be moved to JETTISON position. A hinged stop prevents movement of the control lever from LOCKED to DEPLOY position without lifting the stop in order to prevent inadvertent deployment. LOCKED position holds the spring-loaded drag chute compartment door securely closed. JETTISON position causes release of the jettison mechanism and allows the chute to pull free of the aircraft.

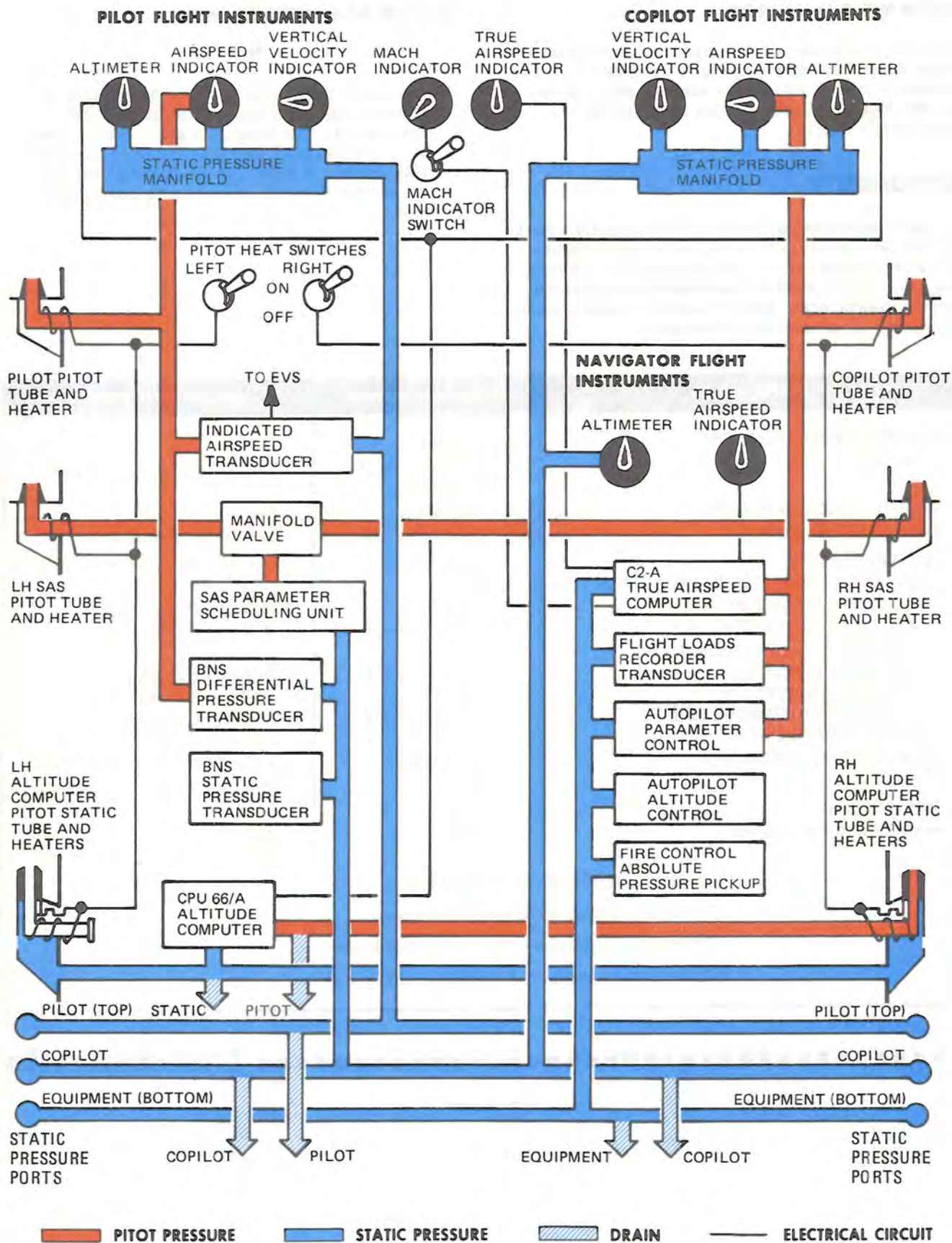
NOTE

A locking device in the control system operated by the drag chute compartment door prevents actuation of the jettison mechanism when the door is closed.



Wheel Brake System Controls

Figure 1-44.



Pitot-Static System (Typical)

Figure 1-46.

Four pitot tubes, two pitot-static tubes, and six static ports (figure 1-46) provide impact and static pressures to operate the pitot-static instruments. Two pitot tubes are located aft of the forward radome on the lower left and lower right of the control cabin. The left forward pitot tube supplies impact pressure to the pilot's airspeed indicator, the EVS IAS transducer, and the BNS equipment. The right forward pitot tube supplies impact pressure to the copilot's airspeed indicator, autopilot equipment, the true airspeed computer, and flight loads recorder. Two pitot tubes are located just below and just aft of the pitot tubes described above. These pitot tubes supply impact pressure through a manifold valve to the parameter scheduling unit. The parameter scheduling unit provides gain signals to the yaw electronic control unit of the stability augmentation system (SAS).

Two pitot-static tubes are located forward of the wing leading edge on the upper left and upper right of the aft control cabin. The aft pitot-static tubes provide impact and static pressure to the AIMS altitude computer. The static lines from both tubes are connected together and supply static pressure to the altitude computer. The right aft tube provides impact pressure to the altitude computer. The impact pressure line from the left aft tube is capped and not used.

Three static ports are located on each side of the control cabin. Each port is interconnected with the corresponding port on the opposite side of the aircraft. The bottom ports provide static pressure for the true airspeed computer, fire control system, the autopilot equipment, and flight loads recorder. The center ports provide static pressure for the copilot's airspeed, altimeter, and vertical velocity indicators, the navigator's altimeter, the BNS equipment, and the SAS parameter scheduling unit. Static pressure for the pilot's altimeter, airspeed, vertical velocity indicator, and the EVS IAS transducer is supplied by the top ports.

For information on pitot head anti-icing, see Section IV.

Indicated Airspeed Indicators

A Type L-7A airspeed indicator (9, figure 1-15) is located at both the left and right sides of the pilots' instrument panel. By the use of two pointers, the pilots can observe the airspeed indication and the maximum allowable airspeed indication at the same time. The airspeed dial is graduated from 50 to 650 in 10-knot increments. A rotating drum, visible through a window in the dial, is graduated from 0 to 100 in 2-knot increments for sensitive indications. Stops limit the maximum speed pointer travel in the range from 200 to 600 knots. Mach number indications from 0.6 to 1.0 are also provided in this range

as a reference for the Mach number index adjustment. A triangular index at the edge of the dial is set to the aircraft maximum allowable Mach number by an adjustment made at the rear of the instrument case. This adjustment governs the rate of change of the maximum airspeed pointer to indicate Mach airspeed of the aircraft for any flight altitude or airspeed. In operation, the maximum airspeed pointer moves down the scale from the upper limits with lowering pressure altitude, and the indicated airspeed pointer moves up the scale with increasing airspeed. When the pointers coincide, the Mach/airspeed for the existing flight condition has been reached.

Altimeters (Navigator's)

A Type MA-1 or AAU-8/A altimeter (figure 4-35) is located on the navigator's instrument panel. Three concentrically mounted pointers indicate hundreds, thousands, and ten thousands of feet with reference to a single dial scale uniformly graduated from 1 to 10. The long pointer indicates 1,000 feet in one revolution, the intermediate pointer 10,000 feet in one revolution, and the small pointer 10,000 feet for each major graduation on the dial up to the maximum possible altitude reading of 80,000 feet. The small 10,000-foot pointer is part of a black disc next to the main dial with a 60° segment cut out of the side opposite the pointer. At zero altitude indication (and below), the 60° cutout in the disc is filled with alternate diagonal fluorescent and black stripes. With increasing altitude, the diagonal stripes are progressively covered until, at 16,000 feet, no stripes are showing. This provides a conspicuous warning of approaching lower altitudes when descending from operational altitudes. The cutout filled with the diagonal stripes is also used as an indication of a correctly zeroed altimeter during the preflight check. The zero setting knob on the front of the instrument sets the pointers to read from any ground pressure altitude between 28.1 and 31.0 inches of mercury as displayed in the Kollsman window between the "2" and "3" on the main dial. On aircraft with the AAU-8/A altimeter, positive stops are provided at or near the extremes of the barometric scale so that the scale cannot be misset by excessive rotation.

NOTE

A Type MA-1 altimeter may be installed in the aircraft although it is not recommended. The MA-1 is identical and performs in the same manner as the AAU-8/A altimeter except that positive stops are not provided on the barometric scale to preclude missetting the scale by excessive rotation.

Vertical Velocity Indicators

An MS28049 vertical velocity indicator (15, figure 1-15) is located at both the right and left sides of the pilots' instrument panel.

ELECTRICALLY OPERATED INSTRUMENTS

Altimeter (Pilot and Copilot)

A type AAU-19/A altimeter (figure 1-46A) is on the pilot's and copilot's instrument panels. The altimeter has a counter-drum-pointer display. The counters (5 and 7, figure 1-46A) and drum provide a direct digital readout in hundreds and thousands of feet. The single pointer (2, figure 1-46A) repeats the 100-foot indications of the drum, serving both as a vernier for the drum and as a quick indication of the rate and direction of altitude change. The altimeter can be operated in either the servo (computer controlled) mode or the standby (static pressure) mode as selected by the reset-stby lever (4, figure 1-46A). The reset-stby lever is spring-loaded to an unmarked neutral position between RESET and STBY positions. When in the standby mode, a STBY flag (1, figure 1-46A) will be in sight on the instrument face. A barometric pressure set knob (6, figure 1-46A) and barometric scale (3, figure 1-46A) are provided for adjusting the altimeter setting. A field elevation check should be made in both modes using ± 75 feet as the maximum altimeter error allowable in either case. In addition, readings between the two modes should correspond within 75 feet.

SERVO MODE. Servo mode is designed to be the primary mode of operation and should be used unless failure prohibits. In the servo mode, the basic pressure altitude indication of the instrument is servo-corrected for position error by the CPU-66 altitude computer. Inflight, the allowable difference between servo mode readings of two altimeters is 75 feet at all altitudes and speeds. The altimeter is placed in servo mode by momentarily positioning the reset-stby lever to RESET. The STBY flag will disappear. A failure monitor circuit will automatically return the system to standby mode and the STBY flag will appear for any of the following malfunctions:

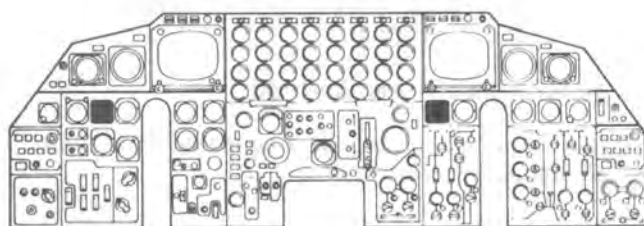
- Primary power failure
- Servo amplifier or motor failure
- Switch failure
- Relay failure
- Monitor failure

The CPU-66 computer error sensing system senses error in a servo loop that takes its input from a pneumatic sensor within the computer. All error sensing is downstream of the sensor and as a result there is no monitor function applied to the sensor itself. The AAU-19/A altimeter also has a means of monitoring internal failures which will revert the altimeter to STBY. In addition, it is designed to be capable of accepting electrical signals from the computer which differ from the uncorrected pneumatic altitude (standby mode) by as much as ± 4500 feet without the altimeter monitor inadvertently switching the altimeter to the standby mode. This is to compensate for large altitude position errors in some airplanes. Since a single CPU-66 computer drives both altimeters in the servo mode, no means of comparison between AAU-19/A altimeters is available if both are in RESET. This condition can be circumvented by operating the pilot's altimeter in RESET and the copilot's altimeter in STBY. Both altimeters will then display data derived from separate sources and provide a means of comparison and independent back up.

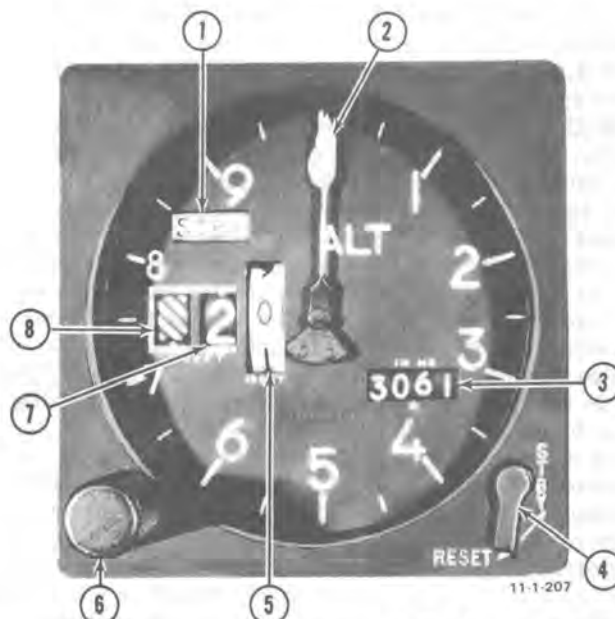
WARNING

- If the computer pneumatic sensor were to fail or become locked in a particular position, or system failures - such as pitot or static source icing, ice or water blockage in static lines, leaks, or pitot head damage - were to occur, the computer could deliver erroneous data to the altimeters. The aircraft could experience a large change in altitude before the AAU-19/A error detection circuit would react and switch the system to standby. Erroneous data would also be delivered to the transponder and relayed, on interrogation, to the ground radar agency.
- If it is determined that the altitude computer (CPU-66) has failed or is delivering erroneous data, place the mode C enabling switch to the OUT position and advise the ARTC center.

If the altimeter reverts to standby mode automatically, attempt should be made to reset to the servo



- | | |
|-----------------------|---------------------------------|
| 1. STBY FLAG | 5. 100-FOOT DRUM |
| 2. 100-FOOT POINTER | 6. BAROMETRIC PRESSURE SET KNOB |
| 3. VAROMETRIC SCALE | 7. 1000-FOOT COUNTER |
| 4. RESET - STBY LEVER | 8. 10,000-FOOT COUNTER |



Altimeter

Figure 1-46A.

mode. If the malfunction was transient, the altimeter will reset. If the fault remains, the altimeter will not reset but will operate normally in the standby mode.

NOTE

- If the altimeter cannot be switched to STBY manually due to a switch malfunction, the STBY mode can be acquired by momentarily opening the computer circuit breaker (for approximately 3 seconds). The altimeter will revert to standby and operate as a pneumatic altimeter.
- The altimeter correction card is not used in the servo mode.

STANDBY MODE. In the standby mode, the altimeter operates solely from the static pressure system. A red-on-black STBY flag will be in view, indicating that the instrument is providing a normal static pressure reading and that the displayed altitude is not corrected for position error. The instrument will be in standby mode when aircraft power is first applied and will remain in standby mode until the reset-stby lever is momentarily placed to RESET. The altimeter may be shifted from servo to standby mode by holding the reset-stby lever in the STBY position until the STBY flag appears. Normally 1 to 3 seconds are required for this to happen due to the time delay built into the instrument to prevent nuisance tripoffs. When the altimeter is in the standby mode, an internal vibrator will operate continuously. The vibrator minimizes mechanical friction, enabling the instrument to provide a smoother display during altitude changes. Should vibrator failure occur, the altimeter will continue to function but a less smooth movement of the instrument display will be evident with changes in altitude. The pilot's and co-pilot's altimeter vibrators receive dc power from

the emergency instrument power bus through a circuit breaker marked "Emer Flight Inst Lights" on the pilot's circuit breaker panel.

CAUTION

During normal use of the barometric setting system, momentary locking of the barocounters may be experienced. If this occurs, do not force the setting. Application of force may cause internal gear disengagement and result in excessive altitude errors in both standby (STBY) and servo (RESET) modes. If locking occurs, the required setting may sometimes be established by rotating the knob a full turn in the opposite direction and approaching the setting carefully.

WARNING

- When the altimeter is operating in standby mode, the appropriate altimeter correction card for the current aircraft configuration must be used to fly corrected altitude for traffic separation.
- If the altimeter's internal vibrator is inoperative, the 100-foot pointer may momentarily hang up when passing through "0" or 12 o'clock position. The pointer hangup can be minimized by tapping the altimeter case. Pilots should be especially watchful for this failure when their minimum approach altitude lies within the 800 to 1000 foot part of the scale, such as 1800 to 2000 feet or 2800 to 3000 feet, and should use any appropriate altitude backup information available.

ALTITUDE COMPUTER (CPU-66). The CPU-66 altitude computer provides the same inputs to both the AAU-19/A altimeter and the AN/APX-64 IFF. The operating mode of the AAU-19/A altimeter (RESET or STBY) has no effect on the CPU-66 computer inputs to the IFF transponder. The computer measures pressure altitude referenced to standard sea level pressure of 29.92 and corrects for position error. For IFF functions this corrected altitude is encoded to the nearest 100-foot level and is furnished to the IFF transponder, which in turn automatically relays the corrected altitude as a pulse train to the Ground Control Center, upon interrogation, provided the mode C enabling switch on the control panel is in the ON position. For altimeter functions, this corrected altitude is used to drive the altimeter display when the altimeter is in servo mode. With an altimeter setting of 29.92, the altimeter altitude displayed will correspond to the computer altitude. Altimeter settings other than 29.92 introduce a corresponding difference between the altimeter altitude displayed and the computer altitude. If either the pilot's, copilot's or both altimeters fail (STBY flag showing) the computer may still operate properly and transmit correct altitude data to the transponder. With both altimeter flags showing simultaneously it may be determined if the altimeters or computer failed by using the IFF self test feature for mode C. With both flags showing, and the system does not self test in mode C, the computer may be assumed to have failed. If both altimeter flags are showing and the system self tests in mode C properly, the two altimeters have failed in the servo mode or have been placed in STBY. In this case, a subsequent failure of the computer would not be indicated to the pilots since the same AAU-19/A STBY flag is used to indicate a failure in the altimeter or the computer. Periodic mode C checks while cruising and a check prior to a change of altitude should be made to assure correct computer operation. The mode C self test check will not detect blockage of static lines to the computer, only a failure within the computer. The computer receives ac power from a circuit breaker marked "ALT COMPTR" on the "Miscellaneous" portion of the left load central circuit breaker panel.

ALTIMETER CORRECTION CARD. Altimeter correction cards and holder (7A, figure 1-9) are located on the pilot's side glare shield. Two altimeter correction cards are necessary, one for clean configuration and one for AGM-69A configuration. These cards reflect position error only and are based on an average gross weight and a standard day temperature. For further information concerning the use of the altimeter correction card, refer to Part 1 of the Appendix.

WARNING

When the altimeter is operating in standby mode, the appropriate altimeter correction card for the current aircraft configuration must be used to fly corrected altitude for traffic separation.

Radar Altimeter AN/APN-150

See "Communication and Associated Electronic Equipment," Section IV.

Mach Indicator

A Type ME-5 Mach indicator (16, figure 1-15) located on the left side of the pilots' instrument panel indicates the ratio of aircraft speed to the speed of sound of the particular pressure altitude at any time during flight. The instrument has a range of 0.5 to 1.0 which is indicated on a stationary dial by a rotating pointer. A rotating subdial is also provided which reads in hundredths and is graduated from 1 to 10. The ME-5 is a servo-type indicator, receiving power from the true airspeed computer through a Mach indicator switch (62, figure 1-15) on the pilots' instrument panel beside the indicator. Movable indices are located on the face of the instrument, one on the main dial and one on the subdial which rotates with the subdial scale. These indices can be moved by the pilot to any value of Mach number he desires as a reference without affecting the reading or adjustment of the instrument. Rotating the knob in the lower right corner of the instrument while in its normal (out) position will move the index on the main dial. Depressing and rotating the knob will allow adjustment of the index on the subdial. If power is on the instrument, movement of the subdial index will not cause movement of the subdial. However, if there is no power on the instrument, movement of the subdial index may cause movement of the subdial and the main dial pointer. This rotation of pointer and subdial scale will not affect indicator reading. A red power-off flag will appear when power to the Mach indicator is off and will remain in view for approximately 40 seconds after Mach indicator switch is turned ON when power is available.

When power is turned ON and the true airspeed computer is warmed up sufficiently, the needle and the subdial will indicate the appropriate Mach reading. The true airspeed computer utilizes 118-volt single-phase a-c power for operation supplied through the "TAS Ind" circuit breaker on the "Miscellaneous" portion of the left load central circuit breaker panel.

NOTE

The Mach indicator ideally would give a true Mach reading; however, there are two sources of error in the system. One is position error inherent in pitot-static system and the other is instrument error which is inherent in the mechanism of the instrument itself. The magnitude of the position error is shown on the "Position Error" chart in Part 1 of the Appendix. Since no calibration is available, the magnitude of the instrument error is not known to the pilot but will be within the maximum allowable tolerance of ± 0.03 . Refer to Part 1 of the Appendix for a further discussion of these errors and a method of inflight determination of the Mach number. All Mach numbers given in this flight manual are indicated Mach unless otherwise noted.

True Airspeed Indicator

A true airspeed indicator located on the pilots' instrument panel (60, figure 1-15) and on the radar navigator's front panel (figure 4-35) is a remote indicating unit. A main dial and subdial in the true airspeed indicator repeat airspeed information transmitted from the true airspeed computer. A cutout and reference mark on the main dial permit reading of the subdial. The power to operate this indicator is supplied by the true airspeed computer. The true airspeed computer uses static pressure, pitot pressure, and temperature to compute true airspeed and Mach information. The computer is supplied 118-volt single-phase a-c power through a circuit breaker marked "TAS Ind" on the "Miscellaneous" portion of the left load central circuit breaker panel. For further information concerning the true airspeed indicator, see "Navigation Equipment," Section IV.

Attitude-Director Indicators

A flight director system instrument, ARU-2B/A attitude director indicator (figure 1-47) on aircraft less BB or ARU-49/A attitude director indicator on aircraft BB, located on both the pilot's and copilot's instrument panel (12, figure 1-15) provides an indication of aircraft pitch and roll attitudes and rate of turn and slip indications. In addition, it provides glide slope and localizer information in that it shows the aircraft position above or below the glide slope and whether the aircraft has the correct bank angle and rate of turn to intercept and maintain a heading or course. In the event of loss of ac electrical system power, the pilot's attitude-director indicator will display attitude and rate of turn information. The copilot's attitude-director will display rate of turn information only. The pitch steering

bar and bank steering bar will be in view but will be inoperative on both instruments. On aircraft BB, the pilot's and copilot's ARU-49/A attitude director indicators are interconnected to provide an attitude comparator warning system. A description of the various components of the attitude director indicator is given below and applies to both the ARU-2B/A and ARU-49/A, except as otherwise indicated.

NOTE

An error in the pitch indication of the attitude indicators is generated during accelerations or decelerations. The error is indicated in a nose-high direction during and after a forward acceleration and in a nosedown direction during and after deceleration. The longer the duration of acceleration (or deceleration), the greater will be the indicated error and the longer it will persist when acceleration (or deceleration) ceases. The erection system will reduce the error at about the same rate it was generated. Pitch error may reach one bar width during a high gross weight takeoff.

PITCH AND ROLL ATTITUDES. Pitch and roll attitudes are identical to those displayed on the MM-4 attitude indicator except that the bank scale (7, figure 1-47) is located on the lower half instead of the upper half of the instrument. The pilot's and copilot's attitude indicators receive pitch and roll signals from their respective MD-1 vertical gyros. The pilot's MD-1 gyro receives power from the No. 3 generator bus or the flight gyro emergency power inverter. The copilot's MD-1 gyro receives power from the No. 5 generator bus. Attitude information is transmitted from each MD-1 gyro to the respective attitude indicator through synchro servos. With the flight director computer gyro select switch in NORMAL, both the pilot's and copilot's synchro servos and ADI's are powered by the No. 3 generator bus. With the gyro select switch in ALTERNATE, the copilot's synchro servo and ADI are powered by the No. 5 generator bus, and the pilot's synchro servo and ADI remain connected to the No. 3 generator bus. See "Gyro Power Switch" for additional power source information.

PITCH TRIM KNOB. A pitch trim knob (8, figure 1-47) permits zeroing the horizon line with reference to the miniature aircraft (12, figure 1-47).

TURN AND SLIP INDICATORS. Indications of aircraft rate of turn and slip are provided by the needle and ball arrangement at the bottom center of the instrument (10, figure 1-47). The pilot's and copilot's turn and slip indicators receive d-c power from the emergency instrument bus through a circuit breaker marked "Rate of Turn" on the "Flight Indicators" portion of the pilot's circuit breaker panel.

OFF FLAG. An OFF flag (11, figure 1-47) will appear upon interruption of any two phases of a-c power to the flight gyro transformer. When the gyro power switch is OFF, the respective OFF flag will be in view.

course." When the nav mode select switch is in TACAN or VOR and normal power is available, the bank steering bar will be out of view.

WARNING

If the CPU-4A computer is calibrated properly and when centering the bank steering bar, an initial bank angle of 30° ($+0^\circ/-5^\circ$) will be indicated. Cross-check the bank steering bar with the bank pointer on the attitude-director indicator to preclude the possibility of exceeding a bank angle of 30° .

NOTE

When in TACAN, VOR, ILS, or ILS APP mode of operation, the course warning flag will appear when the ARN-21 or ARN-14 fails or signals from the URN-3 beacon or the VOR or ILS stations are lost or become unreliable. Continued display of this warning flag after the heading select switch has been positioned to MAN does not indicate faulty operation of the bank steering bar.

COURSE WARNING FLAG. A course warning flag (3, figure 1-47) will come into view during TACAN, VOR, ILS, or ILS APP mode of operation when the ARN-21 or ARN-14 fails or signals from the URN-3 beacon or the VOR or ILS stations are lost or become unreliable.

GLIDE SLOPE WARNING FLAG. A glide slope warning flag (13, figure 1-47) will come into view during ILS or ILS APP mode of operation when the ARN-31 fails or a glide slope signal of dependable strength is not being received.

NOTE

For further information regarding navigation functions (glide slope indicator and pitch and bank steering bars) of the attitude-director indicator, see "Flight Director System Controls," Section IV.

ATT WARNING FLAG. On aircraft **BB**, an ATT warning flag (16, figure 1-47) will come into view, in the pilot's and copilot's ARU-49/A attitude director indicators, under the following conditions:

- 1) When the power is off to one or both indicators or is lost to the comparator circuit.
- 2) When the attitude sphere position between the pilot's and copilot's indicators differ in roll by more than 6° ($\pm 1^\circ$) for more than one second, and when compensated for pitch trim positions differ by more than 6° ($\pm 1^\circ$) in pitch for more than one second.
- 3) When the comparator and related circuits fail.
- 4) When the ATT

TEST pushbutton (17) on the pilot's or copilot's indicator is pressed and held for at least two seconds.

NOTE

BB BC

The ATT warning flag indicates the attitude information displayed on the pilot's and/or copilot's attitude director indicator may be erroneous and the standby attitude indicator should be checked to determine proper attitude references.

ATT TEST PUSHBUTTON. On aircraft **BB**, an ATT TEST pushbutton (17, figure 1-47) is provided for checking the operation of the attitude comparator warning system. When the pilot's ATT TEST pushbutton (17) is pressed, the pilot's attitude sphere (2) rotates 10° ($\pm 1^\circ$) in both the roll and pitch axes and the pilot's and copilot's ATT warning flags (16) appear. When the copilot's ATT TEST pushbutton (17) is pressed, the copilot's attitude sphere (2) rotates 10° ($\pm 1^\circ$) in both the roll and pitch axes and the pilot's and copilot's ATT warning flags (16) appear. This checkout indicates that the attitude comparator warning system is functioning properly.

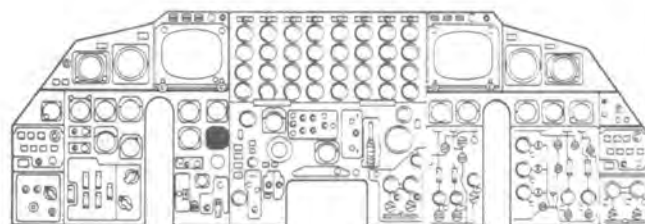
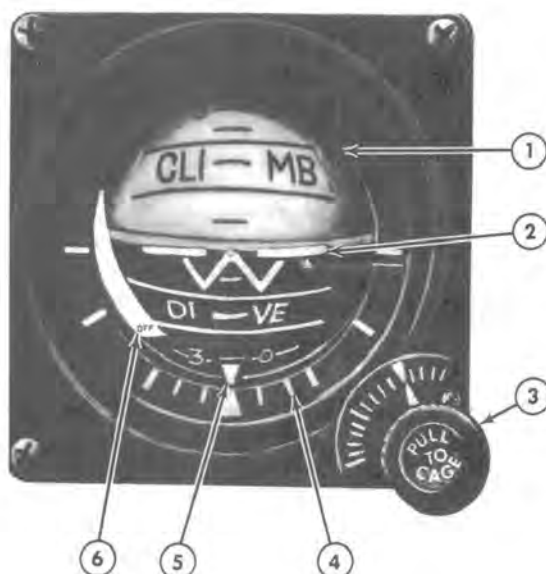
Standby Attitude Indicator

BC

A standby attitude indicator, Type ARU-30/A3, figure 1-47A, located on the pilot's instrument panel, provides a continuously operating source of attitude reference in case of primary attitude indicator malfunction. The standby attitude indicator receives DC power from the emergency instrument bus through a circuit breaker marked "STANDBY ATTITUDE" on the "FLIGHT INDICATORS" portion of the pilot's circuit breaker panel. Normally the emergency instrument bus receives power from the forward TR bus through the left essential bus. If TR power is lost, the indicator receives DC power from the forward/aft battery. See "battery loads," figure 3-19. An OFF flag will appear upon loss of all power to the indicator. A pitch trim and caging knob permits zeroing the horizon line with reference to the miniature aircraft and, when pulled, cages the sphere and causes the OFF flag to appear. The pitch trim and caging knob is spring-loaded. Do not allow the knob to spring back when released or damage to the instrument may result.

Flight Director Computer Gyro Select Switch

A flight director computer gyro select switch (56, figure 1-15) located on the pilots' instrument panel has NORMAL--ALTERNATE positions. The switch serves two purposes. First, it selects either the pilot's or copilot's MD-1 gyro input to the flight director computer for bank steering bar display on the ADI. Second, for the copilot's attitude system, it controls alternate sources of gyro synchro power and ADI power from the No. 3 or No. 5 generator bus. In NORMAL position, information from the copilot's MD-1 gyro is directed to the computer.



1. ATTITUDE SPHERE
2. MINIATURE AIRCRAFT
3. PITCH TRIM AND CAGING KNOB
4. BANK SCALE
5. BANK POINTER
6. OFF FLAG

Standby Attitude Indicator **BC**

Figure 1-47A

Synchro servo and attitude indicator power for the copilot's ADI is provided from the No. 3 generator bus through the "Copilot Gyro Sync and Att Ind" circuit breaker on the left load central circuit breaker panel. In ALTERNATE position, information from the pilot's MD-1 Gyro is directed to the computer. Synchro servo and attitude indicator power for the copilot's ADI is provided from the No. 5 generator bus through the copilot's flight gyro transformer. Power to the switch is supplied through a circuit breaker marked "Radio Nav Ind DC" on the "Flight Indicators" portion of the pilot's circuit breaker panel.

NOTE

- If the No. 3 generator is lost and the bus tie circuit breaker cannot be closed, both pilot's and copilot's ADI steering bars and the copilot's attitude indicator will be inoperative. The pilot's attitude indicator will receive power from the flight gyro emergency power inverter. Placing the flight director computer gyro select switch to ALTERNATE will restore power to the copilot's attitude indicator but the pilot's and copilot's steering bars will remain inoperative in all modes.
- If the No. 5 generator is lost and the bus tie circuit breaker cannot be closed, the copilot's

attitude indicator and pilot's and copilot's steering bars will be inoperative in all modes. Placing the flight director computer gyro select switch to ALTERNATE will restore all steering bar functions.

WARNING

If either of the above noted conditions occur during flight, consideration should be given to terminating the mission.

NOTE

The CPU-4/A flight director computer receives signals from the pilot's or copilot's MD-1 vertical gyro, VOR/localizer receiver, glide slope receiver, and horizontal situation indicator. The computer combines heading, roll, and localizer signals in the roll channel, and pitch and glide slope signals in the pitch channel. Depending on the mode of operation selected, the computer supplies either command heading steering or computed localizer steering signals to the bank steering bar and computed glide slope steering signals to the pitch steering bar.

Heading Indicator (Gyro)

A Type C-2A heading indicator (gyro) (59, figure 1-15) is located on the left side of the pilots' instrument panel. This instrument receives 115-volt three-phase a-c power as controlled by the gyro power switch on the pilots' instrument panel. See "Gyro Power Switch" for additional power source information. The heading indicator is an unslaved-type gyro which provides auxiliary headings for navigational purposes and is also used to provide headings in the event of failure of the main compass system. A calibrated compass card located on the upper portion of the instrument is read against a lubber line fixed on the instrument mask. The mask has a cutout in the lower portion which shows reciprocal heading. A spring-loaded push-to-set type synchronizing knob is located on the lower left portion of the indicator and is used to realign or calibrate the compass card to known references. Emergency d-c power is supplied to the heading indicator clutch at all times through a circuit breaker marked "Dir Ind C-2" above the "Flight Indicators" portion of the pilot's circuit breaker panel.

NOTE

The allowable drift rate is $\pm 8^\circ$ per hour minus the earth's rate; therefore, the instrument should be periodically reset to correct for drift beyond the capabilities of the leveling system.

Horizontal Situation Indicators

See "Flight Director System," Section IV.

Gyro Power Switch

A gyro power switch (63, figure 1-15) located on the left side of the pilots' instrument panel has ON--OFF positions. In ON position, power is supplied to the pilot's and copilot's attitude indicating systems, and the pilot's heading indicator. The 205/115-volt three-phase a-c aircraft power is routed through two transformers, each transformer receiving a separate source of power. The transformers reduce the power to 115-volt a-c which is supplied to the pilot's and copilot's attitude indicating systems and heading indicator. One source of power is supplied to the flight gyro transformer for the pilot's attitude indicating system, and the pilot's heading indicator through fuses marked "ØA," "ØB," and "ØC" on the "Flight Gyros" portion of the pilot's circuit breaker panel. The other source of power is supplied to the copilot's flight gyro transformer for the copilot's attitude indicating system through fuses marked "ØA," "ØB," and "ØC" on the "Flight Gyros" portion of the copilot's circuit breaker panel. This switch also provides gyro synchro power from the "Copilot Gyro Sync and Att Ind" circuit breaker on the left load central circuit breaker panel to the flight director computer gyro select switch.

NOTE

- When one of the flight gyro power fuses burns out, the indicator light will not illuminate and the gyro system will continue to function. The only means of checking for a burned out fuse is to remove the fuses one at a time. A burned out fuse light will illuminate when the first fuse is removed providing the removed fuse is not the burned out fuse. If two fuses are blown, the gyro system will not function properly and the fuse indicator lights will illuminate.
- If two flight gyro power fuses burn out, it is not recommended that the third fuse be pulled to cause the emergency instrument inverter to turn on and supply power for the pilot's attitude indicator, heading indicator, and associated equipment. The emergency inverter is designed to function during aircraft power failures and not during a single instrument failure. The other pilot's attitude indicator should be used instead. If for some reason two fuses have burned out on each attitude indicator circuit, a third fuse may be pulled as a last resort to restore the pilot's attitude indicator operation.

In case of a complete TR or a-c power failure, an emergency flight gyro inverter will supply 115-volt three-phase a-c power to the pilot's attitude indicating system and pilot's heading indicator (gyro). In addition, the inverter supplies lighting power for the pilot's attitude indicator and, on aircraft **W173** **W235**, to the pilot's altimeter. The inverter utilizes emergency d-c power through a circuit breaker marked "Emer Invtr" on the "Flight Gyros" portion of the pilot's circuit breaker panel and is automatically controlled by a gyro power switching relay when the gyro power switch is in ON position. When the gyro power switch is in OFF position, power is cut off to the instruments and the inverter. See "Electrical System Emergency Operation," Section III, for further information concerning the emergency flight gyro inverter.

Outside Air Temperature Gage

A Type G-10 outside air temperature gage (52, figure 1-15) is located on the left side of the pilots' instrument panel. The air temperature gage is operated by an electrical resistance thermometer bulb located flush with the body skin on the lower left side of the forward pressurized section aft of the radar navigator's escape hatch. The temperature range of the gage is -70° to $+50^\circ\text{C}$. The pointer should rest off the scale with power off and should register outside air temperature with power on. Electrical power is supplied by the left TR bus through a circuit breaker marked "Free Air Temp Ind" under "Miscellaneous" on the left load central circuit breaker panel.

SELF-POWERED INSTRUMENTS

Accelerometer

- A Type MA-1 accelerometer is located on the pilots' eyebrow panel (27, figure 1-15). The accelerometer is a self-contained unit requiring no external connections. The dial is calibrated in "g" units from -2 to +4 "g's." The instrument contains three pointers, the main pointer giving continuous indications. Two auxiliary pointers indicate and maintain maximum plus and minus accelerations until they are reset, using the reset knob on the front of the instrument.

Magnetic Standby Compass

- A pilot's magnetic standby compass (29, figure 1-15) is located on the eyebrow instrument panel between the oil pressure gages.

Clocks

- A Type A-13A clock (3, figure 1-15) is provided on the left and right sides of the pilots' instrument panel. They are spring-wound 8-day clocks and have a winding knob on the lower left corner. A sweep second hand and minute totalizer, both controlled by successive depressions of a START--STOP--RESET knob on the upper right corner, are provided.

EMERGENCY EQUIPMENT

For location of emergency equipment, see figure 3-2.

ENGINE FIRE DETECTION SYSTEM

The aircraft is not equipped with an engine fire extinguishing system. The aircraft is equipped with an electrically operated fire detection system. The system consists of separate fire detection circuitry for each engine and a test switch for simultaneous test of all circuits. Each engine is protected by thermally actuated fire detectors wired in parallel, which provide fire warning signals through a light on the pilot's instrument panel. The fire detector system uses left essential d-c power supplied through a circuit breaker marked "Fire Det Outbd Eng" on the "Engine" portion of the left load central circuit breaker panel and right essential d-c power supplied through a circuit breaker marked "Fire Det Inbd Eng" on the "Engine" portion of the right load central circuit breaker panel.

Engine Fire Warning Lights

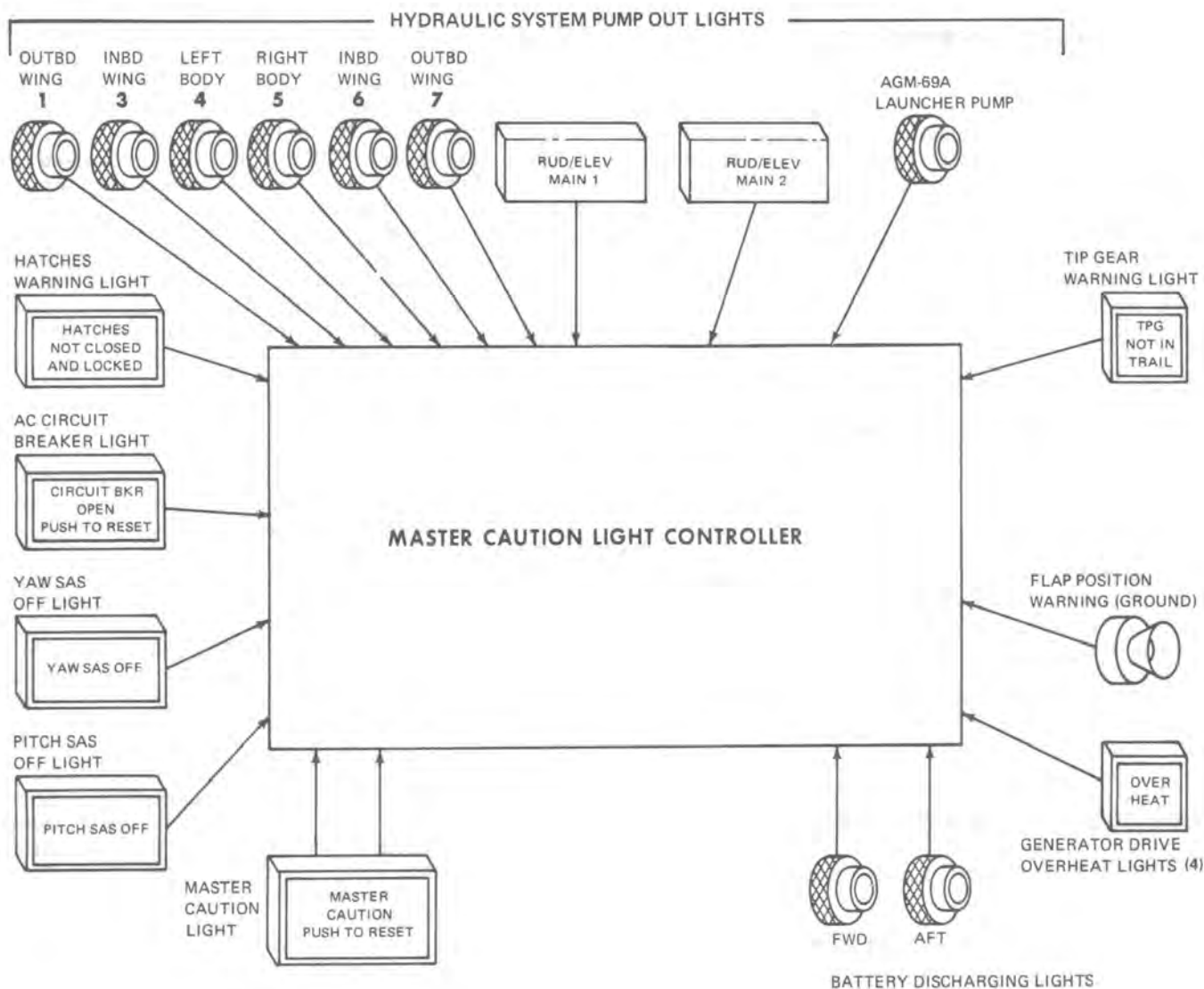
- Eight red engine fire warning lights (33, figure 1-15) are an integral part of the fire shutoff switches on the pilots' instrument panel. A fire warning light will illuminate when a fire detector unit on the affected engine is thermally actuated because of a fire or pneumatic duct air bleed leak.

Engine Fire Detector System Test Switch

An engine fire detector system test switch (58, figure 1-15) is located on the left side of the pilots' instrument panel. The switch is of the rotary type, has two positions, TEST--NORMAL, and is used to test continuity of the engine fire detection system. In the spring-loaded TEST position, illumination of the warning lights indicates that the warning light circuits have continuity. Conversely, failure of the lights to illuminate indicates that the warning light circuits are broken provided the bulbs glow on press-to-test. In NORMAL position, the circuits are armed for fire warning.

ENGINE FIRE SHUTOFF SWITCHES

Eight two-position pull-push fire shutoff switches (33, figure 1-15) on the upper portion of the pilots' instrument panel control engine fire shutdown. Each of the T-shaped switches has a red press-to-test engine fire warning light in the end of the handle. Pulling a switch to FIRE SHUTOFF position closes the engine firewall fuel shutoff valve for the corresponding engine regardless of throttle position. In addition, when No. 1, 3, 4, 5, 6, or 7 switch is pulled, the respective engine firewall hydraulic shutoff valve is closed and, on engine 1, 3, 5, or 7, the respective generator control relay is tripped, de-energizing the generator. The generator circuit breaker will open and, if the respective generator bus tie circuit breaker is open, that bus tie circuit breaker will be closed. Pushing a fire shutoff switch in to the NORMAL position restores the engine firewall fuel shutoff valve to normal control by the throttle. See "Throttles" under "Engine Fuel Control System," this section. Pushing in the switch for engine No. 1, 3, 4, 5, 6, or 7 opens the engine firewall hydraulic shutoff valve but does not restore generators on No. 1, 3, 5, or 7 to normal operation. It is necessary to restart the generator as given in Section VII under "Generator Operation." The firewall fuel shutoff valves utilize essential d-c power for operation from the respective engine-numbered circuit breaker on the "Firewall Fuel Shutoff Valves" portion of the copilot's circuit breaker panel. The outboard engines use left essential d-c power from the left essential start bus and the inboard engines use right essential d-c power from the right essential start bus. When no other power is on the aircraft and one of the batteries goes dead, the remaining battery will automatically be switched to supply power to all the fuel shutoff valves. The engine firewall hydraulic shutoff valves use essential d-c power for operation from the respective engine-numbered circuit breaker on the "Firewall Hydraulic Shutoff Valves" portion of the copilot's circuit breaker panel. Left wing engines use left essential d-c power and right wing engines use right essential d-c power. The generator control power is the same as for normal control; generators on engines 1 and 7 use left essential d-c power and generators on engines 3 and 5 use right essential d-c power, all through circuit breakers on the "AC Generator Control" portion of the copilot's circuit breaker panel.



Master Caution Light Functions(Typical)

Figure 1-48.

MASTER CAUTION LIGHT

A rectangular amber indicator light (36, figure 1-15) with an integral push-to-reset switch is installed on the right side of the pilots' instrument panel. The light has a "word warning" panel which, when illuminated, shows black letters "Master Caution, Push to Reset" on an amber background. The master caution light serves to warn that one of the systems which it monitors (figure 1-48) has a malfunction. The master caution light will illuminate at the same time as the indication in the malfunctioning system occurs and will remain on as long as malfunction

continues unless it is reset. The master caution light may be reset by pressing the face of the light, at which time it will go out and be ready for additional indication of malfunction in the remaining monitored systems. The master caution light will not indicate malfunction on the reset channel until the initial malfunction has been remedied. The systems monitored are graphically shown in figure 1-48 and are as follows:

- Hydraulic Low Pressure (8 airplane system pumps and an AGM-69 launcher pump)
- Battery discharging - forward and aft batteries

- Flap position warning (ground function only)
- Generator drive overheat - 4 generator drives
- A-C circuit breaker open (receives same signal as a-c circuit breaker light) - 8 circuit breakers
- Hatches not locked warning
- Tip protection gear position warning
- SAS yaw and pitch axes

For further information on origination and cause of malfunction signal to this light, refer to the respective system descriptions in this section. The master caution light bulbs may be checked by pressing on the face of the light. The master caution light and controller use right TR power from a circuit breaker marked "Master Caution Light" on the "Miscellaneous" portion of the copilot's circuit breaker panel.

NOTE

Refer to T.O. 1B-52G-30-2 for information on AGM-69A launcher hydraulic low pressure light.

EMERGENCY ALARM SYSTEM

NOTE

The interphone is considered the primary means for crew warning; the emergency alarm system is designed to warn personnel while off interphone.

Red emergency alarm lights are located on the upper part of the forward instrument console at the navigators' station, on the upper part of the instrument console at the defense station, and on the upper part of the right electronic rack at the bunk station in the upper deck walkway in the pressurized crew compartment. In addition, red alarm lights are located in the forward part of the bomb bay, aft wheel well, and aft equipment compartment. A monitor light (18, figure

1-13) for the pilots is provided on the right side of the aisle stand. This light will not press to test. The lights are controlled by a guarded ALERT--OFF--ABANDON emergency alarm switch (19, figure 1-13) on the right side of the aisle stand. When the switch is in ALERT position, a flasher mechanism flashes all alarm lights at a frequency of approximately 30 to 60 times a minute. In ABANDON position, the lights glow continuously. In addition, the lights glow continuously when either the pilot's or copilot's control column is stowed during the ejection sequence. The light circuits in the pressurized compartment are separate from those in the unpressurized part of the aircraft. All lights normally use power from the aft battery bus and therefore operate regardless of battery switch position. All lights use forward battery power when the emergency battery switch is in EMERGENCY. Control power for the emergency alarm light is received from a circuit breaker marked "Bailout Warn Contr" on the "Emer Alarm Sys" portion of the pilot's circuit breaker panel. See "Emergency Signals" in the pilot's "Preparation for Flight Checklist," Section II, for information concerning use of the lights.

HAND FIRE EXTINGUISHERS

Two Type A-20 stored pressure bromochloromethane (CB) type fire extinguishers (13, figure 3-2) are installed in the crew compartment. One extinguisher is located below the instrument console between the EW officer and gunner; the other extinguisher is located on the aft side of the navigator's ejection seat rails. A trigger-type handle located on top of the extinguisher permits the extinguisher to be operated with one hand. A pressure gage on each extinguisher indicates the CB pressure in the extinguisher. When fully serviced, the extinguishers are effective within a range of 20 feet in combating all types of fires. However, the closer the extinguisher can be used to the source of the fire the greater its effectiveness.

Supply of extinguishing agent is depleted in approximately 22 seconds during continuous operation. The fully serviced pressure is 165 (± 10) psi at 70° F.

WARNING

Repeated or prolonged exposure to high concentrations of bromochloromethane (CB) or decomposition products should be avoided. CB is a narcotic agent of moderate intensity but prolonged effect. Normal precautions should be taken including the use of oxygen when available. Crewmembers will go on 100% OXYGEN immediately, with emergency toggle lever in NORMAL position, if exposed to fumes. When using a portable oxygen bottle, the regulator setting will be 30M or higher, commensurate with aircraft altitude.

CAUTION

Bromochloromethane is highly corrosive to aircraft metal, paint, and plexiglass. In the event the fire extinguisher starts to leak, the extinguisher should be inverted and the control valve depressed (cover the nozzle with a cloth or aim into a container to catch any liquid which may be discharged). This will release the stored charge of pressurizing gas with a minimum discharge of fluid and render the extinguisher harmless. The extinguisher should be returned to its bracket and be reported for replacement in Form 781.

NOTE

The type A-20 (CB) hand fire extinguisher should be held upright to fight fire. The extinguishing agent pickup is in the bottom of the extinguisher. In the inverted position the gas pressure charge will bleed off rapidly and render the extinguisher inoperative.

FIREFIGHTING GLOVE CONTAINERS

Two containers (8, figure 3-2) with asbestos gloves for firefighting are installed in the crew compartment. One container is located on the copilot's ejection seat fixed rail cross tube on the aft side of the seat. The other container is located on the aft side of the navigator's seat.

AXE

A hand axe (14, figure 3-2) is provided for emergency escape by the crew. The axe is stowed on the front of the defense instructor's seat. A chopout area is marked with yellow-orange paint on the sidewall outboard of the EW officer's seat.

FIRST AID KITS

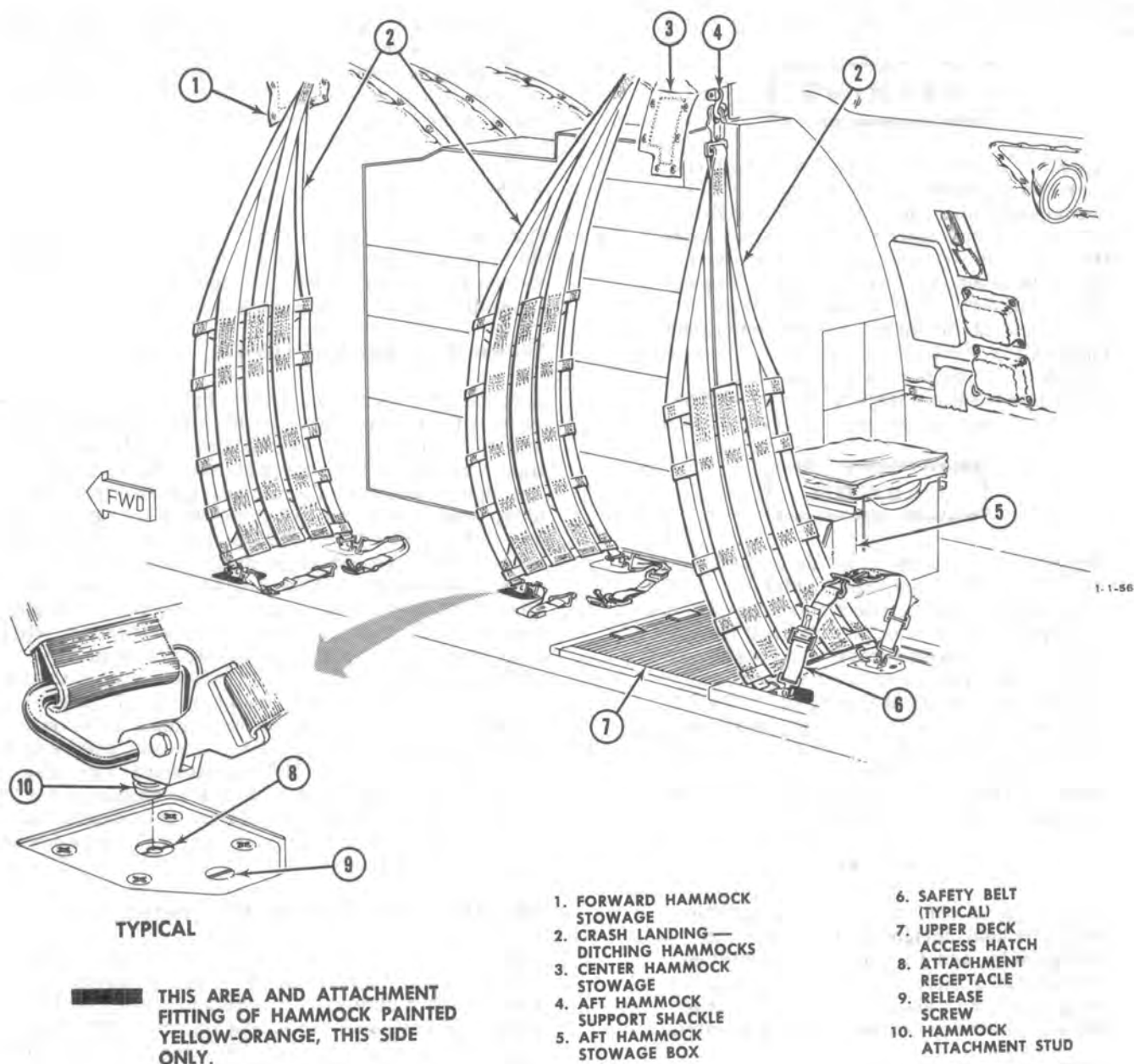
Three aeronautic first aid kits (9, figure 3-2) are installed in the aircraft, two are located on the sidewall outboard of the EW officer's seat and one on the right sidewall adjacent to the navigator's seat.

TERRAIN CLEARANCE LIGHT

A retractable terrain clearance light located just forward of the forward main landing gear provides illumination during night crash landing or ditching. The light may also be used for night takeoff and landings. The light is controlled by an open guarded three-position switch (figure 4-19) on the aisle stand. The switch has EXT--OFF--RET positions. In EXT position, 118-volt a-c power is supplied to a motor which extends the light out of the fuselage. OFF position stops the motor and allows the light to remain at any degree of travel during extension or retraction. RET position supplies power to the motor to retract the light into the fuselage. Limit switches automatically stop the motor at either extreme of travel. Light illumination is independent of the switch and is controlled by position of the light. The light will be illuminated at any time the light is extended more than 10°. Control power for the motor is supplied by a circuit breaker marked "Terrain Light Control" on the "Lighting - Exterior" portion of the left load central circuit breaker panel.

CRASH LANDING-DITCHING STATIONS

All crew seats on the upper deck of the crew compartment have been stressed for use as ditching and crash landing stations. In addition, three crash landing and ditching hammocks (figure 1-50) are provided for use of lower deck crew members when necessary. This gives provisions for nine crew members. The three crash landing-ditching hammocks are normally stowed when not in use but may be installed in the upper deck walkway between the pilots' station and the defense station for crash landing or



Crash Landing— Ditching Hammocks

Figure 1-50.

ditching. The forward and center hammocks remain fastened at their upper ends at all times and are stowed within the compartment lining above the installation location. The forward hammock is stowed within a flap of the lining, marked "Fwd Ditching Station Hammock Stowage," snap-fastened on the aft edge of the flap. The center hammock is stowed within a flap of the lining adjacent to the air refueling receptacle marked "Ditching Station Hammock Stowage," snap-fastened on the inboard edge of the flap. The aft hammock is stowed separately in a box marked "Ditching Hammock Stowage" next to the defense instructor's seat and must be fastened at both upper and lower ends when installing. For installation, the upper end of the aft hammock must be hooked to a shackle mounted over the upper deck access hatch marked "Ditching Hammock Attachment & Hoist Fitting." All three hammocks are of nylon webbing construction, having a single attachment point at the top and two attachment points at the bottom. The fittings on the bottom of the hammock are studs which snap into flush receptacles on the walkway floor. The hammocks are designed to withstand ultimate load factors of 8 "g's" forward and down and 4 "g's" up and aft when properly installed.

NOTE

- Care should be taken when inserting the studs in the receptacles that the correct installation is being made since once the fittings are inserted, it is necessary to use a screwdriver in the screw aft of the fitting in order to release the fitting.
- The upper deck access hatch grating should be closed to allow easy access to the receptacles for the aft hammock.

The hammocks are designed for the occupant to sit on the aft side and are provided with a manual safety belt to secure the occupant in position. To facilitate correct installation of the hammock, each is marked "Aft" on the aft side and "Fwd" on the forward side. In addition, the lower attachment fitting on the hammock and the receptacle in which it fits on the left side of the aircraft are both painted yellow-orange to aid in correct matching.

ESCAPE HATCHES

Crew Compartment

The escape hatches (13, 14, 15, 16, 31, and 32, figure 1-2) in the aircraft are located at each crew station equipped with ejection seats. The hatches (figure 1-51) are designed to facilitate pressurization of the crew compartment, yet be jettisonable to allow the ejection seat to be catapulted through the hatch opening for emergency escape. The hatches are of metal construction and have conventional lining; only the pilots' hatches have windows which provide side

vision when the aircraft is in a banked attitude and provide better vision during air refueling. The aft upward escape hatches (15 and 16, figure 1-2) and the downward escape hatches (31 and 32, figure 1-2) are equipped with aerodynamic hatch lifters which are projected into the windstream as the hatch is unlocked during the automatic ejection sequence. The aerodynamic hatch lifters insure hatch jettisoning during automatic ejection sequence regardless of crew member order of ejection.

NOTE

At airspeeds in excess of 300 knots IAS, the aft upper escape hatch lifter(s) may extend approximately 2 inches. This condition is considered normal and does not constitute a hazard to crew members. It does not affect the functional reliability of the escape system.

EVS monitor optical light filters stowage provisions are installed on the pilot's and copilot's escape hatches. The navigator's and radar navigator's escape hatches have EVS sensor turret fairings attached to the lower side.

Footrests with mike switches are installed on the inside of the lower deck hatches. The hatches are part of the various seat ejection systems and will be opened automatically by a gas-powered thruster when the appropriate seat ejection mechanism is actuated.

WARNING

Removing a hatch without first disconnecting the arming link will fire the catapult safety pin pull initiator and leave the ejection seat catapult in an armed condition.

The hatches may be released manually for use in emergency exit or entrance. Hatch release handles, painted yellow-orange, are provided on the inside of all hatches and, when pulled away from the hatch, will unlatch and open the respective hatch. (On aircraft **W339**, the hatch release handles at the radar navigator's and navigator's stations are painted gray.) The inside handles for the upper deck hatches are inside a transparent flap of the lining. Flush-mounted external hatch release handles are provided for the forward upper hatches. Release handles for the aft upper hatches are flush mounted to the side of the hatch lifters. These handles may be used for emergency entrance by pulling away from the hatch (figure 3-12). Each hatch is provided with six rotary latch hooks which engage latch arms on the fuselage. When the latch hooks are in the latched position, a pair of latch pins is driven into the throat of each latch hook by rotation of torque tubes within the hatch. The latch pins overlap the lip of the latch hook approximately 1/8 inch when properly latched.

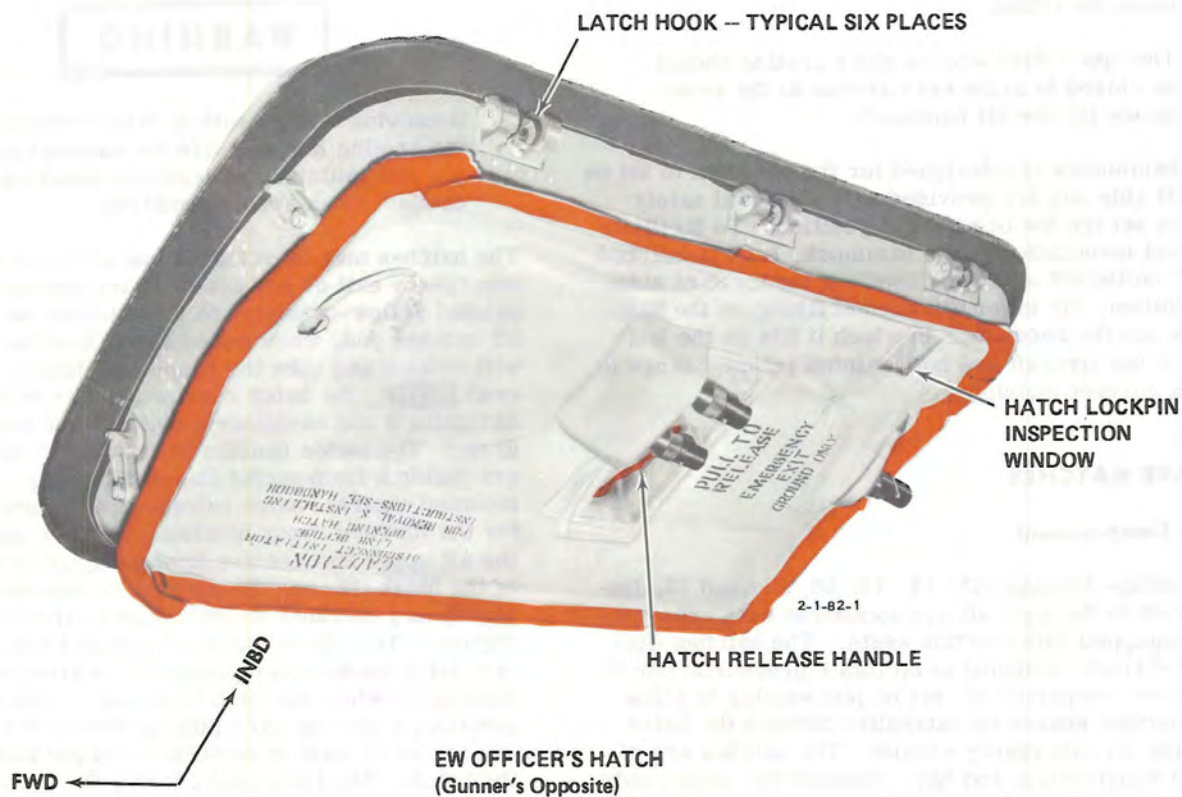
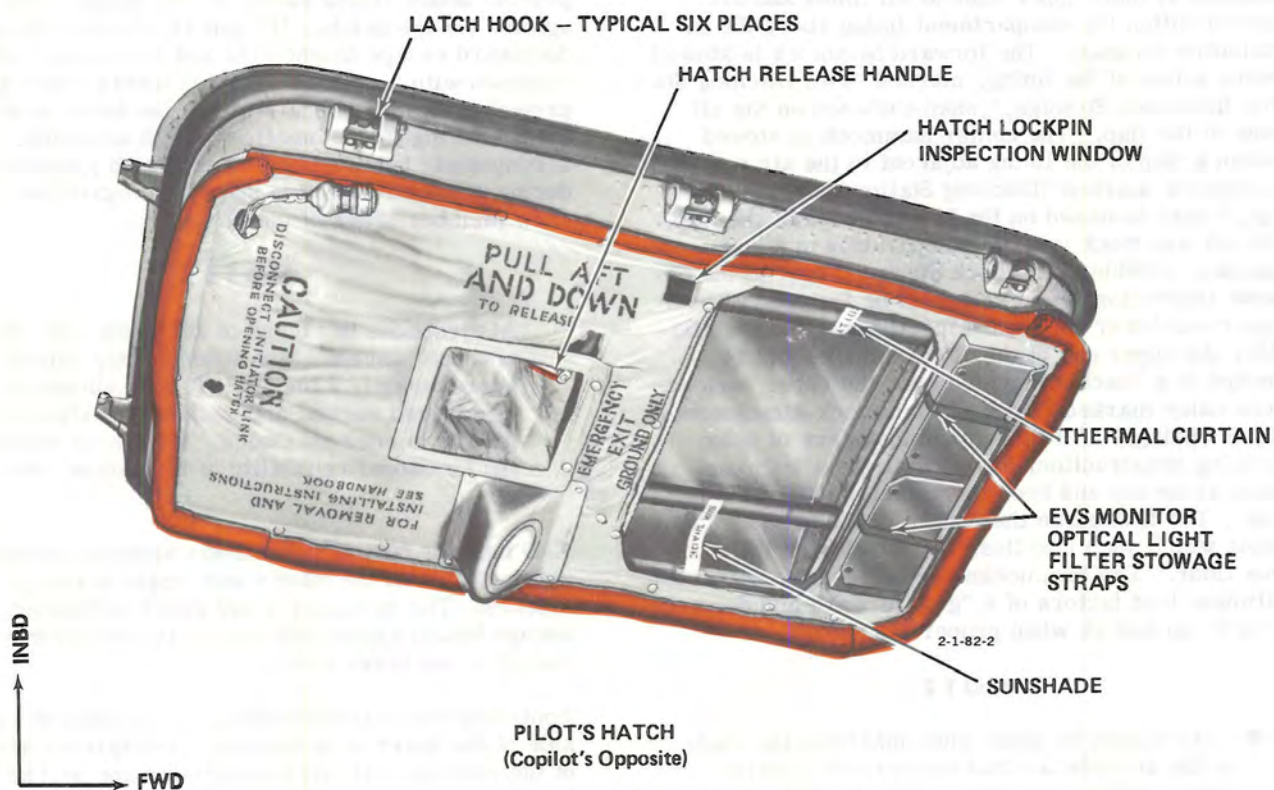
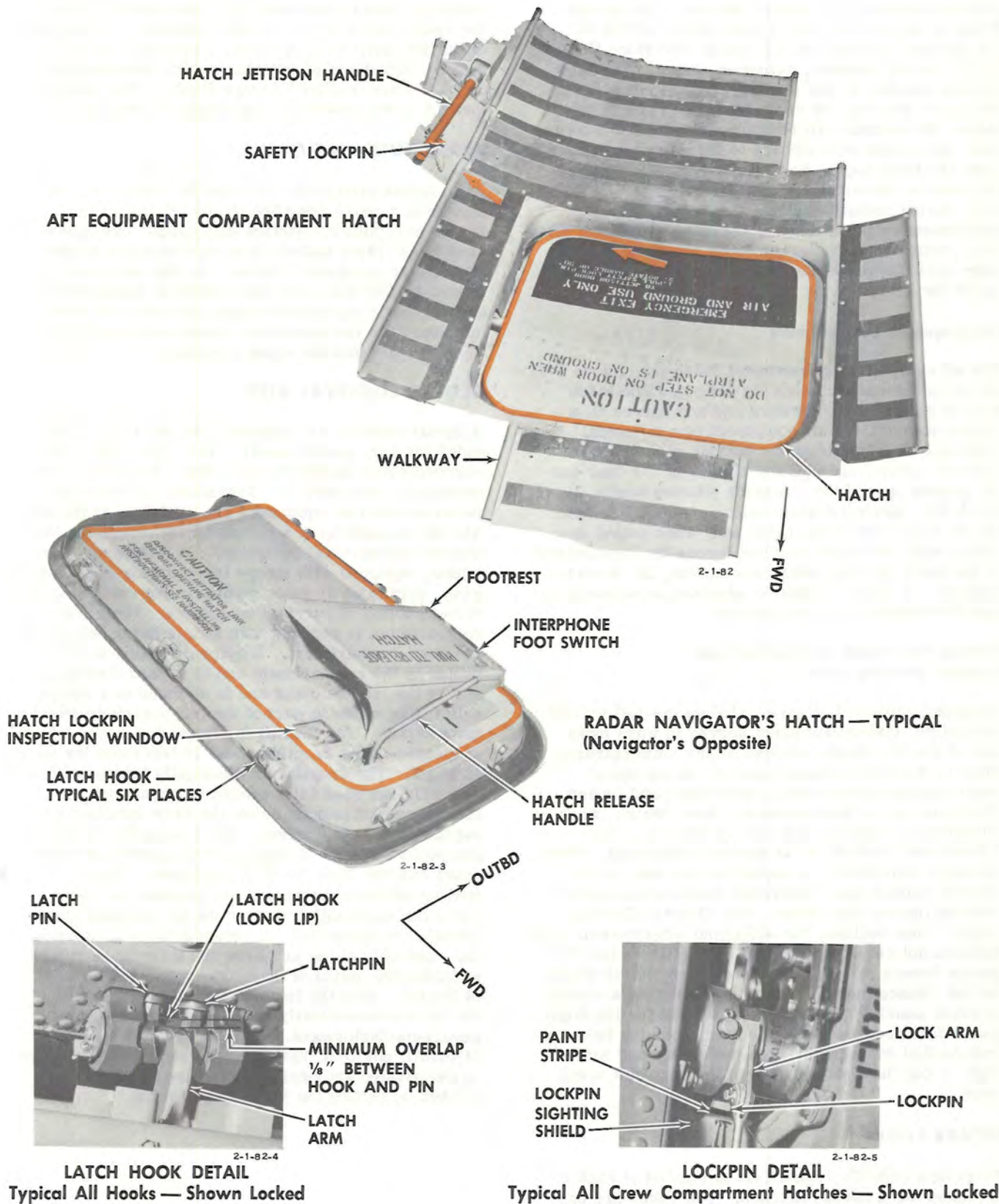


Figure 1-51 (Sheet 1 of 2).



Escape Hatches

Figure 1-51 (Sheet 2 of 2).

A spring-loaded lockpin retains the torque tube in the latched position. A lockpin inspection window is provided in each hatch to allow checking of the lockpin. When in proper position, a paint stripe shows on the lockpin adjacent to its spring cartridge (figure 1-51). At all stations, actuation of any of the hatch release handles or the gas-powered thruster mechanism will perform the same function to unlock the hatch: the lockpin will be disengaged from the torque tube, the torque tube rotates to withdraw the latch pin from the latch hooks, and the latch hooks rotate as the hatch is forced away from the fuselage. In addition, during actuation of the gas-powered thruster mechanism on those hatches provided with hatch lifters, pushrods on the torque tubes force the hatch lifter into the windstream to insure positive jettisoning of the hatch.

Aft Equipment Compartment

The aft equipment compartment hatch (19, figure 1-2) serves as an escape hatch for bailout. The hatch door is hinged at the forward end and serves as an access door for the aft equipment compartment. A flush-mounted handle on the outside of the door is used for normal opening and closing of the door during ground operations. A hatch jettison handle (figure 1-51), painted orange-yellow, is installed near the aft right side of the hatch and, when pulled upward, pulls the hinge pins and forces the forward end of the hatch into the airstream causing the hatch to jettison. A safety lockpin is provided to securely retain the handle in stowed position.

Hatches Not Closed and Locked Light (Hatches Warning Light)

An amber light (47, figure 1-15) on the left side of the pilots' instrument panel serves to warn when any of the six escape hatches or the main entrance door in the crew compartment or the aft equipment compartment hatch is not closed and locked. The light has a "word warning" panel which, when illuminated, shows black letters "Hatches Not Closed and Locked" on an amber background. When the light illuminates, a signal is also sent to the master caution light controller causing the master caution light to illuminate. See "Master Caution Light," this section, for additional information. The hatches not closed and locked light utilizes left TR power from a circuit breaker marked "Hatch Warn" on the "Miscellaneous" portion of the pilot's circuit breaker panel. The energizing circuit for the light loads data recorder uses the hatch warning light circuit so that when the hatches not closed and locked light is out (hatches all closed) the recorder operates.

ESCAPE ROPES

An escape rope (7, figure 3-2) is located at each of the upper deck escape hatches. The ropes are provided to help personnel from the aircraft in any normal or crash attitude. The ropes are designed to be of sufficient length to reach the ground when thrown

through escape hatches. The ropes at the pilots' stations are contained in canvas bags having zipper openings and are installed below the outboard side of the escape hatch aft of the side windows. The ropes at the EW officer's and gunner's stations are contained within flaps of the lining which are snap-fastened and are marked "Escape Rope." The ropes are located on the sidewalls just below the hatches.

PARACHUTE STATIC LINE

A parachute static line (14A and 15, figure 3-2) is stowed in a pouch installed on the aft side of the (radar navigator's) ejection seat rails. The line is used to facilitate bailout of an injured crewmember through the navigator's hatch. At high altitudes (above 14,000 feet), the line should be connected to the automatic parachute arming lanyard. At lower altitudes, the line should be connected directly to the ripcord T-handle of the parachute.

GLOBAL SURVIVAL KITS

A global survival kit (figures 1-54 and 4-81) is provided for each ejection seat. The Type CNU-129/P survival kit is located in the bottom of the seat and includes a seat cushion. Provisions for assorted items of survival equipment are contained in the kit. The kit is made up of a compartment containing the liferaft and survival equipment. A waterproof container, equipped with straps for carrying as a backpack, serves as an inner compartment containing various items of survival equipment. The inner compartment is secured with straps in the bottom of the main compartment. A nylon drop line is connected to the compartment and is passed through a slot in the lid; the other end is attached to a detachable fitting which is part of the left parachute attachment fitting. The liferaft is fastened to a loop which is located on the dropline about 10 feet from the survival kit. The dropline automatically triggers liferaft inflation when fully extended, permitting the liferaft and kit to hang below the crew member during the parachute descent. The automatically deployed survival kit is deployed by a sensor incorporated into the Type BA-27A parachute. The connection between the sensor and actuator is automatically accomplished when the kit and parachute fittings are connected. A selector lever located on the right side of the kit below the kit release handle, provides the option of manual or automatic release of the kit. With the lever in the up AUTO position, the kit is automatically actuated 4 seconds after parachute deployment. With the lever in the down MANUAL position, the automatic deployment feature is deactivated and deployment of the kit is accomplished by pulling the kit release handle.

NOTE

Incorporation of the automatic actuator in the CNU-129/P survival kit does not affect or prevent manual deployment by use of the kit release handle.

Automatic or manual deployment of the survival kit releases the parachute attachment fittings, allowing the kit to drop, the lid to open, and the liferaft to inflate. The dropline remains attached to the parachute harness and is attached to the liferaft and survival kit. The liferaft will hang about 15 feet below the descending airman and the kit about 25 feet below.

The kit is attached to the parachute by means of a linkage assembly strap connected by quick-disconnect fittings to the parachute harness accessory ring. When attached to the modified parachute, the straps with quick-disconnects are passed through loops in the safety belt. This interconnects parachute, safety belt, and survival kit. The kit is installed in the aircraft merely by placing it in the seat bucket. The straps are then passed through the safety belt loops and connected to the parachute accessory rings with the quick-disconnects. The safety belt and parachute are then installed in the integrated harness fittings on the seat. Normally the survival kit is not detached from the parachute except for emergency reasons such as a crash landing or when accomplishing an alternate bailout. Should a crew member have

occasion to leave the seat without the survival kit but wearing the parachute, he may do so by pulling the survival kit release handle while firmly seated on the survival kit. Pulling the release handle while seated on the kit releases the strap adjusters and seat occupant from the survival kit and the kit compartment lid will unlock, but will remain connected in position by the hinge assembly on the front of the kit.

Global Survival Kit Controls

MODE SELECTOR LEVER. A mode selector lever (21A, figure 1-54) is located on the lower right hand side of the front of the survival kit. The lever has two positions, AUTO--MANUAL. In AUTO (up) position, the survival kit will be automatically deployed 4 seconds after parachute opening if connected to a type BA-21A or BA-27A parachute. The deployment sensor in the parachute initiates the deployment actuator in the survival kit. In MANUAL (down) position, the kit will be deployed only upon actuation of the survival kit release handle.

SURVIVAL KIT RELEASE HANDLE. The survival kit release handle (21, figure 1-54) located on the right side of the survival kit is operated by pulling up against the handle latch until the handle pulls free from the container. When the survival kit is in the seat, a plunger (22, figure 1-54) located on the bottom of the kit is depressed. If the kit release

handle is pulled with the plunger depressed, the parachute strap adjuster will be disconnected, thus severing the survival kit from the parachute harness. The lid will not open and the dropline will remain attached to the kit. The kit release handle may then be reset by replacing the handle in the socket, reinstalling the parachute strap adjusters and while pushing firmly down, the adjusters move the release handle to the locked position. Insure the survival kit is locked by pulling on the parachute strap adjusters.

NOTE

- Do not allow the arming plunger to drop down before the release handle and parachute strap adjuster have been reset.
- Do not use the survival kit release handle to lift or carry the kit. To do so may cause the kit to open.
- It is possible to install the survival kit in the ejection seat with the arming plunger extended. Insure that the plunger is fully depressed into the kit before occupying an ejection seat.

When the survival kit is removed from the seat, the arming plunger will be extended, arming the compartment lid opening mechanism. If the kit release handle is pulled with the arming plunger extended, the lid will open, the dropline will remain attached to the parachute harness, the parachute strap adjuster will be disconnected, and the raft will inflate as the dropline is extended.

WARNING

Do not pull the kit release handle while in the aircraft with the kit not installed in the seat. Pulling the handle with the kit suspended will cause the lid to open, leaving the crew member attached to the survival kit. In an emergency, this could cause a fatal delay in escaping from the aircraft.

FIRING PIN INDICATOR. A cylindrical indicator (21B, figure 1-54) having a red ring around its body will protrude from the release mechanism, with the red visible, to indicate that the release initiator has fired.

LIFERAFT DEFLATION TOOL

WARNING

Instances of inadvertent liferaft inflation have occurred in flight resulting in full forward control column displacement. Pilots must be alert to this possibility and be prepared to immediately puncture the liferaft should inadvertent inflation occur.

A knife-like tool (16, figure 3-2) located on the pilot's and copilot's glare shield above their respective side panels is provided for liferaft deflation. In the event the liferaft becomes inadvertently inflated at either pilot's position, the pilot or copilot will puncture the inflated raft with the deflation tool and use a ripping action to make a large opening for rapid deflation.

DOORS

MAIN ENTRY DOOR

A main entry door on the lower forward side of the fuselage (figure 2-1) is provided for access into the lower deck of the crew compartment. An entrance ladder is installed on the inner side of the door. The door can be opened and closed from both the inside and outside but can be locked and unlocked from the inside only. The locking handle is located inside the ladder structure near the left front corner of the door (door closed) and is moved to the left to lock and to the right to unlock the door. The inside operating handle is located outside the ladder structure near the right front corner of the door (door closed) and is moved aft to unlatch and forward to latch the door. The outside operating handle is flush with the surface of the door and is rotated laterally to latch or unlatch the door.

PRESSURE BULKHEAD DOOR

A pressure bulkhead door (73, figure 1-2) at the aft end of the lower deck is provided for inflight access to the unpressurized portion of the fuselage. This door can be opened from either side. The crew compartment must be depressurized before opening the door. This door can be locked from the crew compartment side by disabling the door handle. To lock the pressure bulkhead door, the door must be closed and latched and the lockpin removed. This action disconnects the door handle from the vertical latching bar. To unlock the pressure bulkhead door, the handle is rotated until the hole in the door handle extension lines up with holes on the end of the latching bar and the lockpin is inserted. Rotating

the door handle on either side of the door with the pin in place lifts the latching bar to the unlatched position and the door can be opened.

AFT EQUIPMENT COMPARTMENT HATCH

An aft equipment compartment hatch (19, figure 1-2) also serves as an escape hatch for bailout. See "Escape Hatches," this section, for description of the door.

LOWER DECK FOLDING HATCH

- A lower deck folding hatch (13, figure 4-42) is located over the main entry door and is used to prevent crew members from stepping on the main entry door while moving about on the lower deck. The hatch is held closed by a spring-loaded locking pin. To open the hatch, the locking pin is withdrawn and the door is folded up to its stowed position under the instructor navigator's seat where it is held in place by a spring-loaded latch.

UPPER DECK SLIDING HATCH

- An upper deck sliding hatch (12, figure 4-83) is provided to cover the opening between the upper and lower decks. The hatch is held closed by two spring-loaded locking pins. To open the hatch, the locking

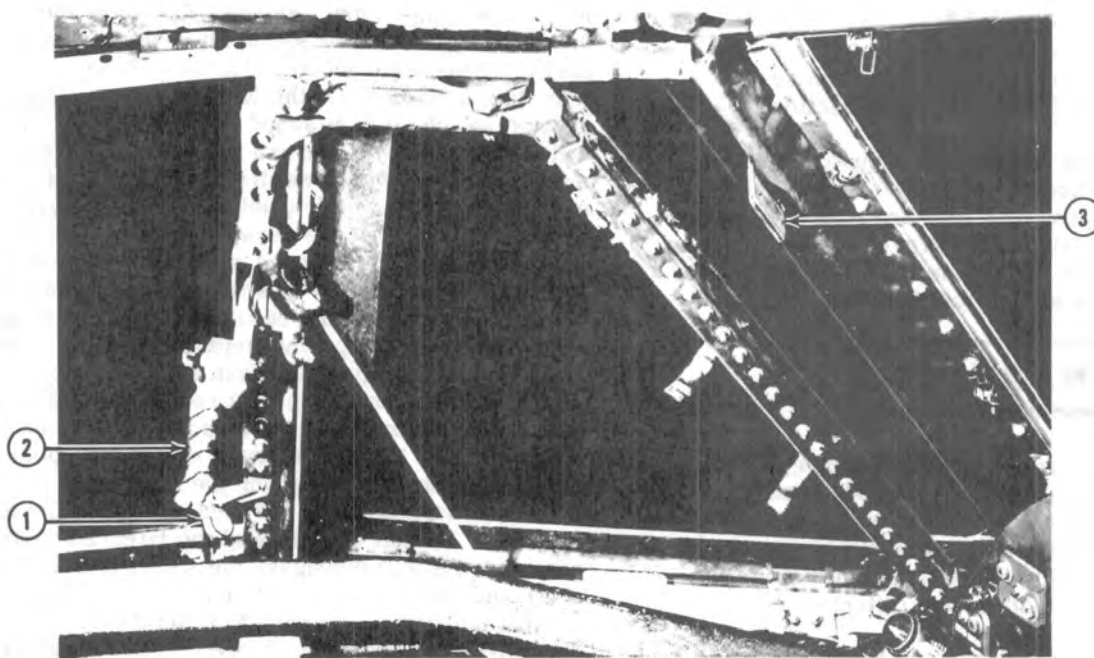
pins are withdrawn and the door is slid aft along permanent tracks.

PILOT'S SLIDING WINDOWS

Pilot's and copilot's sliding windows (figure 1-51A) may be opened or closed (as required) while on the ground. The sliding window assembly is made up of an electrically heated window, tubular window frame, latching mechanism, rubber seal, and an electrical plug connector. Closing the window is accomplished by rolling it forward along the tracks to the forward stop and rotating the latching handle upward until the seal is pressed against its seat. A lockbolt within the handle retains the window in the closed position. Opening the window is accomplished by releasing the handle lockbolt, rotating the handle downward and pulling the window aft.

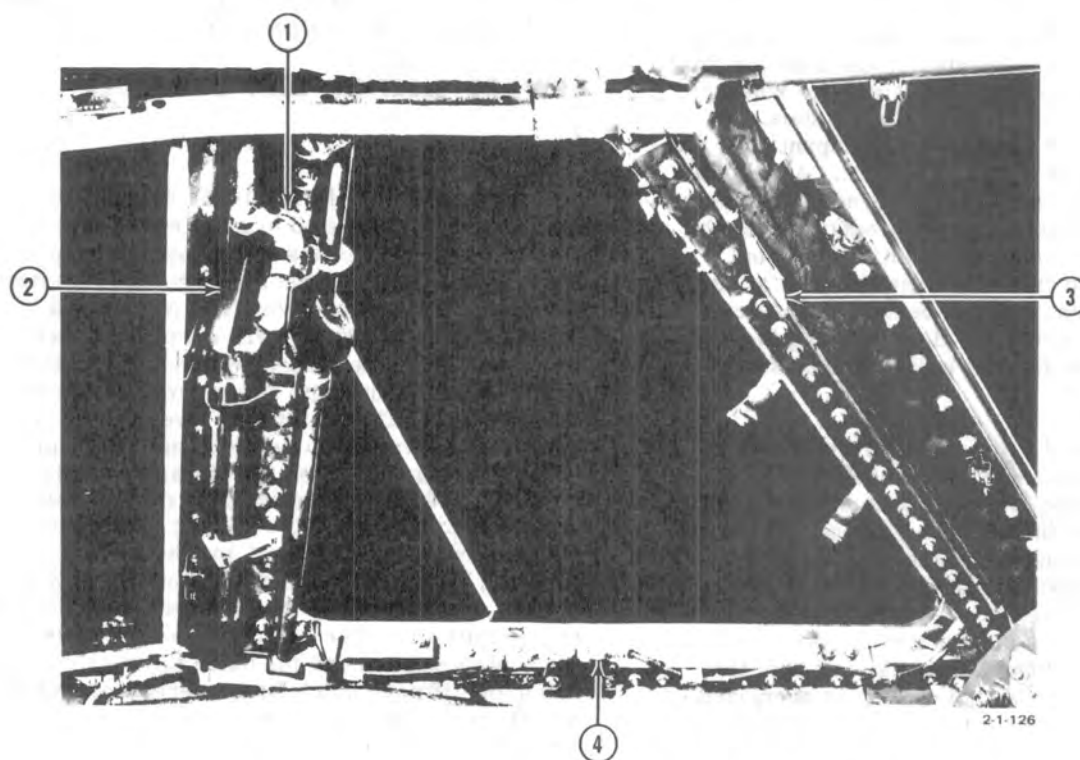
WARNING

To prevent injury to ground crewmembers, one of the pilots' sliding windows will be opened approximately 2 inches before the main entry door is opened or closed.



WINDOW IN
OPEN POSITION

2-1-141



WINDOW IN
CLOSED POSITION

2-1-126

NOTE

PILOT'S WINDOW SHOWN —
COPILOT'S OPPOSITE

1. HANDLE LOCKBOLT
2. WINDOW HANDLE
3. FORWARD STOP
4. ELECTRICAL CONNECTOR

.....Pilot's Sliding Windows

Figure 1-51A.

UPWARD EJECTION SEATS

NOTE

For description of downward ejection seats, see "Downward Ejection Seats," Section IV.

The pilots' positions in the crew compartment are equipped with forward-facing bucket-type ejection seats designed to provide a safe and effective means of bailout from the aircraft. Provisions are made to accommodate a survival kit and back-type automatic opening parachute and integrated harness.

WARNING

Do not use any form of shock absorbing device other than the survival kit and/or seat cushion designated as standard equipment for the ejection seat. To do so would create a definite possibility of serious injury during ejection and/or crash landing/ditching.

Utilizing the wrong seat cushions and/or survival kit or too much cushioning material does not provide comfort but actually creates a definite injury hazard and may position the seat occupant where it is difficult to reach the controls. Chance of vertebral injury is increased considerably by the seat occupant sitting on too thick a compressible mass. When utilizing the ejection seat in this circumstance, it will not exert a direct force on the occupant until the seat has traveled 2 or 3 inches upward. After this amount of travel, the seat has gathered such momentum that excessive impact is produced when the seat initially lifts the seat occupant. Additional cushioning may also raise the seat occupant to such a height that his arms will not be held by the arm retainers on either armrest, thus exposing them to possible injury from flailing in the wind blast following ejection.

Each seat is equipped with folding armrests which may be folded by releasing the armrest catch (11, figure 1-52). Arming levers, one in each armrest, are used to prepare the seat for ejection. A series of ballistic devices and mechanical linkages incorporated in the seat, when initiated by either arming lever, will lock the inertia reel, stow the control column, jettison the hatch, unlatch the pilot and copilot seat drogue parachute arms, and arm the seat for ejection. The alarm system is energized to signal "abandon" when either the pilot's or copilot's control column stows. A catapult is incorporated to eject the seat from the aircraft, and is fired by squeezing either of the firing triggers located inside of each arming lever. The seat is equipped with a drogue parachute and deployment mechanism to positively separate the seat from the seat occupant after the seat leaves the rails.

On the pilot and copilots seat, the parachute is located in a container mounted above the seat on spring-loaded swinging arms. As the seat leaves the rails, the arms and container swing aft of the seat and deploy the drogue parachute, thus separating the seat from the occupant. On the EW and gunners seat, the drogue parachute is attached to the bottom of the seat and is deployed by a lanyard attached to the intermediate rail which allows drogue parachute deployment. The action is fully automatic and requires no action on the part of the crew member.

Each seat can be positioned electrically up and down, fore and aft, and tilted by seat positioning switches. Electrical, oxygen, and ballistic lines are equipped with disconnects to permit separation of the lines when the seat is ejected. Each seat is equipped with a headrest and an inertia reel which assist the occupant in maintaining position during ejection. An integrated harness release mechanism provides a means for separating the safety belt and parachute harness from the seat automatically after ejection. Manual operation of the integrated harness release will disengage the safety belt and parachute and, in addition, will disengage the parachute arming lanyard. A modified parachute and a specially designed manual safety belt are installed in the harness release fittings. See "Integrated Harness," this section, for additional information. For a detailed discussion of seat ejection sequences, see "Escape Systems Operation," Section VII.

UPWARD EJECTION SEAT CONTROLS

Arming Levers

An arming lever (9, figure 1-52) installed in the armrest of each seat is used to prepare the seat for ejection. The arming levers also provide a grip to help keep the occupant's hands and arms in place during ejection. The arming levers are stowed and latched beneath the armrests and will operate only when the armrests are in the raised position. Each lever operates independently and either lever can be used to arm the seat. The use of both levers is recommended whenever possible since the levers provide a suitable handgrip. When the release lever is squeezed and the arming lever is rotated from the stowed position toward the arming locked position, the arming initiator is fired and the inertia reel is locked. Firing the arming initiator actuates the control column stowage thruster and the hatch jettisoning initiator. The control column thruster stows the control column and the hatch thruster unlocks the hatch and lifts the hatch lifter (aerodynamic flap) into the airstream which separates the hatch from the aircraft and unlatches the pilot and copilot drogue parachute support arms. The link connected to the hatch fires the catapult pin-pull initiator which actuates the pin-pull and removes the pin from the catapult initiator, thus arming the seat. See figure 1-53 for arming lever sequence of operation.

WARNING

- To accomplish ejection, at least one armrest must be raised from the stowed position and the arming lever on that armrest must be rotated to the up position. Rotation of the arming lever on a stowed armrest will not fire the arming initiator.
- If the arming lever has been rotated on a stowed armrest, raising the armrest will fire the arming initiator.

NOTE

A pointed instrument (such as a pencil) is needed to stow the arming levers. To stow either arming lever, depress the forward detent lockpin (5, figure 1-53) visible through the inner armrest skin just below arming lever pivot. With this upper lockpin depressed, rotate the arming lever downward until the motion is arrested; then depress the aft detent lockpin (6, figure 1-53) visible through the inner armrest skin just below the arming lever pivot. Rotate the arming lever to the fully stowed position.

Catapult Firing Triggers

A catapult firing trigger (13, figure 1-52) is installed in each arming lever and maintains a 25° lag as the arming lever is moved to the armed position. The firing triggers are locked and cannot be actuated until the hatch is jettisoned. When a trigger is pulled, the catapult is fired and the seat is ejected.

Seat Safety Pins and Streamers

Each upward ejection seat is provided with two safety pins (7, figure 1-52), numbered 1, to be used by the flight crew member to prevent inadvertent initiation of the seat ejection sequence. The two pins (lockpins) are attached to each end of a single red streamer and are inserted in the arming levers through holes in the armrest structure. These two pins should be in place in the arming levers during preflight and post-flight on the ground and whenever the crew member leaves his seat in flight. A stowage pouch for the No. 1 flight safety pins (5, figure 1-52) is located on the inboard side of each upward ejection seat. The pouch on the opposite seat will be utilized by each upward seat occupant for stowage of the No. 1 safety pins from his seat. This will permit stowage of the pins without unstrapping from the seat.

WARNING

- The seat can be armed any time one of the two No. 1 safety pins are removed. Rotation of the arming lever from which No. 1 pin has been removed arms the seat.
- In the event either or both arming levers have been rotated, the seat cannot be safetied until the arming levers have been stowed. (The catapult safety pin-pull pin cannot be reinserted into the catapult initiator in flight.) Lowering the armrests will deactivate the firing triggers by adjusting a series of mechanical linkages. Installation of the safety pins with the arming levers rotated to the up position will not prevent the seat from firing if either trigger is squeezed. The seat can be considered completely safe only after the arming levers have been stowed, No. 1 safety pins inserted, and the armrests lowered (in this sequence).

In addition, each upward ejection seat is provided with three safety pins (numbered 2, 3, and 5) to be used for maintenance operations only. The three pins are attached to a single red streamer and are stowed in the box provided when the seat is on flight status.

Seat Positioning Switches

Three independently operated seat positioning switches (10, figure 1-52) are located on the right front corner of the seat. The up and down switch is mounted vertically, the fore and aft switch is mounted horizontally, and the tilt switch is mounted on a 45° slant. To obtain seat movement, the switch is pushed in the direction movement is desired to electrically position the seat. The electrical positioning actuators are 118 volt ac powered and contain limit switches to stop motor operation at the extremes of travel. The pilot's and copilot's seat actuators are supplied power through circuit breakers on the "Miscellaneous" portion of the pilot's and copilot's circuit breaker panels and marked "Pilot Seat Pos" and "Copilot Seat Pos" respectively.

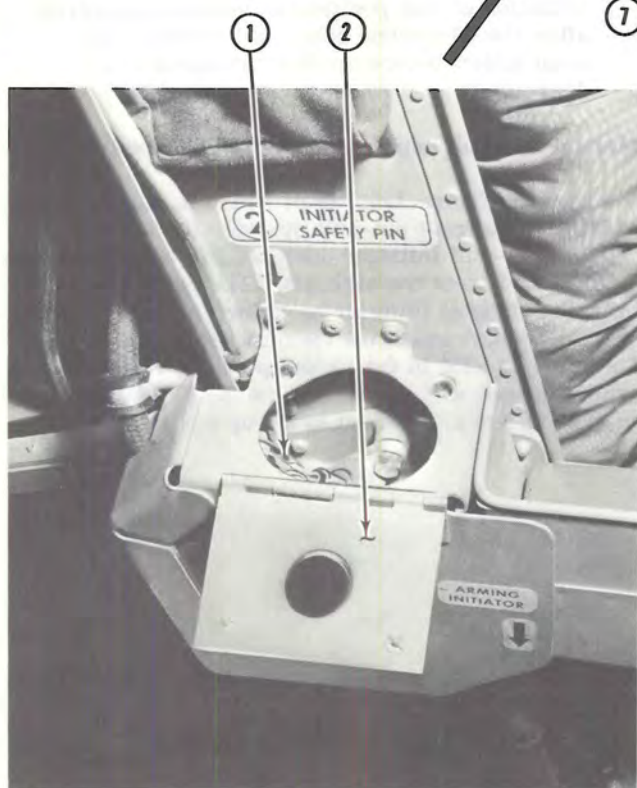
CAUTION

Excessive operation of the positioning motors will shorten their normal duty cycle. A full actuation in one direction should be followed by at least a 30-second rest. If another full actuation of that positioning motor is required after the 30-second delay, a 5-minute rest must follow before another actuation of any degree.

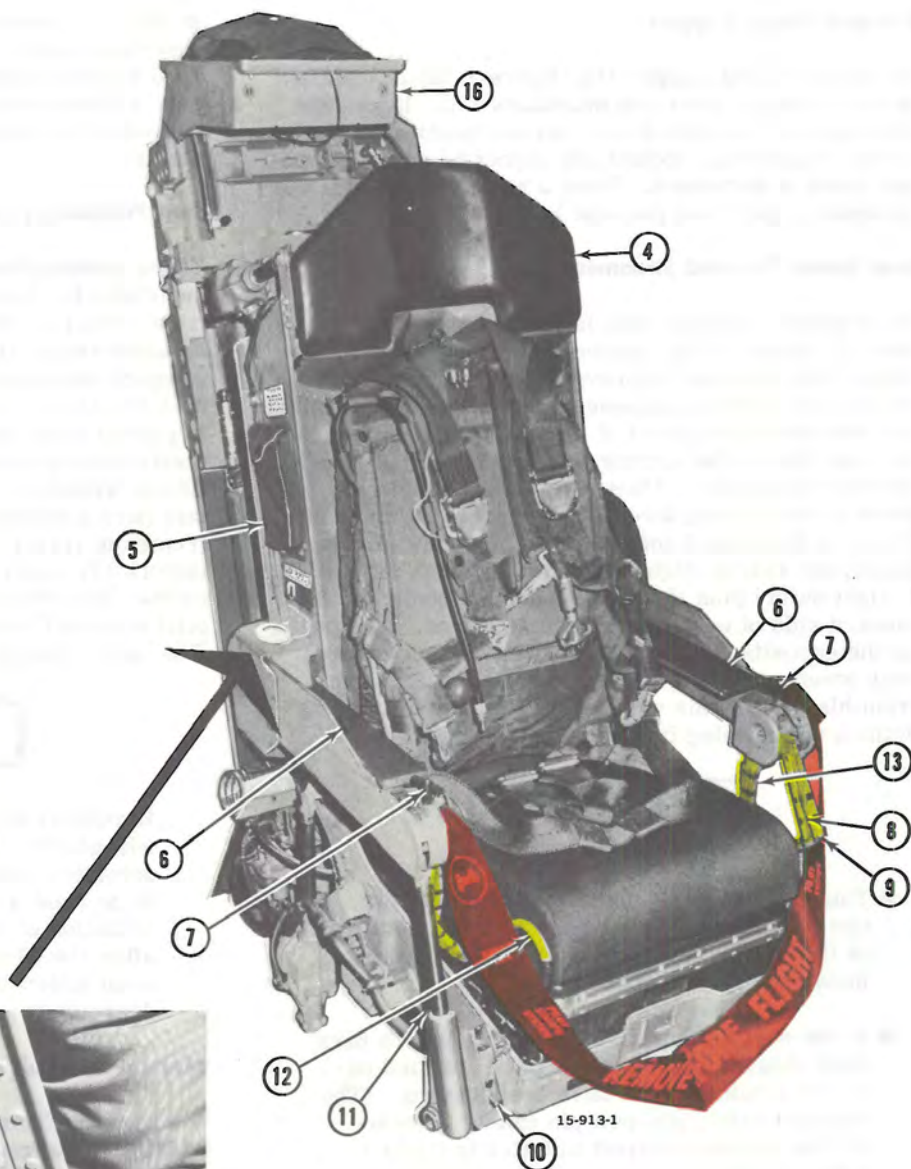
Manual Catapult Initiator Safety Pin Pull Lever

A lever (24, figure 1-52) is provided to manually disengage the catapult pin-pull cylinder in the event the catapult pin-pull initiator does not fire when the hatch is jettisoned from the aircraft. The pin is removed from the catapult initiator by lifting the lever and manually withdrawing the catapult pin-pull cylinder. The lever is held in the locked position when both arming levers are stowed and can be pulled only after an arming lever is raised to the up position.

PILOT/COPILOT SEAT

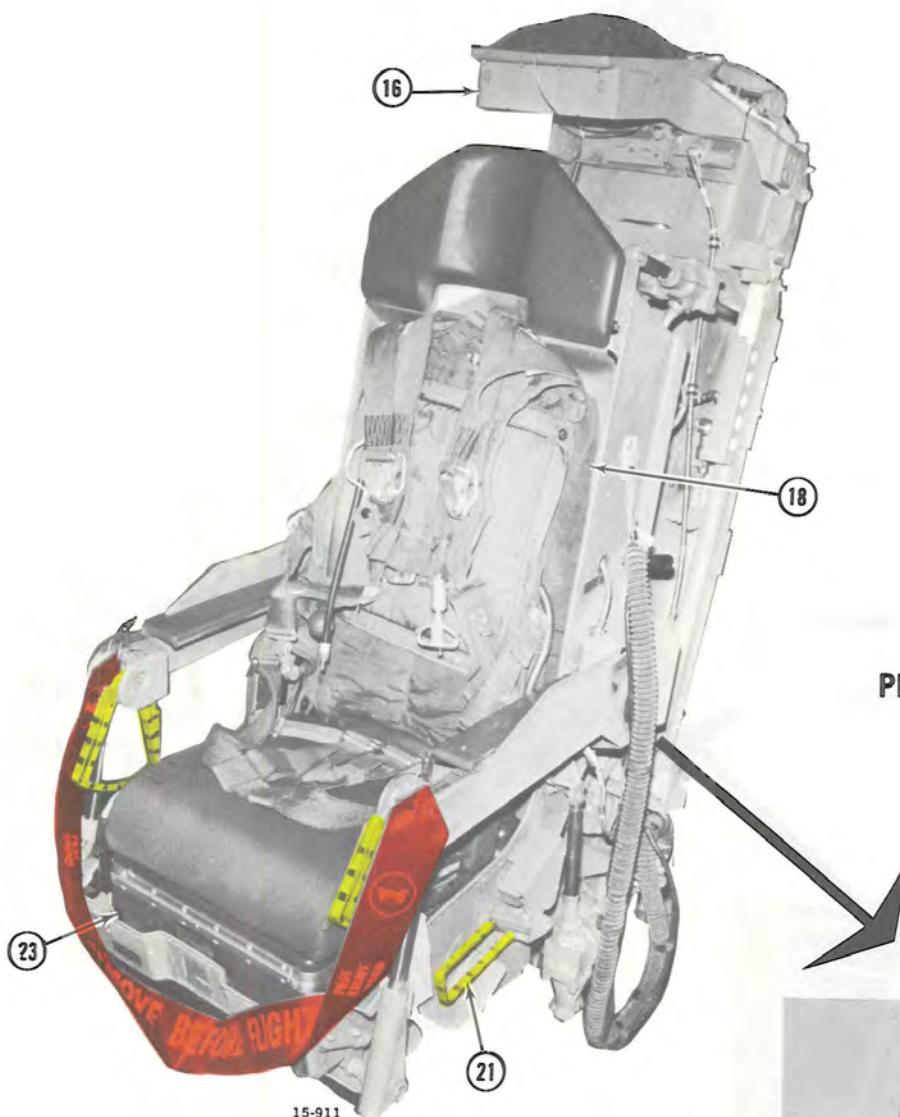


3-1-453

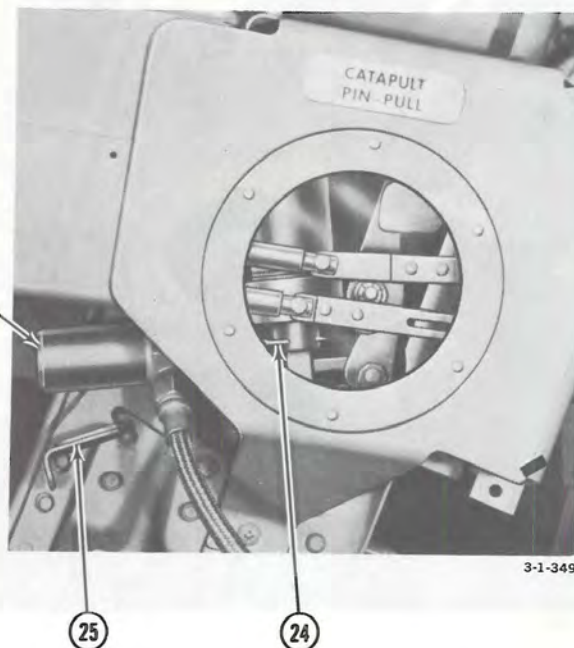


1. ARMING INITIATOR (ACCOMMODATES MAINTENANCE SAFETY PIN NO. 2)
2. INSPECTION DOOR AND WINDOW
3. (DELETED)
4. HEADREST
5. POUCH FOR NO. 1 FLIGHT SAFETY PINS (INBOARD SIDE OF SEAT BUCKET)
6. ARMRESTS
7. FLIGHT SAFETY PINS NO. 1 (ARMING LEVERS)
8. ARMING LEVER RELEASE
9. ARMING LEVER
10. SEAT POSITIONING SWITCHES
11. ARMREST CATCH
12. SURVIVAL KIT RELEASE HANDLE
13. FIRING TRIGGER
14. (SHEET 4 ONLY)

Figure 1-52 (Sheet 1 of 4).



PILOT/COPILOT SEAT



- 15. (DELETED)
- 16. DROGUE PARACHUTE CONTAINER ASSEMBLY
- 17. (DELETED)
- 18. MODIFIED PARACHUTE
- 19. (DELETED)
- 20. (DELETED)
- 21. INTEGRATED HARNESS RELEASE HANDLE
- 22. (DELETED)
- 23. SURVIVAL KIT
- 24. CATAPULT INITIATOR SAFETY PIN
- 25. MANUAL CATAPULT PIN-PULL LEVER
- 26. CATAPULT INITIATOR SAFETY PIN-PULL CYLINDER

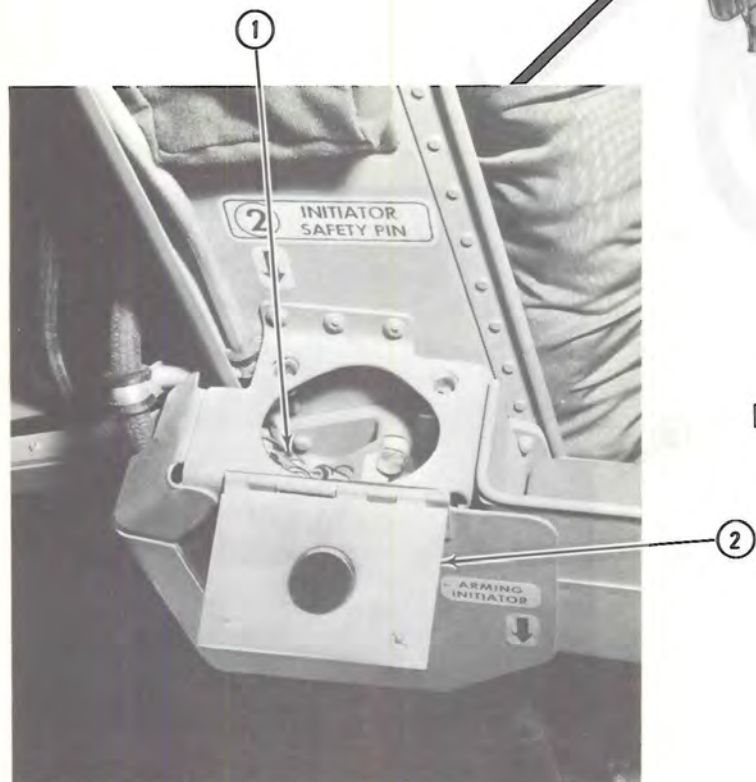
Upward Ejection Seat (Typical)

Figure 1-52 (Sheet 2 of 4).

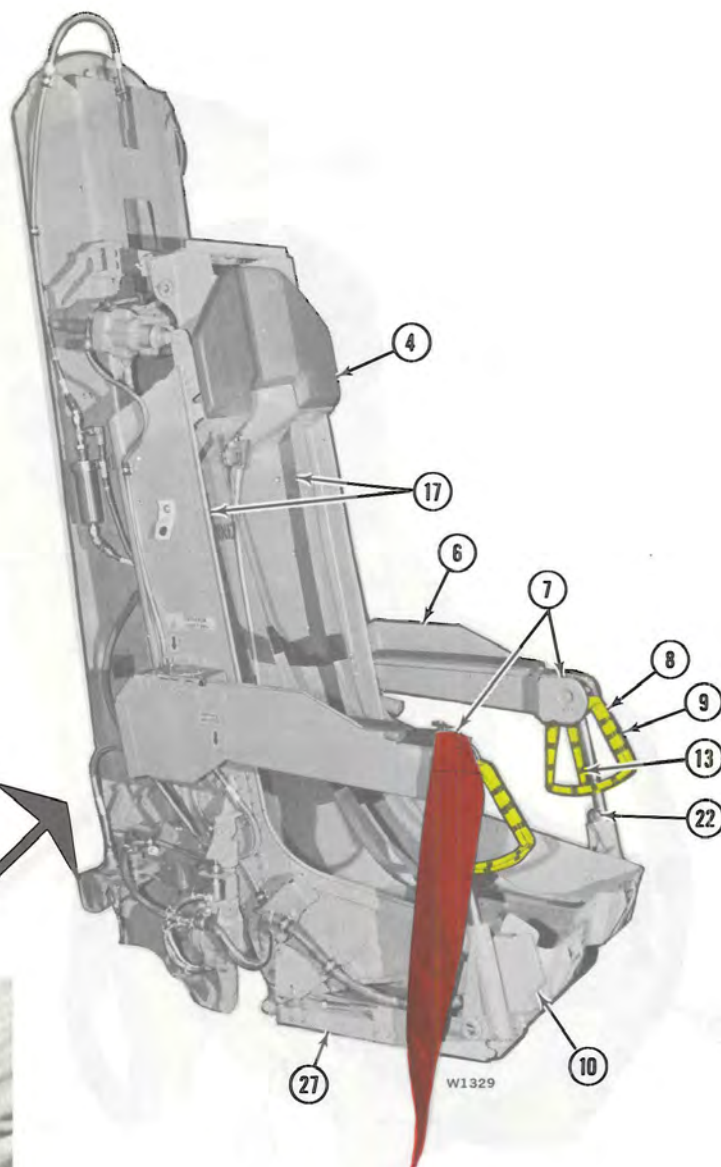
NOTE

BOTH NO. 1 FLIGHT
SAFETY PINS NOT SHOWN

1. ARMING INITIATOR (ACCOMMODATES
MAINTENANCE SAFETY PIN NO. 2)
2. INSPECTION DOOR AND WINDOW
(DELETED)
3. (DELETED)
4. HEADREST
5. POUCH FOR NO. 1 FLIGHT SAFETY PINS (INBOARD
SIDE OF SEAT BUCKET)
6. ARMRESTS
7. FLIGHT SAFETY PINS NO. 1 (ARMING LEVERS)
8. ARMING LEVER RELEASE
9. ARMING LEVER



3-1-453

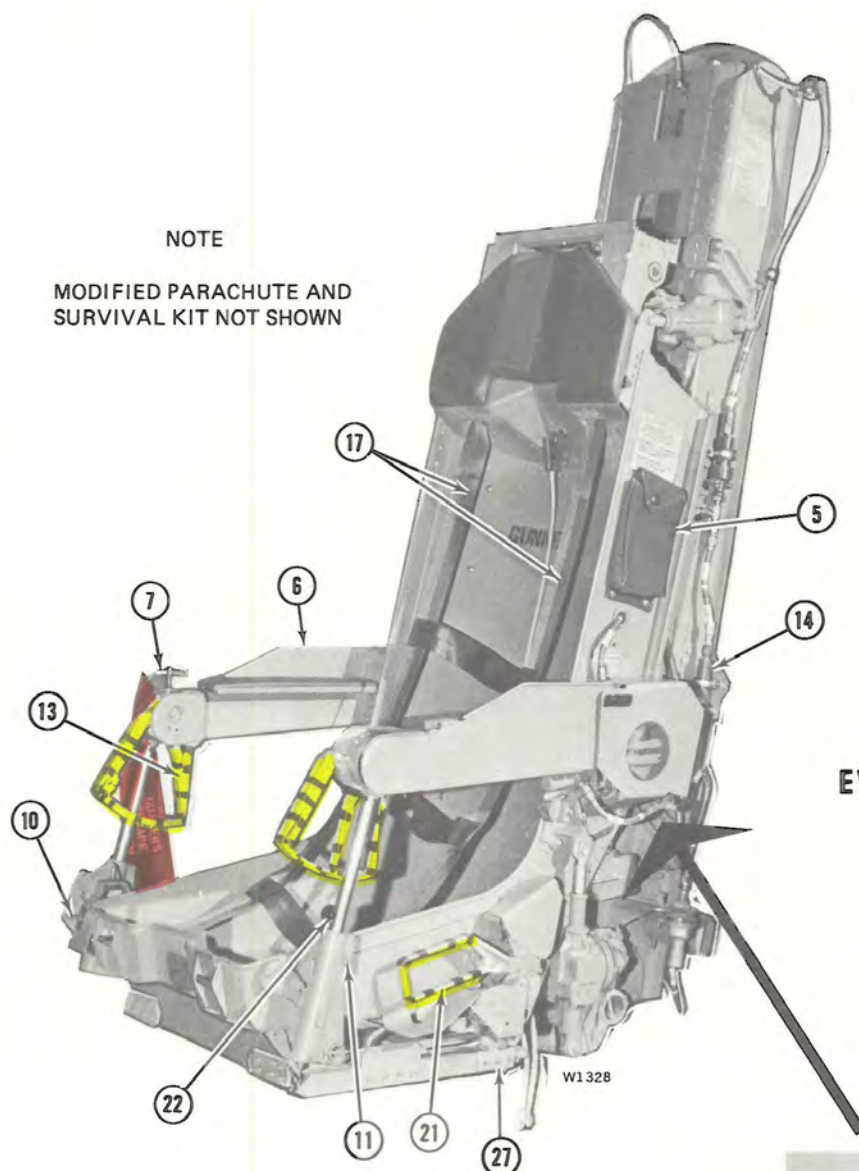


EW OFFICER/GUNNER SEAT

Figure 1-52 (Sheet 3 of 4).

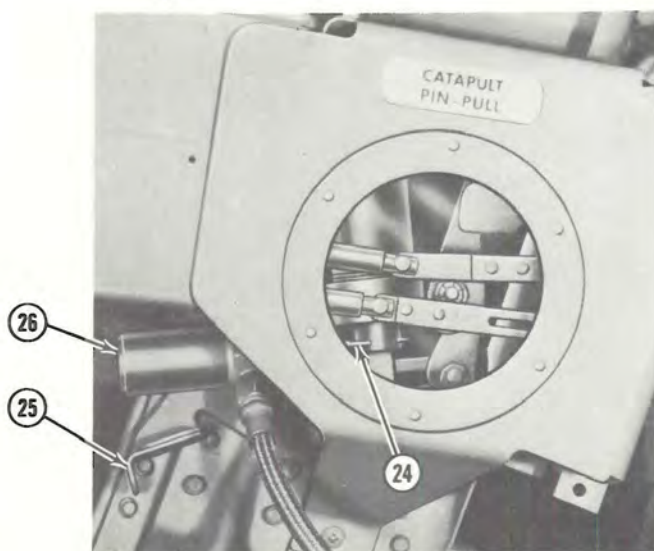
NOTE

MODIFIED PARACHUTE AND
SURVIVAL KIT NOT SHOWN



EW OFFICER/GUNNER SEAT

- 10. SEAT POSITIONING SWITCHES
- 11. ARMREST CATCH
- 12. (SHEET 2)
- 13. FIRING TRIGGER
- 14. INTEGRATED HARNESS RELEASE INITIATOR
(ACCOMMODATES MAINTENANCE SAFETY PIN NO. 5)
- 15. (DELETED)
- 16. (SHEET 2)
- 17. MAN-SEAT SEPARATOR
- 18. (SHEET 2)
- 19. (DELETED)
- 20. (DELETED)
- 21. INTEGRATED HARNESS RELEASE HANDLE
- 22. INERTIA REEL CONTROL HANDLE
- 23. (SHEET 2)
- 24. CATAPULT INITIATOR SAFETY PIN
- 25. MANUAL CATAPULT PIN-PULL LEVER
- 26. CATAPULT INITIATOR SAFETY PIN-PULL CYLINDER
- 27. DRAG PLATE



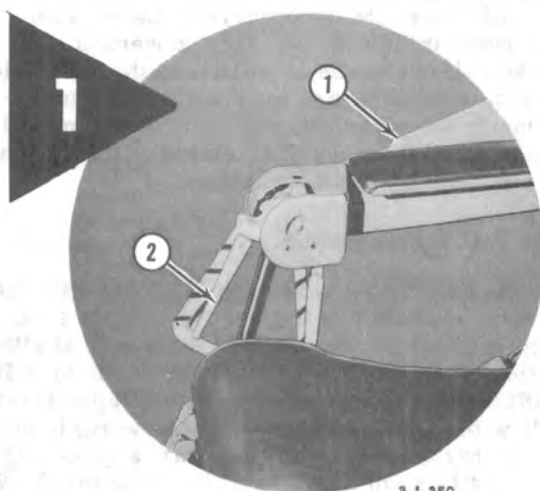
3-1-349

.....upward ejection seat (typical)

Figure 1-52 (Sheet 4 of 4).

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EITHER OR BOTH ARMING LEVERS



1 Raise armrest (1) to locked position.

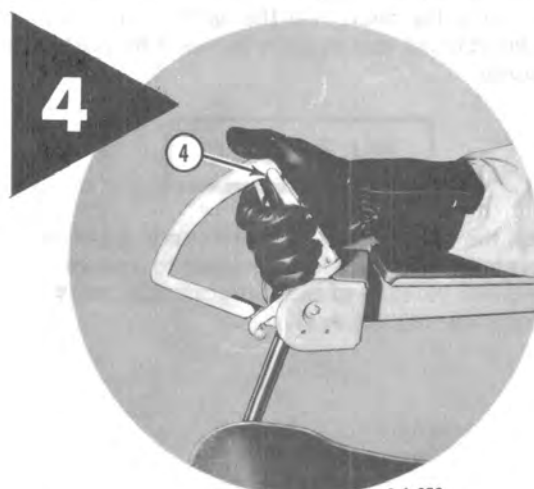
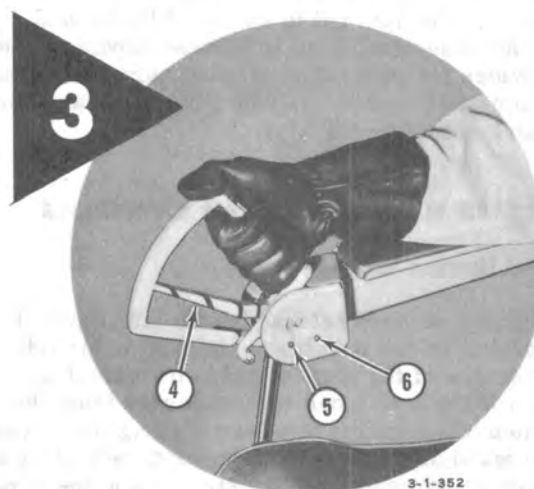
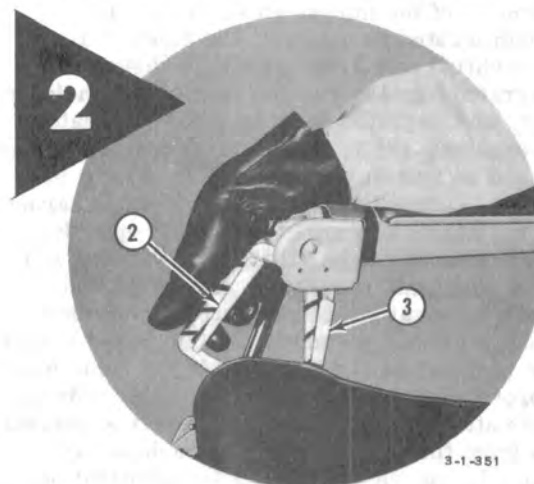
2 Squeeze arming lever release (2).

3 Rotate arming lever (3) forward and upward to locked position. Firing trigger (4) rotates to firing position.

NOTE

- Rotating the arming lever stows control column and jettisons escape hatch. The alarm system is energized to signal ABANDON when either the pilot's or copilot's control column stows. Hatch jettisoning fires initiator, arming seat.
- It is necessary to partially release grip on arming lever to grasp firing trigger.
- Stow arming lever by depressing detent lockpins (5) and (6) in order while rotating arming lever forward and downward.

4 Squeeze firing trigger (4) to fire seat catapult.



Upward Ejection Seat Arming Lever and Trigger Sequence

Figure 1-53.

INTEGRATED HARNESS SYSTEM

The integrated harness system provided in the aircraft consists of the integrated harness release mechanism located on the seat, the safety belt, and the modified automatic parachute (figure 1-54). The integrated harness release mechanism includes a trigger, an integrated harness release initiator with necessary ballistic tubing, an integrated release handle, and an inertia control handle. Firing the ejection seat catapult triggers the integrated harness release initiator. The initiator fires to open the integrated harness release fittings on the seat and allow seat occupant, parachute, and safety belt (along with survival kit) to separate from the seat as an integral unit. An additional integrated harness initiator is installed and functions in the same manner to provide additional reliability. Also a drogue parachute attached to the seat, positively separates the seat from the seat occupant, parachute, and safety belt (along with survival kit). (Separation from the seat arms the automatic parachute since the parachute arming lanyard is anchored to the seat.) Pulling the integrated harness release handle on the seat provides for separation of man, parachute (and arming lanyard), and safety belt from the seat following crash landings or ditching.

INTEGRATED HARNESS SYSTEM CONTROLS

Integrated Harness Release Handle

An integrated harness release handle (19, figure 1-52), painted yellow with black stripes, is provided on the left side of the seat to enable the parachute harness and the safety belt to be detached from the seat in lieu of automatic release. Pulling the release handle upward disengages the two safety belt fittings, the parachute harness shoulder straps, and the parachute arming lanyard, thus completely freeing the occupant from the seat. On the upward ejection seats, the release mechanism is reset by pushing the handle down.

WARNING

Lock the inertia reel before actuating the integrated harness release handle to assure complete release of the integrated harness before leaving the seat.

NOTE

The integrated release handle should not be used to free the occupant from the seat for normal inflight or postflight movement. If the release handle is pulled and the parachute and survival kit are worn during such movement, the parachute will have to be removed to reinstall the shoulder straps in the inertia reel fitting without assistance.

Inertia Reel Control Handle

A handle (20, figure 1-52) with LOCKED--RELEASED positions is located on the left side of each seat. A detent is provided for retaining the handle at either position of the quadrant. When the handle is in RELEASED position, the reel harness strap will extend to allow the crew member to lean forward; however, the reel harness strap will automatically lock when an impact force of 2 to 3 "g's" is encountered. When the reel is locked in this manner, it will remain locked until the handle is moved to LOCKED and then returned to RELEASED position. When the handle is in LOCKED position, the reel harness strap is manually locked so the crew member is prevented from bending forward. LOCKED position is used for ditching and crash landing. The arming lever used for seat ejection also locks the inertia reel. LOCKED position may be used as an additional safety feature over the automatic operation of the inertia reel system.

MODIFIED AUTOMATIC PARACHUTE

A type BA-27A automatic parachute, developed specifically for use in B-52 aircraft upward and downward ejection seats, modified to utilize the integrated harness release mechanism in the seat is provided in the ejection seats. Modifications include shoulder straps (1, figure 1-54) which are sewn into the parachute harness for attachment to the inertia reel fitting.

The parachute contains the following features:

- A pull down vent line (PDVL) parachute canopy, designated as a C-9P type, is utilized. The PDVL improves the low speed inflation characteristics of the parachute and improves the consistency of the parachute opening timing.
- An FXC model 11,000 ballistic automatic parachute opening release which incorporates a 0.75 second delay cartridge that automatically opens the parachute pack 0.75 seconds after seat/man separation occurs or after preset altitude is reached if bailing out above that altitude. The model 11,000 release is activated when the arming lanyard (6, figure 1-54) is pulled, either manually or automatically by separation from the seat.

NOTE

A zero delay lanyard is not provided on the Type BA-27A parachute.

All Parachutes

A bailout oxygen bottle and gage is contained in the parachute and may be inspected by opening the flap located under the right side of the parachute lining. Normal bailout bottle pressure is 1800 psi based on 70°F. A reduction in temperature causes reduction in cylinder pressure of 3.5 psi for each degree of F. The bailout bottle (figure 1-54) is operated by pulling the green knob (11, figure 1-54) on the right front of

the harness. A ripcord T-handle (4, figure 1-54) manually releases the parachute when pulled. The ripcord T-handle bypasses the automatic release device. An automatic survival kit actuator has also been provided in the parachute pack. This actuator consists of a flexible housing and cable assembly. The housing attaches to the inside of the parachute pack and the CNU-129/P survival kit. The actuation cable passes through the housing attaching to both the survival kit automatic actuation mechanism and one of the parachute risers. When the personnel parachute deploys, the force on the risers pulls the survival kit actuator cable thus firing a delay cartridge in the CNU-129/P survival kit actuation mechanism. Four seconds after parachute deployment, the cartridge fires and automatically deploys the survival kit. The parachute actuator is attached to the survival kit when the parachute is installed in the seat. A canopy quick-release fitting (2, figure 1-54) is located on the upper left of the harness to permit release of the left set of risers for spilling the canopy after landing. Two canopy quick-release fittings located on the upper left and right of the harness may be fixed to allow complete release of the canopy after landing. The parachute is installed in the seat as follows:

1. The shoulder strap attaching hardware is inserted into the inertia reel fitting of the strap.

2. The survival kit attachment straps (19A, figure 1-54) are connected to the survival kit strap adjusters. Thread these straps through the loops (18, figure 1-54) in between the webbing of the safety belt and attach to the parachute accessory rings with the quick-disconnect at the opposite end.

3. Safety belt attachment fittings are inserted into integrated harness release fittings on the seat.

4. The parachute arming lanyard anchor is inserted into the integrated harness release fitting at the left rear corner of the seat.

NOTE

The modified automatic parachute safety belt, and survival kit should first be installed in the seat, then buckled to the crew member.

Since the parachute must be removed by the wearer in order to attach the shoulder straps to the inertia reel fittings unassisted, it is recommended that the parachute and survival kit be left in the seat when the crew member desires to make routine movements about in the aircraft. It is then only necessary to buckle chest strap, leg straps, and safety belt and to connect oxygen mask to prepare for ejection in an emergency.

NOTE

Do not open the safety belt to permit unrestrained hip movement. Since the parachute arming lanyard is anchored to the seat, this could spill the parachute in the seat.

Personal Locator Beacons

Most parachutes are equipped with personal locator beacons. The beacon equipped parachutes may have an AN/URT-21, AN/URT-27, or AN/URT-33 installed. Except for size and range, all three beacons are almost identical. Each beacon is designed to begin transmitting automatically when a plastic plug

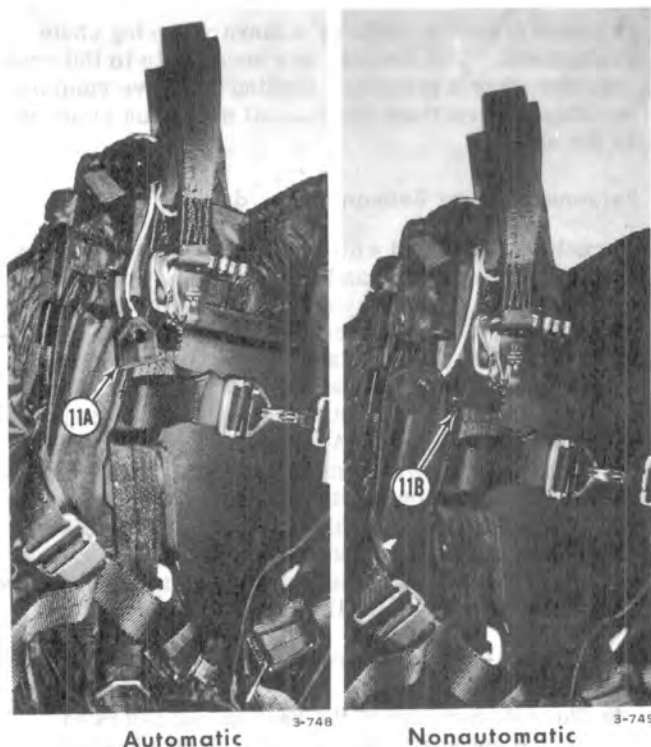
is pulled from the radio by a lanyard during chute deployment. The beacons are accessible to the crew member after a parachute landing and have complete metalcal instructions for manual operation attached to the unit.

Personal Locator Beacon Lanyards

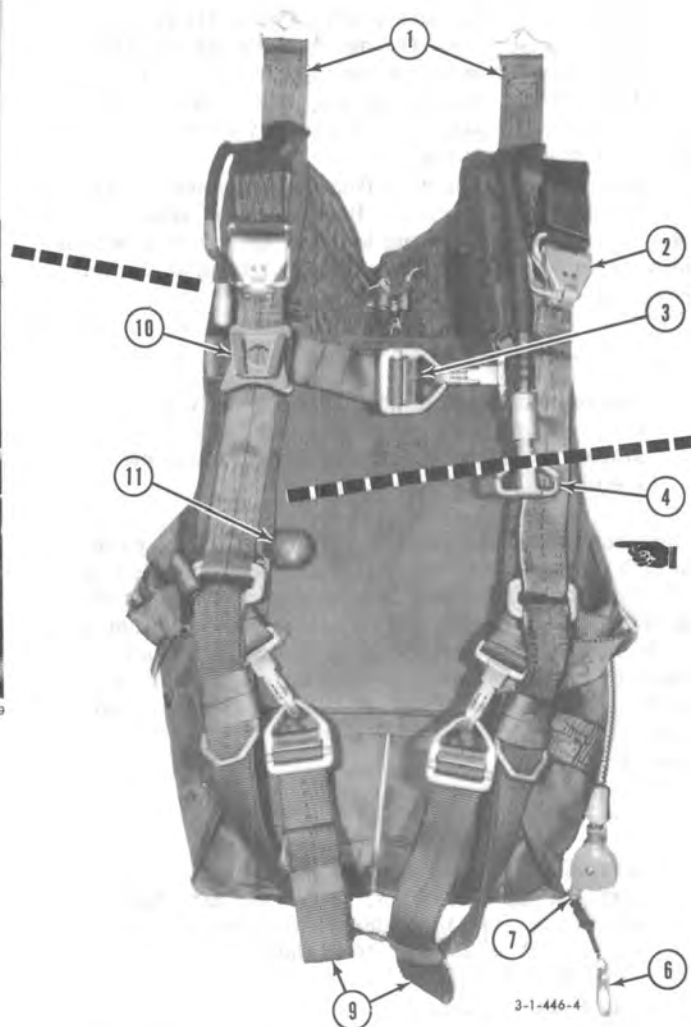
Parachutes equipped with a personal locator beacon have a nylon cord lanyard with a tab and a female snap fastener. The lanyard can accommodate all three personal locator beacons. For automatic actuation of the beacon, the tab fastener is snapped to a male snap fastener located below the right canopy release. For nonautomatic (manual) operation, the tab is left unsnapped (11A and 11B, figure 1-54). For peacetime operations, the personal locator beacon lanyard must be configured for automatic operation. When mission requirements dictate the necessity to avoid detection and automatic actuation of the beacon is not desired, the lanyard must be configured for nonautomatic (manual) operation.

NOTE

- The sole purpose of the beacon lanyard is to assure automatic operation (if desired) after bailout in case the crew member is injured or incapacitated during the egress cycle. For this reason, the beacon lanyard must be configured to the desired operation (automatic or nonautomatic) during the interior preflight and rechecked just prior to bailout.
- Recent experience has indicated that some beacons are unreliable when configured for automatic actuation due to lanyard rigging defects. Operation (transmitting) can be readily confirmed after parachute landing by checking that the plastic plug has been pulled from the radio.



PERSONAL LOCATOR BEACON LANYARD

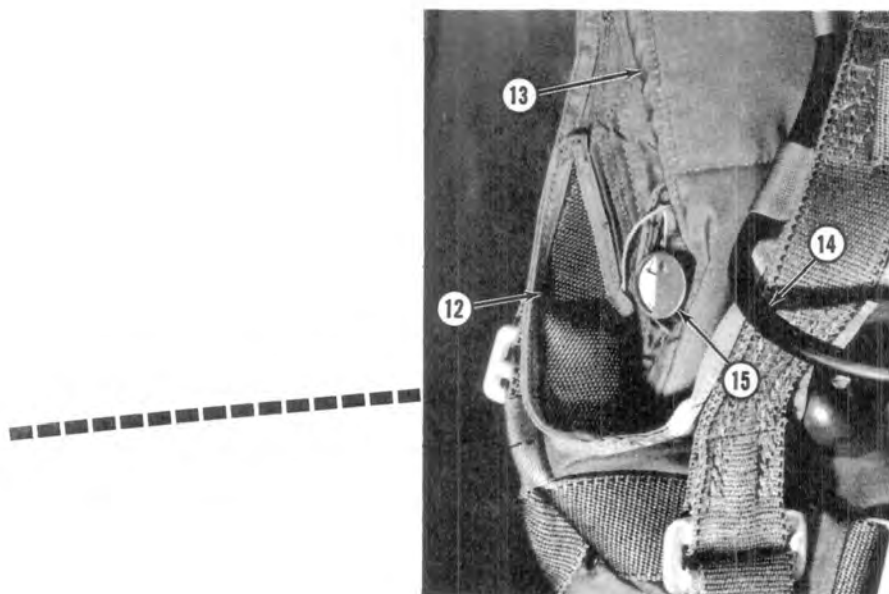


1. SHOULDER STRAPS
2. QUICK-RELEASE
3. CHEST STRAPS
4. RIPCORDER T-HANDLE
5. (DELETED)
6. ARMING LANYARD ANCHOR
7. ARMING KNOB
8. (DELETED)
9. LEG STRAPS
10. OXYGEN HOSE CONNECTOR MOUNTING PLATE
11. BAILOUT BOTTLE RELEASE KNOB
- 11A. PERSONAL LOCATOR BEACON LANYARD SNAPPED (AUTOMATIC ACTUATION)
- 11B. PERSONAL LOCATOR BEACON LANYARD UNSNAPPED (NONAUTOMATIC ACTUATION)

12. BAILOUT BOTTLE INSPECTION FLAP
13. PARACHUTE BACKPAD
14. BAILOUT OXYGEN HOSE
15. BAILOUT BOTTLE PRESSURE GAGE
16. (DELETED)
17. SAFETY BELT ATTACHMENT FITTING
18. UPWARD EJECTION SEAT ATTACHMENT LOOPS
19. COMPRESSIBLE SPACER
- 19A. SURVIVAL KIT QUICK-DISCONNECT FITTING AND STRAP
20. SEAT CUSHION
21. KIT RELEASE HANDLE
- 21A. MODE SELECTOR LEVER
- 21B. FIRING PIN INDICATOR
22. ARMING PLUNGER
23. MAIN COMPARTMENT

MODIFIED AUTOMATIC PARACHUTE

Figure 1-54 (Sheet 1 of 2)



3-1-627

BAILOUT OXYGEN BOTTLE



3-1-500

BELT FOR UPWARD EJECTION SEAT



NOTE
EQUIPMENT SHOWN MAY
NOT BE TYPICAL

15-907

CNU-129/P GLOBAL SURVIVAL KIT

Bailout Equipment— **Upward Ejection Seats**

Figure 1-54 (Sheet 2 of 2)

All data on pages 1-160 thru 1-162B (Deleted).

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SAFETY BELT

A safety belt with standard manual release and lock lever fittings is provided with each ejection seat. The belt is installed by inserting the attachment fittings in the integrated harness fittings on each side of the seat. The survival kit is then secured to the parachute by threading the parachute attachment fittings through the straps on the safety belt and fastening them to the kit. Thus, seat occupant, parachute, safety belt, and survival kit are released from the seat as an integral unit whenever the integrated harness release fittings are opened. For routine movement about in the aircraft, it is recommended that the crew member unlock and open the safety belt, then disconnect the parachute chest and leg straps, leaving the parachute with survival kit attached to the seat.

WARNING

Do not open the safety belt prior to ejection. Severe injury may be incurred if ejection is performed with any integrated harness attachment fitting disconnected.

AUXILIARY EQUIPMENT

The following equipment and its operation is described under "Auxiliary Equipment," Section IV:

- Air Conditioning System
- Anti-Icing
- Communication and Associated Electronic Equipment
- ECM Equipment
- Lighting Equipment
- Oxygen System
- Stability Augmentation System (SAS)
- Autopilot
- Instrument Landing System (ILS) Equipment
- Flight Director System
- Automatic Approach Equipment
- Navigation Equipment
- Aircraft Weapons Control System Monitoring Set
- Weapons Control System - Offensive (AN/ASQ-38(V))
- Terrain Avoidance System
- Electro-Optical Viewing System (EVS) (AN/ASQ-151)
- Bombing System
- Bomb Door System
- Missile System (AGM-69A)
- Gunnery System
- Air Refueling System
- Single Point Ground Refueling System
- EW Officer's and Gunner's Ejection Seats
- Downward Ejection Seats
- Integrated Harness System
- Miscellaneous Equipment (including escape provisions for extra crewmembers)

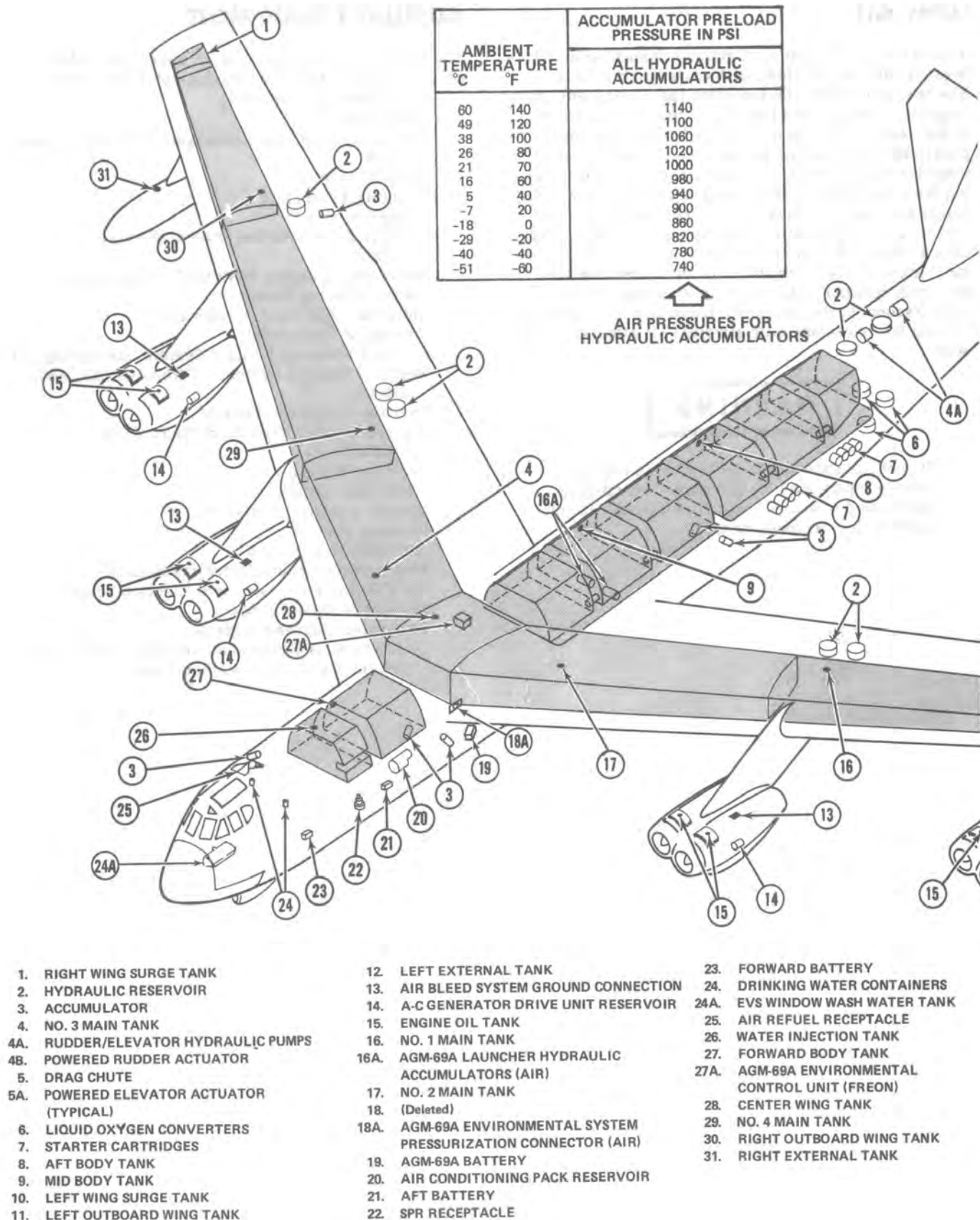
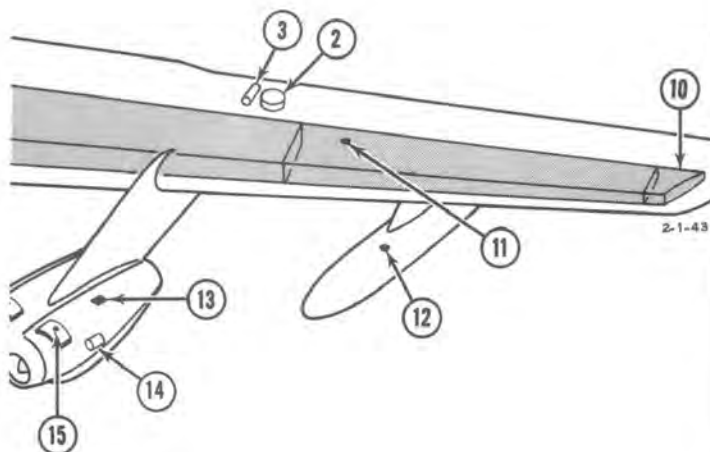
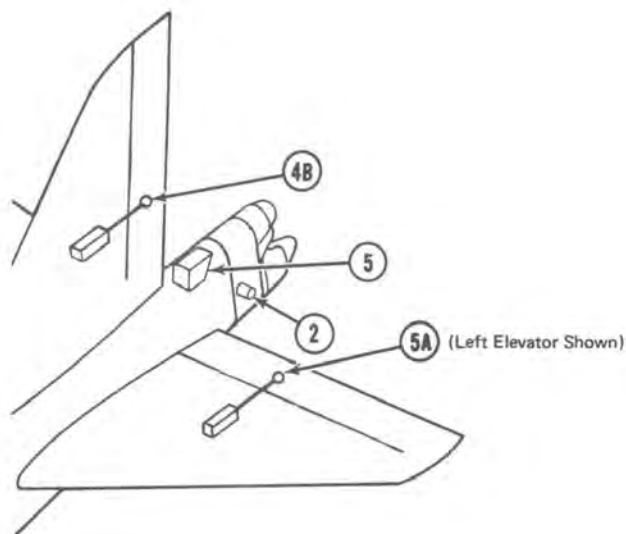


Figure 1-55 (Sheet 1 of 2).

SPECIFICATIONS



TYPE FLUID	USAF SPECIFICATION	NATO SYMBOL
FUEL 12 Tanks	MIL-T-5624 (JP-4)	F-40
FUEL (Alternate)	MIL-T-5624 (JP-5)	F-44
FUEL (Av Gas)	MIL-G-5572	See Section V,
OIL (Turbine) 8 Tanks	MIL-L-7808	0-148
HYDRAULIC FLUID 9 Reservoirs	MIL-H-5606	H-515
GENERATOR DRIVE UNIT OIL 4 Reservoirs	MIL-L-7808	0-148
WATER (EVS WINDOW WASH) 1 Tank	DISTILLED WATER	

AIR CONDITIONING PACK OIL
AS SPECIFIED ON PACK NAMEPLATE
1 PACK

WATER INJECTION
CLEAN UNDISTILLED WATER - WATER WITH LESS
THAN 10 PARTS SOLIDS PER MILLION PARTS. WA-
TER WITH MORE IMPURITIES MUST BE RESTRICTED
TO EMERGENCY USE ONLY.
1 TANK

NOTE
WATER INJECTION SHOULD NOT BE USED
BELOW 40° F OAT

BATTERY WATER
DISTILLED WATER
3 BATTERIES

LIQUID OXYGEN
MIL-O-27210 TYPE II
3 CONVERTERS

STARTER CARTRIDGE
STOWAGE PROVISIONS FOR 8 TYPE MXU/4A

POWER CARTS

- COMPRESSOR, TYPE MA-1A (OR EQUIVALENT)
- EXTERNAL HYDRAULIC TEST STAND, TYPE D-5A
(OR EQUIVALENT)
- GENERATOR SET, TYPE MD-3 (OR EQUIVALENT)
- EXTERNAL GROUND BLOWER, TYPE A-2 (OR
EQUIVALENT)
- EXTERNAL GROUND SUPPORT BLOWER, TYPE
MC-1 (OR EQUIVALENT)

Servicing (Typical)

Figure 1-55 (Sheet 2 of 2).

Normal Procedures

section II

NOTE

- This section contains text and an amplified checklist. The text is divided into primary paragraphs which form the phases of a normal flight. Most of these paragraphs are followed by an amplified checklist for the particular phase of the flight. The amplified checklist is presented in a chronological form that will enable the flight crew to complete their inspection, checks, and operation of the aircraft in an expedient yet thorough manner. The amplified checklist describes in detail the steps to be completed. Each major part has been assigned to one of the pilots or a crew member to be read by him, and to be accomplished by others in the crew. However, there are exceptions as some of the checklists will be read and completed silently. To show which crew member will accomplish certain steps, the normal crew coding will be used and the code letters will appear after the response to each step. At times it may be advantageous for the copilot to accomplish certain items designated for the pilot and vice versa. The terms "As required," "As desired," "Climatic," and "Cross-checked" as used in the checklist indicates equipment operation or settings which may vary according to prevailing conditions. In practice, the response to these items will be the required switch or control position or actual indicator reading. The amplified checklist has also been designed to accommodate the production of the abbreviated checklist to be used during aircraft operation.
- Some system control switches are provided with a guard, such as stabilizer trim cutout, anti-skid, etc. In practice, when these switches are actuated, the desired toggle position must be ascertained and then the guard positioned.
- The thruflight checklist is integrated into the Interior Inspection Checklist (Pilot), Interior Inspection Checklist (Copilot), and Before Starting Engines Checklist. Thruflight checklist items are identified by an asterisk (*). The checklist has been designed to work in conjunction with T.O. 1B-52G-6WC-1 (Inspection Work Cards) and T.O. 00-20-5, and can be used for short time stopovers away from home base as well as turn-around flights. When a different flight crew is to be used for the succeeding flight, the present crew will brief them on the status of the aircraft.

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PREPARATION FOR FLIGHT

FLIGHT RESTRICTIONS

All limitations imposed on the aircraft are described in Section V, "Operating Limitations."

FLIGHT PLANNING

The necessary fuel, airspeed, and thrust settings required to complete a proposed mission should be determined by using the operating data from Part 12 of the Appendix.

FUEL SERVICING

Fuel tank and gage calibration to date has not become sufficiently accurate to be relied upon. For this reason, dipsticks have been provided for use by the servicing crew. In order that the pilot may check the fuel loading, a refueling and distribution log will be with the aircraft Form 781 and will be checked and signed by the pilot during the "Interior Inspection." For information on the "Refueling and Distribution Log," see Part 12 of the Appendix.

TAKEOFF AND LANDING DATA CARDS

Compute all takeoff and landing data and complete the takeoff and landing data cards as illustrated in Parts 2, 3, and 9 of the Appendix. This data should be rechecked just prior to flight to determine the effect of any changes in runway conditions or aircraft configuration.

WEIGHT AND BALANCE

Obtain and check the takeoff and anticipated landing gross weight and balance before flight. Check that the required fuel and ordnance have been loaded. Refer to Section V, "Operating Limitations," for weight limitations. Do not attempt takeoff or landing with cg outside the specified limits. Refer to T.O. 1-1B-40, Handbook of Weight and Balance Data, for weight and loading information. The current load adjuster to use for B-52G aircraft is computer plate No. E1201. Also check Form 365F (Form F) for specific weights and cg information for each flight. See Part 12 of Appendix for a sample copy. This format should be used in preparation of Form F.

ENTRANCE

One main entrance door (figure 2-1) provides normal crew access into the aircraft. The door is located on the lower centerline of the fuselage ahead of the forward landing gear wheel well. A flush-type handle is pulled out to unlatch the door. An entrance light switch is located directly forward of the door at the head of the ladder. The entrance light operates on direct battery power.

CHECKLISTS

The flight manual checklists have been designed so that they may be used for training missions with or without a weapon, for alert posture, and for EWO missions which are launched from other than a ground alert posture. Ground alert checklist implementation and instructions are contained in "Alert Procedures," this section.

NOTE

When no bombs or missiles are loaded, safety wires and seals are not required on the associated monitor control and release system controls.

Nuclear Bombs

Nuclear bomb strike mission amplified checklists appear in Section I of T.O. 1B-52D-25-2. The Pre-Takeoff and Inflight sections only, have been integrated within the flight manual checklists. The integrated items appear without amplification in both the amplified and abbreviated checklists. T.O. 1B-52D-25-2CL-1, "Nuclear Bomb Delivery Procedures," will be maintained as a separate checklist and will be available for use as required. The following additional checklists also appear in T.O. 1B-52D-25-2 and T.O. 1B-52D-25-2CL-1:

- Non-Strike Procedures
- EWO Restrike Procedures
- Emergency Procedures

Nonnuclear Weapons

Nonnuclear weapons procedures from T.O. 1B-52D-34-2-1 have been integrated with the affected flight crew checklists.

Missiles

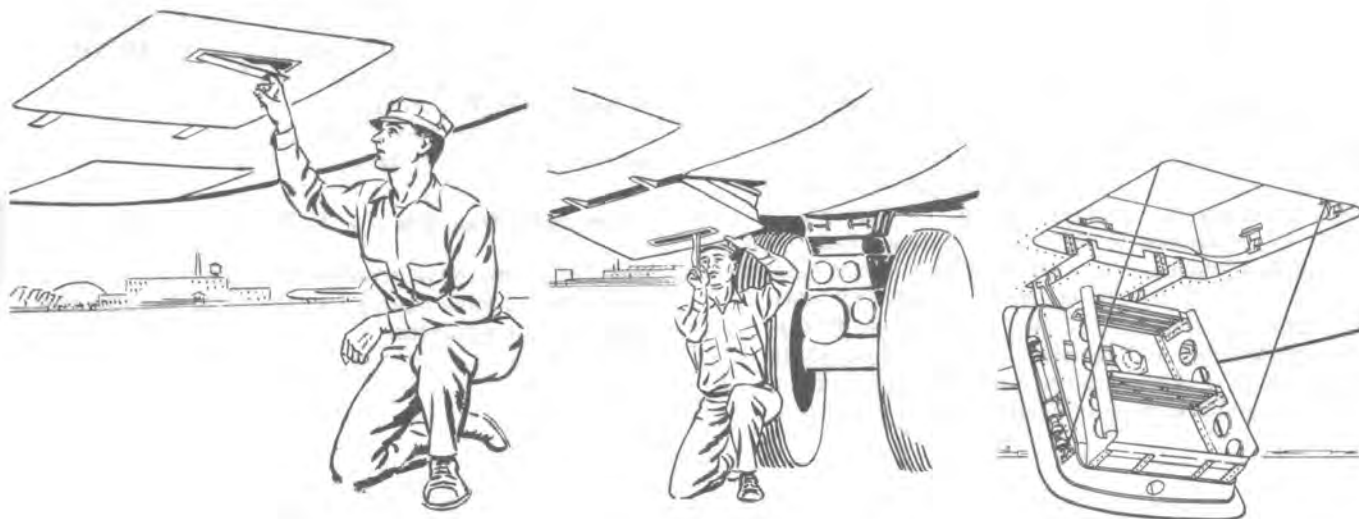
The procedures that lend themselves to integration in existing checklists have been so integrated for applicable crew members. Otherwise, the procedures have been integrated as complete checklists. The integrated procedures appear as line items without amplification in both the amplified and abbreviated checklists. Amplification of the line items pertinent to missile normal procedures may be found in Section II of the appropriate publication as listed below. Numbering of checklist items in the abbreviated checklists will not coincide with the numbering in the amplified checklists as listed below unless the procedure has been integrated as a complete checklist.

AGM-69A CHECKLISTS. The AGM-69A normal procedures amplified checklists will appear in the B-52/AGM-69A Aircrew Weapon Delivery Technical

Manual, T.O. 1B-52G-30-2. The abbreviated checklists for certain AGM-69A normal procedures are integrated in the "Normal" part of the pilots', navigator's, and radar navigator's abbreviated flight crew checklists; "AGM-69A Inflight Procedures" appear nonintegrated in the "Missile" part of the navigator's and radar navigator's abbreviated flight crew checklists. "Unscheduled Landing with AGM-69A Missiles" procedures are in the navigator's and radar navigator's abbreviated flight crew checklists only. The AGM-69A emergency procedures appear in the "Emergency" portion of the appropriate aircrew abbreviated checklists as nonintegrated items.

Bomb Runs

The bomb run checklists in Section VIII have been designed so that they may be used for both training and EWO missions. They have been consolidated for use by both the navigator and radar navigator.



Entrance to Aircraft

Figure 2-1.

PREPARATION FOR FLIGHT CHECKLIST**NOTE**

The following items will be checked by the pilot prior to flight.

1. Pilots'/Crew Information File - Checked (P)

2. Form 175 - Checked (P)

The pilot will complete Form 175 with related attachments in accordance with prescribed procedures.

3. Form 365F - Completed (CP)

The copilot will compute the Form 365F in accordance with Part 12 of the Appendix.

4. Takeoff & Landing Data & Fuel Prediction Curve Form 200 - Completed (CP)

- a. Copilot computes this data in accordance with flight manual appendix.

- b. Minimum items to be accomplished will include all entries on the takeoff data checklist card.

5. Pilots' Route Map - Completed, as required (P-CP)

6. Takeoff Abort Procedures - Reviewed (P-CP)

7. Crew Briefing - Completed (P)

- a. Announce assembly time.

- b. Brief crew and extra crew members on required clothing, equipment, etc.

- c. Brief extra crew members to configure personal locator beacon lanyards per mission requirements. For peacetime operations, the personal locator beacon lanyard must be configured for automatic operation. When mission requirements dictate the necessity to avoid detection and automatic actuation of the beacon is not desired, the lanyard must be configured for nonautomatic (manual) operation.

- d. Brief extra crew members on crew report procedures.

- e. The pilot will brief crew members and extra crew members on uncontrolled bailout procedures. In the event of loss of control of the aircraft, those crew members occupying ejection seats should eject immediately upon receiving the bailout order over the interphone, or when the abandon light comes on. Extra crew members will bail out any opening available.

- f. The pilot will determine qualification of all personnel for the flight. At the discretion of the pilot, fully qualified personnel may be dismissed from the briefing at this time.

- g. Crew members emergency briefing (as required). Each crew member not fully qualified will report his position and exit for crash landing during takeoff and his primary and secondary bailout exit. In the event of planned crash landing, all crew members not essential to flight will bail out if time and conditions permit.

PREPARATION FOR FLIGHT CHECKLIST (Cont)

h. Extra crew members emergency briefing (as required):

- (1) Instructor Pilot Position - Take off and land strapped in position, remain in position for crash landing on takeoff, exit out pilot's/copilot's escape hatch.

Controlled Bailout - Primary, navigator's escape hatch; secondary, radar navigator's escape hatch.

Uncontrolled Bailout - Any open hatch available.

- (2) Instructor Navigator Position - Take off and land strapped in position, remain in position for crash landing on takeoff, exit out pilot's/copilot's escape hatch.

Controlled Bailout - Primary, navigator's escape hatch; secondary, radar navigator's escape hatch.

Uncontrolled Bailout - Any open hatch available.

- (3) DI Position - Take off and land in position, remain in position for crash landing on takeoff, exit out pilot's/copilot's escape hatch.

Controlled Bailout - Primary, navigator's escape hatch; secondary, radar navigator's escape hatch.

Uncontrolled Bailout - Any open hatch available.

- (4) 10th Position - Take off and land in forward hammock, remain in position for crash landing on takeoff, exit out pilot's/copilot's escape hatch.

Controlled Bailout - Primary, navigator's escape hatch; secondary, radar navigator's escape hatch.

Uncontrolled Bailout - Any open hatch available.

i. Emergency Signals - Interphone is the primary means of crew warning. For bailout, pilot will give the command "Bail out." Interphone will be supplemented by the alarm system. Extreme care will be taken to avoid inadvertent actuation of the alarm system during seat changes, etc.

- (1) Alert or Intermittent Signal - Prepare for planned crash landing or ditching, alert signal repeated prior to impact,

- (2) Abandon or Steady Signal - Abandon aircraft. If above minimum altitude, bail out. On land or water, exit out escape hatches on abandon signal after aircraft has stopped.

PREPARATION FOR FLIGHT CHECKLIST (Cont)

(3) Minimum bailout altitudes:

Extra Crew Members - _____ ft
 Downward Ejection - _____ ft
 Upward Ejection - _____ ft

Bailout Order - N, IN, DI, 10th, IP, G, EW, RN, CP, P for controlled bailout.

WARNING

When the aircraft is below 2000 feet above the terrain or if aircraft control is lost at any altitude, crew members occupying ejection seats should eject immediately upon receiving the bailout command by either interphone or abandon signal.

- j. Personnel will wear parachutes IAW command directives. Parachutes, when not being worn, will be located in a manner so as to be immediately available. Spare parachutes will be located in each crew area.
- k. Lifevests will be worn as required.
- l. Oxygen Masks - The pilot will tell the crew when to use oxygen based on applicable regulations and mission requirements.
- m. Fire Extinguisher - One at navigator's position and one at gunner's position.
- n. First Aid Kits - One at navigator's position and two at DI's position.
- o. Crash Axe - One at DI's position.
- p. Escape Ropes - One at each upward escape hatch. Use for emergency ground exit.
- q. Upper deck sliding hatch. The upper deck sliding hatch will be closed and locked when any crew member is required to move about or conduct any activity in the area of the hatch.

WARNING

The upper deck sliding hatch will be open and locked prior to takeoff, air refueling, low level activity, planned unusual maneuvers, penetration, and landing.

- r. Oxygen Report Briefing

Copilot requests oxygen check at level-off and during cruise at 1-hour intervals when cabin altitude is below 12,000 feet, at 30-minute intervals when cabin altitude is 12,000 to 25,000 feet, and at no longer than 10-minute intervals when cabin altitude is above 25,000 feet. If cabin altitude is below 12,000 feet, only the pilot/copilot will report. Oxygen checks are not required below 10,000 feet MSL. The remaining crewmembers will check their equipment and report if abnormal.

PREPARATION FOR FLIGHT CHECKLIST (Cont)**s. Station Checks**

Pilot and copilot accomplish station checks at level-off, at approximately 30-minute intervals during cruise, and prior to leaving crew positions during flight. A check for system operation and proper switch settings for prevailing conditions will be made during each station check. Station checks will include:

- (1) Circuit Breakers
- (2) Generators
- (3) Fuel Panel
- (4) Engine Instruments
- (5) Oxygen Quantity
- (6) Hydraulic Systems
- (7) Anti-Icing Systems

t. Equipment Stowage

Brief crew and extra crew members regarding stowing and securing of personal equipment, extra parachutes, and extra equipment, and the need for constant vigilance during flight to assure that hot air ducts, outlets, electrical wiring, and electronic equipment areas are free of combustible materials.

u. Long Endurance Flights

Special missions requiring long endurance flights are authorized to carry additional items to facilitate aircrew rest and provide for necessary food and liquid nourishment. Additional crew rest and food stowage/preparation equipment is restricted to those items authorized by the flight manual and the major air command. Specific equipment loading plans will be standardized and published by each unit and approved by the major subordinate command. This extra equipment will be stowed, in accordance with approved unit plans, and secured so as to avoid hazardous locations near air conditioning ducts/outlets, electrical equipment/wiring, flight controls, ejection seats, and emergency exits. Briefing and preflight checklists requirements on proper stowage of extra equipment will be completed in accordance with applicable crew members checklists.

PREFLIGHT CHECK

BEFORE EXTERIOR INSPECTION CHECKLIST

NOTE

The crew chief will have the Form 781 available to the pilot and the wing flaps extended when the flight crew arrives at the aircraft (station time). Station time will normally be no longer than 1 1/2 hours prior to takeoff.

1. Check Aircraft Form 781 - Completed (P)

a. Equipment Status - Checked

Pilot checks Form 781 to ascertain the status of equipment necessary for anticipated flight.

b. Discrepancies - Noted and discussed

Each discrepancy noted will be discussed with the crew member concerned.

c. Armament & Electronics Configuration & Load Status - Checked

Pilot or applicable crewmember checks all entries on Form 781C to ascertain that equipment status, loading, and configuration of items, such as: ammunition, chaff, photographic equipment, etc, conforms to the mission requirements. If AGM-69A missiles are carried, check status of aircraft systems which may be pertinent to AGM-69A launch or simulated launch. Ascertain the correct master computer program and mission data are stored, the engineering status of each loaded AGM-69A missile, and the correct payload section loading for each missile as required for the mission. Check that the proper mission tape has been loaded.

d. Fuel Load & Distribution Forms - Checked

Pilot compares the fuel load and distribution as planned on Form 200 with that shown on line 3 of block 1 of Form 6.

BEFORE EXTERIOR INSPECTION CHECKLIST (Cont)**2. Brief Ground Crew - Completed (P)****a. Stabilizer Trim Check - Briefed**

Brief the ground crew member that he will report the movement of the leading edge of the stabilizer and when the stabilizer reaches 0° position during the trim check.

b. Alarm System Check - Briefed

Brief the ground crew member that he will check the alarm system in the bomb bay during the crew report and report condition to the pilot.

c. Cooling Air Check - Briefed

Brief the ground crew member to check for generator and oil cooling air after engine start and report if no cooling air is detected.

d. Bomb Door Closing Procedure (if nonnuclear internal weapons are aboard) - Briefed

Brief the ground crewmember if bomb doors are to be closed prior to taxi (nonnuclear internal weapons only).

e. Taxi Out Procedures - Briefed

Brief the ground crew member on the direction of taxi out, and sequence (if MITO or Cell is scheduled) in relation to other aircraft.

f. Connect External Power for Lighting (as required) - Briefed

Exterior and interior lights may be utilized at the discretion of the pilot to assist in loading equipment and in the interior preflight. Brief the ground crew member to connect external power to aircraft after "Radar Navigator's, Navigator's, and EW officer's Before Exterior Inspection Checklist" has been accomplished (if applicable). Ground crew member or other crew member may then enter the aircraft and place ground power on central bus. (Two-man policy will apply as directed.)

NOTE

If nuclear bombs are aboard, the applicable "Bomb Preflight" checklist of T.O. 1B-52D-25-2CL-1 will be used. The normal two-man policy will be observed. Radar navigator and navigator must complete the "Before Exterior Inspection Checklist" prior to bomb preflight.

EW OFFICER NOT FLYING CHECKLIST

The pilot or other designated crewmember will accomplish the following checklist as required.

BEFORE EXTERIOR INSPECTION (POWER OFF)

1. Ejection Seat Arming Levers - Stowed, No. 1 safety pins installed and locked

WARNING

If the arming lever(s) has been rotated on a stowed armrest, raising the armrest will fire the arming initiator. If the arming lever(s) has been rotated or the arming lever(s) safety pin is not installed, call maintenance immediately and stay clear of the seat.

2. ECM Equipment, Chaff & Flare Power Switches - OFF
3. Chaff, Flare, Rocket & Warning Rcvr Circuit Breakers - Out
4. ALQ-117 Sys 15 and Sys 16 Ind Cont Circuit Breaker - Out

WARNING

Prior to application of electrical power, ensure that all systems are de-activated to prevent inadvertent jamming or dispensing of expendables with the application of electrical power.

5. CM SET Circuit Breaker **BG** - Out

EXTERIOR INSPECTION

1. ALE-20 Safety Interlock Switch Door - Streamer removed, closed

INTERIOR INSPECTION

1. DI Oxygen System - OFF & 100% OXYGEN
2. EW Officer's Oxygen System - OFF & 100% OXYGEN
3. Air Outlet & Auxiliary Heat Knobs:
 - a. Upper - 1/2 to full out
 - b. Warmer - Full in
 - c. Lower - Full out
4. Refuel Valve Emergency Control Lever - Center
5. IFF Mode 4 Computer - Encoded

EW OFFICER NOT FLYING CHECKLIST (Cont)**AFTER LEVEL OFF**

1. Air Outlet & Auxiliary Heat Knobs - Adjusted (CP Notified)
 - a. Upper - Full in
 - b. Warmer - 1/2 to full out
 - c. Lower - Full out

NOTE

Adjustments should occur at planned level-off altitude and after cabin temperature has stabilized. Settings may be other than stated above provided the copilot is notified for each change of setting.

POSTFLIGHT

1. ALE-20 Safety Interlock Switch Door - Opened, streamer installed

GUNNER NOT FLYING CHECKLIST**NOTE**

The pilot or other designated crewmember will accomplish the following checklist as required.

BEFORE EXTERIOR INSPECTION (POWER OFF)

1. Ejection Seat Arming Levers - Stowed no. 1 safety pins installed and locked

WARNING

If the arming lever(s) has been rotated on a stowed armrest, raising the armrest will fire the arming initiator. If the arming lever(s) has been rotated or the arming lever(s) safety pin is not installed, call maintenance immediately and stay clear of the seat.

2. FCS Switches - Checked
 - a. FCS Power Switch - OFF
 - b. Guns Ready-Safe Switch - SAFE and pinned
 - c. Radar Control Panel Switches - OFF

WARNING

Prior to application of electrical power, insure that all systems are deactivated to prevent inadvertent system operation and radiation hazard.

3. AFSATCOM Terminal **AU** :
 - a. AFSATCOM Control Mode Selector - OFF
 - b. Printer Power Switch - OFF

GUNNER'S NOT FLYING CHECKLIST (Cont)**EXTERIOR INSPECTION**

1. Turret Exterior - Visually checked

Accomplish a walkaround inspection of the turret exterior checking for general condition, presence of loose or foreign objects, and any evidence of hydraulic leaks.

INTERIOR INSPECTION

1. Upper Deck Spare Parachute Preflight - Accomplished

This check will be accomplished in accordance with the gunner's spare parachute preflight checklist.

2. Oxygen System - OFF and 100%

3. Hot Cup - OFF

4. ALR-46 Intensity Control - CCW

5. Upper Deck Fire Extinguisher - Checked

Assure that appropriate safety device (safety wire/seal or locking pin/lever, as applicable) is installed. Check for fully serviced pressure.

BEFORE ENGINE START

1. Upper Deck Sliding Hatch - Locked open

AIR REFUELING

1. Upper Deck Sliding Hatch - Locked open

BEFORE DESCENT (LANDING OR LOW LEVEL)

1. Upper Deck Sliding Hatch - Locked open

EXTERIOR INSPECTION**NOTE**

The exterior inspection is designed to be accomplished normally by an experienced pilot and copilot, each inspecting one side of the aircraft simultaneously, one pilot starting with nose section (right) through empennage and the other pilot starting with the left aft wheel well through the nose section (left). However, in the event only one pilot is available, he can perform the complete inspection.

Because of the size and complexity of the aircraft, the detailed inspection will have been completed by qualified ground crew personnel. The flight crew exterior inspection is an inspection of general aircraft condition. This inspection is based on the assumption that the flight crew is merely accepting the

aircraft for flight with emphasis on the items that affect the safety of flight. During the inspection, emphasis will be directed toward a checking for hydraulic leaks, fuel leaks, and general condition. If a fuel leak is detected while making the exterior inspection, a check should be made with maintenance for evaluation of the leak and the airworthiness of the aircraft in accordance with T.O. 1B-52G-2-8. Additional flight crew preflight will not be accomplished. If normal ground support is not available, see "Strange Field Procedures," this section, for amplified checklist. The AGM-69A missile exterior inspection will be accomplished using the abbreviated checklist. The AGM-69A launcher missiles and bomb bay interior preflight will be accomplished by the navigator and radar navigator.

INTERIOR INSPECTION CHECKLIST (PILOT)

- * 1. Equipment - Stowed

WARNING

Ensure that no equipment is stowed on or near heating ducts, outlets, electrical wiring, or electronic equipment.

- * 2. Left Load Central Circuit Breakers - Set

- * 3. Pilot's Ejection Seat:

- a. Arming Levers - Stowed, No. 1 safety pins installed and locked

WARNING

If the arming lever(s) has been rotated on a stowed armrest, raising the armrest will fire the arming initiator. If the arming lever(s) has been rotated or the arming lever(s) safety pin is not installed, call maintenance immediately and stay clear of the seat.

- b. Hatch Link - Checked

Check link connecting escape hatch to catapult safety pin-pull initiator.

- c. Maintenance Safety Pins No. 2, 3, and 5 - Checked removed

WARNING

Ensure that no streamer has been torn from a maintenance safety pin, thus inadvertently leaving the pin installed. If a maintenance safety pin is installed the status of the seat will be ascertained prior to removal of the pin.

- d. Catapult Initiator Safety Pin-Pull Cylinder - Pin in place

Catapult initiator safety pin should extend through the catapult initiator. If pin is pulled out, initiator may have been fired; call maintenance immediately.

- e. Manual Catapult Pin-Pull Lever - Checked

Lever latched, pin-pull cylinder secured.

- f. Initiator Tube Runs - Checked connected

Check tubes for proper and secure connections.

- g. Inertia Reel - Checked

Check inertia reel lock for proper functioning.

- * 4. Parachute Preflight:

- a. Inspection Record:

(1) Inspection & Repack Date - Checked

(2) Automatic Release Time & Altitude Setting - Checked

INTERIOR INSPECTION CHECKLIST (PILOT) (Cont)

- b. Personal Locator Beacon Lanyard - Snapped/Unsnapped (as required)

For peacetime operations, the personal locator beacon lanyard must be configured for automatic operation. When mission requirements dictate the necessity to avoid detection and automatic actuation of the beacon is not desired, the lanyard must be configured for nonautomatic (manual) operation.

- c. Bailout Bottle Pressure & Hose Connector - Checked
- d. Parachute Arming Lanyard Anchor - Installed

WARNING

Be certain that the parachute arming lanyard anchor is securely fastened in the attachment fitting on the seat. Failure to attach the lanyard anchor to the seat will necessitate manual operation after ejection.

- e. Parachute Straps - Adjusted (as required)
- * 5. Global Survival Kit:
 - a. Kit Installed & Plunger Depressed - Checked
 - b. Kit Release Handle - Checked down
 - c. Mode Selector Lever - AUTO
 - d. Kit Straps to Parachute - Checked and attached

Check that the attachment fittings are properly connected to the kit, the attachment straps threaded through the safety belt, and the quick-disconnect fittings are properly attached to the parachute (with release buttons on outside).

WARNING

Care must be taken to insure that the survival kit attachment straps are properly threaded through the safety belt.

- 5A. Liferaft Deflation Tool - Checked installed
- * 6. Safety Belt Release Fittings - Connected
- * 7. Shoulder Strap Attaching Fittings - Connected

INTERIOR INSPECTION CHECKLIST (PILOT) (Cont)**8. Thermal Curtains - Checked and positioned**

During initial acceptance check for an alert aircraft, a check will be made of thermal curtains at all transparent openings for condition and proper fit. The curtains over the pilot and copilot escape hatches and those over the eyebrow windows will remain closed while the aircraft is on alert. Curtains for cockpit windows No. 1, 2R&L, 3R&L, 4R&L, and 5R&L will be returned to the stowed/open position. Refer to Section IV for additional information.

WARNING

Thermal curtains will be kept free from grease, oil and mold as any discoloration will seriously impair the value of the curtains. Oil or grease base materials will ignite upon exposure to thermal radiation. Dirty or cracked thermal curtains will be replaced.

9. EVS Monitor Optical Filters - Stowed

Filters will be stowed except when required for inflight use.

NOTE

To prevent pilot distraction by a falling filter, check for proper stowage and security of filters during Interior Inspection and periodically during flight.

10. Readiness Switch Cover - Closed, sealed***11. Circuit Breakers - Set****12. Autopilot Servos Cutout Switches - IN****13. Water Injection Switches - OFF and CLOSE (OPEN if the aircraft is not serviced with water)**

Water injection system switch OFF; water injection drain valve switch CLOSE.

14. IFF Master Switch - STBY, codes set*15. AGM-69A Consent Panel:**

a. Prearm-Safe Switch - Guard closed and sealed

b. Lock-Unlock Switch - Guard closed and sealed

16. AGM-69A Launcher Hydraulic Control Switch - OFF**17. Hydraulic Standby Pump Switches - OFF*****18. Rudder/Elevator Hydraulic Switches - OFF****19. Pilot's Flare Set Power Switch - OFF**

The OFF position of the switch is the center position of a three-position switch. The switch locks in the center position and is ON in the up position. The down position has no function.

20. Air Outlet Knob - 1/2 out***21. Mach Indicator Switch - ON****NOTE**

The mach indicator will be unreliable and needle oscillation may occur until sufficient pitot pressure is attained during takeoff. The pilot should expect and disregard this oscillation.

INTERIOR INSPECTION CHECKLIST (PILOT) (Cont)

- *22. Clock - Checked and set
- 23. Flight Director Computer Gyro Select Switch - NORMAL
- 24. Anti-Ice Panel Switches - OFF
- 25. Emergency Landing Gear Switches - Guards closed
- *26. Antiskid Switch - ON, guard closed
- 27. Yaw & Pitch SAS Switches - DISENGAGE
- 28. Steering Ratio Selector Lever - TAKEOFF LAND
- *29. Airbrake Lever - OFF
- *30. Stabilizer Trim Cutout Switch - Guard closed
- 31. Lateral Trim Cutout Switch - Guard closed
- 32. Crosswind Crab Knob & Indicator - Down and zero
- 33. Air Conditioning Head Outlet - CLOSED

For other than alert operation, the head outlets may be opened for ground operation during warm weather.

INTERIOR INSPECTION CHECKLIST (COPILOT)

- * 1. Equipment - Stowed

WARNING

Insure that no equipment is stowed on or near heating ducts, outlets, electrical wiring, or electronic equipment.

- * 2. Right Load Central Circuit Breakers - Set
- 3. IP Oxygen Regulator - OFF and 100% OXYGEN (IP not flying)
- * 4. Copilot's Ejection Seat:
 - a. Arming Levers - Stowed, No. 1 safety pins installed and locked

WARNING

If the arming lever(s) has been rotated on a stowed armrest, raising the armrest will fire the arming initiator. If the arming lever(s) has been rotated or the arming lever(s) safety pin is not installed, call maintenance immediately and stay clear of the seat.

INTERIOR INSPECTION CHECKLIST (COPILOT) (Cont)

b. Hatch Link - Checked

Check link connecting escape hatch to catapult safety pin-pull initiator.

c. Maintenance Safety Pins No. 2, 3, and 5 - Checked removed

WARNING

Ensure that no streamer has been torn from a maintenance safety pin, thus inadvertently leaving the pin installed. If a maintenance safety pin is installed, the status of the seat will be ascertained prior to removal of the pin.

d. Catapult Initiator Safety Pin-Pull Cylinder - Pin in place

Catapult initiator safety pin should extend through the catapult initiator. If pin is pulled out, initiator may have been fired; call maintenance immediately.

e. Manual Catapult Pin-Pull Lever - Checked

Lever latched, pin-pull cylinder secured.

f. Initiator Tube Runs - Checked connected

Check tubes for proper and secure connections.

g. Inertia Reel - Checked

Check inertia reel lock for proper functioning.

*** 5. Parachute Preflight:**

a. Inspection Record:

(1) Inspection & Repack Date - Checked

(2) Automatic Release Time & Altitude Setting - Checked

b. Personal Locator Beacon Lanyard - Snapped/Unsnapped (as required)

For peacetime operations, the personal locator beacon lanyard must be configured for automatic operation. When mission requirements dictate the necessity to avoid detection and automatic actuation of the beacon is not desired, the lanyard must be configured for nonautomatic (manual) operation.

c. Bailout Bottle Pressure & Hose Connector - Checked

d. Parachute Arming Lanyard Anchor - Installed

WARNING

Be certain that the parachute arming lanyard anchor is securely fastened in the attachment fitting on the seat. Failure to attach the lanyard anchor to the seat will necessitate manual operation after ejection.

e. Parachute Straps - Adjusted (as required)

INTERIOR INSPECTION CHECKLIST (COPILOT) (Cont)*** 6. Global Survival Kit:**

- a. Kit Installed & Plunger Depressed - Checked
- b. Kit Release Handle - Checked down
- c. Mode Selector Lever - AUTO
- d. Kit Straps to Parachute - Checked and attached.

Check that attachment fittings are properly connected to the kit, the attachment straps threaded through the safety belt, and the quick-disconnect fittings are properly attached to the parachute (with release buttons on outside).

WARNING

Care must be taken to insure that the survival kit attachment straps are properly threaded through the safety belt.

- 7. Liferaft Deflation Tool - Checked installed
- * 8. Safety Belt Release Fittings - Connected
- * 9. Shoulder Strap Attaching Fittings - Connected
- 10. Thermal Curtains - Checked and positioned

During initial acceptance check for an alert aircraft, a check will be made of thermal curtains at all transparent openings for condition and proper fit. The curtains over the pilot and copilot escape hatches and those over the eyebrow windows will remain closed while the aircraft is on alert. Curtains for cockpit windows No. 1, 2R&L, 3R&L, 4R&L, and 5 R&L will be returned to the stowed/open position. Refer to Section IV for additional information.

WARNING

Thermal curtains will be kept free from grease, oil and mold as any discoloration will seriously impair the value of the curtains. Oil or grease base materials will ignite upon exposure to thermal radiation. Dirty or cracked thermal curtains will be replaced.

11. EVS Monitor Optical Filters - Stowed

Filters will be stowed except when required for inflight use.

NOTE

To prevent pilot distraction by a falling filter, check for proper stowage and security of filters during Interior Inspection and periodically during flight.

- *12. Circuit Breakers - Set
- *13. Battery Switch - OFF
- *13A. Battery Charge Test Switch - OFF

INTERIOR INSPECTION CHECKLIST (COPILOT) (Cont)

- *14. Manifold Valve - OPEN
- *15. Engine Starter Switches - OFF and PNEUMATIC (for pneumatic start); START and FLIGHT (for cartridge start)
- 16. Generator Selector Switch - CENTRAL BUS TIE
- 17. Generator Drive Decoupler Switches - Checked OFF
- 18. Air Outlet Knob - 1/2 out
- *19. Clock - Checked and set
- *20. All Fuel System Switches - OFF and CLOSED
- *21. Landing Gear Lever - GEAR DOWN, in detent
- *22. Air Conditioning Panel - Set
 - a. Pressure Release Switch - Guard closed
 - b. Bleed Selector Switch - NORMAL LH INBOARD, guard closed
 - c. Air Conditioning Master Switch - OFF (RAM if cooling air connected)



The MA-3 external air conditioning unit must be disconnected from the cabin emergency ram airscoop before scoop is retracted.

- d. Temperature Selector - AUTOMATIC (temperature as desired)
- *23. Throttles - CLOSED
- *24. Drag Chute Lever - Checked and LOCKED

Move the drag chute lever toward JETTISON. If resistance is encountered, the drag chute door is closed and locked. If no resistance is encountered, the drag chute door has opened and the drag chute is deployed. The drag chute will have to be checked and the door locked prior to flight.

- 25. Wing Flap Lever - OFF
- 26. Terrain Display Mode Selector Switch - OFF
- 27. Air Conditioning Head Outlet - CLOSED

For other than alert operations, the head outlets may be opened for ground operation during warm weather.

BEFORE STARTING ENGINES

BEFORE STARTING ENGINES CHECKLIST (Pilot/Copilot reads)

* 1. Interphone - Checked (P-CP)

Pilot and copilot check for operation of the interphone system by noting sidetone in headset.

At time of turning interphone power switch to ON, the aft battery discharging light should come on and the forward battery discharging and end-of-life lights should remain out.

NOTE

If aft battery discharging light does not come on, turn battery switch ON.
Check that aft battery discharging light comes on and place battery switch OFF.

* 2. Oxygen System - Checked (P-CP)

The following items may be accomplished silently:

- a. Regulator Diluter Lever - 100% OXYGEN
- b. Shutoff Lever - OFF
- c. Mask & Hose - Check disconnect, then reconnect

Check for 10- to 20-pound pull for disconnect, then reconnect mask and hose

WARNING

Insure that oxygen supply hose is under seat armrest before hookup with the oxygen mask hose.

d. Diluter Valve - Checked

Attempt to draw air through the oxygen mask. Ability to draw air indicates a defective diluter valve, oxygen hose and/or connections or mask. Then place the diluter valve to NORMAL position, draw air through the mask, if unable, this would indicate that only 100% oxygen will be available.

NOTE

- If the diluter valve is stuck in the 100% position, this will prohibit the detection of smoke or fumes when use of normal oxygen is required.
- If the CRU-73A regulator is installed, the crew member will not be able to draw air through the system with the shutoff lever OFF. The diluter lever may be moved to NORMAL with the shutoff lever OFF on some CRU-73A regulators. The diluter valve will be in the 100% oxygen position when the shutoff lever is OFF on all CRU-73A regulators.

e. Shutoff Lever - ON

BEFORE STARTING ENGINES CHECKLIST (Pilot/Copilot reads) (Cont)

- f. Pressure - Checked

Pressure gage reads approximately 300 psi.

- g. Emergency Toggle Lever - TEST MASK

With mask disconnected at one side of helmet, the flow indicator should indicate continuous flow.

- h. Mask - Test

Attach mask to helmet and hold breath; indicator should indicate no flow.

NOTE

Flow condition may be indicated by a slight leak around the face form. If light hand-pressure against the mask does not stop the flow, the mask is unacceptable.

- i. Emergency Toggle Lever - NORMAL

- j. Regulator Diluter Lever - NORMAL/100% (as required)

- * 3. Gyro Power Switch - ON (P)

- * 4. Emergency D-C Power Switch - EMERGENCY (EMER), checked, NORMAL (P-CP)

Copilot positions the emergency dc power switch to EMER and checks that aft battery discharging light goes out and forward light comes on, indicating that emergency loads have transferred from the aft battery to the forward battery. Pilot checks operation of gyro flight instruments and illumination of emergency flight instrument lights on battery power. Pilot also checks standby attitude indicator operating, and OFF flag out of view **BC**. Pilot actuates emergency alarm switch to ALERT to check the alarm system on emergency battery power. While in ALERT, copilot returns emergency dc power switch to NORMAL and checks continuous operation of the alarm system. Pilot then turns emergency alarm switch to OFF. Forward battery discharging light goes out upon return to NORMAL.

NOTE

Failure of the battery discharging lights system to check satisfactorily can also affect proper operation of the battery end of life lights. Takeoff should not be made with a battery detector system malfunction.

- * 5. Battery Switch - ON, lights checked (CP)

Both battery discharging lights should come on and end-of-life lights should remain out.

NOTE

The forward battery discharging light may not come on due to sensitivity tolerance of the detector.

BEFORE STARTING ENGINES CHECKLIST (Pilot/Copilot reads) (Cont)

- * 6. Generator Switches - OFF (for pneumatic start); ON (for cartridge start without external power) (CP)

For cartridge starting generators will be placed in ON to close the generator control relays and facilitate generator operation and minimum cut-in speed if external power is not connected.

- * 7. External Power Switch - ON, battery discharging lights out (CP)

External power circuit breaker position indicator will not close if phase sequence is not correct or if generator circuit breaker is closed.

- * 8. Warning & Indicator Lights - Press-to-test (P-CP)

Pilot and copilot press-to-test all warning and indicator lights that are not illuminated. The TACAN TEST light will be tested during radio check. Pilot presses marker beacon test button to check marker beacon lights. Pilot and copilot actuate lamp test switches to test EVS panel indicator lights. Press TA test button above EVS monitor to check TA indicators. Turn on radar altimeter, check lights, and turn off.

- 9. EVS Power Switches - OFF (P-CP)

Check EVS power switch in OFF position by noting integral indicator not illuminated.

- *10. Oxygen Quantity - Checked (P)

Press to test and check for warning light (if installed) at approximately 7.5 liters. Liquid oxygen indicator should indicate required quantity.

- *11. Engine Fire Shutoff Switches - IN and checked (P-CP)

Push the engine fire shutoff switches to NORMAL (in) and check the fire detector system and lights by moving the fire detector switch to TEST.

- *12. Navigation Lights - BRIGHT and FLASH (P)

- *13. Ground, Connect, & Clear Bomb Doors - Connected and clear (GC)

- *14. Radios - ON (CP)

- 15. (Deleted)

BEFORE STARTING ENGINES CHECKLIST (Pilot/Copilot reads) (Cont)***16. Fuel Quantity Check - Completed (P-CP)**

Copilot depresses fuel quantity gage press-to-test button to assure proper operation of fuel gages and observes wing tank warning lights come on. Hold button in until main tank quantities drop to 4,000 pounds and main tank low warning light comes on. Copilot calls off individual tank identity and gage reading to the pilot who records them in the No. 2 column of the fuel log (Form 200). The pilot cross-checks the fuel load dipstick readings from Form 6 with individual tank gage reading and planned fuel load as recorded in the No. 1 column of the fuel log. The pilot totals the individual tank gage readings and compares the total with the totalizer reading. Copilot sets best flare speed computer ring to operating weight plus expendable stores.

NOTE

- Except when missile configuration is asymmetrical, fuel must be loaded symmetrically in the main, outboard, and external tanks. If the difference between a gage reading and dipstick reading or planned fuel for tank and dipstick reading appears abnormal, consult the Mission Planning Section of the Appendix for allowable tolerances.
- Stabilizer trim should be recomputed for any one tank dipstick reading differing from the planned fuel loading by 1000 pounds or if the absolute total of the differences for all tanks between planned fuel loading and dipstick reading exceeds 2000 pounds.

17. Radios - Checked (P-CP)

- a. Copilot checks primary and secondary radios and obtains altimeter setting. On aircraft **AU**, copilot checks operation of LOS radio ARC-171(V) as follows:
 - (1) Interphone selector switch to AUX UHF.
 - (2) LOS radio function select switch on BOTH. The LOS PMT light on the SATCOM control at the gunner's station will illuminate if SATCOM control mode selector is not in OFF/SATL.
 - (3) Rotate the test initiate selector switch to LAMP. After TEST FAULT light comes on, return test initiate selector to OPR.
 - (4) Set MAIN and GUARD SQUELCH switches to ON, and GUARD-PRESET-MANUAL switch to PRESET.
 - (5) Set CHANNEL selector switch for the operating frequency listed on the write-on frequency chart.
- b. Pilot checks VOR equipment:
 - (1) Nav Mode Select Switch - VOR
 - (2) Tune and identify a VOR station.
 - (3) Check that bearing pointer points to the station.
 - (4) Set bearing pointer indicator in the course selector window and check that CDI centers and the TO-FROM indicator indicates TO.
 - (5) Rotate the course set knob $\pm 5^\circ$ to check for proper CDI displacement.
 - (6) Rotate course set knob and check that TO changes to FROM indication after approximately 90° of course selector change

BEFORE STARTING ENGINES CHECKLIST (Pilot/Copilot reads) (Cont)**c. Pilot checks TACAN equipment:**

- (1) Nav Mode Selector Switch - TACAN
- (2) Tune and identify a TACAN station.
- (3) Repeat steps (3) through (6) above using TACAN.
- (4) Check TACAN range indicator warning flag out of view and distance indicates correctly.
- (5) Set X-Y Channel selector and select any channel that cannot be received in the area where the test is being accomplished.
- (6) Select CDI course of 180°
- (7) Momentarily depress test switch.
 - (a) Test light momentarily flashes.
 - (b) DME mask, course warning flag on ADI and CDI warning flag on HSI (if so equipped) in view.
 - (c) HSI bearing pointer moves to 270° .
 - (d) DME mask, course warning flag on ADI and CDI warning flag on HSI (if so equipped) drive out of view.
 - (e) DME shows 000.0 ± 0.5 ; bearing pointer shows $180^{\circ} \pm 3^{\circ}$.

NOTE

DME readings of 300.0 to 399.5 are indications of negative distance and are not a malfunction.

- (f) Course deviation indicator centered ($\pm 1/2$ dot) and TO-FROM indicator on HSI indicates TO.

NOTE

- Test indications last about 15 seconds.
- Refer to Section IV for more detailed information about functions.

(8) Test Light - Out

- (a) If test light remains on, the AN/ARN-118 system is malfunctioning and all TACAN information should be disregarded.

BEFORE STARTING ENGINES CHECKLIST (Pilot/Copilot reads) (Cont)

NOTE

- REC mode may be used. DME will not be available, but other indications will function normally if the TACAN test light does not stay on. With the exception of DME, test cycle will function the same way.
 - Test switch may be used as an inflight confidence test of the AN/ARN-118 equipment.
- d. Copilot checks liaison radio for reception. Allow 15 minutes warmup time for proper system operation.

WARNING

- Ground transmissions of the liaison radio are prohibited on aircraft within 200 feet of any of the following:
 1. Unloaded nuclear weapons or warheads.
 2. Aircraft with external weapons with nuclear warheads installed.
 3. Nuclear weapons loaded in an aircraft (transmitting or adjacent) with its bomb bay doors open.
- Hazardous RF voltages can exist between the aircraft skin and ground when transmissions are being made with the liaison radio.

NOTE

This does not prohibit receiver operation on the ground.

- e. Liaison Radio - OFF (if transmission check is not required)

18. Altimeters - Checked and RESET (P); Checked and STBY (CP)*a. Altimeters - Set, STBY flag in sight**

Set in accordance with AFM 51-37. Insure that each altimeter indicates (± 75) feet of a known checkpoint elevation. Pilot checks that an altimeter correction card is installed for proper aircraft configuration.

b. RESET-STBY Lever - RESET

Hold in RESET position 2 to 3 seconds.

c. STBY Flag - Out of sight

Compare altimeter readings with standby mode reading. Altimeter should read within 75 feet of standby mode reading. Ensure that each altimeter indicates (± 75) feet of a known checkpoint elevation. Pilot's and copilot's altimeters should read within 75 feet of each other. This allowable difference of 75 feet between servo mode readings also applies in flight at all altitudes and speeds.

NOTE

- If the STBY flag appears and mission requirements allow, the mission may be continued.
- For flights conducted by the copilot, his altimeter may be operated in RESET and the pilot's in STBY.

19. (Deleted)***20. AIMS - Checked (P)****a. IFF Antenna Switch - BOTH****b. RAD-TEST/MON Switch - OUT****c. Master Switch - NORM****d. Modes 1, 2, 3A and Mode C - Tested**

Check for test light illumination as each mode switch is held in TEST position.

e. Mode 4 Code Switch - Set as briefed

BEFORE STARTING ENGINES CHECKLIST (Pilot/Copilot reads) (Cont)

- f. Mode Switches - Set as briefed
- g. Master Switch - STBY

*21. Elevator & Rudder - Checked (P-CP)

NOTE

For thruflight sorties, confirm with ground crew that ground cooling system is operating. No other checks are required.

- a. Rudder/Elevator Main & Aux Lights (four lights) - On (P)
- b. Rudder/Elevator Hydraulic Switches - ON, lights out (P); cooling air checked (GC)

Check main and aux hydraulic system lights out.

CAUTION

- Immediately after placing rudder/elevator hydraulic switch to ON, pilot will confirm with ground crew that ground cooling system is operating. Ground crew should report air blowing out of two exhaust ports.
- Maximum time that rudder/elevator hydraulic systems can be operated without ground blower in operation is 4 minutes.

c. Elevator check:

- (1) Control Column - Full forward

Ground observer reports position of elevators.

- (2) Control Column - Full back

Ground observer reports position of elevators.

d. Rudder & Rudder Trim Check:

- (1) Rudder Pedal - Full left

Ground observer reports position of rudder.

- (2) Rudder Pedal - Full right

Ground observer reports position of rudder.

- (3) Rudder Pedals & Rudder Trim Knob - Centered

Ground observer reports position of rudder.

e. Rudder/Elevator Hydraulic Switches - OFF (P)

*22. Ground, Remove Ground Locks & Bypass Keys - Removed (GC)

BEFORE STARTING ENGINES CHECKLIST (Pilot/Copilot reads) (Cont)***23. Standby Hydraulic Pump Pressure - Checked (P)**

Pilot places standby pump switches to STBY and observes buildup of outboard wing and left body pressure to 3000 (± 250) psi. Check right body pressure for reading of 2500 (± 250) psi. If required, momentarily place RUD/ELEV MAIN 2 switch ON. This will close the right hydraulic transformer shutoff valve and provide for a valid indication of right body standby pump pressure. Right body pressure should read 2500 (± 250) psi.

NOTE

- The right body standby pump pressure may fluctuate ± 250 psi.
- Before turning the RUD/ELEV MAIN 2 switch ON, the right body standby pump pressure may read less than 2500 (± 250) psi. After turning the switch OFF, the pressure may again drop to a lower value.

24. Autopilot - Checked and OFF (P)

- a. Check turn knob and roll trim knob in detent position.
- b. Place autopilot master switch ON.
- c. Note trim indicators centered and place servos engage switch to ENGAGE.
- d. Depress pilot's autopilot release button; autopilot should disengage and the disengage warning light should flash.
- e. Turn autopilot master switch OFF.

25. Airbrake, Spoiler & Lateral Trim Check - Completed (P-CP)

CAUTION

To prevent pump overheating, the ground test pumps must be limited to 5 minutes continuous operation.

NOTE

- This check is made in coordination with ground crew observer. Ground crew must hold ground test switches ON during this check. Ground crew observer will report position of spoilers after each movement.
- Spoiler rigging tolerances are such that the spoiler groups on each wing may not exactly line up during partial or full extension of the spoilers. Also, when airbrakes are in position 6, additional raising of the spoilers on a wing when the control wheel is moved out of neutral is normal and the outboard segments will raise from 50° to 60° as more control wheel rotation is applied.

a. Airbrake & Spoiler Check:

- (1) Move airbrake lever to position 6.

Ground reports: Inboard 60° ; Outboard 50°

NOTE

Wing droop associated with high gross weight fuel loads may make it impossible to see the outboard airbrake segments from the cockpit. These segments will be at 50° instead of 60° .

BEFORE STARTING ENGINES CHECKLIST (Pilot/Copilot reads) (Cont)

- (2) Move Control Wheel: Ground reports:

Position	Left Spoilers	Right Spoilers
Full left	Up	Down
Full right	Down	Up
Neutral	Inboard 60°; Outboard 50°	Inboard 60°; Outboard 50°

NOTE

Full control wheel travel will still result in both inboard and outboard spoiler segments assuming the full 60° extension (i. e., with airbrakes in position 6, control wheel displacement to full left will cause the left spoilers to move from inboards 60°, outboards 50° to both segments 60°, and right spoilers from inboards 60°, outboards 50° to both segments zero. Returning control wheel to neutral with airbrakes in position 6 will cause spoilers to assume the position of inboards 60°, outboards 50°).

- (3) Airbrake Lever - OFF. Ground reports, "All airbrakes down."

b. Lateral Trim Check:

- (1) Lateral Trim Button - LDN (left wing down)

Copilot actuates trim control button to LDN and moves control wheel to new center position. Pilot actuates lateral trim cutout when trim indicator reaches approximately 5°. Copilot releases trim button, pilot places trim cutout switch in NORMAL, guard closed. Ground observer reports, "Left spoilers up, right spoilers down." Pilot notes the movement of trim indicator.

- (2) Lateral Trim Button - RDN (right wing down)

Pilot returns lateral trim to neutral and moves control wheel to neutral. Ground observer reports, "All spoilers down." Pilot observes trim indicator for correct indication.

*26. Wing System Standby Pump Switches - OFF (P)

*27. Wing Flaps - Checked and up, lever OFF (CP-GC)

Flaps should be full down at the time the crew enters the airplane. Ground personnel will be on interphone and advise the pilot of flap position and movement. Flaps should be checked that they retract in approximately 60 seconds.

CAUTION

To prevent inadvertent movement of the wing flaps after the desired flap position is obtained, the wing flap lever will be left in DN position at all times when full flap extension is desired. To prevent flap motor damage which may be caused by limit switch actuation after flap retraction, the lever will be moved to OFF when the flaps up indication is received.

BEFORE STARTING ENGINES CHECKLIST (Pilot/Copilot reads) (Cont)***28. Fuel Panel Switches:**

- a. 1 & 4 Above Green Band, Center & Aft Contain 2,000 Pounds or More Each - 1, 2, 3 & 4 ON; 13 & 16 OPEN; 26 & 28 ENGINE FEED (CP) Checked (P)
- b. 1 & 4 Above Green Band, Either Center or Aft Less Than 2,000 Pounds - 1, 2, 3 & 4 ON (CP) Checked (P)
- c. 1 or 4 in Green Band - 1, 2, 3 & 4 ON; 9, 10, 11 & 12 OPEN (CP) Checked (P)

***29. Gyro Instruments - Checked (P-CP)**

Check gyro indicators for indication of power application by noting gyros properly erected and warning flags not showing. Rotate attitude indicator pitch trim knob clockwise and attitude indicator should read not less than 10° dive. Rotate pitch knob counterclockwise and attitude indicator should read not less than 5° climb. Set heading indicator (gyro) to aircraft heading. Less BB

Check gyro indicators for indication of power application by noting gyros properly erected and OFF flags and ATT warning flags not showing. Rotate attitude indicator pitch trim knob clockwise and attitude indicator should read not less than 10° dive. Rotate pitch knob counterclockwise and attitude indicator should read not less than 5° climb. Set heading indicator (gyro) to aircraft heading. Press and hold the ATT TEST pushbutton for at least two seconds and attitude sphere should rotate 10° (±1°) in the roll and pitch axes and the ATT warning flags appear. The sphere should always give a right roll and pitch up indication. Pilot also check standby attitude indicator erected and OFF flag out of view BB
BC

30. Ground Locks & Bypass Keys - Counted and stowed (N)**31. Crew Report - Completed (P)**

- a. Pilot actuates the emergency alarm switch to ABANDON, switches interphone to CALL position and announces, "Crew report."
- b. The sequence for crew reporting is as follows: N, G, EW, RN, CP, P, IN, DI, 10th, IP.
- c. All crewmembers will switch to CALL and report "(Crewmember's) check complete." The check consists of abandon signal and call operation.
- d. Ground crew checks the alarm system in the bomb bay and reports condition to pilot.

32. Steering Ratio Selector Lever - TAXI (P)***33. Windshield Anti-Ice & Defog Switch - NORMAL (P)*****34. Auxiliary Window Defog Switch - ON (P)*****35. Circuit Breakers - Set (P-CP)**

BEFORE STARTING ENGINES CHECKLIST (Pilot/Copilot reads) (Cont)**NOTE**

- For normal training missions, disregard the remaining items in this checklist and proceed to "Starting Engines and Before Taxiing" checklist.
- The aircrew may leave their stations provided they can assure that the configuration of the various controls and switches will not be changed. If not, they must accomplish the "Before Leaving Airplane" checklist. Upon returning to the airplane for flight, the "Interior Inspection" and "Before Starting Engines" checklists must be accomplished for switch positioning prior to starting engines. This requirement does not apply when preparing the aircraft for alert posture.
- For alert posture, engines must be started to check and set stabilizer trim. If no maintenance is required on the aircraft subsequent to the stabilizer trim check or taxiing to the alert area (if applicable), the recocking checklist will be used to recock the aircraft. See "Alert Procedures" this section.

36. Ground, Close Hatches - Roger (GC); light out (P)

WARNING

The MA-3 external air conditioning unit can build up sufficient cabin pressure to cause the entrance hatch to blow even though the air conditioning master switch is in RAM. Ascertain that a sliding window is open prior to opening or closing the hatch.

NOTE

The main entry door must be locked to prevent loss of pressurization during flight. The door can be locked from the inside only.

37. Ground, Open Hatch - Roger (GC)

38. Engine Ignition Circuit Breakers - Pulled (P-CP)

Pull four engine ignition circuit breakers on each load central.

39. Cartridges - Installed (GC)

40. Engine Ignition Circuit Breakers - In (P-CP)

WARNING

Before pushing engine ignition circuit breakers in on each load central, assure that ground crewmember is clear of engine starter exhaust area.

41. Flash Blindness Equipment - Checked (if applicable) (ALL)

Flash blindness equipment will be checked and positioned in accordance with command directives.

42. Bomb Doors - Close (P)

Bomb doors will be closed and remain closed on alert aircraft except for required maintenance and special weapons inventory.

STARTING ENGINES AND BEFORE TAXIING

STARTING ENGINES AND BEFORE TAXIING CHECKLIST (Pilot reads)

NOTE

- Only the **boldface** items need be accomplished for Scramble. All items will be reviewed during climb or as soon as practicable.
- During EWO alert operations, takeoff will not be delayed for items pertaining to crew equipment, radio checks, and IFF settings.
- Engines will not be started until both pilots are in position.

1. **PARKING BRAKES — SET (P)**
2. **BATTERY SWITCH — ON (CP)**
3. **INTERPHONE POWER SWITCH — ON (P)**
4. External Power - ON (CP)

CAUTION

The battery override switch will not be used for normal training missions.

For normal operations, place external power on the aircraft by placing the external power switch to ON. During alert operations or when time is not available to allow external power cart (MD-3) to warm up properly, place external power on the aircraft in the following manner:

- a. Isolate Button - Depressed
- b. External Power Switch - ON
- c. Generator Switches - OFF

Momentarily position generator switches to OFF one at a time and check generator circuit breakers open and bus tie circuit breakers closed.

5. Ground, Close Hatches - Roger (GC); light out (P)

NOTE

The main entry door must be locked to prevent loss of pressurization during flight. The door can be locked from the inside only.

6. Ground, Start External Air 30 Psi Desired (for pneumatic start only) - Roger (GC)

NOTE

Satisfactory starts may be made at less than 30 psi although starting time will be increased. See "Strange Field Procedures," this section.

STARTING ENGINES AND BEFORE TAXIING CHECKLIST (Pilot reads) (Cont)**7. STAND BY TO START ENGINES — FIRE GUARD POSTED AND CLEAR (GC)**

Ground crewman will have microphone and headset plugged into the external microphone system; pilot states "Stand by to start engines." When equipment and personnel are clear of intake and exhaust ducts, chocks are in place, and fire guards posted, ground crew replies, "Fire guards posted and clear."

WARNING

If the aircraft is directly behind another operating jet aircraft or will be run up with its tail into the wind and contamination is suspected, 100% oxygen will be used during ground operation and takeoff.

CAUTION

When practicable, start and run up engines with aircraft on a clean paved surface to reduce possibility of dirt or other objects being drawn into engine compressors and damaging engines.

8. START ENGINES — STARTED (CP)**NOTE**

- If maintenance or other conditions require starting engines in a sequence other than outlined below, engines will be started individually to preclude possible hot starts. When engines are started one at a time, engines operating above idle RPM should be retarded to idle. The starter should first be placed on and then an engine advanced to provide an air bleed source. This is done to prevent starter damage due to bleed air surge.
- External electrical power units will be used for engine starts. Battery starting procedures may be used in the event of external power unit failure. While on alert, battery starting procedures will be used, the external power unit will be positioned for use in the event of battery failure.

The following procedures are designed to be used for starting engines with or without external electrical power. The battery system may not be dependable at low temperatures. When battery start procedures are used, all normal engine and generator starting precautions will be used; engine oil pressure and fuel flow indication will be inoperative until a generator is on the line.

NOTE

- Pilot monitors starting sequence to prevent engines from exceeding limitations.
- Combustion, indicated by a rise in exhaust temperature, must occur within 20 seconds after throttle is advanced. During a normal start, the fuel flow prior to combustion should be between 540 and 1250 pph. As the engine accelerates, the fuel flow will increase to as high as 2000 pph. At a stabilized idle rpm, the fuel flow should drop to 540 to 1250 pph. Fuel flow rates in excess of the above figures can warn of a hot start condition. If fuel flow is below 540 pph, retard throttle to CLOSED, place starter switch to OFF, allow at least 30 seconds for fuel drainage, and check for malfunction before attempting a restart.

STARTING ENGINES AND BEFORE TAXIING CHECKLIST (Pilot reads) (Cont)

- Hung starts, usually characterized by failure of the engine to accelerate to idle rpm, are more likely to occur at temperatures below 45° F (7° C) or above 100° F (38° C). EGT may rise slowly but should not be allowed to exceed the starting limit. If engine does not accelerate to idle rpm within 90 seconds or if a tendency to exceed other limits is observed, proceed with engine shutdown and applicable maintenance instructions for obtaining a satisfactory start.
- If the ambient temperature is -22° F (-30° C) or below, idle the engine for a 2-minute warmup period. See Section IX, "Cold Weather," for engine starting in cold weather.

CAUTION

- Starter dropout should occur at approximately 35% to 45%. In order to prevent starter internal failure in case starters fail to drop out, the starter switches are moved to OFF as the engines attain 45% rpm.
- Advancing the throttle before 15% rpm is reached increases the possibility of a hot start.
- Oil pressure must be 35 psi minimum within 30 seconds. Disregard the low oil pressure warning lights when oil pressure is below 40 psi.
- If external electrical power is lost during an engine start and engines 1, 2, 7, or 8 are below approximately 35% rpm, immediately retard throttle to CLOSED and discontinue the start until electrical power is restored. The loss of a-c power (and TR power) will close outboard strut air bleed valves depriving the engine of starter assistance. This may result in a hot start if the throttle is not closed. To prevent starter damage due to bleed air surge, engine(s) operating above idle rpm should be retarded to idle before any subsequent attempt to restart.
- All cases of overspeed and overtemperature operation will be recorded in Form 781. See figure 5-2 for engine operating limitations.
- Avoid reengaging the engine starter while the engine is still rotating unless it becomes necessary to do so. Such practice may reduce starter service life.
- To prevent damage to wing flap structure, operation at engine rpm greater than 92% with wing flaps extended should be kept to a minimum.
- Ground crew checks for generator and engine oil cooling air. If any engine does not have cooling airflow, the mission may be continued, provided the throttle for the affected engine(s) is kept in the IDLE position until ready for takeoff (a deviation to check stabilizer trim or anti-ice runup is permissible). To prevent exceeding oil temperature limitations for either the engine or generator constant speed drive, takeoff should be accomplished within 45 minutes. Inoperative air ejector valves will be recorded in AFTO Form 781A and replaced prior to the next flight.

STARTING ENGINES AND BEFORE TAXIING CHECKLIST (Pilot reads) (Cont)**Pneumatic Start — With External Electrical Power****NOTE**

Check all engine starter switches OFF and PNEUMATIC.

Pilot announces "Starting No. 4." Copilot positions No. 4 starter switch to START. At a minimum of 15% rpm, pilot advances throttle to 90% rpm. As No. 4 engine reaches 45% rpm, copilot places No. 4 starter switch to OFF then places No. 5 engine starter switch to START. As No. 5 engine reaches 15% rpm, pilot advances the throttle to 85% rpm. As No. 5 engine reaches 45% rpm, copilot places that starter switch to OFF and all remaining engine switches to START. As the remaining engines reach a minimum of 15% rpm, pilot advances throttles No. 1, 2, and 3 and copilot advances throttles No. 6, 7, and 8 to IDLE. As the engines reach 45% rpm, copilot positions the respective starter switches to OFF.

Pneumatic Start — Without External Electrical Power**NOTE**

Check all engine starter switches OFF and PNEUMATIC.

Pilot announces "Starting No. 4." Copilot positions No. 4 starter switch to START. At a minimum of 15% rpm, pilot advances throttle to 90% rpm. As No. 4 engine reaches 45% rpm, copilot places No. 4 starter switch to OFF then places No. 5 engine starter switch to START. As No. 5 engine reaches 15% rpm, pilot advances the throttle to 85% rpm. As No. 5 engine reaches 45% rpm, copilot places that starter switch to OFF and all remaining engine switches to START. Copilot will turn generator No. 5 to ON when second engine (No. 5) reaches idle rpm. As the remaining engines reach a minimum of 15% rpm, pilot advances throttles No. 1, 2, and 3 and copilot advances throttles No. 6, 7, and 8 to IDLE. As the engines reach 45% rpm, copilot positions the respective starter switch to OFF.

Cartridge Start**NOTE**

- This procedure will be used for simultaneous eight engine cartridge starts or any combination of cartridge/pneumatic starts.
- Check all engine starter switches in START and FLIGHT. Generator switches will be placed ON if external electrical power is not connected.
- Before placing start selector switch to CARTRIDGE check throttles fully closed to ensure starter cartridge firing/ignition.
- After starting cartridge configured engines when external electrical power is not available, it will be necessary to delay starting other engines which are pneumatically isolated, until a generator is placed on the line to provide TR power for opening the outboard strut bleed valves.

Pilot announces "Starting engines _____ (Designated)." Copilot positions start selector switch to CARTRIDGE momentarily, then releases to FLIGHT. As each engine reaches a minimum of 15% rpm, advance throttle for that engine to IDLE. For pneumatic starting, advance No. 4 throttle to 90% rpm and

STARTING ENGINES AND BEFORE TAXIING CHECKLIST (Pilot reads) (Cont)

No. 5 throttle to 85% rpm. The pilot will advance the throttles for engines No. 1, 2, 3 and 4 and the copilot No. 5, 6, 7 and 8 as necessary. As each engine reaches 45% rpm, copilot positions the respective starter switch to OFF. After all cartridge started engines are started and starter switches are in OFF positions, copilot places start selector switch to PNEUMATIC. As each engine reaches a minimum of 15% rpm, advance throttle for that engine to IDLE. As each engine reaches 45% rpm, copilot positions respective starter switch to OFF.

WARNING

- In the event starter cartridge does not fire, pilot designates engine on which cartridge did not fire to ground crew over interphone. Copilot places that starter switch to OFF. Cartridge will not be removed until there is no evidence of exhaust smoke at the starter exhaust duct and minimum time interval has elapsed since initiation. Prior to removal of a cartridge, insure that the start selector switch is in FLIGHT and the engine ignition circuit breakers are pulled. The ground crew must observe the handling precautions outlined in Section V. Pilot makes entry on Form 781.
- Simultaneous cartridge starts of "quick start" configured aircraft can produce toxic gases in sufficient concentration to be hazardous to individuals who remain in the immediate vicinity of the aircraft. The potential hazard is dependent on aircraft parking configuration, wind velocity and direction, and other ambient conditions. Ground crewmembers and security police who are required to remain in a toxic cloud must wear proper eye and respiratory protection.

CAUTION

During operation of the cartridge-pneumatic starter system, observe limitations given in Section V.

Cartridge Malfunction During Alert Response

When encountering a cartridge malfunction during alert response, start the remaining engines as expeditiously as possible using bleed air from a started engine or external air, as applicable. All cartridge start restrictions will be observed unless the alert is determined to be actual EWO or an impending disaster makes moving the aircraft necessary. Under these conditions, if a malfunction occurs in both cartridges, the waiting period between start of initiation and removal of unfired cartridge may be reduced to not less than 1 minute provided the specific ground handling precautions outlined in Section V are met. Cartridge malfunctions of two types may occur during the start attempt; hangfire or misfire. Malfunction indications and appropriate alert reactions are as follows:

1. **HANGFIRE.** A delay in the functioning of a propelling charge at the time of firing. The amount of delay is unpredictable, but in most cases will fall within the range of a split second to several minutes. There will be evidence of smoke at the starter exhaust duct. The engine rpm will increase rapidly and the cartridge will give evidence of nearly normal operation. In this type malfunction, the energy is expended and presents no hazard to engine operation.

STARTING ENGINES AND BEFORE TAXIING CHECKLIST (Pilot reads) (Cont)

2. **MISFIRE.** A cartridge that fails to ignite. There will be no physical evidence of smoke at the starter exhaust duct and no engine rotation. If a misfire occurs, observe the proper waiting period from start of initiation prior to removing the unfired cartridge. Upon removal of the defective cartridge, a normal pneumatic start can be accomplished. For actual EWO or if an impending disaster makes moving the aircraft necessary, no attempt should be made to remove the defective cartridge provided the affected engine can be expeditiously started by other means.

Disconnecting External Air

Ground will disconnect external air after engines are started and throttles are retarded to IDLE.

9. **Starter Caution Light - Out (CP)**

As soon as engines are started, check light out.

10. ENGINE ANTI-ICING SWITCH — CLIMATIC (P)

Turn the engine nacelle and scoops anti-icing switch ON if either of the following conditions exist or are anticipated during ground operations up through flap retraction altitude:

- a. The OAT is 8°C (47°F) or below and visible moisture exists. Visible moisture is defined as rain, wet snow, or fog with visibility 1 mile or less.
- b. The OAT is 8°C (47°F) or below and the dew point is within 2.3°C (4°F) of the OAT even though visible moisture is not present.

WARNING

Actuating the engine, nacelle, and scoops anti-icing switch above NRT may cause engine surge and flameout. Therefore, check that starter switches are in START before turning on anti-icing. Leave starter switches in START until rpm and EPR have stabilized.

CAUTION

Engine inlet components are susceptible to icing during extended ground operations at IDLE power settings even though engine anti-ice is on. Periodic engine runups to a nominal 85% RPM can minimize the ice buildup. Such runups should approximate 10 to 20 seconds duration at a maximum of 10-minute intervals. The number of engines to be run up at a time will be dependent upon taxiway surface conditions. Subsequent takeoff under these conditions should be immediately preceded by a static engine runup to assure normal engine operation. Signs of engine icing could include abnormal EPR/EGT relationship, abnormally slow RPM response to throttle movement, and indications of engine surge or stall. If taxiway surface conditions preclude advancing power enough to dissipate or prevent the inlet ice accumulation, takeoff should not be attempted.

STARTING ENGINES AND BEFORE TAXIING CHECKLIST (Pilot reads) (Cont)**NOTE**

Due to engine performance loss, the use of engine and nacelle anti-icing during takeoff will reduce EPR settings, increase S_2 distance by 5%, and reduce the initial climb rate. See Parts 2 and 3 of the Appendix for specific effects on performance.

11. MANIFOLD VALVE SWITCH — CLOSE (CP)**CAUTION**

Place air bleed manifold valve switch in CLOSE position after engines are started to prevent excessive manifold temperature which will be attained if the switch is left OPEN.

12. GENERATORS — ON; BATTERY LIGHTS — OUT (CP)

- a. Momentarily hold each generator switch ON (the generators will parallel). During cartridge start without external power, the generator switches have been prepositioned ON and need only be checked.
- b. Check that generator and bus tie circuit breaker position indicators show closed and generator ammeter readings are approximately the same.

NOTE

- If a generator circuit breaker is open and voltage and frequency are not indicated on the voltmeter and frequency meters, it is possible that the generator drive input shaft is decoupled from the engine shaft.
 - If any generator circuit breaker is open with voltage and frequency normal, advance the respective engine throttle, then retard to the desired position. Generator circuit breaker should close.
 - When switching from ground power to aircraft power, the command radio OFF-MAIN-BOTH-ADF switch may have to be turned OFF then back to MAIN or BOTH to obtain proper system operation. This procedure is necessary since the master voltage oscillator circuit in the power supply may be unable to recover itself and start oscillation after momentary interruption of power. The liaison radio will normally switch to OFF also.
- c. Using the voltage and frequency selector, check voltage at 205 (± 5) volts and frequency at 400 (± 5) cps on central tie bus. Leave voltage and frequency switch on CENTRAL TIE BUS position.
13. Liaison Radio - ON (CP)
14. Ground, Clear Aircraft for Taxi - Roger (GC)

Ground will disconnect and remove all ground support equipment and stand by on interphone.

CAUTION

The MA-3 external air conditioning unit must be disconnected from the cabin emergency ram airscoop before the scoop is retracted.

STARTING ENGINES AND BEFORE TAXIING CHECKLIST (Pilot reads) (Cont)

15. Body System Standby Pump Switches - OFF (P)

16. RUDDER/ELEVATOR HYDRAULIC SWITCHES — ON, LIGHTS OUT (P)

Pilot checks rudder/elevator main 1 and 2 lights on, rudder/elevator aux 1 and 2 lights out, then places rudder/elevator main 1 and 2 switches on and checks all lights out.

17. Hydraulic System Pressures - Checked (P)

Pilot checks each system for pressure (3000 (± 250) psi); pump out lights off.

18. AGM-69A Launcher Hydraulic Control Switch - ON PRIMARY (if required) (P)

When AGM-69A launcher missiles are installed, place the AGM-69A launcher hydraulic control switch to ON PRIMARY. When AGM-69A launcher missiles are not installed, check the AGM-69A launcher hydraulic control switch in OFF position.



Do not place the AGM-69A launcher hydraulic control switch to "ON PRIMARY" unless an AGM-69A rotary launcher is installed and will be rotated, as damage may result to AGM-69A hydraulic pump.

19. AIR CONDITIONING MASTER SWITCH — 7.45 PSI; NOTIFY RN AND GUNNER (CP)

Notify radar navigator and gunner that generators are on the line and cooling air is available. If subsequent entry to the forward cabin is required, cabin pressure must be relieved by opening one of the pilot's sliding windows prior to opening or closing the entrance hatch.

20. Stabilizer Trim - Checked, takeoff trim set (P-CP)

NOTE

For thruflight sorties, set stabilizer trim for takeoff. No other checks are required.

- a. Advance engines 4 and 5 to 82%. Ground observer reports direction in which leading edge is moving for both directions operated.
- b. Nose Down Trim & Force Switch Operation - Checked
 - (1) Copilot applies nose down trim electrically, checking that stabilizer trim wheel and indicator move in correct direction.
 - (2) Pilot momentarily actuates the trim cutout switch, at approximately 1 unit nose down position, to check interruption of electrical trim power and abrupt stoppage of manual trim wheel.
 - (3) Copilot pulls back on his control column while still trimming until trim actuation stops to check force switch operation.
 - (4) Copilot reduces force on control column and continues nose down trim until trim actuation starts, then releases trim switch noting that wheel stops abruptly.
 - (5) Copilot trims electrically toward zero and pushes forward on the control column while still trimming until trim actuation stops to check force switch operation in opposite direction.
 - (6) Copilot trims to zero with the pilot again checking operation of trim cutout switch after approximately 1 unit of travel.

STARTING ENGINES AND BEFORE TAXIING CHECKLIST (Pilot reads) (Cont)

- c. Nose Up Trim & Force Switch Operation - Checked
 - (1) Pilot applies nose up trim electrically, checking that stabilizer trim wheel and indicator move in correct direction.
 - (2) Pilot pushes forward on his control column while still trimming until trim actuation stops to check force switch operation.
 - (3) Pilot reduces force on control column and continues nose up trim until trim actuation starts, then releases trim switch noting that wheel stops abruptly.
 - (4) Pilot trims electrically toward zero and pulls back on control column while still trimming until trim actuation stops to check force switch operation in opposite direction.
 - (5) Pilot returns stabilizer trim to zero electrically.
- d. Ground observer reports leading edge position after pilot returns stabilizer to zero. Acceptable difference between pilot/copilot zero indication and zero indication as reported by ground observer is ± 0.25 unit.
- e. Pilot manually moves stabilizer trim approximately one unit in each direction. Ground observer reports corresponding movement of stabilizer leading edge.
- f. Pilot sets stabilizer trim for takeoff. Acceptable difference between pilots' indicators is 0.50 unit.

21. EVS - On and adjusted (P-CP)

Depress EVS power and STV switches to ON. Rotate brightness knob on monitor CW so presentation is just visible and then rotate CCW until presentation just disappears. Rotate contrast knob CW until optimum presentation is displayed.

NOTE

Readjustment of the monitor will normally be required only when significant ambient light changes occur.

21A. EVS Manual Steering: (P/CP)**a. Crab Switch - ON**

Depress crab switch on EVS display control panel.

b. Steering Knob - As required

Depress steering knob and rotate left or right as required.

STARTING ENGINES AND BEFORE TAXIING CHECKLIST (Pilot reads) (Cont)**22. Crew Equipment - On and adjusted (P-CP)**

Crew equipment should be donned at this time for normal training missions.

WARNING

- Tighten the parachute-survival kit attachment straps as tightly as possible to prevent the safety belt from inflicting facial injuries during ejection bailout.
- Insure that the parachute arming lanyard is not entangled in the parachute harness. Lanyard entanglement could cause failure in seat separation and failure of the automatic features of the parachute.

NOTE

If it becomes necessary to leave the seat, the crew member should open the seat belt and unbuckle the parachute harness, leaving the parachute and survival kit in the seat. If the integrated harness release handle is pulled so that the parachute and survival kit may be worn when leaving seat, it will be necessary upon returning to the seat to take off the parachute in order to attach the parachute shoulder straps to the inertia reel fitting.

23. Bomb Doors (internal weapons only) - Closed (P-GC)

Bomb doors will be closed at this time if internal weapons are aboard. Ground personnel will be on interphone and confirm that bomb doors are clear. Pilot will place the bomb door switch to OPEN to insure that both latches are unlatched, check that the bomb doors not latched light is on, and then place the switch to CLOSED.

NOTE

Whenever bomb bay is empty or during any alert scramble, the bomb doors will be closed while accomplishing the taxiing checklist.

24. GROUND, REMOVE WHEEL CHOCKS & DISCONNECT INTERPHONE — ROGER (GC)**25. ANTICOLLISION AND NAVIGATION LIGHTS — ON AND STEADY (CP)**

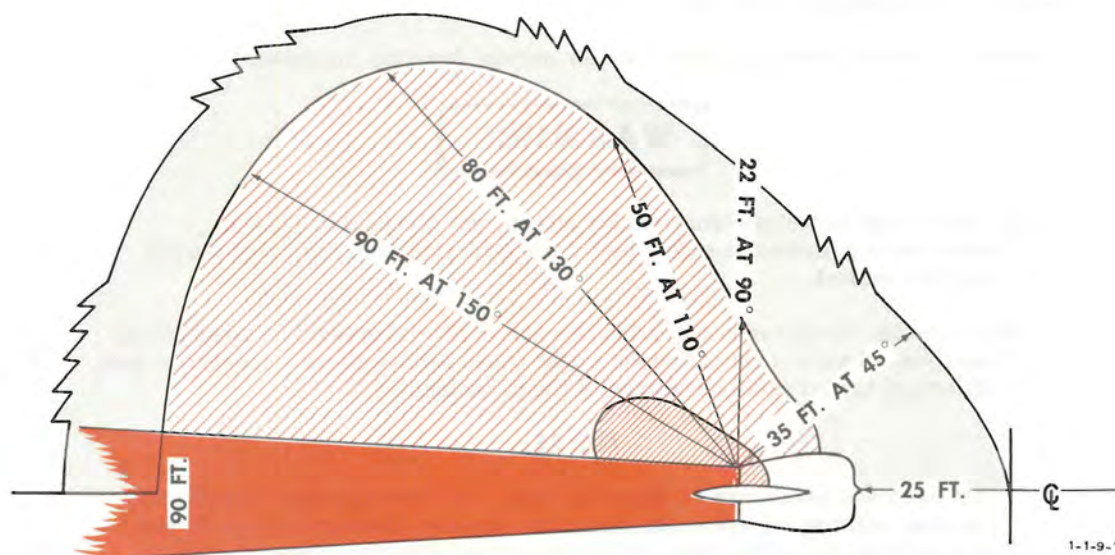
Turn lights on and steady immediately prior to taxiing to indicate the aircraft is ready to taxi.

26. TAXI ON CREW CHIEF'S SIGNAL (P)

Pilot announces "Crew, stand by to taxi."

CAUTION

The aircraft may be taxied over the ground power unit. It is imperative that carts be properly positioned to avoid contact with aircraft when taxiing out. Wing flaps must be up. Pilot taxis aircraft straight ahead until ground crew signals that he is clear of the power units. As soon as the aircraft starts rolling, throttles will be retarded to minimum power required for taxiing to avoid upsetting the power carts by jet blast. Aircraft must be positioned so that no aircraft will have to taxi over the power carts of another aircraft.



ESTIMATED SOUND PRESSURE LEVELS AT TAKEOFF POWER (WET) FOR TWO ENGINE OPERATION WITH SONIC SUPPRESSORS INSTALLED.

NOTE

- ONE ENGINE OPERATION WILL REDUCE THE NOISE LEVEL APPROX 3 DB
- WITH EXCEPTION OF THE 25 FOOT LIMIT FORWARD OF THE ENGINES, THE DISTANCE FIGURES SHOWN WILL INCREASE APPROXIMATELY 10% WITHOUT SONIC SUPPRESSORS INSTALLED.

WARNING

USE EAR PLUGS OR MUFFS WITHIN 90 TO 140 DB AREA. ADDITIONAL PROTECTION, SUCH AS FLIGHT LINE CREW HELMETS, IS REQUIRED IN AREAS GREATER THAN 140 DBS. AREAS IN WHICH THE NOISE LEVEL EXCEEDS 170 DBS MUST BE AVOIDED.

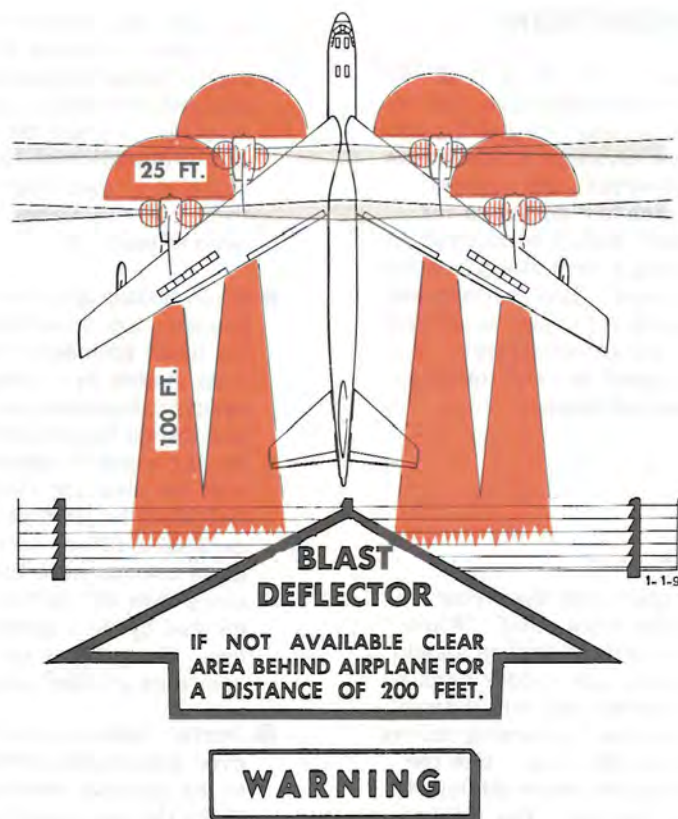
NOTE

TO PREVENT DAMAGE TO ASPHALT TAXIWAYS OR PARKING AREAS, PERFORM ENGINE RUN-UP ON CONCRETE RAMP WHEN SONIC SUPPRESSORS ARE INSTALLED.

NOISE DECIBEL LEVEL, MAXIMUM POWER (WET), WITH SONIC SUPPRESSORS INSTALLED

- EXHAUST BLAST AREA
- 165 TO 170 DB POSSIBLE
- 140 DB DANGER AREA
- 130 DB AREA

Figure 2-2 (Sheet 1 of 2).



- DURING CARTRIDGE STARTS, THE ENGINE CARTRIDGE STARTER EXHAUST IS 850° F. THEREFORE, REMAIN CLEAR OF A 4-FOOT RADIUS AREA AROUND THE CARTRIDGE STARTER EXHAUST DIRECTLY BELOW NACELLES.
- A STARTER TURBINE DISINTEGRATION AREA EXISTS TO THE SIDE OF THE STARTER TURBINE AREA.
- THE AREA 25 FEET IN FRONT AND 100 FEET BEHIND (200 FEET IF DEFLECTOR IS NOT AVAILABLE) IS THE ENGINE INLET DANGER AND EXHAUST BLAST DANGER AREA.

BLAST EFFECT (SINGLE ENGINE WITH SONIC SUPPRESSORS) FIGURES REPRESENTING EGT °F AND VELOCITY IN KNOTS WILL INCREASE APPROXIMATELY ⅓ WITHOUT SONIC SUPPRESSORS INSTALLED.						
JET DISTANCE IN FEET	TAXI POWER (IDLE)		MILITARY PWR (DRY)		MAXIMUM PWR (WET)	
	EGT °F	VEL KNOTS	EGT °F	VEL KNOTS	EGT °F	VEL KNOTS
25	150	75	250	350	270	390
50	100	30	150	155	170	165
75	—	—	120	90	130	100
100	—	—	100	40	110	65
125	—	—	—	—	—	—

	EXHAUST BLAST (AND INLET DANGER) AREAS
	CARTRIDGE STARTER EXHAUST DANGER AREAS
	STARTER TURBINE DISINTEGRATION AREA

Engine Danger Areas

Figure 2-2 (Sheet 2 of 2).

ENGINE GROUND OPERATION

Except for ambient temperatures of -30°C (-22°F) and below, no warmup period is required for the engines. Normally as soon as the engines stabilize at idle rpm, the throttles can be advanced to maximum allowable. After starting, however, the engines (with exception of engines which are advanced for starting the remaining engines) should be allowed to run at idling speed until readings have stabilized and ground check has been completed. Rapid movement of throttles should be avoided at all times to prevent exceeding allowable exhaust gas temperatures. A minimum of 3 to 4 seconds should be used for transition from IDLE to maximum allowable.

TAXIING

PILOT

The pilot will release his brakes upon receiving "Clear to Taxi" signal from the crew chief. When the aircraft starts to roll, a check of brakes should be made. To steer the aircraft, use rudder pedals. Differential braking is not possible and thrust from the outboard engines is ineffective for turning unless used in conjunction with normal steering. Use the largest radius of turn possible and never attempt to steer when the aircraft is not rolling. For minimum turning radius and ground clearance, see figure 2-3. To avoid severe landing gear oscillations during low speed braking and to obtain acceptable brake and tire life and adequate brake performance especially with regard to potential refused takeoffs, observe the limitations outlined under "Ground Limitations," Section V. To prevent overheating of the forward brakes and exceeding brake energy limits, use minimum power during taxi. If possible, when braking is required, use a firm, steady application of brakes until aircraft slows to below desired taxi speed without applying additional power.

CAUTION

- To prevent structural damage when making a turn with the full rudder travel, maximum ground turning speeds should be 5 knots with ratio selector lever in TAXI or 27 knots with ratio selector lever in TAKEOFF LAND.
- To prevent structural damage during high speed taxi runs, place the steering ratio selector lever in TAKEOFF LAND. Steering

in TAXI during high speed taxi runs produces excessive steering when small amounts of rudder pedal displacement are induced which can produce critical side loads on aircraft structure. When taxiing in TAKEOFF LAND, an accumulation of tolerances in the rudder steering system may result in as much as 3 inches of play either side of the rudder pedal neutral position.

- When taxiing at gross weights above 450,000 pounds, taxi speed must be reduced to limit the loads imposed on the aircraft structure. Taxi speeds over rough taxiways should be reduced depending on the degree of roughness and should be limited to a maximum of 5 knots for the worst condition. Ground turn speeds with the steering ratio selector in TAXI position shall be limited to 15 knots for turns not exceeding 20° of forward gear steering and shall not exceed 5 knots for turns requiring more than 20° of forward gear steering as indicated by the crosswind crab position indicator. Sharp turns and abrupt or hard braking are to be avoided whenever possible.
- During taxiing, both tip gears should be on or over maintained surfaces. Structural damage to the tip gear could be sustained while taxiing if the tip gear were permitted to run on rough terrain.
- One or both tip protection gear wheels may be in the trail-forward position (strut inboard) after having been reversed during a sharp turn or rearward towing. This is particularly true when wing and external tanks are full. An amber caution light marked "TPG Not in Trail" indicates the trail-forward condition. For a reversed right tip gear, introduce 20° nose left crosswind crab at a rate of approximately 2.5° per foot while moving forward at 2 or 3 knots until the gear casters. A minimum distance of 20 feet forward and 5 feet to the side is required for this procedure. If the gear does not caster, apply right steering, with the steering ratio selector in TAXI position, until the gear casters. Realign the aircraft with the runway by reverse steering. If necessary, use reverse crosswind crab to recenter the aircraft on the runway. For a reversed left tip gear, the above procedure should be followed using the opposite directions to those stated. If space does not permit use of this procedure, stop the aircraft and have the gear turned manually with the use of a turning bar.

COPILOT

The copilot will assist in maintaining a clearance of all obstacles during taxiing.

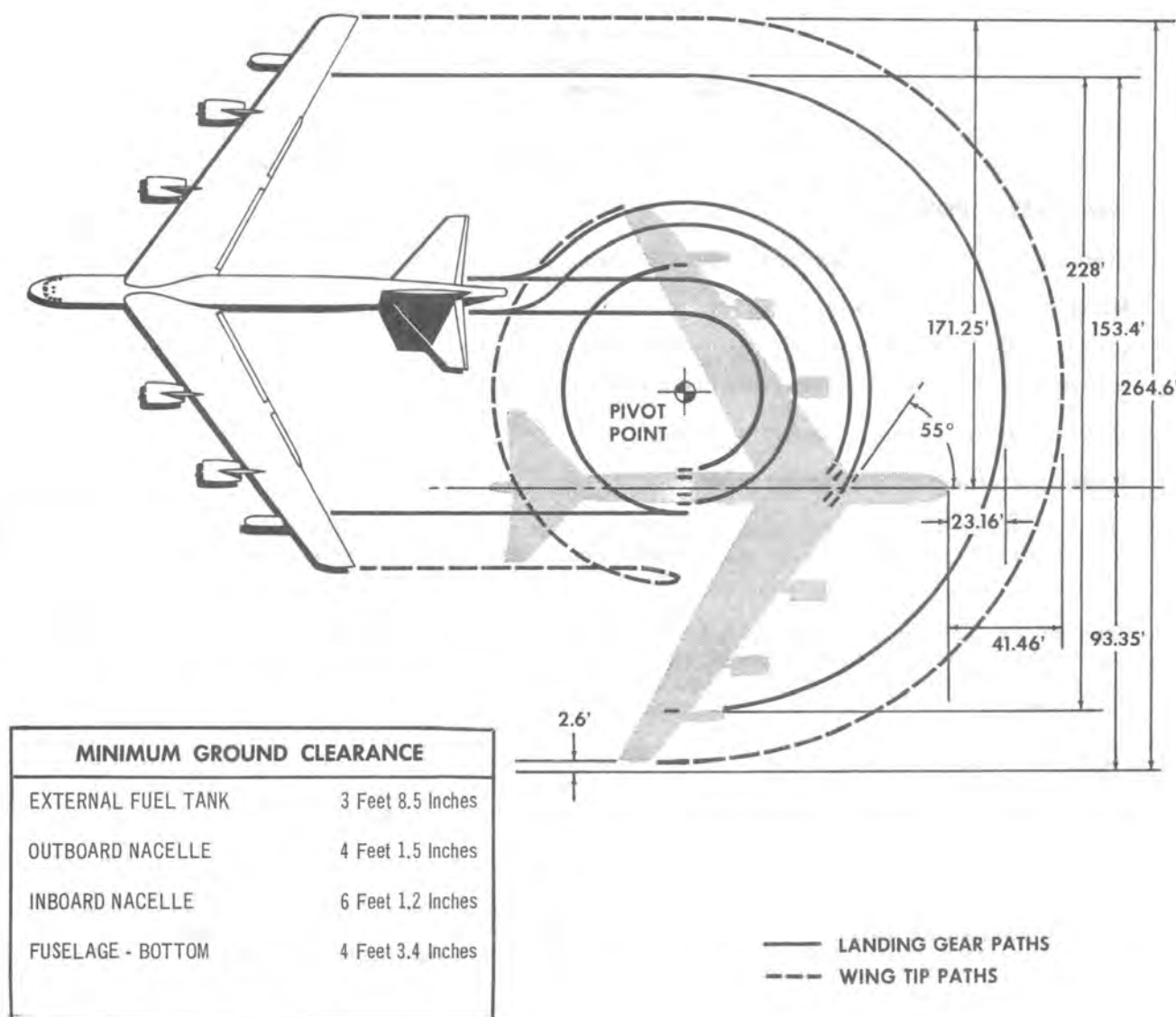
PAINTED SURFACES

Painted areas on runways, taxiways, and ramps are significantly more slippery than nonpainted areas. In addition, painted areas sometimes serve as con-

densation surfaces and it is possible to have wet, frosty, or even icy conditions on painted areas when the overall weather condition is dry.

CAUTION

Use caution when taxiing over wet painted areas because braking conditions may deteriorate to the extent that the braking coefficient is near that for an icy condition.



■■■■■■■■■■ Turning Radius and Ground Clearance

Figure 2-3.

TAXIING CHECKLIST (Copilot/EW reads)**NOTE**

- Only the **boldface** items need be accomplished for Scramble. All items will be reviewed during climb or as soon as practicable.
- The taxiing checklist should not be performed while taxiing through a congested area.
- The manual steering mode of the EVS may be used by the copilot/pilot to aid in taxiing under low light conditions.

1. BRAKES — CHECKED (P)

Check wheel brakes for proper operation as soon as possible after aircraft starts to move. Copilot monitors master caution light while taxiing. Hydraulic pressure fluctuations due to loss of fluid or other malfunctions may be observed on the pressure gages.



Do not attempt to use either steering or crosswind crab when aircraft is not rolling as severe loads would be applied to tires and landing gear.

2. FLAP LEVER — DOWN (CP)

Copilot lowers flaps after taxiing to insure clearance from ground equipment.

3. BOMB DOORS — CLOSED (P)

Pilot will place the bomb door switch to OPEN to insure that both latches are unlatched, check that the not latched light is on, and then place the switch to CLOSED.

4. Radar Altimeter Cursor - Set 500' (P-CP)**5. FLIGHT INSTRUMENTS — CHECKED (P-CP)**Less **BB**

Check needle for turn indication and ball for freedom of movement, attitude indicator erected and flag out of sight, heading indicator for movement in turns, and all pitot-static pressure instruments for correct indications.

BB

Check needle for turn indication and ball for freedom of movement; attitude indicator erected and OFF flag and ATT warning flags out of sight; heading indicators for movement in turns; standby attitude indicator erected and OFF flag out of view **BC**; and all pitot-static pressure instruments for correct indications.

6. Generator Panel - Checked (CP)

Copilot checks ammeters, frequency meter, and voltmeter.

7. Crosswind Crab - Checked and down (P-CP)

If conditions permit, check operation of the crosswind crab to insure positive response in both directions. Manually turn the crosswind crab knob in each direction, recentering the crosswind crab control with the centering button in each instance. Check both indicator needles for correct indication.

BEFORE TAKEOFF**BEFORE LINEUP CHECKLIST (Copilot/EW reads)****NOTE**

Only the **boldface** items need be accomplished for Scramble. All items will be reviewed during climb or as soon as practicable.

1. Parking Brakes - Set (P)
2. Pitot Heat - ON (P)
3. **YAW & PITCH SAS SWITCHES — ENGAGE, LIGHTS OUT (P)**

Place yaw and pitch SAS switches to ENGAGE. Check yaw and pitch SAS lights out and channel fail light out.

4. Control Surface Trim - Set (P-CP)

Pilot and copilot check rudder and lateral trim for takeoff setting.

5. **STABILIZER TRIM — CHECKED FOR TAKEOFF SETTING (P-CP)**

WARNING

To preclude the possibility of inadvertent actuation of the stabilizer trim switch, the pilot should rest his thumb between the horizontal spur and the upright position of the control wheel grip during all normal operations. Special care should be taken during takeoff, landing, and air refueling operations. In addition, the copilot monitors the stabilizer trim indicator during the takeoff roll.

NOTE

During flight, the stabilizer trim switch should be operated in short intermittent bursts to aid in recognizing a malfunctioning electrical trim system before reaching an extreme out-of-trim condition.

6. Airbrake Lever - OFF (P)
7. **WING FLAPS — 100%, LEVER DOWN (P-CP)**

Pilot and copilot check wing flap indicators full down and wing flap lever in DN position. It is possible to see the outboard sections in the down position from the cockpit.

BEFORE LINEUP CHECKLIST (Copilot/EW reads) (Cont)**8. Fuel Panel Switches:**

- a. 1 & 4 Above Green Band, Center & Aft Contain 2,000 Pounds or More Each - 1, 2, 3 & 4 ON; 13 & 16 OPEN; 26 & 28 ENGINE FEED (CP) Checked (P)
- b. 1 & 4 Above Green Band, Either Center or Aft Less Than 2,000 Pounds - 1, 2, 3 & 4 ON (CP) Checked (P)
- c. 1 or 4 in Green Band - 1, 2, 3 & 4 ON; 9, 10, 11 & 12 OPEN (CP) Checked (P)

9. WINDOWS & HATCHES — CLOSED AND LOCKED (P-CP)

Check windows closed and hatches not closed and locked light out.

10. Flight Instruments - Rechecked and set (P-CP-N)

- a. The pilot will announce the latest altimeter setting and the known elevation. The copilot and navigator will check their altimeters within 75 feet of the known elevation.
- b. The pilot will announce his HSI and magnetic standby compass indications. The copilot and navigator will cross-check their instruments for errors.
- c. Pilot positions the heading selector switch to MAN and checks bank steering bar for proper operation. The selector switch will be left in MAN during takeoff and the bank steering bar used to aid in directional control. Set the heading marker to runway heading with crosswind crab correction applied, i.e., if the crosswind crab correction is 10 degrees left, the heading marker should be set 10 degrees left of the runway heading.

NOTE

Cross-checking of bank steering bar, turn needle, and heading indicator will provide indication of attitude indicator failure in the roll axis. If the roll axis of the ADI is inoperative on takeoff, the bank steering bar will aid in maintaining a wings-level attitude until a new heading is selected.

- d. Pilot and copilot set attitude indicators to indicate level flight.

WARNING

Any time during critical phases of flight and especially during night and/or instrument conditions, the pilot not flying the aircraft will closely monitor his flight instruments and cross-check them against the instruments of the other pilot. If an apparent error in aircraft attitude is detected, the pilot flying the aircraft will be advised immediately.

BEFORE LINEUP CHECKLIST (Copilot/EW reads) (Cont)**11. Radio Navigation Instruments - Checked VOR/TACAN (P-CP)**

When a certified ground check point is available (and time permits), check VOR/TACAN equipment within prescribed tolerances. Select the appropriate navigational aids to be used for the departure and set the navigational instruments and switches as required.

12. Air Conditioning Head Outlets - CLOSED (P-CP)**13. STARTER SELECTOR SWITCH — FLIGHT (CP)****14. TAKEOFF DATA — REVIEWED (P-CP-N)**

Review EPR, S_1 speed, S_1 time, and S_2 speed. Procedures to be used in the event an emergency occurs during takeoff will be reviewed. Both pilots must have a complete understanding of actions to be taken if an emergency occurs prior to or after S_1 speed. The pilot/copilot will brief the crew to insure that departure procedures are understood. This will include restrictions, and hazardous terrain. Other crewmembers will report any deviations during the departure.

15. SEAT, RUDDER PEDALS & CONTROL COLUMN — ADJUSTED AND CHECKED (P-CP)

Pilot and copilot adjust seat and check full displacement of control column and control wheel; then adjust rudder pedals to enable full displacement. Copilot holds column rigid near neutral while pilot applies push force and pull force on his column to confirm columns connected.



Do not attempt to check rudder pedal travel as severe loads would be applied to tires and landing gear.

16. Arming Lever Safety Pins (No. 1) - Removed (P-CP-EW-G)**17. IFF - NORM (mode and code as briefed) (P)****18. Lights - ON (P/CP)**

Turn landing, taxi and crosswind landing lights on for night or day operations unless reflection reduces pilot visibility.

TAKEOFF

Close attention must be given to the recommended procedures in order to obtain the best takeoff performance. The normal takeoff technique is that which will be required to produce the results stated in the takeoff charts in the Appendix. These procedures have been selected as being the most desirable from the consideration of safety and the attainment of minimum practical takeoff distance.

CAUTION

- If it is absolutely necessary to fly the aircraft immediately following a heavily braked landing or refused takeoff, a check of the "Brake Energy Limit Chart" (figure 5-12) should be made prior to takeoff.
- If a tire failure is suspected on takeoff before decision speed is reached, the takeoff should be discontinued. This is to preclude the possibility of landing gear failure caused by takeoff with a partially disintegrated tire.

TAKEOFF PERFORMANCE

Performance Data

All takeoff performance data should be determined prior to takeoff. This assures accurate planning and close monitoring of all takeoffs. These data include such items as takeoff gross weight, runway OAT, field length and altitude, wind direction and velocity, aircraft cg, and the runway gradient. From such items, it may be determined whether water injection is needed, what the stabilizer setting is, what the crosswind crab setting is, and what the takeoff distance will be. A change in any one of these items will have a large effect on takeoff performance as shown by figure 2-4. Relative humidity, which appreciably affects reciprocating engines, has a negligible effect on turbojet engines. Sufficient charts to accurately determine takeoff performance are included in Parts 2 and 3 of the Appendix.

Takeoff Planning

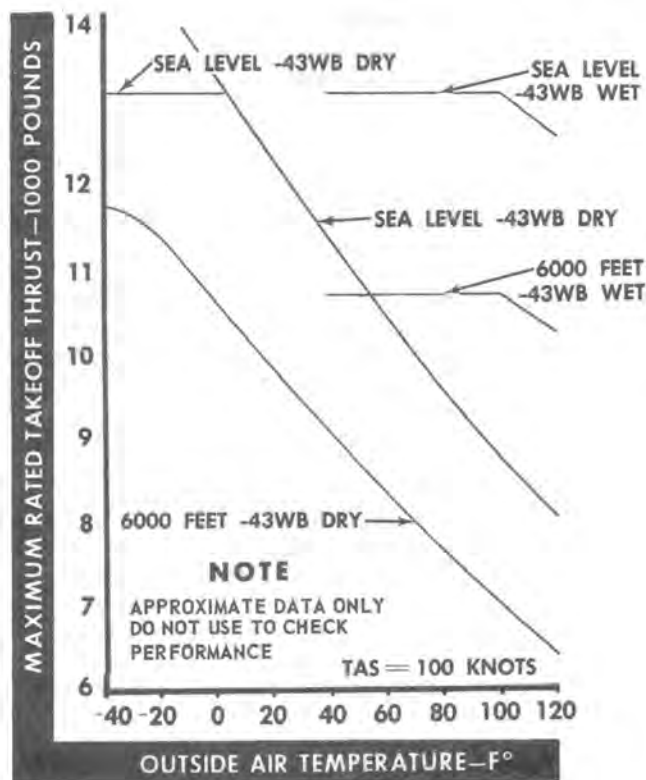
Adequate takeoff planning must always include the possibility of poor acceleration during the takeoff run. Although many factors may cause poor acceleration, the most probable cause is engine failure. If such a failure occurs, it must be possible either to stop in the runway distance remaining or to continue the takeoff safely on seven engines. The decision

FOR SEA LEVEL AND GROSS WT. OF 300,000 POUNDS		
AN INCREASE OF	Changes Takeoff Distance Approx	
	WITH WATER-FT	NO WATER-FT
1000 Feet in Altitude at 100° F	+450	+900
1000 Pounds in Weight at 100° F	+ 30	+ 60
10° F on 100° F OAT	+270	+750
10 Knots Wind	-700	-930

Factors Affecting Takeoff Distance

Figure 2-4.

whether or not a stop can be made in the remaining runway must be made immediately and with the aid of predetermined criteria. This information is shown graphically for all RCR conditions in Part 2 of the Appendix. The minimum runway required is the runway length required to accelerate to S_1 , experience an engine failure, and then take off with seven engines. Minimum runway required charts in Parts 2 and 3 of the Appendix are used to determine the maximum gross weight for a specific runway length. It should be pointed out, however, that climbout performance must be considered when determining the maximum gross weight for operation from a given runway. This is necessary because it is possible under certain runway pressure altitude and temperature conditions to load the aircraft so that, although the takeoff could be accomplished, very poor and sometimes unsafe climbout performance exists. This is discussed more fully under "After Takeoff," this section. To determine the maximum takeoff weight, enter the appropriate minimum runway required chart with the runway length available and arrive at a weight as determined by the existing field pressure altitude and temperature. Check the climbout performance for this weight, temperature, and field pressure altitude by referring to the charts in Part 4 of the Appendix, keeping in mind terrain clearance and flap retraction problems. Once this weight has been determined, the only other information required is that which will enable the pilot to properly monitor the takeoff. These are the minimum EPR settings, the decision speed and time, and the takeoff speed (S_2).



J-57-P-43WB Engine

Takeoff Thrust

Figure 2-5.

S₁ S₂ Acceleration Monitor System

The S₁S₂ acceleration monitor system is based on a timed acceleration check between two indicated airspeeds which can be compared against a precomputed acceleration rate taken from charted values prior to takeoff. Use of this system virtually eliminates wind error, airspeed indicator calibration error is minimized, and no reference point outside of the aircraft is necessary. The S₁S₂ system checks acceleration only after takeoff power is set which increases accuracy during rolling takeoffs. Excellent crew coordination is essential when using the S₁S₂ acceleration check.

NOTE

When the computed takeoff distance is 4000 feet or less, the S₁S₂ takeoff procedure will not be used. In lieu of timing acceleration, a check of all engine instruments will be made when 70 knots is reached during the takeoff roll. At this point, the decision will be made to continue or abort the takeoff except the takeoff may be aborted at any time prior to unstick when the aircraft gross weight is 250,000 pounds or less, and the runway is dry.

INITIAL TIMING SPEED. Initial timing speed is the speed (70 knots IAS) at which timing is started to determine acceleration characteristics of the aircraft.

S₁. S₁ is the computed decision speed (S₁ speed) which must be reached by the termination of the acceleration check time (S₁ time). S₁ speed does not commit the aircraft to takeoff. The end of S₁ timing will determine the decision to takeoff (Committed) or abort (ABORT).

S₂. S₂ is the takeoff indicated airspeed (unstuck speed).

Engine Thrust

The characteristics of a turbojet engine are such that the engine thrust for takeoff decreases considerably with increases in outside air temperature and field elevation. To alleviate this condition, a water injection system has been added to each engine so that reasonable takeoff performance is retained at high OAT's and high field elevation. J-57-P-43WB engines are trimmed per flat rated engine trim procedures which allow the "wet" takeoff thrust rating to be developed through a range of OAT conditions from 40° to 100° F by manipulation of the throttles according to the required EPR indication. Typical J-57-P-43WB engine thrust variations with changes in temperature and altitude are shown in figure 2-5.

CAUTION

- The scaling effect of water tends to decrease engine efficiency. Therefore, use of water injection should not be indiscriminate but rather reserved for heavy weight high temperature takeoffs when it is actually needed as a safety factor and for periodic functional checks of the system.
- Water injection should not be used at pressure altitudes greater than 8000 feet. Use of water injection above this altitude will result in harmful overspeed of the low speed compressor.
- Water injection will not be used if the runway OAT is less than 4° C (40° F). Due to venturi effect at the engine inlets, engine icing may be expected during a water injection takeoff when the runway temperature is approximately 40° F. The engine and nacelle anti-icing system will not prevent icing which will occur under this combination of air and water temperatures.

TAKEOFF PROCEDURES

Correct takeoff procedures may vary under different takeoff conditions. There are, however, some procedures which are standard for every takeoff. These procedures, which are discussed in "All Takeoffs" below, should always be adhered to. For the takeoff

calculations and a summary of the takeoff procedures, see Parts 2 and 3 of the Appendix.

All Takeoffs

Takeoff rated thrust (TRT) or military rated thrust (MRT) will be used for all takeoffs except touch-and-go. The correct stabilizer trim setting will be used for all takeoffs. The wing flaps will be set for 100% down and intermediate settings will never be used.

ROLLING TAKEOFF. In order to minimize the fatigue damage effects to the wing structure, all takeoffs will normally be made from a rolling start. In those situations when safety may be compromised by performing a rolling takeoff or where runway conditions dictate, takeoff may be made from a braked condition; however, maximum power operation with brakes locked will be kept to a minimum. When making a rolling takeoff, the aircraft will be aligned with the runway at normal taxi speeds using the radius guide lines.

CAUTION

The maximum turn-on ground speed for a 140- to 150-foot turn radius is 15 knots. This limit is based on aircraft strength and must not be exceeded.

Steering ratio selector may be placed in TAKEOFF LAND after completion of the "Before Lineup Checklist" if the runway turn radius permits. Not permitting, it will be placed in TAKEOFF LAND when aligned with the runway. Power will never be advanced to TAKEOFF setting until within 15° of runway heading.

THROTTLES. The throttles will be advanced slowly and evenly to the takeoff EPR. Minimum time for movement from IDLE to maximum allowable position is 3 to 4 seconds. No attempt will be made to steer by throttles as differential thrust is ineffective and reduction of thrust on one side will increase the takeoff ground run. For wet takeoffs, the pilot not flying the aircraft will set the part throttle EPR setting. After water augmentation, the pilot not flying will adjust EPR as required. On all takeoffs, the pilot flying the aircraft will maintain throttle control until passing S_1 speed. He will maintain throttle control throughout light gross weight takeoffs (computed takeoff distance 4000 feet or less), touch-and-go, or taxi-backs to include climb through flaps retraction (if applicable).

CAUTION

At the lower ambient temperatures, dry takeoff thrust may be obtained at some setting less than full throttle. It is therefore important that the chart takeoff EPR not be exceeded as engine damage may result.

STABILIZER TRIM. The stabilizer trim setting required for takeoff depends on the center of gravity location of the aircraft weight. The correct stabilizer trim setting may be determined from charts in Parts 2 and 3 of the Appendix.

WARNING

Failure to set the stabilizer correctly could result in:

1. An accelerated stall if the stabilizer trim is set too nose up.
2. Longer than predicted takeoff ground runs if the stabilizer trim is set too nose down.

WING FLAPS. The wing flaps are so designed that the highest lift-drag ratio is achieved in the 100% down position. For this reason, they are always used in this position. Because wing flap extension time is 60 seconds and intermediate settings are ineffective, the lowering of flaps during the takeoff roll is not recommended.

CONTROL TECHNIQUE. Steering should be accomplished with the rudder pedals throughout the ground run. The steering system will be effective until sufficient speed is established for rudder control. The takeoff will require a pull force on the control column approximately 5 to 10 knots prior to unstick speed. The control column will be pulled back as required to achieve the computed unstick speed. At the appropriate speed, the forward wheels will come off the runway first and the aircraft will tend to rotate about the rear wheels. Relaxing back pressure at the time the aircraft leaves the ground will stop this pitching action. However, if the stabilizer trim is set too high (aircraft nose up), the control column must be pushed well forward to stop the pitching action. Should rearward control column movement be delayed until just before the takeoff point, the takeoff ground run may be increased as much as 5%. Refer to Parts 2 and 3 of the Appendix for determination of takeoff distances.

Water Injection Takeoff

CAUTION

The water injection system switch and the water injection drain switch are in close proximity. The conditions of a rolling takeoff make intense demands on the pilot's attention at this time and it is of the utmost importance that the pilot be certain he is not preparing to actuate the water injection drain switch rather than the water injection system switch.

Following alignment with runway, power will be advanced to the part throttle EPR setting for wet takeoff, cross-checking the rpm (approximately 91% rpm). As soon as the part throttle EPR setting has been set and adjusted, the pilot will position the water injection system switch to ON. Note that the water pressure lights go out and the water pressure indicators read ON. The water injection throttle microswitches will have been actuated as the throttles reach an approximate 86% rpm position, allowing the water shutoff valves to open. The most positive indication that the water injection system is operating correctly will be an increase in the fuel flow and EPR of each engine above that normally attained without water. When water reaches the engines, copilot will adjust the throttles to obtain the desired wet EPR. The desired wet EPR will be approximately 0.02 higher than the EPR values listed in Part 2 of the Appendix and assures takeoff rated thrust in the 50- to 80-knot IAS range where water augmentation will take effect. The duration of the water supply for full tanks is 110 seconds. It is desirable to have sufficient water to last during takeoff, landing gear retraction, and acceleration to flaps down initial climb speed. The time required for this will generally be less than 110 seconds if prescribed procedures are employed. To aid in planning a water injection takeoff, ground run time is given on the takeoff ground run charts in Part 2 of the Appendix. At sea level on a standard day with no forward speed, the use of water injection increases fuel flow approximately 4000 pounds per hour per engine. A corresponding increase will also result in the engine pressure ratio but no significant change will occur in rpm. After takeoff has been accomplished and water depleted, the throttles should be advanced to full open until climb speed and attitude has been established. Move the drain valve switch to OPEN position and leave it OPEN. Drain times are 16 minutes for pumps on and 55 minutes for pumps off. Water will not be pressure drained during flight.

CAUTION

After moving the drain valve switch to OPEN position, do not actuate the switch in flight at or above the freezing level. Operation of a frozen valve may cause valve failure.

NOTE

In the short time lapse between water runoff and system shutdown, engine surges may occur momentarily and will be evidenced by fluctuations of EPR. This condition is due to lack of positive pump supply when water nears depletion and will not adversely affect engine life.

PARTIAL WATER TAKEOFF. Water takeoffs may be safely made without water augmentation on all engines; however, the following criteria is established for partial water takeoffs for normal training missions:

1. Water takeoffs will not be planned for an aircraft with any known system malfunction, such as an inoperative water pump.
2. Takeoff will not be continued with more than two engines without water augmentation.
3. Minimum runway required with all eight engines dry will not exceed runway available.
4. Subtract 2 knots per engine without augmentation from the decision speed.
5. Engine(s) not receiving water will be advanced to dry takeoff EPR but must be monitored closely for high EGT and/or high rpm and adjusted to wet takeoff EPR immediately should water suddenly be received by the engine(s).

Heavy Gross Weight Takeoff

The takeoff and initial portion of the climbout are the critical conditions for an aircraft weighing 450,000 to 488,000 pounds. When takeoff is planned at these weights, performance calculations should be gone over thoroughly not only for normal operation but for emergency conditions as well. A positive vertical velocity cannot always be maintained during the complete flap retraction cycle; therefore, at these heavy weights, flap retraction will normally be delayed until reaching 1500 feet. After takeoff, there is ample climb performance. Even with one engine out, the aircraft is well above the outboard engine-out minimum control speed.

Light Gross Weight Takeoff

When the computed takeoff distance is 4000 feet or less, the takeoff will be considered a light weight takeoff. When takeoff is made at light weight, the airspeed and rate of climb increase rapidly after unstick. This condition reduces the time during which trim changes can be made. The pilot should control any nose up rotation with forward control column and nose down trim and check for proper movement of the manual trim wheel. After the landing gear is retracted, the thrust should be adjusted during climb to flap retraction altitude to produce a rate of climb of approximately 1500 to 2000 feet per minute.

NOTE

A wet takeoff will not be made at a gross weight of less than 360,000 pounds.

Traffic Pattern Fuel Management

For takeoffs, transition, low approaches, and landings, with the fuel level in main tank 1 or 4 in the green band area or if any main tank is down to 5,000 pounds, establish a fuel management configuration of main tanks to engines (valves 13, 14, 15, and 16 closed) and open crossfeed valves 9, 10, 11, and 12. If auxiliary fuel usage is desired, it will be transferred directly into main tanks through the main manifold. See "Wing Flutter Airspeed Limitations," Section V, for speed restrictions associated with use of auxiliary fuel in various aircraft/missile configurations.

Obstacle Clearance Takeoff

If obstacle clearance is marginal, retract the landing gear as soon as possible after becoming airborne, leave wing flaps fully extended, and climb at 10 knots above takeoff speed until the obstacle is cleared. The charts in Parts 2 and 3 of the Appendix show the distance required from point of brake release to clear a 50-foot obstacle with seven and eight engines. Since an engine failure may be encountered after S_1 , it is recommended that the charts be entered using the seven-engine ground run distance. After the climb from C to F (figure 2-8), allow the aircraft to accelerate to 180 knots indicated airspeed and continue climb to at least 1000 feet above the terrain before starting flap retraction. See "Obstacle Clearance Climbout," this section, for maximum climb angle discussion.

Crosswind Takeoff

NOTE

- Sustained runway wind velocity plus one-third of the gust factor will be used to compute crosswind crab settings for a takeoff with gusty wind conditions.
- If a crosswind cannot be compensated for by use of the crosswind crab system, a takeoff is not recommended.
- If the wind is a variable wind, the average heading of this variable wind should be used.

Prior to the time of takeoff, the takeoff weight and local field wind velocity and direction should be ascertained and the crosswind crab setting determined for these conditions. If uncorrected tower wind is obtained, it is recommended that 50% of the velocity be used. See Parts 2 and 3 of the Appendix for applicable crosswind takeoff information. While taxiing to takeoff position, set the crosswind crab control knob in the direction the nose of the aircraft is to be crabbed into the wind. Taxi into takeoff position so that the nose of the aircraft is pointing into the direction of the wind component (figure 2-6). The miniature aircraft and pointer on the crosswind crab indicator should point to the degree setting corresponding to the crab angle previously determined for the wind and gross weight. The miniature aircraft and pointer should be crabbed across the simulated runway on the indicator in the same direction that the aircraft is crabbed across the runway on the takeoff run.

CONTROL TECHNIQUE. The takeoff procedure used is the same as that for a normal takeoff except that the aircraft will be crabbed into the wind, a condition which may seem strange the first few times a pilot uses this crosswind crab technique. Engine thrust may pull the aircraft toward the side of the runway from which the wind is blowing before the aircraft becomes airborne. This effect is easily overcome by use of the proper amount of rudder pedal steering. If the crosswind is of a large enough magnitude, it may cause the aircraft to heel over on the downwind tip gear at low speeds. Such a differential tip gear loading can cause high stresses on the tip gear tire as airspeed increases. An attempt to level the wings with lateral control can be initiated when passing through 60 knots IAS on the takeoff roll, but full control wheel travel may be necessary at this low air-

TAKEOFF CHECKLIST**NOTE**

This checklist will be reviewed prior to Takeoff and need not be read during takeoff.

1. Crosswind Crab - Set, Knob down (CP) Checked (P)

Copilot sets crosswind crab while taxiing to takeoff position. Pilot checks crosswind crab position indicator for proper setting.

2. Starter Switches - As required (CP)

Place engine starter switches to START for all wet takeoffs. If icing conditions exist or are anticipated during or after a dry takeoff, place the engine starter switches to START before advancing throttles to takeoff thrust.

3. Air Conditioning Master Switch - RAM (P/CP)

4. (Deleted)

5. Steering Ratio Selector Lever - TAKEOFF LAND (P)

WARNING

If the steering ratio lever is not in TAKEOFF LAND, the landing gear cannot be retracted.

CAUTION

Center the rudder pedals before repositioning the steering ratio selector lever. Actuation of the lever when the rudder pedals are deflected is very difficult and will result in a sudden change in steering angle.

TAKEOFF CHECKLIST (Cont)**6. Throttles - Set (P-CP)**

Advance throttles to applicable EPR setting. Manifold temperature should not exceed 246° C with takeoff power. When making a rolling wet takeoff, a dry EPR check is not required and throttles will be advanced to obtain the part throttle EPR setting for wet takeoff.

WARNING

- If the warning horn sounds and the master caution light comes on as throttles are advanced beyond approximately 88% rpm, the flaps should be rechecked at 100% down.
- To eliminate or reduce the possibility of flameout, it is recommended that if engine, nacelle, and scoops anti-icing is not ON before power is set for takeoff, its use be delayed until water, if used, is expended and power is reduced to NRT. Delay actuation of anti-ice system approximately 1 minute after reducing power to NRT as engine stall or flameout is possible due to water collecting in the engine anti-ice system.

CAUTION

- Extended operation of the engines at full thrust will reduce wing trailing edge service life. Wing flap service life is also adversely affected, especially with flaps down. Do not operate in this condition any longer than necessary.
- Exceeding charted EPR can cause structural damage to the engine causing rapid engine deterioration.

NOTE

When making a takeoff from a standing start, pilots should be alert for possible aircraft movement when throttles are advanced since the parking brakes were not designed to hold the aircraft with all engines at MRT. If movement is detected, depressing the brakes beyond parking brake position may reduce the creeping but may not stop it. If takeoff is not imminent, reduce power to stop the aircraft.

TAKEOFF CHECKLIST (Cont)

7. Water Injection System Switch - ON (if applicable), check increased fuel flow and EPR, tank pump pressure indicators move from OFF to ON, eight amber lights out (the eight amber water pressure-low indicating lights should go out in 5 to 10 seconds) (P)

WARNING

If for any reason the aircraft must be leveled off prior to water runoff, do not reduce power prior to turning off the water injection switch. Once the switch is turned off, do not turn back on, because flame-out can occur when water is reinitiated.

NOTE

If failure of a boost pump occurs, as indicated by a tank pump pressure indicator, the remaining boost pumps will provide sufficient water supply for pressurization to the engines; this will be indicated by the amber warning lights being extinguished. Takeoff will not be continued if two or more water tank boost pumps fail to operate.

8. Power - Checked (P-CP)

In the event no more than two engines are not more than 0.05 below the minimum EPR and the rest of the engines equal or exceed the recommended value and all other instruments indicate normal operation, the takeoff may be continued if the decision speed is attained within the acceleration check time.

9. Engine Instruments - Checked (CP)

During initial takeoff roll, the copilot will check oil pressure and the low oil pressure warning lights, EPR, rpm, and EGT indicators within limits and will monitor engine instruments during remainder of takeoff roll. Exercise caution before retarding any throttle during a wet takeoff. If abnormally high EPR readings are indicated in relation to throttle position, cross-check other engine instruments; the EPR gage may be malfunctioning. A 0.10 scatter above the minimum recommended reading needs no throttle adjustment.

WARNING

During a wet takeoff if an even-numbered engine rpm is reduced below 86% for any reason, complete thrust loss due to water flooding could occur. The wet thrust for the odd-numbered engine of that nacelle would also be lost and its throttle should be advanced to dry takeoff EPR.

10. Stabilizer Trim Indicator - Monitor (CP)

Copilot monitors the stabilizer trim indicator during the takeoff roll in order to detect any inadvertent change in takeoff trim setting.

TAKEOFF CHECKLIST (Cont)**11. 70 Knots - Now (P)**

Pilot announces over interphone "70 knots" at approximately 60 knots IAS. At 70 knots IAS, pilot announces "Now." As pilot announces "Now," navigator starts his stopwatch. (Radar navigator backs up navigator's timing on all takeoffs. If the navigator is not aboard, the radar navigator accomplishes this time check.) Copilot checks his airspeed indicator at the 70 knot check. Airspeed indicators will be written up in Form 781 if difference exceeds 3 knots. Takeoff will be aborted if difference exceeds 6 knots.

NOTE

Crosswinds or wind gusts will affect airspeed indicators. Fluctuations of both indicators can be observed (not necessarily in the same direction) and should be considered during cross-check.

12. S₁ - Now (N)

Navigator announces over interphone "Coming up on _____ seconds" approximately 3 seconds prior to S₁ time. At S₁ time, navigator announces "Now." Pilot checks his airspeed and announces to the crew his decision to take off ("Committed") or abort ("ABORT"), based on the time/speed relationship. Pilot not flying the aircraft will take control of the throttles and set the throttle brake. (Radar navigator backs up navigator's timing on all takeoffs.)

WARNING

Takeoff will not be aborted after S₁ unless, in the opinion of the pilot, the emergency renders the aircraft definitely unsafe to attain emergency bail-out altitude. In those cases where the pilot attempts to abort after S₁, he must accept the fact that he will probably fail to stop within the confines of the runway.

13. Unstick Speed (S₂) - Now (CP)

Copilot calls over interphone "Coming up on unstick speed" approximately 5 knots before reaching unstick speed. At unstick speed, copilot announces over interphone "Now."

AFTER TAKEOFF

CLIMBOUT PLANNING

Under some operating conditions, climbout can be the most critical phase of aircraft operation. For this reason, it is essential that the climbout technique be planned during mission planning prior to flight. The climbout procedures essentially fall into two categories which are explained in the following paragraphs. These are a normal climbout and an obstacle clearance climbout. The "Takeoff Ground Run" and minimum runway required charts in Parts 2 and 3 of the Appendix show a line for the flaps down rate of climb equal to 300 fpm on seven engines using no water injection. During mission planning, if it is found that the combination of gross weight, runway pressure altitude, and OAT are such that the required ground run falls above this line (giving less than 300 fpm rate of climb), the gross weight must be reduced or a marginal climbout will result. If an obstacle must be cleared, the obstacle clearance climbout procedure will be used.

AFTER TAKEOFF PROCEDURES

After leaving the ground, the wheel brakes will be applied before starting gear retraction to avoid wheel well damage from spinning wheels. The landing gear retraction should be started as soon after unstick as

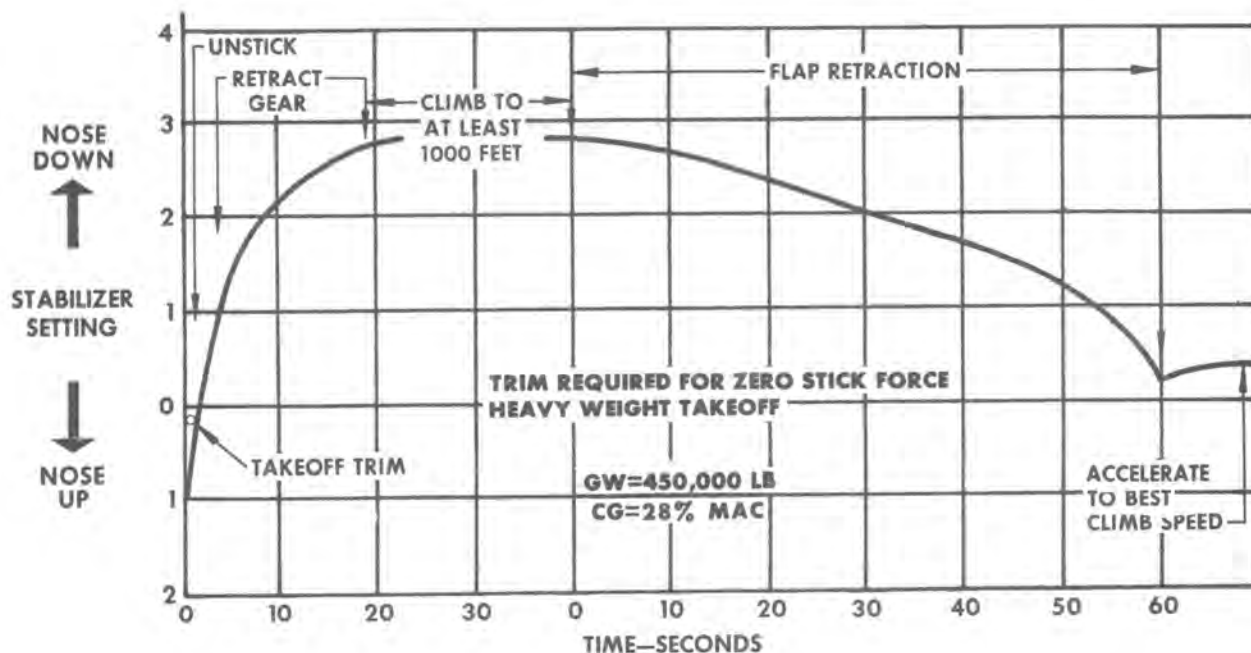
possible. If at a light gross weight when climb is started, the power should be adjusted during climb to flap retraction altitude to a setting which will produce a positive vertical velocity of approximately 1500 to 2000 feet per minute. Keep aircraft trimmed as close as possible to zero stick force in the climb.

Stabilizer Trim Use After Takeoff

The period from takeoff to flaps up requires active stabilizer trim use by the pilot to meet the rapidly changing trim requirements. Stabilizer trim should be utilized as required to maintain stick forces near zero to preclude the rapid development of an out-of-trim condition. Stick forces associated with flaps down are very light even at full travel of the control column and can lead to the false impression that stabilizer trim is not required.

NOTE

Control column force is a function only of control column position and airspeed; this force is not dependent on stabilizer position. If the control column is at full travel and stabilizer trim is being used, no change in control column force will occur until the control column is repositioned by the pilot. A positive method of determining whether or not the trim is working is to note the action of the trim wheel.



Takeoff-Climb Stabilizer Trim Schedule

Figure 2-7.

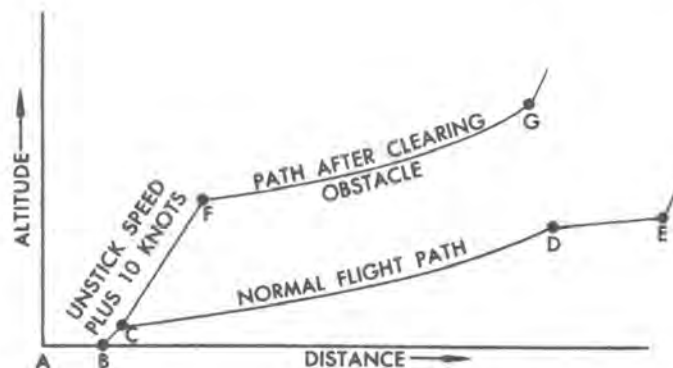
Excessive force is not required to position the control column at full travel in the flaps down configuration. Therefore, if a condition develops in which the pilot is holding the control column hard against the stops and not effecting positive control of the aircraft, he must make a conscious effort to utilize stabilizer trim. If this condition has developed and trimming action has been started, the response of the aircraft may not be immediately apparent. Continue trimming until control is regained. A typical profile of trim requirements is given in figure 2-7. When the aircraft is out of ground effect, landing gear is retracted, and the aircraft is accelerated to 180 knots IAS, a nose down stabilizer trim requirement of approximately 3 units exists. During the first 80% of flap retraction, approximately 1.4 units of stabilizer nose up trim is needed. An additional 1.1 units of nose up trim is required during the last 20% of flap retraction. For these trim requirements, the manual trim wheel is too slow to maintain zero stick force; therefore, the stabilizer trim button should be used. During flap retraction, stick forces are light and a few seconds of holding a rearward control column rather than retrimming can result in an aircraft out-of-trim condition of 2 or 3 units nose down trim and an approaching loss of elevator authority. Application of nose up trim and full up elevator will result in immediate recovery. See "Flight Control System Characteristics," Section VI, for information on elevator and stabilizer characteristics. After the flaps are fully retracted, nose down trim change will be required during acceleration to best climb speed.

WARNING

- When holding full up elevator, the pilot must be certain that he is engaging the trim button in NOSE UP position. Due to the position of the control column, he may be pushing in on the button or down on the trim button guard.
- Since during initial climb phase a severe attitude change occurs requiring considerable manipulation of the stabilizer trim, pilots should be especially alert for a stabilizer trim malfunction during this critical phase of flight, and initiate immediate action as outlined in "Flight Control System Emergency Operation," Section III.

Normal Climbout Procedure

After unstick, the aircraft is accelerated to 180 knots IAS and a flaps down climbout made to at least 1000 feet above the terrain (path CD in figure 2-8). At this point, flap retraction will be initiated. The aircraft will be accelerated on takeoff heading during flap retraction whenever possible. The airspeed



- POINT A. Start takeoff roll using takeoff rated thrust (TRT) with wing flaps down.
- POINT B. Takeoff point; start gear retraction.
- PATH CD. Leave flaps down and climb out at 180 knots IAS to 1000 to 1500 feet above the terrain.
- POINT D. Start flap retraction at 1000 to 1500 feet altitude above the terrain.
- PATH CF. Leave flaps extended and climb at unstick speed plus 10 knots until the obstacle is cleared.
- POINT F. Maximum desired altitude for clearing obstacle (at least 1000 feet above terrain).
- PATH FG. Start flap retraction at 180 knots IAS; maintain a rate of climb sufficient to keep from exceeding flap placard limits.
- POINTS E AND G. Points at which flaps are up. Accelerate to the best climb speed as given in Part 4 of the Appendix.

■■■■ After Takeoff Flight Paths

Figure 2-8.

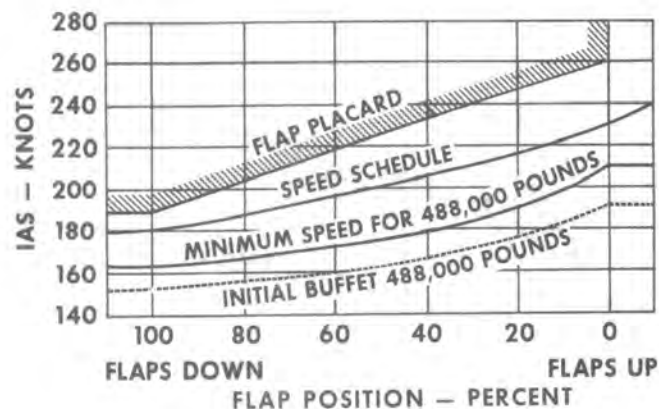
must be maintained above the minimum recommended with flaps up.

Obstacle Clearance Climbout Procedure

When obstacles near the field must be cleared on takeoff, the climbout performance becomes very important. A high angle of climb for clearing close obstacles is maintained by leaving the flaps down and climbing at 10 knots above unstick speed until obstacle is cleared.

Flap Retraction Precautions

During flap retraction, the speed schedule shown in figure 2-9 should be maintained within ± 10 knots. This schedule gives a safe margin between flap placard and minimum speeds. If the airspeed is low, the



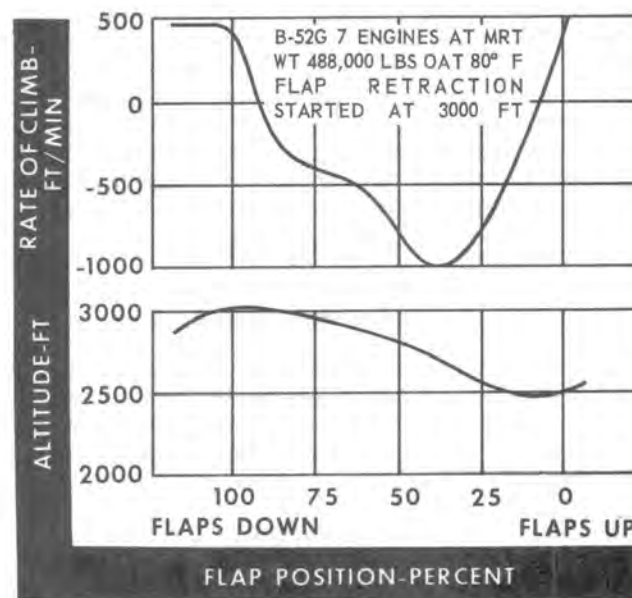
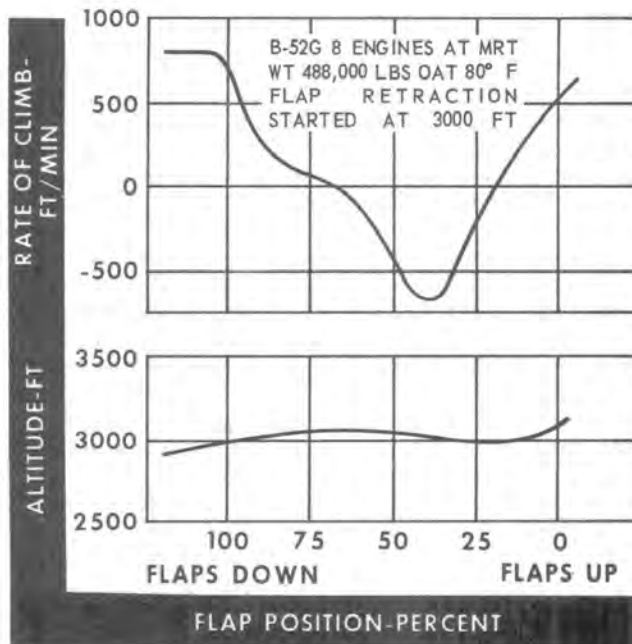
■■■■■■■ Flap Retraction Speeds

Figure 2-9.

vertical velocity should be reduced or power added. During flap retraction cycle, it is required that the pilot monitor the aircraft attitude as closely as possible, keeping the aircraft trimmed to a zero stick force, especially during the last 20% of flap retraction. If the climbout has been properly planned and no emergency develops, a satisfactory vertical velocity can be maintained while accelerating during flap retraction. However, under conditions of high gross weight, high OAT, and high field elevation, or any combination of these factors, it may be impossible to maintain a positive vertical velocity during the latter part of the flap retraction period. Flaps should not be retracted in a turn and the speed schedule of 180 knots IAS at 100% flaps down, 200 knots IAS-flaps 50%, 210 knots IAS-flaps 30%, and 230 knots IAS-flaps full up should be followed. In any event, maintain a sufficient positive vertical velocity to keep from exceeding the flap placard speed of 225 knots IAS at the 50% position and 253 knots IAS at the 10% position.

WARNING

The OFF flag will not appear during every attitude indication failure. Therefore, it is possible that a malfunction of the attitude indicator might be determined only by cross-checking it with the turn and slip indicator and the other remaining flight instruments.



Flap Retraction Performance -

■■■■■■■■■■■■■■■■■■■■ Heavy Weight

Figure 2-10.

CAUTION

An altitude loss can be expected during flap retraction if the maximum allowable dry thrust flaps down positive vertical velocity at 180 knots IAS is less than 1500 feet per minute. At a vertical velocity of 500 feet per minute, the loss at the completion of the flap retraction will be about 500 feet.

NOTE

BB BC

- The ATT warning flag indicates the attitude information displayed on the pilot's and/or copilot's attitude director indicator may be erroneous and the standby attitude indicator should be checked to determine proper attitude references.
- An error in the pitch indication of the attitude indicators is generated during accelerations or decelerations. The error is indicated in a nose high direction during and after a forward acceleration and in a nose down direction during and after deceleration. The longer the duration of acceleration (or deceleration), the greater will be the indicated error and the longer it will persist when acceleration (or deceleration) ceases. The erection system will reduce the error at about the same rate it was generated. Pitch error may reach one bar width during a high gross weight takeoff.

Heavy Weight Flap Retraction Performance

The takeoff and initial portion of the climbout are the critical conditions for an aircraft weighing 450,000 to 488,000 pounds. When takeoff is planned at these weights, performance calculations should be gone over thoroughly not only for normal operation but for emergency conditions as well. A positive vertical velocity cannot always be maintained during the complete flap retractions cycle; therefore, at these heavy weights, flap retraction will normally be delayed until reaching 1500 feet. Figure 2-10 shows the flap retraction performance at 488,000 pounds. It should be noted that with eight engines at MRT, the vertical velocity indicator may indicate a rate of descent of over 500 feet per minute although the actual loss in altitude is quite small. After takeoff, there is ample climb performance. Even with one engine out, the aircraft is well above the outboard-engine-out minimum control speed.

SUMMARY OF AFTER TAKEOFF PROCEDURES

Climb out with flaps full down at 180 knots IAS to an altitude of at least 1000 feet above the terrain and retract the flaps. If a positive vertical velocity of 1000 fpm is not attained when reaching 1000 feet above the terrain, flap retraction will be delayed until an altitude of 1500 feet above the terrain is reached. If an obstacle must be cleared, climb out with flaps down at unstick speed plus 10 knots until a safe altitude has been reached.

AFTER TAKEOFF — CLIMB CHECKLIST

NOTE

All asterisk (*) items will be read by copilot and response given over interphone.

1. Landing Gear Lever - GEAR UP, six up (P-CP)

Pilot will apply wheel brakes firmly for approximately 3 seconds before landing gear retraction. Under slush and wet runway conditions in winter weather, leave landing gear down approximately 30 seconds after takeoff to allow moisture to be blown from landing gear prior to braking wheels and retraction. Pilot calls for gear up. Copilot moves landing gear lever to GEAR UP. He then insures that the lever is in the detent, the warning light is out, and that all six gear indicate up and locked. Copilot will then announce, "Gear up, six up."

CAUTION

To prevent system damage, if any gear fails to indicate up and locked, do not recycle the landing gear system prior to initiating emergency procedure.

AFTER TAKEOFF — CLIMB CHECKLIST (Cont)**2. Flap Lever - UP and OFF (CP)**

At 180 knots IAS and a minimum altitude of 1000 feet above the terrain, the pilot directs the copilot to raise the flaps. If a positive vertical velocity of 1000 fpm is not attained when reaching 1000 feet above the terrain, flap retraction will be delayed until an altitude of 1500 feet above the terrain is reached. At the appropriate time, the copilot advises, "Flaps coming up, flaps 50%, flaps 30%, and flaps full up." In addition, the copilot monitors the flight instruments, including the airspeed, during flap retraction. As a guide, the normal speed schedule during flap retraction should be approximately 180 knots IAS at 100%, 200 knots IAS at 50%, 210 knots IAS at 30%, and 230 knots IAS when flaps reach the full up position. If the actual indicated airspeed varies from these values by 10 knots or more, the copilot should so advise the pilot so he can make necessary pitch changes. When the flaps up indication is received, move the flap lever to OFF to prevent flap motor damage which may be caused by limit switch actuation after flap retraction.

WARNING

- During last 20% of flap retraction, maintain zero stick force using the stabilizer trim button. In event of adverse nose down pitching tendency, airbrakes may be used to correct to a normal nose up condition.
- Any unusual rolling moment encountered during flap operation could indicate an asymmetrical flap condition for which corrective action must be taken immediately. (A discussion of flight characteristics with asymmetrical flaps is included in Section III.)
- If power is reduced during initial climb, it may be necessary to add power during flap retraction to maintain the desired speed schedule and to preclude loss of altitude.

CAUTION

If flaps fail to start moving within 10 seconds, wing flap operation should be discontinued to prevent damage to the flap drive system. See "Wing Flap Limitations," Section V.

AFTER TAKEOFF — CLIMB CHECKLIST (Cont)**3. Throttles - Set (CP)**

An NRT climb at a specific airspeed or Mach number is accomplished by adjusting to the EPR tabulated in the appropriate abbreviated checklist chart in T.O. 1B-52G-1CL-1 for the correct altitude and cockpit OAT gage reading. Computation may be accomplished by the navigator when aboard. EPR settings can also be obtained from the "Thrust Settings" charts contained in Part 4 of the Appendix. It is necessary to recheck the EPR setting by one of the above methods approximately every 10,000 feet during the climb to ensure that NRT is not being exceeded. For practical purposes, this check can be made at oxygen check (12,000 feet) and every 10,000 feet thereafter.

CAUTION

Due to characteristics of the engine, it is important to set NRT by use of EPR. EGT is not to be used as a means for setting climb thrust.

NOTE

- EPR setting to be used in climb should not be made until water supply is exhausted.
- NRT will normally be used for all climbs. MRT may be used for emergency conditions or as mission requirements dictate.
- When EPR computation is accomplished by the navigator, he will be notified as to whether anti-ice is on or off to insure proper EPR setting.

4. Starter Switches - OFF (CP)

When rpm and EPR have stabilized, turn starter switches OFF.

- *5. Air Conditioning Master Switch - 7.45 PSI (prior to 10,000 feet) (CP)
- *6. Slipway Doors - Open, then closed (CP)

CAUTION

Slipway doors will not be opened above 300 knots IAS.

***7. 12,000-Foot Oxygen Check - Completed (G-RN-P/CP)**

- a. During the climb, copilot requests an oxygen check at 12,000 feet. The sequence for oxygen report is gunner, radar navigator, pilot/copilot. The reporting crewmember will visually check other crewmember for alertness. He will report oxygen check for both positions. Oxygen panel at each occupied crew position will be checked on all oxygen checks for:

AFTER TAKEOFF — CLIMB CHECKLIST (Cont)

- (1) Oxygen Supply Shutoff Lever - ON
- (2) Regulator Diluter Lever - As required
- (3) Pressure - 300 psi
- (4) Flow Indicator - Functions normally
- (5) Emergency Toggle Lever - NORMAL

b. Gunner, radar navigator, and pilot/copilot report "Oxygen panels checked." In addition, pilot/copilot reports "Cabin altitude _____ feet."

* 8. Fuel Panel - Fuel sequence as required (CP) Checked (P)

See Section VII for proper sequence and check switches 9, 10, 11, and 12 CLOSED.

* 9. Water Injection Switches (if applicable) - OFF and OPEN (P)

Turn water injection system switch OFF and move drain valve switch to OPEN. If system was serviced but not used during takeoff, move drain valve switch to OPEN and leave water injection system switch OFF. Leave drain valve switch OPEN at all times, except when the system is serviced, to drain water from the lines and to prevent damage to the valves. If the water injection system was not serviced, do not accomplish this item.

CAUTION

Draining 1200 gallons of water requires approximately 55 minutes. Remain below freezing level for a minimum of 55 minutes to allow water drainage.

*10. Altimeter - Set 29.92 (P-CP-N)

Pilot and copilot will periodically cross-check altimeter readings in flight.

WARNING

- If altimeter indications fail to move during climbs or descents while in the reset mode, the altimeter should be placed in the standby mode.
- When the altimeter is operating in standby mode, the altimeter correction card for the current aircraft configuration must be used to fly corrected altitude for traffic separation.

*11. Level-Off Check - Completed (P-CP)

- a. Landing, Taxi & Crosswind Landing Light Switches - OFF
- b. Oxygen & Station Checks

Complete as given in "Preparation for Flight" Checklist.

CLIMB

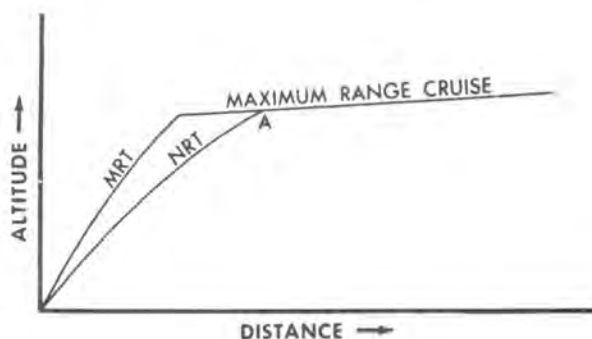
The normal climb technique described herein will be required to produce the results stated in Part 4 of the Appendix. NRT will normally be used for climb. If climbs are made at less than normal rated thrust, a loss of range will result because of the excessive time spent in climbing. MRT may be used for emergency conditions or as mission requirements dictate. Referring to figure 2-11, it should be noted that point A will be reached at approximately the same time regardless of whether military rated thrust or normal rated thrust is used for the climb. Approximately 300 pounds less fuel will be required when military rated thrust is used, but engine life probably will be shortened slightly since higher engine speeds and higher temperatures will be encountered.

NOTE

If the aircraft was serviced with aviation gasoline in any tanks, see "Rate of Climb Limitations with Emergency Fuel (Aviation Gasoline)." Section V.

CLIMB DATA

A study of the climb charts, Part 4 of the Appendix, will show that a constant airspeed is maintained during climb until the proper constant climb Mach number is reached. The loss of one engine during a climb will decrease the aircraft rate of climb. Refer to Part 4 of the Appendix for data on eight- and seven-engine climb performance.



■ ■ ■ ■ ■ ■ ■ ■ ■ ■ Climb Flight Paths

Figure 2-11.

ICING DURING CLIMB

If icing conditions are suspected to exist within the climb flight path, the engine and nacelle anti-icing system should be turned on prior to the time icing conditions are encountered.

CRUISE

RANGE

Normally a combat mission will be flown using procedures which will produce maximum range. The performance of a jet aircraft is such that maximum range is attained by flying at one particular Mach number and gradually increasing altitude as aircraft

weight is decreased through fuel consumption. Such a climbing flight path is accomplished by setting the throttles so as to provide a given engine pressure ratio (EPR) for a corresponding cruise Mach number and checking the altitude frequently to make certain it agrees with that specified by the altitude curve. The rate of climb required is very small (averaging from 16 to 20 feet per minute or about 1000 to 1200 feet per hour). Therefore, rather than attempt to fly at some specified rate of climb, check the flight altitude with that given in the altitude curve at frequent intervals (not to exceed 30 minutes) to assure that the proper climbing flight path is being maintained. Adjust charted EPR as necessary to maintain airspeed and altitude for aircraft gross weight. The autopilot altitude hold position may be used until the airspeed increases, at which time a shallow climb should be initiated to place the aircraft at the correct altitude for the decreased gross weight. This step climb procedure will be repeated as necessary. The cruise true Mach number should be checked frequently by means of the airspeed indicator. The machmeter may be inaccurate, causing a range loss of several percent. There is only one weight-altitude schedule which will result in maximum range. Such information is provided in Part 5 of the Appendix and is the maximum range curve on the charts. The remaining curves on these charts are called the best range for the particular flight condition and result in slightly less range than that attained by flying maximum range. Best range (constant altitude) cruise is usually used for a noncombat mission because the difference in range between this type of cruise and maximum cruise is not great if the altitude is above 35,000 feet. Also, see "Fuel Management for Lateral Trim," this section.

NOTE

Cruise at airspeeds in excess of best range or maximum range airspeeds is detrimental to engine life and should be avoided except when mission requirements dictate. Refer to Part 5 of the Appendix for engine thrust settings.

FUEL MANAGEMENT FOR LATERAL TRIM AND WING FUEL UNBALANCE

When all engines are developing the same thrust and there is no lateral unbalance due to fuel load, small amounts of lateral and rudder trim are required to maintain "hands off" in level flight. Normally, a correctly rigged aircraft meeting the above requirements will need no more than 1 unit of rudder and 2° of spoiler deflection. In the event that maximum range is desired, it should be considered that some degradation of range (in the order of 1% per degree of spoiler deflection) will result from the displaced

spoiler. Maximum range and/or endurance may be obtained by using fuel from the heavy wing in such a way that a differential fuel loading will exist between main tanks 1 and 4 sufficient to obtain minimum lateral trim. To maintain desired main tank fuel balance during cruise conditions, the following procedures will be used during the main tank to engine sequence.

1. Check auxiliary tank fuel flow control switches (13, 14, 15, and 16) closed.
2. Open crossfeed valve switches as required to feed the low tank engines from the high tank.
3. Shut off boost pump switches in the low tank (boost pumps should not be shut off in more than one main tank at any time).
4. When the desired main tank balance is attained, turn on all main tank boost pump switches prior to closing the crossfeed valves.

NOTE

- In order to achieve maximum range and/or endurance with this procedure, the spoilers must be down when the aircraft is in the "trimmed out" condition.
- To achieve a spoiler down position, return the lateral trim system to the indicated zero position and the control wheel to the spoiler down position as determined during preflight check.
- Approximately 1000 pounds of differential fuel is required to compensate for 1 unit of trim under cruise conditions.
- The fuel load configuration established is only an indicated differential and may actually be correcting an unbalance condition which has been caused by fuel gage error.
- Fuel weight differential between main wing tanks 1 and 4 is limited to the following maximums:
 - Above 450,000 pounds gross - 2,000 pounds
 - 400,000 to 450,000 pounds gross - 5,000 pounds
 - Below 400,000 pounds gross - 20,000 pounds
- Under normal conditions, minimum lateral trim should be obtained with a fuel differential between main wing tanks 1 and 4 as follows:
 - 400,000 pounds gross and above - 2,000 pounds maximum
 - Below 400,000 pounds gross - 4,000 pounds maximum
- If minimum lateral trim cannot be achieved within the normal condition limits, an abnormal condition exists which requires maintenance action.

CENTER OF GRAVITY

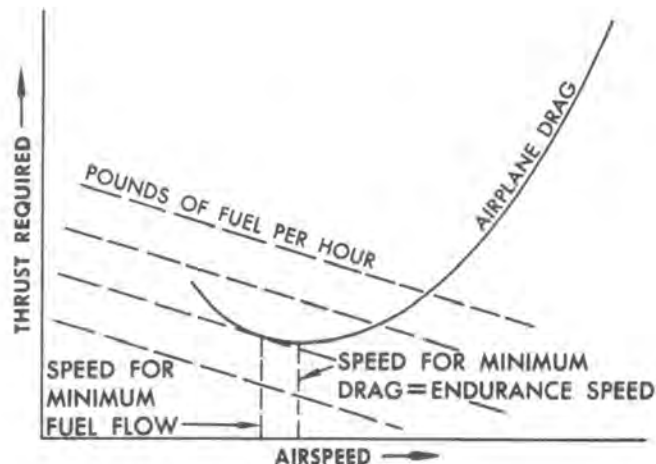
Control of the center of gravity of this aircraft during any cruise operation is simple if the fuel sequence recommended in Section VII is followed. See Section V and Part 5 of the Appendix for center of gravity information. As fuel is consumed, the cg location will shift slightly, and a running check should be maintained so that the approximate cg location is known at all times. The stabilizer trim wheel may be used to make such a check by referring to the chart in Part 5 of the Appendix. For maximum range cruise operation at the chart Mach number, the stabilizer trim indicator should be in the vicinity of zero units. If the stabilizer setting is within the limits of 1 unit nose up and 1 unit nose down, the cg could be expected to be within normal limits. If the stabilizer trim is set outside of these limits, the cg location should be checked against the stabilizer trim chart in Part 5 of the Appendix and compared to calculations based on fuel distribution. Since knowledge of the amount and location of fuel aboard is necessary for flight safety, special care should be taken to detect fuel gage errors. See "Fuel Servicing," this section. To aid in detecting gage errors, a close cross-check should be maintained between planned fuel consumption and gage readings.

WARNING

Loss of an engine or engines, use of any unusual combination of engines, or any fuel usage problems will require close attention to fuel panel settings to assure lateral balance and desirable cg location are maintained. It is essential that any required deviation from the aircraft configuration fuel sequence be planned to maintain the proper differential/balance between paired main/auxiliary tanks. This will preclude an adverse effect on cg location.

NOTE

- The normal limits of 1 unit nose up and 1 unit nose down for the stabilizer trim setting are valid only for maximum range cruise operation (maximum range altitude and chart Mach number) and then for gross weights of 410,000 pounds or less. At gross weights above 410,000 pounds, 1 unit of nose up trim would indicate that the aircraft is out of the forward cg flight limit.
- The normal fuel usage sequences are designed to assure maximum aircraft service life. Precluding wing flutter is a prime factor in the development and use of the prescribed fuel usage sequences as well as wing structural life, lateral balance, and



■■■■■■■■■■ Endurance Airspeed

Figure 2-12.

cg location. All of these factors are inter-related. Therefore, use of other than normal fuel sequences to correct a lateral balance or cg problem may impose wing flutter airspeed limitations as defined in figure 5-5.

- If engine shutdown or other emergency precludes the proper fuel sequence steps, compute the center of gravity for the landing condition. This may be accomplished by use of the load adjuster or by reference to the "Approximate CG Location Landing Configuration" chart in the "Approach and Landing" section of the Appendix.

ENDURANCE

Maximum endurance is frequently desired during operational missions when it becomes necessary to hold over a check point, rendezvous with a tanker, accomplish a navigational check, or provide time to correct aircraft functional difficulties. Maximum endurance can be attained only if the recommended airspeeds are observed within ± 10 knots, by operating the engines as specified in Part 6 of the Appendix, and by maintaining zero lateral trim. See "Fuel Management for Lateral Trim," under "Climb," this section.

Endurance Procedures

Maximum endurance is accomplished by flying at a gradually decreasing airspeed and gradually increasing altitude as the gross weight is decreased through fuel consumption. If the endurance operation lasts

less than 4 hours, the gain in endurance by flying a climbing flight path is negligible and constant altitude operation is recommended. The optimum endurance airspeed for any weight and altitude is the airspeed at which the pounds of fuel per hour is at a minimum. This is slightly less than the airspeed at which the aircraft drag is at a minimum (figure 2-12). The recommended endurance speed schedule is at the minimum drag point. This results in a negligible penalty in fuel flow while the increased speed is desirable from a piloting standpoint. Shutting down some engines at certain altitudes and airspeeds will result in the remaining engines operating in a more favorable range of rpm with higher efficiencies. See Part 6 of the Appendix.

FLIGHT CHARACTERISTICS

See Section VI for information regarding flight characteristics.

AIR REFUELING

See Section IV for air refueling descriptive and operational information.

AGM-69A INFLIGHT OPERATION

Amplified checklists for B-52G/AGM-69A operation are published in T.O. 1B-52G-30-2. The corresponding abbreviated checklists are published in T.O. 1B-52G-1CL-1, pilot's; T.O. 1B-52G-1CL-2, navigator's; and T.O. 1B-52G-1CL-3, radar navigators.

LOW ALTITUDE TACTIC

Penetration airspeed to the low altitude entry point will normally be 280 KIAS, unless aircraft restrictions apply or using commands direct otherwise. If icing conditions are encountered during cruise at low altitude, airbrakes may be used as necessary (do not exceed position 4) to maintain sufficient power for engine anti-icing (see "Normal Operation of Engine,

Nacelle, and Scoops Anti-Icing System" under "ANTI-ICING," Section IV); however, this will impose range penalties. Refer to "Range Correction Factors" and "Fuel Flow Corrections for Anti-Ice" in Part 5 of the Appendix. If conditions require the use of airbrake position 2 during low level flight, the following procedure is recommended:

1. Pull the "Inboard Airbrake Control" circuit breaker located on the pilot's circuit breaker panel.
2. Move airbrake lever to position 4. Drag and range degradation will be approximately the same as that when operating normally in position 2. Buffet level will be substantially reduced. Roll response will be the same since spoiler operation is not affected by pulling the airbrake control circuit breaker.

OPERATION

Present low altitude operational information is based on the results of low altitude flight tests. During these tests, the aircraft and its systems were operated at near maximum design capability. With the requirement of all-weather flying at airspeeds up to the design limit of the aircraft, adequate preflight planning is especially essential for successful completion of a low altitude mission. Icing conditions at low altitudes and high speeds can be more severe than those normally encountered. Also, it is extremely difficult to anticipate icing conditions during low altitude operation, particularly at night. Crew coordination is considered critical when flying at low altitude. There have been some unusual psychological effects on crew members and fatigue is found to increase much more rapidly at low altitude than at high. There is considerable difficulty for pilots in interpreting readings of certain instruments while bouncing due to turbulence; however, it is fairly easy to determine the range of scale which the instrument needle is in and generally this is sufficient. Adverse effects which are frequently encountered at low altitude and which must be considered when planning a mission are increased turbulence, reduced vision,

reduced radar range, the inconsistency of winds due to terrain effect, and extreme difficulty in the use of celestial navigation because of turbulence and the frequency of overcast. Also, noise interference with interphone and radio communication is experienced when the air conditioning pack is in operation during high power settings. This interference may be avoided by positioning the air conditioning master switch to RAM. On climbout, place the air conditioning master switch in 7.45 before reaching 10,000 feet as shown in the "After Takeoff-Climb Checklist," this section. Another obvious consideration while flying at low altitude is that of planning the mission to insure an awareness of any hazardous terrain conditions and an avoidance of dangerous aircraft-terrain relationships. See "Low Altitude Flight Characteristics," Section VI. There is no necessity to deviate from normal fuel management sequences during operation at low altitudes.

CAUTION

When EVS window washing action is initiated during RAM operation, the lines and pump will remain full of water until the cabin is pressurized. Line freeze should be expected if the aircraft is exposed to a low temperature environment prior to cabin pressurization.

NOTE

- Use of RAM setting during low level operation for extended periods of time may result in BNS equipment and/or pressurization compartment overheating.
- For operation of terrain avoidance system, see Section IV.

- For operation of the autopilot during low altitude tactic, see "Low Level Mode" under "Autopilot," Section IV.
- For operation of the electro-optical viewing system (EVS), see Section IV.

INFLIGHT TA FUNCTIONAL CHECK

An inflight functional check of the TA system will be accomplished on every mission.

LOW LEVEL DESCENT

The "Low Level Descent" checklist will be accomplished during entry to a low level tactic.

TA SYSTEM CALIBRATION

A TA system calibration check will be performed prior to entry into a TA low level tactic or when a check of the TA system accuracy is required.

TA SYSTEM ERROR COMPENSATION PROCEDURES

TA system error compensation procedures are included in Section IV and provide a means of compensating for errors determined during the TA system calibration check.

CLIMB AFTER LOW LEVEL

After completion of low level tactic when climbing back to altitude, perform the items in the "Climb After Low Level" checklist.

INFLIGHT TA FUNCTIONAL CHECK CHECKLIST**NOTE**

- All items may be completed silently by the appropriate crewmember. Advise N/RN prior to start of checklist.
- This check will be accomplished prior to descent to low level.
- This check will be accomplished after a 15-minute warmup period of the terrain computer. Coordination with the radar navigator will be made before accomplishing these checks. Pilots' terrain display mode selector switch must be positioned to an operational mode at least 2 minutes (for radar scan converter warmup) prior to performing these checks.
- A failure warning indication may be obtained at high altitude with a normal system due to ground returns. If this occurs, accomplish applicable functional check items.
- If the test pattern does not appear with use of the TA Test switch, the navigators should press the TARSC BIT button on the radar scan converter. This button performs the same function as the TA Test switch and will give the TA test pattern on the pilots' EVS monitors. If the test pattern still does not appear, the TA radar scan converter is malfunctioning and the TA system cannot be used for low-level flight.

1. EVS Power Switches - ON (P-CP)

2. Terrain Display Mode Selector Switch - PROFILE 10 (P/CP)



If the TA OVHT light on the pilot's panel comes on during TA operation, immediately place pilot's terrain display mode selector switch to OFF.

INFLIGHT TA FUNCTIONAL CHECK CHECKLIST (Cont)**3. TA Video - Selected (P-CP)**

Press TA video select switch to ON.

4. Stabilization Reference Selector Switch - FRL (P/CP)**5. Clearance Plane Range - Checked (P-CP)**

Pilot and copilot observe movement of clearance plane indicators while pilot changes selection of clearance plane elevation throughout its range.

NOTE

The TA warning light should not illuminate for clearance plane settings between 200 and 3000 feet except when the TA test switch is pressed.

6. Clearance Plane Set to 800 Feet - Checked (P-CP)**7. Profile 10 Display Mode - Checked (P/CP)****a. Range Gate Lights****b. Horizontal Reference Lines**

Observe that both 10-mile range gate lights illuminate and both horizontal reference lines are present and centered.

8. Profile 6 Display Mode - Checked (P/CP)**a. Range Gate Lights****b. Horizontal Reference Lines**

Observe that both 6-mile range gate lights illuminate and both horizontal reference lines are present and centered.

9. Profile 3 Display Mode - Checked (P/CP)**a. Range Gate Lights****b. Horizontal Reference Lines**

Observe that both 3-mile range gate lights illuminate and both horizontal reference lines are present and centered.

10. TA Test Pattern - Checked (P-CP)**a. Depress and hold TA test switch and observe that:**

(1) The center segment of the HRL is initially filled in and returns to its normally blanked condition after 5 seconds.

(2) Profile 3, profile 6, profile 10, TA-EVS vector, TA warn and TA overheat lights are illuminated.

(3) Profile test video line present and continuous across entire monitor screen in a staircase pattern (figure 4-53).

(4) Horizontal reference line is present on the display (figure 4-53).

INFLIGHT TA FUNCTIONAL CHECK CHECKLIST (Cont)

b. Release the TA test switch and observe that:

- (1) Profile 10, profile 6, TA-EVS vector. TA warning and TA overheat lights go out and profile 3 light remains on.
- (2) Profile trace is completely displayed as antenna completes a full scan. The video line shall remain stable within $\pm 1/32$ inch. Profile terrain trace may not be present at high altitude due to overranging of the computer.

WARNING

If the staircase pattern is not present and the TA warning light is not on, a radar scan converter malfunction is indicated. DO NOT USE TA.

NOTE

The staircase pattern will not be present when the failure warning light is on. This may occur at high altitude with no malfunctions. If this occurs, repeat TA test pattern check if the warning light goes out at a lower altitude.

11. Terrain Display Mode Selector Switch - PROFILE CAL (P CP)

This selects profile manual minimum range mode.

12. Profile Manual Minimum Range Mode - Checked (P-CP)

a. Horizontal Reference Line (HRL)

The horizontal reference line should be approximately 2 inches long at center of monitor with approximately a 1 4-inch break in the line at ground track.

b. Range Gate Light

The 10-mile range gate light shall illuminate.

13. Terrain Display Mode Selector Switch - OFF (if applicable) (P CP)

14. EVS Power Switches - OFF (if applicable) (P-CP)

LOW LEVEL DESCENT CHECKLIST (Pilot/Copilot reads)

1. Altimeter Settings & "D" Values - Obtained (CP)

Obtain updated forecast altimeter settings and "D" values from a designated PMSV station. "D" values at the low level entry point for calibration altitude will also be furnished for designated mountainous routes.

Altimeter Settings & "D" Values:

	PREFLIGHT		IN-FLIGHT PMSV	
	Altimeter	"D"	Altimeter	"D"
Low Level Entry	_____	_____	_____	_____
Calibration Altitude (if applicable)		_____		_____
Midpoint Low Level Route	_____	_____	_____	_____
Target Area	_____	_____	_____	_____

LOW LEVEL DESCENT CHECKLIST (Pilot/Copilot reads) (Cont)**2. Bleed Selector Switch - NORMAL LH INBD (CP)**

Check bleed selector switch in NORMAL LH INBD prior to descent below 25,000 feet.

3. EVS - ON, TA video selected (P-CP)

Depress EVS power switch to ON. Pilot and copilot should both select EVS sensor with best display and vector stabilization.

4. Anti-Icing and Starter Switches - Climatic (P-CP)

If suspected icing conditions exist in the descent area, turn ON the engine, nacelle, and scoops anti-icing switch prior to descent and check for a noticeable drop in EPR on all engines at time of switch actuation to indicate proper operation of the system. When descending under possible inlet icing conditions, starter switches should be placed in START and remain in START until sufficient power for anti-ice heat has been reestablished and stable engine operation obtained.



Insure that the starter switches for engines which have been shut down are off and remain off for the remainder of flight unless intentional engine air starting is accomplished.

5. Stabilization Reference Selector Switch - FVR (P/CP)**6. Clearance Plane Set to 800 Feet - Checked (P-CP)****7. Radar Altimeter Cursor Set to 800 Feet - Checked (P-CP)****8. Taxi Lights - ON (P/CP)**

On training missions, turn taxi lights on during night or day operations unless reflection reduces pilot visibility.

9. Autopilot - Disengaged (P/CP)**10. Altimeters - Set _____ (P-CP-N)**

Set altimeters to station pressure immediately prior to initiating penetration or upon passing through transition altitude. ARTC furnished altimeter setting will be used if available.

LOW LEVEL DESCENT CHECKLIST (Pilot/Copilot reads) (Cont)

11. Terrain Display Mode Selector Switch - PROFILE 10 (P/CP)

NOTE

Allow at least a 2-minute warmup period any time the terrain display mode selector switch is moved from OFF position to an operational mode.

12. Level Off at IFR Altitude/Emergency Minimum Safe Altitude _____ - Accomplished (P-CP-RN-N)

The preplanned level-off altitude will be entered during mission planning.

NOTE

- For descent into Low Altitude High Speed Routes (VFR), initial level-off should be made at the planned emergency minimum safe altitude for that segment.
- When flight at IFR altitude/emergency minimum safe altitude is required, the pilots should select profile 10 with a clearance plane of 800 feet. This TA display will provide additional altitude monitoring.

13. Autopilot Low Level Switch - LOW LEVEL (P/CP)

14. Radar and Pressure Altimeters & H_A Indicator - Cross-checked (P-CP-RN-N)

The navigator will state terrain elevation. The pilot will then read the indications of his radar altimeter and pressure altimeter. The copilot, radar navigator, and navigator will cross-check their instruments for proper indications and respond "cross-checked." If the IFR altitude/emergency minimum safe altitude exceeds 5000 feet absolute altitude (radar altimeter capability), the cross-check must be made as soon as a lower absolute altitude permits.

LOW LEVEL DESCENT CHECKLIST (Pilot/Copilot reads) (Cont)

15. Altimeters - Set _____ (P-CP-N)

Forecast altimeter setting obtained from PMSV will be used for TA calibration. Current altimeter setting obtained by radio from nearby FSS radios will be used for all low level operations except TA calibration check. If unable to obtain FSS altimeter settings while at low level, use PMSV forecast altimeter settings.

WARNING

EVS monitor optical filters of red color must be used on both pilot's and copilot's monitors during all TA operations at night.

NOTE

- A TA calibration check must be performed prior to entry into a TA low level tactic or when a check of the TA system accuracy is required.
- The TA calibration altitude for each calibration point/area will be established during mission planning and clearly annotated on the pilot's, radar navigator's, and navigator's charts.
- See command directives for weather criteria and other restrictions.

TA SYSTEM CALIBRATION CHECKLIST (Pilot/Copilot reads)**TERMINAL AREA PREPARATION**

These items will be accomplished only when TA system calibration in terminal area is required. Run will be performed at 220 KIAS, gear and flaps up, airbrakes down.

1. Stabilization Reference Selector Switch - FVR (P/CP)
2. Clearance Plane Set to 800 Feet - Checked (P-CP)
3. Radar Altimeter Cursor Set to 800 Feet - Checked (P-CP)
4. FRL Angle of Attack Indicator - Set (N)
5. Terrain Display Mode Selector Switch - PROFILE 10 (P/CP)
6. TA Video - Selected (P-CP)

Press TA video select switch to ON.

NOTE

- Allow at least a 2-minute warmup period (radar scan converter warmup time) any time the terrain display mode selector switch is moved from OFF position to an operational mode.
- See command directives for weather criteria and other restrictions.

NOTE

- The navigator will record all readings made by the pilot during this check on the calibration worksheet,
- The radar navigator is responsible for monitoring terrain beyond the range selected on the pilots' EVS monitors. The radar navigator will alert the pilot when approaching the preselected calibration area and will make a 10-mile range call.

1. Level Off at TA Calibration Altitude - Accomplished (P-CP-RN-N)

For flat terrain checks, level-off will be accomplished at 800 feet on the radar altimeter. For peak checks (and flat terrain checks with an inoperative radar altimeter), level off at the computed pressure altitude which is based upon 800 feet above the calibration terrain feature or point.

2. Autopilot - Altitude hold (P-CP)

If turbulence prohibits the use of "Altitude Hold" but is not of such magnitude to require discontinuing low level operation, use the autopilot low level mode.

WARNING

The trim condition of the aircraft should be closely monitored during the TA calibration check. In the event of automatic trim system failure, large amounts of stabilizer trim can be compensated for by the autopilot. This can result in severe pitchdown (up) when either a change in attitude or power setting causes an automatic disconnect or when a manual disconnect is accomplished. To minimize the effect of an automatic trim system failure, the trim meters and fore and aft position of the control column should be closely monitored. If several units of nosedown stabilizer trim and aft position of the control column are detected while flying with autopilot altitude hold engaged, be aware that autopilot disengagement by any means will cause abrupt pitchdown unless proper preventive steps are taken.

NOTE

The rudder axis of the autopilot is automatically disengaged in the low level mode; therefore, insure the autopilot rudder trim indicator has normal indications before engaging normal nonsteering mode.

TA SYSTEM CALIBRATION CHECKLIST (Pilot/Copilot reads) (Cont)**3. Radar Altimeter Indicators & Pressure Altimeters - Cross-checked (P-CP-RN-N)**

The navigator will state terrain elevation. The pilot will then read the indications of his radar altimeter and pressure altimeter. The copilot, radar navigator, and navigator will cross-check their instruments for proper indications and respond "cross-checked." If the IFR altitude/emergency minimum safe altitude exceeds 5000 feet absolute altitude (radar altimeter capability), the cross-check must be made as soon as a lower absolute altitude permits.

WARNING

During the TA calibration checks, the copilot will continually monitor the aircraft visually for safe terrain clearance.

NOTE

Upon completion of step "3," aircraft control will be transferred to the copilot and he will be responsible for flying the aircraft.

4. Stabilization Modes - Compared (P/CP)

Between 9 and 6 miles, select each stabilization mode and, while in each stabilization mode, adjust clearance plane until terrain trace is coincident with horizontal reference line. Record the clearance plane settings in the stab mode check block of the calibration worksheet.

5. Stabilization Reference Selector Switch - FRL (P/CP)**NOTE**

- Flat terrain calibration can only be accomplished in FRL.
- For peak calibration if FRL mode is inoperative or unreliable, accomplish calibration check in FVR. If both FRL and FVR are inoperative or unreliable, accomplish calibration check in horizontal stabilization mode.
- Tilt error compensation can only be accomplished using data collected in FRL stabilization mode.

6. Peak Checks:**a. Tilt Errors- Checked (P-CP-RN)****NOTE**

- Radar navigator will make range calls at 6, 5, 4, 3, and 2 miles for this check.
- Pilot will insure he has selected PROFILE 6 for 6-, 5-, and 4-mile ranges and PROFILE 3 for 3- and 2-mile ranges.

(1) HRL/Trace Coincidence at 6-Mile Range - _____(Ft)

Adjust the clearance plane so that the peak of the terrain trace representing the target coincides with the horizontal reference line at ground track. Note range to the peak and clearance plane setting for each data point on the calibration worksheet.

(2) HRL/Trace Coincidence at 5-Mile Range - _____(Ft)

(3) HRL/Trace Coincidence at 4-Mile Range - _____(Ft)

TA SYSTEM CALIBRATION CHECKLIST (Pilot/Copilot reads) (Cont)

- (4) HRL/Trace Coincidence at 3-Mile Range - _____ (Ft)
 (5) HRL/Trace Coincidence at 2-Mile Range - _____ (Ft)

NOTE

Obtain coincidence data every mile from 6- to 2-mile range if possible. A minimum of three data points are necessary to obtain valid data for error determination.

- b. Determine Zero Range Absolute Altitude - _____ (Ft) (P-CP)

When using a peak or prominent feature for calibration, care must be taken to fly the aircraft directly over the feature or point being tracked in order to obtain a valid radar altimeter reading.

6. Flat Terrain Checks:

Pilot and navigator will determine bias and tilt compensation values as follows:

NOTE

- This is a coordinated procedure between the pilot and navigator. The navigator will vary the FRL angle of attack control while the pilot monitors the terrain trace position and/or adjusts the clearance plane setting to determine system bias and tilt errors and their corrections.
- This procedure results in correction values to be applied directly to the clearance plane and FRL settings without further compensation. The algebraic sign of each of the following values must be carefully applied during arithmetic operations.

- a. FRL Angle - Calibration value computed and set (N)

Compute FRL angle for gross weight and airspeed from figure 4-51 and enter in the following equation:

Chart FRL Value _____ $-0.8^{\circ} =$ _____
 FRL Calibration Value

(Example: $-1.5^{\circ} - 0.8^{\circ} = -2.3^{\circ}$)

Set FRL angle of attack to this value (to be used for calibration run purposes only).

- b. Terrain Display Mode Selector Switch - PROFILE 3(P)

TA SYSTEM CALIBRATION CHECKLIST (Pilot/Copilot reads) (Cont)

c. Bias Compensation Value - Determined (P-N)

While in PROFILE 3, pilot adjusts clearance plane until terrain trace is coincident with the horizontal reference line (HRL). Read the clearance plane value and radar altimeter altitude to the navigator. Navigator computes clearance plane bias compensation value by the following equation:

$$\text{Clearance Plane Reading} - \text{Radar Altimeter Absolute Altitude} = \frac{\quad}{2} = \quad$$

$$\quad \text{Clearance Plane Bias Compensation Value}$$

$$(\text{Example: CP } 800 - 900 \text{ Radar Alt} = \frac{-100}{2} = -50)$$

Record the clearance plane bias compensation value on the calibration worksheet. This value will be applied directly to clearance plane settings throughout the remainder of the flight. Reduce clearance plane settings for negative values and increase settings for positive values.

d. Clearance Plane - Calibration value computed and set (P-N)

Compute calibration clearance plane value by the following equation:

$$550 + \begin{pmatrix} + \\ - \end{pmatrix} \text{Clearance Plane Bias Compensation Value} = \quad \text{Calibration CP Setting}$$

$$(\text{Example: } 550 + \begin{pmatrix} + \\ - \end{pmatrix} 50 \text{ CP Bias Compensation} = 500 \text{ CAL CP})$$

Set clearance plane to calibration value. (This value only used for calibration run purposes.)

e. Tilt Compensation Value - Determined (P-N)

Advise navigator to adjust FRL Angle of Attack control until terrain trace is coincident with the HRL.

Compute tilt compensation value by the following equation:

$$\text{Final FRL Reading} - 0.8^\circ - (\quad) \text{Chart FRL Value} = \quad \text{Tilt Compensation Value}$$

$$(\text{Example: Final FRL Reading } -1.2^\circ - 0.8^\circ - (-1.5^\circ) \text{ Chart FRL Value} = -0.5^\circ \text{ Tilt Comp Value})$$

Record this tilt compensation value on the calibration worksheet. This value will be added algebraically to chart FRL settings throughout the remainder of the flight. For example, with chart FRL value of -1.5° and a -0.5° FRL compensation value, set FRL angle of attack control to -2.0° .

WARNING

If tilt compensation value exceeds 2° , discontinue the calibration and do not use TA.

NOTE

For terminal area calibration check, the following steps will not be performed and the TA system will be turned off. After TA system calibration return the BNS Radar Frequency to high or low end of the frequency band to avoid PAR interference. Execute locally prescribed withdrawal procedure to enter normal traffic/instrument pattern. Proceed with "Traffic Pattern Checklist."

7. Autopilot Low Level Switch - LOW LEVEL (CP)

If time and/or conditions allow, altitude hold may be used until starting descent to final TA altitude.

TA SYSTEM CALIBRATION CHECKLIST (Pilot/Copilot reads) (Cont)**8. Altimeters - Reset (P-CP-N)**

Current altimeter setting obtained by radio from nearby FSS radios will be used. If unable to obtain FSS altimeter setting while at low level, use PMSV forecast altimeter setting.

9. TA System Error Compensation - Accomplish if applicable (N/RN)

If a system error exists, the TA system error compensation procedures in Section IV should be accomplished, time and/or conditions permitting. Normally, a minimum of 60 miles will be required prior to commencing the bomb run to facilitate accomplishment of calibration and error compensation, if required. If time and/or conditions do not allow the necessary compensation procedures to be accomplished, the published IFR altitude will be maintained. In any event, inflight calibration data and TA system error computations will be recorded on the calibration worksheet.

10. FRL & FVR Stabilization Modes - Compared (P/CP-RN)

After tilt compensation is applied (if required), radar navigator select LO ALT TA mode and pilot/copilot select FRL stabilization. Radar navigator fades a return at 6 miles and notes clearance plane setting, then pilot/copilot selects FVR stabilization and radar navigator fades the same terrain feature and notes clearance plane setting. This comparison should be made at approximately 800 feet absolute altitude above the terrain faded. Compare the clearance plane settings and if they do not differ more than 400 feet, then select FVR stabilization for TA low level flight. If the clearance plane settings differ by more than 400 feet, then FRL stabilization must be used for TA low level flight.

11. Stabilization Reference Selector Switch - FVR/FRL (as required) (P)**WARNING**

Use of horizontal stabilization mode is restricted to only the calibration check portion of the low level run except during combat TA altitude operations when FRL and FVR stabilization modes are inoperative or unreliable. When using horizontal stabilization mode, strict adherence to its use as described in Section IV should be followed.

12. Clearance Plane Set to Briefed TA Altitude (Plus or Minus Proper Error Compensation) - Checked (P-CP)**WARNING**

Clearance plane will never be set to a value less than 200 feet.

13. Radar Altimeter Cursor Set to Briefed TA Altitude - Checked (P-CP)

TA SYSTEM CALIBRATION CHECKLIST (Pilot/Copilot reads) (Cont)**14. Final Descent to TA Altitude - Accomplished (P/CP)**

Final descent will normally be accomplished in profile 3 mode with FVR stabilization. Check that clearance plane is set as desired. Maintain the terrain trace at or below the horizontal reference line within the ground track corridor. After descending to final TA altitude, further compensation of the clearance plane setting may be required. Observe the radar altimeter indications to verify TA system performance. If clearance altitude is not within 100 feet of desired clearance, readjust the clearance plane setting to obtain the desired clearance. At the termination of the TA tactic, the pilot must provide the final clearance plane settings used in the TA tactic to the navigator.

WARNING

- In profile 3, the clearance plane will never be set to more than 1000 feet. In profile 6, the clearance plane will never be set to more than 2000 feet.
- If clearance plane settings of more than 2000 feet are required, TA will not be used.
- The clearance plane will never be set to a value less than 200 feet.
- The primary duty of pilot not flying the aircraft is to visually monitor the terrain clearance of the aircraft.
- TA operation without a properly operating radar altimeter is extremely hazardous if visual terrain clearance cannot be maintained.

NOTE

Pilot flying aircraft monitors TA display, radar altimeter, and flight instruments. The radar altimeter is to be used in conjunction with the TA system. It will be included in the pilot's normal instrument scanning pattern for observing peak passage before following a fly-down command. Pilot not flying aircraft monitors aircraft position and aircraft systems operation.

CLIMB AFTER LOW LEVEL CHECKLIST**NOTE**

- All asterisk (*) items will be read by copilot and response given over interphone.
- Accomplish procedures as given in "After Takeoff - Climb" checklist except as directed otherwise.

1. Throttles - Set (CP)
- *2. Autopilot Low Level Switch - OFF (P/CP)
- *3. Anti-Icing Switches & Airbrakes - Climatic (P)

Engine, nacelle, and scoops anti-icing switch will be turned OFF if no longer required. If airbrakes position 4 was used with the inboard airbrake control circuit breaker pulled and airbrakes are no longer required, reset the circuit breaker.

4. Terrain Display Mode Selector Switch - OFF (P/CP)

The TA system should be turned OFF when aircraft has reached either the IFR altitude or the minimum safe altitude as applicable to the mission being flown.

- *5. Air Conditioning Master Switch - 7.45 PSI (prior to 10,000 feet) (CP)

CLIMB AFTER LOW LEVEL CHECKLIST (Cont)

*6. 12,000-Foot Oxygen Check - Completed (G-RN-P/CP)

*7. Altimeter - Set 29.92 (P-CP-N)

*8. Level-Off Check - Completed (P-CP)

a. Taxi Lights - OFF

b. Oxygen & Station Checks

BOMBING

All bombing procedures and operational information are contained in Section VIII. Those procedures involving the pilots are prepared in such a manner as to be performed upon notification from the navigators. Therefore, no abbreviated checklists pertaining to bombing will be prepared for the pilots. A description of bombing equipment is given in Section IV.

DESCENT

The following procedures are for all letdowns where there is no range emergency and should be accomplished as follows:

WARNING

Care should be taken to retrim between each 2-unit increment of airbrake operation.

NORMAL DESCENT

1. Maintain cruising altitude until reaching the computed distance from the landing base. This distance will depend upon aircraft altitude and weight at the end of mission. The performance data for this descent may be determined from Part 8 of the Appendix.

2. Lower the landing gear and retard all throttles to the IDLE stops. Observe the gear extension placard limits in Section V.

3. Extend airbrakes to position 4 or as required.

4. Make descent at 240 KIAS or Mach .75, whichever is slower.

NOTE

Rate of descent may be varied (by airbrake position) but do not exceed 6000 fpm.

ENROUTE DESCENT

1. Enroute descents using the guidelines of AFM 51-37 may be made at the pilot's option.

2. Throttles idle, gear up, and airbrakes as necessary to provide desired airspeed and rate of descent to comply with ATC requirements for the particular enroute descent.

3. The many variables of an enroute descent will prevent precise calculations of range-time-fuel performance.

TACTICAL DESCENT

Assuming the descent will start from cruise altitude and airspeed, the initial task is to retard the throttles to idle and establish a nose-down attitude of approximately 10°. Extend airbrakes to position 6 in increments of 2, trimming to approximately zero stick force prior to raising the airbrakes to the next position. Maintain approximately zero stick force by continually trimming the aircraft during descent. Maintain approximately 10° nose-down attitude and a speed schedule of .84 Mach until reaching 305 knots indicated airspeed. Maintain 305 KIAS during the remainder of the descent. Close coordination between the pilot and copilot is required to insure that a transition is made from indicated mach to indicated airspeed. Pilot will coordinate with the navigator as to level-off altitude to be used for this maneuver. Initiate level off approximately 1000 feet above the desired level flight altitude by retracting airbrakes from position 6 to position 4 to position 2 and retrimming. Complete airbrake retraction at approximately 500 feet above the desired level flight altitude, retrim, and add power as required.

NOTE

● See "Altitude Call Procedures" in Section VIII.

● If turbulence is encountered such that the airspeed indicators are hard to read, hold a 10° nose-down attitude until the turbulence has been penetrated. Aircraft attitude should not exceed 12° nose down.

PENETRATIONS

See "TYPICAL DESCENTS AND PENETRATIONS" in Section IX.

DESCENT AND LANDING CHECKLIST (Copilot/EW reads)**NOTE**

- To preclude the possibility of pilot distraction, this checklist should be completed through step "11" prior to descent.
- To conserve fuel, descent should be conducted with minimum use of drag devices (landing gear and airbrakes).

1. Bleed Selector Switch - NORMAL LH INBD (CP)

Check bleed selector switch in NORMAL LH INBD prior to descent below 25,000 feet.

2. EVS - ON, video and stabilization selected (P-CP)

Depress EVS power switch to ON. Pilot and copilot should both select EVS sensor with best display and vector stabilization.

3. Penetration & Approach - Reviewed (P-CP-RN-N)

Obtain approach, landing weather, compare forecast versus reported altimeter setting, and review the planned penetration and approach. This review will include navigation aid frequencies, minimum and emergency safe altitudes, descent rates, minimums for the approach to be flown, missed approach procedures, and aerodrome sketch. As a minimum the pilot flying the approach will brief the crew on the descent rate, MDA/DH/VDP and missed approach procedures for the planned approach. Lost communications procedures will be coordinated if required. During the descent and approach, other crewmembers will back up the pilot flying and report any deviation from prescribed procedures.

Active Runway _____ Wind _____ Temp _____

PA _____ RCR _____ Ceiling & Vis _____

RVR _____ Altimeter _____

Forecast Altimeter _____ Dest _____

Alt _____

4. Radar Altimeter Cursor - Set (P-CP)

Both pilots will set their radar altimeter cursors to 2000 feet. After passing 2000 feet, the pilot flying the aircraft will set his radar altimeter cursor to the HAA/HAT for the approach being flown. The pilot not flying the aircraft will set his radar altimeter cursor to 100 feet above the HAA/HAT for the approach being flown.

5. Landing Data - Computed and checked (CP-N)

Compute gross weight and best flare speed for planned airbrake position. Adjust best flare speed indicator so that the operating weight plus expendable stores is at the zero point on the total fuel quantity gage. The weight and airspeed value that is adjacent to the needle on the totalizer is the gross weight and the best flare speed for that weight with airbrakes in position 4. As fuel is consumed, the total fuel quantity gage pointer will point to the aircraft gross weight and the corresponding best flare speed for airbrakes in position 4. Check landing data card and recompute required items.

6. Nav Mode Select Switch - VOR/TACAN (P-CP)**7. Fuel Panel - Switches 1, 2, 3 & 4 ON; 9, 10, 11 & 12 OPEN; 13, 14, 15 & 16 CLOSED (CP) Checked (P)**

DESCENT AND LANDING CHECKLIST (Copilot/EW reads) (Cont)

Establish a fuel management configuration of main tanks to engines (switches 1, 2, 3, and 4 ON; 9, 10, 11, and 12 OPEN; 13, 14, 15, and 16 CLOSED).

NOTE

If auxiliary fuel usage is desired, it will be transferred directly into main tanks through the main manifold. See "Wing Flutter Airspeed Limitations," Section V, for speed restrictions associated with use of auxiliary fuel in various aircraft missile configurations. Auxiliary fuel will be used in order of omitted steps.

Following descent, with fuel level in main tanks 1 and 4 above the green band area, close crossfeed valve switches 9, 10, 11, and 12. For takeoffs, transition, low approaches, and landings, with fuel level in main tank 1 or 4 in the green band area, open crossfeed valve switches 9, 10, 11, and 12. In addition, when any main tank is down to 5,000 pounds, open crossfeed valve switches 9, 10, 11, and 12.

WARNING

Failure to accomplish prescribed fuel panel settings with fuel level in main tanks 1 or 4 in green band area or when any main tank is down to 5,000 pounds can provide a potential for engine flameout during a critical phase of flight.

8. Anti-Icing Switches - Climatic (P)

If suspected icing conditions exist in the descent area, turn ON the engine, nacelle, and scoops anti-icing switch prior to descent and check for a noticeable drop in EPR on all engines at time of switch actuation to indicate operation of the system.

9. (Deleted)**10. Lights - ON (P/CP)**

Turn landing, taxi and crosswind landing lights on for night or day operations unless reflection reduces pilot visibility.

11. Autopilot - Disengaged (P/CP)

Autopilot will be disengaged for penetration.

12. Altimeter - Set _____ (P-CP-N)

Reset altimeters to station pressure immediately prior to initiating penetration or upon passing through transition altitude.

13. Landing Gear - DOWN (if required), six down (P-CP)

The landing gear may be lowered at the pilot's discretion during an enroute descent or a published penetration depending upon the rate of descent required. Copilot moves landing gear lever to GEAR DOWN and checks for positive engagement of the pawl in the gear down detent by forcibly and positively pushing in on the landing gear handle after the handle is in GEAR DOWN. Copilot checks operation of the landing gear warning light. Both pilots check that the warning light is out, and that all six gear indicate down and locked.

CAUTION

To prevent system damage, if any gear fails to indicate down and locked, do not recycle the landing gear system prior to initiating emergency procedure.

14. Throttles - Set (P)

DESCENT AND LANDING CHECKLIST (Copilot/EW reads) (Cont)**15. Airbrakes - Set (P)**

Except for enroute descent, the airbrake lever will normally be set at position 4; however, airbrakes may be used as required.

16. Starter Switches - Climatic (CP)

When descending under possible inlet icing conditions, starter switches should be placed in START and remain in START until sufficient power for anti-ice heat has been reestablished and stable engine operation obtained. When landing is anticipated under inlet icing conditions, starter switches should be in START prior to final power reduction.

CAUTION

Insure that the starter switches for engines which have been shut down are off and remain off for the remainder of flight unless intentional engine air starting is accomplished.

17. Wing Flaps - 100%, lever down (CP)

Allow aircraft to decelerate to 220 knots IAS. Copilot extends flaps at the request of the pilot and monitors flap indicator to ascertain both flaps are extending simultaneously. Copilot reports when the flaps are 50% and full down. Flap lever will be left in DN position. Flap extension time is 60 seconds. Flaps may be extended during the penetration descent as required.

CAUTION

If flaps fail to start moving within 10 seconds, wing flap operation should be discontinued to prevent damage to the flap drive system. See "Flap Limitations," Section V.

NOTE

If a flaps-up landing is required, discontinue use of this checklist and refer to "Landing With Wing Flaps Up" checklist, Section III.

18. Fuel Panel Switches - 9, 10, 11 & 12 OPEN/CLOSED (CP); Checked (P)

- a. 1 & 4 Above Green Band - 1, 2, 3 & 4 ON; 9, 10, 11 & 12 CLOSED; 13, 14, 15 & 16 CLOSED (CP) Checked (P)
- b. 1 or 4 in Green Band - 1, 2, 3 & 4 ON; 9, 10, 11 & 12 OPEN; 13, 14, 15 & 16 CLOSED (CP) Checked (P)

NOTE

Copilot computes minimum landing gross weight with lateral unbalance if significant wing fuel disparities exist.

19. Best Flare Speed _____ Knots - Rechecked (CP-N)

Copilot reads best flare speed for airbrakes position 4 from best flare speed indicator, or computes for other airbrake positions, and cross-checks airspeed indicator with pilot's indicator. Best flare speed for airbrake position 4 is approximately 15 knots above the minimum touchdown speed. Minimum touchdown speed is the same value as unstick speed and provides a 7- to 12-knot margin above initial stall buffet speed. Navigator cross-checks the speed.

DESCENT AND LANDING CHECKLIST (Copilot/EW reads) (Cont)

20. Landing Gear - Down, six down (P-CP)
21. Crosswind Crab - Set, knob down (CP) Checked (P)

Obtain wind direction and velocity. Compute and set crosswind crab as required. If crosswind crab is not to be used, knob and position indicator must be checked for zero setting and gear position. Pilot checks crosswind crab position indicator for the proper setting.

CAUTION

If wheel brakes are applied immediately before and held during touchdown when the main gear is turned more than 14° (by any combination of crosswind crab setting and steering), the airplane will land with wheels locked because the antiskid system is inoperative in this condition. When the landing gear is turned, the landing gear centering cams compress the landing gear. At more than 14° from center, the landing gear is compressed enough to actuate landing gear safety switches as if the airplane were actually on the ground. The antiskid system (which is tied into the landing gear safety switches) allows the wheels to be locked when the airplane is on the ground and not moving. Releasing the brakes will activate the antiskid system.

22. Target Trim - Noted (P/CP)

When aircraft is established on final approach in landing configuration (landing gear and flaps down and airbrakes in planned position) at best flare speed plus 10 KIAS, pilot not flying the aircraft will note the stabilizer trim setting for zero stick force. He will call out this value as target trim during an approach with airbrakes in position 0 or 2. For an approach with airbrakes in position 4 or 6, he will compute a trim value two units in the nose up direction from that noted and call out this computed value as target trim.

NOTE

- It is preferable to note stabilizer trim while in straight and level flight. In VFR traffic patterns or situations where it is not readily feasible to establish straight and level on final approach, the stabilizer trim target setting during descent may be used provided rate of descent does not exceed 1000 feet per minute.
- If the stabilizer trim (computed target trim value) is not within the specific range (1.5 to 3.5 units nosedown) or when conditions prohibit landing in the above configuration, gross weight of 325,000 pounds or less, and airbrakes position 4, the 'cg' must be computed by use of the "Approximate CG Location Landing Configurations" chart or the load adjuster.

23. Landing Check - Completed (P/CP)

- a. Gear
- b. Flaps
- c. Airbrakes 4 or as required
- d. Lights

A check of the above items will be made when established on final.

BEFORE LANDING

The before landing procedures are given in the "Descent and Landing" checklist.

APPROACH

Since conditions at airports are continually changing, the landing approach techniques must be varied to meet existing conditions. In general, a normal landing pattern can be used. With full airbrakes, the gliding angle is approximately the same as that for a propeller driven aircraft.

APPROACH PROCEDURE (VISUAL PATTERN)

Referring to figure 2-14, the downwind leg is entered at the altitude specified in applicable regulations. The "Descent and Landing Checklist" will be completed at this point and the airspeed reduced to 30 knots above computed best flare speed. The turn from downwind leg will be descending 90° turn to base leg with a reduction in airspeed and altitude. Roll out to a wings-level attitude while descending on base leg for sufficient duration (approximately 10 seconds) to allow for visual clearance of other aircraft in all directions. Maintain 20 knots above computed best flare speed until starting turn to final approach. A 90° descending turn to final approach will then be initiated and, at the completion of roll-out on final approach, the airspeed will be 10 knots above computed best flare speed, minimum altitude as specified in applicable directives. A 30° bank will be the maximum allowable in the traffic pattern. The 10 knots above best flare speed will be maintained until the flare point is reached. As the flare point is reached and the aircraft is rotated for landing, the throttles will be retarded so as to cross the end of the landing runway at best flare speed. After touchdown, the airbrakes should be fully extended and the drag chute deployed.

NOTE

- During the approach and landing, the copilot should monitor the altitude and airspeed. Warn the pilot when above or below safe altitude or airspeed, or whenever the angle of bank exceeds recommended values.
- Pitch response of the aircraft becomes more sensitive with aft center of gravity conditions particularly in the landing gross weight range. In lightweight aft cg landings, there may be a tendency to flare high and hold the aircraft off the runway in a higher than normal nose up attitude due to lower stick force characteristics and reduced requirements for stabilizer trim during landing flare.
- If a crosswind leg is flown, the aircraft will be rolled out to a wings-level attitude on the crosswind leg for sufficient duration to permit visual clearance of other aircraft in all directions.

- The pilot's and/or copilot's sliding window may be opened at normal traffic pattern speeds and maneuvers provided all hatches are in place. If a hatch has been released, the opening of a sliding window should be avoided as inward acting airloads may cause the window to blow into the cabin area.

Heavy Weight Landing

It is possible to make landings at any weight up to the maximum gross weight as long as rates of descent at touchdown are limited. (See "Weight Limitations," Section V.) Since most landing experience will have been obtained at gross weights less than 290,000 pounds, landings below this weight will be considered a routine operation. If it becomes necessary to land the aircraft above 290,000 pounds, normal landing techniques may be used up to approximately 325,000 pounds. If it should become necessary to land the aircraft above 325,000 pounds gross weight, the following techniques are recommended:

1. Use airbrake position 1. Approach speed will be 10 knots above the airbrake position 1 best flare speed. The slower approach and flare speed with airbrakes 1 will give less flare distance. The danger of a hard landing will also be less because of the slower deceleration when using airbrakes 1.
2. Intercept the approach path farther out than usual. Maintain a fairly normal approach slope with rates of descent on the order of 500 fpm. Plan to arrive over the end of the runway at the best flare speed at a lower altitude than for a normal landing.
3. Reduce thrust cautiously during the landing flare to insure that the rate of descent is controlled. The key to a good heavy weight landing is not the attitude but the speed control using thrust after crossing the end of the runway. The aircraft may settle very rapidly if thrust is suddenly reduced.
4. The landing attitude will be considerably more nose down than for a normal landing because the airbrakes are at 1. For a typical normal weight landing with No. 4 airbrakes, the fuselage will be approximately 2° to 3° nose up at the minimum touchdown speed. For a heavy weight landing with airbrakes 1, the fuselage will be approximately 0° to 1° nose up.

To determine approach speeds and to estimate flare and runway stopping distances, refer to Part 9 of the Appendix.

Airbrakes

The airbrakes are operated by a throttle-type control located next to the throttle quadrant. The aircraft noses up when airbrakes are extended. Although the trim change can be handled by elevator use, retrimming should be accomplished after each position change. Position 4 should be used for landings at gross weights below 325,000 pounds, and airbrakes position 1 above 325,000 pounds gross weight. When

a reduced thrust condition is encountered, airbrake position 2 may be selected instead of position 4 to preclude excessive drag due to airbrakes. Any airbrake position from 0 thru 6 may be used for an approach and landing under unusual conditions. If changes in airbrake position are made on final approach, the change in trim requirements must be observed, particularly between airbrake positions 2 and 4. Airspeeds flown must be based on the actual airbrake position used during final approach. The airspeed versus airbrake position relationship becomes critical at the start flare point due to the change in trim and in airspeed bleed off with various airbrake settings. Therefore, final airbrake selection should be made to allow stabilization at the proper airspeed and trim condition prior to the start flare point. Best flare speed for airbrake position 4 is approximately 10 knots faster than the no airbrake best flare speed and for airbrake position 2 is approximately 5 knots faster than the no airbrake best flare speed. Regardless of airbrake position utilized for approach, a normal glide path (2.5° to 3.0°) should be established as early as practical on the final approach. The minimum touchdown speed is not changed regardless of the amount of airbrake extension, although there is some change in landing attitude. Using full airbrake extension changes the touchdown attitude to such an extent that at minimum touchdown speed the aircraft will touch down rear gear first with the front gear about one-third of a wheel diameter in the air. Touching down all wheels simultaneously with airbrakes fully extended will add 11% to the minimum touchdown speeds. Stalling speeds are not affected by airbrake position. With practice, airbrakes can be used to a great extent to vary the approach and landing pattern, to steepen the final approach, or to reduce airspeed rapidly.

NOTE

If touchdown is to be made with full airbrakes, maintain higher approach speed to the flare point. Refer to Part 9 of the Appendix for precise best flare speeds with full airbrakes.

Minimum Speeds

The minimum recommended airspeeds at which the aircraft should be flown in straight flight with flaps either up or down are given in figure 2-13. It must be remembered that in turns, the minimum speeds must be increased from those shown.

WIND SHEAR

Wind shear is a complex phenomena that can adversely affect the aircraft in all phases of flight, but is most critical during the approach and landing phase. Wind shear can exist as a rapid change

in wind velocity and direction as well as vertical air movement. There are many factors which influence or contribute to a wind shear condition. As a general rule, the amount of wind shear is greater ahead of warm fronts, although the most common occurrences follow the passage of cold fronts during periods of gusty surface winds. When a temperature change of 10°F or more is reported across the front, or if the front is moving at 30 knots or more, conditions are excellent for wind shear. In addition, when thunderstorms are present in the area of intended landing or a strong temperature inversion is near the ground, the possibility of encountering wind shear is increased.

1. Wind shear effects. The thrust required, vertical velocity, and pitch attitude on final approach, used in conjunction with the wind reported on the ground, provide an indication of potential wind shear. Be alert for:

a. Unusual changes in airspeed and rate of descent followed by corresponding changes in glide slope and pitch attitude.

b. An unusually high or low power setting required to maintain airspeed. Caution must be exercised in initial reductions of thrust and pitch to avoid a steep glide slope intercept in a low power, high sink condition.

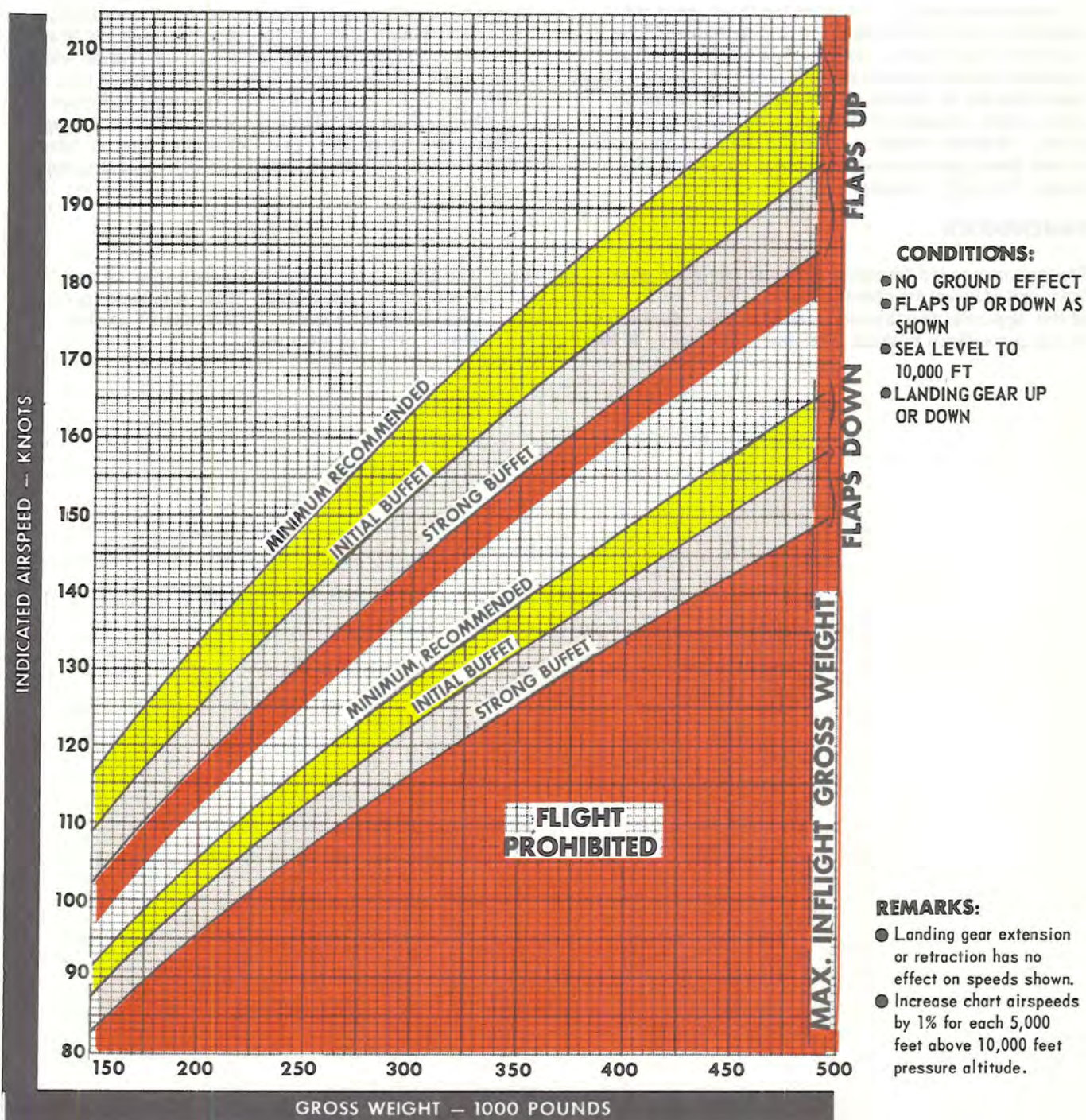
2. Wind shear phenomena. The following are two wind shear phenomena that are commonly found during final approach:

a. Decreasing Headwind. Initial reaction of the airplane when encountering a decreasing headwind (or an increasing tailwind) is a drop in Indicated Airspeed and a decrease in pitch resulting in a loss of altitude. If the wind shear occurs at low altitude, the pilot must add power and increase pitch to regain the proper glidepath. In severe conditions, higher than normal thrust and higher than normal pitch attitudes may be required to maintain the proper descent profile.

b. Increasing Headwind. The initial airplane reaction to an increasing headwind (decreasing tailwind) is an increase in indicated airspeed and an increase in pitch resulting in a gain in altitude. The pilot should reduce pitch and power to regain the proper glidepath. Caution must be exercised in initial reductions of thrust and pitch to avoid a steep glide slope intercept in a low power, high sink condition. This could result in the airplane landing well short of the intended touchdown point.

WARNING

If the airplane becomes unstable on final approach due to wind shear and the approach profile cannot be promptly reestablished, a go-around should be immediately accomplished.



Minimum Speeds—Low Altitude

Figure 2-13.

LANDING

LANDING WITH GUSTY WIND CONDITIONS

It is not necessary to increase the final approach speed for gust velocities up to and including 15 knots. For gust velocities in excess of 15 knots, the final approach speed should be increased two-thirds of the gust velocity in excess of 15 knots. For example, with a wind velocity of 20 knots with gusts to 50 knots, 10 knots would be added to the final approach speed (total gust velocity 30 knots; $30 - 15 = 15$ knots; $15 \times 2/3 = 10$ knots).

TOUCHDOWN

The recommended touchdown is with the rear gear first at minimum touchdown speed. Refer to Part 9 of the Appendix for landing speeds. This allows for an adequate flare without a bounce. However, if the

forward gear is too high when the rear gear touches, a hard landing may result. Full airbrakes should be applied immediately after touchdown provided there is no bounce. With the antiskid system operative, the wheel brakes may also be applied immediately after touchdown although this decreases brake service life. The runway available will determine when the wheel brakes should be applied. The normal landing charts in Part 9 of the Appendix show the landing ground roll distances with wheel brakes applied at 90 knots IAS. See "Minimum Run Landing," this section, for more details on use of brakes and drag chute.

NOTE

The front gear is well forward of the cg and if allowed to touch down first, a bounce is almost certain to occur. This usually is the result of too much speed.

CROSSWIND LANDING**NOTE**

- Sustained runway wind velocity plus one-third of the gust factor will be used to compute crosswind crab settings when landing with gusty wind conditions.
- If a crosswind cannot be compensated for by use of the crosswind crab system, a landing is not recommended.
- If the wind is a variable wind, the average heading of this variable wind should be used.

Prior to or during the time the aircraft is in the traffic pattern, a decision must be made as to whether or not the crosswind crab system is to be used. After obtaining the wind direction and velocity from the tower located at the field at which the landing is to be made, compute the crab angle for the wind and landing gross weight.

CAUTION

If wheel brakes are applied immediately before and held during touchdown when the main gear is turned more than 14° (by any combination of crosswind crab setting and steering), the aircraft will land with wheels locked because the antiskid system is inoperative in this condition. When the landing gear is turned, the landing gear centering cams compress the landing gear. At more than 14° from center, the landing gear is compressed enough to actuate landing gear safety switches as though the aircraft were actually on the ground. The antiskid system (which is tied into the landing gear safety switches) allows the wheels to be locked when the aircraft is on the ground and not moving. Releasing the brakes will activate the antiskid system.

With Use of Crosswind Crab System

Smooth landings can be made through use of the crosswind crab system even though crosswinds of high velocity are encountered. Such landings also require very little additional effort from the pilot. Touching down with the aircraft in a crabbed attitude may seem strange the first few times such landings are tried, but this technique is easily learned by the pilot.

CROSSWIND CRAB SETTING. After voice radio contact has been established with the tower, obtain the runway surface wind and direction. The most accurate wind measurements are obtained close to the ground. Limited experience indicates that 50% of tower values closely approximate runway winds. If only uncorrected tower wind values are used, it is recommended that the crab setting be established using 50% of tower values. From this data, determine the crosswind crab setting to be used in landing by reference to the chart in Part 9 of the Appendix. After the landing gear has been extended, turn the crosswind crab control knob until the miniature aircraft and pointer on the indicator point to the crab angle setting determined for the wind and gross weight. Extend the flaps, raise airbrakes to position 4, and control the airspeed in the same manner as for a normal approach. After rolling out onto final approach and after the aircraft is crabbed into the wind to establish a flight path straight down the runway, recheck the position of the miniature aircraft and pointer on the crosswind crab control indicator. The nose of the aircraft, as well as the nose of the miniature aircraft and pointer on the indicator, should always be pointed off the runway into the direction of the wind component. Lower the crosswind crab control knob after the crab setting has been established.

CAUTION

If rudder trim is used on landing, be certain that the crosswind crab control knob is not turned instead of the rudder trim knob since they are located concentrically.

NOTE

The upper and lower pointers on the crosswind crab position indicator may show a difference in heading once crosswind trim is established. This condition is normal and is caused by the fact that only the forward gear are steerable and operate even when set for crosswind conditions. As a result, any rudder pedal deflections will show up as a difference in indication between the two pointers.

LANDING ROLL. After the aircraft is on the runway, more and more lateral control will be required to hold the wings level as the speed decreases. If difficulty is encountered in maintaining track down the runway at low speeds, the control wheel should be centered since an asymmetric spoiler condition

will cause an unfavorable turning force. Do not change the crosswind crab setting until the aircraft is ready to turn off the runway. Under slippery runway conditions, the crosswind crab setting will help to maintain steering control. The crosswind crab system is not normally used to steer the aircraft on the ground.

NOTE

- When landing under conditions of high crosswinds, light gross weights, and a slippery runway, loss of steering may result. For further information, see "Landing With Crosswind on Slippery Runways" under "Ice and Rain," Section IX.

- Be alert for indication of a missetting of crosswind crab at touchdown. Corrections should be accomplished by normal rudder pedal steering. Do not use the crosswind crab control knob for steering except in an emergency. On very smooth landings, a missetting of the crosswind crab will not immediately manifest itself by the aircraft diverging off either side of the runway; the first indication of incorrect setting will be a deceleration force due to tires scuffing.

Without Use of Crosswind Crab System

If the crosswind crab system is not to be used because of a malfunction, the landing may be made by approaching fully crabbed with rudder and lateral controls centered. If desired, a combination of crabbing into the wind and a slight lowering of the upwind wing may be accomplished, but the wing should not be lowered to such an extent that the tip gear touches the ground first upon landing. Touchdown in the crabbed attitude with normal landing rates of descent will not induce detrimentally high side loads on the landing gear since the gear is lightly loaded at this time. By landing rear gear first, the aircraft will tend to pivot about the rear gear and thereby reduce the crab angle by the time the forward gear touches. Full airbrakes should be applied and the drag chute may be deployed at touchdown since forward gear steering will be adequate by the time the drag chute becomes effective.

MINIMUM RUN LANDING

The approach for a minimum run landing should be planned so as to arrive over the end of the runway with the throttles at IDLE and at a speed as close to best flare speed as possible. A minimum run landing is accomplished by having the brake antiskid system operative, deploying the drag chute, using full airbrakes after touchdown, applying wheel brakes immediately after touchdown, and continuing to apply brakes throughout the landing roll. The drag chute provides considerable deceleration force over the

first portion of the landing roll while the wheel brakes have a small decelerating effect because the wheels are lightly loaded. As the aircraft decelerates, the drag chute becomes less effective while the brakes become more effective.

CAUTION

All landings should be planned from a landing distance standpoint as though the drag chute were not installed. The chute should be considered only an aid to braking and a means of reducing tire and brake wear.

WHEEL BRAKE APPLICATION

Each wheel is equipped with a complete brake anti-skid assembly, eight units per aircraft. Therefore, when one wheel approaches a skid and the brake pressure is released by the skid detector, no other wheel brake assembly is affected. Regardless of this desired feature, however, the wings should be held as near level as possible during the landing roll so that all wheels are on the ground. If the wings are not level, the high tire on each landing gear becomes lightly loaded causing a loss in braking effectiveness because of the limited braking torque on the heavily loaded wheels. Maximum braking effectiveness with antiskid operative is obtained by depressing the rudder pedals fairly hard and letting the individual brakes cycle as required to prevent skids. Application of a fairly hard force on the brake pedals will result in the heavily loaded wheels being cycled at a slower and more desirable rate, while the lightly loaded wheels are cycled quite rapidly. This cycling can be felt by the pilot and becomes quite noticeable, especially if several of the gears cycle on and off at approximately the same time. If several of the gears do start to cycle in unison and cause a violent vibration, the pedals should be released momentarily and then reapplied. The difference between conventional braking and use of antiskid is that with antiskid operating, the brakes can be applied earlier in the landing roll and maximum braking can be maintained throughout the entire roll without excessive tire wear due to skids. On slippery surfaces at low taxi speeds, wheel deceleration is very fast when brakes are applied and skid signals are generated more frequently releasing brake pressure before a locked wheel occurs. Aircraft deceleration is not felt by the pilots because of the fast cycling of the antiskid system. However, the use of antiskid under these conditions is the recommended procedure since attempting to brake without it results in greater stopping distances. See "Touchdown," this section, and Part 9 of the Appendix for maximum rolling speeds for brake application. For brake energy limits, see figure 5-12.

DRAG CHUTE DEPLOYMENT

Normally, the drag chute will be deployed on all landings. The drag chute should be deployed only after touchdown. The time required for the drag chute to open is about 4 seconds after the drag chute lever is pulled to the DEPLOY position. It is not recommended that the drag chute be deployed during the flare while the aircraft is floating since there is a tendency for the aircraft to pitch up or down depending on the speed and to drop in due to rapid deceleration. See Section V for drag chute limitations.

CAUTION

- Dragging the chute along the runway causes considerable wear on the chute suspension lines and canopy. If possible, keep engine thrust high enough at the lower ground run speeds to hold the chute off the ground until the aircraft can be turned off the runway. Request the ground crew to stand by to retrieve the chute as soon as the aircraft is clear of the runway and the chute is jettisoned.
- During prevailing surface winds of 15 knots or greater, do not turn more than 90° away from the wind while drag chute is deployed.

NIGHT LANDING

The procedures and techniques used for a night landing are the same as those used for a normal day landing. In addition, the terrain clearance light may be used at the pilot's discretion.

OBSTACLE CLEARANCE LANDING

The distance to touchdown after clearing a 50-foot obstacle with full flaps is shown on charts in Part 9 of the Appendix. If a relatively high altitude must be maintained to clear some obstacle located within the traffic pattern, a steeper approach must be made after clearing the obstacle. A normal approach with full flaps and airbrake lever in position 4 is made with sufficient altitude to clear the obstacle. If a steeper approach is desired, airbrakes position 6 may be used. Should the obstacle be located close to the end of the runway, it may be necessary to place the airbrake lever in position 6 and steepen the approach before passing over the obstacle. In this case, the pilot should approach at a sufficiently high altitude to assure clearance with the steeper approach. If full airbrakes are used, the rate of descent will be higher than normal and the flare will have to be started earlier.

NOTE

If touchdown is to be made with full airbrakes, maintain higher approach speed to the flare point. Refer to Part 9 of the Appendix for precise best flare speeds with full airbrakes.

LANDING CHECKLIST

Accomplish after touchdown (need not be read)

1. Airbrake Lever - Position 6 (P)
2. Drag Chute Lever - DEPLOY (CP)

Drag chute will be deployed on pilot's command. In the event a go-around is not anticipated and the drag chute does not deploy, do not jettison the drag chute. This will permit the cause of the malfunction to be determined during the "Postflight Inspection." See Section V for drag chute limitations.

3. Wheel Brakes - Checked (P)

After establishing a stable ground roll, brakes will be checked for operation followed by intermittent application of brakes as required.

4. Hydraulic System - Checked (P)

Check all hydraulic pump out lights off.

5. Crosswind Crab Control Knob - Centered (P)
6. Starter Switches - OFF (CP)

LANDING CHECKLIST (Cont)**7. Steering Ratio Selector Lever - TAXI (P)****CAUTION**

Center the rudder pedals before repositioning the steering ratio selector lever. Actuation of the lever when the rudder pedals are deflected could result in a dangerously abrupt change in steering angle.

GO-AROUND

The decision to make a go-around should be made as early as possible since jet engine acceleration time is relatively high and approach speeds are relatively close to touchdown speeds. Normally, this decision can be made prior to touchdown. As soon as it has been decided to go around, increase thrust, retract airbrakes, trim as required, and, after it is certain that the aircraft will not touch the ground, retract the landing gear. The increase in thrust alone, depending on the airspeed and attitude of the aircraft, may require a considerable amount of nose down trim.

WARNING

- In cases where a go-around is initiated just prior to or during the landing flare and where adequate runway is remaining, it may be necessary to maintain a touchdown attitude, contact the runway, then retrim the aircraft during the ground run before initiating power application for a go-around.
- The decision to go-around or land on the remaining runway must remain with the pilot based upon all factors involved. However, if a situation is allowed to develop, which in the pilot's judgment, requires a go-around from a low airspeed/low altitude condition, the pilot must be extremely aware of the hazards of aircraft pitch up and the items affecting pitch control. An unscheduled go-around with a mistrim condition can occur where several other trim items occur simultaneously due to fuel shift, thrust, airbrakes, and ground effect. Each item can be controlled by the use of elevator alone. But when several of these items are combined the elevator, which is the primary flight control system, may not have sufficient authority, and additional authority must be obtained from the stabilizer or airbrakes. A 20° pitch attitude and strong buffet can easily occur in 3 seconds from which a recovery may not be possible. See "Go-Around" under "Flight Character-

istics Under Various Speed Conditions" in Section VI and "Go-Around With One or More Engines Inoperative" in Section III.

For pilot comfort and ease in flying, the thrust should be adjusted during climb to flap retraction altitude to a setting which will produce a rate of climb of approximately 1000 feet per minute. If thrust is reduced during this initial climb, it may be necessary to add thrust during flap retraction to maintain the desired speed schedule and to preclude loss of altitude. When aircraft reaches 1000 feet and 180 knots IAS, the flaps may be retracted. However, if a positive vertical velocity of 1000 feet per minute is not attained when reaching 1000 feet above the terrain, flap retraction will be delayed until an altitude of 1500 feet above the terrain is reached. During the flap retraction cycle, it is required that the pilot monitor his aircraft attitude as closely as possible keeping the aircraft trimmed to a zero stick force especially during the last 20% of flap retraction. (See figure 2-14 for a go-around pattern.) In case the decision to go around is not reached until after the aircraft is on the ground and the drag chute has not been deployed, additional nose down stabilizer trim will normally be required during the takeoff roll in order to keep the nose from pitching upward as soon as the wheels are off the ground.

WARNING

At gross weights above 220,000 pounds, a go-around should not be attempted if the drag chute has been deployed since it is possible that the drag chute may not jettison. The go-around then would be impossible. At gross weights up to 220,000 pounds, sufficient thrust is available to make a go-around successfully while pulling the drag chute. The climbout should be made at 10 knots above best flare speed for a go-around while pulling the drag chute.

NOTE

When go-around is accomplished during closed traffic pattern work, the pilot may, at his discretion, leave the landing gear and flaps down.

GO-AROUND CHECKLIST**NOTE**

If a go-around is required under low altitude/low airspeed conditions, pilots may not have sufficient time to refer to the checklist. Therefore, this checklist should be accomplished as necessary and need not be read. When a safe altitude and airspeed is attained, the pilots will review the checklist and complete required items.

1. Go-Around Thrust - Set (P)

The use of MRT is not normally required. A thrust setting of approximately NRT should provide the performance necessary, result in lower EGT's, and increase engine service life; however, to prevent distraction, the setting of precise EPR values is not required. An acceptable EPR value for NRT reference can be found by using the "Thrust Settings" chart in Part 4 of the Appendix and entering the chart using the OAT gage reading and the "0 MACH NUMBER" line or by using the EPR values for NRT climb found in the performance part of the abbreviated checklist.

WARNING

- Care should be exercised in applying power at light gross weights due to pitchup developing during acceleration. See "Go-Around," Section VI, for detailed discussion of this characteristic.
- If a go-around is initiated after starting landing flare, immediately counter the resultant pitching moment with nose down elevator. Throttles will not be advanced beyond the near vertical position without simultaneously resetting the stabilizer toward target trim. Failure to retrim during the thrust application phase of a go-around can result in pitchup, which combined with other pitch trim items, will exceed nose down elevator authority. Also, with asymmetrical thrust, power must not be applied faster than any generated roll-yaw problem can be controlled.

2. Airbrake Lever - OFF (P)

Pilot retracts airbrakes, levels off, and checks for a positive increase of airspeed.

3. Trim - As required (P)

At all times during go-around, pilot will make a conscious effort to keep the aircraft trimmed to zero stick force.

4. Landing Gear Lever - As required (P-CP)

On pilot's command copilot retracts the gear when it is established that aircraft will not contact the runway.

5. Thrust - Adjusted (P)

Pilot accelerates to desired IAS (best flare speed plus 30 KIAS or 180 KIAS) and adjusts thrust to establish a rate of climb of approximately 1000 fpm.

6. Wing Flaps - As required (CP)

Flaps will be retracted in a wings level attitude, using the normal speed schedule and in accordance with the flap retraction procedures outlined in the "After Takeoff-Climb Checklist," this section. If the flaps are raised to accomplish flaps up training, or if the pilots' intentions are to remain in the aircraft traffic area/terminal control area, accelerate to approach speed plus 30 KIAS.

NOTE

Accomplish "After Takeoff - Climb" or "Traffic Pattern" checklist, as applicable.

DOWNWIND LEG

ALTITUDE AS SPECIFIED — AIRSPEED 30 KNOTS
ABOVE BEST FLARE SPEED FOR AIRBRAKES
POSITION 4 (153 KNOTS IAS, 225,000 lb)

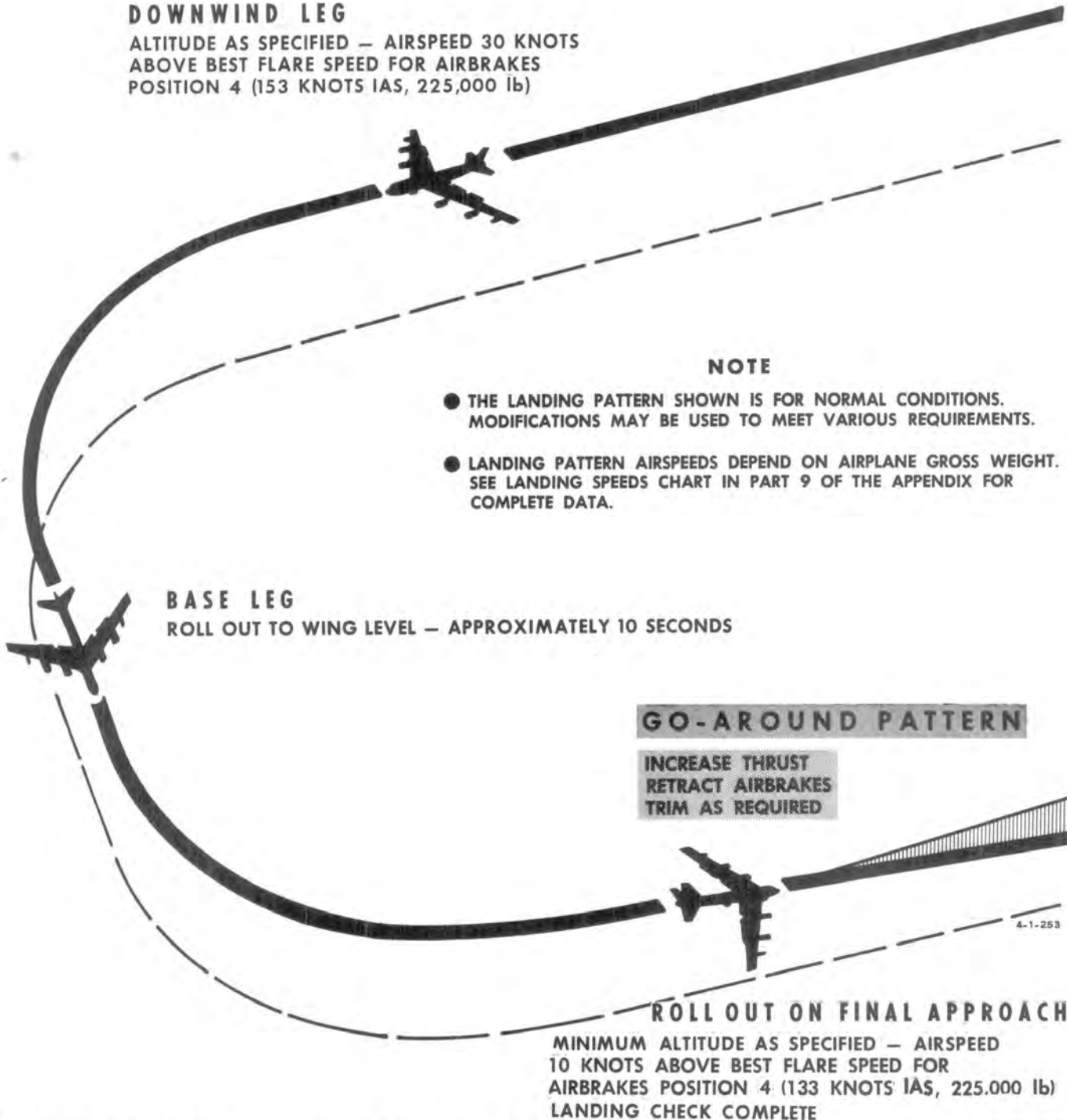
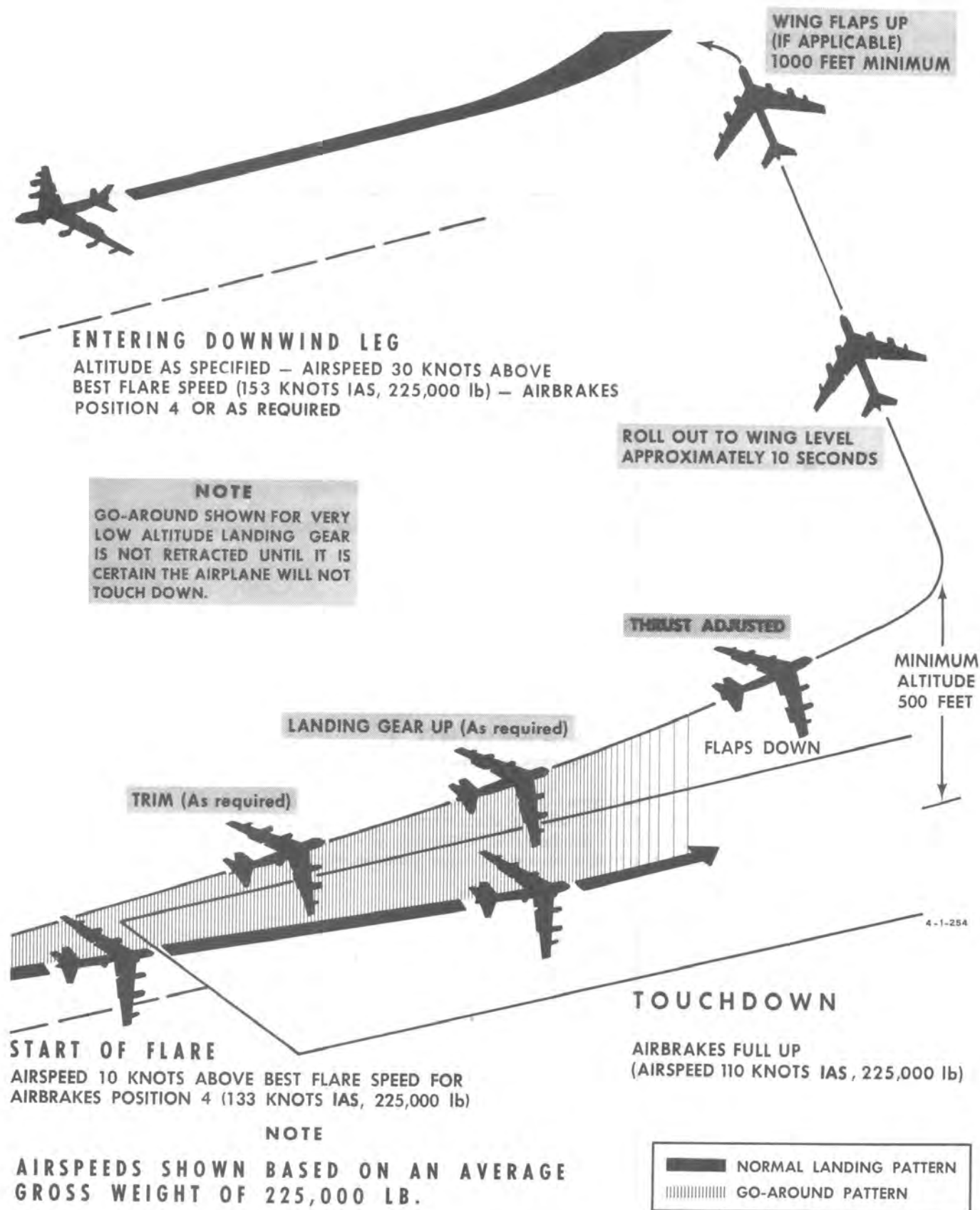


Figure 2-14. (Sheet 1 of 2).



■■■■■ Landing and Go-Around Patterns (Typical)

Figure 2-14. (Sheet 2 of 2).

TOUCH-AND-GO LANDING

Failure to lower airbrakes and retrim the aircraft will result in excessive pitchup immediately following unstuck. At any time that abnormal pitching tendencies are noted, stabilizer trim should be utilized immediately. Touch-and-go landings can normally be

performed within the limits shown on the "Touch-and-Go Landing" checklist unless additionally restricted by the major command concerned.

NOTE

See "Traffic Pattern Fuel Management," this section.

TOUCH-AND-GO LANDING CHECKLIST

NOTE

- While touch-and-go landings may be accomplished successfully under conditions more extreme than those listed below, in the interest of flying safety, they will not be performed when:
 1. Gross weight exceeds 290,000 pounds
 2. Crosswind crab control setting requirement is more than 8°
 3. Any spoiler is inoperative
 4. Any hydraulic system is inoperative due to loss of normal system pressure or when a hydraulic standby pump is known to be inoperative.
 5. Any time stab trim cannot be electrically set.
- Landing gear will remain down a minimum interval of 15 minutes air time prior to a touch-and-go landing after a taxi-back landing.
- This checklist will be reviewed prior to touch-and-go landings and need not be read while on the runway.

1. Airbrake Lever - Position 6 (P)
2. Stabilizer Trim - Reset (P/CP)

Pilot not flying the aircraft will position the stabilizer trim to target trim value noted and notify the other pilot that the trim has been reset.

WARNING

If the stabilizer is not reset prior to takeoff, the excessive amount of nose up trim will cause a pitchup after takeoff. Any pitch attitude changes following a takeoff will be countered immediately by continuous use of the stabilizer trim in addition to control column movement.

NOTE

The operation of the stabilizer trim mechanism during the ground roll of touch-and-go landings is considered to be an inflight procedure and inflight operation limitations will apply.

3. Airbrake Lever - OFF (P)

It is essential that the airbrake lever be returned to OFF before executing the takeoff following a touch-and-go to preclude an unexpected pitchup following takeoff.

TOUCH-AND-GO LANDING CHECKLIST (Cont)**4. Throttles - Advance (P/CP)**

The pilot performing the takeoff after a touch-and-go landing will advance the throttles to near vertical position of the quadrant allowing engines to accelerate and stabilize before any additional power is applied. Do not advance throttles beyond the vertical position until the pilot resetting stabilizer trim has verbally verified that the trim has been reset for takeoff. The use of MRT is not normally required. A thrust setting of approximately NRT should provide the performance necessary, result in lower EGT's, and increase engine service life; however, to prevent distraction, the setting of precise EPR values is not required. The pilot occupying the other seat will monitor the engine instruments and notify the pilot making the takeoff of any abnormal engine acceleration characteristics. Premature liftoff prior to unstick speed (minimum touchdown speed) can be hazardous since there is only a 7- to 12-knot margin between unstick speed and initial stall speed. Premature liftoff can only occur when stabilizer is mistrimmed and/or excessive back column is introduced prior to unstick. Accelerate to best flare speed plus 30 KIAS on climbout. An acceptable EPR value for NRT reference can be found by using the "Thrust Settings" chart in Part 4 of the Appendix and entering the chart using the OAT gage reading and the "0 MACH NUMBER" line or by using the EPR values for NRT climb found in the performance data part of the abbreviated checklist.

NOTE

Accomplish "After Takeoff - Climb" or "Traffic Pattern" checklist as applicable.

TRAFFIC PATTERN

Traffic pattern procedures are given in the "Traffic Pattern" checklist. Fuel system management pro-

cedures during traffic pattern operation are given in "Traffic Pattern Fuel Management", this section.

TRAFFIC PATTERN CHECKLIST (Copilot/EW reads)**1. Airbrake Lever - As desired (P)**

Airbrakes may be used as desired until on final approach when they will normally be Position 4.

2. Planned Approach - Reviewed (if applicable) (P-CP-RN-N)

Check the appropriate navigation aids tuned and identified and brief the planned approach with the applicable crewmembers. Altitude restrictions, descent rate, MDA/DH/VDP and missed approach procedures will be emphasized. Review if type approach/pilot changes.

3. Radar Altimeter Cursor - Set (P-CP)

The pilot flying the aircraft will set his radar altimeter cursor to the HAA/HAT for the approach being flown. The pilot not flying the aircraft will set his radar altimeter cursor to 100 feet above the HAA/HAT for the approach being flown.

4. Wing Flaps - 100%, Lever DOWN (CP)**5. Fuel Panel - 9, 10, 11 & 12 OPEN/CLOSED (CP); Checked (P)**

- a. 1 & 4 Above Green Band - 1, 2, 3 & 4 ON; 9, 10, 11 & 12 CLOSED; 13, 14, 15 & 16 CLOSED (CP) Checked (P)
- b. 1 or 4 in Green Band - 1, 2, 3 & 4 ON; 9, 10, 11 & 12 OPEN; 13, 14, 15 & 16 CLOSED (CP) Checked (P)

WARNING

Failure to accomplish prescribed fuel panel settings with fuel level in main tanks 1 or 4 in green band area or when any main tank is down to 5,000 pounds can provide a potential for engine flameout during a critical phase of flight.

TRAFFIC PATTERN CHECKLIST (Copilot/EW reads) (Cont)**6. Best Flare Speed - Checked (CP-N)**

Copilot reads best flare speed for airbrakes position 4 from best flare speed indicator or computes for other airbrake positions and cross-checks airspeed indicator with pilot's indicator. Navigator cross-checks the speed.

7. Landing Gear - DOWN; six down (P-CP)

Copilot checks gear lever in detent. Both pilots check that the gear warning light is out and that all six gear indicate down and locked.

8. Crosswind Crab - Set, knob down (CP) checked (P)**9. Target Trim - Noted (P/CP)****NOTE**

If the computed target trim value is not within the range of 1.5 to 3.5 units nosedown, a further check of aircraft center of gravity should be made by reference to the "Approximate CG Location Landing Configuration" chart at the specified conditions or the load adjuster.

10. Landing Check - Completed (P/CP)

- a. Gear
- b. Flaps
- c. Airbrakes 4 or as required
- d. Lights

A check of the above items will be made when established on final.

TAXI-BACK LANDING

Full stop taxi-back landings may be accomplished under the following limitations:

1. Aircraft gross weight will not exceed 270,000 pounds.
2. Touchdown will be accomplished in the first third of the existing runway to include the sterile portion of the approach end.
3. Planned landing ground run will not exceed 50% of the available runway exclusive of the sterile portion of the approach end.
4. After establishing a stable ground roll, brakes

will be checked for operation followed by intermittent application of brakes as required.

5. A minimum interval of 15 minutes air time will be established between landings or prior to retracting the gear to provide wheel and brake cooling.

6. If the first taxi-back landing accomplished is:

a. Above 250,000 pounds, a maximum of one full stop taxi-back landing may be accomplished on each sortie, followed by a final full stop landing utilizing the drag chute.

b. At or below 250,000 pounds, a maximum of four full stop taxi-back landings may be accomplished on one sortie. The fourth landing may be followed by a final full stop landing utilizing the drag chute.

TAXI-BACK LANDING CHECKLIST (Copilot reads)**NOTE**

Taxi-back landings may be accomplished using the following checklist and the "Traffic Pattern Checklist." Circled items of the taxi-back landing checklist will be accomplished whenever a change in crew positions(s) is made.

1. Airbrake Lever - Position 6 (P)
2. Wheel Brakes - Checked (P)

After establishing a stable ground roll, brakes will be checked for operation followed by intermittent application of brakes as required. Check all hydraulic pump out lights off.

TAXI-BACK LANDING CHECKLIST (Copilot reads) (Cont)

3. Crosswind Crab - Centered (P)
4. Steering Ratio Selector Lever - TAXI (P)
5. IFF - STBY (P)
6. Parking Brakes - Set (P)
7. Sliding Window - Open (P/CP)
8. Crew Equipment - On and adjusted (P-CP)
9. Windows and Hatches - Closed and locked (P-CP)
10. Seat, Rudder Pedals & Control Column - Adjusted and checked (P-CP)
11. Arming Lever Safety Pins (No. 1) - Removed (P-CP-EW-G)
12. Airbrake Lever - OFF (P)
13. Stabilizer Trim - Set to target trim for takeoff (P-CP)

NOTE

During ground operation of stabilizer trim mechanism, advance engines 4 and 5 to 82% rpm.

14. Control Surface Trim - Set (P)
15. Wing Flaps - 100%, lever down (P-CP)
16. Fuel Panel Switches:
 - a. 1 & 4 above Green Band - 1, 2, 3 & 4 ON (CP) checked (P)
 - b. 1 or 4 in Green Band - 1, 2, 3, & 4 ON; 9, 10, 11 & 12 OPEN (CP) checked (P)

NOTE

See "Traffic Pattern Fuel Management," this section.

17. Takeoff Data - Reviewed (P-CP-N)

Review EPR, S_1 speed, S_1 time, and S_2 speed. Procedures to be used in the event an emergency occurs during takeoff will be reviewed. Both pilots must have a complete understanding of actions to be taken if an emergency occurs prior to or after S_1 speed.
18. Radar Altimeter Cursor - Set 500 feet (P-CP)
19. Crew - Stand by for takeoff (P)
20. IFF - NORM (P)
21. Lights - ON (P/CP)

Turn landing, taxi and crosswind landing lights on for night or day operations unless reflection reduces pilot visibility.
22. Crosswind Crab - Set, knob down (CP) checked (P)

TAXI-BACK LANDING CHECKLIST (Copilot reads) (Cont)

23. Steering Ratio Selector - TAKEOFF LAND (P)
24. Throttles - Set (P-CP)
25. 70 Knots - Now (P)
26. Unstick (S₂) - Now (CP)
27. Stabilizer Trim - Monitor (CP)

AFTER LANDING

The after-landing check shall be performed after the aircraft has been turned off the runway. Hard taxi braking or riding the brakes shall be avoided at all

times, particularly after a landing or refused takeoff. See "Wheel Brake System Operation," Section VII, and "Brake Energy Limits" chart (figure 5-12), Section V.

AFTER LANDING CHECKLIST (Copilot reads)

1. Lights - OFF (if applicable) (P/CP)

Turn landing, taxi and crosswind landing light switches OFF or as necessary for taxi operations.

2. Drag Chute Lever - JETTISON (CP)

The drag chute will be jettisoned and the control handle returned to LOCKED by the copilot after the airplane has turned off the runway and prior to being stopped for completion of the "After Landing Checklist."

CAUTION

To prevent or minimize damage to aircraft structure as the drag chute disconnect link strikes it during the jettison sequence, jettison the chute at the lowest taxi speed that will keep the chute inflated.

3. Parking Brakes - Set (P)
4. Yaw & Pitch SAS Switches - DISENGAGE (P)
5. Rudder/Elevator Hydraulic Switches - OFF (P)
6. IFF - Mode 4, zero, then A, master switch OFF (P)

Zeroize the mode 4 and turn the IFF off as soon after landing as possible. This will ensure removal of the mode 4 code and eliminate signals from taxiing or parked aircraft which would otherwise block the controllers scope and interfere with the control of airborne aircraft.

NOTE

If it is desired to retain the mode 4 code, momentarily place the mode 4 code switch to the HOLD position. Electrical power must be left on the aircraft a minimum of 15 seconds to lock the code in.

7. Pilot's Flare Set Power Switch - OFF (P)
8. Airbrake Lever - OFF (P)

AFTER LANDING CHECKLIST (Copilot reads) (Cont)

9. Stabilizer Trim - Reset to zero and CUTOUT (P)

NOTE

- During ground operation of stabilizer trim mechanism, advance engines 4 and 5 to 82% rpm.
- If snow and icing conditions necessitate leaving the stabilizer leading edge in the up position after parking, it may be set at this time. Procedures and CAUTIONS outlined under "Cold Weather Procedures," Section IX, will apply.

10. Arming Lever Safety Pins No. 1 - Installed (P-CP)
11. Armrests - Stowed (P-CP)
12. Starter Selector Switch - PNEUMATIC (CP)
13. Unnecessary Electrical Equipment: (P-CP)
- a. Liaison Radio, TACAN & Omni Power Switches - OFF
 - b. Mach Indicator Switch - OFF
 - c. Pitot Heat Switches - OFF
 - d. Windshield, Engine Anti-Icing & Defog Switches - OFF
 - e. Radar Altimeter - OFF
 - f. Autopilot Master Switch - OFF
14. Readiness Switch Cover - Closed, latched (P)
15. Generators 1 & 7 - OFF (CP)
16. Throttles 1, 2, 7 & 8 - 75% rpm, then CLOSED (P-CP)

While taxiing back to the ramp, advance throttles 1, 2, 7, and 8 to 75% rpm for not less than 15 nor more than 30 seconds before moving to CLOSED. This will insure complete scavenging of engine oil and prevent overservicing. This procedure will also prevent fuel from accumulating underneath the engines after shutdown. No. 6 engine may also be shut down if necessary to reduce taxi speed and still maintain sufficient electrical and hydraulic power for the aircraft.

NOTE

If the engine is allowed to idle for more than 27 seconds, the oil sump area will fill and the hydraulic reservoir air pressurization lines will accumulate condensation and require scavenging again. Moisture in the reservoir air pressurization lines can collect in the relief valves, freeze in cold weather, and prevent valve operation. Failure of the valves to function can cause partial to complete loss of brakes while taxiing for the next mission.

AFTER LANDING CHECKLIST (Copilot reads) (Cont)

17. Fuel Panel - Checked (CP)

Close all fuel valves not required.

18. Sliding Window - Open (P/CP)

Open sliding window approximately 2 inches to relieve cabin pressure.

19. Bomb Door Switch (nuclear and training missions only) - OPEN (P)

If weapons are aboard or have been released, bomb doors will not be opened until after parking.

ENGINE SHUTDOWN

CAUTION

Normally, an engine will be sufficiently cool after landing to permit an immediate shut-

down. If an engine has been operating at above 85% rpm for a period exceeding 1 minute after landing, allow the engine to idle at least 5 minutes before shutting down. This will prevent damage resulting from rapid temperature change.

BEFORE LEAVING AIRCRAFT

BEFORE LEAVING AIRCRAFT CHECKLIST (Copilot reads)

1. Parking Brakes - Set (P)
2. Anticollision & Navigation Lights - OFF and FLASH (CP)
3. EVS Power Switches - OFF (P-CP)
4. BNS and EVS - Off (RN)

CAUTION

The BNS, radar, and terrain computer power switch and all EVS sub-systems must be OFF to prevent power surge damage when switching from aircraft power to external power or if aircraft power is interrupted.

5. Air Conditioning Master Switch - OFF (CP)
6. Gyro Power Switch - OFF (P)

BEFORE LEAVING AIRCRAFT CHECKLIST (Copilot reads) (Cont)**7. Bomb Door Switch - OPEN (P)**

Bomb doors will be opened at this time if nonnuclear internal weapons were carried. Ground personnel must be on interphone and confirm that bomb doors are clear.

WARNING

If nonnuclear internal weapons were carried, the flight crew must visually check bomb bay prior to opening bomb doors.

8. Generators 3 & 5 - OFF (CP)**9. External Power - ON (if available) (CP)****WARNING**

When nonnuclear weapons are aboard, do not apply external power until shackle locking pins are installed.

10. Throttles - 75% rpm, then CLOSED (P)

Before shutting down any engines, advance throttle to 75% rpm to accomplish scavenging. Sufficient engine scavenging will be accomplished by not less than 15 nor more than 30 seconds of engine operation at 75% rpm. Move throttle to CLOSED within a few seconds after retarding throttle from the 75% setting.

NOTE

If the engine is allowed to idle for more than 27 seconds, the oil sump area will fill and the hydraulic reservoir air pressurization lines will accumulate condensation and require scavenging again. Moisture in the reservoir air pressurization lines can collect in the relief valves, freeze in cold weather, and prevent valve operation. Failure of the valves to function can cause partial to complete loss of brakes while taxiing for the next mission.

11. UHF Radios - OFF (CP)**12. Fuel Panel Switches - OFF or CLOSED (CP)****13. Oxygen System - OFF and 100% OXYGEN (P-CP)**

a. Oxygen Supply Shutoff Lever - OFF

b. Regulator Diluter Lever - 100% OXYGEN

c. Supply Hose - Disconnected and stowed

14. Wheel Chocks - In place (GC)**15. Parking Brakes - OFF (P)**

BEFORE LEAVING AIRCRAFT (Copilot reads) (Cont)

16. Light Switches - OFF or as required (P-CP)
17. Battery Switch - OFF (CP)
18. Control Columns - Stowed (P-CP)
19. Seat Positioning Switch - DOWN and TILT FWD (external power available) (P-CP)
20. Interphone Power Switch - OFF (P)

POSTFLIGHT**POSTFLIGHT CHECKLIST**

1. Brakes - Checked (CP)

The copilot will check for possible cold brakes. He will consider the conditions contained in "Brake Design" under "Wheel Brake System Operation" in Section VII before writing up a cold brake discrepancy.

2. Applicable Forms - Completed (All)

The pilot will assemble the crew to collect completed logs and forms and discuss items pertinent to the mission. The pilot will interrogate each crew member to determine the proper entries in all applicable forms to facilitate maintenance inspections.

- a. Record any limits and/or tolerances that have been exceeded during the mission.

NOTE

All entries shall include to the maximum extent possible, duration, degree and prevailing conditions for each occurrence.

- b. Record the occurrence of any of the following:

- (1) Stick forces in excess of 100 pounds.
- (2) If, in the pilot's opinion, the aircraft has encountered heavy loads due to turbulence (record highest and lowest accelerometer readings).
- (3) Flutter or buffet.

- c. Record any unusual or excessive operations such as:

- (1) Exceeding EPR by more than 0.10 during wet or dry power check prior to takeoff.
- (2) Failure to obtain charted EPR setting at full throttle or failure to obtain charted EPR values without exceeding the EGT limits.
- (3) Wing flap clutch slippage.
- (4) Jettisoning of drag chute or deployment of drag chute over 135 KIAS.

POSTFLIGHT CHECKLIST (Cont)

- (5) Long taxi runs at high speed.
- (6) Excessive braking during aborted takeoffs.
- (7) A live starter cartridge being carried in the starter breech during flight.
- (8) Landing or takeoff with wheel shimmy or hard vibrations.
- (9) Emergency descent or spoiler buffet being encountered.
- (10) Engine failure resulting in seizure or unbalance.
- (11) (Deleted)
- (12) Flight through lightning.
- (13) Hard landings (any landing with sink rate in excess of allowable limits).
- (14) Landings at gross weights over 400,000 pounds.
- (15) Wet takeoff with water impurities of 10 or more parts solids per million parts.
- (16) Contact of flaps with the fuselage.
- (17) Excessive tail shake and/or abnormal twisting of aft body or empennage.
- (18) Excessive dutch roll.

STRANGE FIELD PROCEDURES

If it is necessary to land the aircraft at an airfield where normal ground support is not available, there are several items which must be performed by the flight crew after parking the aircraft and prior to takeoff. To assist the flight crew in accomplishing these steps properly, the following checklists are provided:

NOTE

Refer to T.O. 1B-52G-30-2 for unscheduled landing procedures when AGM-69A missiles are aboard.

AFTER PARKING

1. Parking Ramp - Checked
The pilot should ascertain that the parking ramp is constructed to withstand the aircraft gross weight after refueling.
2. Wheel Chocks - In place
3. Landing Gear Ground Locks - Installed
4. Bypass Keys - Installed
5. Bomb Door Actuators - Disconnected
6. Nuclear Bombs Aboard - Accomplish bomb "After Landing" checklist
Use the bomb "After Landing" checklist contained in T.O. 1B-52D-25-2CL-1
7. Nonnuclear Weapons Aboard - Install shackle locking pins.
8. Bomb Door Actuators - Connected (if nuclear bomb(s) aboard)
9. Bomb Doors - Closed (if nuclear bomb(s) aboard)

10. Duct Plugs - In place
11. Pitot Tube Covers - In place
12. Oxygen Buildup and Vent Valves Handles - Leave in SERVICE
13. Gunnery System - Guns unarmed (if applicable)
14. Windows and Hatches - Closed
15. Security Guard - Posted
16. Drag Chute (if used) - Dried and repacked

PRIOR TO NORMAL PREFLIGHT

Due to unfamiliarity with this aircraft by maintenance personnel at strange fields, the following items must be closely checked by the flight crew.

1. Electrical and air power carts available



When attempting a start at less than 30 psi, monitor the exhaust gas temperature and starting time very closely. Close throttles immediately if EGT exceeds 450° C. Starting at reduced pressure may require starter operation longer than 2 minutes, in which case, the minimum rest period between starting attempts should be extended beyond the minimums set forth in the "Starter Limitations," Section V.

NOTE

- Electrical power can be obtained from an MD -3 power cart or any source of 400-cycle three-phase 200 (±5)-volt a-c power having an AN3430 plug. About 10 amperes of 24-volt d-c power is needed on pin E to close the relays to energize the aircraft circuits with external a-c power.
- External electrical power is not required for starting. See "Starting Engines and Before

Taxiing Checklist," this section. To provide starting on aircraft which do not require use of external pneumatic power, starter cartridges must be installed as given under "Installation of Starter Cartridges," this Section.

- Pneumatic power to start an engine can be obtained from an MA-1A or equivalent air compressor. A source that can supply approximately 1.8 pounds of air per second at a pressure of not more than 200 or less than 30 psi and at a temperature of 300° F for the length of time it will take to start an engine could be used. If the air temperature is below 300° F, a flow of air greater than 1.8 pounds per second will be needed. The use of an air source not specifically designed for aircraft should be limited to starting one engine.
 - If the available source of pneumatic power cannot supply air at a pressure of 30 psi, a start may be attempted at a lower pressure. With no other pneumatically operated equipment operating, allow available pressure to build up and stabilize, then follow normal starting procedures.
 - See "Servicing" diagram (figure 1-55) for fuel, oil, and hydraulic oil grades and specifications.
 - For partial fuel loading charts, refer to T. O. 1-1B-40, "Handbook of Weight and Balance Data."
2. Drag chute installed
 3. Fuel system serviced
 4. Oil tanks serviced
 5. Oxygen system serviced as necessary
 6. Water injection system serviced as necessary
 7. Hydraulic tanks checked, service as necessary
 8. Hydraulic accumulator preloads checked
 9. EVS Window Wash System - Serviced as necessary.
 10. Perform normal flight crew checklist.

Installation of Starter Cartridges

1. Open the cartridge access hinged door located on the lower right side of the engine nacelle cowl panel. The door contains six quick-release type fasteners.
2. Remove breech cap from starter by pulling disconnect handle and rotating breech cap clockwise until cap becomes free.
3. Check and, if necessary, clean inside of breech cap dome to assure good electrical contact with ground clip of cartridge.
4. Remove Air Force MXU-4/A cartridge from its container.
5. Remove shortout clip from Olin Mathieson cartridge and bend ground clip up to assure good contact with breech cap. On Talley cartridges, bend grounding clip away from electrical contact to release contact and to serve as a ground between cartridge and breech.
6. Insert cartridge in breech with ground clip end against cap dome.

WARNING

Before installing cap and cartridge on engines, insure that engine ignition circuit breakers (four on each load central) are pulled and starter switches in OFF and FLIGHT/PNEUMATIC.

7. Place breech cap in position on breech chamber and engage locking lugs. Pull disconnect handle and rotate breech cap counterclockwise until breech connector mates properly.
8. Close and secure cartridge access door.

NOTE

With exception of steps "4," "5," and "6," the above procedure may also be used for cartridge removal.

EXTERIOR INSPECTION CHECKLIST

NOTE

The exterior inspection is designed to be accomplished normally by an experienced pilot and copilot, each inspecting one side of the aircraft simultaneously, one pilot starting with nose section (right) through empennage and the other pilot starting with the left aft wheel well through the nose section (left). However, in the event only one pilot is available, he can perform the complete inspection. The following inspection is based on the as-

sumption that appropriate maintenance personnel are not available to perform this pre-flight and that the flight crew is accomplishing the preflight with emphasis on the items that affect the safety of flight. See figure 2-15 for a diagram of route to be followed during the exterior inspection.

A Right Nose Section

1. Pitot Tube Covers - Removed and clear
2. EVS FLIR Turret - Free and unobstructed

WARNING

Lethal voltage exists on the surface of the FLIR turret window during normal EVS flight operations. This voltage should be inhibited during ground operations by action of the forward landing gear squat switch. However, as an added precaution, insure FLIR turret air switch on the environmental power control panel is in OFF prior to performing any maintenance, other than operational check-out on or near FLIR turret.

3. TACAN Antenna - Checked
Check for cleanliness and security.
4. Escape Hatch - Secure
5. Static Ports & Drain Plugs - Checked
Check static ports clear and drain plugs installed (static ports are located high on the right side of the fuselage).
6. Air Ducts & Vents - Clear
All vent openings clear, access doors secure, duct plugs removed, and fuel cap in place.
7. Single Point Refuel Cap - Secure

B Right Forward Wheel Well

1. Landing Lights - Checked
Check the right landing, terrain clearance, crosswind, and taxi lights for cleanliness and security and glass and filament intact.
2. Wheel Chocks - In place
3. Tires & Hydraulic Lines - Checked
Ascertain tires have been inflated to proper pressure for present gross weight. Check tires for cuts, blisters, and worn spots and hydraulic lines for security and leaks.
4. Safety Switch Linkage, Torsion Link & Oleo Extension - Checked
Oleo safety switch linkage connected and secured. Torsion link connected and pin in place and safetied. Oleo strut for cleanliness, hydraulic leaks, and proper inflation.

5. Landing Gear Ground Lock - Installed

6. Battery Cover - Secure

7. Leaks & General Condition - Checked

Check entire wheel well area for foreign objects, hydraulic or fuel leaks, and security of all equipment.

8. Doppler Radome - Checked

Check for security, cracks, buckling, and cleanliness.

C Right Wing

1. Access Panels, Vents & Drains - Checked

Check access panels fastened and secured, drains clear and unobstructed, and no leaks.

2. No. 3 Strut for Condition - Checked

Check strut for cracks, buckling, and loose rivets.

3. Engines 5 & 6 Aft Section - Checked

Engine tail plugs removed. Insure tailpipes free of foreign matter and turbine buckets not nicked or missing.

4. Nacelle Cowlings & Surge Bleed Valves (2) - Checked

Check nacelle cowlings for cracks and security and check valve on each engine closed.

5. Engine Oil & Generator Cooling Air Inlets & Exhausts - Checked

Check the generator cooling air and engine oil cooler exhausts on the left engine and the engine oil cooler exhaust on the right engine unobstructed and no leaks. Check generator cooling air and engine oil cooler inlets free of foreign matter.

6. Nose Sections 5 & 6 - Checked

Engine intake plugs removed. Insure intakes free of foreign matter. Check anti-ice inlets free of foreign matter. Check for nicked compressor blades.

7. Access Panels - Checked

Check access panels fastened and secured.

8. No. 4 Strut for Condition - Checked

Check strut for cracks, buckling, and loose rivets.

9. Engines 7 & 8 Aft Section - Checked

Engine tail plugs removed. Insure tailpipes free of foreign matter and turbine buckets not nicked or missing.

10. Nacelle Cowlings & Surge Bleed Valves (2) - Checked

Check nacelle cowlings for cracks and security and check valve on each engine closed.

11. Engine Oil & Generator Cooling Air Inlets & Exhausts - Checked

Check the generator cooling air and engine oil cooler exhausts on the left engine and the engine oil cooler exhaust on the right engine unobstructed and no leaks. Check generator cooling air and engine oil cooler inlets free of foreign matter.

12. Nose Sections 7 & 8 - Checked

Engine intake plugs removed. Insure intakes free of foreign matter. Check for nicked compressor blades. Check oil coolers free of dents and cracks.

13. Taxi Light - Checked

Check for cleanliness and security and glass intact.

14. Access Panels - Checked

Check access panels fastened and secured.

15. Tip Gear Door & Well - Checked

Check hydraulic lines and actuators secure, no leaks, and wiring and other equipment secure.

16. Tip Gear Ground Lock - Installed

17. Oleo Strut, Wheel & Tire - Checked

Check oleo strut for cleanliness, hydraulic leaks, and proper inflation. Inspect wheel for cracks and tires for cuts, blisters, worn spots, and slippage.

18. External Tank - Checked

Check access door and filler neck cap secure and vent unobstructed.

19. Access Panels & Surge Tank Vent - Checked

Check access panels secure and surge tank vent clear of obstructions.

20. Wing Tip & Upper Surface - Checked

Check wing tip antennas for cracks and dents. Check upper wing surface for frost, snow, ice, or dust and security of access openings and fuel caps.

21. Outboard wing Trailing Edge - Checked

Check skin for cracks, buckling, and loose rivets.

22. Fuselage Tanks Filler Caps - Secured

23. Outboard Wing Flap Well - Checked

Check hydraulic lines for leaks and security of wiring.

24. Inboard Wing Flap Well - Checked

Check hydraulic lines for leaks and security of wiring, control cables, and circuit breakers set.

25. Lower Surface of Wing Flaps - Checked

Check lower surfaces for loose rivets, cracks or buckling in skin, security, and condition of actuators and screws.

26. Upper Surface of Wing Flaps - Checked

Check upper surfaces for loose rivets, cracks or buckling in skin, security, and condition of rollers and connecting links.

27. Vortex Generators - Checked

Check vortex generators not missing or damaged.

28. Fuselage & Bomb Doors - Checked

Check fuselage and bomb doors for loose rivets, buckling, snow and ice.

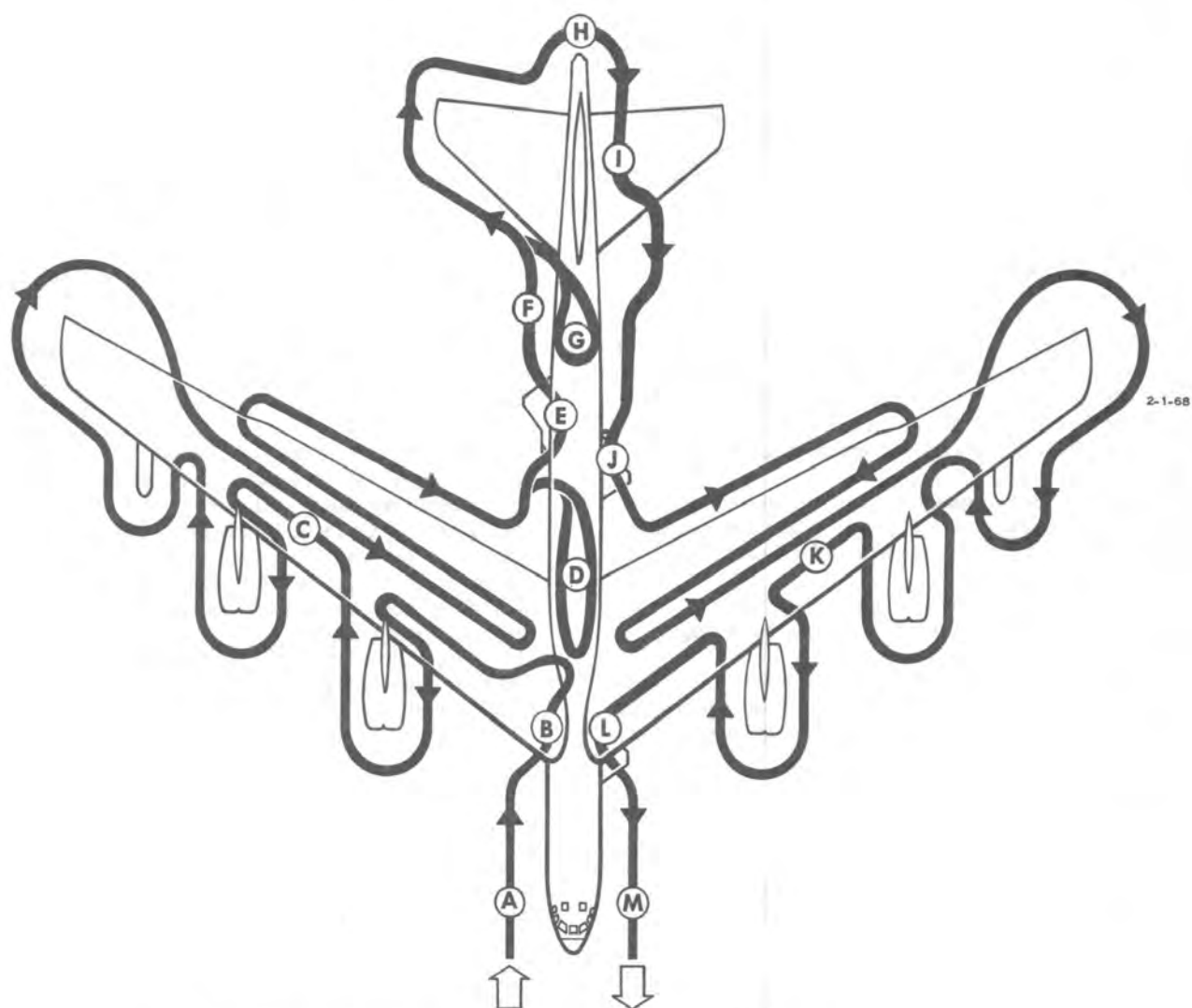
D Bomb Bay

WARNING

The bomb door actuator struts must be disconnected before entering the bomb bay if power is applied to the aircraft.

1. Bomb Bay for Leaks, Security of Wires & Cables - Checked

Check bomb bay for fuel and hydraulic leaks, security of wires and cables, and crew movement doors closed.



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- | | |
|-------------------------------|-----------------------------|
| (A) RIGHT NOSE SECTION | (H) EMPENNAGE |
| (B) RIGHT FORWARD WHEEL WELL | (I) LEFT AFT FUSELAGE |
| (C) RIGHT WING | (J) LEFT AFT WHEEL WELL |
| (D) BOMB BAY | (K) LEFT WING |
| (E) RIGHT AFT WHEEL WELL | (L) LEFT FORWARD WHEEL WELL |
| (F) RIGHT AFT FUSELAGE | (M) LEFT NOSE SECTION |
| (G) AFT EQUIPMENT COMPARTMENT | |

■■■■■■■■■■ Exterior Inspection Diagram (Typical)

Figure 2-15.

2. Hydraulic Controllable Check Valve - Handle safety wired closed
Check valve handle perpendicular to hydraulic line.
3. Nuclear Bombs - Checked for proper configuration.
Use the "Ground Safeing" or "EWO Restrike (MMS not available)" procedures (as applicable) of T.O. 1B-52D-25-2CL-1 to properly configure the nuclear bombs.

(E) Right Aft Wheel Well

1. Tires & Hydraulic Lines - Checked
Ascertain tires have been inflated to proper pressure for present gross weight. Check tires for cuts, blisters, and worn spots. Check hydraulic lines for security and leaks. Check bypass key not installed.
2. Safety Switch Linkage, Torsion Link & Oleo Extension - Checked
Oleo safety switch linkage connected and secured, Torsion link connected and pin in place and safetied. Oleo strut for cleanliness, hydraulic leaks, and proper inflation.
3. Landing Gear Ground Lock - Installed
4. Left Brake Accumulator Air Pressure Gage - 1000 (± 200) psi
5. Leaks & General Condition - Checked
Check entire wheel well area for foreign objects, hydraulic or fuel leaks, and security of all equipment.

(F) Right Aft Fuselage

1. Anticollision Light - Checked
Check for cleanliness, security, and glass intact.
2. UHF Command Radio Antenna - Checked
Check for cleanliness and security.
3. Access Panels & Vents - Checked
Check all plugs removed from vents, vents clear and unobstructed, and access panels and ECM antennas secure.
4. Right Oxygen Buildup & Vent Valve Handle - Checked
Check that liquid oxygen buildup and vent valve handle has been placed in SERVICE position. Close and secure access panel.

(G) Aft Equipment Compartment

1. Entrance Door Jettison Handle - Stowed; pin installed, safetied
2. Rudder Q-Spring - Checked
Check hose and clamp connections.
3. Stabilizer Nut & Jackscrew - Checked
4. Elevator Q-Spring - Checked

5. Powered Rudder/Elevator Systems - Checked
Check for general condition of hydraulic systems; ground cooler blower housing and ducting. Check for system hydraulic leaks.
6. Radio Navigation Equipment Rack - Checked
7. No. 2 & 3 Liquid Oxygen Converters - Checked

WARNING

Do not touch the converters with bare hands as serious injury may result.

8. No. 1 Liquid Oxygen Converter - Checked
9. Camera Cover - Checked
Camera door handcrank removed from door motor and stowed.
10. Aft Body Fuel Tank - Checked
11. Aft A-C Power Box - Cover closed
12. Crawlway Door - Closed
13. Leaks & General Condition - Checked
Check for general condition, security of equipment, and loose items; excessive wear or unsafe condition of wiring, control cables, and ducting; hydraulic, fuel, and oxygen leaks.
14. Compartment Door - Checked and closed
Check for dents and general condition of latch, hinges, and seals.

(H) Empennage

1. Right Horizontal Stabilizer & Elevator - Checked and set at 0°
Check all surfaces for loose rivets, cracks and buckling in skin, snow and ice, and general condition. Specifically check for ice on seal between stabilizer and fuselage.
2. Drag Chute Compartment - Checked
Check door closed, handle flush, and crank removed. If the drag chute has been in place during damp weather, check with crew chief to ascertain that chute is dry.
3. Drag Chute Personnel Safety Rod - Removed
4. Turret - Stowed
5. Vertical Fin & Rudder - Checked
Check all surfaces for loose rivets, cracks and buckling in skin, snow and ice, and general condition.
6. Left Horizontal Stabilizer & Elevator - Checked
Check all surfaces for loose rivets, cracks and buckling in skin, snow and ice, and general condition. Specifically check for ice on seal between stabilizer and fuselage.
7. Air Inlets & Vents - Clear
Inlets and vents clear and unobstructed. Q-spring opening in leading edge of fin clear.

(I) Left Aft Fuselage

1. Ammunition Door (Gunner not flying) - Closed
2. Electronics Rack Door (Gunner not flying) - Closed
3. Left Liquid Oxygen Buildup & Vent Valve Handles (2) - Closed
Check that liquid oxygen buildup and vent valve handles have been placed in SERVICE. Close and secure access panels.
4. ECM Antenna - Secured
5. Electronic Ram Airscoop - Unobstructed

(J) Left Aft Wheel Well

1. Tires & Hydraulic Lines - Checked
Ascertain tires have been inflated to proper pressure for present gross weight. Check tires for cuts, blisters, and worn spots. Check hydraulic lines for security and leaks. Check bypass key not installed.
2. Safety Switch Linkage, Torsion Link & Oleo Extension - Checked
Oleo safety switch linkage connected and secure. Torsion link connected and pin in place and safetied. Oleo strut for cleanliness, hydraulic leaks, and proper inflation.
3. Landing Gear Ground Lock - Installed
4. Right Brake Accumulator Air Pressure Gage - 1000 (± 200) psi
5. Leaks & General Condition - Checked
Check entire wheel well area for foreign objects, hydraulic or fuel leaks, and security of all equipment.
6. Hydraulic Controllable Check Valve - Handle safety wired closed
Check valve handle perpendicular to hydraulic line.

(K) Left Wing

Repeat procedures for right wing in the following order:

1. Fuselage & Bomb Doors - Checked
2. Vortex Generators - Checked
3. Upper Surface of Wing Flaps - Checked
4. Lower Surface of Wing Flaps - Checked
5. Inboard Wing Flap Well - Checked
6. Outboard Wing Flap Well - Checked
7. Outboard Wing Trailing Edge - Checked
8. Wing Tip & Upper Surface - Checked
9. Access Panels & Surge Tank Vents - Checked
10. External Tank - Checked
Check access door and filler neck cap secure and surge tank vent clear of obstructions.
11. Left Taxi Light - Checked

12. Oleo Strut, Wheel & Tire - Checked
13. Tip Gear Ground Lock - Installed
14. Tip Gear Wheel & Door - Checked
15. Access Panels, Vents & Drains - Checked
16. No. 1 Strut for Condition - Checked
17. Engines 1 & 2 Aft Section - Checked
18. Nacelle Cowlings & Surge Bleed Valves (2) - Checked
19. Engine Oil & Generator Cooling Air Inlets & Exhausts - Checked
20. Nose Sections 1 & 2 - Checked
21. Access Panels, Vents & Drains - Checked
22. No. 2 Strut for Condition - Checked
23. Heat Exchanger, Ram Air Inlets & Exhaust - Checked
24. Engines 3 & 4 Aft Sections - Checked
25. Nacelle Cowlings & Surge Bleed Valves (2) - Checked
26. Engine Oil & Generator Cooling Air Inlets & Exhausts - Checked
27. Nose Sections 3 & 4 - Checked
28. Access Panels, Airscoops, Vents & Drains - Checked

(L) Left Forward Wheel Well

1. Wheel Chocks - In place
2. Tires & Hydraulic Lines - Checked
Ascertain tires have been inflated to proper pressure for present gross weight. Check tires for cuts, blisters, and worn spots. Check hydraulic lines for security and leaks.
3. Safety Switch Linkage, Torsion Link & Oleo Extension - Checked
Oleo safety switch linkage connected and secure. Torsion link connected and pin in place and safetied. Oleo strut for cleanliness, hydraulic leaks, and proper inflation.
4. Landing Gear Ground Lock - In place
5. Right & Left Forward Brake Accumulator Air Pressure Gages - 1000 (± 200) psi
6. Hydraulic Handpump - Handle stowed
7. Battery Cover & Drain Lines - Secured
Check covers fastened.
8. Air Conditioning Pack Fluid Level - Checked
Check fluid level at least 1/4 inch above "L" mark in sight gage.
9. Leaks & General Condition - Checked
Check entire wheel well area for foreign objects, hydraulic or fuel leaks, and security of all equipment.
10. Landing Light - Checked
Check left landing light for cleanliness and security and glass and filament intact.

(M) Left Nose Section**1. Air Ducts & Vents - Clear**

Check all vent openings clear, access doors secure, and duct plugs removed.

CAUTION

Operation of an air conditioning unit with the wing duct plugs in place can result in destruction of the unit due to overspeeding of the turbine-driven blower.

2. Static Ports & Drain Plugs - Checked

Check static ports clear and drain plugs installed (three ports are located high on side of fuselage).

3. Escape Hatch - Secured

Check left escape hatch secure and flush with the aircraft skin.

4. Pitot Tube Covers - Removed and clear**5. EVS STV Turret - Free and unobstructed****6. Inlet Ram Airscoops - Unobstructed****ALERT PROCEDURES**

The normal checklists in Sections II and VIII are designed to permit use during alert. The additional checklists in this section are used in situations peculiar only to the alert cycle. Any time bombs/missiles are aboard, the normal two-man policy will be observed. After maintenance has declared an aircraft ready for alert and the bombs/missiles have been loaded, the aircrew will conduct an initial acceptance check. When the aircrew declares the aircraft ready for alert and the aircraft is on the alert line, it will be placed in a "cocked" configuration. The daily alert preflight will be accomplished once each 24 hours, normally at a predesignated time. During crew changeover, the navigators' "Before Exterior Inspection," the "Missile Preflight," and the "Bomb Preflight" checklists will be accomplished by the new crew.

INSTRUCTIONS**Thermal Curtains**

During initial acceptance for an alert aircraft or prior to deploying to assume satellite alert, the pilots will ensure that all thermal curtains at transparent openings in the cockpit are installed, checked for proper fit, and positioned as required. The pilot/copilot escape hatches will remain closed while the aircraft is on alert. Curtains for cockpit windows No. 1, 2L&R, 3L&R, 4L&R, and 5L&R will be returned to the open/stowed position. The pilot/copilot flash divider curtains will be positioned on

top of the instrument panel cover with the lower tapes fastened. For information regarding inspection acceptance criteria, see "Thermal Curtains," Section IV.

WARNING

Thermal curtains will be kept free from grease, oil, and mold as any discoloration will seriously impair the value of the curtains. Oil or grease base material will ignite upon exposure to thermal radiation. Use extreme care when handling the curtains during installation. Dirty or cracked curtains will be replaced.

All thermal and flash divider curtains will be placed in the open/stowed position or appropriate storage containers when deploying to and from the satellite alert base. When assuming initial satellite alert, thermal/flash divider curtains need not be rechecked; however, they will be positioned in accordance with the initial alert acceptance procedures.

When assuming alert duty, the pilot and copilot will check that the flashblindness goggle case seal is not broken and the cases positioned where they are readily available. Monocular eyeshields for remaining crewmembers will be positioned where they are readily available.

Security

Entrance to the designated "No Lone Zone" of a "cocked" configured aircraft will be in accordance with command directives.

Maintenance While on Alert

At any time while the aircraft is cocked, if a requirement exists to refuel (except wing tanks), the aircrew will uncock the aircraft using the "Uncocking Checklist." Normal servicing requirements for water, oxygen, hydraulics, or pneumatics, which do not require access to the cockpit, may be accomplished on a cocked aircraft. Maintenance may be performed without uncocking provided force timing is not degraded, power is not placed on the aircraft, access to the cockpit or bomb bay area is not required, and no electrical component is involved. When the aircraft is uncocked for maintenance/refueling and the maintenance/refueling is completed, the aircraft will be recocked by the alert crew using the "Exterior Inspection Checklist" as applicable, "Interior Inspection Checklist," and "Before Starting Engines Checklist." If other than the alert flight crew personnel have access to the bomb

bay and/or missiles during the required maintenance, the radar navigator's "Before Exterior Inspection," the bomb preflight, and/or missile preflight inspections must also be completed.

NOTE

If the aircraft has been towed for tire rotation etc, insure that the ground locks and bypass keys are removed upon completion of the towing operation.

Pilot Procedures

1. AIRCRAFT AND BOMBS ACCEPTANCE

- a. Before Exterior Inspection
- b. Bomb Preflight. If the bomb preflight is accomplished by a substitute crew, it must be reaccomplished by the crew assigned for alert prior to aircraft cocking.
- c. Exterior Inspection. (This includes missile preflight.)
- d. Interior Inspection
- e. Before Starting Engines
- f. Starting Engines and Before Taxiing. Normally, only engines 4 and 5 will be started to check and set stabilizer trim. All engines may be started if the aircraft is to be taxied to the alert area.

2. AIRCRAFT COCKING

- a. Interior Inspection
- b. Before Starting Engines

3. SCRAMBLE. Pilots will use the normal checklist when the execution order is given. Engines will not be started until both pilots are in position. Bold-faced items contained in the checklist for "Starting Engines and Before Taxiing," "Taxiing," and "Before Lineup" checklists are the minimum items required for a fast reaction takeoff. During EWO alert operations, takeoff will not be delayed for items pertaining to crew equipment, radio checks, and IFF settings. If time permits, these checklists should be used in their entirety. After the aircraft is safely airborne, the "Starting Engines and Before Taxiing," "Taxiing," and "Before Lineup" checklists should be reviewed and applicable items not previously completed should be performed when time permits. "Before Lineup Checklist" will be completed as a continuation of the "Taxiing Checklist" without stopping the aircraft prior to taking the runway. Transfer of control of the aircraft between pilots will be accomplished to insure proper monitoring of aircraft movement and clearance. Upon completion of alert scramble procedures, pilots may recock the aircraft using the "Recocking Checklist."

NOTE

The specially designed roll-over chocks for alert aircraft do not require removal before taxiing; however, thrust settings up to NRT may be required to taxi over the chocks. Upon clearing chocks, immediately reduce thrust to prevent excessive acceleration.

4. UNCOCKING. Use "Uncocking Checklist."

Radar Navigator and Navigator Procedures

1. AIRCRAFT AND BOMBS ACCEPTANCE

- a. Before Exterior Inspection
- b. Exterior Inspection. This includes the bomb preflight.
- c. Interior Inspection

NOTE

This completes the cocking procedure for the radar navigator and the navigator. If the aircraft is uncocked for maintenance or refueling, it will be recocked using the appropriate portions of the "Exterior Inspection" and the entire "Interior Inspection" checklists.

2. SCRAMBLE. Accomplish the "Before Takeoff Checklist." Upon completion of alert scramble procedures, the navigators may recock the aircraft using their "Recocking Checklist."

3. DAILY ALERT PREFLIGHT. There are no specific items that are to be accomplished by the radar navigator or navigator other than those called for by the copilot on his "Daily Alert Preflight Checklist."

4. UNCOCKING. Items to be accomplished by the radar navigator and navigator are on the pilot's "Uncocking Checklist" and will be accomplished at his direction.

EW Officer Procedures

1. AIRCRAFT ACCEPTANCE

- a. Before Exterior Inspection
- b. Exterior Inspection
- c. Interior Inspection
- d. ECM Equipment Operational Check - As required
- e. After Landing

2. SCRAMBLE

- a. Starting Engines
- b. Read over interphone the "Taxiing Checklist" and "Before Lineup Checklist."

3. DAILY ALERT PREFLIGHT. There are no specific items that are to be accomplished by the EW officer other than those called for by the copilot on his "Daily Alert Preflight Checklist."

4. UNCOCKING. Items to be accomplished by the EW officer are on the pilot's "Uncocking Checklist" and will be accomplished at his direction.

Gunner Procedures

1. AIRCRAFT AND FIRE CONTROL SYSTEM ACCEPTANCE.

- a. Before Exterior and Exterior Inspection
- b. Interior Inspection
- c. Before Engine Start
- d. After Engine Start/Before Takeoff
- e. Send and receive an alert acceptance message (AFSATCOM) **AU** - (as required)
- f. After Landing and After Parking

2. DAILY ALERT PREFLIGHT. There are no specific items that are to be accomplished by the gunner other than those called for by the copilot on his "Daily Alert Preflight Checklist."

3. SCRAMBLE. The gunner will don ear protectors and accomplish the ground crew duties of Man No. 2. (See "Ground Crew Checklist," Section VIII, for amplified procedures.) Continue with the normal

checklist beginning with "Before Starting Engines" checklist through "Postflight Checklist" as the alert/exercise dictates.

NOTE

For recovery from practice alerts, the FCS control panel fuses and FCS circuit breaker checklist items of the "After Landing Checklist" will not be accomplished.

RECOCKING CHECKLIST (Copilot reads)

NOTE

- The following checklist will be used to recock the aircraft after an alert exercise including checklist progression up through the "Before Lineup" checklist. It may also be used after starting engines to check the stabilizer trim or to taxi to the alert parking area (if applicable).
- This checklist is valid provided no maintenance is required on the aircraft following any of the above actions.
- Following an alert scramble exercise, this checklist should be initiated after clearing the active runway, time and conditions permitting.

1. IFF - STBY (P)
2. Yaw & Pitch SAS Switches - DISENGAGE (P)
3. Pitot Heat, Windshield & Engine Anti-Icing - OFF (P)
4. Rudder/Elevator Hydraulic Switches - OFF (P)
- 4A. Wing Standby Pump Switches - OFF (P)

NOTE

Unless local conditions and/or command directives dictate otherwise, steps "5," "6," and "7" should be accomplished as soon as practical to conserve fuel.

5. Generators 1 & 7 - OFF (CP)
6. Engine Starter Switches - OFF and PNEUMATIC (CP)
7. Throttles 1, 2, 7 & 8 - 75% rpm, then CLOSED (P-CP)
8. Arming Lever Safety Pins No. 1 - Installed (P-CP)
9. Radar Altimeter - OFF (P)
10. AGM-69A Launcher Hydraulic Control Switch - OFF (P)
11. Fuel Transfer - As required (CP)

Fuel may be transferred as necessary in accordance with local refuel procedures.

RECOCKING CHECKLIST (Copilot reads) (Cont)

12. Parking Brakes - Set (P)
13. Anticollision & Navigation Lights - OFF and FLASH (CP)
14. Body System Standby Pumps - STBY (P)
15. EVS Power Switches - OFF (P-CP)
16. Bomb Doors - Closed (P)
17. Manifold Valve - OPEN (CP)
18. Sliding Window - Open (CP)
19. Flaps - UP and OFF (CP)
20. Fuel Panel Switches - 1, 2, 3, & 4 ON, 13 & 16 OPEN; 26 & 28 ENGINE FEED (CP) Checked (P)
21. BNS & EVS switches - OFF (RN)

CAUTION

The BNS, radar, and terrain computer power switch and all EVS sub-systems should be off to prevent power surge damage when switching from aircraft power to external power or if aircraft power is interrupted.

22. Air Conditioning - OFF (CP)
23. Generators 1, 5 & 7 (External Power Not Available) - OFF (CP)
24. Generators (External Power Available) - OFF (CP)
25. External Power - ON (if available) (CP)
26. Wheel Chocks - In place (GC)
27. Throttles (except No. 3) - 75% rpm, then CLOSED (P-CP)
28. Engine Ignition Circuit Breakers - Pulled (P-CP)

Pull four engine ignition circuit breakers on each load central.
29. Cartridge Installed on Engine No. 5 (GC)
- 29A. Heading Indicator - Checked and set (P)
30. Generator No. 3 - OFF (CP)
31. Throttle No. 3 - 75% rpm, then CLOSED (P)

RECOCKING CHECKLIST (Copilot reads) (Cont)

32. Cartridges Installed on Remaining Engines (GC)

33. Engine Ignition Circuit Breakers - In (P-CP)

Check that circuit breakers are reset after starter cartridges are installed.

WARNING

Before pushing engine ignition circuit breakers in on each load central, assure that ground crewmember is clear of engine starter exhaust area.

34. Engine Starter Switches - OFF and FLIGHT (CP)

35. Oxygen - OFF and 100% (ALL)

36. Parking Brakes - OFF (P)

37. Generator Switches - ON (for cartridge start without external power) (CP)

38. External Power - OFF (CP-GC)

Copilot checks with ground observer and flight crew to determine if further power is required prior to turning external power OFF.

39. Battery - OFF (CP)

40. Engine Starter Switches - START and FLIGHT (CP)

41. Pitot Heat & Windshield Anti-Icing - ON and normal (P)

42. Antiskid Switch - ON, guard closed (P)

43. Interphone - OFF (P)

44. Sliding Windows - Closed (P-CP)

45. Circuit Breakers - Set (P-CP)

46. Crosswind Crab Knob & Indicator - Down and zero (P)

47. Entrance Light - OFF (P)

48. Downlocks & Bypass Keys - Stowed (P/CP)

If the aircraft has been towed, ascertain that the downlocks and bypass keys have been removed and stowed.

RECOCKING CHECKLIST (RN-N)**NOTE**

The following checklist will be used to recock the aircraft only at the termination of an alert exercise.

1. AOU Panel: (RN)
 - a. Multi Tgt-Norm Switch - NORM
 - b. Offset Selector Switch - DIRECT
 - c. Function Switch - RESET
2. BNS:
 - a. Standby Button - Depressed (RN)
 - b. Intensity Knob - CCW (RN-N)
 - c. Receiver Gain Knob - CCW (RN)
 - d. Video Knob - CCW (RN-N)
 - e. Range Selector Switch - 20 (RN)
 - f. Radar Power Switch - OFF (RN)
 - g. Terrain Computer Power Switch - OFF
 - h. BNS Power Switch - OFF (RN)
 - i. Stab Bypass Switch - ON (RN)
 - j. Gyro Erect Switch - HI (RN)
3. EVS:
 - a. EVS Video Select Switch - OFF (RN-N)
 - b. FLIR Mode Select Switch - OFF (RN)
 - c. STV Mode Switch - OFF (RN)
 - d. Environmental Control Switches - OFF (RN)

CAUTION

All electro-optical viewing subsystems (EVS) shall be placed in the OFF position prior to transfer of electrical power from aircraft power to external power to prevent possible damage to the equipment.

RECOCKING CHECKLIST (RN-N) (Cont)

4. Automatic Astrocompass (N)
 - a. Star Selector Switch - OFF
 - b. Power Filter Switch - POWER OFF
5. Doppler Radar (N)
 - a. Radar Silence Switch - SILENT
 - b. System Power Switch - OFF
6. BNS Ground Blowers Switch - OFF (RN)



Do not turn ground blowers switch off until doppler radar system power switch is turned off.

7. APN-69 Power Switch - OFF (N)
8. Oxygen Regulator - OFF and 100% OXYGEN (RN-N)
9. Ejection Control Trigger Ring - Stowed (RN-N)
10. Pin No. 1 - Installed (RN-N)
11. Pressure Bulkhead Door - Closed, latched, and locked (N)

UNCOCKING CHECKLIST (Aircraft on Alert Line — Copilot reads)

1. Interphone Power Switch - ON (P)

Pilot and copilot connect interphone and pilot checks for operation of the interphone system by noting sidetone in headset.

2. IFF:

- a. Code - Classified setting removed (P)
- b. Master Switch - OFF (P)

3. Standby Pump Switches - OFF (P)
4. Fuel Switches - OFF or CLOSED (CP)
5. Engine Starter Switches - OFF and PNEUMATIC (CP)
6. Gyro Power Switch - OFF (P)
7. Pitot Heat - OFF (P)
8. Windshield & Engine Anti-Icing - OFF (P)

UNCOCKING CHECKLIST (Airplane on Alert Line — Copilot reads) (Cont)

9. Battery - ON, lights checked (CP)

Battery discharging lights should come on and end-of-life lights should remain out.

10. External Power - ON (CP)

11. AGM-69A Classified Data Memory Erase - Accomplished as directed (N)

Refer to "Classified Data Memory Erase Checklist," Section II of T.O. 1B-52G-30-2.

12. Flaps - As required (CP)

13. Downlocks & Bypass Keys - Installed (GC)

14. Lights - Off, or as required (P-CP)

15. Radios - OFF (P-CP)

16. Generator Switches - OFF (CP)

17. External Power - OFF (CP)

Copilot checks with ground crew and other crew positions for power requirements prior to turning off electrical power.

18. Battery - OFF (CP)

19. Engine Ignition Circuit Breakers - Pulled (P-CP)

Pull four engine ignition circuit breakers on each load central.

20. Interphone Power Switch - OFF (P)

21. ALE-20 Safety Interlock Switch Door - Open, streamer installed (EW)

22. Bomb Doors - Open (P/RN/N)

WARNING

The bomb door actuator struts must be disconnected before entering the bomb bay if power is applied to the aircraft.

CAUTION

- Unlatching the bomb doors using the aft bomb door latch release cable will not be attempted with power on the aircraft.
- Do not pull down on the door latch release cables as bent and damaged turnbuckles will result. Actuate cables in the proper direction of travel only.

NOTE

- When uncocking for short periods of time, i.e., to perform maintenance on an alert aircraft, the bomb doors will be left closed if not required to be open for specific maintenance.
- Manual opening of the bomb doors will be accomplished using the bomb door latch release cable in the aft wheel well. The cable is the same cable actuated by the aft hydraulic latch actuator and is directly linked to the aft latches and through the coordinating unit to the forward latches.

DAILY ALERT PREFLIGHT CHECKLIST (Aircraft on Alert Line—Copilot reads)

1. Interphone Power Switch - ON (P)
2. CSS Indicator Window - Checked "A" (RN)

NOTE

Cease all activity and request CSS custodians (through the Command Post) if any CSSC indicator window is found set to other than "A."

3. Special Weapons Manual Lock Door - Sealed (EW)

EW officer checks the special weapons manual lock door closed and sealed.

4. AGM-69A Lock-Unlock Switch - Sealed (EW)

EW officer checks that the AGM-69A lock-unlock switch cover is closed with the pin inserted and sealed.

5. Readiness Switch Cover - Closed and sealed (P)

Check that access cover is closed, latched, and sealed.

6. AGM-69A Consent Panel: (P)

a. Prearm-Safe Switch - Guard closed and sealed

b. Lock-Unlock Switch - Guard closed and sealed

7. AGM-69A Launcher Hydraulic Control Switch - OFF (P)

8. Circuit Breakers - Checked (P)

9. Radar Navigator's & Navigator's Stations:

a. Jettison Power Circuit Breaker - Checked out (RN)

b. Normal Release Circuit Breaker - Checked out (RN)

DAILY ALERT PREFLIGHT CHECKLIST (Aircraft on Alert Line — Copilot reads 'Cont)

- c. All Other Circuit Breakers - In (RN-N)
 - d. Release Circuits Disconnect - Disconnected, sealed (RN)
 - e. Master Bomb Control Switch - OFF (RN)
 - f. Bomb System Switch - MANUAL (RN)
 - g. Forward & Rear Special Weapons Manual Release Handles - Stowed and sealed (RN)
 - h. DCU-9/A Control Lever - OS, sealed (RN)
 - i. DCU-9/A Selector Switches - OFF (RN)
 - j. AGM-69A SAF Switch - Guard closed and sealed (RN)
 - k. AGM-69A CLASS III Switch - Neutral lock (RN)
 - l. Pressure Bulkhead Door - Closed, latched, and locked (N)
10. Pitot Heat & Windshield Anti-Icing - OFF (P)
11. Electronic Warfare Section:
- a. Chaff, Flare & Rocket Circuit Breakers - Out (EW)
 - b. Warning Rcvr Circuit Breaker - Out (EW)
 - c. ALQ-117 Sys 15 and Sys 16 Ind Cont Circuit Breaker - Out (EW)
 - d. Doc & Sud Dispense Switches - Guards down (EW)
 - e. Transmitter Mode Switches - Standby (EW)
 - f. ECM Power Switches - OFF (EW)
12. Gunner's Station:
- a. FCS Control Panel Switches - OFF/SAFE and pinned (G)
 - b. Radar Control Panel Switches - NORMAL and OFF (G)
13. Battery Switch - ON, lights checked (CP)
- Battery discharging lights should come on and end-of-life lights should remain out.

DAILY ALERT PREFLIGHT CHECKLIST (Aircraft on Alert Line—Copilot reads) (Cont)

14. External Power - ON (CP)

15. FCS Low Pressure Lights - Checked (G)

After external power is applied, turn standby switch on AUX radar panel ON and check for low pressure condition. If low pressure lights remain on for more than five minutes, maintenance should be called.

16. Flaps - Clear, down (CP)

17. Ground, Check (a) Flap Well, (b) All TR Units, and (c) Generator Trip Boxes (CP)

18. Special Weapons Lock Indicators - Indicate locked (RN)

19. Oxygen Quantity - Checked (P)

20. Coded Switch Set Controller (CSSC): (RN)

NOTE

● Cease all activity and request CSS custodians (through the Command Post) if the enable light comes on at any time other than during the lamp test button check. For other abnormal indications refer to "CSS Malfunction Analysis" in T.O. 1B-52D-25-2 or T.O. 1B-52G-30-2.

● Steps "c" thru "g" need only be accomplished on the first day of each alert tour unless there has been a change of aircraft or is required as a result of maintenance.

a. Oper/Mon Switch - MON, disen light on

Hold the oper/mon switch in MON and check disen light on.

b. Lamp Test Button - Depressed

Disen, enable, and code lights should illuminate.

c. Sum Code _____ - Set

Set briefed sum code in CSSC by rotating thumbwheels.

NOTE

Sum code need only be set and accomplished once during the current tour of alert unless there has been a change of aircraft or is required as a result of maintenance.

d. Oper/Mon Switch - OPER

Code light should blink until end of cycle (approximately 2 minutes).

e. Code & Disen Lights - On

Illumination of the code and disen lights verifies operation of system, that proper enable codes have been entered in the code enable switch and that the system is disabled.

DAILY ALERT PREFLIGHT CHECKLIST (Aircraft on Alert Line—Copilot reads) (Cont)

- f. Oper/Mon Switch - MON (momentarily)

Code and disen lights should go off.

NOTE

System status (enable/disenable) may be verified at any time by holding the oper/mon switch in MON and observing disen and enable light indication.

- g. CSSC Indicator Windows - Set all "A's"

21. Special Weapons Monitor Check (Multiple Carriage): (RN)

NOTE

This check need only be accomplished on the first day of each alert tour unless there has been a change of aircraft or is required as a result of maintenance.

- a. SWK Monitor Select Switch - First bomb to be released

- b. DCU-9/A Selector Switch - SAFE

- c. DCU-9/A Warning Light - Off, tested

Check light off and tested for each position of the SWK box.

- d. SWK Monitor Select Switch - OFF

- e. DCU-9/A Warning Light - Off, tested

If warning light comes on when pressed to test, call qualified personnel.

- f. DCU-9/A Selector Switch - OFF

21. Special Weapons Monitor Check (Single Carriage): (RN)

- a. DCU-9/A Selector Switch(es) - SAFE

- b. DCU-9/A Warning Light(s) - Off, tested

- c. DCU-9/A Selector Switch(es) - OFF

22. SWK Box Illumination Control - Full CCW (RN)

DAILY ALERT PREFLIGHT CHECKLIST (Aircraft on Alert Line—Copilot reads) (Cont)

23. AGM-69A - Checked

a. Weapon Status and Control Panel: (RN)

- (1) SAF Switch - Guard closed & sealed
- (2) Propulsion Disarm Switch - OFF, lock
- (3) Monitor & Jettison Select Switch - ALL

b. Status and Control Panel: (N)

- (1) Missile Select Switch - ALL
- (2) Training/Operation Mode Switch - As required, lock
- (3) Homer/Inertial Mode Switch - INERTIAL lock
- (4) Manual/Auto Mode Switch - MANUAL, lock
- (5) Launch Control Switch - NAV, lock

24. Crew Report - Completed (P)

25. Ground Exterior Check - Completed (GC)

26. Flaps - Clear, UP, lever OFF (CP)

27. Portable Oxygen Bottles - Serviced and stowed (ALL)

28. Mode 4:

- a. Code - Set (EW)
- b. Code Switch - Position A (P)
- c. Caution Light - Out (P)

29. External Power - OFF (CP-GC)

External power will be applied for a minimum of 15 minutes daily to charge the batteries.

29A. Generator Switches - ON (CP)

30. Battery Switch - OFF (CP)

DAILY ALERT PREFLIGHT CHECKLIST (Aircraft on Alert Line — Copilot reads) (Cont)

31. Interphone Power Switch - OFF (P)
32. Pitot Heat & Windshield Anti-Icing - ON and NORMAL (P)

NOTE

When a requirement exists to apply external power to a cocked aircraft, insure that pitot heat and windshield anti-ice switches are turned off prior to application of power. Reaccomplish steps "29" thru "32" of checklist before leaving the aircraft.

33. Flash Blindness Equipment - Checked (ALL)

Flash blindness equipment will be checked and positioned in accordance with command directives.

Exterior Check

1. Pilots will complete visual inspection checking for hydraulic leaks, fuel leaks, and general condition.
2. Bomb preflight inspection will include accomplishment of all steps in T.O. 1B-52D-25-2CL-1.

The bomb preflight need only be accomplished once during the current tour of alert unless there has been a change of aircraft or is required as a result of maintenance.

3. Missile Preflight.

The Missile Preflight need only be accomplished once during the current tour of alert unless there has been a change of aircraft or is required as a result of maintenance.

QUICK REACTION RECOCKING CHECKLIST (Power On Configuration — Copilot reads)**NOTE**

- Quick reaction configuration may be assumed from a normal alert posture. Assumption from this posture will require completion of the Quick Reaction Recocking Checklist. If engines are not started, accomplish only applicable items. Quick reaction may also be assumed through normal generation procedures. Assumption from this method requires completion of all checklists through Starting Engines and Before Taxiing to cock the aircraft. The Quick Reaction Recocking Checklist (Power On Configuration) may be used after starting engines to taxi to the Quick Reaction parking area, if applicable.
 - If after assuming Quick Reaction (Power On Configuration), it is necessary to transition to Quick Reaction (Power Off Configuration), accomplish the applicable items of the Quick Reaction (Power On Configuration) Scramble Checklist followed by accomplishing the Quick Reaction Recocking Checklist (Power Off Configuration).
 - Windows may be left open as provided in the checklist, but hatches will remain closed except as provided in local plans for crew relief and/or changeover.
 - Flight crews will insure that takeoff data and trim are updated at all times as climatic conditions require. Any significant change will be reviewed by the pilot, copilot, and navigator.
 - Insure that aircraft is parked where Command Post radio reception is possible.
 - Ground crew support for engine start must be provided from additional sources. Ground power equipment will be hooked in tandem with the fast ride vehicle for quick removal by the crew chief prior to taxiing, or positioned well clear of the wing to allow rapid aircraft exit.
1. IFF - STBY, mode 4 as briefed (P)
 2. Yaw & Pitch SAS Switches - DISENGAGE (P)
 3. Pitot Heat - OFF (P)
 4. EVS Power Switches - OFF (P-CP)

NOTE

Unless local conditions and/or command directives dictate otherwise, steps "5," "6," and "7" should be accomplished as soon as practical to conserve fuel.

QUICK REACTION RECOCKING CHECKLIST (Power On Configuration — Copilot reads) (Cont)

5. Generators 1 & 7 - OFF (CP)
6. Engine Starter Switches - OFF and PNEUMATIC (CP)
7. Throttles 1, 2, 7, & 8 - 75% rpm then CLOSED (P-CP)
8. Arming Lever Safety Pins (No. 1) - Installed (P-CP)
9. Radar Altimeter - OFF (P)
10. AGM-69A Launcher Hydraulic Control Switch - OFF (P)
11. Fuel Transfer - As required (CP)
12. Parking Brakes - Set (P)
13. Anticollision & Navigation Lights - OFF and STEADY (CP)
14. Standby Pump Switches - STBY (P)
15. Engine Anti-Icing Switch - OFF (P)
16. Bomb Doors - CLOSED (P/RN)
17. Manifold Valve - OPEN (CP)
18. Sliding Windows - Open (P-CP)
19. BNS and EVS - OFF (RN)
20. Flaps - As required (CP)

Flaps may be up or down as dictated by climatic conditions and removal of ground power equipment.
21. Fuel Panel Switches - 1, 2, 3, & 4 ON; 13 & 16 OPEN; 26 & 28 ENGINE FEED (CP)
Checked (P)
22. Air Conditioning - RAM (CP)
23. Generators 1, 5, & 7 (External Power Not Available) - OFF (CP)
24. Generators (External Power Available) - OFF (CP)
25. External Power - ON (CP)
26. Wheel Chocks - In place (GC)

QUICK REACTION RECOCKING CHECKLIST (Power On Configuration — Copilot reads) (Cont)

27. Throttles (except No. 3) - 75% rpm, then CLOSED (P-CP)

28. Engine Ignition Circuit Breakers - Pulled (P-CP)

Pull four engine ignition circuit breakers on each load central.

29. Cartridge Installed on Engine No. 5 (GC)

30. Generator No. 3 - OFF (CP)

31. Throttle No. 3 - 75% rpm, then CLOSED (P)

32. Cartridges Installed on Remaining Engines (GC)

33. Engine Ignition Circuit Breakers - In (P-CP)

Check that circuit breakers are reset after starter cartridges are installed.

WARNING

Before pushing engine ignition circuit breakers in on each load central, assure that ground crewmember is clear of engine starter exhaust area.

34. Oxygen - As required (ALL)

35. Engine Starter Switches - START and FLIGHT (CP)

36. Antiskid Switch - ON, guard closed (P)

If the aircraft has been towed, reposition the antiskid switch ON, guard closed.

37. Circuit Breakers - Set (P-CP)

38. Downlocks & Bypass Keys - Stowed (N-GC)

If the aircraft has been towed, ascertain that the downlocks and bypass keys have been removed and stowed.

39. Entrance Hatch - As required (P-N-GC)

40. Heading Indicator (Gyro) - Checked and set (P)

This could be the primary heading reference for takeoff.

41. Crosswind Crab Knob & Indicator - Down and zero (P)

42. Seat, Rudder Pedals, and Control Columns - Adjusted and checked (P-CP)

43. Rudder Elevator Hydraulic Switches - ON (P)

QUICK REACTION SCRAMBLE CHECKLIST (Power On Configuration — CP/EW reads)

During Quick Reaction Power On Configuration, use the following Scramble checklist.

NOTE

- The Quick Reaction Power On Scramble Checklist places aircrews in the optimum sustainable response position. While in this posture, crews must insure that they accomplish all steps necessary for rapid takeoff capability.
- Takeoff data and stabilizer trim must be updated and reviewed as necessary. They are not included again in the checklist. Flaps should be left in the down position unless climatic conditions or ground equipment (AGE) positioning dictate otherwise. If possible, windows and hatches should be kept in the closed and locked position.
- Crew equipment should be on or readily available.
- BOLD FACE items must be completed before takeoff is initiated.
- If determined previously to be inappropriate for takeoff or already accomplished, asterisked (*) items should be omitted from this checklist.
- The EW officer may not be available to aid in checklist completion.

1. PITOT HEAT — ON (P)**2. START ENGINES — STARTED (P-CP)****3. MANIFOLD VALVE SWITCH — CLOSED (CP)****4. GENERATORS — ON (CP)****5. YAW & PITCH SAS SWITCHES — ENGAGE, LIGHTS OUT (P)*****6. WINDOWS & HATCHES — CLOSED AND LOCKED (P-CP-N)****7. GROUND REMOVE WHEEL CHOCKS, CLEAR AIRCRAFT FOR TAXI, DISCONNECT INTERPHONE — ROGER (GC)****NOTE**

Taxiing may be initiated at any time after this item when a visual signal is received indicating all equipment and personnel are clear.

8. ANTICOLLISION LIGHTS - ON (CP)***9. FLAP LEVER — DOWN (CP)**

Lower flaps after clear of ground power equipment.

10. ENGINE ANTI-ICING — CLIMATIC (P)***11. STABILIZER TRIM — SET FOR TAKEOFF (P-CP)****12. STARTER SELECTOR — FLIGHT (CP)**

QUICK REACTION SCRAMBLE CHECKLIST (Power On Configuration — CP/EW reads) (Cont)**13. STARTERS — ON (IF APPLICABLE) (CP)*****14. TAKEOFF DATA — REVIEWED (P-CP-N)**

Review S1 speed and time.

15. IFF - NORM (mode and code as briefed) (P)**16. TAKEOFF — USE NORMAL TAKEOFF PROCEDURES (P-CP)****NOTE**

- Pilots will monitor extension of flaps to insure flaps are 70% extended taking the runway. Copilot will check flap indicator for full extension at the 70 knot call.
- After the aircraft is safely airborne, the "Starting Engines and Before Taxiing," "Taxing," and "Before Lineup" checklist should be reviewed and applicable items not previously completed should be performed when time permits.

QUICK REACTION RECOCKING CHECKLIST (Power Off Configuration — Copilot reads)**NOTE**

- Quick reaction configuration may be assumed from a normal alert posture. Assumption from this posture will require completion of the Quick Reaction Recocking Checklist. If engines are not started, accomplish only applicable items. Quick reaction may also be assumed through normal generation procedures. Assumption from this method requires completion of all checklists through Starting Engines and Before Taxiing to cock the aircraft. The Quick Reaction Recocking Checklist (Power Off Configuration) may be used after starting engines to taxi to the Quick Reaction parking area if applicable.
 - Windows may be left open as provided in the checklist, but hatches will remain closed except as provided in local plans for crew relief and/or change-over.
 - Flight crews will insure that takeoff data and trim are updated at all times as climatic conditions require. Any significant change will be reviewed by the pilot, copilot, and navigator.
 - Insure that aircraft is parked where Command Post radio reception is possible.
 - Ground crew support for engine start must be provided from additional sources.
1. IFF - STBY mode 4 as briefed (P)
 2. Yaw & Pitch SAS Switches - DISENGAGE (P)
 3. Pitot Heat & Windshield Anti-Icing - OFF (P)

QUICK REACTION RECOCKING CHECKLIST (Power Off Configuration — Copilot reads) (Cont)

4. EVS Power Switches - OFF (P-CP)

NOTE

Unless local conditions and/or command directives dictate otherwise, steps "5," "6," and "7" should be accomplished as soon as practical to conserve fuel.

5. Generators 1 & 7 - OFF (CP)
6. Engine Starter Switches - OFF and PNEUMATIC (CP)
7. Throttles 1, 2, 7, & 8 - 75% rpm then CLOSED (P-CP)
8. Arming Lever Safety Pins (No. 1) - Installed (P-CP)
9. Radar Altimeter - OFF (P)
10. AGM-69A Launcher Hydraulic Control Switch - OFF (P)
11. Fuel Transfer - As required (CP)
12. Parking Brakes - Set (P)
13. Standby Pump Switches - STBY (P)
14. Engine Anti-Icing Switch - OFF (P)
15. Bomb Doors - CLOSED (P/RN)
16. Manifold Valve - OPEN (CP)
17. Sliding Windows - Open (P-CP)
18. BNS and EVS - OFF (RN)
19. Flaps - As required (CP)

Flap position may be up or down as dictated by climatic conditions and removal of ground power equipment.

20. Fuel Panel Switches 1, 2, 3, & 4 ON; 13 & 16 OPEN; 26 & 28 ENGINE FEED (CP) Checked (P)
21. Air Conditioning - RAM (CP)
22. Generators 1, 5 & 7 - OFF (CP)
23. Wheel Chocks - In place (GC)
24. Throttles (Except No. 3) - 75% rpm, then CLOSED (P-CP)
25. Engine Ignition Circuit Breakers - Pulled (P-CP)

Pull four engine ignition circuit breakers on each load central.

QUICK REACTION RECOCKING CHECKLIST (Power Off Configuration — Copilot reads) (Cont)

- 26. Cartridge Installed on Engine No. 5 (GC)
- 27. Heading Indicator - Checked and set (P)
- 28. Generator No. 3 - OFF (CP)
- 29. Throttle No. 3 - 75% rpm, then CLOSED (P)
- 30. Generator Switches - ON (CP)
- 31. Cartridges Installed on Remaining Engines (GC)
- 32. Engine Ignition Circuit Breakers - In (P-CP)

Check that circuit breakers are reset after starter cartridges are installed.

WARNING

Before pushing engine ignition circuit breakers in on each load central, assure that ground crewmember is clear of engine starter exhaust area.

- 33. Oxygen - As required (ALL)
- 34. Parking Brakes - OFF (P)
- 35. Battery - OFF (CP)
- 36. Engine Starter Switches - START and FLIGHT (CP)
- 37. Pitot Heat & Windshield Anti-Icing - ON and NORMAL (P)
- 38. IFF - NORM (mode and code as briefed) (P)
- 39. Antiskid Switch - ON, guard closed (P)

If the aircraft has been towed, reposition the antiskid switch ON, guard closed.

- 40. Interphone - OFF (P)
- 41. Circuit Breakers - Set (P-CP)
- 42. Entrance Light - OFF (P)
- 43. Downlocks & Bypass Keys - Stowed (N-GC)

If the aircraft has been towed, ascertain that the downlocks and bypass keys have been removed and stowed.

- 44. Crosswind Crab Knob & Indicator - Down and zero (P)
- 45. Seat, Rudder Pedals, and Control Columns - Adjusted and checked (P-CP)
- 46. Rudder Elevator Hydraulic Switches - ON (P)

QUICK REACTION SCRAMBLE CHECKLIST (Power Off Configuration — CP/EW reads)

During Quick Reaction Power Off Configuration, use the following Scramble checklist.

NOTE

- Crews must insure that they accomplish all steps necessary to insure rapid takeoff capability.
- Takeoff data and stabilizer trim must be updated and reviewed as necessary. They are not included again in the checklist. Flaps should be left in the down position unless climatic conditions or ground equipment (AGE) positioning dictate otherwise. If possible, windows and hatches should be kept in the closed and locked position.
- BOLD FACE items must be completed before takeoff is initiated.
- Crew equipment should be on or readily available.
- If determined previously to be inappropriate for takeoff or already accomplished, asterisked (*) items should be omitted from this checklist.
- The EW officer may not be available to aid in the checklist completion.

1. INTERPHONE — ON (P)
2. BATTERY SWITCH — ON (CP)
3. PARKING BRAKES — SET (P)
4. START ENGINES — STARTED (P-CP)
5. MANIFOLD VALVE SWITCH — CLOSED (CP)
6. GENERATORS — CHECKED (CP)
7. YAW & PITCH SAS SWITCHES — ENGAGE, LIGHTS OUT (P)
- *8. WINDOWS & HATCHES — CLOSED AND LOCKED (P-CP-N/G)
9. GROUND REMOVE WHEEL CHOCKS, CLEAR AIRCRAFT FOR TAXI, DISCONNECT INTERPHONE — ROGER (GC)

NOTE

Taxiing may be initiated at any time after this item when a visual signal is received indicating all equipment and personnel are clear.

10. ANTICOLLISION & NAV LIGHTS - ON AND STEADY (CP)
- *11. FLAP LEVER — DOWN (CP)

Lower flaps after clear of ground power equipment.

QUICK REACTION SCRAMBLE CHECKLIST (Power Off Configuration — EW reads) (Cont)

- 12. ENGINE ANTI-ICING — CLIMATIC (P)
- *13. STABILIZER TRIM — SET FOR TAKEOFF (P-CP)
- 14. STARTER SELECTOR — FLIGHT (CP)
- 15. STARTERS — ON (IF APPLICABLE) (CP)
- *16. TAKEOFF DATA — REVIEWED (P-CP-N)

Review S1 speed and time.

- 17. TAKEOFF — USE NORMAL TAKEOFF PROCEDURES (P-CP)

NOTE

- Pilots will monitor extension of flaps to insure flaps are 70% extended taking the runway. Copilot will check flap indicator for full extension at the 70 knot call.
- After the aircraft is safely airborne, the "Starting Engines and Before Taxiing," "Taxiing," and "Before Lineup" checklist should be reviewed and applicable items not previously completed should be performed when time permits.

ACCEPTANCE AND/OR FUNCTIONAL CHECK FLIGHT CHECKS

Procedures and criteria for functional check flights will be accomplished in accordance with T.O.'s 1B-52G-6CF-1 and 1B-52G-6CF-1-1. Acceptance and/or Functional Check Flight Procedures manuals. Each manual contains amplified checklists identified as "Before Inflight Checklists," "Inflight System

Operational Checks," and "After Inflight Checklists." Flight crew abbreviated checklists are contained in T.O.'s 1B-52G-6CL-1 thru -6. The "Emergency Procedures" contained in T.O. 1B-52G-1 will be used. Aircraft requiring functional check flights are redelivered aircraft, modification maintenance aircraft, and aircraft wherein maintenance performed requires a functional check flight as specified in T.O. 1-1-300.

Emergency Procedures

section III

INTRODUCTION

This section contains text and amplified checklists to describe procedures to be followed in any emergency except those in connection with auxiliary equipment. The text is divided into primary paragraphs in accordance with the type of emergency, and where applicable, is followed by an amplified checklist for that particular emergency. The amplified checklists describe in detail the action to be taken. Certain actions are printed in capital and bold face type. These actions are called "critical actions" and constitute the minimum required steps to be taken by a crewmember to insure survival and must be committed to memory. Each crewmember should be thoroughly acquainted with that information covering emergencies which may directly affect his actions.

All steps in each checklist must be accomplished when time permits in order to insure complete control of each emergency. In the event a multiple malfunction or failure occurs and the emergency procedures conflict, perform that procedure which will best control the most critical emergency.

Line items directing standard actions such as alerting the crew and maintaining directional control or items involving a crewmember's analysis and judgment of the particular situation (i. e., land as soon as practicable) are not included as critical emergency steps, but will apply to all critical emergencies. The procedures in this section are based on the assumption that all crewmembers will be alerted to the emergency condition as soon as possible.

The pilot's overall analysis of any malfunction or emergency is of prime importance in determining the urgency to land. The following terminology provides general guidance:

Land As Soon As Possible - The mission will be terminated and an emergency declared. Landing should be accomplished at the nearest suitable base.

Land As Soon As Practicable - The mission should be terminated and landing accomplished at the planned destination or a suitable alternate at the discretion of the pilot.

WHEN ACCOMPLISHING EMERGENCY STEPS, COORDINATED ACTIONS BY CREWMEMBERS ARE ESSENTIAL TO INSURE EACH STEP IS CORRECTLY COMPLETED IN THE PROPER SEQUENCE.

Regular personnel coding is used to designate the crewmembers that will accomplish the actions.

MAINTAIN AIRCRAFT CONTROL

STOP ——— THINK ——— COLLECT YOUR WITS

Maintaining aircraft control is paramount. A thorough evaluation of each emergency should be made prior to initiating corrective action. Pilots must critically evaluate the necessity for an immediate landing versus continued flight or controlled bailout under emergency conditions.

NOTE

Accomplishing "critical actions" steps of any emergency procedures checklist solely and without deviation is the immediate response expected. Failure to follow the proper sequence of the checklist as published can cause subsequent steps to be ineffective, e. g., the subsequent steps may require electrical power, pneumatic pressure, etc., which may no longer be available.

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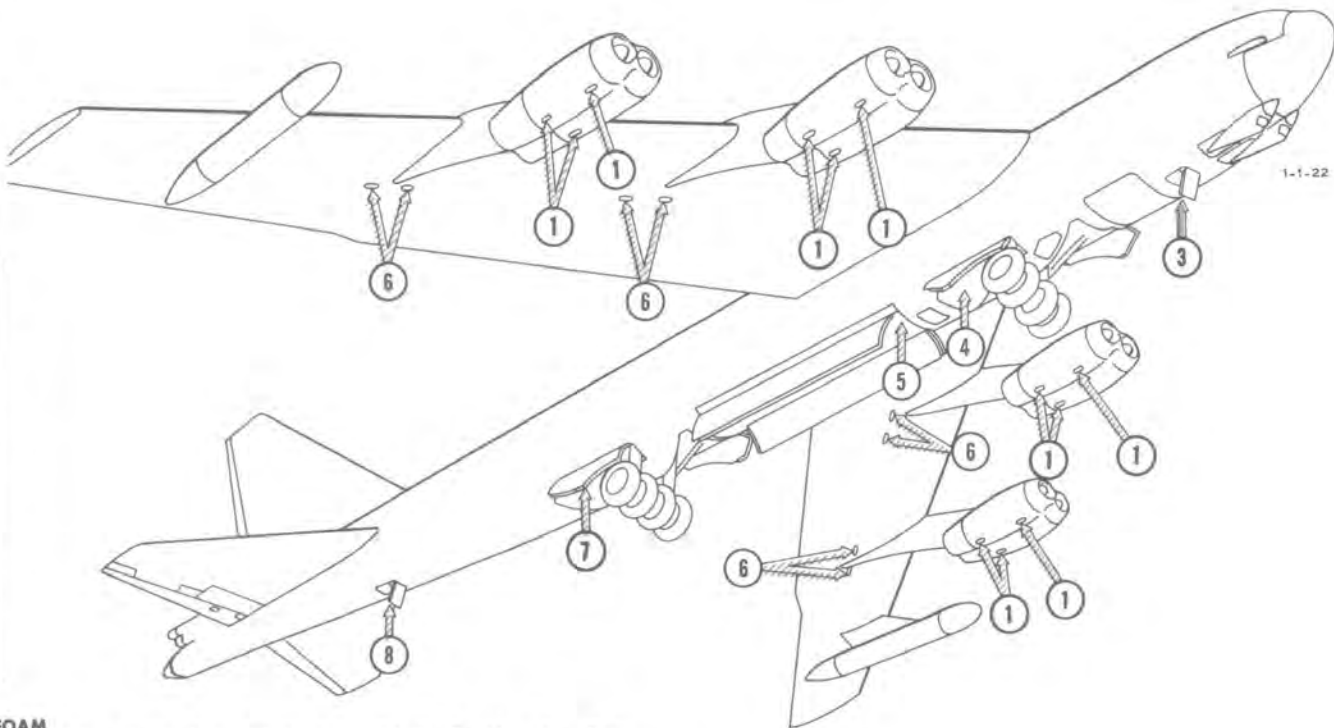
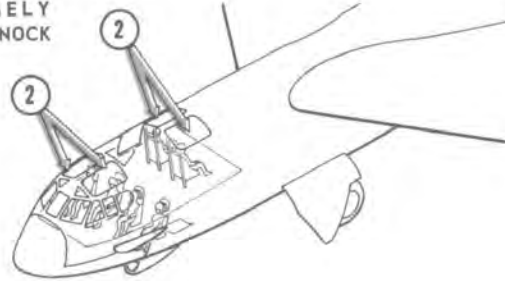
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NOTE

IT IS EXTREMELY
DIFFICULT TO KNOCK
OUT A WINDOW.

-  **PERSONNEL RESCUE ACCESS**
 **GROUND FIRE ACCESS**

**FOAM**

Slightly alkaline. Corrosive if left on. Wash off with water. Non-toxic.

WATER FOG

Plain water. Non-corrosive, non-toxic. No residue.

CO₂

A heavy colorless gas. Leaves the bottle under pressure and extreme low temperature. Evaporates quickly and leaves no residue. Do not remain in confined areas where CO₂ has been released.

CB or CBM (CHLOROBROMOMETHANE)

Toxic. Avoid prolonged or repeated breathing of vapor. Avoid use of water. Heat or moisture breaks down CB into acids which are corrosive to aluminum and other metals. Purge areas with clean dry air.

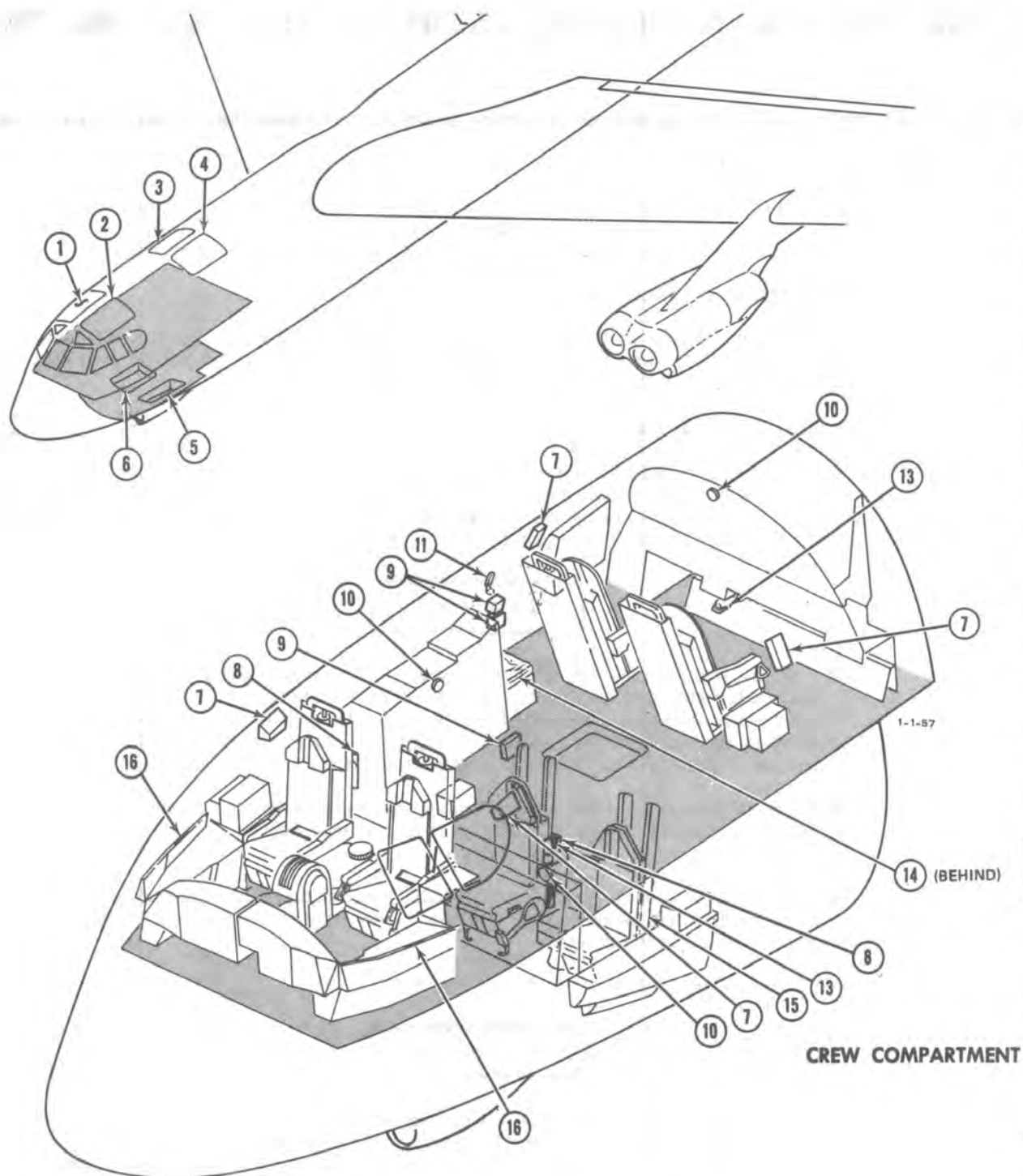
CARBON TETRACHLORIDE

Breaks down to form gases which are highly toxic and corrosive. Avoid prolonged breathing of vapor.

1. ENGINE ACCESSORY AND COMBUSTION SECTION (HINGED SPRING-LOADED DOORS)
2. CREW COMPARTMENT EMERGENCY ENTRANCE THROUGH EJECTION SEAT HATCHES
3. CREW COMPARTMENT NORMAL ENTRY
4. FORWARD WHEEL WELL AREA EQUIPMENT
5. WING FLAP MOTORS IN CENTER WING EQUIPMENT BAY (ACCESS THROUGH BOMB BAY)
6. WING EQUIPMENT BAY ACCESS
7. AFT WHEEL WELL AREA COMPARTMENT
8. AFT EQUIPMENT COMPARTMENT ACCESS

Emergency Entrance and Ground Fire Access

Figure 3-1.



- | | |
|-----------------------------------|--|
| 1. COPILOT'S ESCAPE HATCH | 9. FIRST AID KIT |
| 2. PILOT'S ESCAPE HATCH | 10. EMERGENCY ALARM LIGHT |
| 3. EW OFFICER'S ESCAPE HATCH | 11. EMERGENCY KNIFE (PROVISIONS FOR) |
| 4. GUNNER'S ESCAPE HATCH | 12. (DELETED) |
| 5. RADAR NAVIGATOR'S ESCAPE HATCH | 13. FIRE EXTINGUISHER |
| 6. NAVIGATOR'S ESCAPE HATCH | 14. EMERGENCY AXE |
| 7. ESCAPE ROPE CONTAINER | 15. PARACHUTE STATIC LINE CONTAINER (ON RH RAIL) |
| 8. FIREFIGHTING CONTAINER | 16. LIFERAFT DEFLATION TOOL |

Emergency Equipment

Figure 3-2.

GROUND EMERGENCIES

ENGINE FIRE ON THE GROUND

1. THROTTLE(S) — CLOSED (P)

An engine fire on the ground may be originated and supported by fuel, oil, or hydraulic fluid. When an indication of engine fire is evidenced, the affected engine throttle will be closed. If practicable, the throttle for the adjacent engine should be closed to aid personnel in putting out the fire.

2. FIRE SHUTOFF SWITCH(ES) — PULL (P/CP)

The affected engine fire shutoff switch will be pulled out to assure closing of the firewall fuel shutoff valves in case the throttle fails to do so. The firewall fuel shutoff valves require dc power for operation. See "ENGINE FIRE SHUTOFF SWITCHES," Section I.

3. Starter Switch(es) ON (if air available) - ON (CP)

The most effective means of extinguishing an engine fire is to motor the engine; therefore, it is necessary to have air available to the starter and the starter switch on. Continue motoring the engine until all evidence of the fire has disappeared. An indication of engine fire without air available for motoring may result in a fire which is uncontrollable by the flight crew.

CAUTION

- If engine fire occurs after starter dropout, it will be necessary to turn the starter switch to OFF and back to START in order to motor the engine. Moving the starter switch to OFF, deenergizes the starter lockout relay allowing the starter to be engaged for engine motoring. Ignition should not occur since closing the throttle will interrupt the ignition circuits.
- If engine fire occurs after closing the air bleed manifold valves, they must be reopened to supply bleed air for engine motoring in a nacelle in which the engines have been shut down.
- If the starter selector switch is in FLIGHT position and engine motoring is desired, it will be necessary to place the selector switch to PNEUMATIC to provide air to the starter.

4. Notify Ground Crew & Control Tower - Notified (P/CP)

CAUTION

CO₂ should not be directed into the engine air inlet or tailpipe unless fire is restricted to those areas and is of serious proportions. Shut down the engine if possible, in order to minimize engine damage if CO₂ is to be applied.

5. Throttle(s) Closed - Closed (P)

When fire is out or becomes uncontrollable by the crew, close the throttles to shut down all remaining engines. If fire is uncontrollable, accomplish this step immediately to assist firemen and the first crewmembers who evacuate the aircraft.

6. Starter Switch(es) OFF - OFF (CP)

When the fire is out or becomes uncontrollable by the crew, turn starter switches OFF.

7. If Fire Is Uncontrollable Abandon Aircraft - Abandon aircraft on pilot's order (ALL)

The pilot will activate the abandon light and crewmembers will immediately evacuate the aircraft. Before leaving his position, the copilot will turn controls off or closed and will turn off the battery switch, and external power switch.

NOTE

If external power is connected, the pilot will notify the control tower prior to his evacuation.

WHEEL BRAKE SYSTEM FAILURE

This checklist is primarily designed for loss of braking action during taxi operations. Hydraulic failure procedures affecting brakes and steering during landing that reference this procedure will have provided steps for the operation of antiskid and hydraulic switches. See "Landing With Complete Steering Failure and Landing With Brake System Hydraulic Failure" this section. Therefore, with normal body system hydraulic indications and ineffective or inadequate braking situations arise during high speed aborts or landings, and stopping on the remaining runway is in doubt, the use of this checklist would likely begin with the closing of selected throttles.

1. ANTISKID SWITCH — OFF (IF APPLICABLE) (P)**NOTE**

- Improper servicing of the shock struts or a malfunctioning landing gear safety switch may prevent transfer of the antiskid system from the "airborne" mode to the "ground" mode. If this occurs, the antiskid system automatically releases brakes on the affected gear (possibly all gear) when the aircraft is moving at a slow rate of speed, as during taxiing. When loss of braking due to this condition is experienced, turning the antiskid switch OFF will restore braking action without antiskid protection.
- When the antiskid is OFF, braking action depends entirely on the pressure applied to the brake pedals. Do not pump brakes when only accumulator pressure is available.
- While taxiing on a slippery surface it is possible to lose up to 50% of the effective braking due to locked wheel conditions; however, for this condition leaving the switch ON provides more effective braking action than full braking without antiskid. See "Antiskid Operation," Section VII.

2. BODY SYSTEM STANDBY PUMP SWITCHES — STBY (P)**3. THROTTLES 1, 2, 3, 6, 7 & 8 — CLOSED (P-CP)****NOTE**

Electrical power and hydraulic pressure source is provided by leaving the remaining engines operating. Steer aircraft to avoid collision. If a collision is imminent and the above procedures fail to slow or stop the aircraft, steer toward the selected ground course prior to shutting down remaining engines. Consider steering off prepared surface onto the adjacent sod to slow the aircraft.

4. THROTTLES 4 & 5 — CLOSED (P-CP)

If steering is not available and the above procedures do not slow the aircraft, shut down remaining engines.

TAKEOFF EMERGENCIES

ABORTED TAKEOFF

In event a takeoff emergency arises as a result of engine fire, tire failure, fire during ground roll, or other aircraft malfunction necessitating an aborted takeoff, the procedure to be followed for aborting shall always be the same. Refer to the following checklist for a standard step-by-step procedure for aborting takeoff.

WARNING

Takeoff will not be aborted after S_1 unless, in the opinion of the pilot, the emergency

renders the aircraft definitely unsafe to attain emergency bailout altitude. In those cases where the pilot attempts to abort after S_1 , he must accept the fact that he will probably fail to stop within the confines of the runway.

NOTE

If a water injection takeoff is aborted, water flooding of some engines can occur when the throttles are retarded with the water system switch ON.

ABORT

1. THROTTLES — IDLE (P)
2. AIRBRAKES — SIX (P)
3. DRAG CHUTE — DEPLOY (CP)

The drag chute will be deployed at airspeeds above 70 knots. The maximum drag chute deployment speed is 135 knots.

ABORT (Cont)**4. BRAKES — APPLY (P)**

Full brakes should be applied with the antiskid switch ON. Braking at high speeds with antiskid switch OFF is almost certain to cause locked wheel conditions and tire FAILURES resulting in a serious loss of braking effectiveness. At high speeds initial braking action or response may seem ineffective and be misleading to the pilot causing him to suspect brake failure since optimum braking action cannot be expected until the tires are carrying heavy loads. See "Wheel Brake System Operation," Section VII.

CAUTION

A ground loop should not be attempted at heavy gross weights since structural failure may occur at speeds above 30 knots. A turn of any kind should not be attempted unless conditions straight ahead appear more hazardous.

5. Check Brake Energy Limits - Checked (P/CP)

Refer to instructions provided in Section V to determine the heat energy absorbed during the abort.

**TAKEOFF WITH ONE OR MORE
ENGINES INOPERATIVE**

Takeoff with one or more engines inoperative is not recommended. However, if conditions are such that it becomes necessary or desirable to fly the aircraft to another location, such takeoffs are possible. It will be necessary to consider carefully the field altitude, ambient runway temperature, available runway length, wind velocity, and gross weight at takeoff. With low takeoff gross weight plus the added thrust which can be obtained by water injection to compensate for high ambient field temperatures or high field elevations or both, a successful takeoff will be possible by use of the normal takeoff procedure. Charts are provided in Parts 2 and 3 of the Appendix giving takeoff distances required for seven- and six-engine takeoffs with water injection and for seven engines without water injection.

CAUTION

Because of the reduced thrust available and limited directional control, it is recommended that no takeoffs be made with more than two engines inoperative on the same side.

ENGINE FIRE ON TAKEOFF

If a fire warning light comes on after takeoff is committed, do not retard the throttle for the engine on fire if its thrust is needed for takeoff unless the engine is vibrating seriously. When the landing gear and wing flaps have been retracted and a safe altitude is reached, retard throttle to CLOSED and use "Emergency Shutdown" procedure, this section.

ENGINE FAILURE DURING TAKEOFF

If, for any reason, engine rpm is reduced below 86% during a water injection takeoff, complete thrust loss of that engine and seizure at low rpm may result due to water flooding. If an odd numbered engine rpm is reduced below 86% for any reason, complete thrust loss due to water flooding may occur but will not affect wet thrust on the remaining engines. During a

wet takeoff if an even-numbered engine rpm is reduced below 86% for any reason, complete thrust loss due to water flooding could occur. The wet thrust for the odd-numbered engine of that nacelle would also be lost and its throttle should be advanced to dry takeoff EPR.

TAKEOFF RUN

The possibility of an engine failure during the takeoff run influences takeoff procedure and should always be considered and planned for prior to the time the takeoff run is started. When an engine failure occurs on takeoff, the pilot must be able to stop on the runway remaining or continue the takeoff safely. To aid the pilot in making a decision to stop or continue takeoff, charts are presented in Parts 2 and 3 of the Appendix from which may be determined the decision speed and time (S₁). A check of the airspeed at S₁ will indicate how the aircraft is accelerating. A failing engine may be detected in this manner and, if the decision speed has not been reached, the takeoff must be aborted.

WARNING

Takeoff will not be aborted after S₁ unless, in the opinion of the pilot, the emergency renders the aircraft definitely unsafe to attain emergency bailout altitude. In those cases where the pilot attempts to abort after S₁, he must accept the fact that he will probably fail to stop within the confines of the runway.

TAKEOFF CONTINUED

Be prepared to encounter asymmetric thrust on all takeoffs. Mental preparation has proven to be a significant factor in the successful takeoff with asymmetric thrust. During lineup, pilot and copilot will adjust seat and check full displacement of control column and control wheel; then adjust rudder pedals to enable full displacement. To the pilot flying the aircraft, aircraft yaw will most likely be the first indication of engine failure on takeoff and must be controlled. The pilot should maintain runway centerline. Visually maintaining centerline will ensure proper rudder application. When the yaw forces exceed the capability of rudder/steering, the pilot has two options to maintain aircraft control: 1) reduce

asymmetric thrust or 2) increase flight control effectiveness. Asymmetric thrust can be reduced by retarding throttle(s) for engine(s) opposite to those that have failed. In many cases retarding throttles on takeoff is not recommended. Given full input, flight control effectiveness can be increased by increasing airspeed. Proper pitch control is the pilot's most expeditious method to increase airspeed. Reducing parasite drag and applying asymmetric thrust should also be considered. Conditions permitting, accelerate in ground effect and retract the gear. Energy required for rate of climb can be converted to accelerate the aircraft. Attempt to maintain some bank into the operating engines to take advantage of lateral fuel shift. Do not relax and then reapply control inputs as this will allow the asymmetric condition to become dynamic. Realize it may take some time for the airspeed to increase enough to make the aircraft respond to proper control application.

Landing Gear

If an engine fails during or immediately after the takeoff, climb performance is considerably reduced until the landing gear is retracted. Gear drag lowers the rate of climb approximately 450 feet per minute on takeoff with flaps down on a 400,000-pound aircraft. Therefore, the landing gear should be retracted as soon as possible after the aircraft is airborne. An engine failure decreases the rate of climb about 420 feet per minute under the same conditions.

NOTE

With full control wheel positions, the pilot's view of some instruments, including the airspeed and attitude director indicators, may be obstructed.

Wing Flaps

Wing flap drag increases as the flaps are retracted to the 37.5% position, an increase about equal to the drag that would occur if the landing gear were extended again. After this point in retraction, drag decreases rapidly. It is therefore recommended that with an engine failure on a high weight takeoff, the flaps be left down until a safe altitude is reached and flap retraction can be accomplished in level flight or in a slight dive. Speeds for maximum rate of climb with flaps down while operating on eight or seven engines are presented in Part 4 of the Appendix.

ENGINE FAILURE/FIRE ON TAKEOFF — TAKEOFF CONTINUED

1. ENGINE(S) — SHUTDOWN (P-CP)

Use "Emergency Engine Shutdown" procedures when a safe altitude and airspeed are reached.

TAKEOFF WITH BADLY UNBALANCED TIRE

The landing gear can be seriously damaged under high speed ground run conditions (such as takeoff or landing ground run) with a badly unbalanced tire. A blowout and subsequent high speed wheel rotation may result in partial disintegration of the tire and cause such an unbalance. Therefore, prior to every takeoff following a braked landing (other than a taxi-back landing using normal braking) or refused takeoff, a visual inspection should be made to determine the safe condition of the tires. In addition, if a tire failure is suspected on takeoff before S_1 is reached, the takeoff should be discontinued. If a strong vibration is experienced or tire failure occurs after S_1 is reached, brakes should be applied immediately after the aircraft leaves the ground to minimize possible damage from resultant vibration. Assessment of

damage by a crewmember or chase plane should be the first consideration after wheel rotation is stopped. The landing gear should not be retracted until assessment of damage has been accomplished. The condition of tires, structure, and adjacent system components should be ascertained before any decisions are made. An unbalanced tire condition will be impossible to determine visually unless obvious tire failure can be seen. Failed tire condition (blown out, flat, or chunk loss) can usually be determined by visual inspection. If assessment of damage reveals no degradation of airworthiness, the mission could be continued with either an unbalanced or failed tire condition. However, unless otherwise warranted, it is recommended that the mission be aborted. If necessary to continue the mission, the landing gear should be retracted only after wheel rotation has stopped and hydraulic system pressures have been checked for satisfactory indications.

CRASH LANDING OR DITCHING IMMEDIATELY AFTER TAKEOFF

NOTE

- If a crash landing must be made, the touchdown should be accomplished in a wings level attitude.
- For crash landing or ditching immediately after takeoff the crew will be alerted over interphone rather than by use of the emergency alarm switch to prevent the possibility of incorrectly positioning the switch or of improper crew response. Just prior to touchdown, crewmembers will be notified over interphone to brace for impact.

1. LANDING GEAR — DOWN (UP FOR DITCHING) (CP)

Landing gear will only be lowered after it has definitely been determined that a crash landing will be made.

2. THROTTLES — CLOSED (AFTER IMPACT) (P)

WARNING

Do not cut engines prior to touchdown. This would result in an immediate loss of all primary electric power. Electrical control of stabilizer trim will be lost. The spoilers will operate at a reduced rate on windmill rpm hydraulic pressure.

3. DRAG CHUTE — DEPLOY (CP)

4. BATTERY SWITCH — OFF (CP)

5. Abandon Aircraft - Abandon (ALL)

Remain in positions until aircraft comes to complete stop. After complete stop is made, pilot places emergency alarm switch to ABANDON. Remove upper escape hatches and all crewmembers exit using escape ropes.

WARNING

- To prevent personal injury, ascertain that the escape ropes are fully extended before using them.
- Crewmembers must be aware of protruding objects on the sides of the aircraft fuselage such as pitot tubes, antennas, etc. Attempt to avoid these objects by pushing away from the fuselage with your feet.

LANDING GEAR FAILURE TO RETRACT**Main Gear Fails to Retract****1. Center Crosswind Knob - Centered (P)**

If landing gear appears to be centered and fails to retract, leave the landing gear lever in GEAR UP, hold rudder pedals neutral, and use 5° right and/or left crosswind crab control. If the gear was not centered, it should retract when it reaches center position. If gear does not retract, proceed with step "2."

2. Check Hydraulic Pressure - Checked (P)

Check hydraulic pressure on affected body system. If pressure is normal, proceed with step "3." If pressure is low, proceed to step "4."

3. Hydraulic Pressure Normal, Accomplish the Following:**a. Pull Normal Gear Control Circuit Breakers for All Unaffected Gear - Pulled (CP/EW/G)**

By pulling the normal gear control circuit breakers for all unaffected gear, the unaffected gear will not be recycled unnecessarily.

b. Recycle Landing Gear - Recycled (CP)

Position gear handle to GEAR DOWN and wait for the gear down indication; then return gear handle to GEAR UP. (Observe landing gear retraction placard speed.)

c. Reset All Normal Gear Control Circuit Breakers - Reset (CP/EW/G)**NOTE**

If an extended gear cannot be retracted and it is decided to continue the mission (training only), pull the normal gear control circuit breaker for the affected gear. This will prevent inadvertent retraction of the gear while exceeding gear retraction airspeed limitations. Reset the normal control circuit breaker for the affected gear after landing gear extension for landing.

d. Place Landing Gear Emergency Switch to RETRACT (EWO Only) - RETRACT (P)

If gear does not indicate up and locked after recycling and if opposite body system pressure is normal, move the respective landing gear emergency switch to RETRACT.

CAUTION

To reduce the possibility of system damage, do not change operating position of emergency switch while the gear is in motion.

NOTE

Pressure for emergency actuation of a main gear is provided by the opposite body system.

LANDING GEAR FAILURE TO RETRACT (Cont)

- e. Place Landing Gear Emergency Switch OFF - OFF (P)

As soon as landing gear is up and locked, return emergency switch to OFF. Do not reposition emergency switch to RETRACT unless the gear attempts to move from up with the switch OFF.

CAUTION

There are no limit switches in the emergency system and the emergency circuits are energized when the emergency switch is out of OFF.

- f. If gear has not retracted, it is possible that a partial gear landing will be necessary. See "Landing With Partial Gear Checklist," this section.

4. Hydraulic Pressure Low, Accomplish the Following:

- a. Pull Normal Gear Control Circuit Breaker for the Affected Gear - Pulled (CP/EW/G)

If any main gear does not indicate up and locked and pressure is low on the affected body system, a ruptured hydraulic system may have occurred. Pull the normal gear control circuit breaker for the affected gear. Pulling the breaker will deactivate the gear normal control valve and may prevent loss of fluid from a malfunction downstream of the normal control valve.

NOTE

If the circuit breaker is found to be tripped, reset it and observe position indicator.

- b. Place Landing Gear Emergency Switch to RETRACT (EWO only) - RETRACT (P)

If opposite body system pressure is normal, move the respective landing gear emergency switch to RETRACT for a period not exceeding 10 seconds if landing gear does not move.

CAUTION

- Actuation of the landing gear emergency switch for more than 10 seconds without gear movement may result in complete loss of the opposite body hydraulic system fluid.
- To reduce the possibility of system damage, do not change operating position of emergency switch while the gear is in motion.

NOTE

Pressure for emergency actuation of a main gear is provided by the opposite body system.

LANDING GEAR FAILURE TO RETRACT (Cont)

- c. Place Landing Gear Emergency Switch OFF - OFF (P)

As soon as landing gear is up and locked, return emergency switch to OFF. Do not reposition emergency switch to RETRACT unless the gear attempts to move from up with the switch OFF.

CAUTION

There are no limit switches in the emergency system and the emergency circuits are energized when the emergency switch is out of OFF.

- d. If gear has not retracted, it is possible that a partial gear landing will be necessary. See "Landing With Partial Gear Checklist," this section.

Tip Gear Fails to Retract**NOTE**

There is no provision for emergency retraction of the tip gear.

1. Check Hydraulic Pressure - Checked (P)

Check hydraulic pressure on affected outboard wing system. If pressure is normal, proceed with step "2." If pressure is low, proceed to step "3."

2. Hydraulic Pressure Normal, Accomplish the Following:

- a. Pull Normal Gear Control Circuit Breakers for All Unaffected Gear - Pulled (CP/EW/G)

By pulling the normal gear control circuit breakers for all unaffected gear, the unaffected gear will not be recycled unnecessarily.

- b. Recycle Landing Gear - Recycled (CP)

Position gear handle to GEAR DOWN and wait for the gear down indication; then return gear handle to GEAR UP (observe tip gear retraction placard speed).

- c. Reset All Normal Gear Control Circuit Breakers - Reset (CP/EW/G)

3. Hydraulic Pressure Low, Pull the Normal Gear Control Circuit Breaker for the Affected Gear - Pulled (CP/EW/G)

If either tip gear does not indicate up and locked and pressure is low on the affected outboard wing system, a ruptured hydraulic system may have occurred. Pull the normal gear control circuit breaker for the affected gear. Pulling the breaker will deactivate the gear normal control valve and may prevent loss of fluid from a malfunction downstream of the normal control valve.

NOTE

If the circuit breaker is found to be tripped, reset it and observe position indicator.

4. If gear has not retracted, it is possible that a partial gear landing will be necessary. See "Landing With Partial Gear Checklist," this section.

RUNAWAY OR UNSCHEDULED STABILIZER TRIM**NOTE**

For complete information on nose high and dive recoveries, see "Recovery from Unusual Maneuvers," Section VI.

1. AUTOPILOT — DISENGAGE (P/CP)

As soon as an unscheduled trim indication is noted, the pilot flying the aircraft will immediately apply control column movement, actuate autopilot release button, reposition the trim button to neutral, and monitor the manual trim wheel to make sure the trim has stopped. Apply electrical trim so that the manual trim wheel moves in the desired direction to reduce control column force. At the same time, the pilot not flying the aircraft checks the servos engage switch to DISENGAGE.

2. STABILIZER TRIM CUTOUT SWITCH — CUTOUT (P/CP)

If electrical trim cannot be obtained in the desired direction or cannot be stopped, the stabilizer trim cutout switch will be actuated to CUTOUT. The stabilizer trim cutout switch should be retained in CUTOUT (guard open) to insure that the electrical trim circuit remains interrupted.

WARNING

Do not use the stabilizer trim cutout switch until positive that the attitude change is due to runaway trim.

3. Set Airbrakes - Set (as required) (P)

The pilot may raise the airbrakes to help raise the nose or lower the airbrakes, if they were up, to lower the nose.

WARNING

Incorrect actuation of the airbrakes during recovery from a runaway or unscheduled trim condition will aggravate an already dangerous situation. Caution should be exercised not to retract extended airbrakes during a nosedown trim condition and, conversely, airbrakes should not be extended during a noseup trim condition.

4. Trim Manually - Trimmed (P/CP)

Pilot utilizes the manual trim wheel to reposition the stabilizer. If the application of opposing control column movement and the actuation of the cutout switch plus the autopilot disengagement fail to stop the trim runaway, the manual trim wheel must be held against rotation.

COMPLETE FAILURE OF ALL GENERATORS**1. MASTER ISOLATE SWITCH — PUSH IN AND HOLD WHILE PLACING GENERATOR SWITCHES ON (CP)****WARNING**

If generator failure is encountered before water has depleted during water injection takeoff, turn off water prior to placing generator switches ON to preclude engine flameout.

2. Reduce Electrical Loads - Reduced (ALL)

Copilot monitor ac ammeters for overload indications. Pilot will notify crew to reduce unnecessary electrical loads (e.g., BNS, FCS, and ECM).

3. Check Frequencies & Voltages - Checked (CP)

Check frequency and voltage of each generator using the frequency and voltage selector switch to detect malfunctioning generator.

4. Generator Switch for Operating Generator ON - ON (CP)

Place generator switch for one good operating generator ON to provide an electrical power source to the central bus tie.

5. Generator Switch for Malfunctioning Generators OFF - OFF (CP)

Generators that will not restart or are malfunctioning will be turned off.

6. Generator Switch for Operative Generators ON - ON (CP)

Reparallel all good generators.

NOTE

If all generators fail to restart, see "Conservation of Battery Power Checklist," this section.

INFLIGHT EMERGENCIES

ENGINE FAILURE

The failure of engine 1, 3, 5, or 7 will be accompanied by the loss of electrical power from the generator geared to that engine. See "Electrical System Emergency Operation," this section. Failure of engine 1, 3, 4, 5, 6, or 7 will result in loss of, or reduced, fluid flow in the hydraulic system which is serviced by the respective engine-driven hydraulic pump installed on that particular engine. Even through an engine has failed but is windmilling, near normal system operation can be expected since system pressure will be maintained until the engine reaches a low windmilling speed. See "Landing With Brake System Hydraulic Failure" and "Hydraulic System Emergency Operation" this section.

ENGINE FAILURE INDICATIONS

The first and most positive indication of an engine failure affecting thrust will be a change in the engine pressure ratio gage reading. This method will determine the failure of any engine during takeoff, climb, cruise, or descent. In addition, rpm, exhaust temperature, oil pressure, and fuel flow may change, depending on the type of failure. Severe engine vibration may indicate internal failure of an engine. Aircraft yaw may give a good indication of failure if an outboard engine fails. The failure may be overlooked, however, if one of the inboard engines fail, especially if the aircraft is in a turn.

CAUTION

- Serious engine damage can occur from bird ingestion without accompanying abnormal indications on engine instruments. If bird ingestion is known or suspected, shut the engine down unless its operation is necessary to maintain safe flight.
- Vibration associated with internal failure of an engine can be of severe magnitude and prolonged exposure can result in structural damage to the engine mount components with possible engine separation. If vibration continues in a nacelle after shutdown of both engines avoid flight over populated areas and land as soon as practical. A reduction in IAS and/or altitude should be made to reduce windmill rpm.

ENGINE FAILURE DURING CLIMB

Engine failure during a climb is not considered critical provided the recommended airspeed climb schedule is followed. If an engine failure is encountered during a climb, the airspeed or rate of climb or both will decrease. If the mission is to be continued, a new climb schedule will have to be flown. Directional control can be maintained easily by adding rudder trim and a slight amount of lateral trim.

ENGINE FAILURE DURING CRUISE

If an engine fails during a cruise condition, cut the engine by moving the throttle to CLOSED position. Compensate for the unbalanced thrust condition by adding appropriate directional and lateral trim. Failure of an engine during cruise will not appreciably affect directional control but will result in a decrease in the speed being flown. Normally, the cruise altitude will also be decreased depending on the amount of fuel remaining, type of mission being flown, etc. Applicable charts covering eight-, seven-, and six-engine operation are included in Part 5 of the Appendix. If the engine which failed was not on fire and the malfunction can be corrected, restart the engine as outlined under "Engine Air Starting," this section.

CAUTION

On engines 1, 3, 4, 5, 6, or 7, the engine fire shutoff switch should not be pulled except when a definite requirement exists; such as fire, fuel leak, throttle control fails to shut down the engine, etc. Leaving the hydraulic shutoff valve open when not required to be closed will prevent damage to the engine-driven hydraulic pump. When the hydraulic shutoff valve is closed, damage will be caused from hydraulic fluid starvation while the engine is windmilling. If the fire shutoff switch was pulled, it may be reset in accordance with instructions in the "Emergency Engine Shutdown" checklist.

ENGINE FIRE WARNING LIGHT(S) ILLUMINATED

If engine fire warning light(s) come on shutdown engine(s) in accordance with the "Emergency Engine Shutdown" checklist, this section.

EMERGENCY ENGINE SHUTDOWN**1. THROTTLE(S) — CLOSED (P)****2. FIRE SHUTOFF SWITCH(ES) — PULL (IF REQUIRED) (P/CP)**

- a. This assures closing of the firewall fuel shutoff valves in case the throttle fails to do so. If the engine drives a generator, the switch will also turn the generator off and open the generator circuit breaker. If the engine drives a hydraulic pump, the hydraulic shutoff valve will be closed and no hydraulic pressure will be received from that engine.
- b. After closing the throttle and pulling the fire shutoff switch, if fire warning light continues to illuminate, shut down adjacent engine in nacelle. If fire warning light goes out do not restart either engine in nacelle. If fire warning light does not go out both engines should normally remain shutdown. However, multiple failures may cause the pilot to consider restarting an engine shutdown for precautionary reasons (so long as no additional indications of fire or overheating are noted), e.g., a critical need for electrical power, or for thrust when a marginal go-around capability exists.

CAUTION

- Except on engine(s) shut down for fire or fuel leak, when windmilling above 25% rpm, have fuel available to the firewall fuel shutoff valve, push the engine fire shutoff switch in, and advance the throttle to IDLE for 3 minutes out of every hour to prevent overheating the fuel control unit. If the firewall fuel shutoff valve circuit breaker has been pulled during shutdown of engines, the respective firewall fuel shutoff valve circuit breaker must be reset in order to obtain fuel to the engine.
- If engine 1, 3, 4, 5, 6, or 7 is still windmilling after the fire is extinguished, the hydraulic shutoff valve can be reopened to prevent damage to the pump by pulling the corresponding firewall fuel shutoff valve circuit breaker and returning the engine fire shutoff switch to the NORMAL position. Before reopening the hydraulic shutoff valve, insure that the starter switch is OFF. If the starter switch is placed to START with the firewall fuel shutoff valve circuit breaker pulled, continuous ignition will be provided regardless of throttle position on the affected engine. If the fire reignites due to opening of hydraulic shutoff valve, engine fire shutoff switch should be pulled for complete shutdown.

3. Starter Switch(es) OFF - OFF (CP)**CAUTION**

- Insure that the starter switches for engines which have been shut down are OFF and remain OFF for the remainder of flight unless intentional engine air starting is accomplished.
- When fuel is available to an engine, even with some failures of the fuel control unit, restart could occur if the starter switch is placed to START and the throttle is moved out of the CLOSED position. Continuous ignition will occur regardless of throttle position if the firewall fuel shutoff valve circuit breaker is out and the starter switch is placed to START.

4. Check AC Electrical Loads - Checked (CP)

If the failed engine is one which drives a generator, check that the remaining generators are not overloaded. Reduce loads if necessary.

EMERGENCY ENGINE SHUTDOWN (Cont)

5. Bleed Selector Switch EMERGENCY RH INBD If Engines 3 & 4 Shut Down - EMERGENCY RH INBD (CP)

Use bleed selector switch as required:

- a. When emergency shutdown is necessary on both engines of nacelle No. 2, switch to EMERG RH INBD.
- b. Leave switch in NORMAL LH INBD position if fire occurs on engines of No. 1, 3, or 4 nacelles.

See "Emergency Operation of Air Conditioning System," Section IV.

CAUTION

An engine air start after an emergency shutdown should not be attempted unless it is ascertained that it is reasonably safe to do so. A recurrence of the emergency condition could be more serious than the first occurrence.

6. Persistent Engine Fire in Flight:

NOTE

If fire persists, it may be possible to save the aircraft by allowing the fire to burn the nacelle off the strut.

- a. Increase Airspeed to Maximum - Increased (as applicable to configuration) (P)

Increase airspeed to maximum allowable for the configuration and initiate a shallow descent if conditions permit. Descent will increase acceleration to maximum speed and decrease the angle of attack. Both the increased airspeed and the resultant decreased angle of attack will help keep fire from the wing until the fire is extinguished or controlled.

- b. Observe Cowling, Strut & Wing - Observing (if conditions permit) (P/CP)

If conditions permit, maintain visual surveillance of affected area. When blackened discoloration appears on the cowling, burn-through is probably only a few seconds away and fire will be exposed to airstream. If fire intensifies and spreads to the strut area, the upper strut surface and the wing should be closely observed. Discoloration of the upper strut indicates the fire will probably spread to the wing. Discoloration may be very difficult to detect with a camouflaged aircraft.

NOTE

Cowling burn-through should not be confused with fire burning into the wing.

- c. Abandon Aircraft If Fire Appears to Be Burning into Wing - Abandon aircraft on pilot's order (ALL)

7. Monitor Fuel System Management - Monitored (CP)

NOTE

At any time an engine is shut down or any unusual combination of engines is used, care should be taken to manage fuel so as to maintain proper center of gravity and fuel distribution. See Section V for further information about fuel loading and cg location. Also, see "Fuel Management for Lateral Trim and Wing Fuel Unbalance," under "Climb," Section II.

ENGINE AIR STARTING

The airstart envelope (figure 3-3) indicates the altitude and indicated airspeed envelope in which windmilling starts normally should be attempted. The rpm lines on the curve are approximate. Starts may be attempted up to the airspeed limits of the aircraft. Starts made at an rpm below 65% are termed "airstarts." Starts made above 65% rpm are termed "relights." The starting rpm of different engines is variable depending on the resistance to normal windmilling rpm created by the engine-driven accessories. Engines 4 and 6, which provide power to operate hydraulic pumps, windmill at slightly lower rpm than engines 2 and 8 when the hydraulic pumps are supplying pressure. Engines 1, 3, 5, and 7, which are equipped with engine-driven generators and hydraulic pumps, have a windmilling rpm which is approximately 4% lower than engines 2 and 8 when the hydraulic pumps are supplying pressure. Windmilling engine speeds may be developed up to 45% rpm with variations of airspeed and altitude. Considering that the engines do not develop the same windmilling rpm under the same airspeed and altitude conditions, airspeed should be controlled to provide starting rpm in

accordance with normal windmilling rpm of the particular engine.

ENGINE FLAMEOUT AND RELIGHT

Immediate response by the pilots to an engine flameout can make a relight possible without the necessity of descending to the altitudes and rpm limits shown on figure 3-3. Relights may be made at as low as 65% rpm. To simplify relight procedure, the starter selector switch should always be positioned to FLIGHT when the aircraft is in flight. See "Engine Air Starting" checklist below. For recommended procedures in the event of multiple engine flameout at higher altitudes see "Engine Operations," Section VII, and "Turbulence and Thunderstorms," Section IX.

NOTE

If the adjacent engine in the same nacelle starts to surge or vibrate during the engine relight, retard the adjacent engine throttle to IDLE and advance both engine throttles to the desired setting after the relight has been accomplished.

ENGINE AIR STARTING

CAUTION

- Do not attempt a restart or relight of a flamed-out engine in a nacelle with a known or suspected fuel leak unless a critical need for power exists.
- Immediate response by the pilots to an engine flameout can make it unnecessary to follow the complete engine air starting procedure. This type of relight may be made as low as 65% rpm. To obtain a relight, retard the throttle to IDLE and place the starter switch to START. Do not place the starter switch to START at engine rpm below 65% without following the complete procedure because engine fire or damage can result from accumulation of fuel in the engine.

NOTE

This checklist applies to a normal windmilling airstart (rpm below 65%). See "Airstart Envelope" (figure 3-3) for speed and altitude required for normal windmilling starts.

1. Reset Fire Shutoff Switch - Reset (P/CP)
2. Route Fuel to Engine - Routed (CP)

Have fuel boost pressure available to the firewall fuel shutoff valve. If on a main-tanks-to-engines fuel sequence, open crossfeed valves 9, 10, 11, and 12. If engine restart is unsuccessful, open auxiliary tank engine feed control valves as required to utilize auxiliary to engine feed and initiate restart.

ENGINE AIR STARTING (Cont)

3. Throttle to IDLE, then CLOSED - IDLE, CLOSED (P)

If shutdown was caused by fuel starvation, open the throttle to IDLE until fuel flow is established and retard to CLOSED for 30 seconds. This will purge the fuel control unit of air and the engine of fuel. If the firewall fuel shutoff valve circuit breaker has been pulled during shutdown of engines, the respective firewall fuel shutoff valve circuit breaker must be reset in order to obtain fuel to the engine.

4. Check Engine RPM - Checked (P)

Establish an indicated airspeed which will give an engine speed within the normal air start rpm range. If sufficient airspeed cannot be obtained, use engine starter to increase rpm above 12%. See figure 3-3 for airspeed and altitude for engine air starting.

5. Check Oil Pressure - Checked (P)

6. Start Selector to FLIGHT - FLIGHT (CP)

The start selector switch should be placed in FLIGHT position unless the engine starter is to be used to aid in the start.

CAUTION

The use of engine starters for air starts is restricted to emergencies only.

7. Engine Anti-Icing Switch OFF - OFF (P)

8. Starter Switch to START - START (CP)

9. Throttle to IDLE - IDLE (P)

Fuel flow should be between 540 and 1250 pph prior to combustion. Starts with less than 540 pounds per hour may be attempted. When flow is more than 1250 pounds per hour, retard the throttle below IDLE to reduce the flow below 1250 pounds per hour. During acceleration from combustion to idle rpm, the normal fuel flow may be 2000 pounds per hour. In both cases, the engine operation should be watched carefully for evidence of further malfunctioning of the fuel control unit.

CAUTION

IDLE position may not control fuel flow sufficiently to prevent an over-temperature condition between light-up and idle rpm. The EGT and fuel flow should be monitored closely and regulated by manipulation of the throttle as necessary until the desired power setting is restored.

10. Check Engine Indicators - Checked (P)

Adjust throttle as necessary until engine indicator readings have stabilized as follows:

- a. Check Tachometer 63% to 85% RPM - Checked
- b. Stabilize Exhaust Gas Temperature - Stabilized

ENGINE AIR STARTING (Cont)

- c. Check Oil Pressure Within Limits - Checked (Section V)

NOTE

Combustion normally should occur within 20 seconds and will be evidenced by a rise in exhaust gas temperature. Retard throttle as necessary to maintain EGT within limits when a tendency to overtemperature is observed. If the EGT exceeds limits, if the engine fails to accelerate to idle rpm, or if the oil pressure does not reach 35 psi, discontinue the restart by retarding the throttle to CLOSED and turning the starter switch to OFF. Allow the engine to windmill for 30 seconds before attempting another start.

11. Advance Throttles - Advanced (desired setting) (P)
12. Turn Starter Switch to OFF - OFF (CP)
13. Generator ON (if applicable) - ON (CP)
14. Engine Anti-Icing Switch Climatic - Climatic (P)

DATA BASIS: ESTIMATED

DATE: APRIL 1958

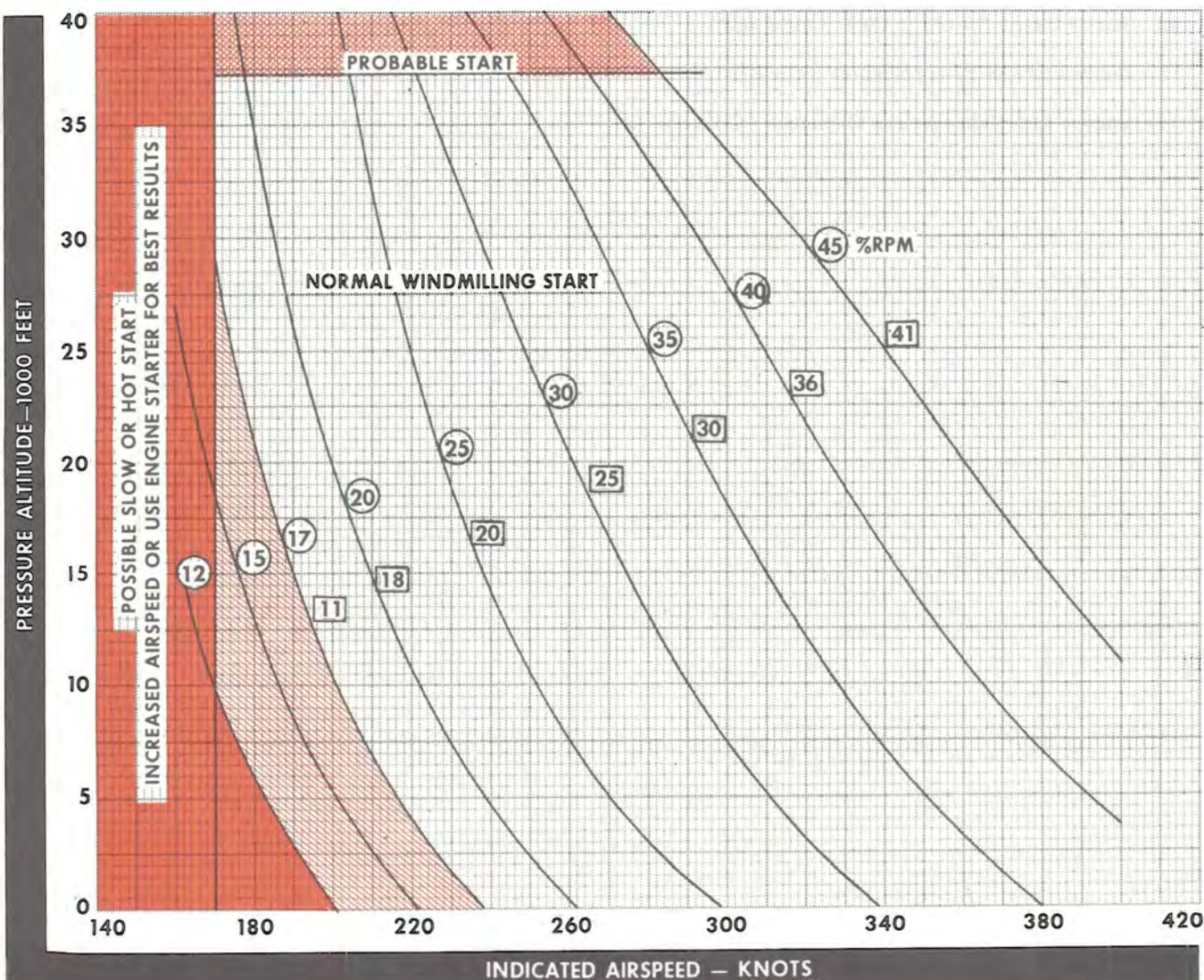
CONDITIONS:

ICAO STANDARD DAY

REMARKS:

○ Engines 2, 4, 6 & 8

□ Engines 1, 3, 5 & 7 (with a-c generator)



POSSIBLE SLOW OR HOT START ON ENGINES 1, 3, 5, AND 7

Air Start Envelope

Figure 3-3.

FLIGHT CHARACTERISTICS WITH ENGINE FAILURE

SINGLE ENGINE FAILURE

The loss of an engine at any time during takeoff or while in flight is considered an emergency, regardless of the amount of thrust still available, since some emergency procedures must be executed.

CONTROL WITH LOSS OF ENGINES

With loss of engines, the pilot is presented with the problem of maintaining control and insuring satisfactory performance of the aircraft. Loss of outboard engines is most critical since this imposes the largest asymmetrical loads. The loss of an engine during takeoff can be controlled easily by correct application of rudder pedal force and a slight amount of lateral control force. The rudder pedal force required in the event of an outboard engine failure is about 40 pounds at speeds below takeoff speed with zero trim. The force increases to about 80 pounds at the recommended climbout speed. All of this rudder correction usually can be removed by application of rudder trim. See "Airspeed Limitations," Section V, for rudder trim limits. When one or more engines fail, the pilot has several methods by which the aircraft may be controlled: thrust adjustment, lateral control, and rudder control. To illustrate these methods, consider an aircraft flying with progressive outboard engine failure; that is engine No. 1 loses thrust and stops; then engine No. 2 fails, etc. This situation gives an increasingly larger turning force on the aircraft. The most effective way to overcome the problem would be to eliminate the turning force by reducing thrust on an engine or engines on the opposite side of the aircraft and advancing thrust on the remaining symmetrical engines. This method will work unless the thrust required to fly the aircraft is greater than that which is available from the operating engines. As the turning force from the progressive engine failure becomes larger, spoiler and gradual rudder application may also be used to counteract the turning force. The total effect of these corrections must exactly balance the turning force due to asymmetric thrust if the aircraft is to hold a constant heading. When a sideslip is imposed on the aircraft by the combination of asymmetrical thrust and spoiler and rudder deflection, the wing on the side toward which the aircraft is slipping becomes more effective. Thus the "upwind" wing will have more lift than the "downwind" wing and this lift differential will impose a rolling force on the aircraft which must be overcome by increased spoiler deflection. When full rudder is insufficient to counteract the induced

turning force, it will be necessary to hold a bank angle with the inoperative engines on the high side to balance the force. As the turning forces due to the progressive engine failures increase, the point will be reached when full rudder and full wheel must be held in order to maintain a constant heading. If the turning forces increase beyond this, the aircraft will turn because the pilot has no more control authority to overcome the turning force. Minimum speed for directional control is defined as the speed at which a constant heading can be maintained with full rudder and one-half lateral control authority with all of the operative engines at a given amount of thrust. (TRT assumed for sea level and MRT assumed for 10,000 feet.) This leaves the remaining one-half lateral control available for maneuvering. The minimum speeds for directional control are shown in figure 3-13. It should be recognized that any attempt to fly below these speeds will result in a further reduction of the maneuvering margin to the point of absolute control limits. Two alternatives are available to the pilot. The pilot must either reduce the thrust on the remaining engines to balance the turning force or allow the aircraft to turn slowly while the speed increases to a point where the directional control margin is regained. In some cases, it may be necessary to use a combination of these two alternatives.

PERFORMANCE WITH LOSS OF ENGINES

The aircraft is unique in its ability to handle asymmetrical thrust conditions provided the prescribed procedures are followed. (See "Multi-Engine Failure On One Side," this section.) The takeoff and climbout performance of the aircraft with inoperative engines is shown in Parts 2, 3, and 4 of the Appendix. In each case, the inoperative engines are assumed to be in the most outboard positions and all on the same side. This is the most adverse condition from the standpoint of trim drag which is associated with control surface deflections. Advancing the throttles to full travel in an emergency situation will give maximum thrust. This may exceed normal engine limits. Overthrusting the engines will accentuate the aircraft control problems and reduce engine life. All instances of overthrust as indicated by excessive EGT and/or rpm will be recorded in Form 781. See "Engine Limitations," Section V.

WARNING

Nonzero lateral trim resulting from inoperative engines must not be compensated for by fuel manipulation because an uncontrollable roll may occur when thrust is reduced on approach for landing.

**STRUCTURAL EFFECTS OF MULTI-ENGINE
FAILURE ON ONE SIDE**

During inflight emergencies involving multi-engine failures on one side, applications of large amounts of rudder and lateral control are necessary in order to maintain control when extreme amounts of asymmetrical thrust exist or are applied. Application of this control creates severe loads on the aircraft structure. These loads vary in magnitude in accordance with the degree of thrust dissymmetry, degree of deflection or corrective rudder, rate of rudder application, amount of yaw/roll displacement that has taken place prior to rudder application, abruptness with which engine thrust is changed, indicated airspeed, gross weight, center of gravity, fuel distribution, amount of air turbulence present, aircraft configuration including flaps and landing gear positions, missile loading, external tank loading, etc.

If these variables occur in certain combinations, critical structural loads can result. In view of the difficulty in controlling these variables, close observance of the following procedure will minimize the possibility of structural overload.

1. If asymmetrical thrust develops abruptly, the resulting yaw/roll tendency should be counteracted with lateral control followed by steady rudder application. Trim as required to balance control forces. (If asymmetric thrust develops at low speed see "Go-Around with One or More Engines Inoperative," this section for the proper lateral control techniques.)
2. If thrust requirements permit, readjust the thrust on the remaining engines to minimize control surface deflections. Thrust adjustments should be applied slowly and simultaneously with control surface movement.
3. Avoid turbulent air and limit maneuvering bank angle to 20° maximum.

SMOKE AND FUMES ELIMINATION

If smoke and fumes are evident in the pressurized compartment, locate the source immediately. If it can be determined that the smoke or fumes are coming from the cabin air outlets, refer to the following checklist.

WARNING

Under takeoff power conditions and with low temperature selection, fog or vapor resembling smoke can occur. Reporting this vapor as smoke or fire at a critical point of the takeoff could create a hazard.

SMOKE AND FUMES ELIMINATION

WARNING

If fire is suspected or evidenced by visible flames and smoke in the pressurized compartment, see "Pressurized Compartment Fire Checklist," this section.

NOTE

- Only the engine at the highest rpm of those connected to the air bleed system manifold will supply the manifold due to check valves at the air bleed ports on the engines. Therefore, by partially retarding the throttle of a suspected engine, it is possible to isolate that engine as a source of bleed air contamination.
- Check manifold temperature gage indication. With high engine thrust settings an open strut bleed valve (for any reason) can result in excessive temperatures in the distribution ducts causing strong odors and fumes to enter the cabin.

1. OXYGEN — 100% (ALL)

All primary crewmembers and extra crewmembers will report to pilot when mask is on and oxygen 100%.

2. Air Bleed Selector to Opposite Position - Opposite position (CP)

WARNING

The bleed selector switch should be returned to NORMAL LH INBD position before descending below 25,000 feet. Excessive duct temperatures may result if this operation is not accomplished. If EMERG RH INBD position must be selected, see "Air Bleed System Emergency Operation," this section, for control of air bleed manifold temperatures.

Place airbleed selector switch to its opposite position. Leave switch in selected position if incoming flow of smoke and/or fumes ceases. Additional ventilation may be obtained by placing the cabin pressure release switch to DUMP (42,000 feet or below) and opening the sextant port. If smoke and/or fumes continue to enter the pressurized compartment, descend to 42,000 feet or below and position air conditioning master switch to RAM. Additional ventilation may be obtained by opening the sextant port. After smoke and fumes have dissipated, repressurize by placing the cabin pressure release switch to RESET or air conditioning master switch to 7.45 PSI and closing the sextant port.

SMOKE AND FUMES ELIMINATION (Cont)**WARNING**

When it is found necessary to depressurize the cabin in order to eliminate smoke and fumes, it will be necessary to descend to below 42,000 feet as this is the maximum altitude for effective use of the combination of the MBU-5/P mask and aircraft system regulator. Crewmembers should experience no difficulty at 42,000 feet or below if they switch their regulator diluter levers to 100% oxygen.

3. Monitor the Affected Nacelle Engines for Malfunction - Monitored (P/CP)

ELECTRICAL FIRE

Since the aircraft electrical circuits have fault-clearance protection, it is not likely that short circuits will cause electrical fires. If an electrical fire does occur, however, the only practical means of stopping it is to deenergize the circuits in the affected area and cautiously put essential equipment back in operation, one circuit at a time.

PRESSURIZED COMPARTMENT FIRE

In the event that fire is discovered, or suspected, in any area of the pressurized compartment, immediately notify the pilot or other crewmembers to go on 100% oxygen and to proceed with proper fire control procedures. The following fire control procedures should be followed to minimize danger to personnel and equipment.

PRESSURIZED COMPARTMENT FIRE**1. OXYGEN — 100% (ALL)**

All primary crewmembers and extra crewmembers will report to pilot when mask is on and oxygen 100%. If possible, extra crewmember oxygen outlets should be used when engaged in firefighting procedures.

2. AIR CONDITIONING MASTER SWITCH — OFF (CP)

The switch must be moved to the OFF position; this allows cabin leakage to depressurize the compartment, and shuts down incoming air.

WARNING

Do not depressurize until all crewmembers are on oxygen and the aircraft is 42,000 feet or below.

3. UNNECESSARY ELECTRICAL EQUIPMENT — OFF (ALL)

Pilot will notify crew to reduce unnecessary loads (i.e., BNS, SRAM, FCS, and ECM).

4. Combat Fire - Combat (RN/N/EW/G/Extra crewmember)

Pilot will direct adjacent or extra crewmembers to institute firefighting procedures.

- a. Locate the fire.
- b. Remove objects that would spread the fire or restrict firefighting procedures from the vicinity of the fire area.

PRESSURIZED COMPARTMENT FIRE (Cont)

- c. Apply extinguishing agent at base of fire.

WARNING

- When fighting a fire with the fire extinguisher, remember that the fumes from the CB fluid are toxic. Heavy, dense, black, suffocative, toxic smoke occurs when fire extinguishing agent is used on hot metal or open fire. The extinguisher must be held above the horizontal position (not upside down) to prevent the propellant charge from escaping. Supply of extinguishing agent is depleted in approximately 22 seconds during continuous operation.
- When using a portable oxygen bottle during fire fighting, the regulator setting will be 30M or higher, commensurate with aircraft altitude. This setting should be used where there is the possibility of heavy concentrations of fumes. The supply in the portable oxygen bottle will last from 4 to 14 minutes depending on regulator position, cabin altitude, and physical activity.

- d. Remove involved combustibles from fire source area.

5. Reduce Airspeed/Altitude - Reduced (P/CP)

Reduce airspeed to insure safe ejection and extra crewmember bailout, and then reduce altitude to 25,000 feet.

6. Repressurize if Fire is Controlled - Repressurized (CP)

After fire is completely extinguished, the most effective way to eliminate smoke from the pressurized compartment is to position the air conditioning master switch to 7.45 PSI, move the cabin pressure release switch to DUMP, and open the sextant port. After smoke has dissipated, repressurize by placing the cabin pressure release switch to RESET and close the sextant port.

7. Abandon Aircraft if Fire is Uncontrollable - Abandon aircraft on pilot's order (ALL)

If it is apparent the fire cannot be controlled, the pilot will order crewmembers to bail out.

WARNING

In the event of fire in forward wheel well area, the jettisoning of an escape hatch will cause smoke and flames to be drawn into the crew compartment. In the event of fire in crew compartment, the jettisoning of an escape hatch will rapidly intensify and spread the smoke and flames throughout the crew compartment. Therefore, the jettisoning of an upward escape hatch prior to the egress of all lower deck members and extra crewmembers could seriously hamper their escape. In this event, the revised order of bailout would be: N, EXTRA CREWMEMBERS, RN, G, EW, CP, and P.

UNSCHEDULED AUTOPILOT INPUTS**WARNING**

- Pilots will disconnect the autopilot immediately if unscheduled autopilot inputs are observed. Autopilot disengagement by means of the autopilot release button will be confirmed by placing the autopilot master switch to the OFF position.
- If an unscheduled autopilot input places the aircraft in or near an unusual position before disconnect is accomplished, smooth coordinated recovery techniques must be made to prevent exceeding aircraft structural limitations. (Structural loads will be less if the controls are manually held in their displaced positions during autopilot disengagement.) See "Recovery From Unusual Positions," Section VI.

1. AUTOPILOT — DISENGAGE (P/CP)

Upon experiencing an unscheduled autopilot input, the pilot flying the aircraft will immediately depress the autopilot release button. At the same time, the pilot not flying the aircraft places the autopilot master switch to OFF position. See "Emergency Operation of Autopilot," Section IV, prior to reengaging.

STRUCTURAL DAMAGE

Occasionally, structural damage may be incurred by an aircraft while in flight. Such damage may be caused by mid-air collision, overstressing the aircraft, and other causes. If the aircraft is still controllable following structural damage, certain procedures may be accomplished to assist in assuring a

safe landing. One basic rule which is generally applicable is to make no gross change in aircraft configuration until the extent of the damage or adverse effect on flying characteristics can be determined. A chase plane may provide valuable assistance in determining the extent of damage. The reason for retaining the configuration existing at the time the damage

occurs may be readily appreciated from the following: Flight loads imparted to the wing structure with flaps full up will vary considerably from the loads that exist with flaps full down. A wing can conceivably contain structural damage or failure of a type and in a location which will permit continued safe flight to a landing under certain prescribed operational conditions. To move the flaps to their opposite position, however, could effect a change in wing loading which would result in further progression of the existing damage. If structural damage has occurred to a flap or portions of its mechanism, an attempt to move the flaps could result in loss of the damaged flap. Structural damage to an aircraft sometimes results in tank rupture and leakage of fuel or other combustible materials. If this should occur, it is necessary under certain circumstances to take precautions in order to reduce to a minimum the possibility of in-flight fire. Major sources of ignition are, of course, electrical arcs and high temperature surfaces or environment.

AIRCRAFT STRUCTURE

NOTE

The following general description and definition of aircraft structure is intended to aid in flight crew comprehension of the B-52 structural makeup and is not intended to be all-inclusive. For additional information, refer to applicable technical manuals.

Primary Structure

Primary structure is the major load carrying members or assemblies, the failure of which would materially decrease the safety of the aircraft as a whole. Each of the aircraft airfoil surfaces (wing, fin, and horizontal stabilizer) has a primary structural skeleton. This structure is generally described as follows: Wing - box beam, encompassing structure between the forward and rear spars and extending from one tip through the center section to the other tip; Fin - box section between the main and auxiliary spars extending from the base up to the fiberglass insulator; Horizontal stabilizer - box section between the main and auxiliary spars extending through the center section to the middle of each surface then becoming a single spar to each tip. Certain ribs running aft to the control surfaces and flaps are also regarded as primary structure. The primary structure of the fuselage is generally the entire fuselage with the exception of the radomes, wheel well doors and covering, bomb bay doors, and the turret.

Secondary Structure

Secondary structure is all structure that is not part of the primary structure and is normally used to maintain the aerodynamic contour of aircraft components. Failure of a small portion of secondary structure will normally affect aircraft control characteristics or performance efficiency, while a major loss of that

structure could completely destroy flight capability. Wing trailing edge is an example of secondary structure which could be damaged to a small extent and slightly affect controllability and performance whereas its complete loss would preclude further flight.

PRELIMINARY PROCEDURES

1. If the aircraft is still controllable following in-flight structural damage or failure, do not immediately make any major changes in existing configuration (retain flaps, gear, and airbrakes in the position existent at time damage was incurred).
2. Avoid turbulence or any maneuver that could apply unnecessary air loads to the aircraft.

NOTE

Known bird strikes should be considered to have caused at least secondary structural damage. Airspeed should be reduced so as not to exceed 250 knots IAS or Mach .77, whichever is lower, for the remainder of the flight. "Damage Determination" procedures will be utilized and consideration given to early termination of the flight.

Damage Determination

If it is practical under the existing situation, request a chase plane to assist in determination of the extent of damage.

WARNING

- Pilot of the chase aircraft will be briefed on command chase aircraft procedures prior to engaging in chase operation.
- It is unsafe to fly two aircraft in close vertical proximity because of the magnitude of interrelated aerodynamic effects.

1. If examination reveals that damage has occurred to secondary structure only and the damage does not include flaps or control surfaces, the flaps may be utilized as necessary.
2. If damage has occurred to wing primary structure, the existing flap position should not be changed.
3. If damage has occurred to elevator or horizontal stabilizer, flap position should not be changed until it is determined that sufficient longitudinal control is available to take care of the changing pitch trim requirements.
4. If damage has occurred to one of the flaps, flap position should not be changed.

Controllability Check

If damage has occurred to any portion of the aircraft structure sufficient to affect the aircraft thrust, drag, lift, or in any other manner change the aircraft normal flight and control characteristics, a controlla-

bility check should be accomplished. This check should be conducted at any altitude at least 10,000 feet above the terrain or cloud cover. At these altitudes the best flare speed will be increased by 1% for each 5,000 feet above 10,000 feet pressure altitude. The check should be accomplished in the intended landing configuration and immediately prior to descent for landing so that the gross weight and airspeed checked will be valid. The controllability check should be accomplished down to, but not below, best flare speed for the existing aircraft configuration and gross weight. Speed reduction for the last 30 knots above best flare speed should not exceed a rate of 1 knot per second. Following the controllability check, maintain aircraft loads and accelerations at a minimum by making all turns and maneuvers as shallow and gentle as possible and avoiding turbulence during the descent and approach to landing. For further information see "Stall or Controllability Checks," Section VI.

WARNING

- When any controllability check is made due to doubtful control characteristics of the aircraft, the airspeed should not be reduced below the best flare speed for the aircraft configuration (approach speed for flaps up) in which the check is to be made. Under these conditions, the check should be discontinued immediately if any buffet or control problem is encountered.
- When the flaps are in a full-down or intermediate position and flap damage exists, such as a missing segment, the best flare speed given in the appendix may no longer apply. In this case, reduce speed slowly until the charted best flare speed is reached or until approximately one-half lateral control authority is required to maintain the wings level. Whichever of these speeds is higher should be used as the best flare speed.

NOTE

It is not always advantageous in modern aircraft to make large reductions of gross weight prior to landing after receiving structural damage. If the damage is a type that has reduced flight control capabilities, the reduced airspeed that would result from landing at low gross weights could result in control difficulties during the final portion of approach.

Fuel Leaks

If a fuel leak is known or suspected to exist due to structural damage or tank rupture, the following procedures, as appropriate, should be followed:

- Deenergize all electrical equipment not essential to continued safe flight and necessary communications.
- If the leak is such as to cause the emptying of a tank in a few minutes:

1. Move the boost pump switch for the affected tank to OFF position.
2. Move the tank fuel level control switch for the affected tank to OFF position.
3. If the leak is in a wing tank, the following procedures should be followed:
 - a. Reduce airspeed so as not to exceed 250 knots IAS or Mach .77, whichever is lower.
 - b. Avoid turbulence or any maneuver that could apply unnecessary airloads to the aircraft.
 - c. Use center wing and body fuel. This will lessen wing bending and cause wing structure loads to become increasingly less.
 - d. Land as soon as practicable.

NOTE

If the fuel leak is of a magnitude such as to deplete one or more tanks in a few minutes, the aircraft may have a tendency to rapidly become wing heavy, tail heavy, or nose heavy. Compensating fuel management for any of these conditions should be set up as soon as possible.

- If the rate of leakage is not excessively high, it is desirable to remove fuel from the leaking tank as rapidly as possible in order to keep any possible fuel contamination of the aircraft and its various compartments at a minimum. See "Fuel System Emergency Operation," this section, for tank emptying procedures.
- If the fuel leak exists in the area of any of the engine pods, the engines in the affected pod should be shut down.
- If the leak is in the bomb bay section, the aircraft should not be depressurized since strong fuel fumes may enter the crew compartment.

Electrical Circuit Damage

All electrical components of the flap and landing gear control circuits are hermetically sealed or explosion proof; therefore, no special precautions will be required in the utilization of these circuits. If, however, structural damage has broken any wires or conduits, arcing could result from energizing these wires or conduits. If it is suspected that such damage may exist, explosion hazard may be minimized by utilizing the following procedure:

1. If damage to gear and flap circuitry is suspected, explosion possibility will be greatly reduced by energizing these circuits at altitudes above 30,000 feet. When gear and flaps are extended at high altitude, pull all circuit breakers to these control systems before descending.

NOTE

At altitudes above 30,000 feet, the possibility of accidentally igniting JP-4 fuel is reduced considerably. Altitudes between 15,000 and 25,000 feet may be more conducive to auto-ignition than either high or lower altitudes.

2. Deenergize all circuitry suspected of being damaged by pulling the appropriate circuit breakers to the extent that is possible, while still retaining the required functions.

ADDITIONAL PROCEDURE

It is seldom that two inflight emergencies are identical; therefore, the proper remedial measures will not necessarily be identical. When the necessary preliminary emergency procedures have been accomplished, contact the appropriate command within radio range for further assistance in determining additional emergency procedures.

WINDSHIELD/WINDOW CRACKS

If crack(s) appear in a heated window or if the window suddenly shatters or "spider webs" (usually accompanied by a pop or thump) immediately turn off windshield anti-ice and defog switch and auxiliary window defog switch. For arcing, discoloration or bubbles in the windows see "Emergency Operation of Windshield Anti-Icing and Window Defogging," Section IV. The structural integrity of a cracked window may be checked by sliding a fingernail across the inner surface to feel for cracks and determine if a crack is in the load bearing inner pane. A crack in only the outer pane will not impair the strength and normal pressurization and flight may be continued. (Unheated windows 6L and 6R are made of laminated acrylic plastic and carry the load on the outer surface.) The following procedure is recommended when a heated window cracks or shatters:

1. Place windshield anti-ice and defog switch and auxiliary window defog switch - OFF.
2. Pull circuit breaker for affected window.
3. Place windshield anti-ice and defog switch and auxiliary window defog switch - ON.
4. If the load bearing pane has cracked:
 - a. Insure all primary and extra crewmembers are on oxygen.
 - b. All crewmembers in upper deck crew compartment should lower helmet visor.
 - c. Place air conditioning master switch to COMBAT 4.50 PSI.
 - d. Conditions permitting, do not exceed 10,000 feet cabin pressure altitude.
 - e. Restrict airspeed to 250 KIAS or less.
 - f. Do not conduct low level tactic operations.
 - g. Land as soon as practicable.

EXPLOSIVE DECOMPRESSION

An explosive decompression occurs when the cabin pressure is reduced to the outside pressure in less than 1 second. Any explosive decompression affects all crewmembers and can be extremely dangerous if occurring at high altitudes. Following are some of the effects accompanying explosive decompression:

- Rush of air from lungs
- A momentary dazed sensation that passes immediately

- Possible gas pains

- Hypoxia if oxygen equipment is not immediately available.

Following are precautions to observe in pressurized compartments:

- Maintain a safe pressure differential
- Have oxygen equipment immediately available
- Have heavy flight clothing available.

If an explosive decompression occurs, ascertain, if possible, the cause of the trouble and, if it cannot be fixed in flight, the pilot should decide whether to continue the mission or to descend to a safe altitude immediately.

WARNING

If explosive decompression occurs above 42,000 feet, descend immediately to 42,000 feet or below.

NOTE

If decompression occurs, an apparent loss of interphone volume may occur due to increased cabin noise level. This situation may be alleviated by increasing interphone volume.

OXYGEN SYSTEM FAILURE

Descend to safe cabin altitude using emergency oxygen supply available.

BALLOUT/EJECTION PROCEDURES

At any time an emergency arises which may progress to a point where loss of aircraft control is possible, the pilot will alert all aboard over interphone to prepare to abandon.

WARNING

Immediately following an alarm, crewmembers in ejection seats should ascertain that safety belts are fastened, ejection seat flight safety pins are removed, and emergency equipment is in readiness. Crewmembers not occupying ejection seats should check their equipment and proceed to the lower deck after depressurization.

NOTE

The interphone must be considered the primary means for crew warning in the crew compartment. The emergency alarm lights will be the only means of crew warning outside the crew compartment.

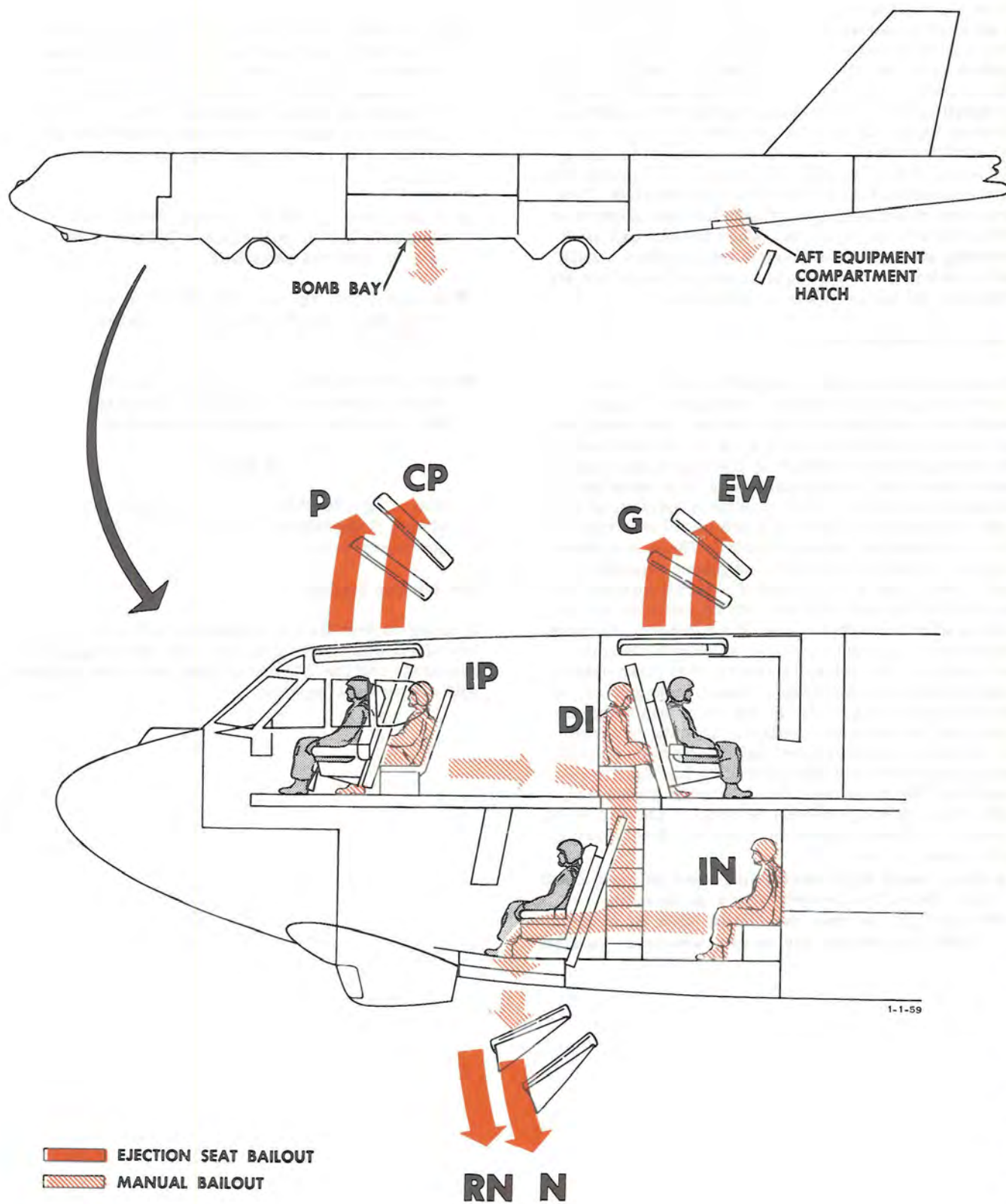
It is recognized that emergencies can arise where loss of aircraft control may be experienced without sufficient warning to allow the pilot to alert the crew before giving the command to bail out. Furthermore, in these cases, time will not permit the pilot to receive an acknowledgment of his bailout command prior to initiating his own ejecting sequence. Upon hearing the bailout command, all personnel will initiate immediate action to bail out as expeditiously as possible. Before his own ejection, the pilot will determine insofar as possible that all other crewmembers have left the aircraft.

The bailout alarm light signals are as follows: For bailout, one abandon light signal. This is obtained by placing the emergency alarm switch in ABANDON position. In addition, a steady signal is obtained when either the pilot's or copilot's control column is stowed during the ejection sequence.

WARNING

When the aircraft is below 2000 feet above the terrain or if aircraft control is lost at any altitude, crewmembers occupying ejection seats should eject immediately upon receiving the bailout command by either interphone or abandon signal.

The primary means for abandoning the aircraft are the ejection seats which are provided for all regular crewmembers (figure 3-4). Although there are alternate means of getting out of the aircraft, the ejection seats will be used unless a seat were to malfunction. When additional crewmembers are carried, manual bailout only is available for them.



..... Bailout Exits and Routes

Figure 3-4.

EJECTION BAILOUT

Both upward and downward ejection seats will function at any speed; however, if time permits, a reduction in aircraft speed would be desirable since it will reduce air blast on the seat occupants. During any low altitude ejection, the chances for successful ejection can be greatly increased by zooming the aircraft (if airspeed permits) to exchange airspeed for altitude. Ejection should be accomplished while the aircraft is in a positive climb and while the airspeed is above 120 knots IAS. This will result in a more nearly vertical trajectory for the seat and crewmember, thus providing more altitude and time for seat separation and parachute deployment. When the aircraft is descending and cannot be leveled out, ejection should not be delayed. Time required to get free of the aircraft may be the most important factor.

Minimum Ejection Altitude

No one minimum ejection altitude can be given to cover all types of ejections. Minimum altitude depends on aircraft speed and attitude, time required for human response and actuation of ejection controls, whether ejection is upward or downward, harness release time delay, type of parachute, and parachute deployment time delay. The minimum ejection altitudes presented in figure 3-5 are based on conditions and configurations stated therein. These minimum ejection altitudes represent equipment capability only, and do not include loss of aircraft altitude occurring during actuation of ejection controls or resulting from improper use of equipment. In many instances, emergencies occur at "safe" altitudes, but ejections are delayed to levels that make unsuccessful ejections inevitable. Also, improper or imperfect functioning of equipment or human response time may increase the minimum altitude required for escape. For increased safety, ejection should not be delayed to the minimum if higher ejection is possible. Ejection must be initiated at higher altitudes when in steep descent or dives. Therefore, to insure the highest degree of survival, the following rules must be observed:

- Under level flight conditions, eject at least 2000 feet above the terrain whenever possible.
- Under spin or dive conditions, eject at least 15,000 feet above the terrain whenever possible.

WARNING

- Do not delay ejection to below 2000 feet above the terrain in futile attempts to start engines or for any other reason that may commit you to an unsafe ejection or a dangerous landing. Accident statistics emphatically show a progressive decrease in successful ejections as altitude decreases below 2000 feet above the terrain.
- If parachute automatic opening device has obviously failed, pull ripcord T-handle manually to open the parachute.
- Manually pull ripcord T-handle to open automatic parachute for all ejections below 14,000 feet.
- Pull survival kit release handle as soon as stable in parachute to lessen impact shock when kit is not automatically deployed.

NOTE

The CNU-129/P kit is automatically deployed if deployment selector lever is positioned to AUTO.

Low Altitude Ejection

In order to provide for completely automatic separation of crewmember from seat, the downward ejection seats and the EW and gunner seats are equipped with a man-seat separator.

UPWARD EJECTION/M-3 CATAPULT	DOWNWARD EJECTION/M-4 CATAPULT
0.75 SECOND PARACHUTE	0.75 SECOND PARACHUTE
• FXC 11,000 Timer • C-9 Canopy • 0 Ft	• FXC 11,000 Timer • C-9 Canopy • 250 Ft
Upward ejection figures are applicable to airspeeds from 90 to 400 knots IAS. Downward ejection figures are applicable to airspeeds from 120 to 400 knots IAS.	
WARNING These are emergency minimums above the terrain. Ejection should be started at or above 2000 feet, if possible. 1. All figures applicable to LEVEL FLIGHT only and are to be used only as guides. They are optimistic for diving attitudes and conservative for climbing attitudes. 2. All altitudes given are contingent upon separation from the seat without delay following ejection. WARNING Emergency minimum ejection altitudes quoted in this table were determined through extensive flight tests and are based on distance above terrain on initiation of seat ejection (i.e., time seat is fired). These figures do not provide any safety factor for such matters as equipment malfunction, delays in separating from the seat, etc. These figures are quoted only to show the minimum altitude you must go up to in the event of such low altitude emergencies as fire on takeoff. <u>They shall not be used as the basis for delaying ejection when above 2000 feet since accident statistics show a progressive decrease in successful ejections as altitude decreases below 2000 feet.</u> Therefore, whenever possible, eject above 2000 feet. To insure survival during extremely low altitude ejections, the automatic features of the equipment must be depended on.	

Emergency Minimum Ejection Altitudes—Level Flight

Figure 3-5.

The downward seats and the EW and gunner seats, have two nylon straps installed in the seat under the survival kit and parachute. A reel-type ballistic actuator is connected to the integrated harness release actuation system. The nylon straps are connected to a jackshaft driven by the reel-type actuator. During ejection immediately after integrated harness release, the reel-type actuator pulls the nylon straps

tight to provide automatic controlled separation of the seat occupant from the seat. Since this is completely automatic, the time delay incurred by a crewmember making a conscious physical effort to kick free of the seat is eliminated. Further, injured or unconscious crewmembers will be automatically separated from the seat and parachute deployed following ejection.

All ejection seats (both upward and downward) are equipped with drogue parachutes to provide for rapid, positive separation of the crew member from his seat. The drogue parachutes are automatically deployed as the seat leaves the aircraft rails. No action is required by the crew member. This minimizes the delay required for separation of the seat from the crew member and hastens deployment of his personal parachute.

Ejection Speeds

Recent study and analysis of escape techniques from aircraft have revealed that ejection from the B-52 aircraft may be successfully accomplished at airspeeds ranging from 120 knots to the limit speed of the aircraft. Whenever circumstances permit, slow the aircraft down as much as possible prior to ejection. When ejecting at low altitudes, pull the nose of the aircraft above the horizon if at all possi-

ble and use excess speed to gain altitude. Eject at the lowest practical airspeed above 120 knots IAS ("lowest practical" would be that speed below which level flight cannot be maintained). The need to be at the lowest possible airspeed down to 120 knots IAS prior to ejection is predicted on many factors such as avoiding bodily injury, precluding parachute or seat structural failure, and providing adequate tail clearance. Below 120 knots IAS, airflow is not sufficient to assure rapid parachute deployment. Therefore, it becomes extremely important during low altitude ejection to obtain at least 120 knots IAS, if possible, to assure complete parachute deployment at the greatest height above the terrain. During high altitude ejection, observing this minimum airspeed (120 knots IAS) becomes less important since there is adequate time (altitude) for parachute deployment. If the aircraft is not controllable, ejection must be accomplished at whatever speed exists as this offers the only opportunity for survival.



3-1-594

A. CHECK SAFETY BELT LOCKED AND TIGHT, OXYGEN MASK FIRMLY SECURED, HELMET VISOR DOWN, BAIL-OUT BOTTLE RELEASE KNOB—PULLED.

B. RAISE ARMRESTS, PLACE FEET FLAT ON FLOOR, AND HEAD AGAINST HEAD-REST.



3-1-595

C. SQUEEZE ARMING LEVER RELEASE TO RELEASE ARMING LEVER.

UPWARD SEAT

Figure 3-6. (Sheet 1 of 3).



3-1-596

3

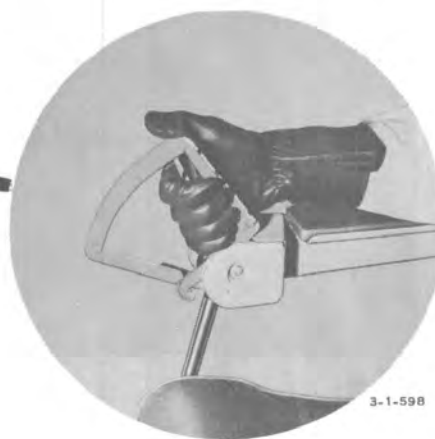
D. ROTATE ARMING LEVERS UPWARD TO LOCKED ARMING POSITION.



2-1-597

4

E. SQUEEZE FIRING TRIGGER TO FIRE CATAPULT AND EJECT SEAT.



3-1-598

NOTE

EQUIPMENT SHOWN MAY NOT BE TYPICAL

UPWARD SEAT

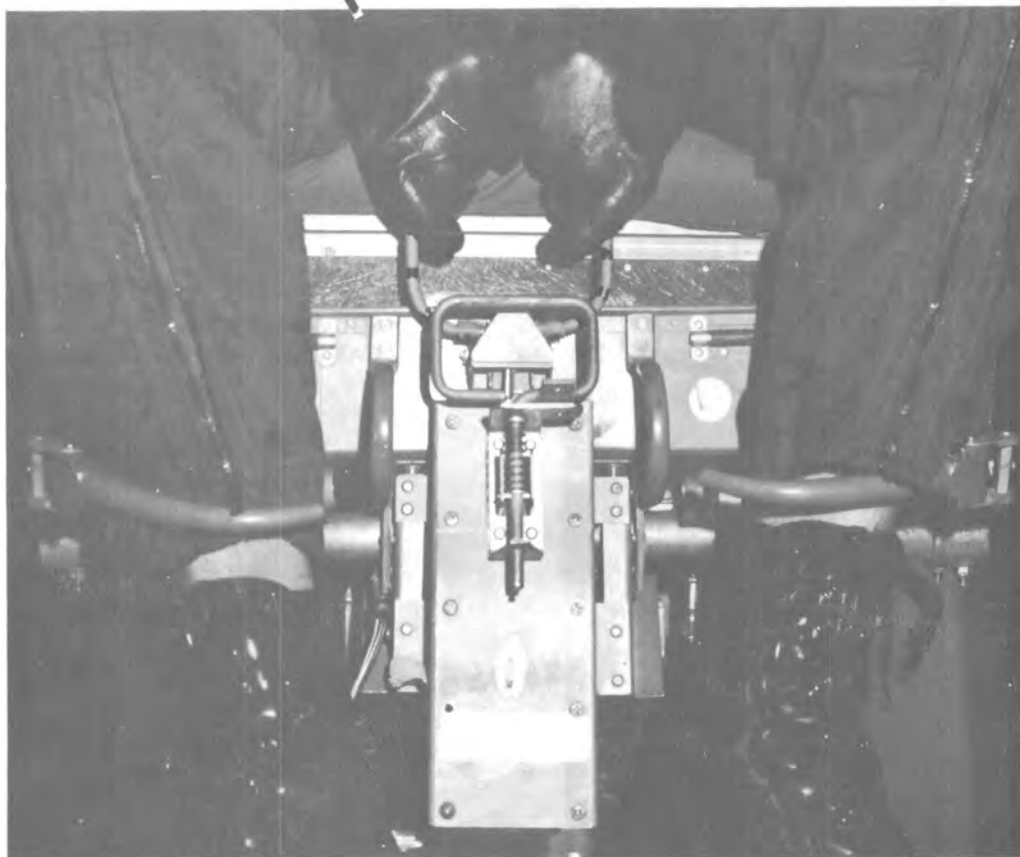
Ejection Bailout Procedures

Figure 3-6. (Sheet 2 of 3).



3-1-670

- A. CHECK SAFETY BELT LOCKED AND TIGHT, OXYGEN MASK FIRMLY SECURED, HELMET VISOR DOWN, BAIL-OUT BOTTLE RELEASE KNOB — PULLED.
- B. PLACE HEAD AGAINST HEADREST.
- C. PULL FEET FULL BACK AGAINST SEAT, THUS TRIPPING ANKLE RESTRAINT TRIGGERS WITH LEGS TO POSITION ANKLE RESTRAINTS.
- D. GRASP EJECTION CONTROL TRIGGER RING AND PULL CONTINUOUSLY TO ROTATE LEG GUARDS, FIRE CATAPULT AND EJECT SEAT.



3-752

DOWNWARD SEAT

NOTE

EQUIPMENT SHOWN MAY NOT BE TYPICAL

Ejection Bailout Procedures

Figure 3-6. (Sheet 3 of 3).

PREPARATORY STEPS FOR EJECTION BAILOUT**NOTE**

If time permits during a controlled bailout, accomplish the following emergency steps.

1. Reduce Airspeed - Reduced (P)

Whenever circumstances permit, pilot will reduce airspeed, trim for level flight, and engage the autopilot prior to bailout.

WARNING

Maximum airspeeds for manual bailout from the navigator's escape hatch are 250 KIAS for gear down and 275 KIAS for gear up. Bailout from the escape hatch at higher airspeeds could result in fatal injuries.

NOTE

At extremely low altitudes, it is recommended that the nose of the aircraft be pulled up in a "zoom up" maneuver during ejection to provide more time for parachute deployment. If an open hatch or bomb bay is being used for bailout, however, the aircraft should be trimmed for level flight.

2. Acknowledge Warning - Acknowledged (ALL)

Acknowledge the pilot's warning signal in the normal crew report sequence.

3. Set IFF - Set (P)

If over friendly territory, place IFF master switch in EMER.

4. Fasten Safety Belt - Fastened (ALL)

Additional crewmembers should remain strapped in position until the aircraft is depressurized or after the navigator's hatch has left the aircraft in his ejection sequence.

WARNING

- Do not attempt downward ejection with safety belt unfastened under any circumstances.
- Do not manually open the safety belt prior to ejection at any altitude.

PREPARATORY STEPS FOR EJECTION BAILOUT (Cont)**5. Check Equipment - Checked (ALL)**

Crewmember will check parachute harness fastened, oxygen mask and chin strap fastened, helmet visor down, and beacon lanyard set as desired.

BAILOUT**1. ORDER CREWMEMBERS TO BAIL OUT (P)**

Pilot gives command "Bail out" by interphone and by placing the emergency alarm switch in ABANDON position. Bailout should be conducted in the order briefed. The navigator is ejected prior to the radar navigator in order to make this hatch available for bailout in case an ejection seat in the compartment fails or for use by extra personnel aboard. Extra crewmembers will commence bailout immediately following navigator in order briefed. The radar navigator waits to inform the pilot that all crewmembers using the navigator's escape hatch have left before ejecting himself. If time permits, each crewmember will inform pilot just before leaving the aircraft. In the event of loss of control of the aircraft, those crewmembers occupying ejection seats should eject immediately upon receiving the bailout order over the interphone, or when the abandon light comes on. Extra crewmembers will bail out any opening available.

WARNING

In the event of fire in the forward wheel well area, the jettisoning of an escape hatch will cause smoke and flames to be drawn into the crew compartment. In the event of fire in the crew compartment, the jettisoning of an escape hatch will rapidly intensify and spread the smoke and flames throughout the crew compartment. Therefore, the jettisoning of an upward escape hatch prior to the egress of all lower deck members and extra crewmembers could seriously hamper their escape. In this event, the revised order of bailout would be: N, EXTRA CREWMEMBERS, RN, G, EW, CP, and P.

BAILOUT (Cont)**NOTE**

- On receiving the pilot's order to bail out, pull bailout bottle release knob and assume position for bailout or ejection.
- Under flight conditions of high cabin pressure differential, the best indication of a hatch having been jettisoned will be a rapid decompression within the crew compartment.
- If time permits, additional crewmembers should bail out prior to firing of upward escape hatch.

UPWARD EJECTION**1. ARMING LEVERS — ROTATE (P-CP-EW-G)**

Squeeze arming lever release to release arming lever and rotate arming levers upward to locked arming position. Rotating either or both arming levers forward and upward to their full travel locks the inertia reel, jettisons the escape hatch, arms the seat, unlatches the drogue parachute deployment arms on the pilot and copilot seats, and stows the control column (on pilots' seats) or gunner's stowable control unit (gunner's seat).

WARNING

- If the control column or gunnery control unit fails to stow automatically, it should be stowed manually to prevent possible leg injury during egress. If the control column fails to latch in the stowed position automatically, it can be latched by fully depressing the control column disconnect lever or by manually assisting the control column to the stowed position, whichever is most expeditious. If the gunner control unit is jammed in the extended position, ejection should not be attempted from the gunner's seat.
- Do not attempt manual release of the hatch. If the hatch fails to jettison, the ejection system has malfunctioned. There is no assurance that manual hatch release can be accomplished or that manual hatch release will correct the ejection system malfunction and make the seat safe for further use. Therefore, if hatch does not jettison, proceed with nonejection (manual) bailout as this provides the greatest survival potential.

UPWARD EJECTION (Cont)**2. TRIGGER — SQUEEZE (P-CP-EW-G)**

Squeeze either trigger against the arming lever to fire the seat. The integrated harness release will operate automatically 0.3 second after ejection and release the safety belt and parachute shoulder straps from the seat. Simultaneously with the integrated harness release on the EW and gunner seats, the man-seat separator actuates to provide controlled automatic man-seat separation and automatic parachute deployment. If the automatic feature fails, pull the yellow integrated harness release handle located on the left side of the seat to manually accomplish release. The automatic timer will start to operate at preset altitude, then, after the delay set on the timer expires, the parachute will open or, if bailout occurs below the preset altitude, 0.75 second after separating from the seat. The parachute arming knob must be pulled if integrated harness is released by actuation of integrated harness release handle. Pulling the ripcord T-handle will override the automatic device and open the parachute immediately.

WARNING

- If the trigger does not fire the catapult:
 1. Insure that the escape hatch has jettisoned.
 2. Reach under the armrest and lift the manual catapult initiator pin-pull release handle, at the same time pulling the assembly forward to withdraw the pin from the catapult initiator. (Do not squeeze the firing trigger while performing this procedure.)
 3. Reposition yourself for ejection.
 4. Squeeze trigger(s).
- If the seat fails to eject:
 1. Pull survival kit release handle (RH).
 2. Lock inertia reel (LH).
 3. Pull integrated harness release handle (LH).
 4. Proceed with manual bailout.
- Immediately after ejection:
 1. Release arming levers.
 2. Kick free of the seat with positive action. (Experience has shown many casualties are caused by people freezing in the seat.)
- If the integrated harness fails to release automatically and the safety belt is unfastened by use of the buckle, the seat occupant will remain attached to the seat by the inertia reel and the survival kit attachment straps threaded through the safety belt.
- If the integrated harness fails to release after ejection:
 1. Pull the integrated harness release handle (LH).
 2. Kick free of the seat with positive action.
 3. Pull parachute arming knob or ripcord T-handle as applicable.
- If parachute automatic opening device has obviously failed, pull ripcord T-handle manually to open the parachute.
- Manually pull ripcord T-handle to open automatic parachute for all ejections below 14,000 feet.
- Pull survival kit release handle as soon as stable in parachute to lessen impact shock when kit is not automatically deployed.

NOTE

- The integrated harness release system has additional reliability and the seat will be positively separated from the occupant by the drogue parachute system.
- The CNU-129/P survival kit is automatically deployed if deployment selector lever is in AUTO.

DOWNWARD EJECTION**1. TRIGGER RING — PULL (N-RN)**

Grasp the trigger ring with both hands and pull. This action will lock the shoulder harness inertia reel, rotate the leg guards, stow the table, jettison the escape hatch, eject the seat, and unlatch the drogue parachute support arms. Approximately 0.3 second after ejection, the integrated harness release will operate, automatically releasing the shoulder harness and safety belt from the seat. Simultaneously with integrated harness release, the man-seat separator actuates to provide controlled automatic man-seat separation and automatic parachute deployment. The parachute automatic timer will start to operate at a preset altitude, then, after the delay set on the timer expires, the parachute will open or, if bailout occurs below preset altitude, 0.75 second after separating from the seat. If the automatic feature of the integrated harness release fails, pull the yellow integrated harness manual release handle located on the left side of the seat to manually accomplish release. If the integrated harness release initiator fails, the man-seat separator will not operate, and a positive effort must be made to kick free of the seat. The parachute arming knob must be pulled if integrated harness is released by actuation of the integrated harness release handle. In either case, pulling the ripcord T-handle will override the automatic device and open the parachute.

WARNING

- When pulling the trigger ring:
 1. The ring must be held tightly during ejection to prevent flailing of the arms.
 2. To prevent injury, the elbows must be kept in against the body when pulling the trigger ring.
- If the trigger ring does not fire the catapult:
 1. Determine positively that the escape hatch has departed the aircraft.
 2. Pull upward on the manual catapult pin-pull handle on the left side of the seat.
 3. Reposition yourself for ejection.
 4. Pull trigger ring.
- If the hatch fails to jettison:
 1. Do not attempt manual release of the hatch. The ejection system has malfunctioned. There is no assurance that manual hatch release can be accomplished or that manual hatch release will correct the ejection system malfunction and make the seat safe for further use.
 2. Proceed with nonejection (manual) bailout as this provides the greatest survival potential.
- If the integrated harness fails to release automatically, and the safety belt is unfastened by use of the buckle, the seat occupant will remain attached to the seat by the inertia reel and the survival kit attachment straps threaded through the safety belt.
- If the integrated harness fails to release after ejection:
 1. Pull the integrated harness release handle (LH).
 2. Kick free of the seat with positive action.
 3. Pull parachute arming knob or ripcord T-handle as applicable.
- If the seat fails to eject, proceed with nonejection manual bailout as follows. Pull the survival kit release handle, lock the inertia reel to assure release of the integrated harness, then pull the integrated harness release handle. Occupant can then leave the seat with the parachute and safety belt.

NOTE

- During controlled bailout, RN will report bailout for additional crewmembers.
- The integrated harness release system has additional reliability and the seat will be positively separated from the occupant by the drogue parachute system.
- The CNU-129/P survival kit is automatically deployed if the deployment selector lever is in AUTO.

NAVIGATOR'S ESCAPE HATCH



GEAR UP — 275 KNOTS IAS OR LESS
GEAR DOWN — 250 KNOTS IAS OR LESS

AFT EQUIPMENT COMPARTMENT HATCH



Manual Bailout Procedures

Figure 3-7.

NONEJECTION (MANUAL) BAILOUT

If a regular crewmember's ejection seat malfunctions or he is out of the crew compartment, it will be necessary to make a nonejection manual bailout. The aircraft will be trimmed for straight and level flight. If additional crewmembers are aboard, they must make manual bailouts (figure 3-4). The minimum safe altitude for nonejection bailout is 500 feet above the terrain. Emergency alarm lights are provided at all exit points however. All crew compartment manual bailouts should be made through the downward ejection hatches.

Downward Ejection Hatch Bailout

The open downward ejection hatch from which the ejection seat has ejected (figure 3-7) is recommended for bailout of additional crewmembers, for regular crewmembers whose seats may have malfunctioned, and for bailout of injured personnel by attachment of the static line. For bailout of injured personnel above 14,000 feet, the static line should be connected to the automatic parachute arming lanyard. At lower altitudes, the static line should be connected directly to the ripcord T-handle of the parachute.

WARNING

- Detach the survival kit before leaving the seat to bail out an alternate exit. Detachment of the kit is necessary because the bulk of the kit would hamper or prevent egress. Pull the kit release handle to disconnect the kit. Be sure to pull the handle while sitting on the kit.
- Do not pull the kit release handle when the global survival kit is not installed in the seat. Pulling the handle with the kit suspended will cause the lid to open leaving the crewmember attached to the survival kit. In an emergency, this could cause a fatal delay in escaping from the aircraft.

Bailout procedures for the downward ejection hatch opening are given in the "Additional Crewmembers Manual Bailout Checklist."



**PULL SURVIVAL KIT
RELEASE HANDLE**

3-1-543



**LOCK INERTIA
REEL**

3-1-543A



- LEAVE SEAT
- DISCONNECT
OXYGEN



**PULL INTEGRATED
HARNES RELEASE HANDLE**

3-1-544



3-1-545

Release From Ejection Seats For Manual Bailout

Figure 3-8.

Aft Equipment Compartment Bailout

No interphone communication is available at this station. The hatch jettison handle must be pulled up after the safety lockpin has been removed in order to jettison the hatch door. Bailout is accomplished by facing forward.

Bomb Bay Bailout

Bailout from the bomb bay may be accomplished provided that time is available to reach the bailout position at the forward end of the bomb bay. No interphone communication is available at this station. Due to the length of the bomb bay, no special technique is necessary; the crewmember drops out from the walkway, taking care not to hit either side of the opening. This bailout may be made at any airspeed.

NOTE

The bomb bay doors should be opened at either the radar navigator's or pilot's position prior to proceeding to the bomb bay for bailout. However, the bomb bay doors can be opened by pushing down the gang switches at the aft actuator rod on aircraft **W173** ▶ **W180** and at the forward actuator rod on aircraft **W181** ▶, provided generator power and hydraulic pressure is available to perform the operation. This will allow the bomb doors to fully open and remain open. Unless the bomb bay doors have previously been opened by the pilot or radar navigator, availability of electrical power and hydraulic pressure must be ascertained before attempting to open the doors from the bomb bay for bailout.

ADDITIONAL CREWMEMBER MANUAL BAILOUT**WARNING**

Unrestrained crewmembers are subject to injury during hatch jettison by air currents caused by the depressurization.

NOTE

The open navigator's escape hatch is the primary exit for controlled bailout. The open radar navigator's escape hatch may be used with equal success. In the event of loss of control of the aircraft, extra crewmembers will bail out any opening available.

1. BAIL OUT THEN PULL PARACHUTE ARMING KNOB

Assume position facing forward and crouch with hands placed on the compartment floor on each side of the hatch opening. Draw arms and legs in close to body. Exit head first, faced away from the slipstream, by rolling forward and downward through the opening. Be sure to duck head and crouch as much as possible to avoid hitting forward part of hatch. No serious turbulence exists in the area inside the open hatch. Altitude does not play a part in clearing the aircraft satisfactorily. Pull the arming knob immediately after clearing the aircraft. If bailout is accomplished above preset altitude, the automatic timer will start to operate at preset altitude, then, after the delay set on the timer expires, the parachute will open. If bailout is accomplished below preset altitude, parachute will open in 5 seconds (0.75 second for ejection seat parachute). Pulling the ripcord T-handle will override the automatic device and open the parachute immediately.

WARNING

- Do not attempt to bail out from the side of the escape hatch as this type of bailout cannot be made in a crouched position. Bailout with the body in an extended position would result in bodily injuries even at moderate airspeeds.
- If parachute opening device has obviously failed, pull the ripcord T-handle manually to open the parachute.
- Manually pull ripcord T-handle to open automatic parachutes for all bailouts below 14,000 feet.

EMERGENCY INFLIGHT MOVEMENT

An inflight emergency may make it necessary to send a crewmember from the forward crew compartment to the unpressurized portion of the fuselage. There are no oxygen recharge points in the crawlway. Emergency alarm lights along the crawlway are the only means of communication (there are no interphone stations in the crawlway) and must be monitored closely by the crewmember in the crawlway. This movement should be made below 10,000-foot pressure altitude.

NOTE

A time delay (up to 2 minutes) may be expected between the time that the cabin pressure is dumped and residual pressure can be depleted, allowing the pressure door to be opened.

EMERGENCY DESCENT

This procedure involves flying a descent speed schedule which is determined by the initial buffet limit and should not be used unless it is necessary to descend to a low altitude at the maximum rate of descent. If buffeting is encountered, it can be stopped by reducing the speed of the aircraft or by lowering the airbrakes to position 4. Do not subject the aircraft to negative "g" maneuvers or nose down flight attitudes more severe than is necessary to maintain the emergency descent speed schedule. Trim to zero force on the control column during the descent.

EMERGENCY DESCENT

1. Throttles IDLE - IDLE (P/CP)
2. Gear DOWN - DOWN (CP)
3. Airbrakes Six - Six (P)

Raise airbrakes to position 4 initially, then to position 6 only after the landing gear is down and locked. Trim to zero force on the control column during the descent.

CAUTION

Severe pitchup will be encountered at any altitude if nosedown stabilizer trim is not started prior to raising airbrakes. This pitchup becomes less severe at lower altitudes and lower speeds or with less than full airbrake extension.

NOTE

Descent to safe altitude at .84 Mach until reaching 305 KIAS.

4. Bleed Selector Switch to NORMAL LH INBD - NORMAL LH INBD (CP)

NOTE

When use of EMERG RH INBD is necessary below 25,000 feet, see "Air Bleed System Emergency Operation."

5. Set IFF - Set (P)

If over friendly territory, place IFF master switch in EMER.

RADOME FAILURE/LOSS

Failure of the large nose radome may begin as a collapse in the form of an inward bulge against the radar antenna. Such a collapse could result from a delaminated or soft spot in the radome caused by inflight collision with birds or hailstones or by ground damage. Failure will be audible as a loud thump accompanied by noise of the antenna bumping or scraping against the radome. If the antenna is completely jammed, the scope will so indicate. Therefore, in the event of a collapsed radome:

1. Immediately shut down radar.
2. Reduce airspeed to the lowest value that will leave a safe and reasonable margin above stall. (See "Airspeed Indication Failure," this section, in case of lost airspeed indication.)
3. Continue flight only as long as necessary.

WARNING

- Continued flight with radome collapsed may result in further structural failure with subsequent departure of the radome and loss of airspeed indications.
- Inflight loss of the nose radome will cause complete loss of airspeed and Mach indications during all flight conditions. An extreme increase in noise level will occur, accompanied by possible buffeting.

AIRSPPEED INDICATION FAILURE

Loss of airspeed indication can result from pitot ice, leaks, loss of radome and other system malfunctions. There is no single best solution to deal with the loss of all airspeed indications under all conditions. However, there are a number of factors which must be considered in arriving at the best solution under a particular set of circumstances. If in cell, useful airspeed information can be obtained by maintaining a position relative to the other aircraft. All of the aircraft can aid in station keeping. In addition to the BNS radar, position indications can be obtained from the gunner's equipment. Setting the EVS pitch and roll indicator on the aircraft ahead may help. The wind dials, which have a TAS input, will be unreliable; but unless otherwise malfunctioning, the doppler ground speed will be reliable. It may also be possible to obtain ground speed from ground radar. To convert ground speed to airspeed requires accurate wind values which may be obtained from other aircraft in the vicinity of ground stations. If the aircraft is not in cell, consideration should be given to providing a chase airplane. A chase airplane should be used for airspeed and altitude if a landing is attempted with no airspeed indication. The first consideration is to keep the aircraft under control and in a safe speed range; i.e., well away from the low speed or high speed buffet. As altitude and gross weight increase, the usable airspeed range between high speed buffet and low speed buffet is decreased. The B-52 aircraft

in level flight is unlikely to encounter high speed buffet at high altitude and high gross weights because of engine thrust limitations. However, if the aircraft is descending under such a condition, the airspeed can rapidly increase and high speed buffet can be encountered. At low altitudes, a descent maneuver can cause the aircraft to exceed the structural placard before the high speed buffet is encountered. The stabilizer trim should be monitored. Progressive noseup trim requirements indicate the aircraft is decelerating and low speed buffet will be encountered. Nosedown trimming indicates that the aircraft is accelerating. Nosedown trimming followed by reverse or noseup trimming indicates that the high speed tuck region has been encountered and increasing speed will result in high speed buffet. If buffeting is accompanied by the nose of the aircraft dropping and a rapid decrease in altitude, the aircraft is either stalling or in a high-speed dive. In a stall, elevator and rudder control pressures will be light, the aircraft will tend to wallow in the lateral axis, and lateral control/airbrakes will be ineffective. In high speed dives, the elevator and rudder pressures will be heavy and the lateral control/airbrakes will be effective. Lateral control pressures will remain the same in all conditions. At spoiler blowdown conditions with airbrakes extended, the wheel movement will have a dead spot in it, however, full wheel will provide a significant lateral control capability. See "Spoiler and Airbrake Blowdown," Section VI. Recovery procedures for both conditions are described in Section VI. The aircraft can be successfully operated without airspeed indications as follows:

1. The pilot will alert all crewmembers over interphone to assume their positions and wear parachutes as directed under critical phases of flight.
2. If practicable, request the immediate services of a chase aircraft for obtaining accurate airspeed checks and land as soon as conditions permit.

WARNING

- Pilot of the chase aircraft will be briefed on command chase aircraft procedures prior to engaging in chase operations.
- It is unsafe to fly two aircraft in close vertical proximity because of the magnitude of inter-related aerodynamic effects.

NOTE

A VFR landing with chase aircraft to monitor approach speed would be the most desirable procedure after due consideration of the following factors: gross weight, weather conditions at intended place of landing, length of time chase aircraft can remain in formation with B-52, and advisability of reducing gross weight prior to landing. If landing above 325,000 pounds gross weight becomes necessary, see "Heavy Weight Landing," Section II.

3. Depending on flight conditions when loss of airspeed occurred, accomplish the following appropriate procedure:

a. When airspeed is lost during level of flight, see paragraph 4.

b. When airspeed is lost during climb, see paragraph 5.

c. When airspeed is lost during descent, see paragraph 6.

4. **LEVEL FLIGHT.** If all airspeed indications are lost in stable level flight, there should not be any immediate problem. If desired, engage autopilot; however, do not engage altitude hold if there is also a static system (altimeter or vertical velocity indicator) problem. Maintain power at the existing setting. Note and monitor stab trim setting especially when altitude hold is engaged. Rapid or continued changes of stab trim in one direction are danger signs. Avoid steep turns.

5. **CLIMB.** If all airspeed indications are lost in a climb, the problem is more complex. If altitude and conditions permit, the best solution is to level off. However, there may be factors favoring continuation of the climb such as; maintenance of cell integrity, adverse weather, terrain, and conflicting traffic. These must be balanced against dangers inherent in coping with the additional variables of attitude and vertical velocity, decreasing performance, and increasing susceptibility to stall.

a. Level off should present no problem if prescribed climb airspeed was being maintained. The existing NRT fuel flow would be safe for initial level off. After the aircraft is in level flight, reduce fuel flow using the chart value from figure 3-9. At low weight and low altitude, do not delay this reduction as aircraft will accelerate rapidly. When level, follow procedures in paragraph 4. The chart values may not accelerate the aircraft to the charted speed, but will maintain it, once reached. The greatest danger is low speed and resultant stall.

b. Level flight fuel flow for charted airspeed can be immediately determined by entering figure 3-9 with altitude and gross weight. Adjusting the fuel flow to the values shown in the chart for a specific altitude and gross weight will not necessarily prevent a stall if level off airspeed is less than that required for best endurance. If in doubt, use NRT and allow the aircraft to accelerate to a safe airspeed. Airspeeds that are less than best endurance will place the aircraft on the back side of the drag curve. For additional discussion of the drag curve, see "Thrust- Drag Speed Stability," Section VI. The data presented in the chart was extracted from the fuel flow charts in the "Range" part of the Appendix. Flight conditions are for a clean aircraft on a standard day. If protuberances or operational factors are present, apply the range correction factors given in the "Range" section of the Appendix.

c. If it is necessary to continue climb, concentration on aircraft attitude and performance is mandatory. Engage autopilot, if desired. Monitor vertical velocity and pitch attitude closely. Note and monitor stabilizer trim. Closely monitor EPR to insure that NRT is maintained. Avoid steep turns. If in cell, use every aid for station keeping and coordinate closely with other aircraft concerning relative position and performance. Cross-check doppler ground speed. At level off, follow procedures in paragraph 5a.; however, it must be assumed that airspeed will have varied during continued climb. If at high weight and/or altitude, it would be safe to maintain NRT for several minutes to insure that a safe airspeed has been reached.

6. **DESCENT.** If all airspeed indications are lost during descent, a different set of problems ensue. Again, there may be factors which might suggest continued descent, but unless there are compelling reasons to the contrary, leveling off is probably the better decision. During descent, concentrate on aircraft attitude and performance. Use autopilot and monitor vertical velocity and attitude closely. Note and monitor stabilizer trim and cross-check doppler ground speed. An important consideration would be to level off at an altitude which would permit safe bailout if controlled flight becomes impossible.

a. When the decision is made to level off, break descent in the normal manner, lower air brakes, and apply power. Prior to level off, time permitting, obtain fuel flow from the chart. If time does not permit, 7% of the aircraft gross weight (clean aircraft) will equal a safe initial fuel flow setting, e.g., for a 300,000-pound aircraft initially set 21,000 PPH fuel flow until the flight manual can be consulted.

7. If altitude changes become necessary because of weather or other reasons and no chase aircraft is available, use of the following procedure will provide an approximate target airspeed. This procedure should be used only if another means of obtaining airspeed information is not available.

WARNING

Due to variations in engines and aircraft and RPM lag due to engine inertia, the actual airspeed could be considerably low when using engine rpm to obtain target airspeed during letdown. Closely monitor for indications of low or high speed conditions as described in the above "Airspeed Indication Failure" text.

Shut down engine 2 or 8. Enter chart in figure 3-3 "Air Start Envelope" with pressure altitude and desired indicated airspeed for letdown and obtain the desired windmill rpm for engine that has been shut

TOTAL FUEL FLOW (1000 LBS/HR) LEVEL FLIGHT

ALTITUDE — 1000 FT	GROSS WEIGHT — 1000 POUNDS															
	200		240		280		320		360		400		440		480	
	KIAS	FUEL FLOW	KIAS	FUEL FLOW	KIAS	FUEL FLOW	KIAS	FUEL FLOW	KIAS	FUEL FLOW	KIAS	FUEL FLOW	KIAS	FUEL FLOW	KIAS	FUEL FLOW
SEA LEVEL	240	16.3	240	17.7	250	20.2	270	23.5	290	26.6	290	28.2	290	30.0	290	31.6
5	240	16.1	240	17.4	260	20.6	280	23.5	300	26.5	300	28.0	300	29.6	300	31.3
10	240	15.5	240	16.8	260	19.5	280	22.7	300	25.8	300	26.9	300	28.2	300	26.9
15	240	15.1	240	16.2	260	19.0	280	21.8	300	24.4	300	23.3	300	24.4	300	25.6
20	240	15.0	240	16.0	260	18.6	280	21.0	290	20.5	300	22.2	300	23.4	300	24.7
25	240	14.3	240	15.2	260	17.5	280	18.0	290	19.7	300	21.5	300	22.7	300	23.9
30	240	13.5	240	14.5	260	16.8	280	17.4	280	18.5	285	20.2	290	22.1	290	23.8
35	240	13.0	240	14.1	250	14.4	260	16.5	260	17.9	270	20.9	270	23.0	—	—
40	230	12.6	230	12.6	230	14.2	240	16.9	245	20.3	245	24.5	—	—	—	—
45	220	12.3	220	14.2	220	16.6	220	21.3	—	—	—	—	—	—	—	—

WARNING

Below 20,000 feet, NRT may accelerate aircraft past structural speed limits.

NOTE

- Increase fuel flow by 10% if loss of airspeed was caused by radome failure. In this case these speeds may cause severe buffeting and a lower speed may be appropriate.
- Increase fuel flow by 2% for each 10°C over standard day temperature.
- Power setting in this chart will not necessarily prevent a stall if level off airspeed is less than that required for best endurance. If in doubt, use NRT and allow aircraft to accelerate to a safe airspeed.
- If protuberances or operational factors are present, apply the fuel flow correction factors in the "Range" section of the Appendix.

■ ■ ■ ■ Fuel Flow For Airspeed Indication Failure

Figure 3-9.

down. The following example lists desired windmill rpm for a 240 KIAS letdown:

Pressure Altitude	Desired Windmill RPM
40,000	36%
35,000	33%
30,000	31%
25,000	28%
20,000	27%
15,000	25%
10,000	23%
5,000	20%
2,000	19%

NOTE

During level flight on seven engines, the chart can be entered with pressure altitude and stable windmill rpm to obtain the resultant indicated airspeed.

Pitch corrections should not exceed 2° on the attitude gyro. Corrections in excess of 2° will cause over-control due to time lag to achieve stabilized windmill rpm. Traffic pattern should not be flown without chase aircraft; however, knowledge of wind velocity and direction, coupled with doppler ground speed, will provide the most reliable airspeed information. Subtract effective tailwind or add effective headwind from doppler ground speed to obtain approximate KIAS. Eight engine operation should be resumed after arrival of chase plane.

FUEL FLOW FOR AIRSPEED INDICATION FAILURE

Level flight fuel flow for charted airspeed can be immediately determined from figure 3-9 by entering the chart with altitude and gross weight. This chart provides a minimum speed of 240 KIAS except for some low weight/high altitude conditions. All airspeeds shown are at least 15 knots above best endurance and

generally approach best range speeds. Adjusting the fuel flow to the values shown in the chart for a specific altitude and gross weight will not necessarily prevent a stall if level off airspeed is less than that required for best endurance. If in doubt, use NRT and allow the aircraft to accelerate to a safe airspeed. Airspeeds that are less than best endurance will place the aircraft on the back side of the drag curve. If the speed is less than the speed for minimum drag (best endurance) and thrust equals drag, altitude will be held. If a gust or control input occurs, it can cause a drag increase and a deceleration will occur. If the pilot or autopilot is trying to hold altitude, this will not permit an accelerating force to develop and the deceleration will become more severe. In this situation, the aircraft will continue to decelerate further and stall will result unless power is applied or the nose is lowered enough to develop an accelerating force. The data presented in figure 3-9 was extracted from the fuel flow charts in the "Range" part of the Appendix. Flight conditions are for a clean aircraft

on a standard day. If protuberances or operational factors are present, apply the fuel flow correction factors in the "Range" section of the Appendix.

EMERGENCY JETTISONING

ALE-20 INFLIGHT EMERGENCY JETTISON

During a planned crash landing or landing with both rear gears retracted, a possibility exists that loaded flares may be ignited from the ensuing heat and/or shock. For this reason, it is recommended that the flares be jettisoned if conditions permit. Time available, aircraft performance, fuel remaining, etc, are all considerations in electing to jettison the flares. The flares should be expended over an open water or isolated land area. If over land, the minimum altitude for jettisoning is 5000 feet. When flares are to be jettisoned, follow the procedures in the "ALE-20 Inflight Emergency Jettison" checklist.

ALE-20 INFLIGHT EMERGENCY JETTISON**NOTE**

During flare dispensing, as each flare leaves the aircraft, crewmembers can expect a bright white flash visible within the crew compartments accompanied by a slight vibration of the aircraft similar to firing of guns. These flashes will be most noticeable at night, in the vicinity of cloud formations, or during IFR flight conditions; however, the flashes are discernible even during daytime VFR flight conditions

1. Flare Circuit Breakers IN- IN (EW)
2. Pilot's Flare Set Power Switch ON - ON (P)
3. Power Switch ON - ON (EW)
4. Transfer Switch OFF - OFF (EW)
5. Depress Fast Train Button - Depressed (EW)

The "Program in Progress" light will illuminate when the fast train button is depressed. When the last flare has left the aircraft, the "RH Empty" light will illuminate.

6. Power Switch OFF - OFF (after "RH Empty" light illuminates) (EW)
7. Pilot's Flare Set Power Switch OFF - OFF (P)

LANDING EMERGENCIES

LANDING GEAR FAILURE TO EXTEND

Main Gear Fails to Extend

1. Check Hydraulic Pressure - Checked (P)

Check hydraulic pressure on affected body system. If pressure is normal, proceed with step "2." If pressure is low, proceed to step "3."

2. Hydraulic Pressure Normal, Accomplish the Following:

- a. Pull and Reset Normal Gear Control Circuit Breaker for Affected Gear - Pulled and reset (CP/EW/G)

During gear extension, an intermediate gear position may be the result of a malfunctioning position switch; pulling and resetting the breaker will break the holding circuit of the position switch relay. If the gear is actually down and locked, a gear down indication should appear and a normal landing can be made. If a gear down indication is not obtained, proceed with step "b."

- b. Pull Normal Gear Control Circuit Breakers for All Unaffected Gear - Pulled (CP/EW/G)

By pulling the normal gear control circuit breakers for all unaffected gear, the unaffected gear will not be recycled unnecessarily.

- c. Recycle Landing Gear - Recycled (CP)

Position gear handle to GEAR UP (observe landing gear retraction placard speed) and wait for the gear up indication; then return gear handle to GEAR DOWN.

- d. Reset All Normal Gear Control Circuit Breakers - Reset (CP/EW/G)

- e. Place Landing Gear Emergency Switch to EXTEND - EXTEND (P)

If gear does not indicate down and locked after recycling and if opposite body system pressure is normal, move the respective landing gear emergency switch to EXTEND for a period not exceeding 10 seconds if landing gear does not move.

CAUTION

- Actuation of the landing gear emergency switch for more than 10 seconds without gear movement may result in complete loss of opposite body hydraulic system fluid.
- To reduce the possibility of system damage, do not change operating position of emergency switch while the gear is in motion.

NOTE

Pressure for emergency actuation of a main gear is provided by the opposite body system.

LANDING GEAR FAILURE TO EXTEND (Cont)

- f. Place Landing Gear Emergency Switch OFF - OFF (P)

As soon as landing gear is down and locked, return emergency switch to OFF. Do not reposition emergency switch to EXTEND unless the gear attempts to move from down with the switch OFF.

CAUTION

There are no limit switches in the emergency system and the emergency circuits are energized when the emergency switch is out of OFF.

- g. Accomplish Appropriate "Landing With Partial Gear Checklist" - Accomplished (P)

If (after executing proper emergency procedures) gear does not indicate down and locked, further actuation attempts should not be made; use appropriate procedure outlined under "Landing With Partial Gear Checklist," this section, when ready to land.

WARNING

Due to hazards involved, installation of downlocks in flight is not recommended.

3. Hydraulic Pressure Low, Accomplish the following:

- a. Pull Normal Gear Control Circuit Breaker for the Affected Gear - Pulled (CP/EW/G)

If any main gear does not indicate down and locked and pressure is low on the affected body system, a ruptured hydraulic system may have occurred. Pull the normal gear control circuit breaker for the affected gear. Pulling the breaker will deactivate the gear normal control valve and may prevent loss of fluid from a malfunction downstream of the normal control valve.

NOTE

If the circuit breaker is found to be tripped, reset it and observe position indicator.

- b. Place landing gear Emergency Switch to EXTEND - EXTEND (P)

If opposite body system pressure is normal, move the respective landing gear emergency switch to EXTEND for a period not exceeding 10 seconds if landing gear does not move.

CAUTION

- Actuation of the landing gear emergency switch for more than 10 seconds without gear movement may result in complete loss of the opposite body hydraulic system fluid.
- To reduce the possibility of system damage, do not change operating position of emergency switch while the gear is in motion.

NOTE

Pressure for emergency actuation of a main gear is provided by the opposite body system.

LANDING GEAR FAILURE TO EXTEND (Cont)

- c. Place Landing Gear Emergency Switch OFF - OFF (P)

As soon as landing gear is down and locked, return emergency switch to OFF. Do not reposition emergency switch to EXTEND unless the gear attempts to move from down with the switch OFF.

CAUTION

There are no limit switches in the emergency system and the emergency circuits are energized when emergency switch is out of OFF.

- d. Accomplish Appropriate "Landing With Partial Gear Checklist" - Accomplished (P)

If (after executing proper emergency procedures) gear does not indicate down and locked, further actuation attempts should not be made; use appropriate procedure outlined under "Landing With Partial Gear Checklist," this section, when ready to land.

WARNING

Due to hazards involved, installation of downlocks inflight is not recommended.

- e. Before Landing, Standby Pump Switch to STBY - STBY (P)

Depending on the nature and location of the malfunction, use of the body standby pump on the same side as the malfunctioning gear will provide pressure for brakes, steering, and crosswind crab. The standby pump should be turned on immediately prior to landing.

CAUTION

If main landing gear malfunction is associated with loss of hydraulic fluid, anticipate loss of 1/2 rate of stabilizer trim capability and possible loss of braking and steering on the extended gear which operates on the same hydraulic system as the malfunctioning gear.

Tip Gear Fails to Extend

1. Check Hydraulic Pressure - Checked (P)

Check hydraulic pressure on affected outboard wing system. If pressure is normal, proceed with step "2." If pressure is low, proceed to step "3."

2. Hydraulic Pressure Normal, Accomplish the Following:

- a. Pull Normal Gear Control Circuit Breakers for All Unaffected Gear - Pulled (CP/EW/G)

By pulling the normal gear control circuit breakers for all unaffected gear, the unaffected gear will not be recycled unnecessarily.

- b. Recycle Landing Gear - Recycled (CP)

Position gear handle to GEAR UP and wait for the gear up indication; then return gear handle to GEAR DOWN.

- c. Reset All Normal Gear Control Circuit Breakers - Reset (CP/EW/G)

LANDING GEAR FAILURE TO EXTEND (Cont)

- d. Landing Gear Emergency Switch to EXTEND - EXTEND (P)

If gear does not indicate down and locked after recycling and if adjacent inboard wing system pressure is normal, move the respective landing gear emergency switch to EXTEND.

NOTE

Pressure for emergency extension of a tip gear is provided by the adjacent inboard wing system.

- e. Landing Gear Emergency Switch OFF - OFF (P)

As soon as landing gear is down and locked, return emergency switch to OFF. Do not reposition emergency switch to EXTEND unless the gear attempts to move from down with the switch OFF.

CAUTION

There are no limit switches in the emergency system and the emergency circuits are energized when the emergency switch is out of OFF.

- f. Accomplish Appropriate "Landing With Partial Gear Checklist" - Accomplished (P)

If (after executing proper emergency procedures) gear does not indicate down and locked, further actuation attempts should not be made; use appropriate procedure outlined under "Landing With Partial Gear Checklist" this section, when ready to land.

3. Hydraulic Pressure Low, Accomplish the Following:

- a. Pull Normal Gear Control Circuit Breaker for the Affected Gear - Pulled (CP/EW/G)

If either tip gear does not indicate down and locked and pressure is low on the affected outboard wing system, a ruptured hydraulic system may have occurred. Pull the normal gear control circuit breaker for the affected gear. Pulling the breaker will deactivate the gear normal control valve and may prevent loss of fluid from a malfunction downstream of the normal control valve.

NOTE

If the circuit breaker is found to be tripped, reset it and observe position indicator.

- b. Landing Gear Emergency Switch to EXTEND - EXTEND (P)

If adjacent inboard wing system pressure is normal, move the respective landing gear emergency switch to EXTEND.

CAUTION

Actuate switch one time only; do not repeat. Further attempts may result in a complete loss of hydraulic fluid if a rupture exists in the lines or component parts within the system. A 120 cubic inch automatic reset fuse is installed in the emergency tip gear system upstream of the emergency extend control valve. One cycle of the fuse will not deplete the system to such an extent that normal spoiler operation will be impaired.

NOTE

Pressure for emergency extension of a tip gear is provided by the adjacent inboard wing system.

LANDING GEAR FAILURE TO EXTEND (Cont)

- c. Landing Gear Emergency Switch OFF - OFF (P)

As soon as the landing gear is down and locked, return emergency switch to OFF. Do not reposition emergency switch to EXTEND unless the gear attempts to move from down with the switch OFF.

CAUTION

There are no limit switches in the emergency system and the emergency circuits are energized when emergency switch is out of OFF.

- d. Accomplish Appropriate "Landing With Partial Gear Checklist" - Accomplished (P)

If (after executing proper emergency procedures) gear does not indicate down and locked, further actuation attempts should not be made; use appropriate procedure outlined under "Landing With Partial Gear Checklist," this section, when ready to land.

- e. Before Landing Approach, Standby Pump Switch to STBY - STBY (P)

Depending on the nature and location of the malfunction, use of the outboard wing standby pump on the same side as the malfunctioning gear will provide pressure for operation of the outboard spoilers and airbrake systems. The standby pump should be turned on prior to the landing approach.

LANDING WITH BADLY UNBALANCED TIRE

If the decision is made to land with a failed tire condition (blown out, flat, or chunk loss), the following criteria are recommended in order to determine landing configuration.

1. If the specific unbalanced or failed tire cannot be identified, it is recommended that the landing be accomplished at minimum gross weight with all gear extended.
2. When the specific main landing gear tire failure can be determined and the affected gear can be retracted with the normal system, subsequent landing on the affected gear will not be attempted. Since there is no way to determine certain minor damage to the landing gear strut or assembly, a landing on that gear may induce initial damage or aggravate already existing damage resulting in possible complete failure of the landing gear.

NOTE

The following procedures apply to main landing gear only. An affected outrigger gear should be down and locked for landing; however, the landing checklist for one or both tip gear retracted will be followed.

Before landing (if the landing gear has been retracted), pull the normal and emergency control circuit breakers for the affected gear to assure that it will remain up and locked when landing gear lever is actuated to lower the landing gear. If the landing gear remained down and locked after takeoff, the affected gear should be retracted using the following procedures:

1. Pull the normal gear control circuit breakers for the nonaffected gear.
2. Place gear lever to the GEAR UP position.
3. When the affected gear indicate up and locked, pull the normal and emergency control circuit breakers for the affected gear.

CAUTION

Do not attempt retraction of the affected gear by the emergency retraction system when main gear hydraulic system damage is suspected since alternate hydraulic system fluid may be depleted. If the affected gear remained fully extended, additional gear damage may be expected upon landing.

4. Place the gear lever to the GEAR DOWN position. Reset the normal gear control circuit breakers for the nonaffected gear.
5. Check all nonaffected gear down and locked.

NOTE

See "Landing With Partial Gear" checklist, this section, when ready to land.

LANDING WITH PARTIAL GEAR**One Main Gear Retracted or One Forward and One Rear Gear Retracted on Opposite Sides**

1. Reduce Gross Weight - Reduced (P)

Reduce gross weight to as low as possible, but assure that 20,000 pounds of usable fuel remains when initiating the landing. If missiles and/or internal weapons are aboard, the landing gross weight may be above 200,000 pounds. Landing gear loading at 200,000 pounds with one gear retracted corresponds to a 400,000-pound landing with all gear extended. Weight reduction can be accomplished by flying at low altitude and high thrust settings (up to NRT) with airbrakes and landing gear extended.

NOTE

In the case of one main gear retracted, there is no requirement to establish a lateral fuel unbalance in order to reduce the tip gear load on the side with the retracted gear. A differential significant enough to reduce tip gear load would result in an increase in landing gross weight, lateral unbalance which could introduce controllability problems, and possible fuel starvation due to uncovered pumps. The tip gear load imposed in this situation is relatively small when compared to ultimate design load.

2. Accomplish Normal Approach & Landing - Accomplished (P)

Make normal approach with airbrakes in position 4. Touch down on main gears simultaneously at the minimum rate of descent. Hold the wings level and apply minimum braking and steering. Use all of the runway if necessary to stop the aircraft on minimum braking.

WARNING

Do not move steering ratio selector lever to TAXI during ground roll. Even if the retracted gear is a forward gear, sufficient steering normally should be available. Stop the aircraft straight ahead on the runway.

CAUTION

Do not attempt to taxi the aircraft except in an emergency which requires clearing the runway.

LANDING WITH PARTIAL GEAR (Cont)**One Forward and One Rear Gear Retracted on Same Side****1. Check Weight Distribution - Checked (CP)**

Reduce gross weight to as low as possible, but assure that 20,000 pounds of fuel remain when initiating the landing. Distribution of the 20,000 pounds of asymmetrical fuel should be: 7500 pounds in each main tank and 5000 pounds in the outboard wing tank on the side opposite the gear failure. Prior to initiating landing, fuel should be depleted from the main tanks on the side with gear failure and boost pumps turned off. Full lateral trim plus partial lateral control will be required at all flaps down speeds to compensate for asymmetrical fuel loading.

NOTE

- Landing gross weight may be less than shown in the "Minimum Landing Gross Weight with Lateral Unbalance" chart in the "Approach and Landing" section of the Appendix. More than 50% of lateral control may be required at touchdown speed.
- If time is available, a controllability check should be made to determine the control characteristics which will be encountered on landing. This check is described under "Stall or Controllability Checks" in Section VI.

2. Crossfeed Valves 9, 10, 11 & 12 OPEN - OPEN (CP) Checked (P)

The landing should be made by operating all engines on the fuel remaining in the main tanks on the side with gear extended.

3. Accomplish Normal Approach & Landing - Accomplished (P)

Make normal approach with airbrakes in position 4. Touch down with both main gears simultaneously at the lowest possible rate of descent. Hold the wings nearly level with the tip gear on the side with the extended main gear riding firmly on the runway. Apply minimum braking and steering. Use all of the runway if necessary to stop the airplane on minimum braking.

WARNING

Do not move the steering ratio selector lever to TAXI during ground roll. Stop the airplane straight ahead on the runway.

CAUTION

Do not attempt to taxi the aircraft except in an emergency which requires clearing the runway.

Both Forward Gears Retracted

It is not recommended that a gear down landing be made when the forward landing gear cannot be extended. In such a case, all extended landing gear should be retracted if a crash landing must be made.

LANDING WITH PARTIAL GEAR (Cont)**Both Rear Gears Retracted****NOTE**

When the rear main landing gears will not extend but the landing conditions are otherwise favorable, a landing on the runway with the forward and tip gears extended is recommended. This will probably result in less damage to the aircraft than crash landing off the runway. The fire hazard due to the location of the fuel vent in the bottom of the fuselage is a small additional risk in a rear gear up landing on concrete.

1. Reduce Gross Weight - Reduced (P)

Reduce gross weight to an absolute minimum. Weight reduction can be accomplished by flying at low altitudes and high thrust settings (up to NRT) with airbrakes and landing gear extended.

2. Accomplish "Crash Landing and Ditching" checklist - Accomplished (ALL)**One or Both Tip Gears Retracted****1. Check Weight Distribution - Checked (CP)****a. Landing with one tip gear retracted**

Establish a 6000-pound differential between tanks No. 1 and 4 with the greater weight on the side of the extended tip gear.

b. Landing with both tip gears retracted**(1) Landing without crosswind**

Maintain symmetrical fuel load.

(2) Landing with crosswind

Establish a 3000-pound differential between tanks No. 1 and 4 with the greater weight on the upwind side.

NOTE

- Every effort will be made to land into the wind avoiding crosswinds.
- If time is available, a controllability check should be made to determine the control characteristics which will be encountered on landing. This check is described under "Stall or Controllability Checks," Section VI.

2. Accomplish Normal Approach & Landing - Accomplished (P)

With one tip gear retracted, make a normal approach and landing, touching down at the lowest possible rate of descent. Hold wings nearly level with the extended tip gear riding firmly on the runway. Apply minimum braking and steering.

WARNING

Stop the aircraft straight ahead on the runway. If taxiing is required, make only large radius turns and make all turns away from the extended tip gear if possible.

CAUTION

Do not attempt to taxi the aircraft except in an emergency which requires clearing the runway.

With both tip gears retracted, make a normal approach and landing, touching down at the lowest possible rate of descent. Hold the wings as level as possible. If a wing starts to drop while at low speed during landing roll, even though full lateral control is used, a sharp turn toward the dropping wing may assist in bringing it back up. If crosswind crab is used, brake application may tend to cause the aircraft to heel over toward the downwind wing. Therefore, brake application should not be heavy until crosswind crab has been centered during the roll. Apply only small forward gear steering corrections during the roll unless steering is used to bring up a wing.

WARNING

Stop the aircraft straight ahead on the runway.

CAUTION

Do not attempt to taxi the aircraft with the tip gears retracted.

LANDING WITH ONE FORWARD GEAR STEERING FAILURE

In case steering is lost on one forward main landing gear, the aircraft may still be landed without undue concern. As the other main landing gear is turned, a sufficiently large turning moment is introduced to change the direction of the aircraft path down the runway. The main landing gear on which steering has failed will tend to caster and normally will follow the wheels which are turning unless some unusual failure has occurred. More rudder pedal travel along with more rudder pedal force will be required to obtain the same amount of effective steering as when both steering systems are operating. Maintain

the aircraft in as near a level attitude as possible during the landing roll and, when the aircraft slows down to taxi speed, move steering ratio selector lever to TAXI position.

NOTE

The rudder pedals should be in neutral when the steering ratio selector lever is moved to the TAXI position.

Drag chute deployment during a strong crosswind is not desirable since this tends to turn the aircraft. If drag chute deployment is necessary, the chute should be jettisoned early.

WITH ENGINES 4 AND/OR 5 INOPERATIVE

When engine No. 5 has failed and reaches a low windmilling rpm, hydraulic pressure will not be available on the right body system to provide steering control of the right forward landing gear and may result in the forward gear being out of alignment with each other when steering is attempted at slow taxi speed or if a complete stop is made following landing roll. Standby pump pressure is not available to the right forward landing gear since the manually operated bypass valve is not readily accessible to the flight crew. Steering control may be maintained by avoiding slow turns and complete stops. If engine No. 5 has been shut down in flight but is still capable of windmilling, the procedure listed below can be used to maintain hydraulic pressure for the right forward landing gear steering and brake system. However, if the engine has been shut down due to fire and it is not desired to push the engine fire shutoff switch in, this procedure cannot be used as hydraulic supply fluid is not available to the pump with the engine fire shutoff switch out. It will then be necessary to have ground crew open the manual check valve and allow the forward gear to move to alignment by use of standby pressure.

CAUTION

The following procedure can be used to turn off of the active runway and to make subsequent turns while taxiing. After completion of a turn, No. 5 starter switch should be turned OFF to avoid unnecessary motoring during straight-line taxiing. Should the engine starter limitations as listed in Section V be exceeded, a notation to that effect will be entered in Form 781 indicating the time used.

1. Pull No. 5 ignition circuit breaker on the right load central.
2. Push engine No. 5 fire shutoff switch in.
3. Place start selector switch in PNEUMATIC.
4. With throttle No. 5 in CLOSED, place No. 5 starter switch to START.
5. Increase engine No. 6 rpm a sufficient amount to allow engine No. 5 to be motored at approximately 20% rpm by the engine starter. This will supply sufficient hydraulic pressure to steer the aircraft throughout a turn.

NOTE

Approximately 67% rpm will be necessary initially on engine No. 6 in order to obtain 20% rpm on No. 5. No. 6 throttle must be adjusted thereafter to maintain a constant 20% rpm on No. 5.

6. If engine No. 6 is not available, open the air bleed manifold valves and increase appropriate engine(s) rpm in order to obtain 20% rpm on engine No. 5.

CAUTION

Do not attempt to motor engine No. 5 through use of bleed air from the outboard nacelles. This practice will result in excessive bleed air manifold temperatures even though the manifold temperature gage does not exceed the red lined value. When using engine No. 3 or 4 to motor engine No. 5, its rpm must exceed all other engine rpm by at least 10%. This will prevent airflow from the outboard nacelles.

7. After completion of the turn, place No. 5 starter switch OFF.
- When engine No. 4 and the left standby body pump have become inoperative, a motoring procedure similar to that for engine No. 5 may be used.

LANDING WITH COMPLETE STEERING FAILURE**WARNING**

- Prior to landing, crosswind crab should never be set if steering has failed on both forward gears. Rotation of the rear gear only will produce turning moments which may result in a high speed ground loop.
- If the forward gear steering fails because of complete loss of right and left body hydraulic system pressure, normal brake operation will not be available and braking will be limited to brake accumulator pressure as supplemented by the left and right body systems standby pumps. Only the left front and right rear brakes will receive pressure from the standby pumps. See "Landing with Brake System Failure," this section.

FAILURE OF STEERING WITH REAR GEAR CROSSWIND CRAB OPERABLE

It is quite unlikely that both of the forward gear steering systems will fail at the same time. This would require that the left and right body hydraulic system main pumps as well as the left body hydraulic system standby pump must fail at the same time, or it would require some multiple failure of the steering or hydraulic mechanism. However, if such a combination of failures is encountered, the aircraft can be steered by use of the rear gear through actuation of the crosswind crab system which can be supplied pressure by the right body hydraulic system standby pump. Corrections should be made by turning the crosswind crab control knob and pushing the rudder pedals in the direction in which it is desired that the aircraft go. For instance, if the aircraft is about to run off the right side of the runway, the knob should be turned to the left by a very small amount. This will cause the rear wheels to turn to the right which in turn will result in the aircraft turning to the left.

CAUTION

If the crosswind crab system is used on the rear gear in order to keep the aircraft on the runway, only a very small turning correction should be applied since a small turning angle introduces large turning components.

FAILURE OF STEERING WITH REAR GEAR CROSSWIND CRAB INOPERATIVE

If it is known that both forward gear steering systems have failed while the aircraft is still in the air and the crosswind crab system is also inoperative, it is recommended that the landing be made at some field which has no crosswind. If no such field is located within the vicinity, the runway selected should be the one with the least amount of crosswind and the one that has the smoothest grading off the runway proper. Without use of the crosswind crab system on the rear gear, only small turns can be made by applying full rudder. Such action will cause the tires to corner slightly, but is only effective down to speeds of approximately 90% of touchdown speed. At speeds below 90% of touchdown speed, the rudder becomes ineffective in producing any change in direction. Some steering at lower speeds can be accomplished by banking the aircraft in the direction in which it is desired to turn. In this manner, a roller skate turning effect is introduced which may aid in keeping the aircraft on the runway. If the failure has occurred because of complete loss of hydraulic pressure, limited braking may be available from brake accumulator pressure. See "Landing with Brake System Failure,"

this section. If brakes are available, the drag chute should not be deployed unless the wind is straight down the runway since any wind at some angle off the runway will cause the chute to stream in a similar direction with the result that the aircraft will turn further into the wind. The chute should be jettisoned at any time an insufficient amount of directional control is available to keep the aircraft on the runway unless an overrun is probable.

LANDING WITH INSUFFICIENT STEERING ANGLE

Under certain emergency conditions on the ground, if a larger steering angle is necessary to control the aircraft, the steering ratio selector lever may be actuated toward the TAXI position. Applying pressure to the steering ratio selector lever steers the aircraft further in the direction applied by the rudder pedals. Gaining this additional steering angle with the steering ratio selector lever may require the application of considerable force. The action must be smooth and firm.

CAUTION

Extreme caution must be exercised to avoid overcontrolling the aircraft and causing structural damage.

LANDING WITH CROSSWIND CRAB SYSTEM MALFUNCTION

ONE GEAR INOPERATIVE

If the crosswind crab control knob is turned and the indicator shows that one or more of the gears has not turned with the others, additional checks must be made to determine whether or not the crosswind crab system should be used for the landing. It cannot be established from observations made in the cockpit that the crosswind crab system has failed on any one gear since the indicator is electrically connected only to one forward and one rear gear. Therefore, in order to determine if a single or multiple failure has occurred, a visual inspection of the wheels must be made by a member of the flight crew at the wheel well. If it can be determined that crosswind crab has failed on only one gear, a normal crosswind landing can be accomplished if the crosswind encountered is of such magnitude to warrant such use. Such a landing should be accomplished using the minimum rate of sink at touchdown so as to minimize the side loads which will be imposed on the misaligned gear. Depending on the type of malfunction, the misaligned

gear normally will caster so that it will trail in approximately the same direction as the remaining wheels. If the crosswind component is of low magnitude, the crosswind gear should not be used and a normal landing made. The decision to accomplish the landing with or without use of the crosswind crab system will depend on the experience the pilot has had in making crosswind landings without use of the crosswind crab system.

CAUTION

When landing with left rear crosswind crab inoperative due to No. 4 hydraulic pump inoperative or No. 4 engine shut down, perform crosswind centering manually as the centered signal originates from the centered position of the left rear gear which will lag the powered gear.

NOTE

The crosswind crab centering button will not center the gear properly since the centered signal originates from the inoperative left aft gear. Depressing the centering button will drive the centering motor which would normally cause all gear to center. If the left aft gear hydraulic system is inoperative, the left aft gear will lag the other three gear during centering. Consequently, the other gear will drive on past center before the left aft gear reaches center and shuts off the centering motor. Therefore, it is necessary to monitor the position of the indicator in the crosswind crab control knob while centering the gear.

TWO OR MORE GEARS INOPERATIVE

WARNING

Prior to landing, crosswind crab should never be set if forward gear steering has failed on both the forward gears. Rotation of only the rear gears will produce turning moments which may result in a high speed ground loop.

If the magnitude of the crosswind is large and the crosswind crab system has failed on only the rear gear, then a landing may be made using crosswind crab on the forward gear only. Under such a condition, the gross weight should be decreased as low as possible and the computed crab angle applied to the forward gear by rotation of the crosswind crab control knob. The crab angle setting must not exceed 9°

since the misalignment between the front and rear wheels will tend to swing the aircraft in a circle which must be counteracted by the forward gear steering as the aircraft swings parallel with the runway. Twelve degrees of steering are available to counteract the 9° of misalignment leaving a 3° margin in case the aircraft starts heading off the downwind side of the runway. The approach should be made so as to remove most of the drift by crabbing. The landing should be accomplished using the minimum rate of sink at touchdown so as to minimize side loads imposed on the rear gear and, if possible, touch down all gears at the same time. The drag chute may be deployed, but should be jettisoned if it starts to turn the aircraft off the runway. This action will be especially noticeable if the runway is icy. Again, the decision to accomplish the landing with or without use of partial crosswind crab will largely depend on the experience the pilot has had in making crosswind landings without use of the crosswind crab system.

LANDING WITH SPOILER CONTROL FAILURES

NOTE

If either inboard or outboard airbrake control circuit breaker was pulled as suggested under "Asymmetrical Airbrake Control," this section, the circuit breaker must be reset after penetration has been completed and flaps extended for the following landing procedures.

In case of partial loss of operation of any of the spoilers, sufficient lateral control will be available from the remaining spoilers and the rudder to fly the aircraft satisfactorily during normal flaps-up operation. If complete loss of spoiler operation is experienced, the only remaining lateral control available is that which the rudder can provide. In this circumstance, the aircraft can be flown satisfactorily at altitude, but a landing should not be attempted. When landing with partial spoiler operation, the aircraft will exhibit lower maximum roll rates, and larger control wheel deflections will be required for normal corrections. The landing should be made at a gross weight of approximately 270,000 pounds. At lighter gross weights, the stopping distance will decrease; however, lateral control response will deteriorate as airspeed is reduced. It is recommended that a normal approach and landing be planned except that a wider than normal traffic pattern should be flown to compensate for the slower roll response. In order to reduce lateral control requirements, the crosswind crab system should always be utilized when making any landing in crosswind conditions after partial loss of lateral control has been experienced.

PARTIAL SPOILER FAILURE ON ONE WING

Loss of either an inboard or an outboard group of spoilers will result in a loss of approximately one-half the lateral control power in the direction of the affected wing. A normal landing can be made with more nearly equalized lateral control in the following manner: After the flaps are fully extended, raise the airbrakes to position 4. Extending the airbrakes will cause the aircraft to roll toward the side with the operative spoiler groups if the airbrake capability has also been lost on the affected spoiler group. Airbrake capability of an affected outboard spoiler group may remain if the malfunction is due to a cable failure between the inboard and outboard spoiler differential units. Trim the aircraft by applying rudder trim toward the wing with the inoperative spoiler group. Approximately two-thirds directional trim will be required. When stabilized in a straight flight path, the aircraft will be in a slightly banked and sideslipped attitude.

COMPLETE SPOILER FAILURE AND AIRBRAKES FAILURE ON ONE WING

Loss of both inboard and outboard spoiler groups on one side will result in marginal lateral control for landing purposes. However, the remaining lateral control can be used in both directions by establishing a fuel differential between main tanks 1 and 4, the heavier load being on the side with the inoperative spoilers. Obtain the needed weight differential by turning the master refuel switch ON, the defuel valve switch OPEN, and open valves 9 and 22 to transfer fuel from 1 to 4, or open valves 12, 19, and 29 to transfer fuel from 4 to 1. All auxiliary tank fuel flow control switches should be OFF and all auxiliary tank engine feed control switches should be CLOSED.

NOTE

- Approximately 4000 pounds of fuel differential should contribute sufficient lateral control.
- The copilot should monitor fuel transfer closely since the fuel transfer rate is well over 20,000 pounds per hour.
- If time is available, a controllability check should be made to determine the control characteristics which will be encountered on landing. This check is described under "Stall or Controllability Checks," Section VI.
- Rudder trim, rudder, and differential power are still available as an aid to lateral control.

- The hydraulic systems malfunctions causing loss of both spoiler groups on one side may also prevent extension of the tip gear on that side. Since the lateral control problem is the most critical, disregard the procedure outlined in "One or Both Tip Gear Retracted" under "Landing With Partial Gear Checklist," this section. The fuel differential established to compensate for the loss of both spoiler groups will not cause the external tank on that side to contact the runway during a properly executed landing under optimum wind conditions even though the tip gear is retracted.

The landing should be made in the following manner: After the flaps are fully extended, raise the airbrakes to position 4. This will cause the aircraft to roll toward the wing with the operative spoiler groups and is compensated for by displacing the control wheel in the opposite direction. Continue approach and landing with landing flare, touchdown, and drag chute deployment executed as normal. Stop the aircraft straight ahead on the runway. Sufficient lateral control is available to maintain a nearly wings-level attitude down to 50 knots provided no adverse surface winds exist.

CAUTION

Do not attempt to taxi the aircraft with the tip gears retracted.

COMPLETE SPOILER FAILURE ON ONE WING, AIRBRAKES OPERATIVE

Certain cable failures can result in loss of spoiler control on one wing; however, partial or full airbrake capability will remain. Airbrake capability contributing to lateral control can be determined by displacing the control wheel in the direction of the affected wing and extending airbrakes. If airbrakes are operative, the aircraft will roll toward the affected wing. If airbrakes are used as spoilers for turns into the affected wing, displace the control wheel in the desired direction and extend airbrakes in single increments until the desired bank angle is obtained (not to exceed 15° bank). To maintain the desired bank angle, adjust airbrakes as necessary. To roll out of a turn, airbrake lever should be placed to the OFF position in single increments prior to displacing the control wheel in the desired direction. Procedures described under "Complete Spoiler Failure and Airbrake Failure on One Wing," will apply except the amount of fuel differential required will be less with airbrake capability contributing to lateral control.

THREE SPOILER GROUPS INOPERATIVE

With three spoiler groups inoperative, lateral control will be very low and a landing under anything but ideal conditions will be extremely hazardous. Lateral control can be obtained in both directions by extending the airbrakes to position 4 and applying rudder trim, in the manner described above, toward the wing with both spoiler groups inoperative. In addition, the rudder should be used to augment lateral control. A flaps-up landing is recommended. Prior to landing, the airbrake control circuit breaker for two of the inoperative spoiler segments (inboard or outboard segments) may be pulled to prevent inadvertent operation during landing.

ALL SPOILER GROUPS INOPERATIVE

With all spoiler groups inoperative, the only roll control available will be that resulting from sideslip produced by the rudder. The time required to establish a roll rate will be extremely long because a sideslip motion must first be established before any roll motion can be effected. A landing under these conditions is not recommended.

LANDING WITH STABILIZER TRIM FAILURE

If stabilizer trim should fail during flight, the aircraft can still be flown satisfactorily through proper application of the elevator control. Normally, at the time of failure, the aircraft would be trimmed to fly hands off for that particular weight and cg location. This cg location should be held at approximately the same value by shifting the fuel loading during the remainder of the flight. If such action is not possible or practicable, then the cg location may shift as required since the elevator is powerful enough to counteract for a shift within the limits of 18% and 34% MAC as long as the stabilizer fails within its normal operating range. Needless to say, the further the cg location moves from the location which existed at time of stabilizer trim failure, the greater the pilot control column forces will be at the original trim speed. The elevator is also sufficiently powerful to permit a safe landing if stabilizer trim fails within its normal operating range. If sufficient fuel remains to do so safely as the aircraft approaches the landing base, the cg should be shifted aft to approximately the 30% MAC position by transferring fuel so as to compensate for the nose up trim which will be required as the speed is decreased. Between 3° and 5° of stabilizer nose down trim normally is required when the wing flaps are moved rapidly from the flaps up to the fully extended position. The wing flaps therefore should be lowered in small increments. While lowering the wing flaps, the airspeed should be allowed to decrease. This will assist in compensa-

ting for the out-of-trim condition by keeping the control forces at low level and will require less down elevator or forward control column travel. The change in trim due to wing flap extension will actually work to the advantage of the pilot and probably result in the requirement of down elevator and a push force on the control column during the final approach. For this reason, adequate up elevator travel will be available for producing the final flare. The airbrakes produce a nose up trim so that considerable trading is available between airbrake position and elevator position for obtaining a desirable trim and control situation for such an emergency. If the emergency is such that, even with the aid of airbrakes, little elevator can be made available for landing flare, a very flat approach should be made at normal approach speeds by carrying power. Under such conditions, it may not be possible to get the tail down far enough with the result that the forward landing gear will touch down first. Such a landing may cause the aircraft to porpoise between the forward and rear landing gear.

NOTE

If time is available, a controllability check should be made to determine the control characteristics which will be encountered on landing. This check is described under "Stall or Controllability Checks," Section VI.

LANDING WITH RUDDER/ELEVATOR SYSTEMS INOPERATIVE

NOTE

With complete failure of both rudder/elevator systems, a flaps-up landing is required.

Flight test with simulated failure of the rudder/elevator systems has demonstrated that the aircraft can be landed safely with this condition. However, a complete failure rendering the rudder and elevators completely inoperative is a serious emergency. The aircraft will be quite difficult to control and the procedure for landing will be difficult to execute and requires some practice. The decision to attempt to land or abandon the aircraft must remain with the pilot based on all the factors involved for there may be conditions that make it impossible to land safely. Landing procedures for coping with the complete loss of all rudder and elevator control are basically the same as for a flaps up approach which places the aircraft in a nose up attitude and requires little or no attitude change from final approach to touchdown. Observe the "Landing With Wing Flaps Inoperative" procedures and checklists as applicable, modified by particular techniques applicable to this emergency as follows:

1. The recommended landing condition is between 230,000 and 260,000 pounds gross weight and CG of 20 to 25% MAC. The aircraft can be landed outside these limits, but it is recommended that weights above 270,000 pounds and CG's forward of 17% or aft of 30% not be attempted. Normal or forward CG's provide better handling qualities while aft CG's reduce the longitudinal stability, increase the sensitivity to pitch control inputs, and increase the aircraft response to gusts. Normal trim change requirements should be reviewed and some trim changes made automatically because there will be no stimulus from "feel" to trim as with normal controls. For instance, the gear extension requires approximately one unit of nose up trim. Airbrake extension to position 2 provides an equal compensation if it is applied as the gear extends, but a small input of stabilizer trim might be necessary. Trim is required as the airspeed changes. When the airspeed decreases, nose up trim is required to raise the nose and hold altitude. Rolling into a turn causes a pitch up tendency because of spoiler extension (airbrake position 2 or 3 minimizes this) but after the turn is established the nose will drop unless nose up trim is applied (a little thrust increase is also required to maintain airspeed and this provides some pitch up assistance). Increased thrust causes a pitch up and decreased thrust causes a pitch down. All of the above normal trim requirements should be expected and anticipated if the aircraft is to be kept under control. Care must be taken not to over-trim, since large pitching motions can develop which are very difficult to control. Should a pilot experience the situation where he is chasing the pitching motion due to excessive trimming or inappropriate airbrake control, the aircraft can best be stabilized by referring to the attitude indicator and trimming as necessary to obtain and hold a constant attitude, then correcting the attitude to obtain the desired flight path. If the trim is moved, the aircraft will pitch and continue to move until the trim is removed. Therefore, each trim input must be removed with an opposite input to stop the pitching motion. For instance, assume a level flight attitude and an in trim condition. It is desired to gain 500 feet of altitude. The nose may be raised a few degrees with a small input of nose up trim. As soon as a nose up attitude is achieved, the trim must be returned to near its original position to prevent the nose from pitching up further. The airbrake lever is operated in the same manner. Pulling aft on the airbrake lever will start a nose up motion, but when the desired attitude is achieved, the airbrake lever must be returned to its original position. The procedure recommends using small inputs of stabilizer trim for most of the maneuvers entering downwind leg, turning base, and turning final. The airbrake lever is recommended for pitch control on final approach. Combinations of both con-

trols may sometimes be necessary. Most important is the control of the pitch attitude by constant reference to the attitude indicator. Control of altitude, and control of descent and ascent rate is maintained only by establishing a proper pitch attitude. All control inputs should be made with reference to the attitude indicator with rapid cross-checks to the altimeter and vertical velocity indicator. This control is critical and demands much concentration. There is a natural tendency to continue moving the control column for pitch control even after it is realized the elevator has failed. The feel mechanism will still be operative and control column forces will still be present. Therefore, a conscious effort must be made to use the airbrake lever and the stabilizer trim for pitch control. The following items are emphasized and should be reviewed before commencing a descent and approach for landing.

- A penetration type approach is not desirable and should be avoided.

- A gradual descent with a gradual approach to a precision instrument (PAR/ILS) glideslope is recommended with a transition to runway reference at approximately 600 feet AGL or above.

- It is expected that several practice approaches will be required before the pilot can commit to a landing. Since go-arounds are not difficult or hazardous, do not hesitate to abandon any approach.

- The pilot should be relieved of some of his duties by having the copilot control airspeed with the throttles, handle communications, set navigational aids, etc.

- The minimum ceiling and visibility recommended for an approach is 600 feet and 2 miles. Turbulence and/or gusty winds or crosswinds may make it impossible to land the aircraft. In the event conditions prevail which are less than desirable at the landing destination, or if after some practice approaches, satisfactory control cannot be maintained, proceed to a suitable alternate or consider abandoning the aircraft.

- The recommended landing weight is between 230,000 and 260,000 pounds gross weight with a CG of 20 to 25% MAC.

- Do not attempt to operate an ineffective control column. The column will still have "feel" but will be ineffective with complete elevator system failure.

- Remember that the airbrakes do not operate smoothly as the lever is moved but move suddenly in step fashion and create abrupt pitching motions. Therefore, the lever must be moved from one position to the other with constant reference to the attitude indicator.

- Do not use airbrake position 6 for pitch control below 100 feet above ground level. Position 6 initially results in a momentary sink rate prior to nose up rotation.

2. The higher speeds, larger turning radius, and difficulty in establishing speeds in an unfamiliar configuration require additional maneuvering space and make a long extended landing pattern desirable. The only controls available for pitch are the stabilizer trim and the airbrakes. These controls do not provide sufficient control to flare or rotate the aircraft precisely for a flaps down approach. If the aircraft is already in a gear down, flaps down configuration, raise the flaps in increments, maintaining altitude with small inputs of stabilizer trim as necessary. Leave the gear down and stabilize with airbrake position 3 at flaps-up approach speed plus 30 knots IAS. If in the cruise configuration, gear and flaps up, and airbrakes down proceed as follows:

- a. Extend the landing gear at the normal gear extension time, altitude, and speed. Place airbrakes to position 2 as the gear extends.
- b. Gradually decelerate to flaps-up approach speed plus 30 knots IAS and place airbrakes to position 3.
- c. Maintain a trim condition, i.e., constant attitude and altitude with small inputs of stabilizer trim.

NOTE

Extreme care should be exercised to avoid overtrimming. Normally after trim is applied for an attitude change the trim must be removed to avoid overtrimming. This technique must be practiced carefully prior to commencing an approach.

- d. Request either a straight-in approach or a wide extended pattern with shallow turns (limit bank angles to 20°) and slow changes in altitude. Several small turns to final are helpful.

e. The copilot will operate the throttles to maintain the desired airspeed, handle communications, set navigational aids, etc.

3. The final approach to glideslope should be flown with gear down, flaps up, and trimmed for level flight at airbrake position 3. The airbrake lever should now be considered as the control column or control stick with its neutral position "spring loaded" to position 3. All pitch corrections should be made with the lever in and out of position 3. Since there is no feel or detent at position 3 it is necessary to make continuous visual reference to the airbrake lever to insure its constant return to position 3. The copilot will take the throttles on the downwind leg and maintain desired airspeed from there through final approach to touchdown. He should make smooth thrust changes and attempt to hold constant airspeed on final approach by minimizing the size and rate of thrust changes. He should anticipate the pilot's requirements and attempt to stay in phase. For instance, at glide slope intercept, throttle movement should be phased with the pilot's pitch

down input to hold a constant airspeed. The copilot should be alert for a go-around requirement. The throttles should be placed to idle after touchdown. Another item to consider is ground effect on the aircraft during the pre-touchdown phase. The term "ground effect" refers to change in airflow around an aircraft as a result of proximity to the ground. The B-52 "feels" ground effect at approximately 60 feet above the ground. When entering ground effect, the aircraft will pitch slightly nose down unless a nose up control input is made to maintain the original attitude. If the nose is allowed to drop as the aircraft enters ground effect, the rate of descent will increase. However, if the controls are operated to maintain the original pitch attitude, the aircraft rate of descent will be decreased sufficiently through ground effect to allow the aircraft to be landed in this attitude. Assuming that the aircraft was stable on glide slope with airbrakes in position 3, a movement of the airbrake lever to position 4 will usually be sufficient to maintain aircraft attitude when compensating for ground effect. The timing and amplitude of this pitch input must be based on pilot judgment and should not be performed in a mechanical manner. In the event of an over-rotation either (1) decrease the airbrake position and lower the nose and then reapply a nose up airbrake input or (2) initiate a go-around if there is any doubt of the ability to control the aircraft motion.

NOTE

The use of airbrake position 6 is not recommended since initially a high sink rate occurs before the aircraft pitch angle is increased.

Establish the aircraft on the final approach and proceed as follows:

- a. Decelerate to approach speed and carefully keep the aircraft in trim so that it flies constant altitude with airbrake position 3.

b. Control the heading with small bank angle changes.

c. At glide slope intercept, lower the nose approximately 2° to 3° and reduce thrust smoothly to maintain airspeed.

d. The primary pitch control is the airbrake lever, with the lever being modulated about position 3. There is no detent in position 3; therefore, constant reference to the lever position must be made. Less than precise control of the glide slope can be expected with some deviations above and below. Ideally, operating the lever from 3 to 4 and back to 3, and 3 to 2 and back to 3, will keep the aircraft sufficiently close to the glide slope. Retrim as necessary to maintain trim at airbrake position 3. However, if large pitch oscillations are experienced, abandon the approach by applying thrust and going around, see "Go-Around With Rudder/Elevator Systems Inoperative," this section.

e. From 600 feet AGL or above, control the flight path and glide slope by flying with visual reference to the runway. Monitoring the glide slope by using PAR, ILS, or VASI is helpful for aircraft position information, but reference to the runway and attitude control are primary. A stabilized attitude and constant airspeed should be maintained to touchdown.

f. At between 50 and 100 feet above ground level, a slight nose up control input (airbrakes) is usually necessary to compensate for ground effect and to maintain touchdown attitude.

g. As the aft wheels touch down, reduce thrust to idle. Expect a firm contact with the runway with the nose lowering rapidly to the ground. Raise airbrakes to position 6 after all gear are firmly on the ground. Extend the drag chute observing the chute placard.

GO-AROUND WITH RUDDER/ ELEVATOR SYSTEMS INOPERATIVE

The basic "Flaps-Up Go-Around" procedure will apply except that the airbrakes will not be retracted (left in position 3). Also thrust must be advanced smoothly to avoid putting the aircraft suddenly out of trim. Judgment must prevail with respect to the rate of thrust change required. Some steps to be emphasized during go-around follow:

1. Pilot calls for go-around and the copilot advances the throttles smoothly until a 500 to 1500 foot per minutes rate of climb is established. The pilot will then command more or less thrust and control the aircraft pitch using airbrakes and trim. Climb straight ahead until well stabilized.
2. Accelerate to approach speed plus 30 knots.
3. Make all turns gradually and limit bank angles to 20°. Make all altitude changes gradually.

NOTE

Some difficulty may be encountered if turns and altitude changes are made simultaneously.

LANDING WITH WING FLAPS INOPERATIVE

Normally, landings should not be made with wing flaps retracted since the touchdown speed is significantly higher than for a wing flaps-down landing. However, if the wing flaps malfunction or some other emergency exists, a safe landing can be made.

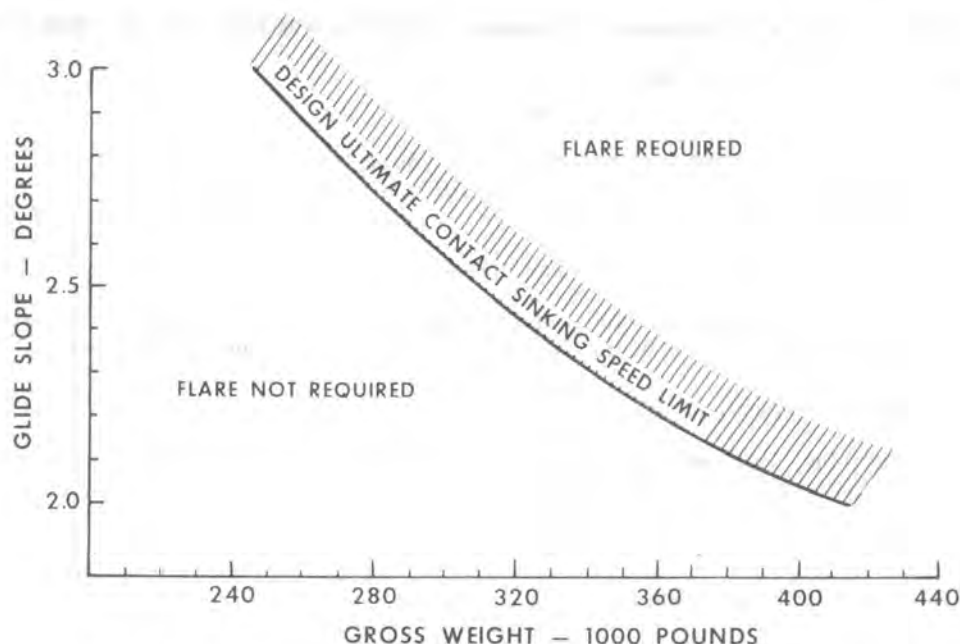
Flaps-up landings at heavy gross weights are not recommended. To preclude exceeding tire and brake energy limits and to reduce landing ground run, the gross weight should be reduced to as low a value as practicable. The airspeed schedule for flaps-up traffic pattern is as follows:

- Downwind Leg - Approach speed plus 30 knots
- Base Leg - Approach speed plus 20 knots
- Turn to Final (until established on final) - Approach speed plus 10 knots
- Final Approach - Approach speed

The higher speeds require additional maneuvering space and an extended final approach is desirable. Control response during the entire traffic pattern will be more positive than that experienced during a flaps-down pattern. The use of airbrakes provides excellent engine response and airspeed control throughout the final approach. A precision instrument approach should normally be flown. Under emergency landing conditions, glide slope angles of 3° or less may be utilized; however, an angle of approximately 2.5° is most desirable. If facilities or equipment are inoperative, the VASI approach lights may be used or, if necessary, a visual final approach may be flown.

NOTE

- For lower gross weights, flare is not required since the flare resulting from ground effect alone will reduce the rate of descent to a value that is less than the design ultimate contact sinking speed. See figure 3-10.
- For gross weights above 250,000 pounds, some flare may be required to prevent possible structural damage depending upon the glide slope angle. See figure 3-10. Since flare will increase the touchdown distance, a touchdown decision point will be required. Subtracting the charted ground roll distance from the available runway length results in a touchdown decision point (touchdown decision point may be computed as runway remaining to make it compatible to runway markers). If this touchdown decision point is exceeded, a go-around will be necessary. The flare required for aircraft gross weights above 250,000 pounds but below 310,000 pounds is minimal and only required to reduce vertical velocity to an acceptable value.



Effect Of Glide Slope Angle On Flare Technique With Ground Effect

Figure 3-10.

The latter stage of the final approach is the critical phase of a flaps-up landing. The aircraft should be flown onto the runway at approach speed and attitude. At aft gear touchdown, the power should be reduced to idle and the control column should be positioned aft to cushion forward gear touchdown. Power should not be reduced to idle prior to aft gear touchdown. If power is reduced to idle prior to aft gear touchdown, airspeed may decrease below minimum touchdown speed resulting in a hard landing.

WING FLAPS-UP LANDING DATA

Landing data for flaps-up landings are given in figure 3-11. These charts have been designed to provide the required landing data in a minimum amount of time. The charts are: "Landing Ground Run - Flaps Up With Airbrakes Only, SL to 1000 Feet" and "Landing Ground Run - Flaps Up With Airbrakes and Drag Chute, SL to 1000 Feet." Normally, the airbrakes only chart is used for planning purposes. The landing data supplied by the charts include the flaps-up approach speed, minimum touchdown speed, landing ground run, and wheel brake application speed. When the field pressure altitude is above

1000 feet, the altitude correction rules shown with the charts must be used to adjust the ground run and wheel brake application speed values given in the chart. For example, with airbrakes only and with a gross weight of 315,000 pounds, temperature of 60° F and field pressure altitude of 1000 feet, the ground run and brake application speed with airbrakes only is found to be 9000 feet and 148 knots. If, however, the field pressure altitude were 3,000 feet, it would be necessary to increase the ground run by 1,240 feet (to 10,240 feet) and to reduce the wheel brake application speed by 6 knots (to 142 knots). When making a flaps-up landing, the brake energy limits chart (figure 5-12, sheet 2) should also be used to determine if the brake energy limits will be exceeded. With this chart, the total heat energy absorbed by the brakes, with or without the drag chute, may be readily determined. The 12,000-foot landing ground run lines on the chart are provided for a quick reference only of the stopping distances involved at particular gross weights and brake application speeds. Any point lying above these lines indicates a ground run of more than 12,000 feet at sea level, standard day conditions.

LANDING WITH WING FLAPS UP**Flaps Up Before Landing (Copilot reads)****NOTE**

If a flaps-up landing is due to electrical failure, see "Conservation of Battery Power Checklist" this section for fuel system, landing gear, airbrakes, etc, operation.

1. Compute Landing Data - Computed and checked (CP-N)

The following information may be extracted and/or computed from data presented on charts located in the "Emergency Procedures" parts of the pilot's and navigator's abbreviated checklists.

a. Flaps-Up Approach Speed_____.

For gust conditions, increase approach speed by full gust factor. Example: Winds 230 at 30 knots gusting to 40, add 10 knots to approach speed.

b. Go-Around Speed (approach speed plus 30 knots)_____.

c. Maximum Brake Application Speed_____.

d. Landing Ground Run (flaps up with airbrakes and no drag chute)_____.

e. Check Brake Energy Limits_____.

Brake energy limits should be checked to determine if the limits will be exceeded. Data should be based on a no-drag chute situation.

NOTE

- Landing ground run is the amount of runway that must be available after touchdown for a complete stop on the remaining runway. If the runway remaining after touchdown is less than this distance, a go-around is mandatory.
- The landing ground run distances on these tabular charts (figure 3-11) are based on dry surfaces. When other than dry conditions exist, obtain the RCR and use the appropriate flaps-up chart in Part 9 of the Appendix.

2. Review Planned Approach - Reviewed (P-CP-RN-N)

Check the appropriate navigation aids tuned and identified and review the planned approach with the applicable crewmembers. Altitude restrictions, ceiling and visibility minimums, DH/MDA, and missed approach procedures will be emphasized. Review if type approach/pilot changes.

3. Set Radar Altimeter Cursor - Set (P-CP)

The pilot flying the aircraft will set his radar altimeter cursor to the HAA/HAT for the approach being flown. The pilot not flying the aircraft will set his radar altimeter cursor to 100 feet above the HAA/HAT for the approach being flown.

4. Landing Gear DOWN - DOWN, Six down (P-CP)

Copilot checks gear lever in detent. Pilot checks that the gear warning light is out and that all six gear indicate down and locked.

5. Flap Lever OFF - OFF (CP)

6. Set Fuel Panel - 9, 10, 11 & 12 OPEN/CLOSED (CP) Checked (P)

- a. 1 & 4 Above Green Band - 1, 2, 3, & 4 ON; 9, 10, 11, & 12 CLOSED; 13, 14, 15, & 16 CLOSED (CP) Checked (P)
- b. 1 or 4 in Green Band - 1, 2, 3, & 4 ON; 9, 10, 11, & 12 OPEN; 13, 14, 15, & 16 CLOSED (CP) Checked (P)

LANDING WITH WING FLAPS UP (Cont)

7. Set/Check Crosswind Crab - Set, knob down (CP) Checked (P)

Obtain wind direction and velocity. Compute and set crosswind crab as required using 70% of the flaps-down crosswind crab setting. If crosswind crab is not to be used, knob and position indicator must be checked for zero setting and gear position.

CAUTION

If wheel brakes are applied immediately before and held during touchdown when main gear is turned more than 14° (by any combination of crosswind crab setting and steering), the aircraft will land with wheels locked because the antiskid system is inoperative in this condition. Releasing the brakes will activate the antiskid system.

8. Recheck Approach Speed _____ knots - Rechecked (CP-N)

Recheck approach speed (plus gust factor) and cross-check airspeed indicators. On downwind leg, maintain approach speed plus 30 knots; on base leg, maintain approach speed plus 20 knots; and on turn to final, maintain approach speed plus 10 knots. After established on final and during remainder of approach, maintain approach speed.

NOTE

Flaps-up approach speeds do not change if airbrakes are inoperative.

9. Airbrake Lever Position 4 - Position 4 (P)

10. Note Target Trim - Noted (P/CP)

When aircraft is on final approach in landing configuration at approach speed, pilot not flying will note the stabilizer trim setting for zero stick force and call out this value as target trim.

11. Complete Landing Check - Completed (P/CP)

- a. Gear
- b. Airbrakes
- c. Lights

Flaps Up Landing

Accomplish after flaps-up touchdown (need not be read).

1. Airbrakes Position 6 - Position 6 (P)

Full airbrakes should be extended as soon as all wheels are on the ground.

2. Apply Wheel Brakes & Deploy Drag Chute - Applied and deployed (P/CP)

Normally pilot applies brakes at touchdown and copilot deploys drag chute at 135 knots IAS. However, brake application will be delayed until below charted maximum brake application speed.

CAUTION

Application of brakes above the maximum brake application speed will exceed the brake energy limit and may result in complete loss of brakes, rupture of hydraulic lines, and subsequent fire.

LANDING WITH WING FLAPS UP (Cont)

3. Check Hydraulic System - Checked (P)
4. Center Crosswind Crab Control Knob - Centered (P)
5. Starters OFF - OFF (CP)
6. Steering Ratio Select Lever TAXI - TAXI (P)

CAUTION

Center the rudder pedals before repositioning the steering ratio selector lever. Actuation of the lever is very difficult when the rudder pedals are deflected and could result in a dangerously abrupt change in steering angle.

Flaps Up Go-Around**NOTE**

If a go-around is required under low altitude/low airspeed conditions, pilots may not have sufficient time to refer to the checklist. Therefore this checklist should be accomplished as necessary and need not be read. When a safe altitude and airspeed is attained, the pilots will review the checklist and complete required items.

1. Set Go-Around Thrust - Set (as required) (P)
2. Airbrakes - As required (P)

Level off and check for a positive increase of airspeed.

3. Trim Aircraft - Trimmed (P)

At all times during go-around, pilot will make a conscious effort to keep the aircraft trimmed to zero stick forces.

4. Landing Gear UP - UP (as required) (P-CP)

On pilot's command copilot retracts the gear when it is established that aircraft will not contact the runway.

5. Adjust Thrust - Adjusted (P)

Pilot accelerates to approach speed plus 30 knots and adjusts thrust to establish approximately 1000 feet per minute rate of climb.

NOTE

Accomplish "After Takeoff-Climb Checklist, " "Traffic Pattern Checklist, " or "Flaps-Up Before Landing Checklist" as applicable.

**LANDING GROUND RUN — FLAPS UP, WITH AIRBRAKES ONLY,
SL TO 1000 FEET (Chart 1 of 2)**

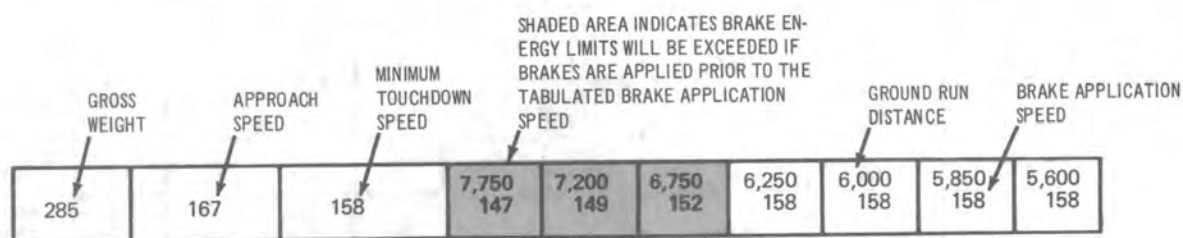
GROSS WEIGHT 1000 LB	APPROACH SPEED KIAS	MINIMUM TOUCHDOWN SPEED KIAS	120° F	100° F	80° F	60° F	40° F	20° F	0° F
200	140	132	4,100 132	3,900 132	3,750 132	3,600 132	3,500 132	3,400 132	3,300 132
205	142	134	4,250 134	4,100 134	3,950 134	3,800 134	3,650 134	3,550 134	3,450 134
210	143	136	4,400 136	4,200 136	4,050 136	3,900 136	3,750 136	3,700 136	3,550 136
215	145	137	4,550 137	4,350 137	4,200 137	4,050 137	3,900 137	3,800 137	3,650 137
220	147	139	4,700 139	4,500 139	4,350 139	4,150 139	4,050 139	3,900 139	3,800 139
225	149	140	4,850 140	4,700 140	4,450 140	4,300 140	4,150 140	4,050 140	3,900 140
230	150	142	5,000 142	4,800 142	4,600 142	4,450 142	4,300 142	4,150 142	4,050 142
235	152	143	5,150 143	4,950 143	4,800 143	4,600 143	4,400 143	4,250 143	4,150 143
240	154	145	5,300 145	5,100 145	4,950 145	4,750 145	4,550 145	4,400 145	4,300 145
245	155	146	5,400 146	5,250 146	5,100 146	4,850 146	4,700 146	4,550 146	4,400 146
250	156	148	5,600 148	5,400 148	5,200 148	5,000 148	4,800 148	4,650 148	4,500 148
255	158	149	5,750 149	5,600 149	5,400 149	5,150 149	5,000 149	4,850 149	4,650 149
260	160	151	6,000 151	5,750 151	5,550 151	5,300 151	5,150 151	5,000 151	4,850 151
265	161	152	6,150 152	5,950 152	5,700 152	5,500 152	5,300 152	5,100 152	4,900 152
270	163	154	6,300 154	6,100 154	5,900 154	5,650 154	5,450 154	5,300 154	5,100 154
275	164	155	6,800 149	6,500 155	6,050 155	5,800 155	5,650 155	5,450 155	5,250 155
280	166	156	7,250 148	6,800 150	6,300 156	6,050 156	5,800 156	5,650 156	5,450 156
285	167	158	7,750 147	7,200 149	6,750 157	6,250 158	6,000 158	5,850 158	5,600 158
290	169	159	8,250 146	7,750 148	7,150 151	6,650 153	6,100 159	5,900 159	5,700 159
295	170	161	8,750 145	8,150 147	7,650 150	7,100 152	6,550 155	6,100 161	5,900 161
300	172	162	9,300 144	8,750 146	8,200 149	7,550 151	7,050 154	6,450 156	6,050 162

Flaps-Up Landing Data

Figure 3-11 (Sheet 1 of 4).

**LANDING GROUND RUN — FLAPS UP, WITH AIRBRAKES ONLY,
SL TO 1000 FEET (Chart 2 of 2)**

GROSS WEIGHT 1000 LB	APPROACH SPEED KIAS	MINIMUM TOUCHDOWN SPEED KIAS	120° F	100° F	80° F	60° F	40° F	20° F	0° F
305	173	163	9,800 142	9,250 145	8,650 147	8,100 150	7,500 152	6,900 155	6,350 158
310	175	165	10,300 141	9,750 144	9,150 146	8,550 149	7,950 151	7,350 154	6,800 157
315	176	166	10,750 140	10,200 143	9,600 145	9,000 148	8,450 150	7,750 153	7,250 156
320	178	168	11,250 139	10,700 142	10,150 144	9,500 147	8,900 149	8,300 152	7,700 155
325	179	169	11,800 138	11,200 141	10,650 143	10,050 146	9,400 148	8,750 151	8,200 154
330	180	170	12,350 137	11,750 139	11,200 141	10,600 144	9,900 147	9,300 150	8,700 153
335	182	171		12,300 138	11,750 140	11,150 143	10,550 145	9,800 148	9,200 151
340	183	173			12,250 139	11,600 142	10,950 144	10,300 147	9,700 150
345	184	174				12,100 141	11,500 143	10,800 145	10,200 148
350	186	176					12,000 142	11,300 145	10,700 148
355	187	177						11,800 144	11,200 147
360	188	178						12,300 143	11,700 146
365	190	179							12,150 145

**CONDITIONS:**

DRY RUNWAY ONLY

REMARKS:**FIELD PRESSURE ALTITUDE CORRECTION:**

- For gross weights less than the altitude correction line (▨), increase ground run by 250 feet for each 1000 feet altitude above 1000 feet.
- For gross weights greater than the altitude correction line (▨), increase ground run by 620 feet for each 1000 feet altitude above 1000 feet.
- For gross weights in the shaded area, delay brake application 3 knots for each 1000 feet of altitude above 1000 feet.

Figure 3-11 (Sheet 2 of 4).

**LANDING GROUND RUN — FLAPS UP, WITH AIRBRAKES AND DRAG CHUTE,
SL TO 1000 FEET (Chart 1 of 2)**

GROSS WEIGHT 1000 LB	APPROACH SPEED KIAS	MINIMUM TOUCHDOWN SPEED KIAS	120° F	100° F	80° F	60° F	40° F	20° F	0° F
200	140	132	3,400 132	3,300 132	3,200 132	3,050 132	2,950 132	2,850 132	2,750 132
205	142	134	3,500 134	3,400 134	3,300 134	3,200 134	3,100 134	3,000 134	2,900 134
210	143	136	3,650 136	3,500 136	3,400 136	3,300 136	3,200 136	3,100 136	3,000 136
215	145	137	3,800 137	3,650 137	3,500 137	3,400 137	3,300 137	3,200 137	3,100 137
220	147	139	3,950 139	3,750 139	3,600 139	3,500 139	3,400 139	3,300 139	3,200 139
225	149	140	4,050 140	3,850 140	3,700 140	3,600 140	3,500 140	3,400 140	3,300 140
230	150	142	4,100 142	3,950 142	3,800 142	3,700 142	3,600 142	3,500 142	3,350 142
235	152	143	4,200 143	4,100 143	3,950 143	3,800 143	3,700 143	3,550 143	3,400 143
240	154	145	4,350 145	4,200 145	4,050 145	3,900 145	3,800 145	3,650 145	3,500 145
245	155	146	4,450 146	4,300 146	4,150 146	4,000 146	3,900 146	3,750 146	3,600 146
250	156	148	4,600 148	4,450 148	4,250 148	4,100 148	4,000 148	3,850 148	3,700 148
255	158	149	4,800 149	4,600 149	4,400 149	4,300 149	4,200 149	4,000 149	3,800 149
260	160	151	4,950 151	4,700 151	4,550 151	4,400 151	4,300 151	4,100 151	3,900 151
265	161	152	5,050 152	4,850 152	4,650 152	4,500 152	4,400 152	4,200 152	4,100 152
270	163	154	5,200 154	5,000 154	4,850 154	4,700 154	4,500 154	4,350 154	4,200 154
275	164	155	5,350 155	5,150 155	5,000 155	4,850 155	4,650 155	4,500 155	4,300 155
280	166	156	5,550 156	5,350 156	5,150 156	4,950 156	4,800 156	4,650 156	4,450 156
285	167	158	5,700 158	5,500 158	5,350 158	5,150 158	4,950 158	4,800 158	4,600 158
290	169	159	5,900 159	5,700 159	5,500 159	5,300 159	5,100 159	4,950 159	4,800 159
295	170	161	6,050 161	5,850 161	5,700 161	5,500 161	5,300 161	5,100 161	4,900 161
300	172	162	6,300 162	6,050 162	5,850 162	5,700 162	5,500 162	5,300 162	5,100 162
305	173	163	6,750 160	6,350 163	6,000 163	5,800 163	5,650 163	5,400 163	5,200 163
310	175	165	7,200 159	6,750 161	6,300 165	6,000 165	5,800 165	5,600 165	5,400 165
315	176	166	7,600 158	7,150 160	6,700 163	6,250 166	5,900 166	5,700 166	5,500 166
320	178	168	8,050 157	7,650 159	7,150 162	6,700 164	6,150 168	5,900 168	5,700 168
325	179	169	8,500 156	8,150 158	7,600 161	7,150 163	6,550 166	6,100 169	5,850 169
330	180	170	9,000 155	8,550 157	8,050 159	7,550 162	7,000 164	6,400 168	5,950 170

Flaps-Up Landing Data

Figure 3-11 (Sheet 3 of 4).

LANDING GROUND RUN — FLAPS UP, WITH AIRBRAKES AND DRAG CHUTE, SL TO 1000 FEET (Chart 2 of 2)

GROSS WEIGHT 1000 LB	APPROACH SPEED KIAS	MINIMUM TOUCHDOWN SPEED KIAS	120° F	100° F	80° F	60° F	40° F	20° F	0° F
335	182	171	9,450 153	9,000 155	8,500 158	8,000 160	7,500 163	6,900 167	6,250 170
340	183	173	9,950 152	9,400 154	8,900 157	8,400 159	7,850 162	7,300 166	6,650 169
345	184	174	10,400 151	9,850 153	9,450 156	8,900 158	8,300 161	7,750 165	7,100 168
350	186	175	10,850 150	10,350 152	9,800 154	9,350 157	8,750 160	8,100 163	7,550 167
355	187	177	11,400 149	10,900 151	10,350 153	9,850 156	9,200 159	8,650 162	8,000 166
360	188	178	11,850 148	11,350 150	10,800 152	10,250 155	9,650 157	9,000 161	8,400 165
365	190	179	12,350 146	11,850 148	11,250 151	10,700 153	10,150 156	9,450 160	8,850 163
370	191	180	12,800 145	12,250 147	11,700 149	11,150 152	10,550 155	9,900 158	9,250 162
375	192	182		12,750 146	12,150 148	11,600 151	11,000 154	10,350 157	9,700 161
380	193	183			12,600 147	12,100 150	11,450 153	10,800 156	10,150 160
385	194	184				12,500 148	11,900 151	11,250 155	10,600 158
390	196	185					12,350 150	11,700 153	11,050 157
395	197	187						12,150 152	11,450 156
400	198	188							11,850 155
405	200	189							12,400 153

SHADED AREA INDICATES BRAKE ENERGY LIMITS WILL BE EXCEEDED IF BRAKES ARE APPLIED PRIOR TO THE TABULATED BRAKE APPLICATION SPEED

GROSS WEIGHT	APPROACH SPEED	MINIMUM TOUCHDOWN SPEED	GROUND RUN DISTANCE	BRAKE APPLICATION SPEED
315	176	166	7,600 158	7,150 160
			6,700 163	6,250 166
			5,900 166	5,700 166
				5,500 166

CONDITIONS:

DRY RUNWAY ONLY

REMARKS:**FIELD PRESSURE ALTITUDE CORRECTION:**

- For gross weights less than the altitude correction line (▨), increase ground run by 210 feet for each 1000 feet altitude above 1000 feet.
- For gross weights greater than the altitude correction line (▨), increase ground run by 580 feet for each 1000 feet altitude above 1000 feet.
- For gross weights in the shaded area, delay brake application 3 knots for each 1000 feet of altitude above 1000 feet.

Flaps-Up Landing Data

Figure 3-11 (Sheet 4 of 4).

LANDING WITH BRAKE SYSTEM HYDRAULIC FAILURE

It is probable that the only indication of reduced braking capabilities that will be known in advance by the pilot will be the loss of an engine-driven pump which provides normal body system pressure or the loss of pressure on either body system. If a loss of the left main body pump is experienced, pressure can be supplied to the left forward brake system only by use of the respective standby pump. If the right main body pump is inoperative, pressure can be supplied to the right rear brake system only by use of the respective standby pump. If the loss of system pressure is due to lack or loss of hydraulic fluid, pressure may still be supplied by the standby pump which has a 1-gallon fluid reserve in the standby tank. Further reduction of the fluid supply will result in the loss of braking capabilities as provided by pressure from the respective standby pump. Charts and correction factors for stopping distances when brakes are applied at touchdown and for partial braking are included in Part 9 of the Appendix.

LANDING WITH MAIN HYDRAULIC BODY AND STANDBY PUMPS INOPERATIVE

BOTH MAIN HYDRAULIC BODY PUMPS INOPERATIVE

When landing with standby pumps as the only source of hydraulic pressure, the following procedure should be used: Turn the antiskid system switch off. Normal approach and landing procedure should be followed except that crosswind crab should not be used. Deployment of the drag chute and raising of full airbrakes should take place as soon after touchdown as possible. Brake application should take place as soon as the weight of the aircraft is on the wheels and should be smooth and firm. Pumping or repeated brake application should be avoided.

BOTH MAIN BODY HYDRAULIC PUMPS INOPERATIVE AND ONE BODY STANDBY PUMP INOPERATIVE

NOTE

With only one body system standby pump operating, stabilizer trim rate will be reduced to approximately one unit of trim every 10 seconds. The left body system standby pump will not supply pressure to the stabilizer system.

Left Body Standby Pump Operative

The landing gear may be extended by opening the manually operated bypass valve for the left body system (open with the gear up). The left body system bypass valve is located on the left side of the forward bomb bay bulkhead. The left forward and aft gear will extend (at a reduced rate) when the landing gear lever is placed in the GEAR DOWN position and the right forward and aft gear will extend (at a reduced rate) when the right forward and aft landing gear emergency switches are placed to EXTEND.

Right Body Standby Pump Operative

The landing gear may be extended in the same manner as that of the previous procedure except that the right forward and aft gear will extend when the landing gear lever is placed in the GEAR DOWN position and the left forward and aft gear will extend when the left forward and aft landing gear emergency switches are placed in EXTEND. The right body system bypass valve is located on the right side of the left aft wheel well.

BOTH MAIN BODY HYDRAULIC PUMPS AND BOTH BODY STANDBY PUMPS INOPERATIVE

When landing with both main body system pumps and their respective standby pumps inoperative, the only source of hydraulic pressure for the forward brakes and slave control pressure for the rear brakes will be from the forward brake accumulators; therefore, the following landing procedure should be used: Reduce the aircraft gross weight as low as practicable in order to keep touchdown speed low. Turn the antiskid system switch OFF.

WARNING

Prior to landing, the crosswind crab system should not be moved from the neutral position. With steering inoperative, the directional heading of the gears should be restricted to that of the aircraft.

Deployment of the drag chute and raising of full air-brakes should take place as soon after touchdown as possible. Brake application should take place as soon as the weight of the aircraft is on the wheels. One smooth and gradually increasing brake application should be made.

WARNING

Do not pump the brakes. Pumping will deplete brake accumulator pressure causing complete loss of all braking action. See "Wheel Brake System Failure," this section.

If system pressure is less than 3000 psi, the parking brake hydraulic hand pump located in the forward wheel well may be used to build up the brake pressure for the left forward main gear. This pressure will not register on the cockpit gage; however, it may be read from the gage in the wheel well.

WARNING

This action should be considered as a last resort due to the location of the hand pump and handle.

LANDING WITH DRAG CHUTE INOPERATIVE

If the drag chute fails to deploy when the drag chute deployment lever is actuated, there is nothing else that the pilot can do to get the drag chute out of the compartment. The effect of the drag chute on ground roll distance is shown by the landing charts in Part 9 of the Appendix.

CRASH LANDING

A crash landing is defined as controlled landing under conditions such that damage to the aircraft is to be expected. If a crash landing or ditching becomes imminent and time and conditions permit, a bailout of crewmembers is recommended. However, if conditions dictate for survival or other reasons, extra crewmembers may, at pilot's discretion, stay with the airplane. These people are taking a calculated risk and they should brace themselves as best they can. Individuals have crash landed in this aircraft under these conditions and were not injured.

EMERGENCY EXIT

A manual hatch release handle (figure 1-51) is provided inside each escape hatch in order that the hatch may be manually opened from inside the aircraft during ground emergency or after crash landing or ditching. If manual removal of the hatch is necessary, observe the following procedure:

Upper Deck Crewmembers (P-CP-EW-G)

1. Install armrest pins.
2. Unfasten safety belt.
3. Disconnect oxygen and interphone.
4. Remove parachute and survival kit by unfastening parachute leg and chest straps.
5. Stow control column (P-CP)
6. Stand facing aft.
7. Pull hatch release handle down and rotate full length of travel (approximately 80°).
8. Release hatch release handle.

NOTE

It is not necessary to hold the hatch release handle when removing the hatch. Although the hatch settles somewhat when the handle is released (because of hatch weight), the locking cam will not travel back past over-center.

9. Push hatch upward and aft, stepping into seat while doing so. Continue pushing until hatch has rotated approximately 95° and falls free of aircraft.

NOTE

As the hatch is rotated, the mechanical link connecting the hatch to the catapult safety pin-pull initiator will fire the initiator. Do not be alarmed; although the seat catapult is now armed, it will not fire unless the firing trigger on the armrest is squeezed.

Lower Deck Crewmembers (N-RN)

1. Stow ejection control trigger ring.
2. Unfasten safety belt.
3. Disconnect oxygen and interphone.
4. Remove parachute and survival kit by unfastening parachute leg and chest straps.
5. Reach down and forward of footrest, grasp hatch release handle, and rotate upward full length of travel (approximately 80°). Hatch will fall free of aircraft.

NOTE

As the hatch falls, the mechanical link connecting the hatch to the catapult safety pin-pull initiator will fire the initiator. Do not be alarmed; although the seat catapult is now armed, it will not fire unless the firing trigger ring is pulled.

CRASH LANDING AND DITCHING**WARNING**

- If an emergency arises necessitating immediate abandonment of the aircraft under unplanned circumstances, all crewmembers free themselves of parachute and safety belt in the quickest possible manner to evacuate the aircraft.
- After the alert signal has been given to warn the crew to stand by for ditching or crash landing, it must be realized that the situation which dictated the pilot's decision to crash land or ditch may become so critical that the pilot will decide a bailout is mandatory. Therefore, if the abandon (steady light) signal is given, the crew should bail out immediately.

NOTE

The crash landing and ditching alarm light signal is an alert (flashing light) signal. This signal is obtained by placing the emergency alarm switch in ALERT position. The alert signal will remain on until the gunner, radar navigator, and copilot have acknowledged over interphone. Just prior to touchdown, the emergency alarm switch will be placed in ALERT position and crewmembers will be notified over interphone to brace for impact. Use of ABANDON position after contact with the ground will be the signal to exit from the aircraft.

1. Landing Gear DOWN (UP for Ditching) - DOWN (or UP) (CP)

Landing gear will only be lowered after it has definitely been determined that a crash landing will be made (except when both forward gear will not extend, in which case all gear will be retracted).

2. Wing Flaps DOWN - DOWN (CP)
3. Jettison Flares as Directed - Jettisoned (P-EW)

At the pilot's discretion, the flares will be jettisoned as directed.

NOTE

During flare dispensing, as each flare leaves the aircraft, crewmembers can expect a bright white flash visible within the crew compartments accompanied by a slight vibration of the aircraft similar to firing of guns. These flashes will be most noticeable at night, in the vicinity of cloud formations, or during IFR flight conditions; however, the flashes are discernible even during daytime VFR flight conditions.

CRASH LANDING AND DITCHING (Cont)

4. Jettison Stores as Directed - Jettisoned (P-RN-EW)

At the pilot's discretion, the stores may be jettisoned as directed.

5. Close Bomb Doors - Closed (RN)

The radar navigator will close the bomb doors immediately after completing jettison operation.

6. Complete Emergency Radio Transmission - Completed (P-CP)

Place IFF master switch in EMER. The pilot/copilot will call "Mayday" over UHF.

7. Stow Loose Equipment - Stowed in lower deck compartment (RN-N)

All loose equipment from the upper deck should be passed to the lower deck.

8. Jettison Aft Upper Escape Hatches - Jettisoned (EW-G)

WARNING

- Because of high noise level, air buffeting, and the circulation of foreign particles by turbulent air, the aft upper escape hatches should be jettisoned below 250 knots IAS and at a low altitude, preferably not lower than 1000 feet. If the hatch does not jettison, do not attempt manual release until the aircraft has come to a complete stop. The forward upper escape hatches will not be removed until aircraft comes to a complete stop.
- The seat cannot be safetied until the arming levers have been stowed. Installation of the safety pins with the arming levers rotated to the up position will not prevent the seat from firing if either firing trigger is squeezed.

NOTE

Although jettisoning the upper escape hatches arms the upward ejection seats, inertia forces due to crash landing or ditching normally are not great enough to fire these seats. To prevent accidental firing of the seat during egress, lower the armrests to the fully stowed position or, if time permits, stow the arming levers in accordance with the procedure outlined under "Upward Ejection Seat Controls," Section I, and reinsert the safety pins.

9. Airbrakes Position 4 - Position 4 (P)

At gross weights above 325,000 pounds, the airbrakes should be used only as required to maintain pitch control.

CRASH LANDING AND DITCHING (Cont)**10. Accomplish Final Crew Warning - Accomplished (P)**

Warn crewmembers of impending impact over interphone and again actuate emergency alarm switch to ALERT. Crewmembers will unbuckle parachute leg straps, tighten safety belt, lock inertia reels, disconnect the male bayonet connector on the end of the oxygen mask hose, disconnect the seat oxygen hose from the CRU-60/P connector, and lower clear helmet visor, if installed. All personnel brace for impact.

WARNING

Touchdown at lowest possible rate of descent in a wings level attitude. Do not stall the aircraft; such action will probably result in complete destruction of the underside of the fuselage and may cause the fuselage to break completely apart.

CAUTION

The crewmember is prevented from bending forward when the shoulder harness inertia reel is locked. Therefore, all switches not readily accessible should be properly positioned prior to locking the shoulder harness.

11. Throttles CLOSED - CLOSED (after impact) (P)**WARNING**

Do not cut engines prior to touchdown. This would result in loss of all primary electrical power. Electrical control of the stabilizer trim will be lost. The spoilers will operate at reduced rate on windmill rpm hydraulic pressure.

12. Drag Chute Lever DEPLOY - DEPLOY (CP)**13. Battery Switches OFF - OFF (CP)****14. Abandon Aircraft - Abandon (ALL)**

Remain in positions until aircraft comes to complete stop. After complete stop is made, pilot places emergency alarm switch to ABANDON and pilot and copilot remove the two forward escape hatches.

NOTE

If time permits, safety pins should be reinserted in the arming levers to prevent accidental firing of the seats during egress.

CRASH LANDING AND DITCHING (Cont)

Remove available survival kits and pass them to crewmembers who have already abandoned the aircraft. All crewmembers exit through upward ejection hatches using escape ropes.

WARNING

- To prevent personal injury, ascertain that the escape ropes are fully extended before using them.
- Crewmembers must be aware of protruding objects on the sides of the aircraft fuselage such as pitot tubes, antennas, etc. Attempt to avoid these objects by pushing away from the fuselage with your feet.

POSITION	PRIMARY EXIT
PILOT'S EJECTION SEAT	PILOT'S ESCAPE HATCH
COPILOT'S EJECTION SEAT	COPILOT'S ESCAPE HATCH
RADAR NAVIGATOR'S EJECTION SEAT	GUNNER'S ESCAPE HATCH
NAVIGATOR'S EJECTION SEAT	EW OFFICER'S ESCAPE HATCH
EW OFFICER'S EJECTION SEAT	EW OFFICER'S ESCAPE HATCH
GUNNER'S EJECTION SEAT	GUNNER'S ESCAPE HATCH
INSTRUCTOR PILOT'S SEAT	PILOT'S/COPILOT'S ESCAPE HATCH
DEFENSE INSTRUCTOR'S SEAT	PILOT'S/COPILOT'S ESCAPE HATCH
INSTRUCTOR NAVIGATOR'S SEAT	PILOT'S/COPILOT'S ESCAPE HATCH
10th MAN POSITION, FORWARD HAMMOCK	PILOT'S/COPILOT'S ESCAPE HATCH
NOTE ● Utilize escape ropes where applicable. ● If primary exit route is blocked, proceed to nearest available exit. ● Any additional passengers will exit as instructed at crew briefing.	

Takeoff and Landing Emergencies Exit Chart

Figure 3-12.

EMERGENCY ENTRANCE

Entrance into the aircraft during any emergency such as a fire or crash can best be accomplished by using the various hinged or latched access doors and escape hatches (figure 3-1) located throughout the aircraft. The escape hatches located in the top of the aircraft are the primary entrances for use in crew rescue work. Flush-mounted external hatch release handles are provided for the forward upper hatches. Release handles for the aft upper hatches are flush mounted to the side of the hatch lifters. Secondary access for crew rescue and primary access to fuselage fires are gained through use of the bomb bay, wheel wells, and aft equipment compartment door. Access to wing fires is accomplished through use of hinged flush-latching doors in the wing surface and by placing the wing flaps down. The knock-in panels in the engine nacelles are hinged and spring loaded.

DITCHING

WARNING

Bailout of all crewmembers is recommended in a ditching situation. The aircraft should be ditched only as a last resort.

If an emergency condition arises when over water which indicates that continued flight is impossible, it is not recommended that the crew ditch the aircraft. The aircraft is not structurally designed to withstand ditching and no information is available to indicate the resultant structural condition of the aircraft if ditched. Further, crewmembers with survival kits attached would find escape from the aircraft difficult after ditching even though the aircraft was not badly damaged. Therefore, it is recommended that the aircraft commander bail out all crewmembers in any ditching situation where time and conditions will permit. This procedure will ensure that each crewmember is equipped with liferaft and survival kit upon abandoning the aircraft.

NOTE

For procedure to be followed when there is no alternative to ditching, see "Crash Landing and Ditching Checklist," this section.

DITCHING TECHNIQUE

The aircraft should be prepared for ditching by transferring fuel to move the cg aft of 27% MAC. After the alert signal has been given, the direction of the ditching operation should be chosen carefully. The recommended procedure is to ditch into the wind unless very high swells are running, accompanied with very light wind conditions. Try to touch down on the crest of the swell if landing across the swells. Under light wind conditions accompanied with uniform wave or

swell patterns, best results will be achieved by ditching parallel to the waves or swells. Under such a condition, try to touch down on the crest of the swell or just after the crest passes. Touch down at a speed of approximately 5 knots above initial stall warning if possible. Airbrakes do not provide a lower stalling speed but may be used as desired to vary the approach path and determine the point of touchdown. In a properly executed ditching, the control cabin and the body and wing fuel tanks should keep the aircraft afloat long enough to allow the crewmembers to abandon the aircraft. If the aircraft remains afloat after ditching, stay with the aircraft. However, if the aircraft appears as though it will sink, get clear of the aircraft prior to the time it sinks.

MINIMUM SPEED FOR DIRECTIONAL CONTROL

WARNING

The use of full rudder is mandatory to realize the charted minimum directional control speeds. Failure to use full rudder to counteract an engine out condition can increase the minimum control speed for one inoperative outboard engine by approximately 25 knots.

Minimum speed for directional control is defined as the speed at which a constant heading can be maintained with full rudder and one-half lateral control authority with all operative engines at a given amount of thrust. Only one-half lateral control authority is used in order to allow some reserve for maneuvering, gust loads, and dynamic conditions.

NOTE

With full control wheel positions the pilots view of some instruments, including the airspeed and attitude director indicators, may be obstructed.

The minimum speeds for directional control are shown in figure 3-13. It should be recognized that any attempt to fly below these speeds will result in a further reduction of the maneuvering margin to the point of absolute control limits. The pilot can reduce the thrust on the asymmetric engines to balance the yaw and subsequent roll forces. The pilot can also reduce pitch and retract gear to accelerate the aircraft so that control effectiveness can be enhanced. In some cases, it may be necessary to use a combination of these alternatives. For go-around, the charts may be used to estimate the maximum thrust (EPR) which can be applied to the asymmetric engines if the entering airspeed is maintained or exceeded. In no case should asymmetric thrust be applied just to enhance climb capability if sufficient performance can be achieved. When using the charts to determine the maximum thrust (EPR) which can be

applied for a go-around at any given approach speed, it is not intended to restrict the EPR on engines which are not opposite to inoperative engines. As an example, engines No. 4 and 5 may be set up to MRT with three outboard engines inoperative; engines No. 3, 4, 5, and 6 may be set to MRT with two outboard engines inoperative. For approach planning, both the minimum control speed with all operating engines at MRT and the maximum allowable EPR setting (engines opposite to inoperative engines) for a go-around from best flare speed plus 10 knots should be computed. Flaps up charts provide for an emergency wherein the flaps cannot be extended.

NOTE

When entering figure 3-13 with an airspeed to determine a maximum allowable EPR, the line brought up from the bottom of the chart should be taken first to the proper pressure altitude line. This determines the maximum allowable EPR on engines opposite inoperative engines for purposes of directional control. The EPR for MRT should then be determined by following the pressure altitude line to the reported field temperature line. Use the lesser of the two EPR's as maximum allowable asymmetrical thrust EPR for go-around.

FUEL SHIFT EFFECTS ON DIRECTIONAL CONTROL SPEED

It has been determined in a limited flight test that fuel shift can have a significant effect on minimum directional control speed. Theoretically, airplane gross weight has no effect on minimum directional control speed. However, when flying in uncoordinated flight, such as multiple engine out flight with a wing low, the fuel does not remain level in the fuel tanks but assumes an equilibrium attitude which depends on the bank angle. This causes the lateral center of gravity to shift from the airplane centerline when the fuel tanks are partially full. In an engine out condition, the primary requirement for lateral control is to balance the roll moment due to sideslip. The sideslip causes a lateral fuel shift that reduces the lateral control requirement. As the center of gravity moves laterally, airplane sideslip can be increased while retaining half lateral control authority. As a result, lower minimum directional control speeds can be obtained when wing tanks are partially full. The "Minimum Speed for Directional Control" charts (figure 3-13) include the beneficial effects of lateral fuel shift. Chart values are correct for partially full wing tanks. However, as wing tank quantity increases toward full or decreases to empty, a correction must be applied to chart values since the benefit from lateral fuel shift diminishes to zero at full or empty wing tank quantities.

NOTE

The pilot must be aware that any beneficial effects of lateral fuel shift are due entirely to the aircraft sideslip being controlled by rolling toward the operative engines. In the event the aircraft is allowed to roll toward the inoperative engines the amount of sideslip that can be controlled will be greatly reduced and minimum speed for directional control will increase significantly. This is true for both flaps up and flaps down configurations and is at its maximum during normal landing gross weights.

Chart Corrections Due to Fuel Shift

No corrections are required for the flaps up gear down chart (figure 3-13, sheet 1) since the effect of fuel quantity and fuel shift has been accounted for by the addition of gross weight curves to the chart. However, the following correction shall be added to the charted values of the flaps down, gear down chart (figure 3-13 sheet 3) when computing minimum speed for directional control or shall be subtracted when computing maximum EPR for a given airspeed. That is: (1) when the chart is entered with pressure altitude and temperature and a minimum control speed read from the chart, add the correction to the chart speed to determine the correct minimum control speed, or (2) when the chart is to be entered with a given speed to determine maximum EPR, subtract the correction from the given speed and enter the chart with the corrected speed. For example, if it is desired to determine maximum EPR for Best Flare plus ten, enter the chart with Best Flare plus ten minus correction.

FUEL TOTALIZER READING - 1,000 LB	FLAPS DOWN CORRECTION KNOTS IAS
300	30
260	28
220	26
180	24
140	12
100	0
60	0
20	0
0	30

NOTE

- Correction increments above the 180,000 pound fuel totalizer reading are attributable to main wing fuel used during takeoff and body fuel shift effects.
- Corrections are based on fuel distributions resulting from flight manual fuel usage sequences.

OPERATION WITH ONE OR MORE ENGINES INOPERATIVE

For any partial thrust operation, observe the following:

1. Avoid turbulent air and limit maneuvering bank angle to 20° maximum to reduce the "g's" encountered and the resulting fuselage loads (two or more engines inoperative).
2. Simulated inoperative engines should be idled and not shut down.
3. Trim followup should be made with thrust changes.
4. Thrust should be applied smoothly when simulating a go-around.

CAUTION

Whenever engine-out condition is simulated (or actually experienced), it is important that the "good" throttles be advanced or retarded smoothly to minimize yaw and subsequent structural loads induced by corrective flight control inputs. Rudder alone will not be used to oppose the initial yaw/roll tendency.

During simulated failure of one or two engines on one side, the airspeed should not be reduced below minimum directional control speed or best flare speed plus 30 knots, whichever is higher, until on final. The final approach phase should be flown at best flare speed plus 10 knots. The maximum thrust (EPR) should be computed from figure 3-13 for the particular indicated airspeed being used on the final approach. Use of asymmetrical thrust up to this value is desired in order to simulate thrust requirements encountered during heavy weight, multi-engine out operation. This EPR value does not prohibit using a higher EPR value up to MRT on opposite engines for balanced thrust if necessary to maintain thrust requirements. These minimum directional control airspeeds are based on the use of not more than 50% of the lateral control available. When simulating failure of one or two engines on one side, the aircraft gross weight should not be greater than that established by command directives. In addition, descents should not be made below the minimum altitude as specified by command directives. Under these conditions, minimum control speeds will be lower than those shown in figure 3-13; however, considering that operations are accomplished with throttle levers controlling simulated failed engines positioned at IDLE, the minimum airspeeds shown

in the chart should be adhered to as a safety factor. Within these limitations, operations such as simulated approach and landing and go-around with reduced thrust may be practiced safely with an engine or engines retarded to IDLE rather than shut down completely. With an engine throttle positioned at IDLE, the reduction in thrust will provide control and maneuverability problems essentially the same as with a complete loss of thrust on an engine.

USE OF CHARTS FOR ASYMMETRIC THRUST

After experiencing engine failure or when simulating failure of engines, figure 3-13 can be used in two ways. One is to determine the minimum speed for directional control associated with a specific EPR such as MRT and the other is to determine the maximum EPR which can safely be applied at a given airspeed. The following are examples on the use of figure 3-13 (sheet 3 of 3):

1. Determine the EPR for MRT and the minimum speed for directional control under the following conditions:

- Pressure altitude 2000 feet
- Temperature 45°F
- Flaps down, gear down
- Two outboard engines out on one side

Enter the flaps down, gear down chart (figure 3-13) on the pressure altitude 2000-foot line and follow to the point intersected by the ambient temperature for MRT (45°F). The EPR (2.55) is read to the left of this point. Dropping down from the same point to the line representing the number of engines out (two), read right to the minimum speed for directional control (120 knots IAS). Above this speed, MRT may be safely applied but below this speed, the use of MRT would impose a critical control situation.

2. Determine the maximum thrust (EPR) which can be safely applied at a specific speed for a go-around from final approach under the following conditions:

- 130 knots IAS final approach speed (best flare speed plus 10 knots)
- Pressure altitude 2000 feet
- Temperature 30°F
- Flaps down, gear down
- Two outboard engines out on one side

Enter the flaps down, gear down chart (figure 3-13) on the 130 knots IAS line. Read up from the point of intersection with the two-engine out line to the pressure altitude line or to the ambient temperature for MRT, whichever comes first, then left to find maximum EPR. In this case, the temperature for MRT line is reached first resulting in an EPR of 2.66. If the 2000 feet line was reached before the 30°F temperature for MRT line, then the pressure altitude line would be used resulting in a lower EPR reading.

DATE: SEPTEMBER 1975

DATA BASIS: FLIGHT TEST**CONDITIONS:**

- STANDARD DAY
- FULL RUDDER AND ONE HALF LATERAL CONTROL AUTHORITY
- MRT ON SYMMETRIC ENGINES

REMARKS:

The MRT temperature lines are for quick reference only and were calculated for an average pattern speed. Refer to Appendix 1, T.O. 1B-52G -1-1 for precise settings. MRT should not be applied for a go-around unless necessary. See text for amplification.

EXAMPLE:**GIVEN:**

Pressure altitude = 2000 ft

Temperature = 25°F

Flaps up

2 Outboard engines out on one side

Gross weight = 300,000 lb

FIND:

EPR for MRT

Minimum speed for directional control

SOLUTION:

MRT = 2.71 EPR

Minimum speed for directional control = 180 KIAS

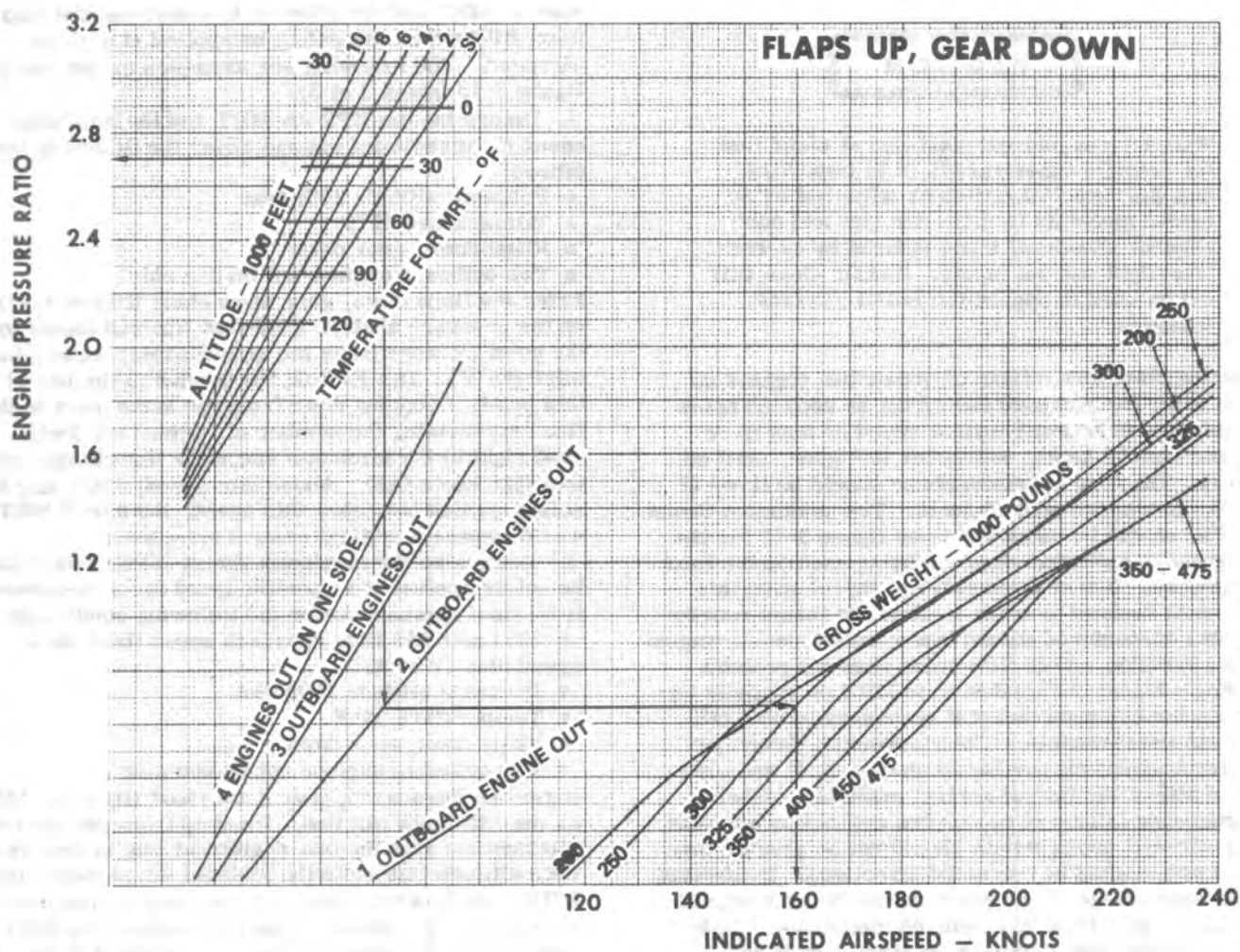


Figure 3-13 (Sheet 1 of 3)

FLAPS UP, GEAR DOWN 2 OUTBOARD ENGINES OUT

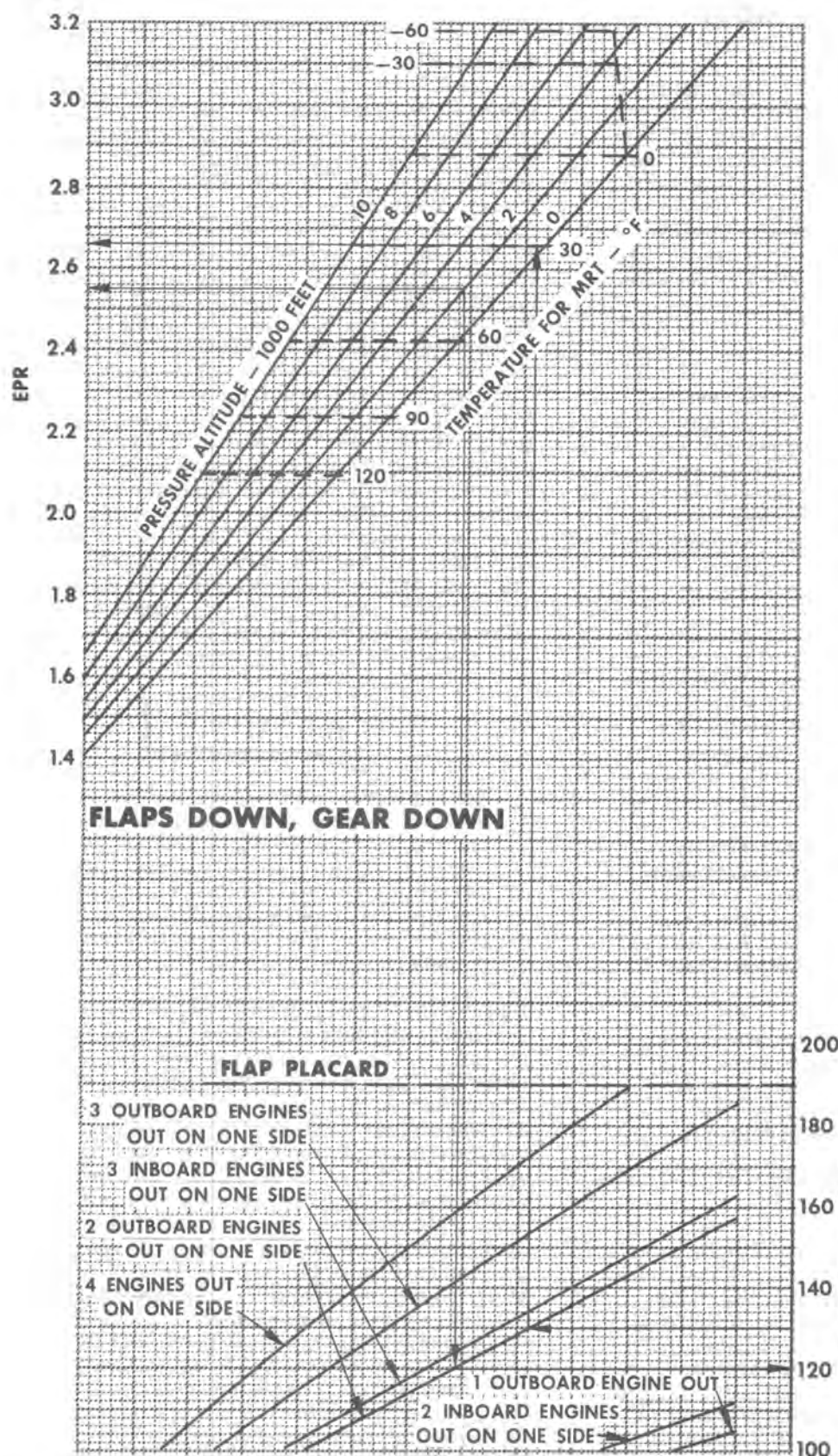
IAS-KNOTS	EPR SL	EPR 2000 FT	EPR 4000 FT	GROSS WT-POUNDS
120	1.85	1.93	2.00	200000 ↓
125	1.98	2.06	2.15	
130	2.12	2.21	2.31	
135	2.23	2.33	2.44	
140	2.32	2.43	2.55	
145	2.41	2.53	2.65	
150	2.49	2.61	2.73	
155	2.57	2.69	2.82	
160	2.65	2.77	2.91	
165	2.73	2.86	3.00	
170	2.81	2.95	3.08	
175	2.91	3.04	—	
180	2.98	3.10	—	
185	3.05	—	—	
130	1.96	2.05	2.13	250000 ↓
135	2.12	2.21	2.31	
140	2.27	2.36	2.47	
145	2.41	2.53	2.65	
150	2.54	2.66	2.79	
155	2.65	2.77	2.91	
160	2.73	2.86	3.00	
165	2.81	2.95	3.08	
170	2.88	3.02	—	
175	2.98	3.10	—	
140	1.98	2.06	2.14	300000 ↓
145	2.13	2.23	2.35	
150	2.29	2.40	2.50	
155	2.45	2.56	2.68	
160	2.58	2.71	2.83	
165	2.72	2.85	2.98	
170	2.81	2.94	3.08	
175	2.93	3.05	—	
180	2.99	—	—	
155	2.08	2.17	2.27	350000 ↓
160	2.24	2.35	2.45	
165	2.38	2.49	2.60	
170	2.51	2.63	2.75	
175	2.63	2.76	2.89	
180	2.75	2.89	3.02	
185	2.84	2.98	3.10	
190	2.92	3.05	—	
195	2.99	—	—	
165	2.23	2.33	2.43	400000 ↓
170	2.37	2.48	2.59	
175	2.51	2.63	2.75	
180	2.66	2.79	2.92	
185	2.78	2.92	3.05	
190	2.90	3.04	—	
195	3.01	—	—	
175	2.35	2.46	2.58	450000 ↓
180	2.47	2.59	2.72	
185	2.61	2.74	2.87	
190	2.77	2.90	3.04	
200	2.90	3.04	—	

FLAPS UP, GEAR DOWN 1 OUTBOARD ENGINE OUT

IAS-KNOTS	EPR SL	EPR 2000 FT	EPR 4000 FT	GROSS WT-POUNDS
116	2.52	2.64	2.77	200000 ↓
120	2.69	2.82	2.95	
124	2.89	3.02	—	
128	3.08	—	—	
128	2.81	2.95	3.08	250000 ↓
130	2.90	3.04	—	
132	3.03	—	—	
140	2.95	3.08	—	300000 ↓
142	3.07	—	—	

Minimum Speed for Directional Control

Figure 3-13 (Sheet 2 of 3)



DATE: MAY 1969

DATA BASIS:**ESTIMATED****CONDITIONS:**

- STANDARD DAY
- FULL RUDDER AND ONE HALF LATERAL CONTROL AUTHORITY
- MRT ON SYMMETRIC ENGINES

REMARKS:

The MRT temperature lines are for quick reference only and were calculated for an average pattern speed. Refer to Appendix 1, T.O. 1B-52G-1-1 for precise settings. MRT should not be applied for a go-around unless necessary. See text for amplification.

EXAMPLE 1:**GIVEN:**

Pressure altitude = 2000 feet

Temperature = 45°F

Flaps down

2 Outboard engines out on one side

FIND:

EPR for MRT

Minimum speed for directional control

SOLUTION:

MRT = 2.55 EPR

Minimum speed for directional control = 120 KIAS

EXAMPLE 2:**GIVEN:**

Best flare +10 knots = 130 KIAS

Pressure Altitude = 2000 feet

Temperature = 30°F

Flaps down

2 Outboard engines out on one side

FIND:

Maximum EPR

SOLUTION:

2.66 EPR

■■■■■■■■ Minimum Speed for Directional Control

Figure 3-13 (Sheet 3 of 3)

LANDING WITH ONE OR MORE ENGINES INOPERATIVE

Landing with an engine failure can be accomplished by following the normal landing procedure with the addition that, as thrust is decreased, trim will have to be decreased to compensate for reduction of the unequal thrust. Engine failure will not materially affect the landing gear extension time. The gear is normally extended in 15 to 20 seconds. Consideration must be given to planning for a go-around. See "Go-Around With One or More Engines Inoperative," this section.

NOTE

- Under any approach conditions involving reduced power, the necessity of early anticipation of additional power requirements cannot be overemphasized. Most landing experience has been obtained at gross weights less than 290,000 pounds; therefore, it is strongly emphasized that weight be reduced to this value or less to allow landing in a familiar configuration and provide better performance capability.
- All procedures and data provided for three or four engine failure on one side, including the tables for "Outboard Engines EPR for Go-Around," are based on the worst case of four engines being inoperative. If only three engines are inoperative on one side, the performance data will be conservative.
- With three or four engines inoperative on one side, a flaps-up landing is recommended rather than a flaps-down landing. The flaps-up approach will provide more positive control of the aircraft, is less hazardous, and results in a lower altitude go-around capability.
- If conditions permit, at least one practice approach and go-around should be made at an altitude of 5000 feet above ground level except that the landing gear should not be lowered until the actual landing approach.

THREE OR FOUR ENGINE FAILURE ON ONE SIDE WITH FLAPS UP

Flight tests have demonstrated that, with three or four engines inoperative on one side, a flaps-up landing provides more positive control of the aircraft during the approach as well as a lower altitude go-around capability than a flaps-down landing. Airbrake position 2 will be used on final approach for all gross weights. The roll response of the aircraft is significantly increased with airbrake position 2 over airbrake position zero or 1. For airbrake position zero a half-wheel deflection represents 50% lateral control authority; the same lateral control authority for airbrake position 2 is obtained at approximately one-third wheel deflection. This characteristic allows the pilot to obtain a large portion of the spoiler authority with small wheel inputs,

thus reducing pilot effort.

There are several factors that should be considered because of possible system failures and multiple emergencies associated with engine failures. Two generators and three engine driven hydraulic pumps could be rendered inoperative on one side. Standby pumps may or may not be available. These conditions will affect the brakes, steering, crosswind crab setting, stabilizer trim operation, powered rudder/elevator, and landing gear extension and retraction time as well as having a possible effect on the pilots' ability to control the aircraft due to reduced pitch trim and roll rates available or lack of spoiler operation. An emergency with four engines shutdown one one side may preclude fuel transfer from the engine-out side; thus, once body fuel is consumed, a lateral fuel unbalance could not be prevented. In this case, the pilot should either land immediately or be aware of lateral control problems if a go-around is attempted. Approximately 20,000 pounds fuel unbalance between the total of No. 1 and No. 2 main tanks and the total of No. 3 and No. 4 main tanks will cause a rolling moment which will require an additional one-quarter of the lateral control authority. If the inoperative engines are on the heavy wing this will leave only one-fourth lateral control authority for maneuvering, etc.

WARNING

Loss of engines will require close attention to fuel panel settings to control lateral balance and desirable cg locations. Required deviations from the aircraft configuration fuel sequence must be planned to maintain the proper differential/balance between paired main/auxiliary tanks whenever possible.

Observe the "Landing With Three or Four Engine Failure On One Side With Flaps Up." procedures and checklist. Also, see "Landing With Wing Flaps Inoperative," this section. The higher speeds, larger turning radius, and difficulty in establishing speeds in an unfamiliar configuration require additional maneuvering space and make a long extended final approach desirable. A long straight-in pattern or an extended rectangular pattern should be flown at least 2,000 feet above ground level, in the clean configuration, and airbrakes zero. At approach speed plus 30 knots IAS up to 30° of bank in either direction may be used with no adverse effects on handling qualities or performance. However, it is recommended that bank angle be limited, normally to 20°. The speed schedule in the pattern will depend on the availability of hydraulic pressure to the landing gear. If hydraulic pressure is available, fly the normal no-flaps speed schedule. When approaching the glideslope extend the landing gear, place airbrakes to position 2, and reduce to final approach speed just before glideslope interception. If only standby pump pressure is available for the landing gear, maintain approach speed plus 30 knots IAS (either straight-in or rectangular) until 2 minutes

from glideslope interception. Extend the landing gear and allow airspeed to decrease so as to intercept the glideslope at approach speed with airbrake position 2. Systems failure may require the use of some emergency gear extension switches. The final approach should be flown with landing gear down, airbrakes position 2, and at approach speed using a precision instrument (PAR/ILS) glideslope with a transition to VASI when appropriate. If facilities or equipment are inoperative, the VASI approach lights may be used or if necessary a visual final approach may be flown while attempting to maintain a 2.5° glideslope angle. Intercept the glide slope at 2,000 feet or more above the runway elevation. Maintain the flaps-up approach speed on the glideslope by using all operating engine throttles together in a

staggered setting with the inboard throttles further forward. Rudder trim should be used as necessary throughout the pattern and approach. With full rudder trim and some rudder input by the pilot, zero bank angle can be maintained during the pattern and approach. The approach patterns are illustrated in figure 3-13A.

NOTE

Full rudder trim should be used on the approach and should be zeroed when the decision to land is made. Caution must be exercised not to zero the rudder trim too quickly and to carefully compensate with rudder pedal force while doing so.

LANDING WITH THREE OR FOUR ENGINE FAILURE ON ONE SIDE AND WING FLAPS UP

Flaps Up Before Landing With Three or Four Engine Failure on One Side (Copilot reads)

1. Compute Landing Data - Computed and checked (CP-N)

The following information may be extracted and/or computed from data presented on charts located in the "Emergency Procedures" parts of the pilot's and navigator's abbreviated checklists.

a. Flaps-Up Approach Speed _____.

For gust conditions, increase approach speed by full gust factor. Example: Winds 230 at 30 knots gusting to 40, add 10 knots to approach speed.

b. Go-Around Speed (approach speed plus 10 knots) _____.

c. Maximum Brake Application Speed _____.

d. Landing Ground Run (flaps up with airbrakes and no drag chute) _____.

NOTE

- Landing ground run is the amount of runway that must be available after touchdown for a complete stop on the remaining runway. If the runway remaining after touchdown is less than this distance, the pilot must accept the fact that he will probably fail to stop within the confines of the runway.
- The landing ground run distances on these tabular charts (figure 3-11) are based on dry surfaces. When other than dry conditions exist, obtain the RCR and use the appropriate flaps-up chart in Part 9 of the Appendix.

e. MRT EPR _____, See figure 3-13.

f. Maximum EPR for Outboard Engines _____, See figure 3-14A.

g. Gear Down Rate of Climb _____ fpm. See figure 3-14A.

WARNING

A go-around should not be attempted unless a gear down climb capability of 300 feet per minute exists. If the charts (figure 3-14A) indicate that a climb potential of less than 300 FPM exists, gross weight should be decreased prior to the approach.

LANDING WITH THREE OR FOUR ENGINE FAILURE ON ONE SIDE AND WING FLAPS UP (Cont)

- h. Check Brake Energy Limits_____.

Brake energy limits should be checked to determine if the limits will be exceeded. Data should be based on a no-drag chute situation.

2. Review Planned Approach - Reviewed (P-CP-RN-N)

Check the appropriate navigation aids tuned and identified and review the planned approach with the applicable crewmembers. Altitude restrictions, ceiling and visibility minimums, DH/MDA, and missed approach procedures will be emphasized.

3. Flap Lever OFF - OFF (CP)

4. Set Fuel Panel - Set, as required (CP) Checked (P)

5. Landing Gear DOWN - DOWN, six down (P-CP)

Copilot checks gear lever in detent. Pilot checks that the gear warning light is out and that all six gear indicate down and locked. Flight tests have shown that when the landing gear is extended using the standby pump and windmilling pressure, extension time is approximately 45 seconds.

6. Airbrake Lever Position 2 - Position 2 (P)

Normally the landing should be made with airbrake position 2. Airbrake position 2 should be used from glideslope interception until after touchdown or until completion of the go-around. However, once a decision to land has been made airbrake position 4 may be used to reduce excessive speed. The aircraft should be flown onto the runway at approach speed and attitude in accordance with published flaps-up procedures.

7. Set Crosswind Crab - Set, knob down (CP) Checked (P)

Obtain wind direction and velocity. Compute and set crosswind crab as required using 70% of the flaps-down crosswind crab setting. If crosswind crab is not to be used, knob and position indicator must be checked for zero setting and gear position.

CAUTION

If wheel brakes are applied immediately before and held during touch-down when main gear is turned more than 14° (by any combination of crosswind crab setting and steering), the aircraft will land with wheels locked because the antiskid system is inoperative in this condition. Releasing the brakes will activate the antiskid system.

8. Complete Landing Check - Completed (P/CP)

- a. Gear
- b. Airbrakes
- c. Lights

LANDING WITH THREE OR FOUR ENGINE FAILURE ON ONE SIDE AND WING FLAPS UP (Cont)**Flaps Up Landing With Three or Four Engine Failure on One Side**

Accomplish after flaps-up touchdown (need not be read).

1. Airbrakes Position 6 - Position 6 (P)

After forward gear touchdown select airbrake position 6 with a pause at position 4 to prevent an abrupt wing dip should an unbalanced airbrake condition exist.

2. Apply Wheel Brakes & Deploy Drag Chute - Applied and deployed (P/CP)

Normally pilot applies brakes at touchdown and copilot deploys drag chute at 135 knots IAS. However, brake application will be delayed until below charted maximum brake application speed.

CAUTION

Application of brakes above the maximum brake application speed will exceed the brake energy limit and may result in complete loss of brakes, rupture of hydraulic lines, and subsequent fire.

3. Check Hydraulic System - Checked (P)
4. Center Crosswind Crab Control Knob - Centered (P)
5. Starters OFF - OFF (CP)
6. Steering Ratio Select Lever TAXI - TAXI (P)

CAUTION

Center the rudder pedals before repositioning the steering ratio selector lever. Actuation of the lever is very difficult when the rudder pedals are deflected and could result in a dangerously abrupt change in steering angle.

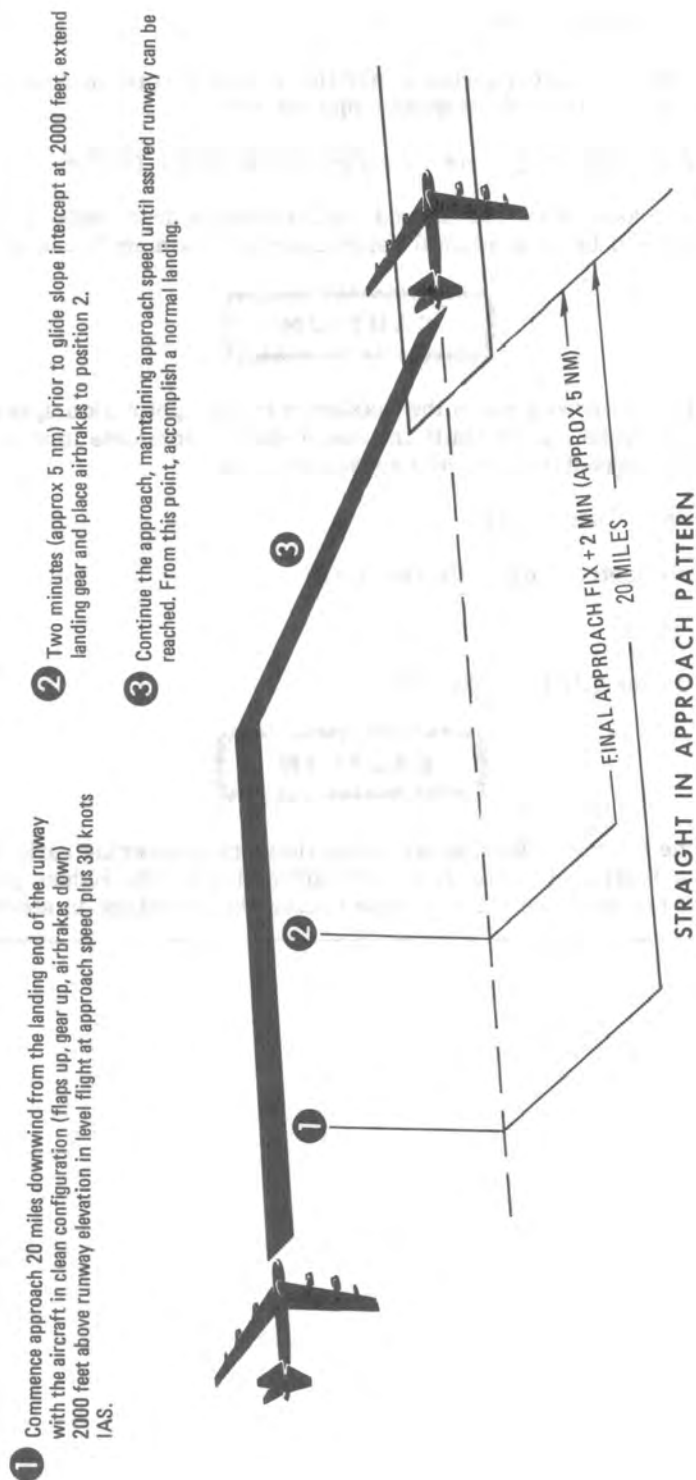
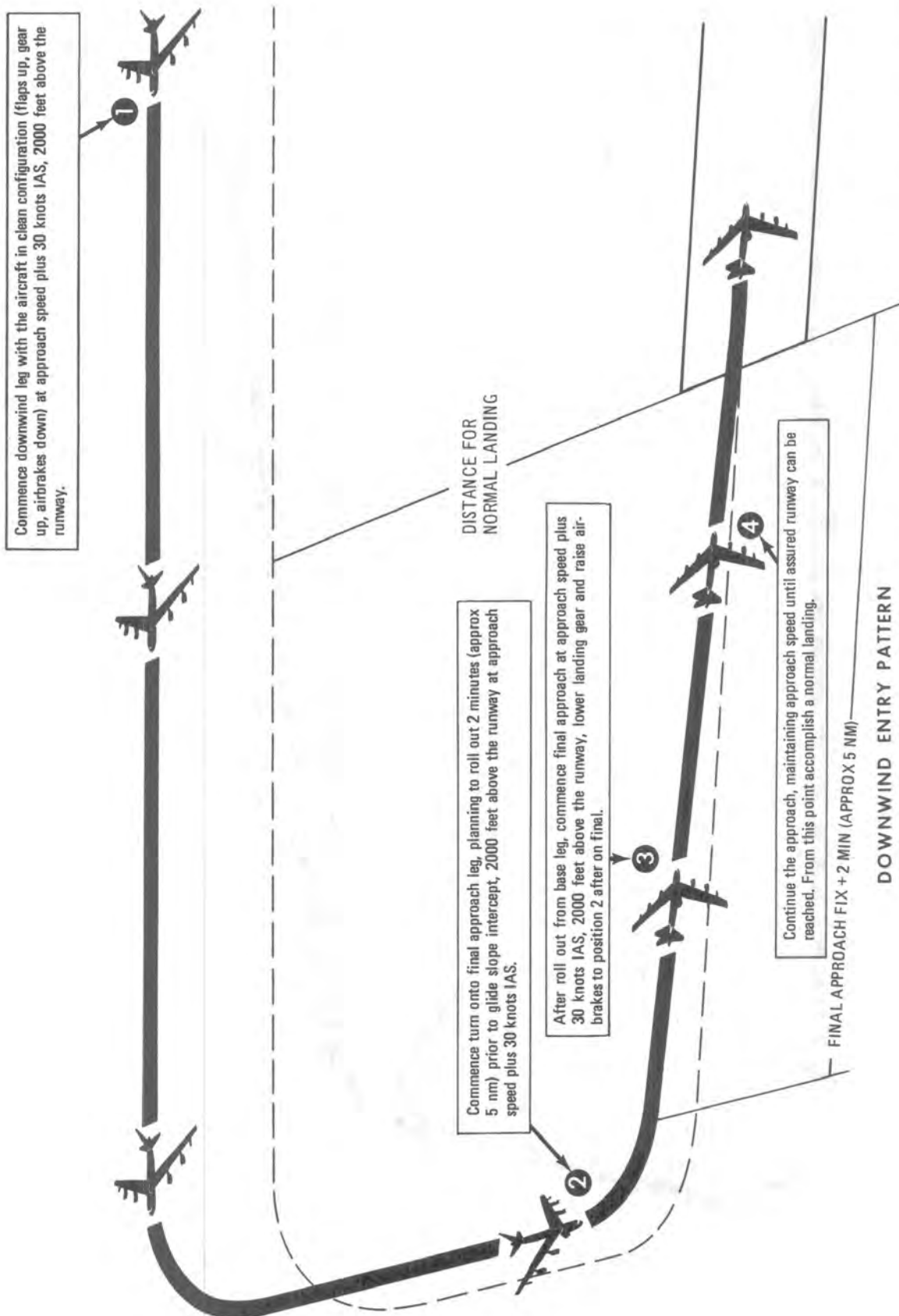
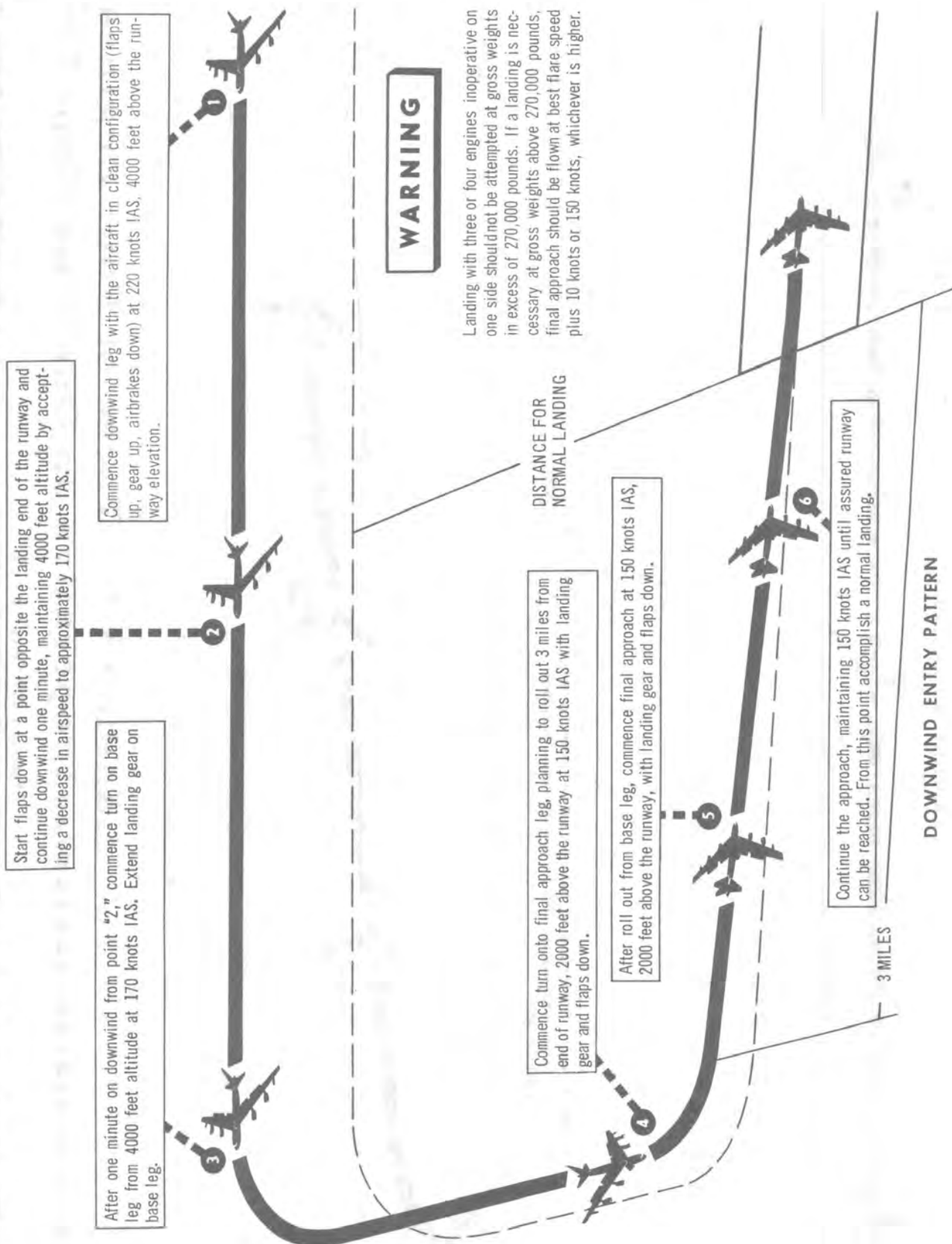


Figure 3-I3A (Sheet 1 of 2)



Landing With Three or Four Engines Inoperative on One Side Flaps Up

*Figure 3-13A (Sheet 2 of 2)



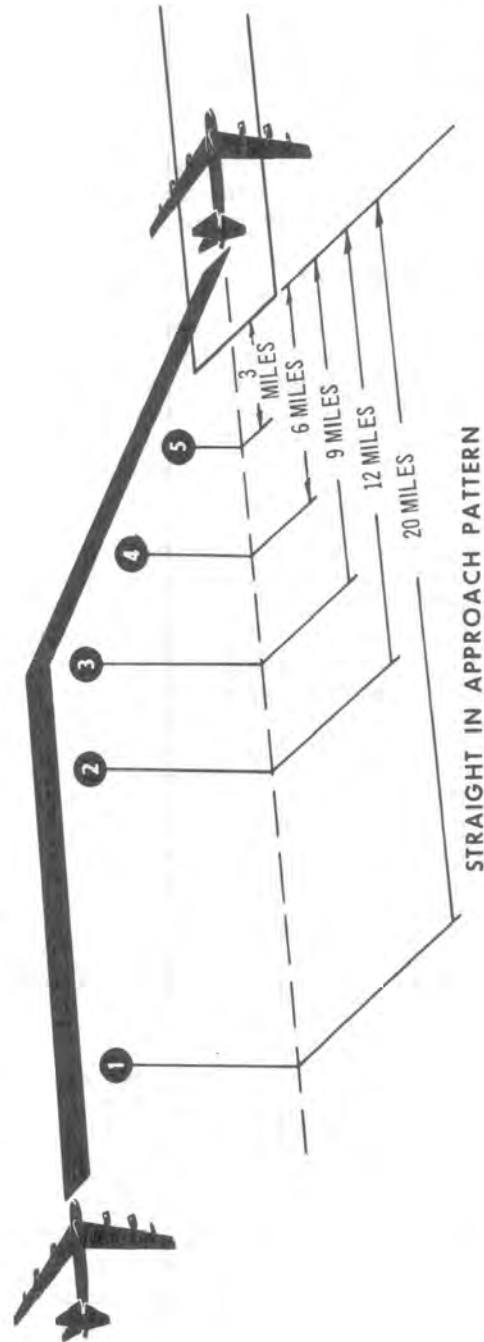
DOWNWIND ENTRY PATTERN

Figure 3-14 (Sheet 1 of 2).

WARNING

Landing with three or four engines inoperative on one side should not be attempted at gross weights in excess of 270,000 pounds. If a landing is necessary at gross weights above 270,000 pounds, final approach should be flown at best flare speed plus 10 knots or 150 knots, whichever is higher.

- 1 Commence approach 20 miles downwind from the landing end of the runway with the airplane in clean configuration (flaps up, gear up, airbrakes down), 4000 feet above runway elevation in level flight at 220 knots IAS.
- 2 After maintaining 4000 feet altitude and 220 knots IAS in clean configuration to a point 12 miles from the runway, start the flaps down maintaining 4000 feet altitude by accepting a decrease in airspeed to approximately 170 knots IAS.
- 3 Flaps should be fully extended approximately 9 miles from the runway at an altitude of 4000 feet and an airspeed of 170 knots IAS.
- 4 After maintaining 170 knots IAS to a point 6 miles from the runway at 3000 feet, extend landing gear and plan to arrive at a point 3 miles from the landing end of the runway at 2000 feet altitude and 150 knots IAS, with landing gear and flaps down.
- 5 From a point 3 miles from the landing end of the runway at 2000 feet altitude and 150 knots IAS, continue the approach maintaining 150 knots IAS until assured the runway can be reached. Then accomplish a normal landing.



Landing With Three or Four Engines Inoperative on One Side Flaps Down

Figure 3-14 (Sheet 2 of 2).

**THREE OR FOUR ENGINE FAILURE ON ONE SIDE
WITH FLAPS DOWN****WARNING**

- With three or four engines inoperative on one side, altitude cannot be maintained with gear and flaps extended except at very light gross weights of approximately 230,000 pounds or less.
- It is recommended that a landing under this condition should not be attempted at gross weights in excess of 270,000 pounds.

NOTE

With three or four engines inoperative on one side, a flaps-up landing is recommended rather than a flaps-down landing. The flaps-up approach will provide more positive control of the aircraft, is less hazardous, and results in a lower-altitude go-around capability.

Flight tests have demonstrated that landings can be successfully accomplished with three or four engines inoperative on one side provided proper techniques and procedures are followed. Figure 3-14 illustrates two landing patterns from which landing may be accomplished with three or four engines inoperative on one side. From an operational standpoint, it is desirable to make the emergency patterns as near normal as possible. With three or four engines inoperative on one side for any given speed, there is a thrust level which will make that speed the minimum directional control speed. In order to keep the landing pattern speeds normal, the only way to reduce the thrust level is to increase the rate of descent. For example, an approach slope of 10 to 1 is required on the final approach leg to keep the thrust below the critical value as contrasted to the normal approach slope of approximately 20 to 1.

There are several factors that should be considered because of possible system failures and multiple emergencies associated with engine failures. Two generators and three engine driven hydraulic pumps could be rendered inoperative on one side. Standby pumps may or may not be available. These conditions will affect the brakes, steering, crosswind crab setting, stabilizer trim operation, powered rudder/elevator, and landing gear extension and retraction time as well as having a possible effect on the pilots' ability to control the aircraft due to reduced pitch trim and roll rates available or lack of spoiler operation. An emergency with four engines shutdown on one side may preclude fuel transfer from the engine-out side; thus, once body fuel is consumed, a lateral fuel unbalance could not be prevented. In

this case, the pilot should either land immediately or be aware of lateral control problems if a go-around is attempted.

WARNING

Loss of engines will require close attention to fuel panel settings to control lateral balance and desirable cg locations. Required deviations from the aircraft configuration fuel sequence must be planned to maintain the proper differential/balance between paired main/auxiliary tanks whenever possible.

The downwind entry pattern landing is accomplished as follows:

1. The downwind entry pattern shown in figure 3-14 may be flown making turns into or away from the inoperative engines with no appreciable difference in aircraft flight handling characteristics. The downwind leg, which is the same distance out from the runway as for a normal landing, should be intercepted with the aircraft in clean configuration (flaps up, gear up, airbrakes down) at 220 knots IAS, 4000 feet above the runway elevation.
2. Maintain 4000 feet and 220 knots IAS until opposite the landing end of the runway. At this point, start the flaps down. Continue downwind 1 minute, maintaining 4000 feet altitude by accepting a decrease in airspeed to approximately 170 knots IAS.

NOTE

- Slight thrust adjustment may be required during flap extension if 220 knots IAS is maintained prior to initiating flap extension. Thrust reduction is required after full flap extension is accomplished in order to descend properly throughout the remainder of the landing pattern.
 - It is recommended that directional control be maintained using lateral control with rudder control as necessary without use of lateral or rudder trim. This eliminates the requirement for trim changes throughout final approach, flare, and touchdown. Sideslip may be decreased slightly by use of the rudder.
3. After 1 minute on downwind from a point opposite the landing end of the runway, commence turn on base leg from 4000 feet altitude at 170 knots IAS. Extend the landing gear on base leg and plan to roll out on final approach 3 miles from end of runway at 150 knots IAS with landing gear and flaps down. If a go-around is to be made, it must be initiated prior to descending below 2000 feet above the terrain. MRT may be required in order to arrest the rate of descent and accelerate the aircraft to climb speed

within the 2000-foot altitude and still retain a satisfactory safety margin.

WARNING

A successful go-around with three or four engines inoperative on one side cannot be assured any time the aircraft descends below 2000 feet above the terrain. Flight tests have indicated that a minimum of 1000 feet altitude must be sacrificed in order to arrest the descent and accelerate the aircraft to minimum directional control speed if flaps and landing gear are retracted simultaneously with thrust increase. Thrust increase must be commensurate with the pilot's ability to control the sideslip and maintain the heading. The use of rudder will assist in keeping sideslip to a minimum during a go-around. Any hesitation on the part of the pilot in performing any of the above steps will result in a loss of altitude in excess of 1000 feet. It is recommended that climb back to pattern altitude be accomplished at 220 knots IAS.

4. Commence turn to final approach leg, planning to roll out on final approach at 2000 feet, 150 knots IAS.

WARNING

- If a landing is necessary at gross weights above 270,000 pounds, final approach leg should be flown at best flare speed plus 10 knots or 150 knots, whichever is higher. However, landing above 270,000 pounds should not be attempted unless no other alternative exists.
 - For weights above 270,000 pounds, do not attempt a go-around since the thrust required to arrest the loss of altitude may exceed the thrust permitted to maintain directional control.
5. After rollout from base leg, commence final approach at 150 knots IAS, 2000 feet above the runway altitude, with landing gear and flaps down. This altitude initially appears high for landing; however, since a rate of descent of approximately 1500 feet per minute can be expected, it is necessary to be at this altitude in order to accomplish a normal touchdown with minimum thrust.

WARNING

This is the final point in the landing pattern from which a successful go-around can be initiated. In addition, 150 knots IAS is below minimum directional control speed for four engines inoperative on one side and the operating engines at MRT. A go-around

from such a speed is potentially hazardous. Flight tests conducted from this speed and configuration demonstrated that this maneuver required loss of altitude but could be made within the control capability of the pilot.

6. Continue the approach, maintaining 150 knots IAS until assured the runway can be reached. From this point, thrust may be gradually further reduced, sideslip and bank angle further decreased, and a normal landing accomplished. Airbrake response may be limited as dictated by engine-out configuration. Airbrakes should be used if available to decrease altitude and airspeed to compensate for wind effect and/or pilot technique. Avoid abrupt lateral control movements by raising airbrakes in increments of two. If airbrake position 6 is to be used to decrease speed on the runway, raising airbrakes in increments of two will prevent an abrupt wing dip should an unbalanced airbrake condition exist.

The straight-in approach landing is accomplished as follows:

1. The straight-in approach is shown in figure 3-14 and is basically an extended downwind entry pattern which has been straightened out and aligned with the centerline of the landing runway. It should be planned to intercept a point 20 miles downwind from and lined up with the runway, 4000 feet above runway elevation, in level flight at 220 knots IAS, with the aircraft in clean configuration (flaps up, landing gear up, airbrakes down).
2. Continue approach to the runway, maintaining 4000 feet altitude and 220 knots IAS in clean configuration to a point 12 miles from the runway. At this point, start the flaps down, maintaining 4000 feet altitude by accepting a decrease in airspeed to approximately 170 knots IAS.

NOTE

- Slight thrust adjustment may be required during flap extension if 220 knots IAS is maintained prior to initiating flap extension. Thrust reduction is required after full flap extension is accomplished in order to descend properly throughout the remainder of the landing approach.
- It is recommended that directional control be maintained using lateral control with rudder control as necessary without use of lateral or rudder trim. This eliminates the requirement for trim changes throughout final approach, flare, and touchdown. Sideslip may be decreased slightly by use of rudder.

3. Flaps should be fully extended at a point approximately 9 miles from the runway at an altitude of 4000 feet and an indicated airspeed of 170 knots.

4. Maintain 170 knots IAS, planning to reach a point 6 miles from the runway, at 3000 feet and 170 knots IAS. At this point, extend landing gear. Plan to arrive at a point 3 miles from the landing end of the runway at 2000 feet altitude and 150 knots IAS with landing gear and flaps down. If a go-around is to be

made, it must be initiated prior to descending below 2000 feet above the terrain. MRT may be required to arrest the rate of descent and accelerate the aircraft to climb speed within the 2000-foot altitude and still retain a satisfactory safety margin.

WARNING

A successful go-around with three or four engines inoperative on one side cannot be assured any time the aircraft descends below 2000 feet above the terrain. Flight tests have indicated that a minimum of 1000 feet altitude must be sacrificed in order to arrest the descent and accelerate the aircraft to minimum directional control speed if flaps and landing gear are retracted simultaneously with thrust increase. Thrust increase must be commensurate with the pilot's ability to control the sideslip and maintain the heading. The use of rudder will assist in keeping sideslip to a minimum during a go-around. Any hesitation on the part of the pilot in performing any of the above steps will result in a loss of altitude in excess of 1000 feet. It is recommended that climb back to pattern altitude be accomplished at 220 knots IAS.

5. Start down final leg of approach from a point 3 miles from the runway, 2000 feet altitude, 150 knots IAS. This altitude initially appears high for landing; however, since a rate of descent of approximately 1500 feet per minute can be expected, it is necessary to be at this altitude to accomplish a normal touchdown with minimum thrust.

WARNING

- If a landing is necessary at gross weights above 270,000 pounds, final approach leg should be flown at best flare speed plus 10 knots or 150 knots, whichever is higher. However, landing above 270,000 pounds should not be attempted unless no other alternative exists.
- For weights above 270,000 pounds, do not attempt a go-around since the thrust required to arrest the loss of altitude may exceed the thrust permitted to maintain minimum directional control.
- This is the final point in the landing pattern from which a successful go-around can be initiated. In addition, 150 knots IAS is below minimum directional control speed for four engines inoperative on one side and the operating engines at MRT. A go-around from such a speed is potentially hazardous. Flight tests conducted from this speed and configuration demonstrated that this maneuver required loss of altitude but could

be made within the control capability of the pilot.

6. Continue the approach, maintaining 150 knots IAS until assured the runway can be reached. From this point, thrust may be further gradually reduced, sideslip and bank angle further decreased, and a normal landing accomplished. Airbrake response may be limited as dictated by engine-out configuration. Airbrakes should be used if available to decrease altitude and airspeed as required to compensate for wind effect and pilot technique. Avoid abrupt lateral control movements by raising airbrakes in increments of two. If airbrake position 6 is to be used to decrease speed on runway, raising airbrakes in increments of two will prevent an abrupt wing dip should an unbalanced airbrake condition exist.

GO-AROUND WITH ONE OR MORE ENGINES INOPERATIVE

WARNING

- It may not be possible to maintain directional control if all throttles are advanced to MRT. MRT may be set on all symmetric engines. See "Minimum Speed for Directional Control," this section. Thrust must not be applied faster than any generated roll-yaw problem can be controlled. Maintain directional control and accelerate to climb speed (it may be safer to descend and trade altitude for airspeed).
- The decision to go-around should be made as early as possible. This is of extreme importance when one or more engines are inoperative since the reduced thrust available and limited directional control under such circumstances may make a go-around impossible near the ground.
- A go-around can be extremely hazardous when one or more engines are inoperative and existing conditions (i.e., gross weight, ambient temperature, pressure altitude, center of gravity, and asymmetrical thrust) make controllability or performance of the aircraft marginal.
- If two outboard engines on the same side are inoperative and go-around is required, it is imperative that full rudder be applied as thrust is applied. If full rudder is not used to oppose the yaw, the spoiler deflection required to maintain control can reduce the climb or acceleration capability at heavy weights to almost zero. The rudder pedal force required to achieve full rudder deflection is approximately 200 pounds during a go-around when rudder trim is not used.

NOTE

- Pilot height, seat position, rudder pedal adjustment and foot position on the rudder pedal will determine the pilot's ability to counteract the high rudder pedal force and obtain full rudder. The copilot should assist in holding full rudder during the go-around.
- When one or more engines have been shut down and fuel usage and management have been modified, compute the center of gravity for the landing condition or refer to the "Approximate CG Location Landing Configuration" chart in the "Approach and Landing" section of the Appendix. A determination of the cg is necessary to assess the handling characteristics for landing.
- For effect of control displacement on performance during go-around, see "Go-Around Characteristics With Asymmetric Thrust" Section VI.

GO-AROUND WITH ASYMMETRICAL THRUST

Aircraft climb performance with seven, six, and five engines operating at MRT at best climb speed is shown in Part 4 of the Appendix. These charts, along with the minimum speed for directional control charts (figure 3-13), can be used as a guide to the feasibility of making a go-around with less than eight engines under specific circumstances. When landing with engines out, the minimum speed for directional control should be regarded as the minimum speed from which go-around can be safely accomplished. However, it may be possible to perform a go-around from lower speeds using a combination of engines which will result in symmetrical thrust. In this case, directional control would not be a problem. Under extreme circumstances, it may be possible to make a go-around from a speed at which full control deflections are not sufficient to maintain a heading. This will cause the aircraft to make a gradual turn and, as speed is increased, directional control will be regained. The point to remember is that a safe go-around is not assured from a speed lower than the minimum directional control speed even though it may be possible to do so in some cases. See "Loss of Engines," this section. Therefore, in planning an approach with engines out, the minimum speed for directional control should be used to determine whether the landing is committed or a go-around can be safely executed. The use of nosedown trim due to thrust application will still be required in case of a go-around with less than eight engines; therefore, care should be taken to keep the aircraft trimmed for zero stick force as in a normal go-around. This is particularly important since other distractions will be present during this time.

ONE ENGINE FAILURE

When attempting a landing with one engine inoperative and a go-around becomes necessary, adequate control can be maintained quite easily by applying proper rudder pedal force and a slight amount of lateral control force. All corrective control inputs required can be trimmed out to fly hands off, even though military rated thrust is applied on the remaining good engines and the engine which failed is located at the outboard position.

TWO ENGINE FAILURE

If two outboard engines located on the same side become inoperative and a go-around becomes necessary, there will be an insufficient amount of rudder available to completely balance out the yawing movement encountered at the low go-around speeds. However, by applying appropriate lateral control as well as full rudder, straight ahead directional control can be maintained. See figure 3-13 for minimum speeds for directional control. If full rudder trim is used at speeds above 180 knots IAS, rapid rudder manipulations must be avoided because of the structural limits of the vertical tail and rudder. Steady flight conditions can be established only with the thrust deficient wing a few degrees high.

THREE OR FOUR ENGINE FAILURE

Many different combinations of engine failures are possible and go-around techniques will vary slightly with each. The most critical conditions are those go-around which occur when the outboard engines have failed, since directional control is the limiting condition.

Five-engine climb curves are presented in Part 4 of the Appendix. Any go-around which must be made with more than two outboard engines inoperative on the same side should be accomplished with utmost caution. Pilot application of directional and lateral control must be simultaneous with throttle movement. It is recommended that the throttles be moved to some position less than full forward until the pilot has determined his capabilities for handling such an emergency. Engine failure will not materially affect the landing gear retraction time if the failure is on any engine other than 4 or 5. However, gear retraction time will be longer if either engine 4 or 5 is shut down. For additional information, see "Landing With Three or Four Engine Failure on One Side," this section.

THREE OR FOUR ENGINE FAILURE ON ONE SIDE

Observe the "Landing With Three or Four Engine Failure On One Side With Flaps Up," procedures and checklist. Also, see, "Landing With Wing Flaps Inoperative," this section.

GO-AROUND WITH THREE OR FOUR ENGINE FAILURE ON ONE SIDE AND FLAPS UP**WARNING**

- A go-around should not be attempted unless a gear down climb capability of 300 feet per minute exists. If the charts (figure 3-14A) indicate that a climb potential of less than 300 FPM exists, gross weight should be decreased prior to the approach.
- Observe for a lateral fuel unbalance. If possible avoid a heavy wing and inoperative engines conditions on the same side. A go-around should not be attempted if a fuel unbalance of 20,000 pounds or more exists.
- The effects of spoiler deflection, gear down, and fuel unbalance can become critical if go-around speed is not quickly attained and maintained.

NOTE

- The decision to go around or land must remain with the pilot and be based on all factors involved. The decision should be made as early as possible and not later than 600 feet above ground level.
- If a go-around is required under low altitude/low airspeed conditions, pilots may not have sufficient time to refer to the checklist. Therefore this checklist should be accomplished as necessary and need not be read. When a safe altitude and airspeed is attained, the pilots will review the checklist and complete required items.

1. Set Go-Around Thrust - Set (as required) (P/CP)

The pilot flying the aircraft should smoothly advance inboard throttles to MRT. After MRT has been set on the inboard engines, the outboard throttles will be advanced as their thrust is needed. Maximum EPR for outboard engines may be varied depending on conditions and requirements.

WARNING

- Rudder will be applied as thrust is applied; the pilot should anticipate the bank angle requirement by rolling 10 degrees towards the operative engines. If sufficient rudder is not used to combat yaw, controllability and climb or acceleration capability will be significantly degraded. The rudder pedal force required to achieve full rudder deflection during a go-around is approximately 130 pounds. This force increases markedly when rudder trim is not used.
- It may not be possible to maintain directional control if all throttles are advanced to MRT.

NOTE

- Pilot size, seat position, rudder pedal adjustment and foot position on the rudder pedal, will determine the pilot's ability to counteract the high rudder pedal force and obtain full rudder. The copilot should assist in holding full rudder during the go-around if requested by the pilot.
- Accelerate to a minimum of approach speed plus 10 knots by continuing descent, using MRT on inboard engines, and retracting the landing gear prior to increasing pitch and/or application of outboard EPR setting. Do not increase pitch to level off until necessary to avoid obstructions or sufficient airspeed is obtained. The aircraft will become much easier to control as airspeed increases.

GO-AROUND WITH THREE OR FOUR ENGINE FAILURE ON ONE SIDE AND FLAPS UP (Cont)**2. Airbrake Lever Position 2 - Position 2 (P)**

Leave airbrakes in position 2. Airbrake position 2 will give more spoiler authority with less wheel deflection than position 1 or zero and require less pilot effort, with no significant increase in drag.

3. Landing Gear UP - UP (as required) (P-CP)

Raising the landing gear will increase rate of climb approximately 500 fpm and will allow the aircraft to accelerate more rapidly.

4. Trim Aircraft - Trimmed (P)

At all times during go-around, pilot will make a conscious effort to keep the aircraft trimmed to zero stick forces.

NOTE

If the computed thrust for one-half lateral control authority is applied and speed is less than approach speed plus 10 knots, then more roll control will be required to maintain a heading. This will result in an increase in drag and a decrease in remaining roll control.

5. Adjust Thrust - Adjusted (P)

Accelerate to approximately approach speed plus 30 knots and adjust thrust to establish positive rate of climb.

NOTE

Accomplish "After Takeoff-Climb Checklist," "Flaps-Up Before Landing With Three or Four Engine Failure on One Side Checklist," and "Flaps Up Landing With Three or Four Engine Failure on One Side Checklist," as applicable.

CONDITIONS:

- FLAPS UP
- GEAR DOWN
- AIRBRAKES POSITION 2
- INBOARD ENGINES AT MRT
- FULL RUDDER
- ONE-HALF LATERAL CONTROL AUTHORITY
- APPROACH SPEED PLUS 10 KNOTS

EXAMPLE:

GIVEN:
 Gross weight = 270,000 lb
 Ambient Temperature = 60°F
 Altitude = Sea level
 Inboard Engines at MRT

FIND:
 EPR for outboard engines and rate of climb

SOLUTION:
 EPR = 2.06
 Rate of Climb = 430 ft/min

DATE: MARCH 1975

**DATA BASIS:
FLIGHT TEST****NOTE**

- To convert °C to °F, refer to Part I of the Appendix.
- If only three engines are inoperative on one side, the performance data is conservative.

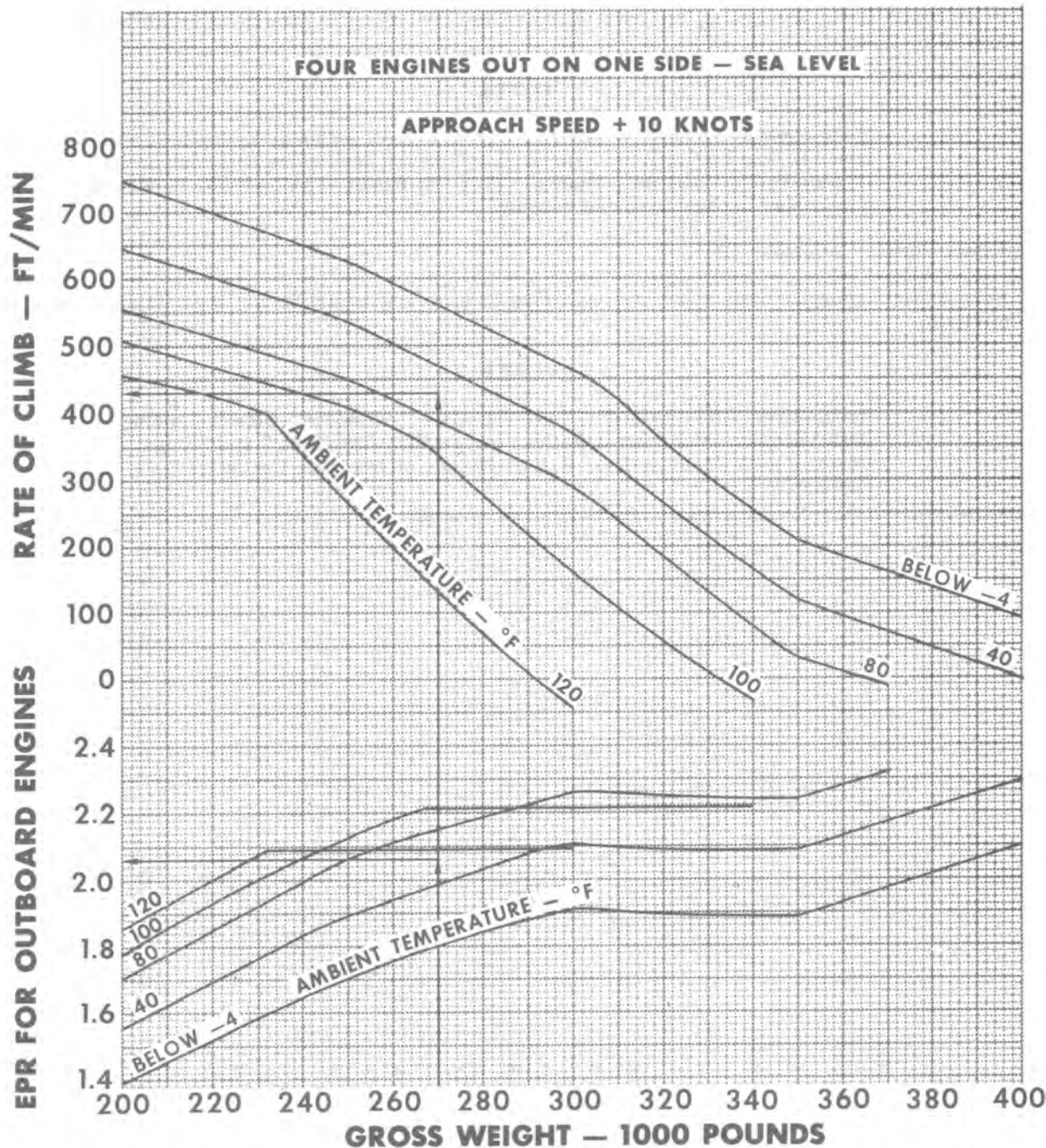


Figure 3-14A (Sheet 1 of 4).

CONDITIONS:

- FLAPS UP
- GEAR DOWN
- AIRBRAKES POSITION 2
- INBOARD ENGINES AT MRT
- FULL RUDDER
- ONE-HALF LATERAL CONTROL AUTHORITY
- APPROACH SPEED PLUS 10 KNOTS

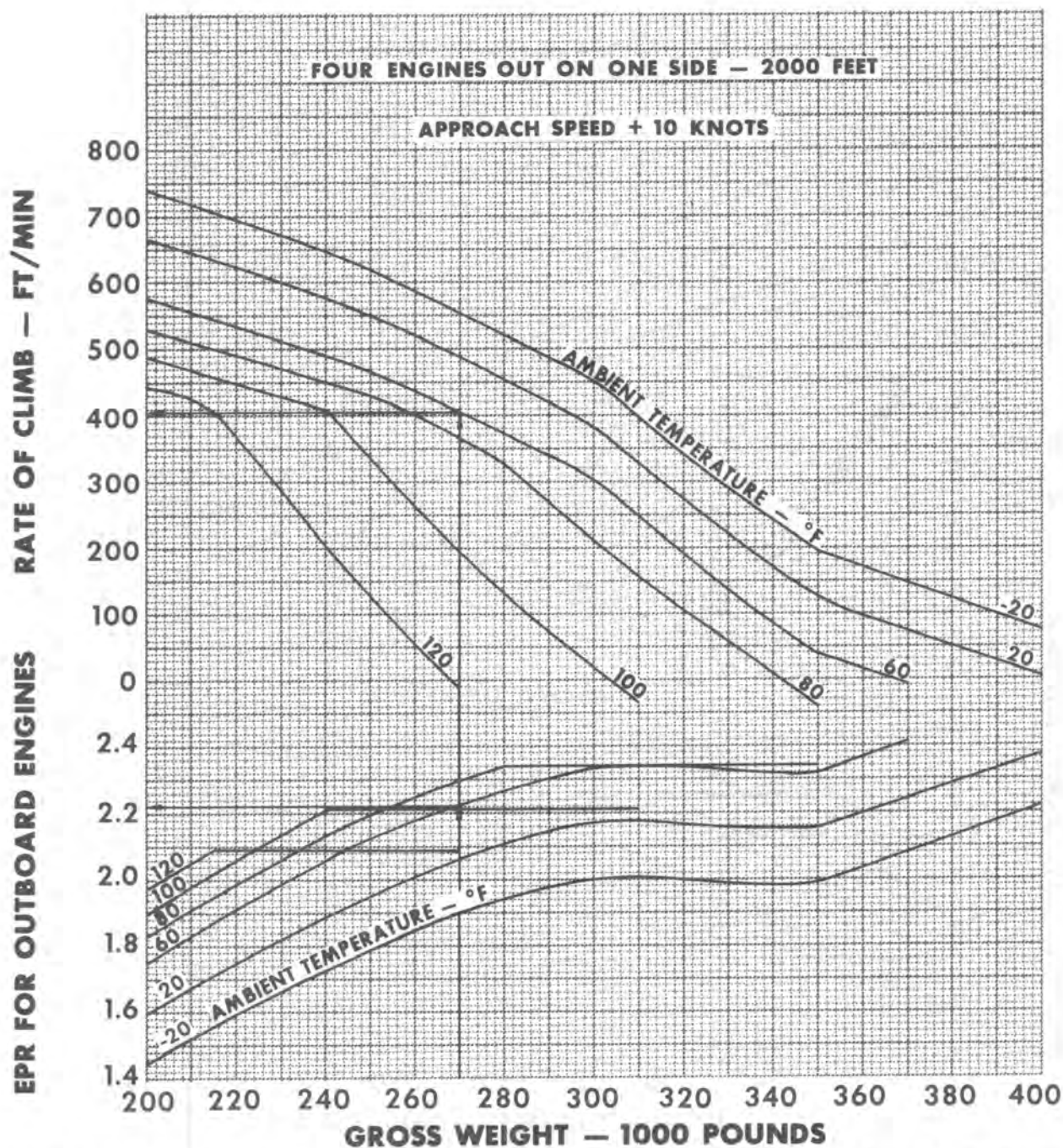
DATE: MARCH 1975

NOTE

- To convert °C to °F, refer to Part I of the Appendix.

**DATA BASIS:
FLIGHT TEST**

- If only three engines are inoperative on one side, the performance data is conservative.



Outboard Engines EPR For Go-Around

Figure 3-14A (Sheet 2 of 4).

CONDITIONS:

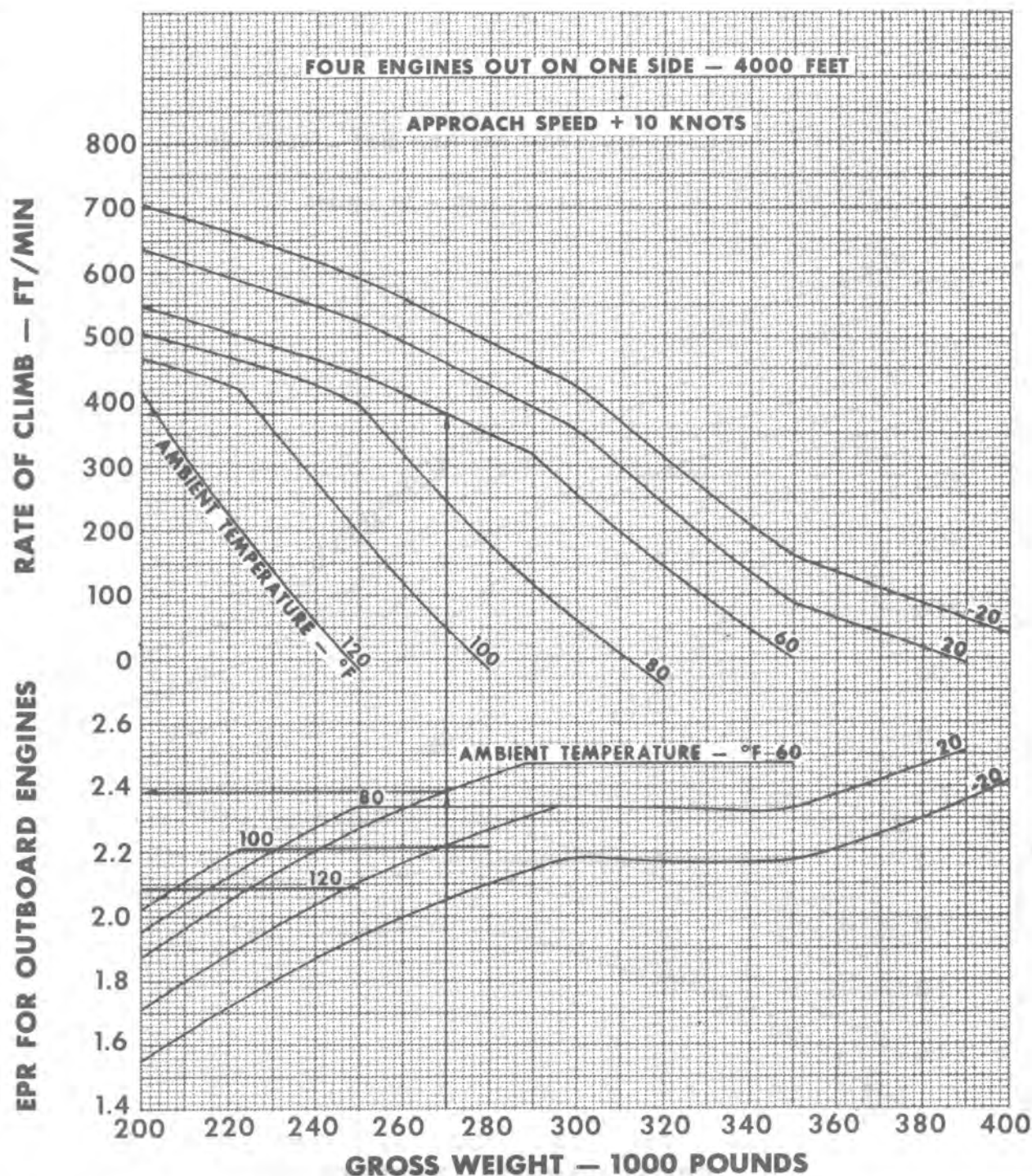
- FLAPS UP
- GEAR DOWN
- AIRBRAKES POSITION 2
- INBOARD ENGINES AT MRT
- FULL RUDDER
- ONE-HALF LATERAL CONTROL AUTHORITY
- APPROACH SPEED PLUS 10 KNOTS

NOTE

- To convert °C to °F, refer to Part I of the Appendix.
- If only three engines are inoperative on one side, the performance data is conservative.

DATE: MARCH 1975

DATA BASIS:
FLIGHT TEST



CONDITIONS:

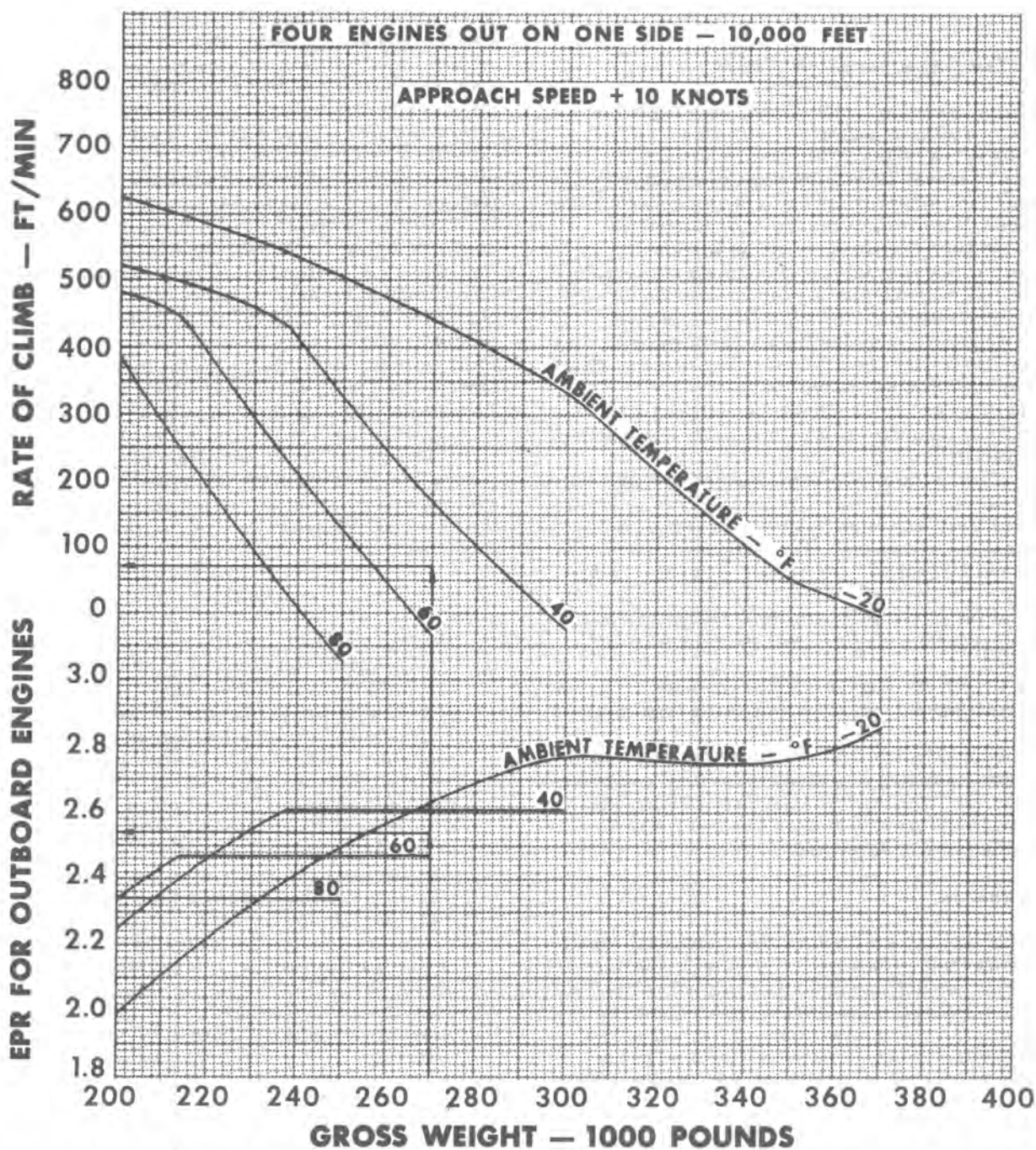
- FLAPS UP
- GEAR DOWN
- AIRBRAKES POSITION 2
- INBOARD ENGINES AT MRT
- FULL RUDDER
- ONE-HALF LATERAL CONTROL AUTHORITY
- APPROACH SPEED PLUS 10 KNOTS

DATE: MARCH 1975

**DATA BASIS:
FLIGHT TEST****NOTE**

● To convert °C to °F, refer to Part I of the Appendix.

● If only three engines are inoperative on one side, the performance data is conservative.



■■■■■ **Outboard Engines EPR For Go-Around**

Figure 3-14A (Sheet 4 of 4).

SYSTEMS EMERGENCY OPERATION

FLIGHT CONTROL SYSTEM EMERGENCY OPERATION

LATERAL TRIM MALFUNCTION

Unscheduled operation of the lateral trim system due to an electrical control circuit malfunction can be stopped by actuation of the guarded lateral control trim cutout switch on the pilot's side of the aisle stand.

STABILIZER TRIM MALFUNCTION

Unscheduled stabilizer trim operation in flight can cause severe attitude changes if immediate corrective action is not taken. The time required for the stabilizer to travel beyond the limit of elevator control capability is approximately 5 seconds under most conditions. However, at maximum indicated airspeeds, the time may be as short as 2 seconds; therefore, it is essential that immediate corrective action be taken by the pilots when an unscheduled or runaway trim condition arises in flight. In most cases of runaway stabilizer trim, one of the following has occurred to give the pilots the idea that the stabilizer trim was running away:

1. A malfunction which allows the autopilot to remain on when the pilot is flying manually and believes the autopilot is off.
2. One of the pilot's trim buttons stuck in NOSE UP or NOSE DN.
3. The aircraft has been thrown out of trim by use of flaps and/or airbrakes. For complete information on flaps and airbrakes, see "Flight Controls," Section VI.
4. One of the pilots actuating the trim button, causing the other pilot to believe that the trim was malfunctioning.
5. Stabilizer trim response in the opposite direction to that commanded (caused by stabilizer trim motor reversal).

Any of the above situations can cause the pilots to take actions resulting in a dangerous flight condition; therefore, the "Runaway or Unscheduled Stabilizer Trim Checklist" should be used whenever stabilizer trim malfunction is suspected.

Force Switches

To provide the pilots with a means of instantly terminating unscheduled stabilizer trim, a pitch attitude control force switch assembly is installed in the control column linkage. The pilot's trained reaction with the control column in counteracting undesired aircraft pitch attitude variation operates to cut out any opposing electrical stabilizer trim (figure 1-32).

NOTE

Stabilizer trim reversal will not be interrupted by actuation of the force switches for the reasons noted in the following paragraph.

FORCE SWITCH OPERATION. Application of a forward load of more than the preset value (24 to 36 pounds) on a spring in the force switch assembly compresses the spring to interrupt the stabilizer nose up trim circuit. When this same preset value is exceeded in the aft direction, the spring is also compressed and the nose down trim circuit is interrupted. The autopilot, if engaged, will disengage upon actuation of the force switches in either direction. Since the electrical circuit opposite the fault side continues to be operative, unless deactivated by the trim circuit cutout switch or circuit breakers, electrically controlled trim opposing the unscheduled trim movement is available through actuation of the trim button. Normally, trim cutout switch actuation should be delayed until the opposing force on the control column is reduced to the preset value by corrective trimming because an out of trim condition can be corrected more rapidly by using electrical trim. It should be noted that as soon as the control column force is reduced to this point, the force switches will close and allow an unscheduled trim to be reactivated. To prevent continuation of the unscheduled stabilizer trim operation and to permit manual trimming for the remainder of the flight, the trim cutout switch should then be placed in the CUTOUT position in sequence with the other corrective action measures noted in the following "Runaway or Unscheduled Stabilizer Trim Checklist."

NOTE

Certain malfunctions within the aircraft electrical system can create a condition wherein the stabilizer trim motor may drive in the opposite direction to the input signal commanded by the stabilizer trim button. In event of such stabilizer trim motor reversal, the pilot's natural reaction in responding to an aircraft pitch movement with an opposing control column force will not interrupt driving the reversed trim motor. The force switches interrupt the power to the trim motor clutch on the side opposite that required for proper trim direction. In the reversed motor situation, the correct clutch is engaged but the direction of rotation is reversed. Stabilizer trim reversal can be interrupted by repositioning the trim button to neutral or by actuating the stabilizer trim cutout switch to the CUTOUT position.

ELEVATOR AND RUDDER CONTROL MALFUNCTION

Loss Of Artificial Feel

If, at any time, loss of artificial feel is encountered, check the flight instruments for aircraft response to control movement. Loss of feel may be interpreted as loss of control response especially in the yaw axis. The start of yaw with rudder deflection is slow and close observance of flight instruments is necessary to detect aircraft response to control movement. If abnormally light elevator or rudder control forces are encountered, abrupt maneuvers should be avoided to prevent overstressing the aircraft. Loss of artificial feel can occur as a result of Q-spring ram air inlet ice or loss of ram air pressure from other causes. An additional tension spring provides partial feel in the elevator axis in event Q-spring pressure is lost. The most significant indication of loss of Q-spring pressure is loss of rudder feel. The loss of elevator feel is masked for small control column displacements by the centering spring. Therefore, in event of loss of rudder feel, it should always be suspected that the elevator feel has also been lost and caution should be exercised when applying large control column inputs.

Control Stiffness

Stiffness of elevator and rudder control may be encountered when Q-spring ram air duct blockage from ice or other foreign material has occurred or when mechanical jamming or failure has taken place. Blockage of this duct may result in pneumatic locking of the feel system. If such a condition occurs, descend to a warmer altitude. If a landing must be made with stiff controls, accomplish the following:

1. Check aircraft center of gravity location. Forward center of gravity loadings should be avoided and a more aft cg utilized since elevator requirements to maneuver during flare diminish as cg moves aft. In no case should a landing be made with cg outside the normal flight and ground handling limits.
2. Trim aircraft carefully during approach. During approach, the flare may require judicious use of stabilizer trim and airbrakes for a safe landing.
3. If steering control is inadequate after touchdown, place steering ratio selector lever to TAXI. Steering in TAXI position requires cautious use of rudder pedals, especially if steering control returns to normal during the landing roll.

CAUTION

Steering in TAXI during high speeds produces excessive steering when small amounts of rudder displacement are induced which can produce critical side loads on aircraft structure.

If the above procedure does not provide sufficient steering, application of spoiler control in the desired direction may produce enough landing gear bicycling effect to maintain the desired heading.

Rudder/Elevator Hydraulic Malfunctions

NOTE

Should certain hydraulic hardware failures occur in both rudder/elevator systems or if the rupture of an elevator or rudder actuator occurs, complete hydraulic fluid loss can result. Complete fluid loss from both systems will render the rudder/elevator flight controls inoperative; however, the control column forces and artificial feel system will not be affected. There are no mechanical cables or rods to provide any backup or alternate source of control. The only source of pitch control will be thrust, airbrakes, and stabilizer trim.

Complete loss of the rudder/elevators is unlikely since the system is highly redundant. If failure of a main hydraulic power supply pump does occur, check ruder/elev aux lights off for the failed main system, and attempt reset of the circuit breaker for the failed pump. If the circuit breaker will not reset or pump out light will not go out, place the system power switch to off and continue mission. If any two of the hydraulic power supplies fail (any combination of main or auxiliary supplies), abort the mission and land as soon as practicable.

WARNING

When operating on one auxiliary pump only, flight control power will be reduced during stabilizer trim and landing gear operation. If remaining auxiliary pump is the right hand pump, use the right hand body standby pump to augment the body low pressure condition.

NOTE

- When operating on auxiliary pumps only, flight control power will be slightly reduced during stabilizer trim and landing gear operation. This can be alleviated by using the body standby pumps for landing gear operation and for large trim requirements (such as flaps).
- When operating on auxiliary pumps only, the use of stabilizer trim and demands from elevator inputs during the landing flare can reduce hydraulic pressure available to these systems. Therefore use of stabilizer trim should be minimized or discontinued during the landing flare to ensure adequate elevator authority for attitude control during touchdown. See "Flare" in Section VI.
- Landing gear and flap operation should be accomplished when in straight and level, trimmed flight.

Should complete failure of both systems ever occur requiring cruise flight conditions to destination the aircraft can be controlled fairly well. An airspeed of 250 knots IAS or .72 Mach, whichever is less recommended. Air refueling is considered impracticable to attempt and is probably impossible. Yaw SAS will be inoperative and the pilot will be required to manually damp any dutch roll motion using only lateral control inputs. The manual damping procedures, see "Dutch Roll Damping," Section IX, applies except that the airbrakes will be in position 3 and used for pitch control.

NOTE

Avoid turbulence to the maximum extent possible if complete loss of both rudder/elevator systems occurs.

STABILITY AUGMENTATION SYSTEM (SAS) MALFUNCTION

Malfunction within the SAS electronic units or foreign matter in the elevator or rudder hydraulic actuators can cause unscheduled pitch or yaw inputs.

Unscheduled Pitch Oscillations

If unscheduled pitch-inputs are observed, accomplish the following:

1. Disengage the autopilot. If oscillations do not cease immediately, place the pitch SAS switch to DISENGAGE.

WARNING

The urgency of this step is increased if these oscillations occur during takeoffs and landings, air refueling, low altitude flight, and low level operations.

2. If oscillations cease upon disengaging the pitch SAS, leave pitch SAS switch disengaged and continue mission. Autopilot may be reengaged to ascertain if malfunction was in the SAS pitch control, and left engaged if no further oscillations are experienced.

Unscheduled Yaw Oscillations

Unscheduled yaw oscillations of small amplitude from the SAS are classified as a nuisance factor and do not affect safety. If such a condition occurs, continue the mission; however, the following instructions will apply:

NOTE

These small amplitude oscillations are usually noticed in smooth air only when the system is searching around a null point. When the aircraft is in turbulence, refueling, or is not in a clean configuration, the oscillations are not likely to be observed.

1. Do not disengage the yaw SAS switch to eliminate these nuisance oscillations.

CAUTION

Turbulence encounters with yaw SAS disengaged and no yaw damping could result in structural damage.

2. The source of the malfunction causing the oscillations should be determined and a Form 781 entry made.

NOTE

Of special interest to the maintenance debriefing team will be the flight conditions associated with the writeup. Therefore, it should be established that oscillations were not due to turbulence.

3. If the oscillations are observed with autopilot engaged, it should be disengaged. If oscillations do not cease, place the yaw SAS switch to disengage. If oscillations cease upon disengaging the yaw SAS, the malfunctioning system has been identified. The yaw SAS switch will be reengaged and left engaged. The autopilot may be reengaged if the malfunctioning system was identified as the yaw SAS.

If unscheduled yaw oscillations severe enough to cause yaw SAS switch disengagement occur, accomplish the following:

1. Attempt to reengage the yaw SAS switch.
2. If the switch will not engage, leave switch in DISENGAGE. Continue mission and observe the restrictions under "Yaw SAS Switch Disengagement," this section.

Stability Augmentation System (SAS) Switch Disengagement

PITCH SAS SWITCH DISENGAGEMENT:

1. Check circuit breakers in; attempt reengagement of pitch SAS switch.
2. If switch will not engage, leave switch in DISENGAGE and continue mission.

NOTE

Reengagement of the pitch SAS switch may produce an engage transient. This is considered normal.

YAW SAS SWITCH DISENGAGEMENT:

NOTE

- The aircraft will be without yaw damping if yaw SAS is inoperative.
- Reengagement of the yaw SAS switch may produce an engage transient. This is considered normal.

1. Check circuit breakers in; attempt reengagement of yaw SAS switch.

2. If the switch will not engage, leave switch in DIS-ENGAGE. The mission may be continued while observing the following restrictions/instructions.

a. Avoid turbulence or any maneuver that could apply unnecessary side loads to the aircraft. If turbulence is encountered, accomplish turbulent air penetration procedures as given in Section IX.

b. Low level activity will not be continued/attempted.

c. Adjust altitude to near but not above 10,000 feet below that indicated by the maximum range M-.77 line on the "Best Range Constant Mach Cruise Altitude Chart" in the Appendix, unless turbulence is encountered or forecast at this altitude.

d. Air refueling will be conducted only when necessary to extend the flight during emergencies. The air refueling mode of the autopilot will substantially reduce the loads on the aircraft during refueling and will be used if operative.

e. Do not conduct evasive action or breakaway maneuvers associated with bomb runs.

f. A minimum of 250 KIAS should be maintained during cruise flight conditions.

g. Low approaches and touch-and-go landings may be accomplished during smooth, stable flight conditions. Do not practice flaps up approaches or simulated engine out conditions.

ASYMMETRICAL AIRBRAKE CONTROL

Whenever a hydraulic or mechanical malfunction occurs to a spoiler group, pulling the respective (inboard or outboard) airbrake control circuit breaker will assure symmetrical airbrake position during subsequent airbrake operation. If a malfunction affects any outboard spoiler group, turn the applicable outboard wing system standby pump switch to STDBY prior to pulling the circuit breaker. If this does not restore system pressure, pull the outboard airbrake control circuit breaker. Pulling these circuit breakers does not affect the operation of the spoilers. Airbrake effect will be reduced for a selected airbrake position, but the desired results can be obtained by using a higher airbrake position, if available. If airbrakes are used after a hydraulic failure has occurred and the applicable circuit breaker is not pulled, a sudden roll to the side of the operating airbrakes will occur. The character of the roll will depend on the spoiler group or groups inoperative and the position of the airbrakes used. Although the aircraft is less maneuverable, it can be flown without the assistance of one or two spoiler groups. With one or more spoiler groups inoperative, see "Landing with Spoiler Control Failure" under "Landing Emergencies," this section.

WING FLAP SYSTEM EMERGENCY OPERATION

NOTE

The aircraft is not equipped for emergency extension or retraction of the flaps; however, all four flap sections are simultaneously driven by a power unit which normally has two 205-volt a-c motors operating at the same time. Normally, the flaps will fully extend or retract in approximately 60 seconds. If either motor becomes inoperative, the other motor will extend or retract the flaps in approximately 120 seconds.

ASYMMETRICAL WING FLAP CONDITIONS

An asymmetrical wing flap condition may or may not be evidenced to the pilot by an unusual rolling and yawing moment. The asymmetrical wing flap yawing effect arises from the increased drag of the flapped wing as compared to that of the wing without flaps. Furthermore, when the rolling moment is counteracted by spoiler action, the resulting yawing moment adds to that from the flaps. Effective countermeasures for asymmetrical wing flap conditions which result in unusual rolling and yawing moments will then include the application of opposite rudder in addition to lateral control. Flap damage which could result in an asymmetrical condition is most likely to occur during extension or retraction. To successfully counteract any adverse rolling moment due to asymmetrical flaps, it is essential that corrective action be taken immediately. The possible conditions which could cause asymmetrical flaps and the results expected are as follows:

1. An outboard section could leave the aircraft instantaneously with the other three sections either full or partially down. This condition can be adequately counteracted at all speeds above unstick speed by the application of full lateral control and rudder.

2. An inboard section could leave the aircraft instantaneously with the other three sections either full or partially down. Experience shows that this condition can be counteracted by application of one-half to two-thirds of the lateral control.

3. If a torque tube fails between the two sections on one side, the outboard section could go to full up while the others went to full down (corrective capabilities are the same as for the first condition above) or could go to full down when the other three sections went to full up. In the latter case, full lateral control and rudder can counteract the rolling moment at speeds over 20% above unstick speed.

4. If a torque tube breaks between an inboard flap section and the power unit, both sections on one side could go up or down while the two sections on the other side went in the opposite direction. This condition may be controlled by immediately chasing the free flap sections with the driven sections. Free travel of a broken torque tube is limited by an overspeed flap drive brake which allows enough time to

establish control if immediate corrective action is taken. Full lateral control and rudder can control a maximum of 25% asymmetry in the up position (flaps up on one side and 25% extended on the other side) and a maximum of 60% asymmetry in the down position (flaps down on one side and 40% down on the other side).

Wing Flap Movement Following Torque Tube Failure

If the flaps are less than 20% extended and a section becomes disconnected from the torque tube drive, airloads will probably carry the section to the full up position. If the break occurs when the flaps are 30% or more extended, the airloads will probably move the section to the full down position. In the range between 20% and 30% extended, airloads could move the section either up or down with the probably crossover point at 25%. Therefore, if a torque tube broke when the flaps were 30% extended and the flap lever was immediately moved to DN, a free flap section could reach full down in not less than 25 seconds. The maximum asymmetry would occur at that time with the free section, or sections, full down and the driven section 71.5% down.

Action To Be Taken With Asymmetrical Wing Flaps

When an asymmetrical flap condition exists, a landing in that configuration will be necessary. A check of aircraft controllability and initial buffet speed should be made. See "Stall or Controllability Checks," Section VI. Use normal flaps down "Landing Checklist." Determine the best flare speed from Part IX in the Appendix for intermediate flap settings.

WARNING

- When the flaps are in a full-down or intermediate position and flap damage exists, such as a missing segment, the best flare speed given in the Appendix may no longer apply. In this case, reduce speed slowly until the charted best flare speed is reached or until approximately one-half lateral control authority is required to maintain the wings level. Whichever of these speeds is higher should be used as the best flare speed.
- Pilot of the chase aircraft will be briefed on command chase aircraft procedures prior to engaging in chase operation. It is unsafe to fly two aircraft in close vertical proximity because of the magnitude of interrelated aerodynamic effects.

NOTE

If time is available, visual observation of the wing flap condition may be made by a chase plane pilot or tower flyby to aid in assessing the damage.

a. When any unusual rolling moment is encountered during wing flap operation and the flap indicator needles remain synchronized or stop, immediately place the flap lever to OFF. The synchronized indicator needles usually mean that the torque tubes are intact and therefore a flap section has either ceased to move or has fallen from the aircraft. The pilot must maintain the flap placard speed that is commensurate with the indicated flap position until a controllability check can be made.

CAUTION

- If visual observation reveals that one of the flap sections is damaged or cocked, or if visual observation cannot be made and the condition of the flaps is unknown, further operation of the flaps must be discontinued and a landing made with the flaps remaining in the position in which they stopped.
- Additional attempts to operate damaged flaps can result in further damage to the aircraft and could cause an increase in rolling moment. A cocked flap is subject to buffeting and vibration and may fall from the aircraft. To reduce this hazard, consideration should be given to landing the aircraft when practical.

b. When any unusual rolling moment is encountered during wing flap operation or the flap indicator needles become unsynchronized, immediately place the flap lever to OFF. Since the flap position indicator transmitters are on the outer extremities of the torque tubes, an unsynchronized indicator needle movement accompanied by a rolling moment can usually be associated with failed torque tube. If the rolling moment continues to increase, the copilot must "chase" the free flap section with the flap lever.

(1) If the flaps were more than 25% down, move the flap lever to DN. Monitor the needles to insure that both are moving in the down direction. If one needle has stopped or is going in the up direction, reposition the flap lever to OFF or UP as required to synchronize the needles.

(2) If the flaps are less than 25% down, move the flap lever to UP. Monitor the needles to insure that both are moving in the up direction. If one needle has stopped or is going in the down direction, reposition the flap lever to OFF or DN as required to synchronize the needles.

WING FLAP STOPPAGE

If both needles stop during extension or retraction, immediately move the flap lever to OFF. Flap stoppage can usually be associated with electrical problems or excessive friction in the system. The landing should be made with the wing flaps remaining in the position where they stopped. Determine the best flare speed from Part IX in the Appendix for intermediate flap settings.

CAUTION

If a partial flap landing is inadvisable due to critical landing factors, only flap extension may be attempted, and then only if visual observation by a chase plane pilot reveals that no unusual position or alignment of flaps exists. Flap extension may be continued while under visual observation. Use caution in reactivating the flaps, and be prepared to counteract any unusual rolling moment that may be encountered. Discontinue extension of flaps if the flap indicator needle motion becomes jerky or if the needles stop or become unsynchronized.

UNSCHEDULED FLAP MOVEMENT

All four flap sections are simultaneously driven by a common drive shaft operated by the wing flap power unit. Certain failures within the power unit could cause loss of flap response to the flap motors and flap lever. Such a failure would allow airloads to position all four flap sections, depending on flap position when failure occurs, as described under "Wing Flap Movement Following Torque Tube Failure," this section. During flap operation if the flaps stop and reverse direction, reposition the flap lever to agree with flap movement. When flap movement stops, place flap lever OFF to prevent extended flap motor operation should limit switches not be deenergized.

OIL SYSTEM EMERGENCY OPERATION

NOTE

- When a malfunction occurs in the oil system which could cause damage to the engine bearings or when an engine has windmilled in flight with low or zero oil pressure, an entry will be made on the Form 781. This informa-

tion will aid maintenance personnel in determining the extent of damage and/or maintenance inspections required. Entries should provide information on elapsed time the engine(s) windmilled, what percent RPM windmilled, the oil pressure indicated, and the low oil pressure warning light indication.

- If oil pressure indicator circuit breaker has popped, oil pressure gage indications are unreliable.

OIL PRESSURE LOW

When engine oil pressure drops below 40 psi while operating above idle rpm, the following instructions apply:

1. If oil pressure readings drop below 40 psi while operating above idle rpm and a low oil pressure light illuminates, immediately shut down the engine unless its thrust is necessary to maintain flight.
2. If oil pressure readings are normal and the low oil pressure light illuminates, continue normal operation monitoring the engine instruments closely. Any erratic operation of any of the affected engine instruments will require an immediate shutdown of the engine unless its thrust is necessary to maintain flight.
3. If oil pressure readings drop below 35 psi and the low oil pressure light does not illuminate, press to test light. If light illuminates when press to test, continue normal operation monitoring the engine instruments.

If the thrust of an engine with low oil pressure is required to maintain flight, the pilot should be aware of the results of operating an engine during oil starvation. If an engine oil system malfunction has caused prolonged oil starvation of engine bearings, the result will be a progressive bearing failure and subsequent engine seizure. This progression of bearing failure starts slowly and will normally continue at a slow rate up to a certain point at which the progression of failure accelerates rapidly to complete bearing failure. The time interval from the moment of oil starvation to complete failure depends on such factors as condition of bearings prior to oil starvation, operating temperature of bearings, and bearing loads. A good possibility exists for up to 30 minutes of operation after experiencing oil starvation. Bearing failure due to oil starvation is generally characterized by a rapidly increasing vibration; when vibration becomes moderate to heavy, complete failure is only seconds away and may be avoided only by immediate engine shutdown. Since the end result of

oil starvation is engine seizure, at the first indication of oil system malfunction the procedure outlined below should be followed to forestall engine seizure as long as possible.

1. Immediately shut the engine down unless its thrust is necessary to maintain flight.
2. If thrust is required from the affected engine, reduce thrust to minimum required to maintain flight. Avoid rapid and large variations in thrust settings on affected engine.
3. Jettison, if necessary, external stores not required.
4. Avoid all abrupt maneuvers causing high "g" forces. This prevents unnecessary bearing loads.
5. After critical thrust conditions are past, immediately shut the affected engine down. Reduction in IAS and altitude will reduce the engine windmilling rpm and delay engine seizure after the engine is shut down.
6. After engine shutdown, if the oil pressure gage does not indicate a positive value, land the aircraft as soon as practicable to prevent possible engine damage or seizure. Consideration should be given to gross weight for landing (325,000 pounds or less) and availability of a suitable landing base.

OIL PRESSURE ERRATIC

If the engine oil pressure gage shows erratically lowering oil pressure below 40 psi when operating above idle rpm, or rises to approximately 55 psi, monitor the engine and continue normal operation until pressure drops to 35 psi or rises to 55 psi. Oil pressure fluctuations up to 5 psi total are allowable; however, the mean should not be lower than 35 psi. It may not be possible to distinguish between an oil pressure transmitting system malfunction and an engine oil pressure system malfunction. Therefore, if engine oil pressure drops below 35 psi, proceed as instructed under "Oil Pressure Low," this section. If oil pressure exceeds the maximum limit, shut the engine down unless its thrust is necessary to maintain flight.

FUEL SYSTEM EMERGENCY OPERATION

NOTE

An emergency condition may make it necessary to deviate from the prescribed normal fuel sequence. After the emergency has passed, the remaining fuel load should be adjusted to reestablish a proper cg. See Section V for flutter limits if using other than normal fuel sequence.

FUEL QUANTITY GAGE MALFUNCTION

A malfunction of any fuel quantity gage may indicate a failure that would, with proper sequence of events, allow the introduction of high voltage electrical power into the associated fuel tank. Therefore, if any fuel quantity gage malfunction occurs, pull the applicable fuel quantity indicator circuit breaker. During flight operations attempt to pull the circuit breaker

so the gage pointer will indicate the estimated landing quantity (or zero if desired) in that specific tank.

WARNING

If any fuel quantity gage malfunction occurs, pull the applicable fuel quantity indicator circuit breaker. Do not reset the circuit breaker. Make an AFTO Form 781A entry to document the discrepancy for necessary corrective action by maintenance personnel.

NOTE

If a fuel quantity indicator circuit breaker is pulled and the gage pointer reads full (by weight), the corresponding fuel level control valve will remain closed if the master refuel switch is ON. In this configuration the tank cannot be refueled.

FUEL MANAGEMENT WITH MAIN MANIFOLD INTERCONNECT VALVES FAILED

Valves Failed Closed

In the event that both main manifold valves (No. 29 and 29A) should fail in the closed position, it would be indicated first during the fuel feed step of "Mid-Body-to-All" by a gradual decrease in the quantity of fuel in main tanks 1 and 2 while the quantities in main tanks 3 and 4 remain unchanged. This indicates mid body fuel is only being fed to engines on the right wing. To feed all engines during this step, place engine crossfeed valves switches No. 9, 10, 11, and 12 in OPEN. To accomplish subsequent steps in the fuel sequence, place crossfeed valve switches in OPEN as necessary to use fuel through the crossfeed manifold. At a point in the sequence when using "Mains to All," use normal main tank balancing procedure to attain balance between main tanks 1 and 2 and main tanks 3 and 4. Failure of the main manifold interconnect valves in closed position will be indicated during normal air refueling to all body and center wing tanks simultaneously by the aircraft center of gravity moving forward with no indication of fuel quantity increase in the aft body tank.

Valves Failed Open

In the event either one or both of the main manifold valves should fail in the open position, there is a possibility of having unequal fuel usage during auxiliary fuel feed steps utilizing pairs of auxiliary tanks. This unequal usage could affect cg or lateral balance. In general, during steps using pairs of body tanks, such as forward body and aft body, cg could be affected. During steps using outboard wing tanks or external tanks, lateral balance could be affected. Monitoring the fuel quantity gages will indicate this type of malfunction and can be corrected by momentarily stopping feed from the "light weight" tank and providing all override feed from the "heavy weight" tank.

FUEL LEAK DETECTION

Small fuel leaks may be detected by plotting against a predicted fuel consumption. Wing tank warning light will come on if external fuel quantity drops below full prior to usage. The following procedure will isolate and detect a suspected fuel leak:

1. At the first indication of a fuel leak, stop all auxiliary tank fuel feed, isolate all tanks, close all crossfeed valves, and feed mains to engines with all auxiliary tank fuel flow control switches closed.

2. Take complete fuel gage readings.

NOTE

If a fuel indicating system malfunction is suspected, the most positive indication of a fuel leak may be an abnormal change in the pitch or lateral trim requirements.

3. If an auxiliary tank continues to lose fuel while isolated with boost pumps off, it is leaking and should be emergency emptied. See "Emergency Emptying of an Auxiliary Tank," this section.

4. If a main tank leak is indicated by excessive fuel consumption for that particular tank, provide an alternate source of fuel from the adjacent main tank (open crossfeed valves 9 and 10 or 11 and 12 as appropriate) and turn off the affected main tank boost pump switch.

5. If the adjacent main tank now indicates an excessive fuel consumption, the fuel leak is in the nacelle or engine fuel lines of the tank with the boost pump switch off. In this instance, the nacelle must be isolated to stop the fuel leakage. Shut down both engines, using the "Emergency Shutdown" checklist, this section.

CAUTION

- Do not attempt a restart of either engine unless a critical need for power exists.
- Do not attempt cooling off of the fuel control unit as specified in the "Emergency Shutdown" checklist.
- Do not open the corresponding crossfeed valve (9, 10, 11, or 12) for that engine during the "Descent" and "Landing" checklists.

NOTE

- Hydraulic pump power may be available from an engine that has been shut down. See "Emergency Shutdown Checklist" and "Hydraulic System Emergency Operation," this section.
- For weight distribution, it may be desirable to transfer fuel from the affected main tank. See "Emergency Emptying of a Main Tank," this section.

6. If no fuel leak is detected with the above procedure, there is still the possibility of a fuel leak in the main manifold. Turn on an auxiliary tank with engine feed control valve switches No. 13, 14, 15, and 16 closed. If the fuel flow indicator light does not flash, there is probably a leak in the main manifold. This leak may be isolated by closing valve No. 29 and rechecking the fuel flow indicator light. If the light flashes, the leak is on the downstream side of valve No. 29 and can be further verified by energizing the pumps in an auxiliary tank on the downstream side of valve No. 29. If the fuel flow indicator light does not flash, the leak is upstream of valve No. 29. The manifold leak may be isolated by leaving valve No. 29 closed and feeding all engines from the side opposite the manifold leak. See "Fuel Management With Manifold Interconnect Valves Failed Closed," this section. Since the main manifold lines are routed through all fuel tanks, the main manifold may leak into another tank. This can only be detected by taking an accurate reading of each fuel tank gage. Check for an increase in fuel quantity in any tank. If any tank shows an increase in fuel quantity, it is an indication that the main manifold line through that tank is leaking. This should not present a problem since the fuel can be safely transferred from the tank and used as desired.

MAIN TANK FUEL LEAK

If a rapid main tank fuel leak is experienced, it must be assumed that some structural damage has occurred to the wing since the fuel tanks are an integral part of the main wing structure. For a comprehensive discussion and procedures to accomplish for a main tank fuel leak, see "Structural Damage," this section.

EMERGENCY EMPTYING OF A MAIN TANK

Severe fuel leaks or combat damage could make it necessary to empty a main tank to prevent loss of fuel. In this event, fuel remaining in the tank should be transferred to other main tanks or auxiliary tanks as desired. This is accomplished by the following procedures:

1. Check all auxiliary tank engine feed control switches (13 thru 16) and engine crossfeed manifold valve switches (9 thru 12) CLOSED.
2. Check all auxiliary tank fuel flow control switches OFF.
3. Check boost pump switch for main tank to be emptied in ON position.
4. OPEN the engine crossfeed manifold valve (9, 10, 11, or 12) of the tank to be emptied.
5. Set defuel valve switch to OPEN.
6. Set master refuel switch to ON.
7. Set the desired tank fuel level control valve switch(es) to the REFUEL position.
8. If necessary, open the main manifold interconnect valve No. 29.

Monitor the cg and lateral trim changes. Due to the rapid transfer of fuel from the emptying tank, the tank low warning light should be monitored for the first indication of fuel depletion. When the low warning light glows, reset the fuel panel using the following procedures:

1. Turn the tank fuel level control valve switch(es) OFF.
2. Move the defuel valve switch to CLOSED.
3. Turn the master refuel switch OFF.
4. OPEN the engine crossfeed manifold valve for the corresponding tank on the opposite wing. This will pressurize the crossfeed manifold from an additional source and will prevent flameout of the two engines being fed from the damaged main tank as this tank becomes empty.
5. When the tank is empty, turn the affected main tank boost pump switch OFF to prevent boost pump operation in an empty tank.

EMERGENCY EMPTYING OF AN AUXILIARY TANK

An auxiliary tank may be emptied quickly by routing fuel from it to all engines. This is accomplished by moving the respective auxiliary tank fuel flow control switch to ENGINE FEED and moving switches 13, 14, 15, 16, and 29 to OPEN (figure 3-15). When the affected tank is empty, the main tank boost pumps will take over fuel supply to the engines with no interruption in fuel flow.

MAIN TANK COMPLETE BOOST PUMP FAILURE

In the event that all boost pumps in a main tank fail and fuel pressure is not available, engines normally supplied by that tank can be supplied fuel from another main tank by using the crossfeed manifold (figure 3-15). If this emergency should occur before all auxiliary tank fuel is used, fuel can be supplied to the affected engines from any auxiliary tank by using the normal override system fuel control selections.

NOTE

The engines may be operated at substantial thrust with the boost pumps inoperative. The engine-driven fuel pumps can supply sufficient fuel pressure to sustain thrust and assure reliable engine operation at an altitude of 14,000 feet or below. See "Fuel Management Without Boost Pumps," this section for additional information.

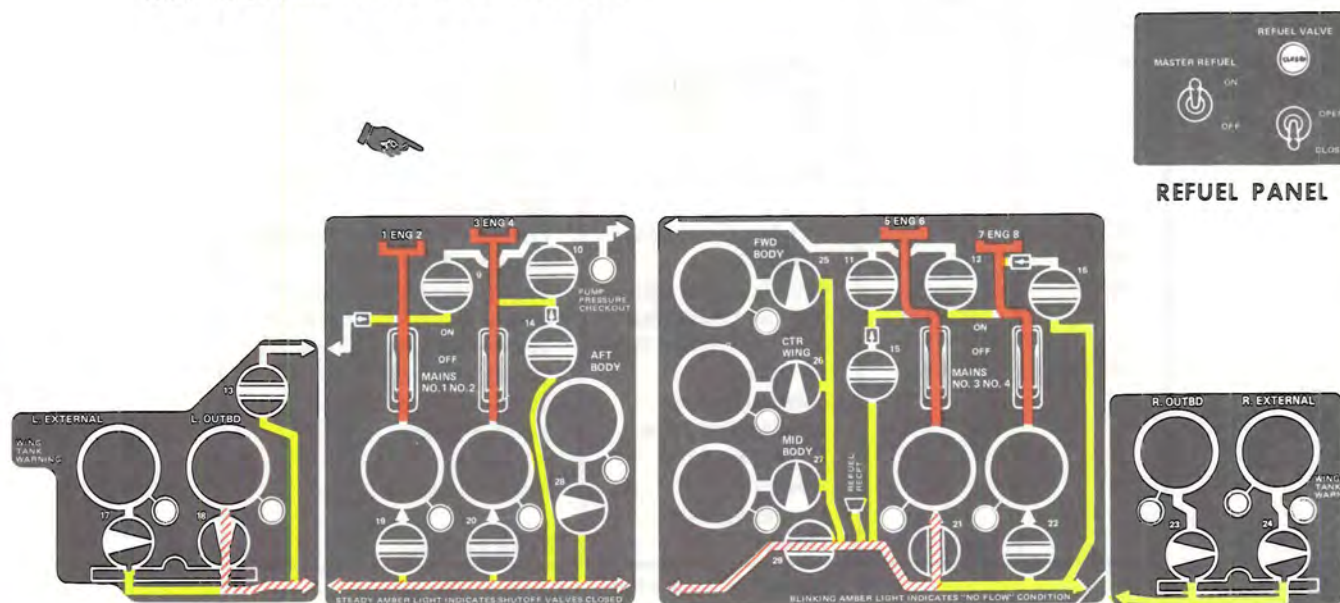
EMERGENCY FUEL TRANSFER FOR WEIGHT REDISTRIBUTION — AUXILIARY TANK TO MAIN TANK

Emergency conditions may make it necessary to transfer fuel to correct aircraft cg location or to obtain desired balance of wing fuel loading. Aircraft cg may be moved forward by transferring fuel from a rearward body tank to the inboard wing tanks and balance of wing fuel loading may be adjusted by transferring fuel from a body tank to a wing tank. This is accomplished by turning the master refuel switch ON, turning the desired main tank fuel level control valve switch to OPEN, turning main manifold interconnect valve No. 29 to OPEN if necessary, and turning the desired auxiliary tank fuel flow control switch to ENGINE FEED (figure 3-15).

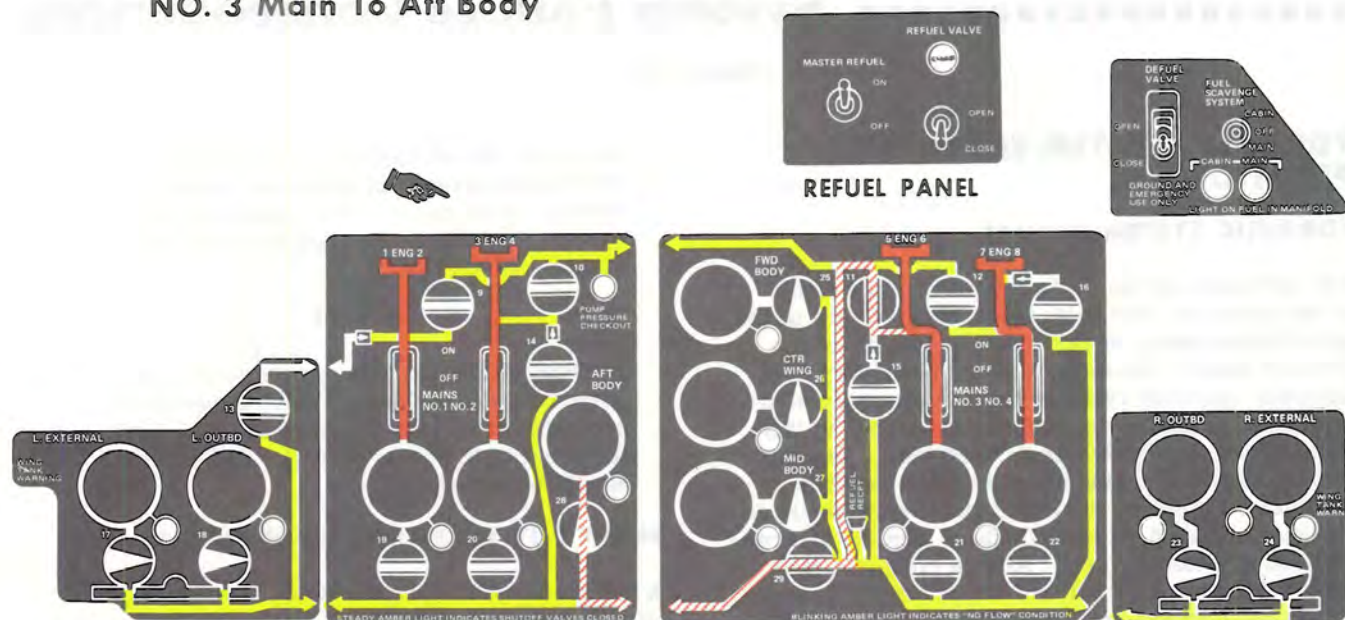
EMERGENCY FUEL TRANSFER FOR WEIGHT REDISTRIBUTION — MAIN TANK TO AUXILIARY TANK

Emergency conditions may make it necessary to transfer fuel to correct aircraft cg location. Aircraft cg may be moved aft by transferring fuel to the rearward body tanks as discussed in "Landing With Stabilizer Trim Failure," this section. This is accomplished by turning the master refuel switch ON, the defuel valve switch OPEN, the desired engine crossfeed manifold valve OPEN, main manifold interconnect valve OPEN if necessary, and the desired auxiliary tank fuel flow control switch to REFUEL (figure 3-15). This routes main tank fuel from the crossfeed manifold through the defuel valve to the main manifold and then to the desired auxiliary tank.

EMERGENCY FUEL TRANSFER FOR WEIGHT REDISTRIBUTION Left Outboard To NO. 3 Main



EMERGENCY FUEL TRANSFER FOR WEIGHT REDISTRIBUTION NO. 3 Main To Aft Body



— NORMAL FUEL FLOW
 — EMERGENCY FUEL FLOW
 — STATIC

Fuel System Emergency Operation (Typical)

Figure 3-15 (Sheet 2 of 2).

Figure 3-15A (Deleted)

BODY HYD FAILURE		SYSTEM AFFECTED	PROCEDURE TO BE USED
LEFT	RIGHT		
✓ **	✓ **	Left Fwd Landing Gear	Landing Gear Emer Operation **
✓ *		Right Fwd Landing Gear	Landing Gear Emer Operation **
		Steering - Left Gear	Landing with One Forward Gear Steering Fail
	✓	Steering - Right Gear	Landing with One Forward Gear Steering Fail
✓ *	✓	Fwd Gear Crosswind Crab	Landing with Crosswind Crab Inop
✓ *	✓	Forward Brakes	Landing with Brake Fail
✓ **		Left Aft Landing Gear	Landing Gear Emer Operation **
	✓ **	Right Aft Landing Gear	Landing Gear Emer Operation **
✓	✓ *	Aft Gear Crosswind Crab	Landing with Crosswind Crab Inop
✓	✓ *	Aft Brakes	Landing with Brake Fail
✓	✓ *	Stabilizer Trim Nut	Normal Procedure
	✓ *	Stabilizer Trim Screw	Normal Procedure
✓		Powered Rudder/ Elevator	Normal Procedure
	✓	Powered Rudder/ Elevator	Normal Procedure

* Operates on Standby Pump

** Operates on Opposite System Pressure

Body Hydraulic System Failure Consequences

Figure 3-16.

HYDRAULIC SYSTEM EMERGENCY OPERATION

HYDRAULIC SYSTEM FAILURE

If any hydraulic system fails to operate, the cause may be hydraulic fluid loss, mechanical failure of the engine-driven pump, or failure of the engine which drives the pump. All important and necessary hydraulically operated systems have an alternate source of hydraulic pressure available as described in "Hydraulic Power Supply Systems," Section I. In event of failure of No. 5 engine and the engine reaches a low windmilling speed at which hydraulic pressure is no longer furnished, it is difficult to turn the aircraft at the end of a landing roll. After a complete stop, the right forward gear will not caster into alignment with the left forward gear. See "Landing With One Forward Gear Steering Failure" under "Landing Emergencies," this section, for a procedure to obtain hydraulic pressure to allow the gear to be steered and the aircraft taxied from the runway.

CAUTION

In event of a complete loss of right body hydraulic system pressure, the bomb bay doors should not be operated at aircraft speeds in

excess of 325 knots IAS, if practicable, as a precaution against buffeting and structural damage to the doors. See bomb door operation with failure of the right body hydraulic system, Section IV.

NOTE

If a body hydraulic failure occurs and the powered rudder/elevator main pumps have been shut down to conserve electrical power, the respective rudder/elevator main pump should be turned on.

PUMP OUT WARNING LIGHT FLICKER

A pump out warning light cycling between on and off may indicate hydraulic reservoir pressurization has been lost. This can occur with the aircraft at or above 13,000 feet altitude and is dependent on atmospheric pressure. It is caused by not maintaining an adequate head of available hydraulic fluid at the pump. Under these conditions, the pump cannot suck fluid from the reservoir fast enough to keep up with demand and momentary low pressure conditions occur. Equipment will still operate through its complete range but operation will be on a start-stop-start basis. Below 13,000 feet altitude, atmospheric pressure will be great enough to overcome this difficulty.

HYDRAULIC SYSTEM FAILURE**CAUTION**

For a body system malfunction, accomplish this checklist just prior to landing gear extension.

NOTE

- Failure of hydraulic system pressure normally will be indicated by illumination of the respective hydraulic pump out light on the hydraulic control panel and the master caution light on the pilots' instrument panel. If system pressure, as indicated by the gage, returns to normal after a demand is placed on a hydraulic power supply system it is the warning system which has malfunctioned.
- There may be no hydraulic system failure indications from a failed engine that is windmilling until the engine reaches a low windmilling speed, e.g., landing phase. Before landing, the appropriate hydraulic system failure should be planned and standby pump pressure provided, if available.

1. Standby Pump Switch to STBY - STBY (P)
2. Check Hydraulic Pressure for Buildup - Checked (P)

If hydraulic pressure builds up slowly, pressure loss was due to engine-driven pump failure or tubing break upstream of the check valve. The low pressure warning lights will remain illuminated even though the standby pump provides system pressure. There is no time limit on operation of the standby pumps.

NOTE

Each standby pump provides ample flow and pressure for normal operation of a system; however, with continuous use of the various hydraulic power supply systems, the response of operation will slow down because the rate of flow is considerably less than that of an engine-driven pump.

3. If Pressure Stays Down, Check Standby Pump Circuit Breakers IN - IN (P)
4. If Pressure Still Down, Standby Pump Switch OFF - OFF (P)

If pressure is not increased by the standby pump, it is possible that a tubing break exists downstream of the system one-way check valve and the fluid is depleted. As a result, all equipment depending on that hydraulic system will not be supplied hydraulic power for normal operation. However, equipment which is supplied alternate power from another system may be operated from that system by use of the emergency (or alternate) switch for that system.

NOTE

For malfunctions involving lateral control, see "Asymmetrical Airbrake Control," this section.

AGM-69A LAUNCHER POWER PUMP LOW PRESSURE LIGHT ON

Illumination of the AGM-69A launcher power pump low pressure warning light with the AGM-69A launcher control switch in the ON PRIMARY position indicates insufficient pressure is being supplied by

the launcher power pump to rotate the launcher. Returning the control switch to OFF deactivates the launcher power pump and causes the low pressure light to go out. Operation of the AGM-69A launcher may be continued using the secondary (right body) hydraulic system by selecting ON RH BODY with the control switch.

If the AGM-69A launcher power pump low pressure warning light illuminates, proceed as follows:

1. AGM-69A launcher control switch - OFF

CAUTION

If a hydraulic line failure has occurred downstream of the launcher power pump, continued operation in the ON PRIMARY position will result in depletion of the left body system hydraulic fluid.

2. AGM-69A launcher control switch - ON RH BODY - if launcher operation is to be continued.

When operating the launcher with the secondary hydraulic system, a hydraulic line failure downstream of the solenoid operated control valve can be detected by a low pressure indication on the right body pressure gage. If this condition occurs, the launcher control switch should be returned to OFF, as continued operation of the launcher will deplete the right body system hydraulic fluid.

ELECTRICAL SYSTEM EMERGENCY OPERATION

A-C POWER SYSTEM FAILURE

The electrical power system has been designed to automatically clear system faults and shut down malfunctioning generator systems. When a generator fails during normal (parallel) operation, its loads are automatically redistributed. During parallel operation, the load of a failed generator receives power from the central bus tie. If a generator fails to trip off automatically when an abnormal operating condition is indicated on the a-c control panel, the generator should be isolated or turned off, depending upon the situation. If a bus tie circuit breaker opens automatically and cannot be closed, the generator should be operated isolated rather than shutdown if voltage and frequency are stable and within limits. If a generator drive malfunction is indicated by the generator drive overheat light on the a-c control panel, the generator drive should be decoupled from the engine by use of the decoupler switch, and the generator should be turned off. If the drive fails to decouple, the engine should be shut down. For a list of possible generator failures, their probable causes, and the corrective action to be taken, see "Generator Emergency Operation," figure 3-17. When operating with one generator isolated and that generator fails, its load will be automatically placed on the central bus tie. If the load is not automatically placed on the central bus tie, the failed generator load may be placed on the central bus tie by placing the respective generator switch to OFF position and checking the

bus tie circuit breakers closed. If two generators are lost, unneeded loads should be dropped, and consideration should be given to terminating the mission. For further information on loads, see "Electrical Loads Chart," figure 3-18.

NOTE

- In the event a generator drive is decoupled during flight, it can only be recoupled while on the ground.
- In the event of generator bus failure and/or generator shutdown that would require reducing loads from the buses, a bus-by-bus listing of the a-c loads is in figure 3-21 and in the emergency portion of the pilots' abbreviated checklist.
- If the powered rudder/elevator main pumps have been turned off to conserve electrical power and a body hydraulic failure occurs, it will be necessary to turn the respective rudder/elevator main pump switch on. Additional load reduction may be necessary to compensate for this added load.

A-C Power Loss Due to Engine Shutdown

The shutdown of engine 1, 3, 5, or 7 will be accompanied by the loss of electrical power from the generator geared to that engine. Although an engine at idling speed will transmit enough energy to the generator drive to maintain full a-c power output, a windmilling engine will not. The underexcitation (undervoltage) relay will detect the low output and will automatically trip the generator circuit breaker and deexcite the generator. As during generator failure for any other reason, the electrical loads on the remaining generators should be closely monitored through the ammeters to prevent overloading. If failure of the underexcitation (undervoltage) relay and associated circuits allows the generator to remain on (generator circuit breaker closed) when the engine is windmilling, it could be motored by power provided through the central bus tie from the remaining generators. Since the motoring of a generator will drain a-c power which may be needed for other equipment, the generator on the dead engine should be taken off the line. Pulling the fire shutoff switch in the course of engine shutdown will open the generator circuit breaker taking the generator off the line. If the fire shutoff switch is not pulled, the generator switch may be used placing it to OFF position.

A-C Transformer Failure

If any 28-volt a-c transformer fails, flight will be continued with the loss of some units, mostly lights which are powered by the transformers. No emergency power for these units is available.

INDICATION OF TROUBLE	POSSIBLE CAUSE	REMEDY
Generator circuit breaker position indicator open	Generator drive trip or protective circuit trip	See "Generator Trip Checklist."
Generator control circuit breaker pops	Fault within the circuit or fault within circuit components	Reset circuit breaker. If circuit breaker will not reset and loss of the generator is not critical, hold the generator switch in OFF, set and hold the circuit breaker in until the generator turns off. If generator will not turn off, the generators should be isolated to preclude possible complete A-C power failure, and consideration should be given to landing at the nearest suitable base.
NOTE If it becomes necessary to shut down affected engine, the respective bus will not be powered.		
Generator drive overheat light comes on	Generator drive failure	Accomplish "Generator Drive Overheat Light Illuminates Checklist."
Bus tie circuit breaker position indicator open	Abnormal excitation	Hold generator switch ON until generator parallels. Should the bus tie circuit breaker remain open, operate generator isolated if within limits. Place faulty generator switch in OFF if not within limits.
Multiple bus tie position indicators open	Multiple malfunctions	Attempt reparalleling. If bus tie circuit breakers do not close, operate generators isolated if within limits.
All bus tie circuit breaker position indicators open	Fault on central bus tie	Hold generator switches ON until generators parallel. If bus tie circuit breakers trip, operate isolated.
Multiple generator and bus tie circuit breaker position indicators open	Multiple malfunctions	Push master isolate switch in and hold while placing generator switches ON.
Abnormally unbalanced ammeter readings in parallel	Component failure	Press isolate switch. Check voltage, frequency, and load. If readings not within limits, first reparallel the properly operating generators by holding the generator switches ON and then place the faulty generator switches OFF.
Excessive load oscillations	Fluctuating frequency or voltage	See "Generator Amps or Frequency Fluctuation Checklist."
Failure of three generators	Multiple malfunction	Turn off nonessential loads. Place good generator switch ON, monitor loads to avoid overloading the generator. Attempt to restart failed generators by placing generator switches ON. If failed generators do not restart, place failed generator switches OFF and check all bus tie circuit breakers closed.

Generator Emergency Operation

Figure 3-17.

GENERATOR TRIP

1. Reset Generator - Reset (CP)

Attempt to reset generator by placing generator switch to ON. If generator resets and load is fluctuating, see "Generator Amps or Frequency Fluctuation Checklist."

NOTE

A total of two resets may be attempted at approximately 15-second intervals.

2. Generator Switch to OFF if Generator Fails to Reset - OFF (CP)

If generator will not reset, place generator switch momentarily to OFF and check bus tie circuit breakers closed.

GENERATOR DRIVE OVERHEAT LIGHT ILLUMINATES**NOTE**

The generator drives cannot be recoupled during flight. Therefore, prior to decoupling more than two drives, factors other than drive damage such as electrical power shortage should be considered.

1. Place the frequency and voltmeter selector switch to the affected generator position, check for indication of voltage and frequency and check position of GEN CIRCUIT BKR - Checked (CP)

NOTE

Do not isolate.

2. Generator Drive Decoupler Switch to DECPL - DECPL (CP)

Hold switch in DECPL for 1 to 2 seconds, then release.

NOTE

Throttle must be out of cutoff when actuating decoupler switch.

3. Check Generator Drive Decoupled - Checked (CP)

If generator circuit breaker indicator indicates open and generator voltage and frequency drop, the drive has decoupled.

NOTE

The drive overheat light may not go out immediately due to slow cooling of drive and lower switch turnoff setting. Depending on a combination of factors such as altitude, airspeed, ambient temperature, etc, it may require up to 30 minutes for the overheat light to go out following a successful generator drive decouple. If light is on, wait a reasonable time before proceeding with engine shutdown.

4. Reset Master Caution & A-C Circuit Breaker Lights - Reset (CP)

5. If generator drive decoupled, continue mission with all engines operating and turn generator switch OFF - OFF (CP)

NOTE

A drive overheat light that remains illuminated does not require engine shutdown provided it is positively determined that drive decouple has occurred.

6. If generator drive decouple was not verified, shut down engine using "Shutdown After Generator Drive Decoupler Failure Checklist" - Shutdown (P-CP)

SHUTDOWN AFTER GENERATOR DRIVE DECOUPLER FAILURE

1. Generator Switch to OFF - OFF (CP)
2. Throttle CLOSED - CLOSED (CP)
3. Establish 25% or Less Windmill RPM - Established (P)

After engine shutdown, establish 25% or less windmill rpm as soon as possible.

CAUTION

Continued operation at higher windmill rpm may result in extensive damage to CSD gear box and adjacent components.

NOTE

At some gross weights, it will be necessary to change altitudes to establish a 25% windmill rpm maximum.

4. If Fire Is Observed in Engine Area, Pull Fire Shutoff Switch - Pulled (P-CP)

CAUTION

The fire shutoff switch should not be reset for remainder of flight since fuel lines in the area of the constant speed drive may have been damaged.

5. Adjust Electrical Loads & Bleed Selector as Necessary - Adjusted (P-CP)
6. Maintain 40 Knots Above Initial Stall Warning Speed - Maintained (P)

Maintain at least 40 knots above initial stall warning speed if possible until entry into traffic pattern.

7. Land as soon as practical at a suitable airfield. (P)

The 25% windmilling rpm may be exceeded if necessary to maintain a safe landing speed.

GENERATOR AMPS OR FREQUENCY FLUCTUATION

1. Push Isolate Button - Pushed (CP)
2. Check Isolated Generators - Checked (CP)

Check frequency and voltage of each generator using the frequency and voltage selector switch to determine malfunctioning generator(s).

3. Generator Switch for Operating Generator ON - ON (CP)

Place generator switch for a good operating generator ON to provide an electrical power source to the central bus tie.

4. Malfunctioning Generator(s) OFF/DECPL - OFF/DECPL (CP)

If any generator indicates abnormal voltage fluctuations with normal frequency, place generator switch OFF. If generator will not turn off, decouple generator drive using "Generator Drive Overheat Light Illuminates" checklist. If any generator indicates abnormal frequency fluctuations, proceed to decouple using the "Generator Drive Overheat Light Illuminates" checklist.

5. Parallel Remaining Generators - Paralleled (CP)

A-C CIRCUIT FAULTS**Current Limiters (Fuses)**

Each fuse has a visual indicator to allow detection when the fuse is blown. Short-time electrical faults will burn themselves out (with the multiwire feeder system) without interruption of electrical power.

WARNING

Changing fuses located in the power distribution boxes, load boxes, and panels (excluding neon light indicating fuses on panels at crew stations) inflight is extremely dangerous and should not be attempted unless a serious emergency exists.

If possible, all electrical power including battery power should be shut off before changing fuses. Care should be exercised to use fuses of the correct rating.

NOTE

Any fuse which is in series with a blown fuse should be replaced because it may have been damaged.

Circuit Breakers

A circuit breaker which has opened because of an existing fault condition (short circuit or overload) should be reset only when absolutely necessary. Two resets

can be attempted. However, if the circuit continues to open, one additional reset may be attempted after a 5-minute time interval. If this procedure fails to close the circuit, the fault will not clear by itself and, unless the trouble can be located and corrected, the unit should be shut down.

NOTE

Checking for opened circuit breakers is necessary during the execution of most emergency checklists in this section; however, an item for specific circuit breakers appears on the checklists only where special emphasis or action is required.

D-C SYSTEM FAILURE**Failure of Aft Battery Charging TR Unit**

Failure of the aft battery charging TR unit will result in no charging current for the aft battery and will cause the master caution light to come on if dc power is available on the right essential bus. If the interphone power switch is ON, and the battery switch is ON, the aft battery charging TR unit is not functioning; the indication will be the illumination of the aft battery discharging light on the copilot's side panel. This light will illuminate when the aft battery discharging rate is greater than 0.25 (+.75/-0) ampere. If the aft battery becomes totally discharged, control power to the copilot's left essential bus will be lost. The loads on the aft battery should be minimized. If failure of aft battery charging TR unit occurs, accomplish the following checklist:

FAILURE OF AFT BATTERY CHARGING TR UNIT

1. Pull LEFT ESS DC BAT RELAY Circuit Breaker - Pulled (P/CP/EW/G)

Pulling the 5 ampere circuit breaker on the left load central will allow TR power to be routed to the copilot's left essential bus.

2. Emergency DC Power Switch EMERGENCY - EMERGENCY (CP)

This will power the emergency instrument bus and the emergency battery bus from the forward battery.

3. Recheck Entry Light OFF - OFF (CP)

NOTE

If the forward battery discharging light comes on see "Failure of Both Battery Charging TR Units Checklist," this section.

4. Consideration should be given to terminating the mission.

Failure of Forward Battery Charging TR Unit

Failure of the forward battery charging TR unit will result in no charging current for the forward battery and will cause the master caution light to come on if dc power is available on the right essential bus. If the interphone power switch is ON, and the battery switch is ON, the forward battery charging TR unit is not functioning; the indication will be the illumina-

tion of the forward battery discharging light on the copilot's side panel. This light will illuminate when the forward battery discharging rate is greater than 0.25 (+.75/-0) ampere. If the forward battery becomes totally discharged, control power to the copilot's right essential bus will be lost. The loads of the forward battery should be minimized. If failure of forward battery charging TR unit occurs, accomplish the following checklist:

FAILURE OF FORWARD BATTERY CHARGING TR UNIT

1. Pull RIGHT ESS DC BAT RELAY Circuit Breaker - Pulled (P/CP/EW/G)

Pulling the 5 ampere circuit breaker on the right load central will allow TR power to be routed to the copilot's right essential bus.

2. Emergency DC Power Switch NORMAL - NORMAL (CP)

NOTE

See figure 3-19 for loads on the forward battery bus.

3. Consideration should be given to terminating the mission.

NOTE

If the aft battery discharging light illuminates, see "Failure of Both Battery Charging TR Units Checklist," this section.

Failure of Both Battery Charging TR Units

Complete failure of the battery charging TR units will result in an emergency condition which will require conservation of battery power. The failure of these units will result in no charging power for either the forward or the aft battery. This condition will cause the master caution light to come on if dc power is available on the right essential dc bus. Failure of both battery charging TR units will be indicated by the illumination of the battery discharging lights. Proceed to the nearest suitable air base. Since

there are no means to positively measure the amount of battery charging capacity remaining, it is essential that the capacity be conserved to the maximum degree possible. Battery power should not be used for any equipment item, unless the use of the item is necessary to maintain flight. Antiskid, airbrakes, and interphone will become inoperative when the batteries are discharged. Do not use airbrakes for descent and turn off antiskid until ready to land. If failure of both battery charging TR units occurs, accomplish the following checklist:

FAILURE OF BOTH BATTERY CHARGING TR UNITS

1. Battery Switch OFF - OFF (CP)

Turn the battery switch OFF to conserve as much battery power as possible for later use.

2. Pull LEFT and RIGHT ESS DC BAT RELAY Circuit Breakers - Pulled (P/CP/EW/G)

Pulling both 5 ampere circuit breakers on the left and right load centrals allows power to be available to the copilot's left and right essential buses.

3. Emergency DC Power Switch NORMAL - NORMAL (CP)

This will supply power to the emergency instrument bus from the forward TR units.

4. Reduce Battery Loads - Reduced (P/CP)

CAUTION

It is essential that battery power be conserved to allow operation of airbrakes during final approach and antiskid after touchdown.

- a. Do not use airbrakes for descent.
- b. Turn interphone switch to OFF during any period when communications are not necessary.
- c. Check entry light OFF.

FAILURE OF BOTH BATTERY CHARGING TR UNIT (Cont)**5. Set Airbrakes - Set (P)**

Set airbrakes as required during final approach and landing.

Forward Transformer Rectifier System Failure

Complete failure of the forward TR bus will result in an emergency condition. Proceed to nearest suitable field. Those loads on right and left essential buses will transfer to battery power; however, systems which utilize TR power or are controlled by TR power, will cease to function. As a result, even

some systems which are ac powered will be unusable. Among such systems which will be unusable are flaps, fuel boost pumps, fuel transfer pumps, electrical stabilizer trim, N-1 compass system and radar. Crossfeed valves should be closed. For TR powered equipment, see figure 3-20. There is no indication of partial forward TR unit failure. If failure of forward transformer rectifier system occurs accomplish the following checklist:

FORWARD TRANSFORMER RECTIFIER SYSTEM FAILURE**NOTE**

If the autopilot or BNS systems have failed during flight, check the electrical stabilizer trim and press the master caution light. If these circuits are not functioning, the forward TR system has failed.

1. Proceed to the nearest suitable airfield.
2. Crossfeed valve switches to CLOSED (if open) - CLOSED (CP)
3. Trim As Required Manually - Trimmed (P)

Electrical stabilizer trim will be inoperative.

4. See "Landing With Wing Flaps-up Checklist" (if flaps are up)

The flaps will be inoperative.

5. Maintain VMC conditions, if able.

Anti-icing will be inoperative.

6. See figure 3-20, sheets 2 and 3 for list of inoperative equipment.

NOTE

- TACAN navigation and use of the auxiliary command radio No. 2 will not be possible.
- The only fuel available for the engines will be that fuel which remains in the main tanks. See "Fuel Management Without Boost Pumps," this section.

Aft Transformer Rectifier System Failure

There is no indication of total aft TR bus failure other than the failure of the equipment supplied by that bus (figure 3-20, sheet 3). There is no indication of partial aft TR unit failure. Equipment that will be lost includes ODR power (ILS, VOR) and the command radio. If you lose the aft transformer rectifier system, it should not be considered a serious emergency.

COMPLETE A-C POWER FAILURE

If all four generators fail and the procedures outlined in figure 3-17 do not result in restarting any generator, the only power source remaining will be the batteries. This condition will result in an emergency which will require conservation of battery power.

NOTE

With all electrical power turned off, the fuel boost pumps will be inoperative and the engines will operate at reduced thrust.

The buses receiving battery power are shown on figure 1-23. For information on dc loads, see figures 3-18 and 3-19. The battery system is designed to provide 4 hours of battery power to the loads connected to the emergency dc power switch. This time element is based on fully charged relatively new batteries. The procedures outlined under "Conservation of Battery Power" checklist should be followed.

FUEL MANAGEMENT WITHOUT BOOST PUMPS

After complete ac or forward TR electrical failure occurs, the only fuel available for the engines will be that fuel which remains in the main tanks. Use of auxiliary tank fuel will not be possible because the boost pumps are powered by alternating current and the engine-driven fuel pumps draw fuel from the main tanks only. The auxiliary tank boost pumps incorporate pressure-loaded check valves that prevent engine-driven fuel pumps from drawing auxiliary fuel. Above 14,000 feet the engine-driven fuel pumps tend to cavitate without boost pump pressure. This may cause some or all engines to flame out. Sufficient fuel pressure will be available to the engine-driven pumps for substantial thrust and reliable engine operation on all engines at 14,000 feet or below. Although engine operation on suction feed at higher altitudes is possible, it cannot be considered reliable. Conditions permitting a descent to 14,000 feet or below should be considered. A restart should be attempted since engine ignition will be available from battery power (battery switch must be ON to obtain ignition). See "Engine Air Starting" and "Engine Flameout and Relight" this section. The engine crossfeed manifold valves (switches No. 9 thru 12) are operated by battery power.

WARNING

When fuel in the main tanks has been used to the point that the fuel inlets on boost pumps not having pressure-loaded check valves are uncovered (5,000 pounds in 1 or 4 and 7,000 pounds in 2 or 3 - however, all fuel gages will be inoperative), air will be drawn into the fuel lines resulting in fuel starvation. The fuel management procedure should be such that each main tank is supplying its own nacelle with the engine crossfeed manifold valves CLOSED.

NOTE

Restarts after flameouts caused by cavitation or fuel starvation are doubtful at any altitude without a source of boost pump pressure; however, an altitude of 14,000 feet or below will provide the fuel pressure required at the engine-driven fuel pump to warrant a restart attempt.

If complete electrical failure occurs, accomplish the following:

1. If on an override sequence, close all auxiliary tank engine feed control valves (13 thru 16) as soon as possible, using essential battery power. When on the ground and starting engines without the use of external electrical power, it is permissible to have valves 13 and 16 open.
2. If on a crossfeed operation, close all engine crossfeed manifold valves (9 thru 12) as soon as possible, using essential battery power.
3. Maintain aircraft in as nearly level attitude as possible and avoid abrupt changes in speed or direction.

WARNING

Changes in flight attitude or acceleration forces may cause main tank boost pumps to become uncovered allowing air to be drawn into the system, thus causing engine flame-out.

Instrument Operation

The only instruments operating after complete a-c electrical power system failure will be:

- Airspeed Indicators
- Altimeters (pitot-static)
- Vertical Velocity Indicators
- Magnetic Standby Compass
- Clocks
- Tachometers
- EGT Gages
- Pilot's Attitude Indicator
- Pilot's Turn-and-Slip Indicator
- Copilot's Turn-and-Slip Indicator
- Pilot's Heading Indicator
- Standby Attitude Indicator **BC**

In addition, the emergency instrument lights for the essential flight instruments, the emergency alarm system, and interphone power for all stations will be available. The EPR gages and the fuel quantity gages will be inoperative. In case of a complete a-c power failure, an emergency flight gyro inverter will supply 115-volt three-phase a-c power to the pilot's attitude indicator and pilot's heading indicator. In addition, the inverter supplies lighting power for the pilot's altimeter (**W173** **W219**) and attitude indicator. The inverter utilizes emergency d-c power through a circuit breaker marked "Emer Invtr" on the "Flight Gyro" portion of the pilot's circuit breaker panel and is automatically controlled by the gyro power switching relay when the gyro power switch is in ON position. If for any reason, the gyro power indicating type fuses illuminate (indicating open), or the power failure indicator flag in the pilot's attitude indicator appears, or the No. 3 generator fails and its bus tie circuit breaker cannot be closed, a simulated complete a-c power failure should be used. The following procedure should be used to obtain power for the

affected flight instruments:

1. Place gyro power switch ON.
2. Place emergency d-c power switch to EMERGENCY (EMER).
3. If the inverter does not operate, the battery control switch should be placed in OFF (this eliminates the possibility of an overvoltage trip-off condition).

CAUTION

If step "3" is used, placing the battery switch in OFF will disconnect the battery charging circuit and leave the inverter and loads connected to the 24-volt battery output. This condition should be used only in case of extreme emergency as the resultant battery life will be limited.

CONSERVATION OF BATTERY POWER

NOTE

Failure of the forward TR bus may result in illumination of either or both battery discharging lights because the essential dc bus loads added to the battery buses as a consequence of the failure may result in battery bus loads that exceed the capacity of the battery charging TR unit. The battery discharging lights are powered from their respective batteries. Autopilot, electrical stabilizer trim, and master caution light are powered from the forward TR bus. Failure of these systems is proof that the forward TR system bus failed. Proceed with the following steps:

1. Emergency DC Power Switch NORMAL or EMERGENCY - NORMAL or EMERGENCY (as required) (CP)

- a. Leave switch NORMAL if conditions do not require power for emergency instrument lights, turn-and-slip indicator, pilot's attitude indicator, and standby attitude indicator **BC**.
- b. Place switch to EMER if conditions require power for emergency instrument lights, turn-and-slip indicator, pilot's attitude indicator, and standby attitude indicator **BC**. If forward battery end-of-life lights come on, place emergency battery switch to NORMAL. If power for emergency instrument lights, turn-and-slip indicator, and standby attitude indicator **BC** is still needed, place battery switch to ON.

2. Battery Switch OFF - OFF (CP)

Turn battery switch OFF to conserve as much battery power as possible for later use.

3. Gyro Power Switch ON or OFF - ON or OFF (as required) (P)

If a-c power is not available, turn off gyro power switch when attitude indicator is not required.

4. Reduce Battery Loads - Reduced (P-CP)

CAUTION

It is essential that battery power be conserved to allow operation of airbrakes during final approach and antiskid after touchdown.

NOTE

The flaps will be inoperative. Therefore, if the flaps are up, a flaps-up landing will be made. See "Landing With Wing Flaps-Up Checklist," this section.

- a. Do not use airbrakes for descent.
- b. Do not use engine ignition for descent.
- c. If turn-and-slip indicator(s) are not required, pull the RATE-OFF-TURN circuit breaker on pilot's CB panel.
- d. If the heading indicator (gyro) is not required, pull the DIR IND C-2 circuit breaker on pilot's CB panel.

CONSERVATION OF BATTERY POWER (Cont)**BC**

- e. If standby attitude indicator is not required, pull the "STANDBY ATTITUDE" circuit breaker on pilot's CB panel.
 - f. If emergency flight instrument lights are not required, pull the "EMER FLIGHT INSTR LIGHTS" circuit breaker on the "MISCELLANEOUS" portion of the pilot's CB panel.
 - g. Turn interphone power switch to OFF during any period when communications are not necessary.
 - h. If ac generators are inoperative, pull all GENERATOR CONTROL circuit breakers on the co-pilot's CB panel.
 - i. Pull "Right Fwd, Right Aft, Left Fwd, and Left Aft Squat Switch Control" circuit breakers on pilot's circuit breaker panel. Locked wheel protection and gear retraction capability will not be available. (Do not apply brakes before wheels start to rotate.) However, antiskid operation will be normal after touchdown.
5. Landing Gear Lever GEAR DOWN - GEAR DOWN (when required) (CP)

When ready to lower landing gear, proceed as follows:

NOTE

If fuel, gross weight, and other conditions permit, the landing gear should be lowered as soon as it is determined that TR power will not be available for the remainder of the flight. Landing gear extension may be delayed if a landing cannot be made immediately and fuel quantity is such that a suitable landing field could not be reached due to the increased drag. When the end-of-life light comes on, the battery is almost depleted and gear extension may not be possible.

- a. Battery Switch ON Until All Gear Indicate Down **W250** - ON (CP)

NOTE

On aircraft **W173** **W249** landing gear position indicators operate on forward TR power. With no forward TR power, gear position indicators will be inoperative. Landing gear warning light operates on essential dc power and can be used to confirm gear extension.

- b. Place Battery Switch OFF - OFF (CP)
 - c. Pull POS IND Circuit Breaker - Pulled (P)
6. If crossfeed valves are open:
- a. Crossfeed Valve Switches to CLOSED - CLOSED (CP)
 - b. Battery Switch ON for 15 seconds, then OFF - ON, OFF (CP)

7. System Configuration Change:

If a-c generators or other systems on the essential battery bus require changes, proceed as follows:

- a. System Switches - As required (P-CP)
 - b. Battery Switch ON - ON until changes are accomplished (CP)
 - c. Battery Switch OFF - OFF (CP)
8. Battery Switch ON - ON (for antiskid) (CP)

Just prior to final approach, place battery switch ON to provide antiskid.

9. Set Airbrakes - Set (P)

Set airbrakes as required during final approach and landing.

A-C LOADS

EQUIPMENT	NO. OF UNITS	LOAD PER UNIT — AMPS				GENERATOR BUS			
		ØA	ØB	ØC	TOTAL	No. 1	No. 3	No. 5	No. 7
AFSATCOM AU									
• LOS Radio Set (AN/ARC-171(V))	1	2.4	2.4	2.4	7.2		X		
• Logic Power Supply (Printer and Keyboard)	1	—		2.37	2.37		X		
AIR CONDITIONING SYSTEM									
Bleed and Shutoff Valves	4	—	—	*	*			X	
Cabin Temperature Regulator	1	—	—	*	*			X	
Emergency Ram Aircoop	1	2.3	2.3	2.3	6.9		X		
Modulating Valve	1	*	*	*	*		X		
AN/AJM-14(V) MONITORING SET	1	5.5	—	—	5.5		X		
ARMAMENT									
Fire Control System AN/ASG-15	1	58	58	58	174	X			
Momentary		75	75	75	225	X			
Ammo Hoist	1	3	3	3	9	X			
ECM									
Air Heater, System 15	1	7.7	7.7	7.7	23.2	X			
Air Heater, System 16	1	7.7	7.7	7.7	23.2			X	
ALQ-122 AL	1	4.6	—	—	4.6				X
ALQ-153 BG	4	5.4	5.4	5.4	16.2				X
ALR-20A	1	1.9	1.4	1.5	4.8			X	
Chaff Dispensers No. 1 thru 4	4	1.9	1.9	1.9	5.7	X			
Chaff Dispensers No. 5 thru 8	4	1.9	1.9	1.9	5.7				X
Flare Ejector	1	2.1	—	—	2.1	X			
Systems 1 and 2 (ALT-28)	2	15.8	15.8	15.8	47.4	X			
Less AX									
Systems 3 and 5 (ALT-28)	2	15.8	15.8	15.8	47.4		X		
Less AX									
Systems 4 and 6 (ALT-28)	2	15.8	15.8	15.8	47.4			X	
Less AX									
Systems 7 and 8 (ALT-28)	2	15.8	15.8	15.8	47.4		X		
Less AX									
Systems 1 and 2 (AN/ALQ-155) AX	2	16.4	16.4	16.4	49.2	X			
Systems 3 and 5 (AN/ALQ-155) AX	2	16.4	16.4	16.4	49.2		X		
Systems 4 and 6 (AN/ALQ-155) AX	2	16.4	16.4	16.4	49.2			X	
Systems 7 and 8 (AN/ALQ-155) AX	2	16.4	16.4	16.4	49.2				X
CM-465/ALQ-155	1	1.2	1.2	1.2	3.6			X	
Signal Processor AX									
System 9 (ALT-16) Less AL	1	8.3	8.3	8.3	24.9				X
System 9 (AN/ALT-16A) AL	1	8.3	8.3	8.3	24.9				X
System 10 (ALT-6B)	1	8.8	8.8	8.8	26.4				X
Systems 11 and 12 (ALT-32H)	2	14.6	14.6	14.6	43.8				X
System 13 (ALT-6B) Less AX	1	14.0	—	—	14.0				X
System 14 (ALT-6B) Less AX	1	—	14.0	—	14.0				X
System 13 (AN/ALQ-155) AX	1	16.4	16.4	16.4	49.2				X
System 14 (AN/ALQ-155) AX	1	16.4	16.4	16.4	49.2				X
System 15 (ALQ-117)	1	8.3	8.3	8.3	25.0				X
System 16 (ALQ-117)	1	8.3	8.3	8.3	25.0			X	
System 20 (ALT-32L)	1	1.4	1.4	1.4	4.1			X	
System 21 (ALT-16A) AL	1	8.3	8.3	8.3	24.9			X	

NOTE

Total generator loads cannot be determined from the chart since the loads are single and three-phase loads. In the event a generator becomes overloaded, the chart will help the crew to determine the loads to drop for completion of the mission.

* Momentary Load

** Insignificant Load

Figure 3-18 (Sheet 1 of 7).

A-C LOAD (Cont)									
EQUIPMENT	NO. OF UNITS	LOAD PER UNIT — AMPS				GENERATOR BUS			
		ØA	ØB	ØC	TOTAL	No. 1	No. 3	No. 5	No. 7
ENGINE INSTRUMENTS									
Engine Pressure Ratio	8	—	—	1	1			X	
Fuel Flow	8	—	**	—	**			X	
Fuel Flow Totalizer	1	—	**	—	**			X	
Oil Pressure Indicators	8			**	**			X	
EVS									
Displays (Monitors)	4	0.9	—	0.9	1.8		X	X	
FLIR ENV Fan	1	3.48	3.48	3.48	10.44		X		
FLIR ENV Heater	1	6.47	6.47	6.47	19.41		X		
FLIR System	1	4.98	4.98	4.98	14.94		X		
FLIR Window Heater	1	10	—	—	10		X		
SCU	1	0.89	—	0.89	1.78		X		
SSG (SYMBOL GEN)	1	0.28	0.28	0.28	0.84		X		
STV	1	—	—	1.28	1.28			X	
STV ENV Fan	1	0.82	0.82	0.82	2.46			X	
STV ENV Heater	1	2.14	2.14	2.14	6.42			X	

Electrical Loads Chart (Typical)

Figure 3-18 (Sheet 1A of 7).

A-C LOADS (Cont)									
EQUIPMENT	NO. OF UNITS	LOAD PER UNIT — AMPS				GENERATOR BUS			
		ØA	ØB	ØC	TOTAL	No. 1	No. 3	No. 5	No. 7
EVS (Cont)									
STV Window Heater	1	3.48	3.48	3.48	10.44			X	
VDU	1	0.64	—	0.64	1.28		X	X	
Window Wash Pump	1	1.49	1.49	1.49	4.47			X	
Window Wash Tank Heater	1	7.3	7.3	7.3	21.9			X	
FLIGHT CONTROLS									
Autopilot	1	—	5	—	5		X		
Lateral Trim	1	1.5	—	—	1.5		X		
Stability Augmentation System	1	3.80	—	—	3.80		X		
Stabilizer Trim	1	1	1	1	3	X			
Wing Flaps (Left and Right)	1	39	39	39	117	L			R
FLIGHT INSTRUMENTS									
Altitude Computer		0.3	—	—	0.3		X		
AN/AJA-1	1	2	2	2	6		X		
Flight Gyros	2	0.02	0.02	0.02	0.06		P	CP	
Gyro Synch and Attitude Indicator (Copilot)	1	—	0.01	—	0.01		X		
N-1 Compass	1	0.5	0.5	0.5	1.5		X		
Radar Altimeter (AN/APN-150)	1	—	0.07	—	0.07	X			
True Heading	1	0.4	0.4	0.4	1.2		X		
True Airspeed	1	—	0.07	—	0.07		X		
FUEL									
Fuel Pumps — Auxiliary	16	4.7	4.7	4.7	14.1				
Tank Pump No.		EACH INDIVIDUAL PUMP HAS THREE-PHASE POWER AND SAME LOAD REQUIREMENT							
Aft Body 30							X		X
Aft Body 31									
Aft Body 32						X			
Center Wing 25						X			
Center Wing 26									X
Forward Body 23							X		
Forward Body 24								X	
Left External 1						X			
Left Outboard 2							X		
Left Outboard 3						X			
Mid Body 27								X	
Mid Body 28						X			X
Mid Body 29									X
Right External 22									X
Right Outboard 20									X
Right Outboard 21	X							X	
Fuel Pumps — Main	16	2	2	2	6				
Tank No. Pump No.		EACH INDIVIDUAL PUMP HAS THREE-PHASE POWER AND SAME LOAD REQUIREMENT.							
1 4						X			X
1 5									
1 6							X		
1 7								X	
2 8						X			
2 9									X
2 10							X		
2 11								X	
3 12							X		
3 13								X	
3 14						X			
3 15									X
4 16							X		
4 17								X	
4 18						X			
4 19									X

*** Insignificant Load

Electrical Loads Chart (Typical)

Figure 3-18 (Sheet 2 of 7).

A-C LOADS (Cont)

EQUIPMENT	NO. OF UNITS	LOAD PER UNIT — AMPS				GENERATOR BUS			
		ØA	ØB	ØC	TOTAL	No. 1	No. 3	No. 5	No. 7
(FUEL (Cont)									
Fuel Quantity Indicators (includes totalizer)	13	**	—	—	**			X	
Fuel Scavenge Pumps									
Cabin Manifold	1	1.5	—	—	1.5			X	
Main Manifold	1	—	—	1.5	1.5	X			
HEAT AND ANTI-ICE									
Battery Heaters	2	FWD	AGM	AFT	2.5	AFT		FWD	AGM-28
		2.5		2.5					
Camera Heaters	8	1.5	1.5	1.5	4.5	X			
Heater, ECM System 15	1	16.8	16.8	16.8	49.3	X			
Heater, ECM System 16	1	16.8	16.8	16.8	49.3			X	
Pitot Tube Heaters									
• Altitude Computer	2			2.5	2.5		X		
• Left and SAS	2			2.5	2.5		X		
• Right and SAS	2			2.5	2.5			X	
Q-Spring Airscoop Anti-Ice	1	—	—	2.3	2.3	X			
Ram Airscoop (Emergency)	1	2	2	2	6		X		
Stabilizer Screw Heat	2	—	1.7	—	1.7	X			
Window Heat									
No. 1	1	22	—	—	22		X		
No. 2 Left	1	—	24	—	24		X		
No. 2 Right	1	24	—	—	24			X	
No. 3 Left	1	5	—	—	5		X		
No. 3 Right	1	—	5	—	5			X	
No. 4 Left	1	—	—	5	5		X		
No. 4 Right	1	—	5	—	5			X	
No. 5 Left	1	—	—	2.4	2.4		X		
No. 5 Right	1	—	—	2.4	2.4			X	
No. 7	1	—	—	2	2			X	
Escape Hatch	2	—	—	4.3	4.3		P	CP	
Weapon Heaters							FWD		AFT
HYDRAULIC									
Pressure Indicator	6	**	—	—	**		X		
Standby Pumps									
Continuous									
Left Body	1	4.1	4.1	4.1	12.3		X		
Left Outboard	1	4.1	4.1	4.1	12.3	X			
Right Body	1	4.1	4.1	4.1	12.3	X			
Right Outboard	1	4.1	4.1	4.1	12.3				X
Momentary	4	7	7	7	21	X	X		X
Powered Rudder/Elevator System									
• Pump No. 1	1	21	21	21	63	X			
• Pump No. 2	1	21	21	21	63				X
LIGHTING (EXTERIOR)									
Air Refueling	5	**	—	—	**			X	
Anticollision	3	0.8	—	—	0.8		X		
Crosswind Taxi	1	2.5	—	—	2.5				X
Landing (Left and Right)	2	9.4	—	—	9.4	L			R
Navigation	9	**	—	—	**		X		
Terrain Clearance	1	—	—	11.5	11.5		X		
Wing Taxi	2	—	2.5	—	2.5			X	

** Insignificant Load

Figure 3-18 (Sheet 3 of 7).

A-C LOADS (Cont)									
EQUIPMENT	NO. OF UNITS	LOAD PER UNIT — AMPS				GENERATOR BUS			
		ØA	ØB	ØC	TOTAL	No. 1	No. 3	No. 5	No. 7
LIGHTING (INTERIOR)									
Cabin					31.0				
Aisle and Spot							X		
Dome (BNS and Miscellaneous)							X		
Dome (P-CP-EW-G)								X	
Flood (BNS, Copilot's)							X		
Flood (Pilot, EW, and Gunner)								X	
Instrument (Copilot)								X	
Instrument (Pilot and BNS)							X		
Panel (Copilot, EW, and Gunner)								X	
Panel (Pilot and BNS)							X		
Periscopic Sextant								X	
Signal Light Recp								X	
Table (BNS)							X		
Thunderstorm							X		
Walkway						AFT	FWD		
Walkway Section 43 (Right and Left)						R			L
MISCELLANEOUS									
AN/ARC-58 Ground Blower	1	0.6	0.6	0.6	1.8		X		
Food Warmers (Hot Cup and Oven)	3	BNS	P-CP-EW	—	5.9		BNS	P-CP-EW	
		5.9	5.9						
FCS and BNS Ground Blowers	2	4.7	4.7	4.7	14.1		BNS		FCS
Hydraulic Ground Cooler									
Blower	1	9.47	9.47	9.47	28.41	X			
Oxygen Quantity Indicator	1	—	**	—	**		X		
Pressure Pumps	1	0.8	0.8	0.8	2.4		X		
Parastatic Line Control	2				**	FWD		AFT	
Seat Position	6	CP-EW	RN-G	P-N	**		P-N-RN	CP-EW-G	
Transformer 28-Volt AC	2	**	**	**	**		L	R	

** Insignificant Load

Electrical Loads Chart (Typical)

Figure 3-18 (Sheet 4 of 7).

A-C LOADS (Cont)									
EQUIPMENT	NO. OF UNITS	LOAD PER UNIT — AMPS				GENERATOR BUS			
		0A	0B	0C	TOTAL	No. 1	No. 3	No. 5	No. 7
MISSILE SYSTEMS									
AGM-69A	1	162.0	160.9	160.9	482.8	X		X	X
PHOTOGRAPHIC									
Camera Blower	1	0.7	0.7	0.7	2	X			
Camera Door	1	1.5	—	—	1.5	X			
POWER									
TR Units (Fwd)	5	5.5	5.5	5.5	16.5	No. 1	No. 3	No. 4	No. 2 & 8
TR Units (Aft)	3	5.1	5.1	5.1	15.3	No. 5 6, 7			
Battery TR (Fwd)	1	1.3	1.3	1.3	3.9				X
Battery TR (Aft)	1	1.8	1.8	1.8	5.4	X			
RADIO AND NAVIGATION									
AN/ARC-58 Liaison Radio	1	6.5	6.5	6.5	19.5	X			
AN/ARN-118 TACAN	1	—	2.3	—	2.3		X		
AN/ARN-31 Glide Slope	1	—	—	1.2	1.2			X	
RADAR									
BNS System (AN/ASB-16)	1	35	35	35	105		X		
BNS Heat (Equipment)	1	6	6	6	18		X		
BNS Pressure Kit	1	6.1	—	—	6.1		X		
Doppler (AN/APN-89A)	1	7.4	3.4	2.9	13.7		X		
IFF (AN/APX-64)	1	—	0.9	—	0.9		X		
Rendezvous Beacon (AN/APN-69)	1	5.6	—	—	5.6	X			
SPECIAL ELECTRONICS									
Astrocompass	1	0.7	0.7	0.7	2		X		
WATER INJECTION PUMPS	4	16.5	16.5	16.5	49.5	No. 1	No. 3	No. 2	No. 4

Figure 3-18 (Sheet 5 of 7).

D-C LOADS (FORWARD)						
EQUIPMENT	NO. OF UNITS	AMPERES PER UNIT		EQUIPMENT	NO. OF UNITS	AMPERES PER UNIT
AFSATCOM AU				FLIGHT CONTROLS		
• LOS Radio Control	1	0.70		Airbrake Valves	4	2.2
• SATCOM Control	1	1.25		Autopilot (Steady)	1	24.1
• Dual Modem	1	3.04		Autopilot (Turn)		46.5
• Test Relay	1	0.50		Flap Brakes	2	10.0
• Transfer Relay	1	0.50		Stability Augmentation System		2.0
• UHF Preamplifier	1	0.25		• Pitch SASS Control	1	
AIR CONDITIONING				• Yaw SASS Control	1	
Cabin	1	5.2		Stabilizer Trim	2	0.9
Water Separator Bypass	1	2.0		FLIGHT INSTRUMENTS		
ARMAMENT AND BOMBING				AJA-1 True Heading Computer	1	0.5
Bomb Door	1	5.7		Directional Indicator	1	1.1
Fire Control System (AN/ASG-15)	1	25.0		Flight Gyro Emergency Inverter	1	5.0
IFC (DCU-9/A)		2.5		Flight Gyro Control Relay	4	0.5
Weapon Release		2.8		N-1 Compass System	1	1.0
ECM				Turn-and-Slip Indicators	2	0.2
AN/ALR-20A Receiver	1	0.5		Standby Attitude Indicator BC	1	0.4
ECM Indicator Dimming Unit	1	0.6		FUEL		
System 1 Antenna Selector	1	1.5		Air Refueling Control		11.9
System 2 Antenna Selector	1	1.5		Fuel Pump Relays	32	0.3
Systems 1 thru 6 (AN/ALT-28)				Refuel Valves	17	1.5
Less AX	6	1.8		Water Injection		14.1
Systems 7 and 8 (AN/ALT-28)				HEAT AND ANTI-ICE		
Less AX	2	1.8		Relays and Valves		13.0
Systems 1 thru 8 (ALQ-155(V)) AX	4	3.6		HYDRAULICS		
System 15 & 16 Blanking Module	1	1.0		Powered Rudder/Elevator System		3.0
System 15 and 16 Heater and Blanking Control	1	0.9		• Hydraulic Ground Cooling Control	1	
System 16 (AN/ALQ-117)	1	6.8		• Pressure Warning Light	1	
System 20 (AN/ALT-32L)	1	2.1		• Pump No. 1 Control	1	
System 21 (AN/ALT-16A) AL	1	12.1		• Pump No. 2 Control	1	
ENGINE CONTROL				LANDING GEAR		
Ignition	8	2.6		Anti-skid Valves	4	1.5
Oil Cooler Valves	8	1.0		Control and Indicator		3.1
Start Relays	16	0.5		Emergency Valves	2	1.0
Start Valves	8	3.0		Relays	2	0.5
EVS				Squat Switch Relays	10	0.5
Dimming Relay	1	0.2		LIGHTING		
Dimming Units	2	0.15		Dimming Control		2.9
Environmental	1	1.5		Emergency Instrument		0.9
FLIR	1	1.5		Landing Lights Control	2	0.5
FLIR AZ & EL Servo	1	1.8		Taxi and Crosswind Cont	3	0.5
Indicator Light Power	1	2.7		MISCELLANEOUS		
Monitors	4	3.2		Astrocompass (MD-1)	1	2.8
Panels	10	0.04		Generator Drive		
SCU	1	1.7		Decoupler	4	11.0
STV	1	0.5		Flare Ejector Control	1	3.0
STV AZ & EL Servo	1	2.8		Monitor Set (AN/AJM-14)	1	2.5
STV Camera Shutter	1	0.2		Relays		0.5
Turret Servos	1	10.4		Wing Chaff Control	1	7.2
Window Wash Valves	1	0.1		Window Wipers	2	5.3
Window Wash	1	0.2		MISSILE SYSTEMS		
ENGINE INSTRUMENTS				AGM-69A Control Power		11.9
Fuel Flow Indicators	8	0.2		PHOTOGRAPHIC		
				Camera Control	1	10.0

Electrical Loads Chart (Typical)

Figure 3-18 (Sheet 6 of 7)

D-C LOADS (FORWARD) (Cont)						
EQUIPMENT	NO. OF UNITS	AMPERES PER UNIT		EQUIPMENT	NO. OF UNITS	AMPERES PER UNIT
POWER				IFF (AN/APX-64)	1	1.5
Battery Change	2	1.0		RADIO		
Momentary		24.0		AN/AIC-10A (Interphone)	11	0.4
Relays		2.0		AN/ARC-58 (Liaison Radio)	1	0.1
RADAR				Command Radio		
BNS (AN/ASB-16)	1	22.1		AN/ARC-34 Less AU	1	13.0
BNS Pressure Kit	1	2.0		AN/ARC-164	1	4.1
Doppler Radar (AN/APN-89A)	1	2.5		AN/ARN-118 (TACAN)	1	1.0
D-C LOADS (AFT)						
AIR CONDITIONING (FCS)				PHOTOGRAPHIC		
Controller	1	1.5		Camera	1	6.1
ARMAMENT AND BOMBING				Camera Vacuum Pump	1	9.5
Fire Control System	1	49.0		RADAR		
Emergency Manual Bomb Release	1	3.1		AN/APN-69 (Rendezvous Beacon)	1	1.0
ECM				AN/APN-150 (Radar Altimeter)	1	2.5
ALQ-122 AL	1	1.0		RADIO		
System 9 (AN/ALT-16) Less AL	1	12.1		AN/ARC-58 (Liaison Radio) W181	1	1.5
System 9 (AN/ALT-16A) AL	1	12.1		AN/ARC-65 (Antenna Coupler) W173 W180	1	8.0
Systems 10, 13, and 14 (AN/ALT-6B) Less AX	3	14.0		AN/ARC-65 (Liaison Radio) W173 W180		20.0
System 10 (AN/ALT-6B provisions only) AX	1	14.0		Command Radio		
Systems 11 and 12 (AN/ALT-32)	2	2.1		AN/ARC-34 Less AU	1	20.0
Systems 13 and 14 (ALQ-155(V)) AX	1	3.6		AN/ARC-164	1	4.1
System 15 (AN/ALQ-117)	1	6.8		AN/ARN-14 (Omni-Dir-Range)	1	5.2
MISCELLANEOUS				AN/ARN-32 (Marker Receiver)	1	0.6
Flare Ejector	1	3.7				
Flight Loads Recorder	1					
Pressure Kit (APN-69)	1	2.6				

Electrical Loads Chart (Typical)

Figure 3-18 (Sheet 7 of 7).

1. D-C LOADS AVAILABLE WITH BATTERY SWITCH ON AND EMERGENCY D-C POWER SWITCH NORMAL

FORWARD BATTERY	AFT BATTERY
RIGHT ESSENTIAL START BUS  Firewall Fuel Shutoff Valves — Inboard Engines Ignition — Engines 3, 4, 5, and 6	LEFT ESSENTIAL START BUS  Firewall Fuel Shutoff Valves — Outboard Engines Ignition — Engines 1, 2, 7, and 8
RIGHT ESSENTIAL BUS Antiskid: • Left and right aft antiskid control Battery Detector Power Bomb Door: • Control relays • Forward valve control • Aft valve control Engine Fire Detectors — Inboard Engine Starter Valves — Inboard Engine Firewall Hydraulic Shutoff Valves — Engines 5, 6, and 7 Fuel: • Engine crossfeed manifold valve No. 10 and 11 • Auxiliary tank, engine feed control valve No. 13 and 16 Generator: • Engine No. 3 and 5 control • Bus tie and generator circuit breaker position indicators (inbd) • Master circuit breaker trip indicator light (Cont)	LEFT ESSENTIAL BUS Antiskid: • Left and right forward antiskid control Battery Detector Power Bomb Door, Forward Emergency Valve Engine Fire Detectors — Outboard Engine Starter Valves — Outboard Engine Firewall Hydraulic Shutoff Valves — Engines 1, 3, and 4 Fuel: • Engine crossfeed manifold valve No. 9 and 12 • Auxiliary tank, engine feed control valve No. 14 and 15 Generator: • Engine No. 1 and 7 control • Bus tie and generator circuit breaker position indicators (outbd) Landing Gear: • Left forward gear control (normal) • Right aft gear control (normal) (Cont)

 With Battery Power Only, Loads On This Bus Will Automatically Switch To The Other Battery In Event Of Malfunction Of The Normal Battery Shown.

Battery Loads (Typical)

Figure 3-19 (Sheet 1 of 3).

1. D-C LOADS - BATTERY SWITCH ON AND EMERGENCY D-C POWER SWITCH NORMAL (cont).

FORWARD BATTERY	AFT BATTERY
RIGHT ESSENTIAL BUS (CONT) • Generator trip indicator box power • External power and bus tie isolate Landing Gear: • Right forward gear control (normal) • Left aft gear control (normal) • Left aft and right forward squat switch control (normal and emergency) • Right tip gear control (normal). Left tip gear control (emergency) • Position indicators W250 • Tip protection gear warning light W250 • Landing gear (and lever position) warning Standby Start Power — Outboard Engines Start Control — Aft Bus	LEFT ESSENTIAL BUS (CONT) • Left forward and right aft squat switch control (normal and emergency) • Left tip gear control (normal). Right tip gear control (emergency) Standby Start Power — Inboard Engines Start Control — Forward Bus AFT BATTERY BUS Aft battery bailout warning lights (aft fuselage) Emergency Manual Bomb Release Entry light Jettison power Left forward and right forward antiskid valves Right forward and left aft main landing gear emergency control

Figure 3-19 (Sheet 2 of 3).

1. D-C LOADS BATTERY SWITCH ON AND EMERGENCY D-C POWER SWITCH NORMAL (cont)

FORWARD BATTERY	AFT BATTERY
FORWARD BATTERY BUS Aft and forward weapon IFC Forward battery bailout warning lights (crew compartment) Left aft and right aft antiskid valves Right aft and left forward main landing gear emergency control SWESS EMERGENCY BUSES (No forward battery loads. Emergency instrument bus and emergency battery bus are energized by aft battery)	EMERGENCY BUSES ● Emergency Battery Bus Airbrake control Bailout warning control Interphone power ● Emergency Instrument Bus Emergency Flight Instrument Lights Flight gyro emergency inverter Pilot's and copilot's turn-and-slip indicators Pilot's heading indicator (gyro) Standby attitude indicator BC

2. D-C LOADS AVAILABLE WITH BATTERY SWITCH ON AND EMERGENCY D-C POWER SWITCH EMERGENCY

FORWARD BATTERY	AFT BATTERY
RIGHT ESSENTIAL BUS (Same loads as with emergency d-c power switch NORMAL) FORWARD BATTERY BUS (Same loads as with emergency d-c power switch NORMAL) EMERGENCY BUSES ● Emergency Battery Bus Airbrake control Bailout warning control Interphone power ● Emergency Instrument Bus Emergency flight instrument lights Flight gyro emergency inverter Pilot's and copilot's turn-and-slip indicators Pilot's heading indicator Standby attitude indicator BC	LEFT ESSENTIAL BUS (Same loads as with emergency d-c power switch NORMAL) AFT BATTERY BUS (Same loads as with emergency d-c power switch NORMAL) EMERGENCY BUSES (No aft battery loads. Emergency instrument bus and emergency battery bus are energized by forward battery)

Battery Loads (Typical)*Figure 3-19 (Sheet 3 of 3).*

D-C SYSTEMS/INDICATORS INOPERATIVE WITH LOSS OF FORWARD/AFT TR POWER

LEFT TR BUS	FUSE	RIGHT TR BUS
AIR CONDITIONING Cabin emergency ram air control Free air temperature indicator ANTI-ICE CONTROL Control pods 1 & 2 Airscoop shutoff valve Left window and left auxiliary window relays ELECTRONICS AFSATCOM • LOS Radio Control • Modem • SATCOM Control • SYNC Power Supply Autopilot Astrocompass Doppler radar IFF (AN/APX-64) TACAN AN/ARN-118 ECM indicator lights ECM system 1 & 2 antenna selectors ECM systems 15 and 16 monitor control ECM system 15 • blanking module • pressure pump W173 W180 ECM system No. 15 and 16 indicator control AF ECM system 16 • blanking module • pressure pump N-1 compass dc True heading computer system Flight gyro control FCS control system FCS pressurization APN-69 pressure kit control Stability augmentation system ELECTRICAL MISCELLANEOUS Faceplate defog Generator drive overhead No. 1 & 3 Left chaff dispensers 1, 2, 3 & 4 Pilots windshield wiper ENGINE Water injection indicator lights Water injection pump controls 1 & 2 Oil cooler valves 1, 3, 5 & 7 Drain tank valve (water injection) EVS EVS indicator dimming Navigator's Display (monitor) Pilot's display (monitor) Pilot-navigator power		AIR CONDITIONING Cabin air control Bleed valve struts 1 & 4 ANTI-ICE Control pods 3 & 4 Right window and right auxiliary window relays ELECTRONICS UHF command AN/ARC-34 auxiliary Less AU AN/ARC-164 Liaison radio control (AN/ARC-58) W181 Monitoring set (AN/AJM-14) ECM systems 15 and 16 heaters ECM system 16 • PD power • PR power ECM transmitter system 20 Copilot flight gyro control Radar receiver (AN/ALR-19) Radar receiver (AN/ALR-20A) Radio nav indicator dc (AN/ARN-21) ELECTRICAL MISCELLANEOUS Faceplate defog (DECM and instructor) Chaff deactivate Copilot window wiper Flare ejector program power Generator drive overheat No. 5 & 7 Generator drive decoupler Wing chaff control power Wing chaff, right 5, 6, 7 & 8 ENGINE Water injection pump controls 3 & 4 Oil cooler valves 2, 4, 6 & 8 Low oil pressure warning lights EVS Copilot's display (monitor) Copilot — radar nav power FLIR servo az & elevation FLIR control FLIR ENV control FLIR power FLIR servo turret Radar nav display (monitor) SSG Window wash control Window wash valves

Figure 3-20 (Sheet 1 of 3).

D-C SYSTEMS/INDICATORS INOPERATIVE WITH LOSS OF FOWARD/AFT TR POWER (cont)

LEFT TR BUS	FUSE	RIGHT TR BUS
EVS(Cont) STV ENV control STV power STV servo az & elevation STV servo turret FUEL Left master fuel level control Pump control Left outboard pump 2 Main tank 1, pumps 6 & 7 Main tank 2, pumps 10 & 11 Forward body tank, pump 24 Center wing body tank, pump 25 Mid body tank, pump 29 Aft Body tank, pumps 30 & 32 Main tank 3, pumps 12 & 13 Main tank 4, pumps 16 & 17 Right outboard, pump 20 Crossfeed fuel valve 29 HYDRAULICS Powered rudder elevator system Hydraulic ground cooling control Pressure warning light Pump control No. 1 Pressure warning light Standby pump control left body Standby pump control left outboard LANDING GEAR Crosswind crab indicator LIGHTS Hatch position warning Press to test Walkway light, aft control Pilot and copilot dim control Taxi and crosswind control SURFACE CONTROLS Wing flap position indicator Lateral trim indicator Trim control Left wing flap control Left flap brake WEAPON SYSTEMS Weapon, release indicator lights Normal release bomb systems Special weapon rack select Forward bomb bay IFI power Bomb door position indicator Bomb door hold open BNS timer door close Forward parachute static line control Forward alternate weapon release heater control MISSILE SYSTEM AGM-69A control power		FUEL Level control Aerial refueling Flow indicator dc Management indicator Refuel valve Defuel valve 30 Main tank low level warning Outboard and external tank level warning Main manifold scavenge control Cabin manifold scavenge control Master right level control Crossfeed control valve 29a Pump control Left wing external tank, pump 1 Left outboard, pump 3 Main 1, pumps 4 & 5 Main 2, pumps 8 & 9 Main 3, pumps 14 & 15 Main 4, pumps 18 & 19 Forward body, pump 23 Center wing, pump 26 Mid body, pumps 27 & 28 Aft body, pump 31 Right outboard, pump 21 Right wing external, pump 22 HYDRAULICS Powered rudder elevator system Pump control No. 2 Standby pump control right body Standby pump control right outboard LANDING GEAR Centering control Position and flap warning horn LIGHTS Master caution light SURFACE CONTROLS Right wing flap control Right flap brake WEAPONS SYTEM Aft parachute static line control Aft bomb bay IFI power Aft weapon release heater control

TR Powered Equipment

Figure 3-20 (Sheet 2 of 3).

D-C SYSTEMS/INDICATORS INOPERATIVE WITH LOSS OF FOWARD/AFT TR POWER (cont)

AFT TR BUS

ELECTRONICS

ECM receiver pressure kit
ECM transmitter systems 9 thru 14
ECM system 15
• PD power
• PR power
Fire control system
Camera and camera vacuum pump
Radar altimeter
ODR power

Marker beacon
Rendezvous beacon
Command radio
Cooling and pressure AN/ARC-58 and ECM system 15
Remote keyer **W173** **W180**
Liaison radio (AN/ARC-65) **W173** **W180**

MISCELLANEOUS

Flight loads recorder

TR Powered Equipment

Figure 3-20 (Sheet 3 of 3).

NOTE

The equipment shown in this chart is a bus-by-bus listing of the a-c operated equipment. This will give the crew an idea of a system or portion of a system that would be lost if a bus was not receiving power.

GENERATOR NO. 1

Aft Battery Charging TR Unit
Battery Heater (Aft)
Camera Blowers, Doors and Heaters
ECM System 15 Air Heater
ECM Transmitter Systems 1 and 2
Fire Control System
Flap Motor (Left)
Flight Loads Recorder
Forward Weapon Heater Release
Fuel Pumps — Auxiliary

<u>TANK</u>	<u>PUMP NO.</u>
Aft Body	32
Center Wing	25
Left External	1
Left Outboard	3
Mid Body	29

Fuel Pumps — Main

<u>TANK</u>	<u>PUMP NO.</u>
1	4
2	8
3	14
4	18

Fuel Scavenge Pump (Main Manifold)

Hydraulic Standby Pumps (Left Outboard and Right Body)

Lights

Aft Walkway Dome
Landing (Left)
Walkway Section 43 (Right)

Liaison Radio

Parastatic Line Control (Fwd)

Powered Rudder Elevator Pump No. 1

Pressurization Kit

• APR-9 ECM and APN-69

• ARC-58

• ECM System 15

Q-Spring Airscoop Anti-Ice

Radar Altimeter

Rendezvous Radar

Rudder Elevator Ground Cooling Blower

Stabilizer Screw Heat

Stabilizer Trim

Total Fuel Quantity Recorder

TR Unit No. 1 (Fwd)

TR Units No. 5, 6, and 7 (Aft)

Water Injection Pump No. 1

Wing Chaff Dispensers (No. 1, 2, 3, and 4)

GENERATOR NO. 3

AFSATCOM **AU**

• Logic PWR SPLY (Printer and Printer)

• LOS Radio Set (ARC-171(V))

Air Conditioning (Emergency Ram Airscoop and Mod Valve)

Automatic Pilot

BNS Control Power

BNS Ground Blowers

ECM Transmitter Systems No. 3 and 5

ECM Systems No. 7 and 8

EVS

• Displays (Monitors) (CP & RN)

• FLIR ENV Fan

• FLIR ENV Heater

• FLIR System

• FLIR Window Heater

• SCU

• SSG

• VDU

Flight Instruments

Altitude Computer

Flight Gyros (Pilot)

Gyro Synch and Attitude Indicator (Copilot) ★

★ Copilot's attitude indicator can be restored (transferred to generator No. 5) by shifting flight director computer gyro select switch to ALTERNATE.

Figure 3-21 (Sheet 1 of 3).

Forward Battery Charging TR Unit
Fuel Pumps — Auxiliary

TANK	PUMP NO.
Aft Body	31
Center Wing	26
Mid Body	28
Right External	22
Right Outboard	20

Fuel Pumps — Main

TANK NO.	PUMP NO.
1	5
2	9
3	15
4	19

Hydraulic Standby Pumps (Right Outboard)
Lights

Crosswind Landing and Taxi
Landing (Right)
Walkway Section 43 (Left)
Powered Rudder Elevator Pump No. 2
TR UNITS No. 2 and 8 (Fwd)
Water Injection Pump No. 4
Wing Chaff Dispensers (No. 5, 6, 7, and 8)

A-C Powered Equipment

Figure 3-21 (Sheet 3 of 3).

AIR BLEED SYSTEM EMERGENCY
OPERATION**WARNING**

When EMERG RH INBD is selected below 25,000 feet, the manifold temperature gage must be monitored closely since the bleed air is not precooled by a heat exchanger and the duct temperatures will be dependent on engine thrust settings, altitude, and OAT. Since the bleed air is not precooled, the distribution ducting may be subjected to temperatures up to 399° C (750° F) creating a potentially hazardous condition if fuel vapors are present in the wing leading edge and because of excessive temperatures at all of the hot air duct outlets. When the aircraft is below 25,000 feet, an explosive condition can exist in the wing by possible auto-ignition of accumulated fuel vapor in the duct area when the duct temperatures are above 246° C (475° F). Above 25,000 feet, this explosive condition no longer exists due to the high auto-ignition temperature of fuel vapor at high altitude. A hazardous condition exists at all altitudes at the hot air outlets when combustible materials are stored on or close to the hot air duct outlets.

NOTE

- At altitudes below 25,000 feet, place bleed selector switch in NORMAL LH INBD position.
- At altitudes of 25,000 feet or above, the bleed selector switch may be placed in EMERG RH INBD position.

In the event of failure of the bleed air supply from No. 2 nacelle, either through duct failure or shut-down of engines 3 and 4, emergency bleed air may be obtained from No. 3 nacelle by placing the bleed selector switch in the EMERG RH INBD position. When use of EMERG RH INBD is necessary below 25,000 feet, reductions in thrust settings on engines 5 and 6 will usually be necessary to limit manifold temperatures to 246° C (475° F) or less. If thrust requirements will not permit reductions in thrust settings, the cabin pressure master switch should be placed in RAM or OFF position. If NORMAL LH INBD bleed air is not available during a landing, the air conditioning master switch should be placed to RAM since the use of EMERG RH INBD bleed air during a landing will result in excessive manifold temperatures if a go-around is necessary. Excessive manifold temperatures may also be caused by the failure of a strut bleed valve to close when the manifold valve switch is returned to CLOSE after starting the engines. If this occurs, to determine which nacelle is the source of overtemperature air, retard throttles in pairs in the following sequence: 3 and 4, 1 and 2, 7 and 8, and 5 and 6. In each case, check for a drop in manifold temperature before restoring thrust and retarding the next pair. Relatively small reductions in thrust should close engine bleed air check valves in one nacelle if engines in another nacelle are supplying bleed air to the system. If a bleed valve had failed to close after engine start and a takeoff has been made, operation with a differential thrust setting may be necessary to maintain safe manifold temperatures.

NOTE

Bleed air is supplied to the AGM-69A environmental control system air ducts in bleed selector switch position of either NORMAL LH INBD or EMERG RH INBD.

See Section IV, "Emergency Operation of Air Conditioning System," for additional information.

ACCIDENTAL DRAG CHUTE DEPLOYMENT

The drag chute is designed to operate without failure at indicated airspeeds (IAS) of 135 knots or less. If the drag chute is fully inflated at higher speeds, it will seriously weaken the risers and failure may result. Also, a shear pin may fail thus releasing the chute. Such accidental deployment will exert only minor effect on the aircraft handling characteristics but deployment at lower airspeeds would be critical. It would induce considerable drag causing a pitch-down tendency with wing flaps up or a slight pitch-up with the wing flaps extended. This pitching would be controllable but the sudden decrease in airspeed could result in a stall condition. It is necessary, therefore, to increase thrust and to jettison the drag chute immediately under these conditions. If the drag chute is jettisoned or deployed over 135 knots IAS, the pilot shall so note on the Form 781. The drag chute mechanism is designed so that if the drag chute door should open inadvertently while the drag chute lever is in LOCKED position, the chute will jettison automatically.

NUCLEAR BOMB EMERGENCY PROCEDURES

Amplified checklists for nuclear bomb emergency procedures are published in T.O. 1B-52D-25-2. The abbreviated checklist for Emergency Manual

Bomb Release is published in T.O.'s 1B-52G-1CL-2(N) and 1B-52G-1CL-3(RN). Safe Jettison Procedures, Armed Jettison Procedures, and DCU-9/A Malfunction Correction Procedures are published in T.O. 1B-52D-25-2CL-1.

NONNUCLEAR WEAPONS EMERGENCY PROCEDURES

Amplified checklists for nonnuclear weapons emergency procedures are published in T.O. 1B-52D-34-2-1. The corresponding abbreviated checklist are published in T.O.'s 1B-52G-1CL-2(N) and 1B-52G-1CL-3(RN).

AGM-69A EMERGENCY OPERATION

Amplified checklists for B-52G/AGM-69A emergency operation are published in T.O. 1B-52G-30-2. The corresponding unclassified abbreviated checklists are published in T.O. 1B-52G-1CL-1, pilot's; T.O. 1B-52G-1CL-2, navigator's; and T.O. 1B-52G-1CL-3, radar navigator's.

Auxiliary Equipment

section IV

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AIR CONDITIONING SYSTEM

The air conditioning system (figure 4-2) provides crew compartment ventilation with filtered temperature controlled air, piped cooling to electronic equipment, pressurization, and emergency ram air ventilation. High pressure hot air from the air bleed system (figure 1-30) provides the energy to air condition and pressurize the crew compartment utilizing the equivalent of approximately 6% of thrust output of one engine. Bleed air is admitted to the system by the air conditioning shutoff valve which is operated electrically by the cabin pressure (air conditioning) master switch on the aisle stand. From the air conditioning shutoff valve, bleed air passes through a catalytic filter and a pressure limiter, then divides. Part of the hot air is cooled by the air conditioning pack. The remaining uncooled bleed air is utilized in maintaining the desired cabin temperature. The air cooled by the air conditioning pack goes through a check valve into the pressurized compartment where it supplies piped cooling to electronic equipment and crew station cooling outlets. Cabin pressurization is provided by regulating the discharge of cabin air through combination cabin pressure safety and outflow valves. Inflowing air also provides ventilation. Ram air ventilation of the crew compartment and cooling of electronic equipment may be obtained by positioning the air conditioning master switch in RAM to shut off bleed air, open the emergency ram air scoop, and open the outflow valves. This same switch position is used for ground operation when the MA-3 ground cooling cart is connected to the cabin ram air intake to cool electronic equipment and ventilate the compartment.

AIR SUPPLY REGULATION

The bleed air supply is normally collected from engines 3 and 4 and precooled in a ram air heat exchanger in the No. 2 strut before delivery to the air conditioning system. An emergency (not precooled) bleed air supply from engines 5 and 6 is available when selected with the bleed selector switch on the aisle stand. Bleed air passes through a pressure limiter which controls the airflow through the air conditioning system at high pressures. The pack airflow is limited to 140 pounds per minute. The airflow divides beyond the pressure limiter, one stream going through the air conditioning pack to be cooled and the other stream going directly to the cabin through a temperature modulating valve in the hot air outlet duct. Up to 70% of the total bleed airflow, depending on the position of the temperature modulating valve, bypasses the air conditioning pack in maintaining a selected cabin temperature. The temperature modulating valve is electrically controlled remotely from a combination switch-rheostat (temperature selector) on the pilots' instrument panel or copilot's side panel and an automatic electronic cabin temperature regulator. The bypassed hot air is ducted through a check valve directly to the cabin and the crew station hot air outlets for heating the cabin. With exception of the hot air spray tube just forward of the pressure bulkhead door, control of

the quantity of air to each crew station is provided by controls at the crew stations.

WARNING

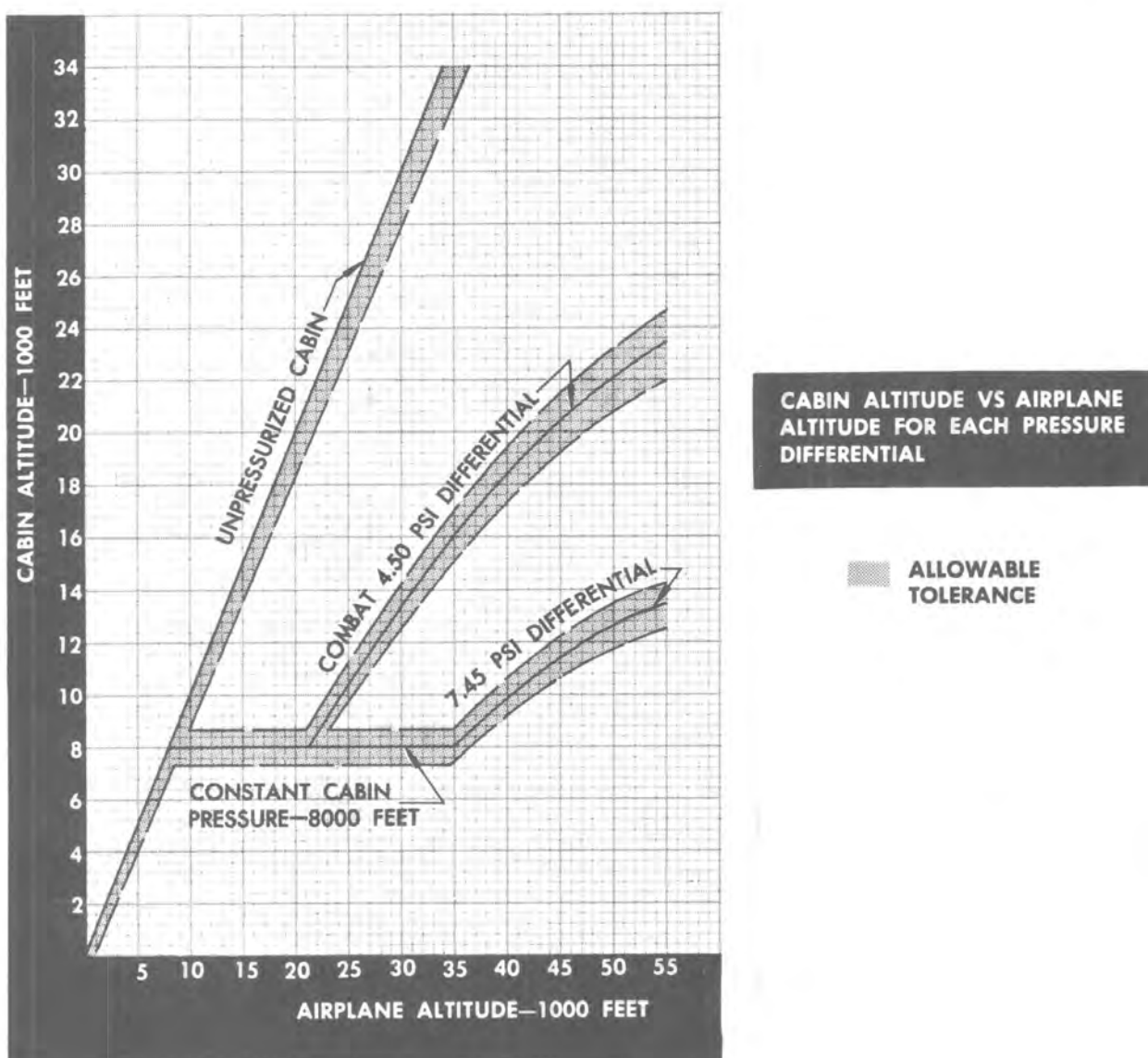
Extreme caution must be exercised by all crew members when stowing and securing gear aboard the aircraft. Care must be taken to assure that gear is safely secured and is not stowed on or near heating ducts, outlets, electrical wiring, and electronic equipment. Periodically during flight each crew member should check ducts, outlets, electrical wiring, and electronic equipment in his immediate area to see that they are free of combustible materials. For location of hot air ducts and outlets, see figure 4-2A.

AIR CONDITIONING PACK

The air conditioning pack located just aft of the pressurized compartment cools the hot bleed air by means of two air-to-air heat exchangers and an air cycle machine. Both heat exchangers, known respectively as the ram and the blower heat exchangers, use ram air as the coolant which is obtained through separate ducts from a common anti-iced air scoop in the leading edge of the left inboard wing panel. The air cycle machine consists of an expansion turbine and a centrifugal blower directly coupled together. The bleed air is subjected to a decrease in pressure and temperature in passing through the expansion turbine, with the heat energy being converted into work as the blower assists ram pressure in drawing cooling air through the heat exchanger. The cold air output must be warmed above freezing, when operating at aircraft altitudes less than 25,000 feet, to prevent ice blockage of the water separator and to minimize snow buildup within cabin ducting. An electronic controller automatically maintains an above freezing temperature in the cold air output by operating a modulating (anti-icing) valve to bypass bleed air from the first stage (ram) heat exchanger output into the output of the air cycle machine. An aneroid switch operates at 36,000 feet to close the modulating valve and actuate a solenoid which allows the water separator bypass valve to open, since air above this altitude contains little moisture.

Water Separator

The water separator removes part of the moisture precipitated by refrigeration of engine bleed air to minimize fogging and snow conditions in the cabin. The separator is installed with an automatically controlled bypass just downstream of the air cycle machine. Water collected is drained overboard. The water separator bypass valve is opened automatically at altitudes above 25,000 feet (or 36,000 feet) and opens at any other altitude as a fail-safe feature if a malfunction or a freezeup restricts airflow. Excessive amounts of moisture as introduced during a water injection takeoff will not be removed by the separator.



Cabin Pressure Schedule

Figure 4-1.

AIR DISTRIBUTION

Cabin air is distributed by separate hot air foot outlet spray tubes at all crew members' feet, by cold air foot outlet spray tubes at pilots' and defense stations, by auxiliary cold air overhead outlets at all stations, and by piped forced air cooling to electronic equipment. The foot outlets are intended to provide the normal air distribution for the crew, while head outlets provide an auxiliary source of cold air for

low altitude cooling. The cold air supply is divided between crew and equipment cooling so the crew will receive up to 75% of the cold air output for low altitude cooling with all outlets open. With the head outlets all closed and the foot outlets open, 40% of the cold air will be distributed by the foot outlets while 60% is piped to the electronic equipment. All the crew air outlets have positive shutoff controls except the hot air spray tube outlet just forward of the pressure bulkhead door which relieves pressure on the system ducting when all other outlets are closed.

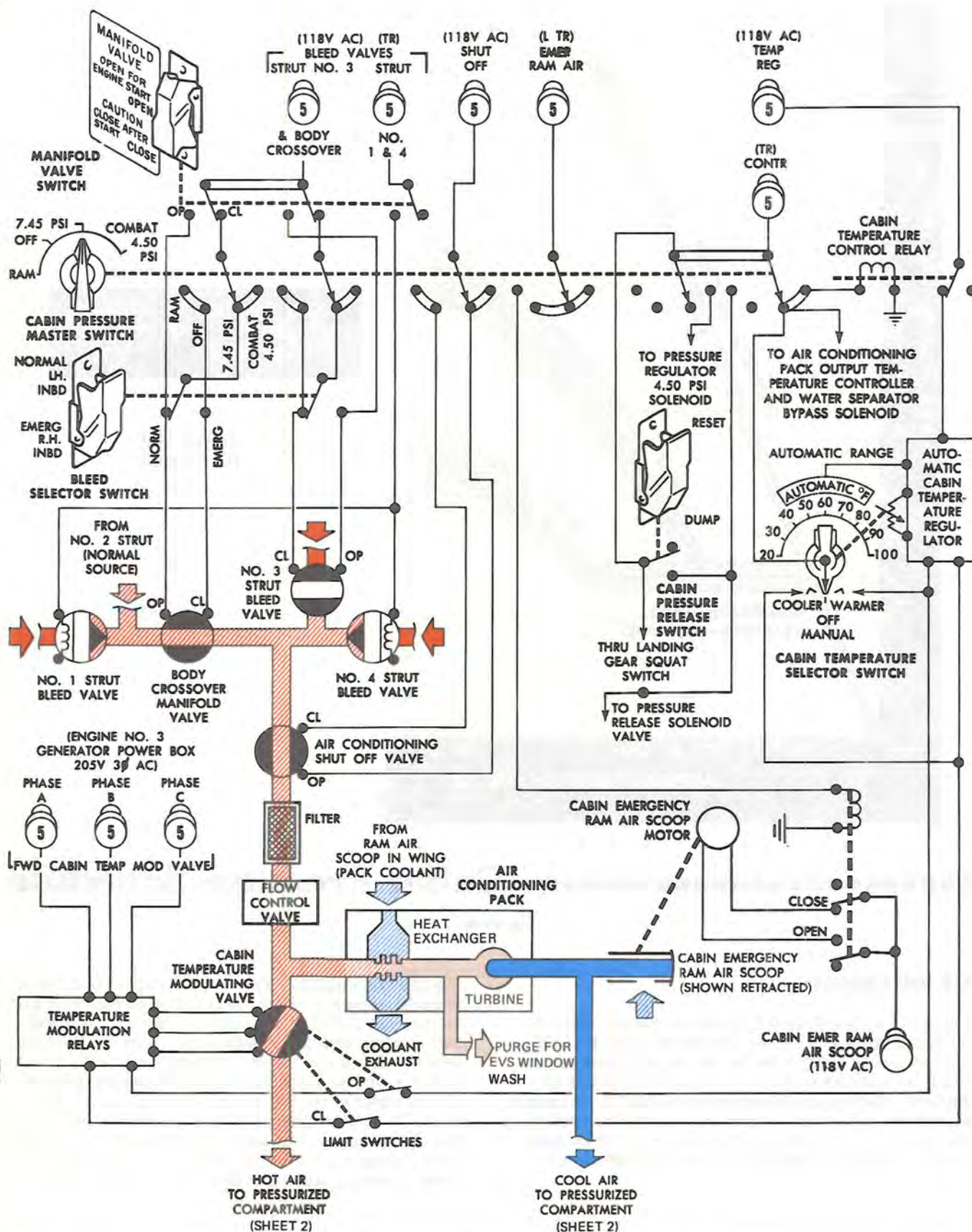
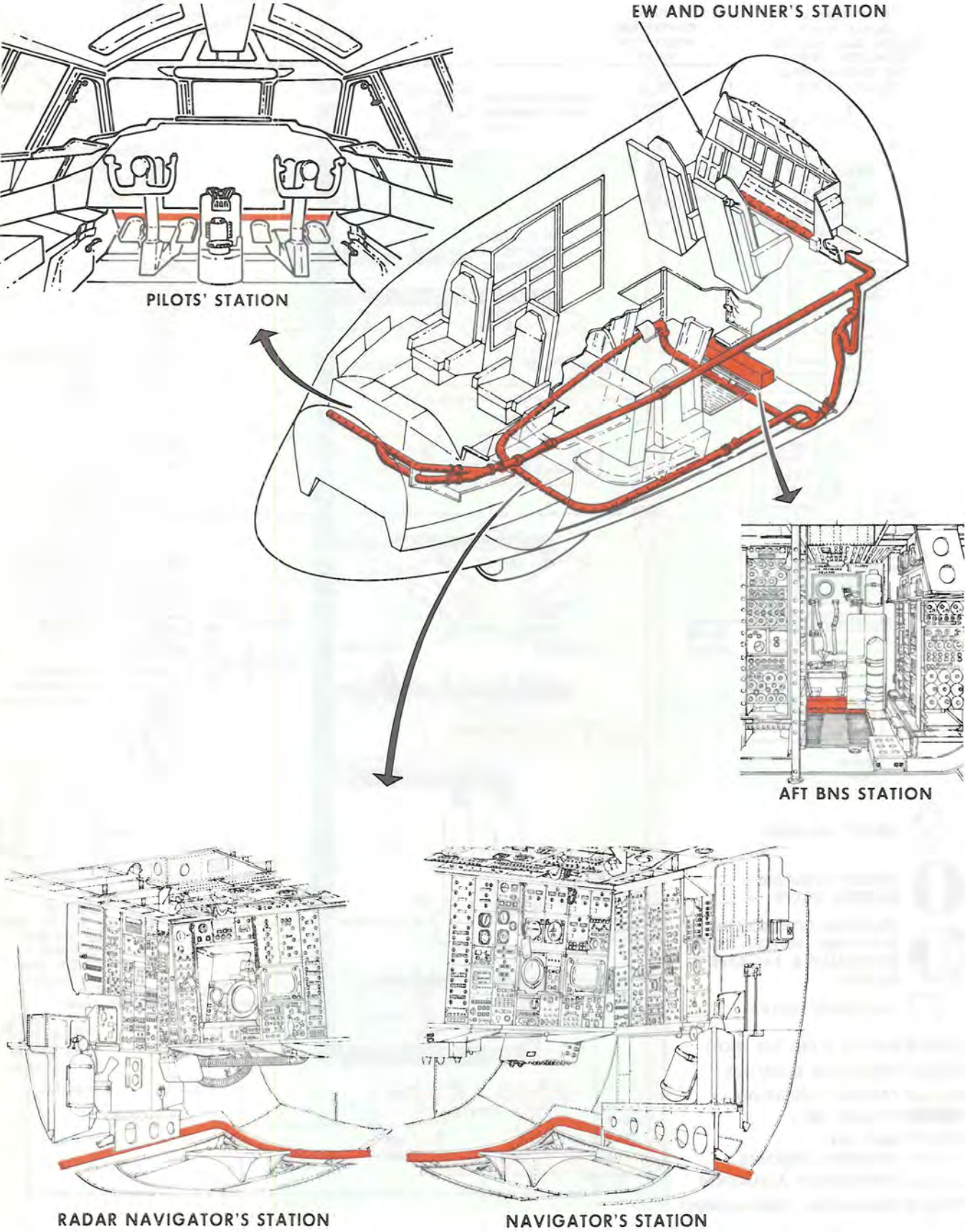


Figure 4-2 (Sheet 1 of 2).



■■■■■■■■■■ Hot Air Duct Locations and Outlets

Figure 4-2A.

The shutoff controls, also used to control quantity, are mechanically operated from each crew station. In addition, the head outlets are adjustable to control direction of flow, thus giving the crew complete control of the auxiliary cold air. Quantity of air output from pilots' and defense stations foot outlets is variable by means of controls which simultaneously operate butterfly valves in the respective hot and cold air supply ducts; however, there is no independent control for regulating either hot or cold airflow. Defense station crew members have an additional control which operates an independent butterfly valve to close their cold air foot outlet supply duct when warmer air is desired at their feet. An auxiliary heat control at the BNS station operates a butterfly valve to increase hot airflow at the BNS station foot outlets and restrict hot airflow downstream to the foot outlets at both defense and pilots' stations. Due to shutting off almost all hot air to the upper crew members when pulled out, positioning of the BNS station auxiliary heat control is the most critical point of operation in the system and the control position should be monitored very closely if the cabin airflow low warning light illuminates. Regulation of this auxiliary heat control must be maintained through cooperation of the copilot and radar navigator when adjusting cabin temperature. The quantity and temperature of air to the piped equipment depend on the variable airflow split. The airflow split is governed by the cabin temperature control system regulation of the amount of hot air by-passing the air conditioning pack and by manual control of crew air distribution outlets. The piped cooling to the electronic equipment is supplemented by circulation of cabin air through the electronic compartments to the controlled outflow valve(s) located at the left side of the upper deck and the right side of the lower deck. Pressurized cabin air is used for environmental control of the EVS turrets. For further information see "EVS Environmental Control and Turret Window Wash Systems" under "Electro-Optical Viewing System (EVS)," this section. For control of airflow at individual air outlets, see "Normal Operation of Air Conditioning System" this section.

PRESSURE REGULATION

Cabin pressure is regulated by controlling the outflow of air from the cabin. The cabin pressurization equipment includes one automatic pressure regulator, a pneumatic relay, and two outflow valves which also function as safety valves. A repressurization rate control is incorporated in the regulator to limit the rate of cabin pressure increase to not more than 1 psi per minute.

NOTE

A three-position test valve handle on the regulator is marked TEST ONLY-DIFF OFF --TEST ONLY-ALL OFF-- FLIGHT. The handle may be used during ground maintenance testing, but at all other times it should

be safety wired to FLIGHT. If the handle is not in FLIGHT, the cabin would pressurize ahead of the selected schedule until the handle is returned to FLIGHT position. Access to regulator for purpose of checking the handle position is only gained by crawling forward of the BNS station on the floor under the navigator's table. The lower deck outflow valve is located on the right side of the aircraft about four feet up from the floor. The pressure regulator is located slightly above inboard aft of the outflow valve near the top of the compartment.

The control of cabin pressure is entirely automatic and normally involves the following operational ranges:

1. Unpressurized operation from ground level to 8000 feet in which cabin pressure is maintained substantially at ambient pressures.
2. Isobaric operation in which the cabin pressure is maintained at essentially an 8000-foot pressure level. Isobaric operation will be maintained until the pressure differential from cabin to ambient equals 4.50 or 7.45 psi (figure 4-1) depending on the schedule selected with the master switch.

NOTE

When changing the cabin pressure differential from 7.45 to 4.50 psi, an overshoot of cabin altitude may occur. This momentary overshoot of up to 3000 feet higher than expected should be considered normal. Figure 4-1 depicts cabin altitude versus aircraft altitude for the two pressurization schedules.

Both outflow valves (left side upper deck and right side lower deck) serve the following functions:

- Relieve overpressure by allowing air to flow overboard to prevent cabin pressure from exceeding a differential of 8.0 psi with respect to ambient pressure.
- Relieve negative pressure by allowing ambient air to flow into cabin to prevent cabin pressure from becoming less than 0.37 psi lower than ambient pressure.
- Regulate normal outflow of air in response to the automatic signals supplied by the regulator.
- Dump cabin pressure when a dump signal is initiated by turning the master switch to RAM or by turning the emergency cabin pressure release handles to DUMP or by selecting DUMP with the cabin pressure release switch.

The crew compartment cannot be pressurized when the cabin pressure release solenoid valve is open. This valve will be open under any one of the following conditions:

- Pressure Release Switch in DUMP (electrically)
- Air Conditioning Master Switch in RAM (electrically)

- Emergency Cabin Pressure Release Handle in DUMP (mechanically)
- Aircraft weight on wheels actuates landing gear squat switch relays (electrically)
- Main landing gear extended and crabbed in flight to an angle of 14° or more through any combination of crosswind crab setting and rudder motion actuates landing gear squat switch relays (electrically). Up to 8000 feet, this is not critical since cabin pressure is regulated to approximately 0.25 psi (1/2 inch Hg) above atmospheric or substantially ambient pressure.

CONTROL POWER SUPPLY

The body crossover manifold valve and the No. 3 strut bleed valve are operated by 118-volt single-phase a-c motors which are supplied power through a circuit breaker marked "Strut No. 3 & Body Crossover." Strut No. 1 and 4 bleed valves are operated by solenoids which are supplied TR power through a circuit breaker marked "Strut No. 1 & 4." Both bleed valve circuit breakers are located on the "Cabin Air Cond - Bleed Valves" portion of the right load central circuit breaker panel. The air conditioning shutoff valve is operated by a 118-volt single-phase a-c motor which is supplied power through a circuit breaker marked "Shutoff" on the "Cabin Air Cond" portion of the right load central circuit breaker panel. TR power is supplied through a circuit breaker marked "Contr," also located on the "Cabin Air Cond" portion of the right load central circuit breaker panel, to operate the following:

- Cabin pressure release solenoid valve
 - Pressure regulator 4.50 psi solenoid
 - Cabin temperature modulation relays which control the 205-volt three-phase a-c cabin temperature modulating valve motor
 - Anti-icing controller relays which control a 205-volt three-phase a-c modulating valve motor according to water separator anti-icing requirements
 - Water separator bypass solenoid valve **W173** **W286**
 - Water separator bypass valve relay **W287**
 - Cabin temperature control relay which connects 118-volt single-phase ac from the circuit breaker marked "Temp Reg" on the same portion of the same circuit breaker panel to the electronic cabin temperature regulator for automatic operation of the cabin temperature modulation relays.
- The emergency cabin ram air scoop is operated by a 118-volt single-phase a-c motor which is controlled by power supplied through a circuit breaker marked "Emer Ram Air" on the "Miscellaneous" portion of the auxiliary BNS circuit breaker panel. On aircraft **W287**, TR power is supplied to operate the water separator bypass valve solenoid under control of the water separator bypass valve relay through a circuit breaker marked "By-Pass Valve" on the

"Cabin Air Cond" portion of the right load central circuit breaker panel.

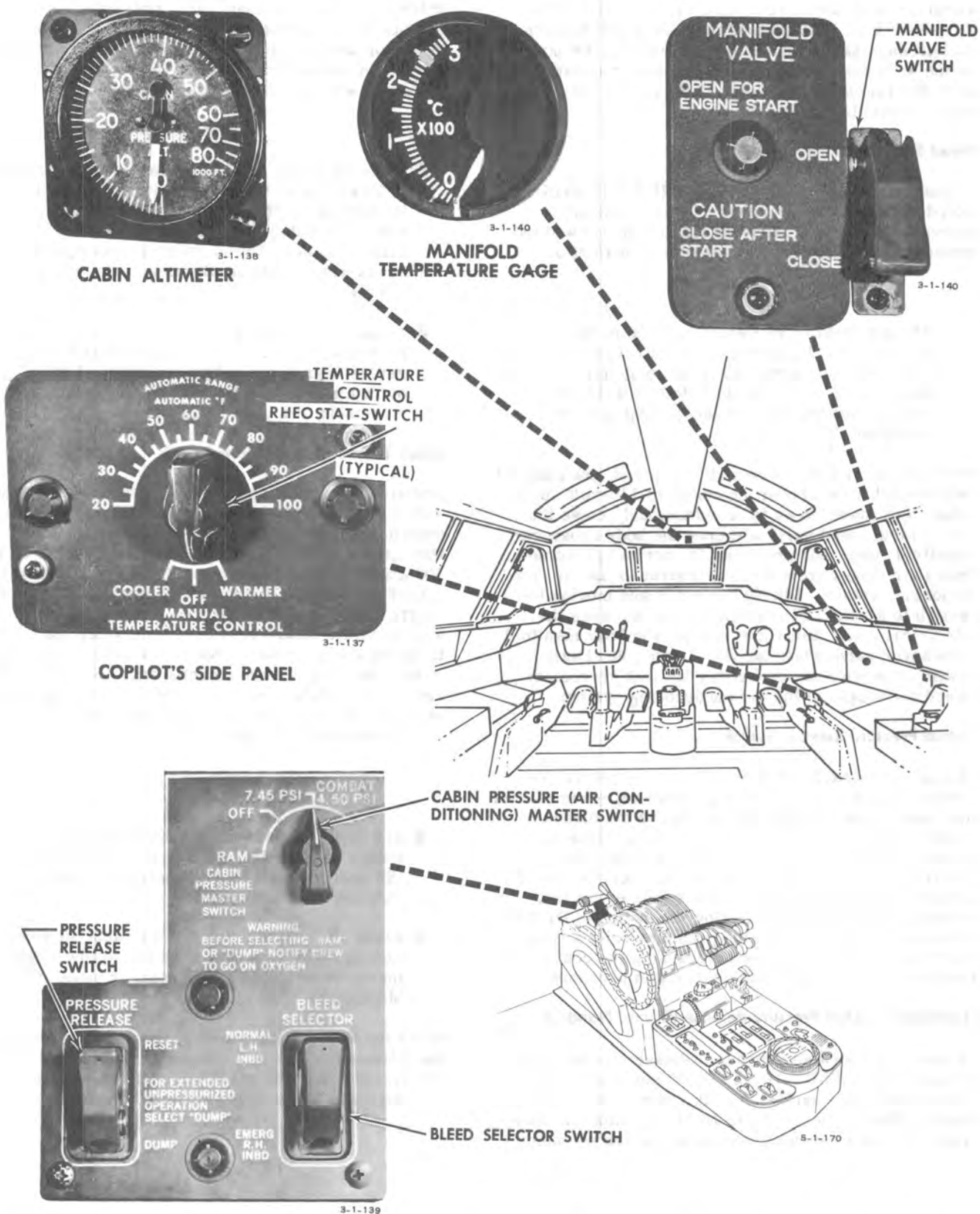
AIR CONDITIONING SYSTEM CONTROLS

Manifold Valve Switch

The OPEN--CLOSE manifold valve switch (figure 4-3) is described as part of the "Air Bleed System," Section I. OPEN position opens No. 1 strut bleed valve, No. 3 strut bleed valve, No. 4 strut bleed valve, and the body crossover manifold valve and removes all control from the bleed selector switch and the air conditioning master switch (figure 4-2). This position directs hot bleed air, interconnected between all engines (figure 1-30), to the air conditioning shutoff valve. CLOSE position closes No. 1 and 4 strut bleed valves and returns control of No. 3 strut bleed valve and the body crossover manifold valve to the bleed selector switch and the air conditioning master switch.

Cabin Pressure (Air Conditioning) Master Switch

A four-position RAM--OFF--7.45 PSI--COMBAT 4.50 PSI cabin pressure (air conditioning) master switch (figure 4-3) is on the aisle stand located between the stabilizer trim wheels, grouped with the pressure release and bleed selector switches, and is accessible to both pilots. Either RAM or OFF position shuts off the hot air supply to the air conditioning system by supplying 118-volt single-phase ac to close the air conditioning shutoff valve and, when the manifold valve switch is in CLOSE and the bleed selector switch is in NORMAL LH INBD position, to close the body manifold crossover valve while maintaining the No. 3 strut bleed valve closed. Also, RAM or OFF position removes TR control power and 118-volt single-phase ac from temperature control circuits preventing the 205-volt three-phase a-c operating power from reaching temperature modulating valve motors. The emergency cabin ram air scoop will be driven closed by 118-volt single-phase ac in every position of the switch except RAM position, which is used to open the ram air scoop. RAM position also dumps cabin pressure by supplying TR power to open the cabin pressure release solenoid valve. OFF position does not dump cabin pressure which, however, will bleed down by normal leakage. Both 7.45 PSI and COMBAT 4.50 PSI positions close the emergency ram air scoop while at the same time opening the air conditioning shutoff valve to admit bleed air to the air conditioning system from the air bleed system according to positions of the manifold valve switch and the bleed selector switch. Also, 7.45 PSI and COMBAT 4.50 PSI positions energize the temperature control circuits for either manual or automatic operation, and remove power from the cabin pressure



Air Conditioning Panels

Figure 4-3.

release solenoid valve which then closes to permit cabin pressurization according to selected schedule. COMBAT 4.50 PSI position provides a low differential pressurization schedule by connecting TR power to the 4.50 psi solenoid in the pressure regulator to shift the regulator from high (7.45 psi) to low pressure differential operation.

Bleed Selector Switch

A guarded NORMAL LH INBD--EMERG RH INBD bleed selector switch (figure 4-3) is on the aisle stand with the cabin pressure master switch and the pressure release switch accessible to both pilots.

NOTE

The manifold valve switch must be in the guarded CLOSE position and the cabin pressure (air conditioning) master switch must be in either 7.45 PSI or COMBAT 4.50 PSI position for the bleed selector switch to be energized.

With the bleed selector switch energized, the guarded NORMAL LH INBD position connects 118-volt single-phase a-c power so as to simultaneously close the No. 3 strut bleed valve and open the body crossover manifold valve thus providing the normal precooled bleed air supply from the No. 2 strut to the air conditioning system. Lifting the guard and moving the switch to EMERG RH INBD position reverses the electrical connections thus closing the body manifold crossover valve while the No. 3 strut bleed valve opens to provide an emergency hot (not precooled) bleed air supply to the air conditioning system.

Cabin Pressure Release Switch

A guarded RESET--DUMP cabin pressure release switch (figure 4-3) is on the aisle stand, grouped with the cabin pressure master switch and the bleed selector switch, accessible to both pilots. During pressurized operation, the switch will be in the guarded RESET position and will be energized by TR power through the cabin pressure master switch. Raising the guard and actuating the switch to DUMP position energizes the cabin pressure release solenoid valve to the open position causing the connected outflow valves to open and dump cabin pressure.

Emergency Cabin Pressure Release (Dump) Handles

An emergency cabin pressure release (dump) handle (figure 4-4) with DUMP--CLOSED positions is provided just above each side of the pressure bulkhead door. Moving the handle to DUMP position mechanically actuates the cabin pressure release solenoid

valve to open position causing the connected outflow valve(s) to open and dump cabin pressure. CLOSED position of the handle permits the cabin pressure release solenoid valve to return to the normal spring-loaded closed position allowing the outflow valve(s) to resume a selected pressurization schedule.

NOTE

- The emergency cabin pressure release handle is lockwired to CLOSED position to prevent inadvertent opening of the valve by partial actuation of either the outside or the connected inside handle. The lockwiring is designed to break when either handle is actuated intentionally.
- A guard is installed around the handle on the pressurized side of the door to prevent inadvertent depressurization caused by clothing or equipment catching on the handle during movement of a crew member.

Cabin Temperature Selector Switch

The rotary cabin temperature selector switch (figure 4-3) on the copilot's side panel is a combination switch-rheostat. Markings of "Automatic Range" with graduations marked "Automatic °F" from 20 to 100 and "Manual Temperature Control" with COOLER--OFF--WARMER positions indicate two modes of controlling cabin temperature, automatic and manual, with separate means of regulation. When the cabin temperature selector switch is set in the automatic mode, the temperature selected will not necessarily reflect the actual temperature of the crew members' stations but should be an approximate indication of the average cabin temperature.

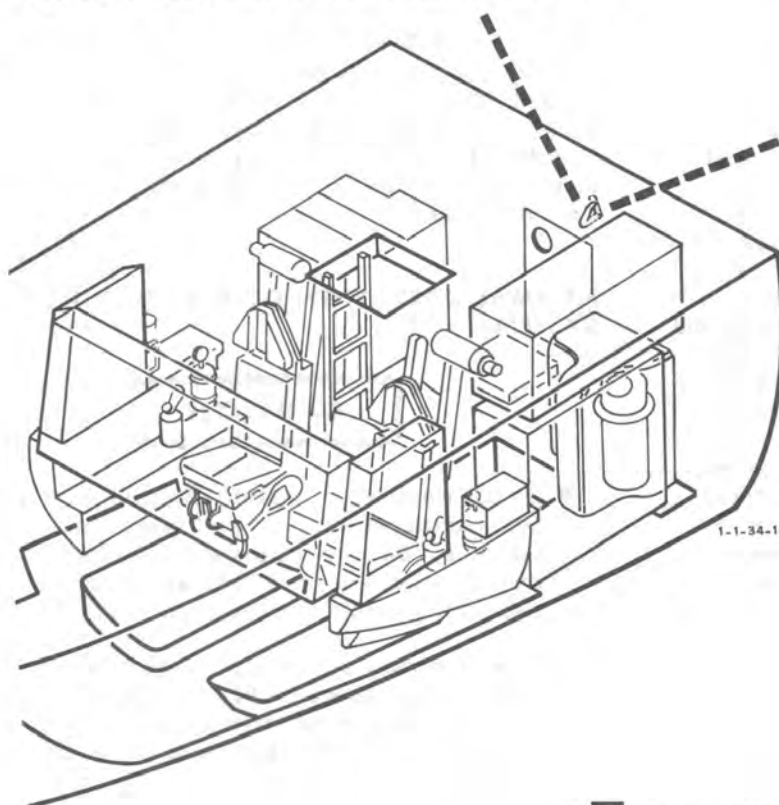
NOTE

- The cabin pressure (air conditioning) master switch must be in 7.45 PSI or COMBAT 4.50 PSI position for cabin temperature control circuits to be energized.
- Allow 15 to 20 minutes for the cabin temperature to stabilize at the selected setting when the cabin temperature selector is in AUTOMATIC.

When the knob is positioned on the graduated scale of the "Automatic Range," TR power is switched to the electronic automatic cabin temperature regulator for cycling cabin temperature modulation relays which



PRESSURE BULKHEAD DOOR—PRESSURIZED SIDE



UNPRESSURIZED SIDE

Emergency Cabin Pressure Release (Dump) Handles (Typical)

Figure 4-4.

connect 205-volt three-phase a-c power to the motor-driven cabin temperature modulating valve in the hot air duct, as required, to drive the valve toward open or toward closed in maintaining the temperature selected. Rotating the knob to OFF position removes the power from the cabin temperature modulating valve which then remains stopped at the last position to which cycled, causing a constant ratio of hot to cold air to be delivered to the cabin regardless of

temperature. Holding the knob momentarily from OFF to WARMER or COOLER position switches the TR power directly to the cabin temperature modulation relays to connect the 205-volt three-phase a-c power as necessary to reposition the cabin temperature modulating valve toward open for increased temperature or toward closed for decreased temperature, setting up a new constant ratio of hot to cold air in manual regulation of cabin temperature.

Air Outlet Controls

AIR OUTLET KNOBS. Two knobs marked "Air Outlet" (figure 4-2) at each crew station remotely control shutoff and quantity of airflow from outlets at that station and may affect the overall distribution as described under "Air Distribution." The knobs on the radar navigator's left sidewall, those between the EW officer and gunner, and those at the lower part of each end of the pilots' instrument panel are placarded "Pull to Open" for increased airflow. By an arrow-indicated turn-clockwise-to-lock feature, the knobs may be set at a desired intermediate point between all the way in and out. The air outlet knobs at the BNS and defense stations are grouped in a cluster with the auxiliary heat knob. The air outlet knob at the top of the cluster associated with the placard "upper" controls the head outlets airflow at that station. The air outlet knob associated with the placard "lower" controls foot outlets airflow at that station. For operation of BNS and defense station auxiliary heat knobs, see "Auxiliary Heat Knobs," this section.

HEAD OUTLETS. The pilots' head outlets (figure 4-2) do not have remote control knobs, but are regulated directly by the outlets themselves. Each pilot's movable head outlet, ball-mounted at the forward end of spray tube, may be opened or closed by 90° rotation of the cylindrical portion of the outlet. On early aircraft, the spray tube above each pilot's head is controlled by a knurled thumb lever which is rotated 90° outboard from the extended (off) position to open a sliding gate type valve for airflow from the spray tube holes. Each head outlet other than the pilots' has, in addition to remote control of shutoff and quantity at the station, a separate built-in control of the direction and amount of air flowing from the particular outlet. For control of airflow at individual air outlets, see "Normal Operation of Air Conditioning System," this section.

AUXILIARY HEAT KNOBS. A knob marked "Warmer" (figure 4-2) is grouped with the air outlet knobs beside the "Pull to Open" placard at the BNS station and the defense station. Pulling either knob out remotely controls a butterfly valve in the lower air supply duct for that station to increase the hot airflow and raise the temperature at the crew members' feet. An arrow-indicated turn-clockwise-to-lock feature provides for any desired intermediate setting of a knob between all the way in and out. Pulling the defense station knob to obtain warmer air decreases the cold air supplied to those foot outlets. Pulling the BNS station knob restricts hot airflow to both other crew stations (pilots' and defense) to force a greater proportion of the available hot airflow through BNS station foot outlets.

AIR CONDITIONING SYSTEM INDICATORS

Cabin Altimeter

The single pointer Type MA-2 cabin altimeter (figure 4-3) marked "Cabin Pressure Alt" on the eyebrow instrument panel or on the pilots' instrument panel is graduated to indicate cabin pressure altitude in 1000-foot increments to 50,000 feet, then in 5000-foot increments from 50,000 to 80,000 feet. The instrument is a self-contained unit requiring no external power source.

Cabin Airflow Low Warning Light

An amber press-to-test cabin airflow low warning light on the BNS airflow low lights panel (11, figure 4-40) is described as part of the bombing navigational system (BNS) in T.O. 1B-52E-1-6-1. The light is illuminated by action of a cabin airflow detector within a duct delivering piped cooling to electronic equipment when flow becomes insufficient to safely cool the equipment.

NORMAL OPERATION OF AIR CONDITIONING SYSTEM



- Do not run the air conditioning pack with the heat exchanger ram air duct plugs in place in the wing. Such operation will overspeed the expansion turbine-driven blower to destruction with possible damage to the aircraft.
- The necessary airflow for adequate equipment cooling above 54,000 feet flight altitude will require 93% rpm on engine 3 or 4 and a cabin temperature selection of 50° F or lower.
- To prevent possibility of damage to electronic or other equipment from water in the form of rain which is not removed from bleed air during a water injection takeoff, and to prevent windshield and instrument fogging, such takeoffs should be made with the air conditioning system on RAM. The system must then be returned to 7.45 PSI within 10 minutes after the cabin airflow low warning light illuminates to prevent overheat damage to the BNS equipment.

System Turn-on

For normal pressurized operation, the air conditioning system should be used from the ground up (except that ram air is used during takeoff) and is placed in operation as follows:

1. Emergency Cabin Pressure Dump Handle - CLOSED

CAUTION

For the cabin to be pressurized, the emergency cabin pressure dump handle must be set positively to CLOSED. If the dump handle is cocked slightly from the shallow CLOSED position detent, to which position it has been lockwired, the lockwire may be stretched or broken and cabin pressure may be inadvertently dumped.

2. Cabin Pressure Release Switch - RESET
3. Manifold Valve Switch - CLOSE
4. Bleed Selector Switch - NORMAL LH INBD
5. Cabin Pressure (Air Conditioning) Master Switch - 7.45 PSI (or COMBAT 4.50 PSI may be selected, according to operational requirements)

CAUTION

When EVS window washing action is initiated during RAM operation, the lines and pump will remain full of water until the cabin is pressurized. Line freeze should be expected if the aircraft is exposed to a low temperature environment prior to cabin pressurization.

NOTE

- Heating or cooling, according to cabin temperature selector switch settings and availability of pneumatic system hot air, is provided with the air conditioning master switch in 7.45 PSI (or COMBAT 4.50 PSI) whether the cabin is pressurized or not.
- During extended periods of unpressurized operation, move cabin pressure release switch to DUMP position in order to provide additional airflow for cooling of electronic equipment.
- If excessive noise tends to blank out interphone and radio communication, the air conditioning master switch may be positioned to RAM during low altitude operation at power settings which cause difficulty in communications. On climbout, return master switch to 7.45 PSI before reaching 10,000 feet.
- Use of RAM setting during low level operation for extended periods of time may result in BNS equipment and/or pressurization compartment overheating.

6. Cabin Temperature Selector Switch - AUTOMATIC (Set at desired temperature)

7. Air Outlet Knobs - Set

To obtain maximum comfort for all crew members, the optimum position for each control knob is shown in figure 4-5. Depending upon changes in altitude and differences experienced at the individual stations, the controls may be further adjusted with slight variations as necessary. With increased changes in control knob settings, air distribution may become unsatisfactory and it will then be necessary to return the control knobs to positions as specified in figure 4-5 before satisfactory control may be established. The pilots' head outlets should be fully closed at all times except during ground or low altitude operation. The auxiliary heat knob at the radar navigator's position should be initially full in until cabin temperature has stabilized. Pulling the radar navigator's auxiliary heat knob completely out will direct most of the hot air to the BNS station. This will have an adverse effect on controlling cabin temperature and, in the case of erratic temperature control, the position of this knob should be checked before attempting to adjust cabin temperature. With the knob pushed full in, unrestricted hot air will be distributed to all crew members and must be regulated individually at each station (figure 4-2). While operating at altitudes above 40,000 feet, it may be necessary to refer to the procedure outlined under "Electronic Equipment Cooling at High Altitudes," this section, to keep the cabin airflow low warning light extinguished.

Electronic Equipment Cooling at High Altitude

Altitude has a direct bearing on operation of the air conditioning pack. With the aircraft at high altitudes (above 40,000 feet), it may be necessary to accomplish a check of the following items in order to keep the cabin airflow low warning light extinguished. The check may also be used to determine that a system malfunction does not exist when erratic temperature control is experienced.

1. Throttle setting for engines 3 and 4: If possible, sufficient power to provide adequate airflow for electronic equipment cooling should be maintained (depending upon the flight condition) on these engines.
2. Position of cabin temperature selector switch: If it is necessary to maintain low power settings on engines 3 and 4, it will also be necessary to maintain a low cabin temperature setting. A cabin temperature setting which is lower than desired for comfort will position the cabin temperature modulating valve to a more closed position and force more bleed air through the air conditioning pack to provide electronic equipment cooling.
3. Position of air outlet controls: The air outlets will not need to be completely closed, but any reduction of airflow for crew outlets will tend to build up back pressure and furnish more air for electronic equipment cooling.
4. Position of radar navigator's auxiliary heat knob: This knob should be positioned full in, never full out. If the knob is pulled full out, most of the hot air will be

System Ground Operation

To obtain air conditioning for ground operation from a connected MA-3 weather simulator, place cabin pressure (air conditioning) master switch in RAM position. To obtain air conditioning for ground operation from an external air supply attached to the ground start connection at No. 3 nacelle, place bleed selector switch to EMERG RH INBD position and further operate per steps "5" thru "7" of "System Turn-On." Ground air conditioning may also be obtained from ground operation of an engine in No. 2 nacelle and system operation per steps "3" thru "7" of "System Turn-On."

EMERGENCY OPERATION OF AIR CONDITIONING SYSTEM

Failure of Water Separator

To prevent or minimize reduction of visibility from fogging caused by a failed water separator, the following procedures should be used:

1. During takeoff, increase the cabin temperature setting if fog streamers come from air outlets and tend to reduce visibility.
2. During descent, and at approximately 10,000 feet altitude, fog streamers in excess of 15 inches may issue from air outlets. Increase the temperature setting until fog streamers are reduced to approximately 6 inches in length.
3. During descent at approximately 5000 feet altitude, if fog streamers exceed 6 inches in length, turn the cabin pressure master switch to RAM and continue descent and landing.

Water Separator Freezeup

Frequent cases have been reported in which freezeup of the water separator has, due to pressure, resulted in blowing the connecting tube sleeve off. Separation of the sleeve located near the separator is normally accompanied by an explosive sound and loss of cabin pressurization. Normally, at medium and low altitudes, the blowoff of this tube is evidenced by dense fog in the wheel well area. The sleeve can be safely replaced if the clamps are not broken. To proceed with repair, immediately turn the cabin pressure master switch to RAM position and descend to 10,000 feet or below. Partial pressurization can be temporarily restored during descent by selecting a cabin temperature near the extreme hot position; however, this will result in loss of equipment cooling and uncomfortable cabin temperatures. Ordinarily, this means of partial pressurization should not be used except during emergency descent or last resort (EWO).

Failure of Normal Bleed Air Source on the Ground

For maximum safety and equipment life, emergency air bleed should not be selected for air conditioning while on the ground as there is a possibility of reach-

ing excessive duct temperatures and of reducing air conditioning pack bearing life. In case of failure of normal bleed air source for air conditioning on the ground, the following procedure should be observed:

1. BNS Equipment - OFF
2. Cabin Pressure Master Switch - RAM
3. Takeoff - Deferred until failure is remedied.

Failure of Normal Bleed Air Source in Flight

To regain air conditioning and pressurization in the event of failure of the normal bleed air source, place the bleed selector switch to EMERG RH INBD and monitor the manifold temperature gage. If NORMAL LH INBD bleed air is not available during a landing, the air conditioning master switch should be placed to RAM since the use of EMERG RH INBD bleed air during a landing will result in excessive manifold temperatures if a go-around is necessary.

WARNING

- When EMERG RH INBD is selected below 25,000 feet, the manifold temperature gage must be monitored closely since the bleed air is not precooled by a heat exchanger and the duct temperatures will be dependent on engine thrust settings, altitude, and OAT. Since the bleed air is not precooled, the distribution ducting may be subjected to temperatures up to 399° C (750° F) creating a potentially hazardous condition if fuel vapors are present in the wing leading edge and because of excessive temperatures at all of the hot air duct outlets. When the aircraft is below 25,000 feet, an explosive condition can exist in the wing by possible auto-ignition of accumulated fuel vapor in the duct area when the duct temperatures are above 246° C (475° F). Above 25,000 feet, this explosive condition no longer exists due to high auto-ignition temperature of fuel vapor at high altitude. A hazardous condition exists at all altitudes at the hot air outlets when combustible materials are stored on or close to the hot air duct outlets.
- Engines in outboard nacelles should not be considered an alternate source of emergency bleed air (by use of OPEN position of the manifold valve switch) since outboard sections of the air bleed manifold are not designed for such use and are therefore not insulated. As a result, the heat loss from the outboard air bleed manifolds is much greater than the heat loss from the inboard air bleed manifolds. This prevents accurate manifold temperature readings by the manifold temperature gage and can result in unindicated overheating of the outboard air bleed manifolds.

Operation With Emergency Bleed Air

When cabin pressurization cannot be maintained or cabin temperature regulated (by automatic or manual operation of temperature selector switch) while operating in NORMAL LH INBD position as outlined in this section, the procedures for emergency operation of EMERG RH INBD position should be followed.

WARNING

The bleed selector switch must be returned to NORMAL LH INBD position before descending below 25,000 feet unless a failure of the normal bleed air source has occurred. Excessive duct temperature may result if this operation is not accomplished. If EMERG RH INBD position must be selected, see "Air Bleed System Emergency Operation," Section III, for control of air bleed manifold temperatures.

If cabin heating problem is caused by overcooling of the bleed air supplied to the air conditioning system, the bleed selector switch may be placed to the EMERG RH INBD position to increase cabin heat and restore cabin pressurization. With the bleed selector switch in either position, the temperature control rheostat switch does not regulate the temperature of the hot air entering the pressurized compartment. It regulates only the volume of hot air coming from the hot air outlets.

WARNING

When operating in EMERG RH INBD position, the hot air entering the compartment could possibly ignite material such as cushions, cloth, or paper. Prior to placing the bleed selector switch in this position, the pilot shall direct crew members to confirm that all hot air outlets and adjacent areas are free from combustible materials.

When operating in EMERG RH INBD, the following procedures and those under "Air Bleed System Emergency Operation," Section III, must be followed to insure safe operation.

1. Recheck all exposed hot air ducts and inlets to insure no flammable articles are within 12 inches from air outlets or 6 inches from hot air ducts.
2. Select manual operation on the temperature control rheostat switch and hold in the COOLER position for 15 seconds.
3. Position the bleed selector switch to EMERG RH INBD.
4. Manually control cabin temperature by actuation of the temperature control rheostat momentarily to the WARMER position until there is adequate warm airflow.

Air Contamination Through Air Conditioning System

In case of a failure of an engine or a system in a nacelle supplying the air conditioning system causing oil or fumes to enter cabin, proceed as follows:

1. Crew Warning - Accomplish
2. Oxygen - 100%
3. Bleed Selector Switch - Place switch in position opposite to that in use (NORMAL LH INBD or EMERG RH INBD)
4. Continuing contamination on alternate source of bleed air indicates probable malfunction of the air conditioning pack, which should then be shut down by placing cabin pressure master switch in RAM position. This action also depressurizes the cabin and provides ram air ventilation.
5. Monitor engines in affected nacelle for signs of malfunction if alternate air bleed source cleared contamination of cabin.

NOTE

- Only the engine at the highest rpm of those connected to the air bleed system manifold will supply the manifold due to check valves at the air bleed ports on the engines. Therefore, by partially retarding the throttle of a suspected engine, it is possible to isolate that engine as a source of bleed air contamination.
- Check manifold temperature gage indication. With high engine thrust settings an open strut bleed valve (for any reason) can result in excessive temperatures in the distribution ducts causing strong odors and fumes to enter the cabin.

Failure To Regulate Cabin Temperature

NOTE

To provide accurate temperature control, do not obstruct the louvered airflow openings in the cabin temperature sensor case by placing briefcase, clothing, or other items in the area slightly aft and to the right of the gunner's station.

In case of difficulty in controlling cabin temperature, proceed as follows:

1. If the automatic control system fails to provide the proper temperature regulation, turn the cabin temperature selector switch to OFF position of "Manual Temperature Control." Then manually control cabin temperature by actuation of the switch momentarily to COOLER or to WARMER as necessary.

NOTE

To minimize overshooting of desired temperatures, on manual control, allow sufficient time between readjustments for cabin temperature to change, then make new changes in increasingly smaller increments.

2. If only hot air is available from the upper outlets, turn cabin pressure master switch to RAM when the cabin airflow low warning light glows since air at the same temperature is delivered to electronic equipment as from crew upper air outlets. Since cabin pressure will be dumped, crew will use oxygen as indicated under "Oxygen System," this section.

3. Complete loss of heat control (automatic and manual) usually indicates jamming of the cabin temperature modulating valve.

WARNING

- Failure of the cabin temperature modulating valve in full cold position is cause to abort flight at altitude. Since the system air is normally governed to 39° F, extended flight will result in supercooling of cabin temperature which will drop to a value near that of OAT.
- Failure of the cabin temperature modulating valve in the full hot position will result in overheating the navigators' compartment due to an uncontrollable hot air supply and will necessitate eventual evacuation of that compartment. If flight must be continued, it is recommended that descent be made to 10,000 feet or below with the pack turned OFF to maintain partial pressurization before switching to RAM position of the cabin pressure (air conditioning) master switch.

Depressurized flight at lower altitudes will be necessary to alleviate either extreme in temperature caused by failure of the cabin temperature modulating valve. The cabin temperature modulating valve is located in the immediate proximity of the air conditioning pack and an attempt can be made to free the butterfly part within the valve to restore normal control. This has been successfully accomplished by rapping the outer surface of the valve with a soft-faced tool such as a flight boot.

Failure of Cabin Pressurization System

In case of difficulty in maintaining cabin pressurization, a crew member should check the lower deck right side outflow valve to determine if the cabin lining has been sucked into the valve, blocking it in the open position. If this condition exists, the lining should be removed from the valve. (This valve is located in the area forward of the navigator's instrument panel.)

Filter Failure

Failure of the air conditioning system catalytic filter will cause a finely divided black powder to issue from

the cabin air outlets. In some cases, crew visibility will be totally obscured, and manual control of the aircraft will be marginal. Therefore, consideration should be given to engaging the autopilot as soon as filter failure is detected, to assist in maintaining a stabilized flight condition. All crewmembers should go on 100% OXYGEN and the air conditioning master switch should be turned to OFF. After the powder has settled, the air conditioning master switch should be turned to RAM and left in this position for the remainder of the mission.

WARNING

To avoid possible harmful effects of breathing the powder when failure of the filter occurs during flight, crew must go on 100% OXYGEN.

Releasing Cabin Pressure

If for any reason immediate release of cabin pressure is desired, place the cabin pressure release switch to DUMP or the cabin pressure master switch to RAM position. If these electrical means of dumping cabin pressure are not operable, turn the manual emergency cabin pressure dump handle to DUMP position. If it should become necessary to bleed cabin pressure down to zero differential in order to open the pressure bulkhead door, turn the cabin pressure master switch to OFF.

CAUTION

The BNS equipment must be turned OFF when the cooling airflow is stopped by turning off the air conditioning system.

Shutdown of Air Conditioning System Without Dumping Cabin Pressure

To shut down the air conditioning system in flight without dumping cabin pressure, turn the cabin pressure master switch to OFF position. However, the cabin will depressurize in a few minutes due to normal leakage and no ram air will be provided.

Repressurizing

To repressurize, check that:

1. Cabin Pressure Release Switch - RESET
2. Cabin Pressure Master Switch - 7.45 PSI (or COMBAT 4.50 PSI)
3. Emergency Cabin Pressure Dump Handle - CLOSED

ANTI-ICING

Anti-icing of engines, nacelles, scoops, windshield, windows, and pitot heads is provided. The anti-icing controls, except for EVS windows, are all grouped together at the left side of the pilots' instrument panel. A single switch provides connections to cause anti-icing of the engine inlet components, nacelles, and the air conditioning pack heat exchanger ram air scoop in the left wing by engine bleed air as well as the Q-spring ram air inlet and cabin emergency ram air scoop by an electric heater. The engine, nacelle, and scoops anti-icing switch provides inflight relay control of power used to open a solenoid valve which connects anti-icing bleed air to the AGM-69A environmental system ram air scoop located in the right wing leading edge (figure 4-6). This switch also controls the electric heaters for the angle of attack vanes. Two additional switches operate electrical heaters for all pitot tubes. A rotary switch provides selection of two heats in electrical operation of windshield anti-icing and defogging. An auxiliary window defog switch (3, figure 4-7) is used to allow window defog to be turned off during peak electrical load conditions as a power saving measure.

ENGINE, NACELLE, AND SCOOPS ANTI-ICING SYSTEM

Engine, nacelle, and scoops anti-icing (figure 4-6) is accomplished thermally by hot air bled from the engine high pressure compressors except for the Q-spring ram air inlet which is heated electrically. Engine inlet guide vanes and nose domes receive hot compressor bleed air independently, as an individual system on each engine, by means of a duct on each side of each engine, each duct having a thermal restrictor and a TR powered relay-controlled motor-driven shutoff valve. Nacelle anti-icing uses hot air from the air bleed system through a shutoff valve in each nacelle to prevent ice formation on the leading edges of the nose cowl, oil cooler inlets, and, on engines 1, 3, 5, and 7, generator cooling air inlets. For anti-icing each engine nose cowl, hot air from the shutoff valve is directed through a venturi at each engine to mix with ambient air drawn through ducts from the oil cooler inlet. The mixture provides sufficient volume at safe temperatures and pressures for anti-icing the engine nose cowl without need for overheat controls. The nacelle anti-icing shutoff valves are air actuated, fail-safe-to-closed, and solenoid-operated to open when the air bleed system is

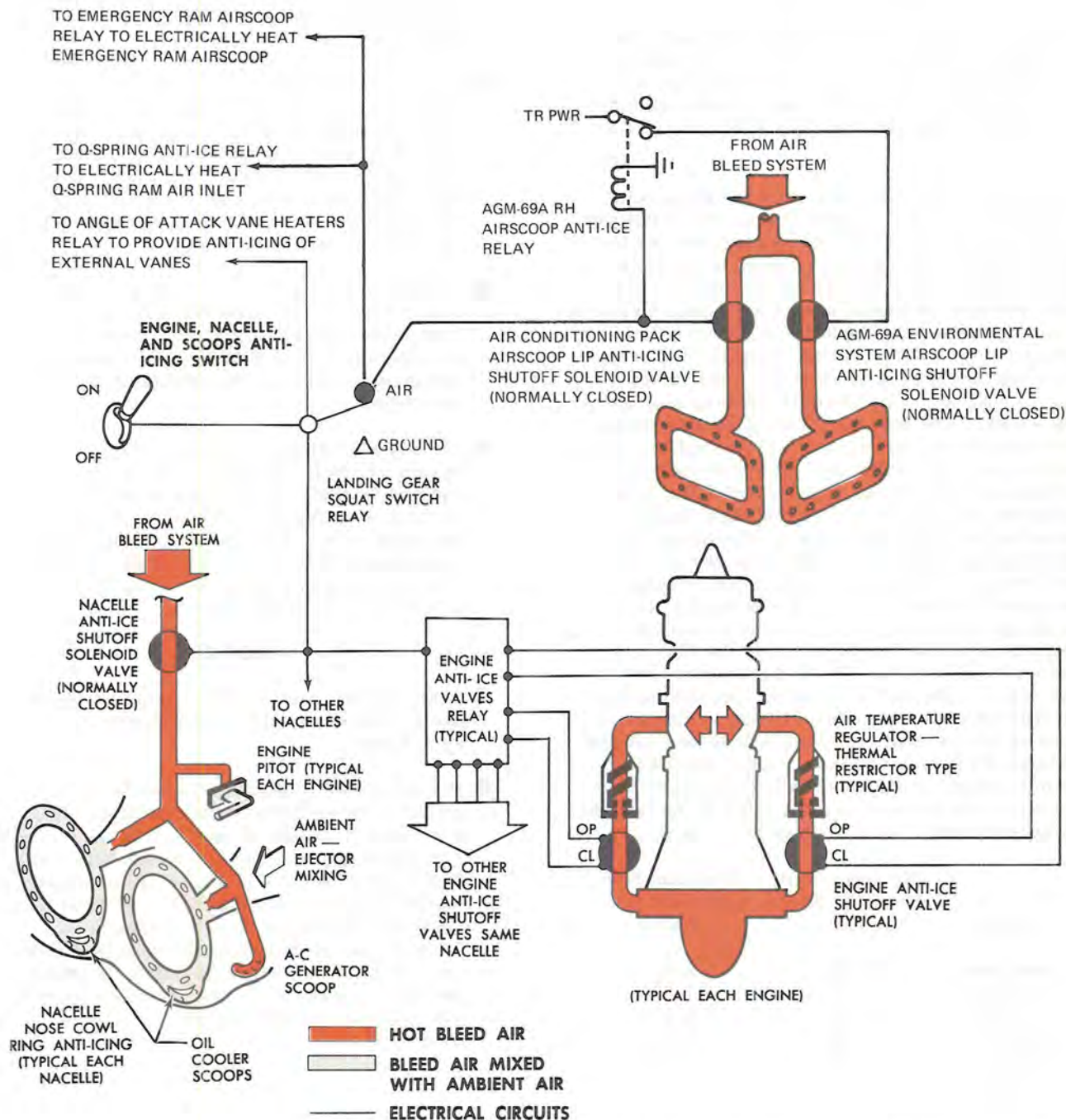
pressurized and the solenoid is energized by TR power. Engine and nacelle anti-icing shutoff valves are supplied TR power (left or right) through a circuit breaker numbered for each nacelle and marked "Pod Control" on the "Anti-Ice" portion of the load central circuit breaker panel with pods No. 1 and 2 on the left and No. 3 and 4 on the right respectively. The ram air scoop in the left wing, which supplies the ram air coolant to the air conditioning pack heat exchangers, and the right wing ram air scoop, receives anti-icing air from the air bleed system through a shutoff valve which is air actuated, fail-safe-to-closed, and solenoid-operated to open when the air bleed system is pressurized and the solenoid energized by TR power. The Q-spring ram air inlet is electrically anti-iced by 118-volt single-phase ac and relay controlled by TR power. The cabin emergency ram air scoop is electrically anti-iced by 118-volt single-phase ac and relay controlled by TR power. TR power to turn on both bleed air and electrical anti-icing of scoops is supplied through a circuit breaker marked "Air Scoop Shutoff Valve" on the "Anti-Ice" portion of the left load central circuit breaker panel and through the landing gear squat switch relay, when aircraft weight is off the wheels, for inflight use only. The AGM-69A air scoop anti-ice valve receives relay controlled TR power from the "RH Airscoop Anti-Ice" circuit breaker located on the RH forward d-c power panel. Relay control power is furnished from the "Airscoop Shutoff Valve" circuit breaker through the control panel switch (1, figure 4-7) and the landing gear squat switch relay.

Engine, Nacelle, and Scoops Anti-icing Switch

The ON--OFF engine, nacelle, and scoops anti-icing switch (1, figure 4-7) on the anti-ice control panel controls anti-icing of engine inlet components, nacelle leading edge areas, the ram air scoop lip in the left wing, cabin emergency ram air scoop, and the Q-spring ram air inlet area in the leading edge of the fin. The engine, nacelle, and scoops anti-icing switch controls anti-icing of the movable external guide vanes for the angle of attack computer in the AN/ASB-9A bombing navigational system. ON position makes the connections to supply TR power to energize the various solenoids and relays which cause the anti-icing air valves to open and turn on the electrical heater power. Also, when the engine, nacelle, and scoops anti-icing switch is ON and the air conditioning master switch is in RAM, the emergency cabin ram air scoop will cycle approximately

1 minute open and 15 seconds closed to prevent ice formation. OFF position deenergizes the solenoids

and relays, causing engine, nacelle, scoop, and vanes anti-icing to be shut off.



Engine, Nacelle, and Scoops Anti-icing System (Typical)

Figure 4-6.

Normal Operation of Engine, Nacelle, and Scoops Anti-Icing System

WARNING

Actuating the engine, nacelle, and scoops anti-icing above NRT settings may cause engine surge and flameout. Before turning on anti-icing, ascertain that the engine starter switches are in START. Do not turn starter switches OFF until rpm and EPR have stabilized.

Normal operation of engine, nacelle, and scoops anti-icing consists of turning the control switch ON before entering suspected icing conditions and turning the switch OFF as soon as there is no further need for anti-icing. Proper operation of the anti-icing system is indicated when a noticeable EPR drop on all engines is noted upon actuating the anti-icing control switch to ON. Engine, nacelle, and scoops anti-icing should remain on at all times during icing conditions. This includes static ground operation, taxiing, and takeoff. The engine and nacelle anti-icing system was designed to prevent the accumulation of ice in the inlet section of the engine, not to remove it. Thus, it is essential that icing conditions be anticipated. During night flights, an inadvertent encounter of icing conditions or unobserved ice build-up is more likely to occur. Therefore, whenever there is any indication or suspicion that icing conditions may exist, the engine, nacelle, and scoops anti-icing switch will be turned ON during night flights below 20,000 feet when the OAT gage reading is below 10°C. If ice should form, the engines will be operated at or above a minimum EPR that will maintain adequate anti-icing. Flying at a speed of 340 knots IAS or above will insure that the minimum EPR required to anti-ice is available. When flying below 340 knots IAS, the EPR must be kept above the minimum values noted in the table below by extension of airbrakes as necessary.

Altitude	Minimum EPR Below 280 Knots	Minimum EPR 280 KIAS and Above
	IAS	
Sea Level	1.61	1.50
5,000 ft	1.75	1.57
10,000 ft	1.83	1.63
15,000 ft	1.90	1.69
20,000 ft & up	1.95	1.75

CAUTION

- To prevent loss of thrust and possible engine damage due to ice ingestion, engine, nacelle, and scoops anti-icing will be turned ON prior to encountering ice.
- Indiscriminate or prolonged use of engine and nacelle anti-icing may cause cracking of inlet guide vanes. Anti-icing should be used only as necessary in prevention of icing and not for prolonged periods in dry air. When the possibility of encountering icing conditions no longer exists, engine and nacelle anti-icing should be turned off.
- No EPR drop noted on one or more engines upon actuating the engine and nacelle anti-icing control switch would indicate possible malfunction of the anti-icing system and known or suspected icing conditions should be avoided.
- If ice is inadvertently allowed to build up on the engine inlet, throttle setting should be reduced (if flight conditions permit) before anti-ice is activated to prevent or reduce engine damage. Throttle settings should be consistent with minimum EPR's for use of anti-ice heat and ignition should be turned ON until engine stabilizes.

NOTE

- Using engine, nacelle, and scoops anti-icing during takeoff results in a 5% increase in S₂ distance.
- Possible icing conditions are indicated by either of the following speed, temperature, and moisture combinations:
 1. Ground operation and at speeds below 250 knots IAS if the OAT is 8°C (47°F) or below and the dewpoint is within 2.3°C (4°F) of the OAT with or without visible moisture.
 2. Flight above 250 knots IAS with OAT true below 0°C (32°F) and with visible moisture present. Visible moisture is defined as rain, wet snow, or fog with visibility 1 mile or less.

Emergency Operation of Engine, Nacelle, and Scoops Anti-Icing System

No provisions are made for emergency operation of the engine, nacelle, and scoops anti-icing system.

PITOT ANTI-ICING

Left pitot tube heat is supplied 28 volt ac power through a circuit breaker marked "Left Pitot Tube Htr" on the "Flight Indicators" portion of the pilot's circuit breaker panel. Right pitot heat is supplied 28 volt ac power through a circuit breaker marked "RH Pitot Htr" on the "Miscellaneous" portion of the copilot's circuit breaker panel. Left and right pitot heat power is supplied through the circuit breakers described above to the left and right pitot tubes serv-

ing the parameter scheduling unit of the stability augmentation system (SAS). The altitude computer pitot heaters are supplied 118 volt ac power from two circuit breakers marked "LH" and "RH" on the "Altitude Computer Pitot Heat" portion of the pilot's circuit breaker panel. There is no emergency provision for pitot anti-icing.

Pitot Heat Switches

Left and right ON--OFF pitot heat switches (2, figure 4-7) are located on the left side of the pilots' instrument panel. ON position of each switch energizes the pitot tube and fairing heaters on the respective (left or right) side of the aircraft to prevent pitot tube stoppage by icing. OFF position removes power from the heaters.

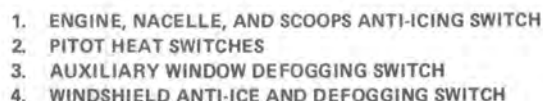


Figure 4-7.

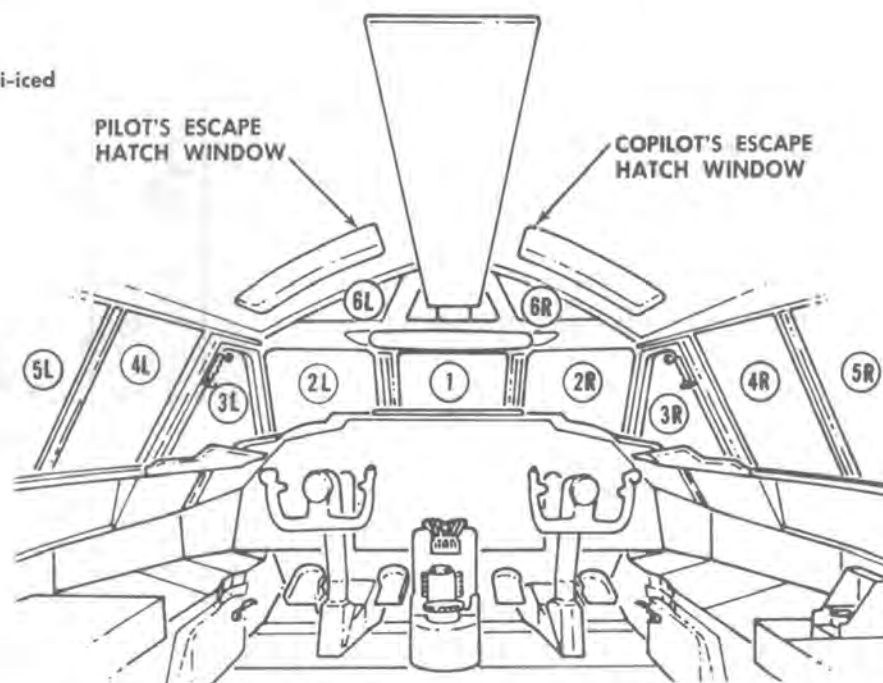
Pitot heat switches should be ON prior to takeoff or in flight whenever icing conditions are anticipated to prevent ice formation and loss of airspeed indication. Switches should be turned OFF after landing.

The main windshield windows and all auxiliary windows except the panes at each side of the upper center window are heated for anti-icing or defogging by means of transparent electrically conductive film between the glass laminations. The main windshield windows are numbered (figure 4-8) right and left from the center, which is No. 1 thru 4L & R, and are anti-iced by having the conductive film next to the outer pane. Inner surfaces of the main windows are defogged by part of the anti-icing heat being conducted through the laminated glass. The auxiliary windows include those numbered 5L & R, 6L & R, and the pilot's and copilot's escape hatch windows. The auxiliary windows, except 6L & R which are unheated, have the conductive film next to the inner pane with the primary purpose of defogging the inner glass surface. A-C power at the necessary voltages for heating the respective conductive films to the required operating temperature for each heated window is

supplied by 118-volt a-c autotransformers. The autotransformers are energized from circuit breakers on the pilot's and copilot's circuit breaker panels marked "Window Heat Power," "1," "2 Left" (and Right), "3 & 4 Left" (and Right), and Aux Windows Left" (and Right) when connected by relays actuated by left (or right) TR power through "Window Relays" or "Aux Window Relays" circuit breakers in the left (and right) load central circuit breaker panels as directed by the windshield anti-ice and defogging switch. Auxiliary window heating is controlled by a separate ON--OFF switch (3, figure 4-7) located on the "Anti-Ice Control" panel. Circuit breakers marked "Window Contr Units" on the left (and right) load central circuit breaker panels supply 118-volt a-c power to operate electronic temperature control units for automatically regulating anti-icing temperatures of the main windshield windows (1 thru 4L & R) as monitored by sensing elements in the respective conductive films. Heater power to the auxiliary windows is interrupted by individual thermal snap switches on the inner surface of each window as protection from overheating. The main windshield windows may be heated at either of two heating rates while only a single heating rate is provided for the auxiliary windows, as selected by the windshield anti-ice and defogging switch. Main windshield windows 3L & R are the pilot's and copilot's sliding windows. When either sliding window

NOTE

6L and 6R not anti-iced



Windshield and Window Numbering

Figure 4-8.

is opened, a limit switch also opens causing power to be removed from the autotransformer supplying both 3L (or R) and 4L (or R) so main windshield windows 3 and 4 will neither one be anti-iced while the sliding window on that side is open.

Windshield Anti-Ice and Defogging Switch

The three-position OFF--NORMAL--HIGH rotary selector windshield anti-ice and defogging switch (3, figure 4-7) is located on the left end of the pilots' instrument panel. The switch electrically controls application of power to autotransformers supplying the respective window heater voltages as required. In OFF position, no power reaches the autotransformers and a-c power is removed from the main windshield window electronic temperature control units so windows will not be heated. NORMAL position causes the main windshield window power transformers to be energized to produce the lower of two output voltages for anti-icing the main windows with the necessary a-c power supplied to operate the electronic temperature control units. HIGH position switches connections to the main windshield window power transformers so they produce the higher output voltage required for anti-icing the main windows (1 thru 4L & R) under the most severe icing conditions.

Auxiliary Window Defogging Switch

Auxiliary window heating is controlled by a separate ON--OFF switch marked "Auxiliary Window Defog" (3, figure 4-7) located on the "Anti-Ice Control" panel. ON position causes the auxiliary window power autotransformers to be energized to heat the auxiliary windows for defogging.

Normal Operation of Windshield Anti-Icing and Window Defogging

NORMAL position of the windshield anti-ice and defogging switch will give the longest main windshield service life and will provide satisfactory anti-icing and defogging under normal flight conditions. The following procedure is recommended:

1. Turn windshield anti-ice and defogging switch to NORMAL prior to takeoff. Leave the switch in this position as long as satisfactory anti-icing and defogging is obtained.

CAUTION

To prevent damage to the heated windows, operate on NORMAL 15 minutes before turning switch to HIGH position.

2. The switch should be set to HIGH at any time the NORMAL setting does not provide satisfactory anti-icing or defogging of main windshield windows.
3. Turn the switch to OFF after landing.

Emergency Operation of Windshield Anti-Icing and Window Defogging

In case of arcing at the power terminals on the heated windows, arcing at the sensing element, cracking, or discoloration or bubbles in the windows, immediately pull the individual circuit breakers for each affected window autotransformer. These circuit breakers, as

previously noted, are located on the pilot's and copilot's circuit breaker panels and marked for identification with the respective windows as shown on figure 4-8.

NOTE

- Do not pull the window control units and relays circuit breakers located on the left and right load central circuit breaker panels for an individual window malfunction since these circuit breakers each provide power for control of heat to more than one window.
- The structural integrity of a cracked window may be checked by sliding a hand across the inner surface to feel for the crack. Since the inner pane of a heated window is the primary structure, a crack in only the outer pane will not impair the strength. (Unheated windows, 6L and 6R, are made of laminated plastic and carry the load on the outer surface.)

ANGLE OF ATTACK VANES ANTI-ICING

To insure operation of the angle of attack feature of the terrain avoidance system, 118-volt a-c power is provided for anti-icing of the exterior angle of attack vanes through a controlling circuit breaker marked "Vane Heaters" which is located on the auxiliary BNS circuit breaker panel. The engine, nacelle, and scoops anti-icing switch will energize the vane heaters circuit.

EVS TURRET WINDOW ANTI-ICING

Anti-icing and defogging of the FLIR and STV turret windows is provided when the FLIR and STV turret air switches on the EVS environmental power control panel are placed on. The FLIR window is made out of germanium and contains a sensor which is connected to a temperature controller to maintain a temperature range from 86°F to 98°F. This germanium window is used as an electrical semiconductor, therefore, when the FLIR window heat system is energized, lethal voltage is present on the window surface. The temperature controller is connected through a squat switch relay to prevent inadvertent FLIR window heat operation while the aircraft is on the ground. Heating power is 118-volt ac. Control power for the FLIR window temperature controller is right TR through a circuit breaker marked "FLIR Environmental Control" on the EVS circuit breaker panel. The STV window is heated by means of transparent electrically conductive film between the glass laminations. This window contains a sensor which is connected to a temperature controller to maintain a temperature range from 86°F to 98°F. The STV window heat system is not connected to the squat switch and may be operated safely while the aircraft is on the ground. Heating power is 118-volt ac through three circuit breakers marked "STV Window Heater" on the EVS circuit breaker panel. Control power for the STV window temperature controller is left TR through a circuit breaker marked "STV Environmental Control" on the EVS

circuit breaker panel. For additional control information, see "EVS Environmental Power Control Panel" under "Electro-Optical Viewing System (EVS)," this section.

COMMUNICATION AND ASSOCIATED ELECTRONIC EQUIPMENT

The communication and associated electronic equipment (figure 4-9) includes an interphone system, UHF command radio, Line-of-Sight (LOS) radio set **AU**, Air Force Satellite Communications System (AFSATCOM) terminal **AU**, liaison radio, TACAN radio, omni-range radio, glide slope equipment, marker beacon receiver, radar altimeter, rendezvous radar, IFF radar, radar warning receiver, fire control radar, doppler radar, automatic astrocompass, AJA-1 true heading computer system, N-1 compass system, and BNS radar. For antenna locations, see figure 4-11.

INTERPHONE SYSTEM AN/AIC-10A

A transistorized interphone system provides intercommunication between the crew stations, transmission and reception on UHF command and liaison radio sets, and reception of audio signals from specialized receivers. Control panels (figure 4-10) vary according to station requirements. The pilot's, copilot's, instructor pilot's, radar navigator's, navigator's, instructor navigator's, gunner's, EW officer's, and defense instructor's stations each have a control panel containing a selector switch and five mixing switches. In addition, each of the above-named stations, with the exception of the gunner's, has an auxiliary interphone panel containing an additional five-mixing switches. The selector switch is used for selecting transmitting and receiving channels. The mixing switches permit simultaneous monitoring of channels essential to the station. Stations of limited use (forward wheel well) utilize interphone and call functions only. Only direct battery power is used to power the system, all stations being in parallel. Normal power is from the aft battery bus and emergency power from the forward battery bus. The power is supplied to the system through a circuit breaker marked "Main Inph Pwr" located on the pilot's circuit breaker panel. Additional circuit breakers are in series with the main system circuit breaker to protect various interphone panels as follows:

Panel	Circuit Breaker Location	Nomenclature
P, N, G	R Fwd BNS Panel	Inph Pwr
CP, RN, EW	Copilot's Panel	Inph Pwr
IP, IN, DI	EW Officer's Panel	Inph Pwr
Main Ext Pwr and Fwd Wheel Well	FCS Panel	Inph Pwr

TYPE	DESIGNATION	FUNCTION	OPERATOR	HORIZONTAL RANGE	LOCATION OF CONTROLS
INTERPHONE	AN/AIC-10A	Intercrew communication	Any crewmember		Each crew station
UHF COMMAND	AN/ARC-164	Short range, two-way voice and code communication	Pilot and Copilot	75 to 270 miles	Pilots' overhead panel
UHF COMMAND NO. 2 Less AU	AN/ARC-34				
UHF LINE-OF-SIGHT (LOS) RADIO AU	AN/ARC-171(V)	Short range two-way voice communications	Pilot and Copilot	Line-of-sight. Range varies with altitude	Pilots' overhead panel
AIR FORCE SATELLITE COMMUNICATIONS SYSTEM TERMINAL AU	AN/ASC-19	Communications using satellite as relay	Gunner	Line-of-sight via satellite	Gunner's station
LIAISON RADIO	AN/ARC-65 W173 W180 Less BL AN/ARC-190 W173 W180 BL AN/ARC-58 W181	Long range, two-way voice and code communication	Copilot	800 to 1500 miles	Copilot's side panel
TACAN RADIO	AN/ARN-118	UHF navigation	Pilot and Copilot	300 miles	Pilots' overhead panel
OMNI RANGE RADIO	AN/ARN-14	Indicates lateral alignment with runway and used for VHF navigation	Pilot and Copilot	Line-of-Sight	Pilots' overhead panel
GLIDESLOPE	AN/ARN-31	Indicates glide angle for landing	Pilot and Copilot	15 miles	Operates through omni range radio
MARKER BEACON	AN/ARN-32	Receives location marker signals on navigation beam	Pilot and Copilot	Low altitude	Operates through omni range radio
RADAR ALTIMETER	AN/APN-150	Measures terrain clearance	Pilot		Pilots' instrument panel
RENDEZVOUS RADAR	AN/APN-69	Aerial rendezvous	Navigator	150 to 200 miles	Navigator's side panel
IFF RADAR	AN/APX-64	● Aircraft recognition ● IFF Mode 4	Pilot	Line-of-Sight	Pilot's side panel

Figure 4-9 (Sheet 1 of 2).

N-1 COMPASS SYSTEM		Provides heading reference	Navigator		Navigator's station
BNS RADAR (COMPONENT OF AN/ASQ-38(V))		Provides bombing, navigation, and low level flight assist	Pilot, Copilot, and Radar Navigator		Pilot, copilot, and radar navigator's station
AUTOMATIC ASTROCOMPASS SYSTEM (COMPONENT OF AN/ASQ-38(V))	MD-1	Provides heading reference	Navigator		Navigator's station
AJA-1 TRUE HEADING COMPUTING SYSTEM (COMPONENT OF AN/ASQ-38(V))	AN/AJA-1	Provides heading reference	Navigator		Navigator's station
DOPPLER RADAR (COMPONENT OF AN/ASQ-38(V))	AN/APN-89A	Ground speed and wind drift	Navigator		Navigator's side panel
BOMBING NAVIGATION SYSTEM (COMPONENT OF AN/ASQ-38(V))	AN/ASB-16	Bombing and navigation	Radar Navigator		Radar navigator's station
ELECTRO-OPTICAL VIEWING SYSTEM EVS	AN/ASQ-151	Low level flight assist	Pilot, Copilot Radar Navigator and Navigator	Line of Sight	Pilot, copilot, radar navigator, and navigator's stations
FIRE CONTROL SYSTEM	AN/ASG-15	Fire control	Gunner		Gunner's station

Communication and Associated Electronic Equipment

Figure 4-9 (Sheet 2 of 2).

Interphone System Controls

INTERPHONE SELECTOR SWITCH. A selector switch (7, figure 4-10) on each crew member's interphone panel has CALL--INTER--COMM--LIA--AUX UHF--PVT INTER positions. When any selector switch is held in CALL position (the switch is spring-loaded away from this position), all stations are contacted simultaneously regardless of their selector switch positions. INTER position provides normal interphone communication between crew members. COMM, LIA, and AUX UHF positions permit corresponding transmission and reception via UHF command, liaison, and auxiliary (No. 2) UHF command less **AU**, line-of-sight (LOS) **AU** radios. PVT INTER position provides another interphone channel identical in function to the normal channel and can be used at the same time for private or extended communication between two or more crew members.

NOTE

When the call channel is energized, it is not necessary to depress any mike switches to talk on this channel, as the mike switches are bypassed. Use the call channel only in emergencies or to direct someone to another facility.

INTERPHONE VOLUME CONTROL KNOB. A volume control knob (8, figure 4-10) on each interphone panel regulates the volume level received at that station. Normally the volume control knob should be set at or less than the midposition (approximately 9 to 12 o'clock position). When the volume control knob is rotated beyond the midposition, distortion becomes excessive. When the auxiliary listen switch is in AUX LISTEN position, the volume control knob is ineffective. It is also ineffective at all stations except the forward wheel well stations when the auxiliary listen switch is in NORMAL position and the call channel is energized.

AUXILIARY LISTEN SWITCH. An auxiliary listen switch (6, figure 4-10) on each interphone panel is used to provide listening facilities at that station if the amplifier in that panel fails. This switch has NORMAL--AUX LISTEN positions and is lockwired in the NORMAL position. If the amplifier in the panel should fail, breaking the lockwire and positioning the switch to AUX LISTEN will permit a crew member to listen to one facility at a time at that panel. If the panel has mixer switches and they are off or if the panel does not have mixer switches, the facility heard will be selected by the selector switch. If the panel has mixer switches and any of them are on, the facility heard will be the one associated with the farthest left switch which is on.

NOTE

The mixer switches on the interphone control panel take precedence over the auxiliary mixer switches on the auxiliary interphone control panel.

MIXER SWITCHES. The mixer switches (figure 4-10) on the pilot's, copilot's, radar navigator's, navigator's, EW officer's, gunner's, instructor pilot's, instructor navigator's, and defense instructor's interphone panels allow them to monitor channels essential to individual crew positions. Placing one or more mixer switches to the ON (up) position provides listening to the corresponding channel(s) simultaneously with transmission or reception on any other channel selected on the interphone selector dial. The mixer switches allow listening to the interphone system, UHF command radio, liaison radio, auxiliary (No. 2) UHF command less **AU**, line-of-sight (LOS) **AU**, TACAN or omni-range radio, and marker beacon (pilot, copilot, navigator, radar navigator, instructor pilot, and instructor navigator), APN-69 (pilot, copilot, navigator, radar navigator, instructor pilot, and instructor navigator), ALR/46 warning rcvr (EW officer, gunner, and defense instructor), ALR-20/20A (EW officer and defense instructor) and IFF mode 4 (pilot).

INTERPHONE POWER SWITCH. An ON--OFF interphone power switch (figure 4-10) is located on the pilot's side panel. ON position provides direct battery power to the pilot's, copilot's, instructor pilot's, radar navigator's, navigator's, instructor navigator's, EW officer's, gunner's, and defense instructor's interphone facilities. In addition, when positioned to ON, direct battery power is supplied to the two interphone facilities in the left forward wheel well provided the battery switch is ON. The interphone power switch also controls operation of the battery detector systems. See "D-C System" under "Electrical Power Supply Systems," Section I.

NOTE

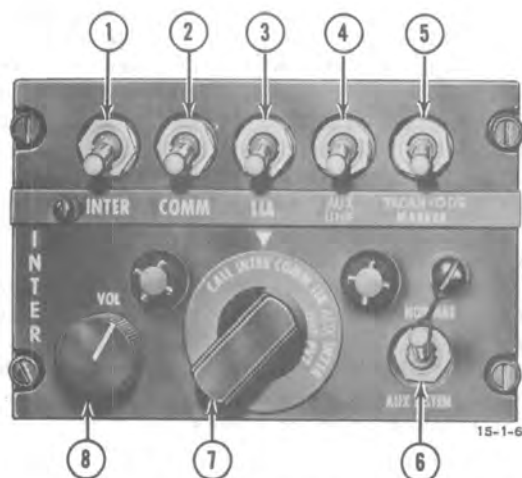
This switch provides a direct connection of a portion of the interphone system to the batteries independent of the battery switch. To conserve batteries, this switch should be placed in OFF position whenever a-c power is lost or removed from the aircraft and the interphone system is not to be operated.

CALL BUTTON. A call button (12, figure 4-10) on the interphone panel at the forward wheel well, when pressed down, is used to call all other stations on the call channel.

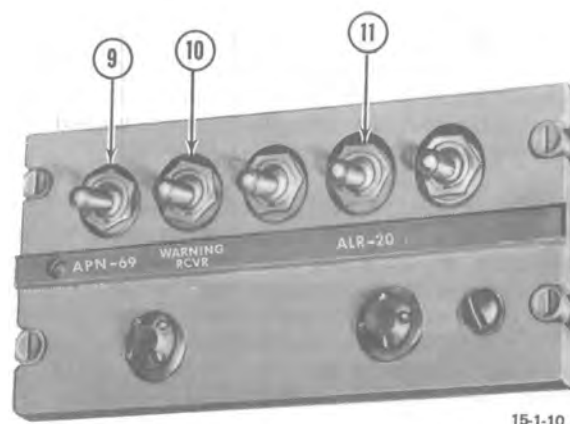
NOTE

The call button cover must be removed before the button can be depressed.

TRIGGER SWITCH. A trigger switch (figure 4-10) on the pilot's and copilot's control wheels has three positions, INTER--OFF--MIKE, and is spring-loaded to OFF position. When the switch is held in MIKE position, the crew member may speak through the facility selected with the interphone selector switch. When the switch is held in INTER position, the crew member can speak on the interphone channel only. The purpose of the trigger switches is to provide the



TYPICAL INTERPHONE PANEL FOR THE PILOT, COPILOT, INSTRUCTOR PILOT, RADAR NAVIGATOR, NAVIGATOR, INSTRUCTOR NAVIGATOR, EW OFFICER, DEFENSE INSTRUCTOR, AND GUNNER



TYPICAL AUXILIARY MIXER SWITCHES FOR THE PILOT, COPILOT, INSTRUCTOR PILOT, RADAR NAVIGATOR, NAVIGATOR, INSTRUCTOR NAVIGATOR, EW OFFICER, AND DEFENSE INSTRUCTOR



INTERPHONE POWER SWITCH, PILOT'S SIDE PANEL



TYPICAL TRIGGER SWITCH ON PILOT'S AND COPILOT'S CONTROL WHEELS



TYPICAL INTERPHONE PANEL FOR THE FORWARD WHEEL WELL



HAND SWITCH FOR THE INSTRUCTOR PILOT, INSTRUCTOR NAVIGATOR, AND DEFENSE INSTRUCTOR STATIONS.



FOOT SWITCH FOR THE RADAR NAVIGATOR, NAVIGATOR, EW OFFICER, AND GUNNER.

- | | |
|---|---|
| 1. INTERPHONE MIXER SWITCH | 9. APN-69 MIXER SWITCH (PILOT, COPILOT, NAVIGATOR, RADAR NAVIGATOR, INSTRUCTOR PILOT, INSTRUCTOR NAVIGATOR) |
| 2. COMMAND RADIO MIXER SWITCH | 10. ALR-46 WARNING RCVR MIXER SWITCH (EW OFFICER, DEFENSE INSTRUCTOR) |
| 3. LIAISON RADIO MIXER SWITCH | 11. ALR-20/ALR-20A MIXER SWITCH (EW OFFICER, DEFENSE INSTRUCTOR) |
| 4. AUXILIARY COMMAND MIXER SWITCH | 12. IFF MODE 4 (PILOT) CALL BUTTON |
| 5. TACAN ODR MARKER MIXER SWITCH (PILOT, COPILOT, NAVIGATOR, RADAR NAVIGATOR, INSTRUCTOR PILOT, INSTRUCTOR NAVIGATOR) | |
| 6. AUXILIARY LISTEN SWITCH | |
| 7. INTERPHONE SELECTOR SWITCH | |
| 8. INTERPHONE VOLUME CONTROL KNOB | |

Interphone System Controls (Typical)

Figure 4-10.

pilots with a microphone switch and a quick method for speaking on the interphone without changing the selector switch. When the interphone selector switch is in CALL position, the trigger switch need not be actuated to speak to the crew.

FOOT SWITCH. A foot switch (figure 4-10) on the floor at the EW officer's, radar navigator's, navigator's, and gunner's stations is the microphone switch for the respective crew member. When the switch is depressed, the crew member may speak through the facility selected with the interphone selector switch. When the interphone selector switch is in CALL position, the foot switch need not be depressed in order to speak to the crew.

HAND SWITCH. The instructor pilot's, instructor navigator's, and defense instructor's interphone stations are equipped with a microphone hand switch (figure 4-10). When the switch is depressed, the crew member may speak through the facility selected with the interphone selector switch.

Normal Operation of Interphone System

WARNING

Except when specifically cleared by the aircraft commander, all crew members must be on interphone at all times as the interphone is considered the primary means for crew warning.

To transmit or receive over any interphone facility, observe the following procedure:

1. Pilot places interphone power switch to ON position.
2. Turn volume knob to or slightly less than its midpoint (approximately 9 to 12 o'clock position). Reception will become distorted if volume is turned too high.
3. Turn interphone selector switch to desired facility (e.g., COMM, LIA). It is necessary to hold CALL switches or buttons in position.

NOTE

As only the pilots can turn on or select channels on the UHF command, liaison, and omni radios, it will be necessary for other crew members to contact these stations on interphone and request the respective set be turned to the desired channel.

4. Close mike switch to talk. The speaker will hear only his own voice unless someone else is speaking on CALL.

5. Place mixer switch(es) in ON (up) position for any channel(s) to be monitored except the channel to which the interphone selector (wafer) switch is set. Adjust radio volume for balanced reception with either the respective mixer switch ON or the interphone selector switch set to that radio, but not both. Placing both the mixer switch and the interphone selector switch to a particular channel doubles the effective volume of that channel at that interphone panel; adjusting the radio volume control with such a setting effectively cuts the volume in half at other stations, making monitoring of the radios and interphone very difficult.

Emergency Operation of Interphone System

In an emergency, the interphone system can be operated from the forward battery by placing the emergency battery switch in EMERGENCY position. This provides normal interphone operation for all stations.

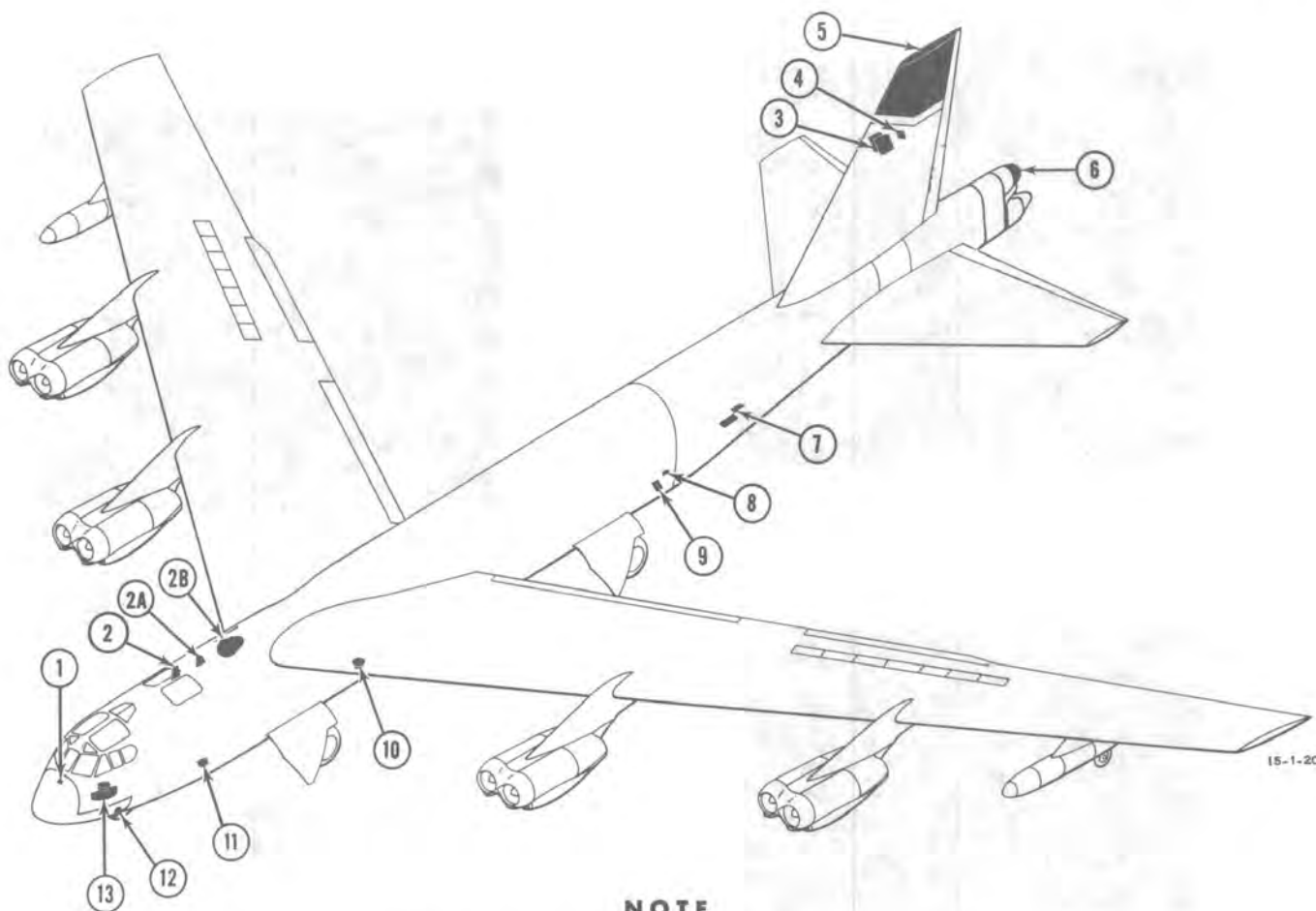
UHF COMMAND RADIO AN/ARC-34

Less **AU**

The AN/ARC-34 radio, in the auxiliary UHF position, provides voice and modulated code communication from aircraft to aircraft and aircraft to ground. There are 1750 frequencies available in steps of one-tenth of a megacycle within the frequency range of 225.0 to 399.9 megacycles. Any 20 frequencies may be preset in any order at the control panel (figure 4-12) located on the pilots' overhead panel. If it is desired to tune to a frequency other than one which has been preset, that frequency may be set manually without disturbing any of the preset channels. Receiver and transmitter tuning is automatically completed after a channel or frequency change. Both a main receiver and a preset guard receiver are provided to permit a selected frequency and the guard frequency to be received simultaneously.

NOTE

No transmission will be made on emergency (distress) frequency channels except for emergency purposes. For test, demonstration, or drill purposes, this radio equipment will be operated in a shielded room to prevent transmission of messages that could be construed as actual emergency messages.



NOTE

FOR ECM ANTENNA LOCATIONS REFER TO T.O. 1B-52D-1-2

- | | | | |
|-----|---|-----|-------------------------|
| 1. | GLIDE SLOPE ARN-31 | 6. | FCS SEARCH RADAR |
| 2. | UHF COMMAND NO. 2 RADIO Less AU | 7. | RADAR ALTIMETER APN-150 |
| | UHF LINE-OF-SIGHT (LOS) RADIO ARC-171 AU | 8. | MARKER BEACON ARN-32 |
| 2A. | IFF (UPPER) | 9. | UHF COMMAND RADIO |
| 2B. | AFSATCOM ASC-19 AU | 10. | DOPPLER RADAR APN-89A |
| 3. | OMNI-RANGE RADIO ARN-14 | 11. | TACAN |
| 4. | RENDEZVOUS RADAR BEACON APN-69 | 12. | IFF (LOWER) (FLUSH) |
| 5. | LIAISON RADIO | 13. | BNS RADAR |

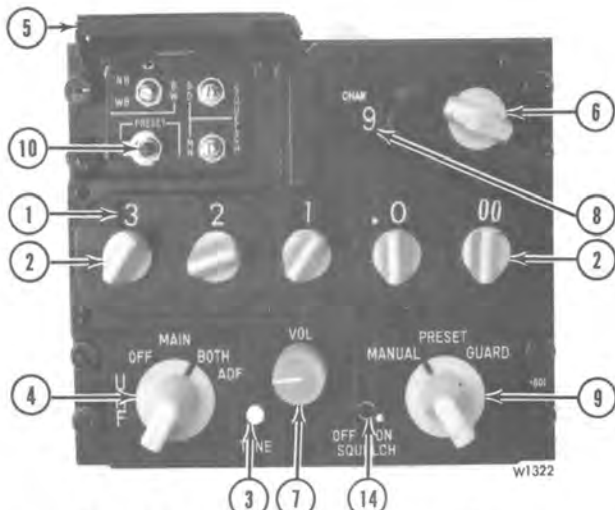
.....Antenna Locations (Except ECM)

Figure 4-11.

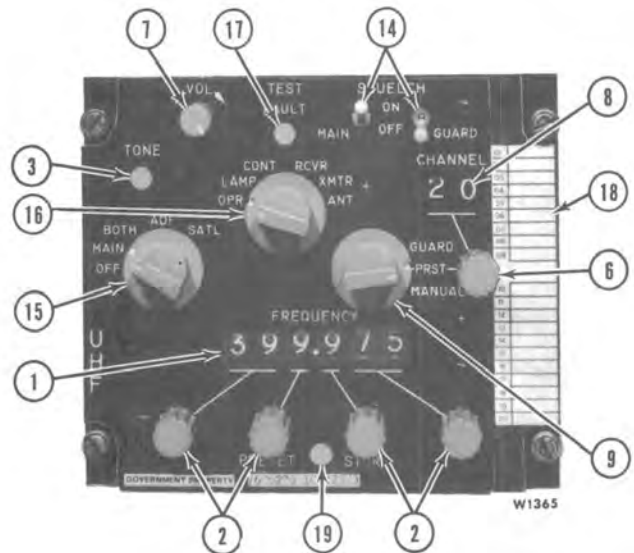
The AN/ARC-34 radio set has its own antenna as shown in figure 4-11. The No. 2 auxiliary UHF radio antenna is located as shown on the top of the fuselage just forward of the wing. The No. 1 AN/ARC-164 antenna is located as shown on the bottom centerline of the aircraft just aft of the aft wheel well. The two UHF antennas are so installed so that their radiation patterns complement each other thus eliminating "blind spots." When both No. 1 and 2 radios are operated simultaneously, more efficient operation may result if the radios are tuned at least one half of a megacycle apart. The No. 2 AN/ARC-34 set operates on TR power provided through a

circuit breaker marked "Aux UHF Com" located on the right load central circuit breaker panel. The following values of range for various aircraft altitudes are typical for the AN/ARC-34 radio set:

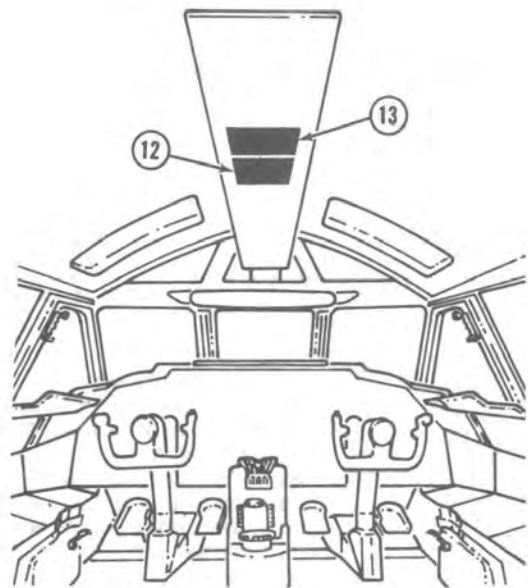
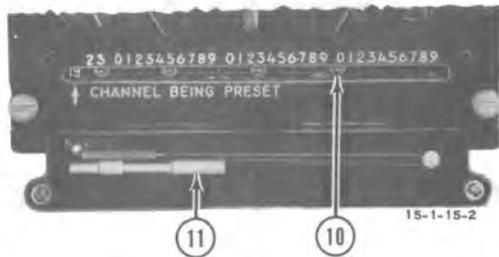
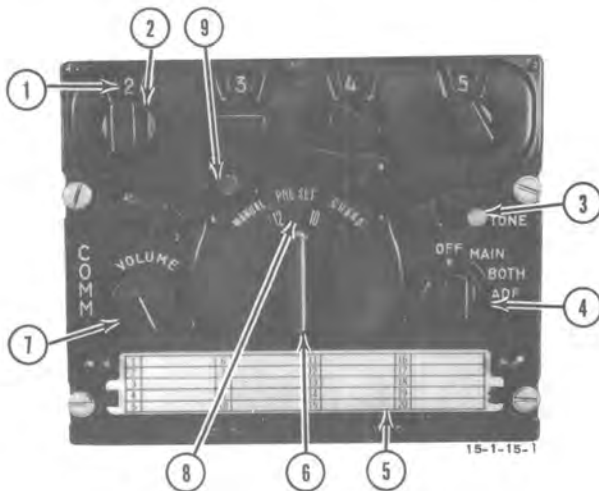
Altitude (1000 feet)	Average Range (Nautical miles)
50	270
40	240
30	210
20	170
10	120



AN/ARC-164(V) COMMAND UHF



AN/ARC-171(V) LINE-OF-SIGHT UHF AU



AN/ARC-34(V) AUXILIARY UHF Less AU

1. MANUAL FREQUENCY INDICATORS
2. MANUAL FREQUENCY SELECTOR KNOBS
3. TONE BUTTON
4. OFF-MAIN-BOTH-ADF SWITCH
5. PRESETTING COVER AND FREQUENCY CHART
6. PRESET CHANNEL SELECTOR SWITCH
7. VOLUME CONTROL KNOB
8. PRESET CHANNEL INDICATOR
9. MANUAL-PRESET-GUARD SWITCH

10. CHANNEL PRESETTING BUTTONS
11. FREQUENCY PRESETTING TOOL
12. COMMAND UHF
13. AUXILIARY UHF Less AU LOS UHF AU
14. SQUELCH SWITCH
15. FUNCTION SELECTOR SWITCH
16. TEST INITIATE SELECTOR SWITCH
17. TEST FAULT LIGHT
18. PRESET FREQUENCY WRITE-ON CHART
19. PRESET STORE BUTTON

UHF Command Radio Controls

Figure 4-12.

ARC-34 UHF Command Radio Controls

MANUAL FREQUENCY SELECTOR KNOBS. The manual frequency selector knobs (2, figure 4-12) located on the UHF command radio control panel are used to set up any of the operating frequencies other than those already available on the preset channels. This does not disturb any of the preset channels. The manual-preset-guard switch must be in MANUAL position before the dial numbers above the control knobs will become visible. Each knob is turned until the proper digit appears in the window.

TONE BUTTON. The tone button (3, figure 4-12) located on the UHF command radio control panel energizes an oscillator and turns on the transmitter when depressed and held. A continuous tone is transmitted until the button is released.

OFF-MAIN-BOTH-ADF SWITCH. A four-position rotary switch (4, figure 4-12) located on the UHF radio control panel has OFF--MAIN--BOTH--ADF positions. The set is inoperative in the OFF position. When in MAIN position, the transmitter and main receiver are operative at the same frequency. The guard receiver is inoperative and the guard frequency can be received only if it is one of the preset channels or if it is manually set up using the manual frequency control knobs. In BOTH position, it is possible to transmit on a selected frequency and simultaneously receive the main receiver frequency and the fixed guard receiver frequency. The ADF position is not used on this aircraft configuration.

PRESET CHANNEL SELECTOR SWITCH. A rotary-type preset channel selector switch (6, figure 4-12) located on the UHF radio control panel is used to select any one of 20 preset frequencies.

VOLUME CONTROL KNOB. A volume control knob (7, figure 4-12) located on the UHF radio control panel is used to adjust the volume of both main and guard receivers. However, receiver output cannot be reduced below a fixed audible level.

MANUAL-PRESET-GUARD SWITCH. A MANUAL--PRESET--GUARD switch (9, figure 4-12) located on the UHF radio control panel selects the method of frequency selection. In MANUAL position, the covers over the digit windows are retracted, exposing the frequency numbers. The frequency can then be set using the manual frequency selector knobs. Preset channels can be checked or changed without disturbing the MANUAL operating frequency. The preset channel number is covered in this switch position and PRESET and GUARD are seen through a green window. PRESET position allows the preset channel selector to be used to select any one of 20 preset frequencies. MANUAL and GUARD are covered by a

green window. In GUARD only position, the main receiver and transmitter are operative even though the off-main-both-ADF switch is set to BOTH position. The guard frequency is set up prior to installing the equipment in the aircraft and can be changed only by removal of the control panel. MANUAL and PRESET can be seen through a green window.

CHANNEL PRESETTING BUTTONS. The channel presetting buttons (10, figure 4-12) located on the presetting drum behind the drum cover are used for presetting channel frequencies. Each channel has four buttons and only one channel is accessible at a time. With the drum cover open, the preset channel selector is turned to rotate the presetting drum until the desired channel appears in the opening. The presetting tool then can be used to position the preset buttons under the digits corresponding to the frequency. Only the channel number appearing on the left end of the drum is used for reference when presetting.

FREQUENCY PRESETTING TOOL. A small tool (11, figure 4-12) located on the back of the drum cover (5, figure 4-12) is used to position the frequency preset buttons on the preset drum. Access to the tool and preset drum is gained by opening the drum cover.



Do not set the preset buttons or select a frequency on MANUAL that is below 225.0 megacycles (the lowest operating frequency) as the automatic tuning mechanism cannot set up on that frequency and will hunt. If the set does not channel within 2 minutes or is shut down by a protective relay, reset to a frequency within the operating range. Turn the off-main-both-ADF switch to OFF, then to BOTH position and allow approximately 1 minute for the set to resume operation.

ARC-34 UHF Command Radio Indicators

MANUAL FREQUENCY INDICATORS. The manual frequency indicators (1, figure 4-12) located on the UHF radio control panel consist of four windows which indicate the manual operating frequency set by the manual frequency selector knobs. The manual-preset-guard switch must be on MANUAL before the frequency numbers will appear in the windows indicating that manual selection is possible.

PRESET CHANNEL INDICATOR DIAL. An indicator dial (8, figure 4-12) indicates the channel to which the preset channel selector switch is set. The dial numbers are visible only when the manual-preset-guard switch is on PRESET.

Normal Operation of ARC-34 UHF Command Radio

To put the set in operation on a preset command frequency and the fixed guard frequency, proceed as follows:

1. Off-Main-Both-ADF Switch - BOTH

NOTE

A minimum warmup time of 1 minute that includes a 4-second tuning cycle is required before operating the command radio.

2. Manual-Preset-Guard Switch - PRESET
3. Preset Channel Selector Switch - Set to desired channel
4. Volume Control Knob - Turn clockwise to approximately the one o'clock position

To turn the set off:

1. Off-Main-Both-ADF Switch - OFF

To select frequencies manually:

1. Off-Main-Both-ADF Switch - MAIN or BOTH
 2. Manual-Preset-Guard Switch - MANUAL
- Ascertain that the tabs in the frequency indicator windows have retracted, exposing the numbers.
3. Manual Frequency Selector Knobs - Set to desired frequency

NOTE

Operator should wait approximately 4 seconds for tuneup and the set will be ready for operation.

To transmit and receive on the guard frequency:

1. Off-Main-Both-ADF Switch - MAIN or BOTH
2. Manual-Preset-Guard Switch - GUARD

Emergency Operation of ARC-34 UHF Command Radio

If the set fails to tune properly, the difficulty often can be corrected by switching to a different channel or trying either of the two remaining positions on the manual-preset-guard switch. If this fails, turn the set off for a few minutes and try again.

UHF COMMAND RADIO AN/ARC-164**NOTE**

One AN/ARC-164 command radio is installed in the command UHF radio position. On aircraft less **AU** one AN/ARC-34 radio is installed in the auxiliary UHF position. On aircraft **AU** one AN/ARC-171 (V) line-of-sight (LOS) radio is installed in the auxiliary UHF position.

The UHF command radio is a short range set for air-to-air or air-to-ground voice communications. The set includes two antennas, (2 and 9, figure 4-12), a transmitter, two receivers (guard and main), and a control panel, (figure 4-12) on the overhead panel. The UHF frequency range is 225.0 to 399.975 megahertz. There are 7000 frequencies available in steps of .025 of a megahertz. Twenty frequencies can be preset in any order within the operating range of the equipment. Rotating the preset channel selector (6, figure 4-12) to a channel number gives the desired frequency. Selection of any one of the 7000 frequencies is possible by using the manual function of the set. The transmitter and main receiver tune to the same operating frequency. The guard receiver is set to a predetermined frequency and cannot be changed in flight. The 28 volt DC power supply for command radio No. 1 is through a circuit breaker marked "Command Radio" located on the aft d-c power box.

NOTE

- No transmission will be made on emergency (distress) frequency channels except for emergency purposes. For test, demonstration, or drill purposes, this radio equipment will be operated in a shielded room to prevent transmission of messages that could be construed as actual emergency messages.
- When the aircraft is equipped with ice-tread tires, radio noise is generated in the No. 1 UHF command radio during the takeoff roll and the landing roll.
- When both command radios are operated, more efficient operation may result if radios are tuned at least one-half megahertz apart.

The following values of range for various aircraft altitudes are typical for the UHF command radio:

ALTITUDE (1000 FEET)	AVERAGE RANGE (NAUTICAL MILES)
50	270
40	240
30	210
20	170
10	120

ARC-164 UHF Command Radio Controls

MANUAL FREQUENCY SELECTOR KNOBS. Five knobs (2, figure 4-12) across the control panel are for selection of any frequency within the operating range of the equipment. The knobs are used to manually select frequencies when the manual-preset-guard switch is in MANUAL, and to preset frequencies into memory when used in conjunction with the preset button (10, figure 4-12) with the manual-preset-guard switch in PRESET.

TONE BUTTON. The tone button (3, figure 4-12) located on the UHF command radio control panel energizes an oscillator and turns on the transmitter when depressed and held. A continuous tone is transmitted until the button is released.

OFF-MAIN-BOTH-ADF-SWITCH. The rotary selector switch (4, figure 4-12) has four positions: OFF--MAIN--BOTH--ADF. With the switch in the OFF position, the command radio is deenergized. In the MAIN position the set transmits and receives on the selected frequency but the separate receiver for the guard frequency is not heard. BOTH indicates simultaneous reception from both the main and guard receivers. ADF function is not operable.

PRESET CHANNEL SELECTOR SWITCH. The preset channel selector switch (6, figure 4-12) is operative when the MANUAL--PRESET--GUARD switch (6, figure 4-12) is in the PRESET position. To select one of the twenty preset frequencies, refer to the frequency chart at the upper left corner of the panel for the corresponding channel number, then rotate the selector knob until the channel number appears in the channel indicator (8, figure 4-12) adjacent to the selector.

VOLUME CONTROL KNOB. A volume control knob (7, figure 4-12) on the UHF radio control panel is used to adjust the volume of both main and guard receivers. However, receiver output cannot be reduced below a fixed audible level.

MANUAL-PRESET-GUARD SWITCH. Frequencies on the UHF command radio can be selected by three methods. A rotary switch marked MANUAL--PRESET--GUARD (9, figure 4-12) provides the three methods. In the MANUAL position, the frequency selector knobs (2, figure 4-12) are used to quickly select an operating frequency without disturbing the preset frequencies. The manually selected frequency appears in the windows across the panel. Rotating the selector to PRESET shifts control of the frequency control to the preset channel selector (6, figure 4-12) and preset button (10, figure 4-12). In the GUARD position, the transmitter and main receiver operate on a fixed frequency and the guard receiver is not heard. The fixed frequency cannot be changed in flight.

CHANNEL PRESETTING BUTTON. The channel presetting button (10, figure 4-12) is located under the presetting cover and frequency chart and is used to set preset channel frequencies. A preset frequency can be changed by setting the OFF--MAIN--BOTH--ADF Switch (4, figure 4-12) to MAIN and the

manual-preset-guard switch (9, figure 4-12) to PRESET. Turn the preset channel selector switch (6, figure 4-12) to the desired channel number. Set the desired frequency on the manual frequency windows with the frequency selector knobs (2, figure 4-12). Lift the frequency chart cover and press the preset button (10, figure 4-12). Record new preset frequency on the frequency chart adjacent to appropriate channel number.

ARC-164 UHF Command Radio Indicators

MANUAL FREQUENCY INDICATORS. The manual frequency indicators (1, figure 4-12) on the UHF radio control panel consist of five windows which indicate the manual operating frequency set by the manual frequency selector knobs.

PRESET CHANNEL INDICATOR DIAL. An indicator dial (8, figure 4-12) indicates the channel to which the preset channel selector switch is set. The dial numbers correspond to frequency numbers on the frequency chart (5, figure 4-12).

Normal Operation of ARC-164 UHF Command Radio

To put the set in operation on a preset command frequency and the fixed guard frequency, proceed as follows:

1. Off-Main-Both-ADF Switch - BOTH
2. Manual-Preset-Guard Switch - PRESET
3. Preset Channel Selector Switch - Set to desired channel
4. Volume Control Knob - As desired

To turn the set off:

7. Off-Main-Both-ADF Switch - OFF

To select frequencies manually:

1. Off-Main-Both-ADF Switch - MAIN or BOTH
2. Manual-Preset-Guard Switch - MANUAL
3. Manual Frequency Selector Knobs - Set to desired frequency

To transmit and receive on the guard frequency:

1. Off-Main-Both-ADF Switch - MAIN or BOTH
2. Manual-Preset-Guard Switch - GUARD

Emergency Operation of ARC-164 UHF Command Radio

If the set fails to tune properly, the difficulty often can be corrected by switching to a different channel or trying either of the two remaining positions on the manual-preset-guard switch. If this fails, turn the set off for a few minutes and try again.

UHF LINE-OF-SIGHT (LOS) RADIO AN/ARC-171(V) **AU**

The AN/ARC-171(V) (line-of-sight) radio provides voice and modulated code communication from aircraft to aircraft and aircraft to ground. There are 7000 frequencies available in steps of 25 kHz within the frequency range of 225.0 to 399.975 MHz. Any 20 frequencies may be preset in any order at the control panel (figure 4-12) located on the pilots' overhead panel. If it is desired to tune to a frequency other than one which has been preset, that frequency may be set manually without disturbing any of the preset channels. Receiver and transmitter tuning is automatically completed after a channel or frequency change. Both a main receiver and a preset guard receiver are provided to permit a selected frequency and the guard frequency to be received simultaneously. The AN/ARC-171(V) radio control panel is installed aft of the UHF command radio control panel on the pilot's overhead panel. The AN/ARC-171(V) radio set has its own antenna (2, figure 4-11) and is located as shown on the top of the fuselage just forward of the wing. Power for the AN/ARC-171(V) is 118/205 VAC three-phase from the No. 3 generator bus through circuit breakers marked AFSATCOM R-T on the right load central circuit breaker panel. Control power is left TR from a circuit breaker marked AFSATCOM R-T on the right load central circuit breaker panel.

Line-Of-Sight Radio Controls and Indicators

FUNCTION SELECTOR SWITCH. The function selector switch (15, figure 4-12) selects the desired function and has OFF--MAIN--BOTH--ADF--SATL positions. OFF position removes power from the radio set or transfers control to the satellite terminal. MAIN position turns the main receiver-transmitter on in the receive mode. BOTH position energizes both the main and guard frequencies. SATL position transfers control to the satellite terminal at the gunner's station. ADF position is not used on this aircraft. However, the ADF position preempts the satellite terminal.

NOTE

When the function selector switch is in MAIN, BOTH or ADF position, the LOS radio preempts the satellite terminal.

MANUAL-PRESET-GUARD SELECTOR SWITCH. A MANUAL--PRESET--GUARD switch (9, figure 4-12) controls the mode of frequency selection: manual frequency when in MANUAL position, preset frequency when in PRESET position, and guard frequency when in GUARD position.

MANUAL FREQUENCY SELECTOR KNOBS. The four manual frequency selector knobs (2, figure 4-12) are used for selection of any one of 7000 frequency channels other than those already available on the preset channels. They have the capability of selecting any 25 kHz increment frequency from 225 thru 399.975 MHz.

MANUAL FREQUENCY INDICATORS. The manual frequency indicators (1, figure 4-12) located on the LOS UHF radio control panel consist of a six digit display which indicates manual operating frequency set by the manual frequency selector knobs.

PRESET CHANNEL SELECTOR SWITCH. A preset channel selector switch (6, figure 4-12) is used to select any one of 20 preset channel frequencies.

PRESET CHANNEL INDICATOR. An indicator (8, figure 4-12) indicates the channel to which the preset channel selector switch is set.

PRESET-STORE BUTTON. The PRESET-STORE button (19, figure 4-12) stores the selected frequency and channel into the control unit when pressed. A write-on chart (18, figure 4-12) for recording the 20 preset channels is provided on the front panel.

SQUELCH SWITCHES. The MAIN and GUARD squelch switches (14, figure 4-12) having ON--OFF positions disable the main or guard receiver squelch circuits when desired. When the squelch switches are ON, the squelch circuits are enabled. When they are OFF, the squelch circuits are disabled.

VOLUME CONTROL KNOB. A volume control knob (7, figure 4-12) located on the radio control panel is used to adjust the volume of both main and guard receivers.

TONE BUTTON. The tone button (3, figure 4-12) AM tone modulates the UHF transmitter when depressed and held. A continuous tone is transmitted until the button is released.

TEST INITIATE SELECTOR SWITCH. The test initiate selector (16, figure 4-12) has OPR--LAMP--CONT--RCVR--XMTR--ANT positions and tests the fault light, control, receiver, transmitter, and antenna when the corresponding position is selected. In OPR position, the system is in normal operation selected by the function selector.

TEST FAULT LIGHT. A red fault light (17, figure 4-12) is provided to indicate an equipment fault when in OPR mode, or a fault in an area selected for test by the test initiate selector switch when in CONT, RCVR, XMTR, or ANT positions.

Normal Operation of LOS Radio

To put the set in operation on a preset command frequency and the fixed guard frequency, proceed as follows:

1. Position function selector switch to BOTH. The LOS PMT light on the SATCOM control at the gunner's station will illuminate if the mode selector is ON.
2. Test initiate selector switch to OPR.
3. MAIN and GUARD SQUELCH switches to ON.
4. MANUAL-PRESET-GUARD selector switch to PRESET.
5. Set PRESET channel selector switch to desired channel.
6. Adjust VOL control knob to desired level.

For satellite operation:

1. Position function selector switch to OFF or SATL.

NOTE

When the function selector switch is in MAIN, BOTH or ADF position, the LOS radio pre-empt the satellite terminal.

To turn the set off:

1. Position function selector switch to OFF.

To select frequencies manually:

1. Position function selector switch to MAIN or BOTH.
2. MANUAL-PRESET-GUARD switch to MANUAL.
3. Set manual frequency selector knobs to desired frequency.

To transmit and receive on guard frequency:

1. Position function selector switch to MAIN or BOTH.
2. MANUAL-PRESET-GUARD switch to GUARD.

SATELLITE COMMUNICATIONS TERMINAL AN/ASC-19 AU

The AN/ASC-19 Air Force satellite communications system (AFSATCOM) terminal is a half-duplex (HDX) UHF single integrated operational plan (SIOP) communications terminal providing line-of-sight (LOS) and satellite communications. See figure 4-76 for general arrangement of SATCOM panels and equipment at the gunner's station. Satellite communications are controlled by the gunner and permit teletype satellite communication of UHF frequencies utilizing narrow band FSK (frequency-shift-keyed)

capability on certain selected preset satellite frequency plans or by alternate frequency selections. Frequency range of the system is 225 to 399.975 MHz selectable in 25 kHz increments. The satellite communications system utilizes the AN/ARC-171(V) receiver-transmitter with an FM output power of 100 watts delivered to a subsonic antenna. This antenna has a nominal 0 db gain with a maximum 1 db loss near the zenith and a maximum loss of 1 db near the horizon, thus providing nearly uniform upper hemispherical coverage without requiring operator selection of zenith or horizontal elements. Power for the receiver-transmitter is 118/205 volt ac three-phase from the No. 3 generator bus through circuit breakers marked AFSATCOM R-T; for the printer 118 volt single phase ac through circuit breaker marked CONTR PS & MODEM and for the SATCOM control panels 28 volt dc through circuit breakers marked AFSATCOM DC No. 1 and No. 2 and AFSATCOM R-T. All circuit breakers are on the right load central circuit breaker panel. The Automatic Send Receive (ASR) equipment consists of a keyboard unit, printer, and logic/power supply. The keyboard unit consists of the character and control keys, indicators, and displays necessary for the operator to prepare messages and select operating modes. The printer is capable of printing 100 words per minute with 20 characters per line. The logic/power supply unit contains the microprocessor, character memory and control logic to provide and accept data and control information for the printer and keyboard.

SATCOM Control Panel AU

The SATCOM Control Panel (Control-Indicator C-10357(V)1/A) provides full control of the Dual Modem (MD-1035/A) for single channel, half duplex operation over both the Lincoln Laboratory experimental satellite (LES) and AFSATCOM satellite for the 1BX configuration.

MODE SELECTOR. The mode selector switch, a seven-position rotary switch, (10, figure 4-12B), selects modes of SATCOM control operation. In OFF position, normal power to the dual modem, SATCOM control panel and receiver-transmitter are turned off. The BIT position is provided for localizing faults. It can be used for checking for a GO condition and fault localization. In the KEY position, the AFSAT sync code and alternate frequency plan can be displayed and modified via the six digit display and the three control indicator buttons which control three two-digit groups and the DISPLAY CONTROL button. In the OPR 1 position, AFSAT communication is in operation. OPR 2 position is reserved for future use and is presently inoperative. In OPR 3

position, LES mode is selected. In OPR 3/LOAD position, the six digit display is used as a real-time clock. In the LOAD position the LES sync code is loaded and verified via the keyboard by: entering COMP EDIT, selecting a buffer, typing in the sync code, pressing AUTO XMT and number of buffer sync code is in. Real time is set in LOAD and must be within 1 second of GMT to synchronize your terminal with the satellite in OPR-3.

NOTE

- If the mode selector is turned OFF or aircraft power is interrupted, the sync code and alternate frequency may have to be re-inserted and must be verified as correct after power is reapplied and prior to using equipment.
- When both the I/O FLT and XMT FLT annunciators are illuminated, real time cannot be altered in LOAD and the sync code or alternate frequency cannot be altered in KEY.

CONTROL INDICATOR BUTTONS. The control indicator buttons (11, figure 4-12B) in conjunction with the DISPLAY CONTROL button enter data displayed on the six digit display in KEY, OPR 1, and LOAD modes. Each button is associated with a two digit segment of the display.

DIGITAL DISPLAY. The digital display (12, figure 4-12B) is a red six digit display which can display fault indications; thumbwheel CHANNEL SELECT data, AFSAT sync code, alternate transmit frequency, time slot, and frame number; and time.

SLOT ANNUNCIATOR. The green SLOT annunciator (1, figure 4-12B) illuminates when the mode selector switch is set to OPR 1 and indicates that the time slot number is being displayed in the two left most digits directly under the SLOT annunciator. The time slot can be set with the control indicator button located directly below the corresponding display.

FRAME ANNUNCIATOR. The green FRAME annunciator (2, figure 4-12B) illuminates when the mode selector switch is set to OPR 1 and the dual modem is in the timed state. It indicates that the digits displayed below the FRAME annunciator are the frame number.

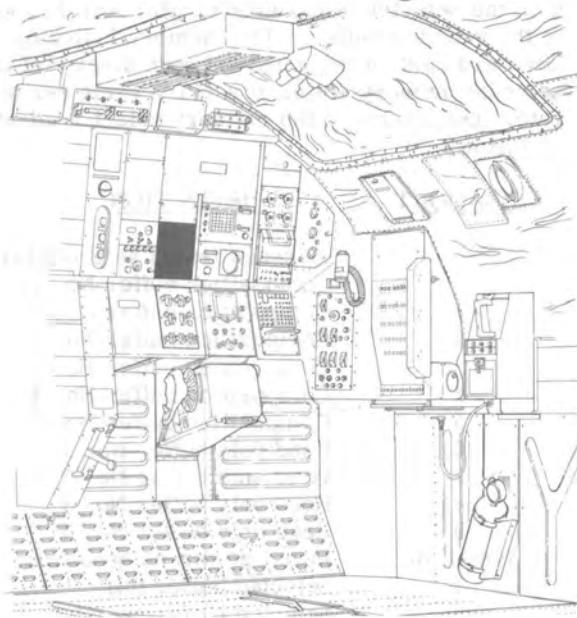
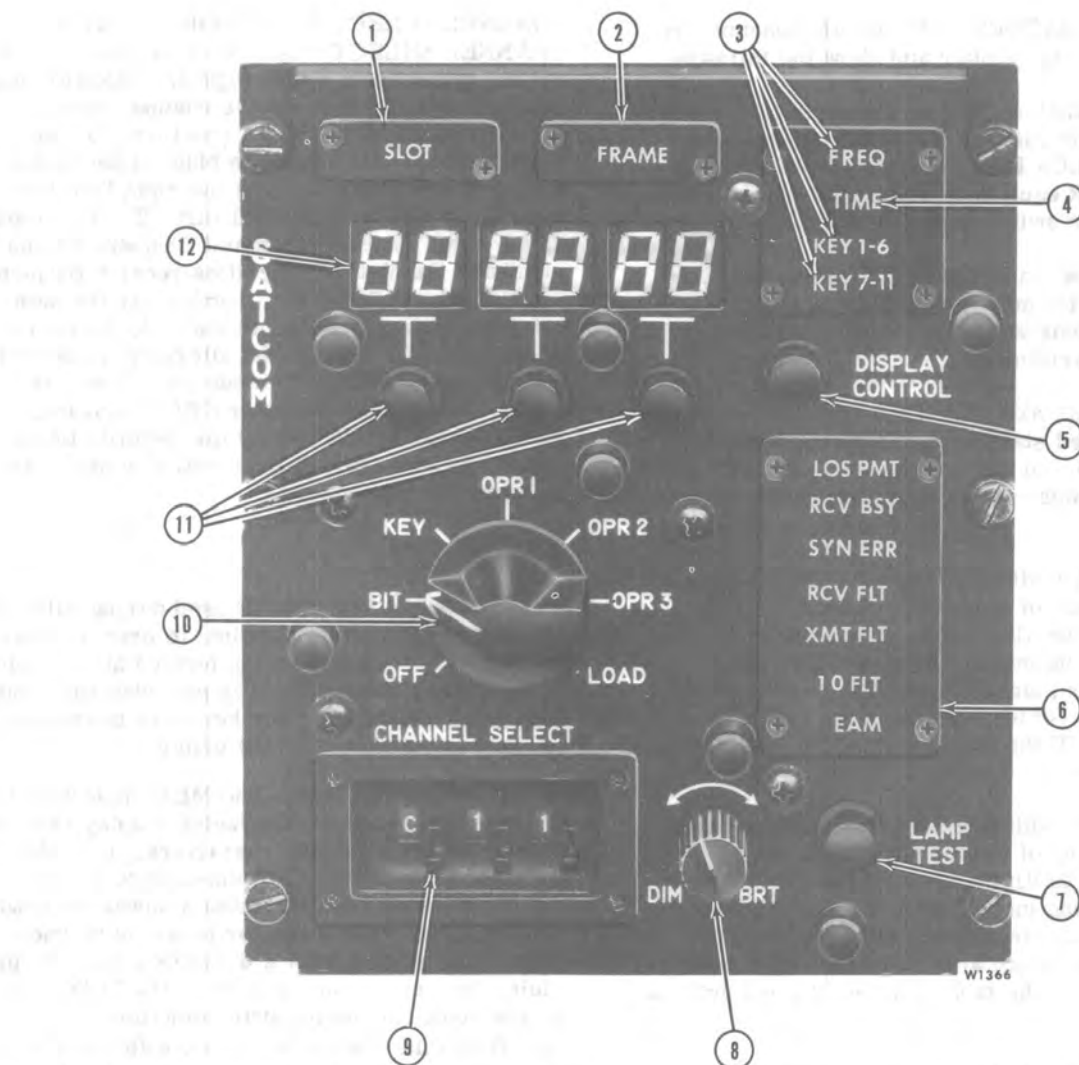
KEY MODE ANNUNCIATORS. The green key mode annunciators (3, figure 4-12B) are comprised of the KEY 1-6, the KEY 7-11 and FREQ annunciators. The KEY 1-6 annunciator illuminates when the KEY mode is first entered and indicates that the first six digits of the key are being shown in the display. The

values of the first six digits may be modified by pressing the buttons under the corresponding display when the KEY 1-6 annunciator is illuminated. Successively pressing the DISPLAY CONTROL button when in KEY mode causes KEY 1-6, KEY 7-11 and FREQ annunciators to illuminate in turn, so that every third depression of the DISPLAY CONTROL button causes the KEY 1-6 annunciator to illuminate. The KEY 7-11 annunciator indicates that the last 5 digits of the key are being shown. These digits may be modified by pressing the buttons under the corresponding display. The FREQ annunciator illuminates when the display is showing the ALT frequency. The digits may be modified by pressing the buttons under the corresponding digits.

TIME ANNUNCIATOR. The green TIME annunciator (4, figure 4-12B) illuminates when the mode selector switch is set to either OPR 3 or LOAD positions and indicates that the digital display is showing real-time. These digits may be modified by pressing the button under the corresponding display.

DISPLAY CONTROL BUTTON. The DISPLAY CONTROL button (5, figure 4-12B) is a switch that causes the display to change in different ways according to the mode selector switch position as follows:

- **BIT** - When a fault is detected, execution of tests is stopped and the appropriate number is displayed on the digital display. When the DISPLAY CONTROL button is pressed, the display is blanked and the execution of tests is resumed. However, there are certain failures that are too serious to permit testing to be resumed in which case the number remains on the display.
- **KEY** - Successively pressing the DISPLAY CONTROL button causes the display to indicate KEY 1-6, KEY 7-11 and FREQ in turn.
- **OPR 1** - The DISPLAY CONTROL button is used to alternately blank and illuminate the SLOT and FRAME numbers.
- **OPR 3** - Pressing the DISPLAY CONTROL button causes the displayed time to be alternately displayed and blanked. The EAM annunciator (an EAM alarm) can be reset by pressing the DISPLAY CONTROL button.
- **LOAD** - The DISPLAY CONTROL button is used to start and stop the real-time clock. Real time is entered by first stopping the clock, then setting a time somewhat in advance of the reference time by pressing the 3 display buttons as needed and, finally as reference time reaches display time, pressing the DISPLAY CONTROL button to start the clock.



1. SLOT ANNUNCIATOR
2. FRAME ANNUNCIATOR
3. KEY MODE ANNUNCIATORS
4. TIME ANNUNCIATOR
5. DISPLAY CONTROL BUTTON
6. STATUS ANNUNCIATORS
7. LAMP TEST BUTTON
8. DIM/BRIGHT CONTROL
9. CHANNEL SELECT THUMBWHEEL SWITCH
10. MODE SELECTOR
11. CONTROL INDICATOR BUTTON
12. DIGITAL DISPLAY

.....SATCOM Control Panel AU

Figure 4-12B

STATUS ANNUNCIATORS. The status annunciators (6, figure 4-12B, are amber and show the following:

- **LOS PMT** - When control of the radio is preempted by the LOS control, the LOS PMT annunciator illuminates. In LOS PMT, a new request to transmit from the ASR equipment is ignored except when the mode selector switch is in the LOAD position.

- **RCV BSY** - When in the OPR 1 mode, the RCV BSY annunciator illuminates upon recognition of an acceptable preamble and remains illuminated until the message is terminated.

- **SYN ERR** - The SYN ERR annunciator illuminates in an AFSAT timed state when a sync message is missed in slot 60. In the OPR 3 mode, the SYN ERR annunciator illuminates until acquisition is accomplished.

- **RCV FLT** - A fault affecting the receive mode detected during any of the modes causes the RCV FLT annunciator to illuminate. The annunciator is cleared by changing mode, changing SATL PLAN thumbwheel switch, or by depressing the DISPLAY CONTROL button (which also stops the clock when in LOAD mode). If the fault remains the annunciator again illuminates.

- **XMT FLT** - A fault affecting the transmit mode detected during any of the modes causes the XMT FLT annunciator to illuminate. The annunciator is cleared by changing mode, changing SATL PLAN thumbwheel switch, or by pressing the DISPLAY CONTROL button (which also stops the clock when in LOAD mode). If the fault remains the annunciator again illuminates.

- **I/O FLT** - A fault affecting the I/O device (automatic send receive equipment) the Memory Unit, or the low power RAM detected during any operating mode causes the I/O FLT annunciator to illuminate. The annunciator is cleared by changing mode, changing SATL PLAN thumbwheel switch, or by depressing the DISPLAY CONTROL button (which also stops the clock when in LOAD mode). If the fault remains the annunciator again illuminates.

- **EAM** - The EAM annunciator flashes approximately twice a second when an EAM is recognized. Depressing the DISPLAY CONTROL button clears the annunciator.

LAMP TEST BUTTON. The LAMP TEST button (7, figure 4-12B) causes all displays, lights, and indicators on the SATCOM control to illuminate, including all segments of the six-digit display, even if the SATCOM control is connected to a faulty dual modem.

DIM/BRT CONTROL. The DIM/BRT control (8, figure 4-12B) provides continuously variable brightness control from full off to full on of the seven-segment digital displays and the annunciators; FRAME, SLOT, FREQ, TIME, KEY 1-6, and KEY 7-11.

CHANNEL SELECT THUMBWHEEL SWITCH. The CHANNEL SELECT thumbwheel switches (9, figure 4-12B) select from left to right the satellite plan, transmit channel and receive channel when the mode selector switch is in OPR 1 position. The lefthand thumbwheel switch (satellite plan) is set to a letter A thru M (excluding I) while the right two thumbwheels are set to numbers 1 thru 12. The middle thumbwheel specifies transmit frequencies and the righthand thumbwheel specifies receive frequencies. Satellite plans F, G, H, J, and K use the same receive frequency as satellite plans A, B, C, D, and E respectively, but use the alternate transmit frequency entered when the mode switch is in the KEY mode. In the mode selector OPR 3 position, a satellite plan is selected by the satellite thumbwheel and a transmit channel is selected by use of the remaining two thumbwheels.

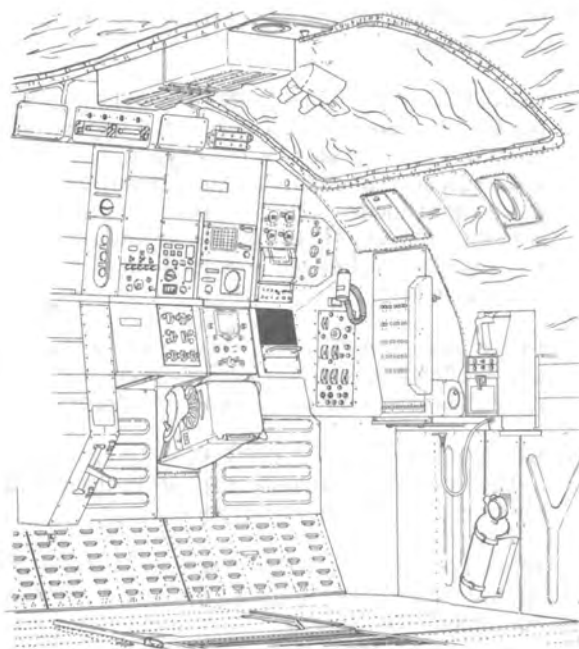
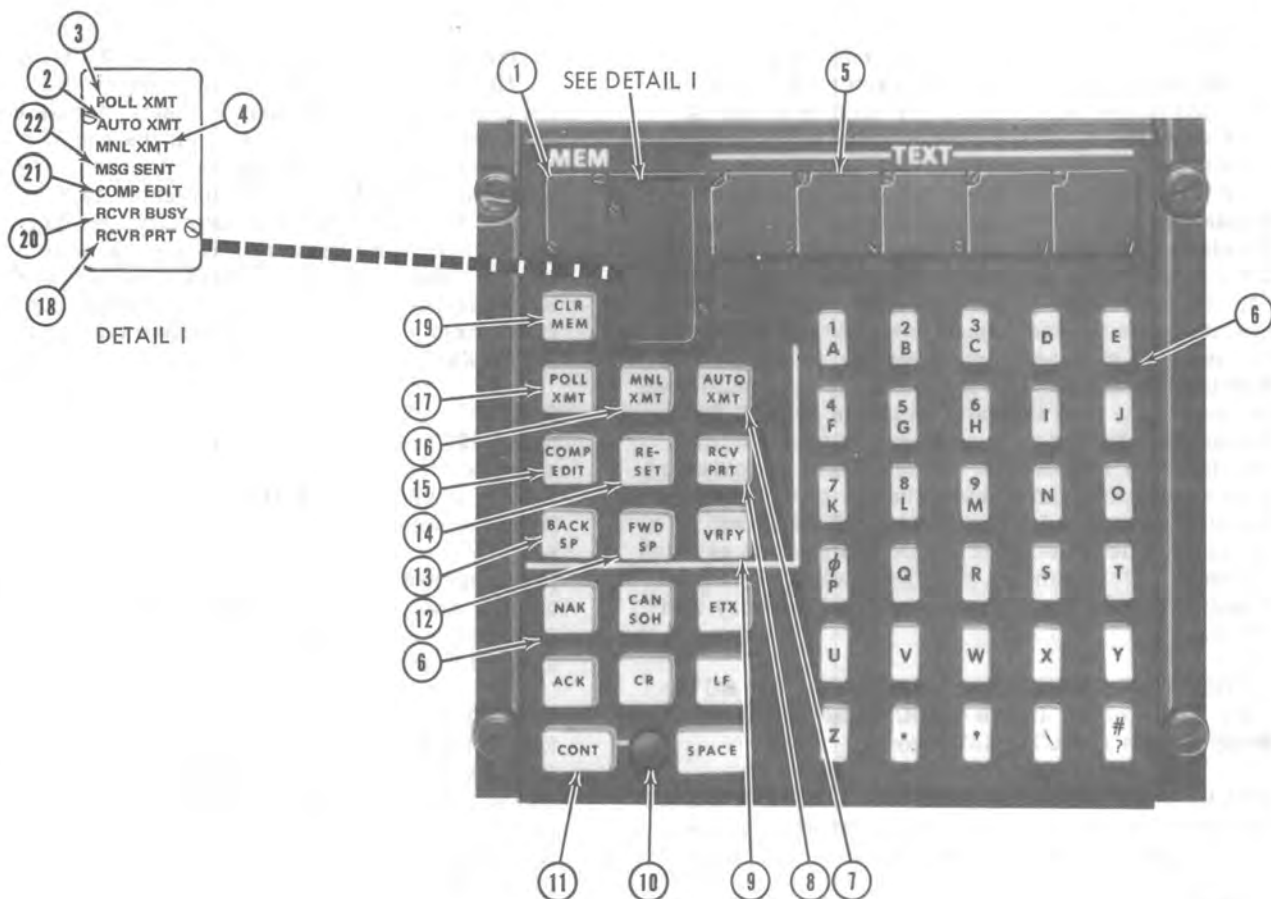
Keyboard AU

The C-10080/A keyboard is used during satellite operating mode of the terminal to prepare and send messages. The keyboard is located at the right side of the gunner's station and is provided with a hand-rest below the panel. The keyboard power and panel lighting is controlled by the printer.

MEMORY INDICATOR. The MEM indicator (1, figure 4-12C) is a one character display capable of displaying the following characters: 1, 2, 3, 4, 5, 6, 7, 8, 9, 0, F, E, C, a small zero (o) and a dash (-). The small zero indicates a power-on condition. Any time the MEM indicator is not being used to display status information it displays a dash (-) providing the printer power is on. The MEM indicator is also used for the following functions:

1. To display the numeric identifier associated with the selected composition buffer and the status of the selected buffer. The memory indicator on the keyboard control is cycled between display of the selected memory status at a 1-1/3 cycle per second rate. Definitions of the memory select readouts are as follows:

<u>READOUT</u>	<u>DEFINITION</u>
0	Message length selected for Composition buffer No. 1
1	Composition buffer No. 1
2	Composition buffer No. 2
3	Composition buffer No. 3
4	Composition buffer No. 4
5	Composition buffer No. 5
6	Read only buffer No. 1
7	Read only buffer No. 2
8	Read only buffer No. 3
9	Read only buffer No. 4
(small o)	Initial power-on condition
F	Selected buffer full
E	Selected buffer overflow
C	Selected memory clear
dash (-)	No memory selected



1. MEMORY INDICATOR DISPLAY
2. AUTOMATIC TRANSMIT INDICATOR
3. POLLING TRANSMIT INDICATOR
4. MANUAL TRANSMIT INDICATOR
5. TEXT INDICATOR DISPLAY
6. KEYBOARD
7. AUTO TRANSMIT KEY
8. RECEIVE PRINT KEY
9. VERIFY KEY
10. CONTROL INDICATOR
11. CONTROL KEY
12. FORWARD SPACE KEY
13. BACK SPACE KEY
14. RESET KEY
15. COMPOSE AND EDIT KEY
16. MANUAL TRANSMIT KEY
17. POLLING TRANSMIT KEY
18. RECEIVE PRINT INDICATOR
19. CLEAR MEMORY KEY
20. RECEIVER BUSY INDICATOR
21. COMPOSE AND EDIT INDICATOR
22. MESSAGE SENT INDICATOR

Keyboard AU

Figure 4-12C

2. To indicate a memory full condition and is enabled when the last input character has filled the selected character memory, or upon detection of ETX after the remainder of the selected memory format length has been filled with ASCII SYN characters. The memory full indication is provided by displaying F on the keyboard memory indicator. Display of the full status alternates with display of the currently selected buffer numeric identifier.

3. To indicate a memory overflow condition and is enabled when the last input character has exceeded the selected message format length, or when the last input character has exceeded the maximum buffer capacity. The indicator remains on until the keyboard is backspaced, memory is cleared, or a new memory is selected. If data entry is continued, it is stored until the upper boundary of the selected memory is reached. Continuation of additional characters does not alter the contents of the existing message. The memory overflow indication is provided by displaying E on the keyboard memory indicator.

AUTOMATIC TRANSMIT INDICATOR. The AUTO XMT indicator (2, figure 4-12C) indicates when equipment is in AUTO XMT mode.

POLLING TRANSMIT INDICATOR. The POLL XMT indicator (3, figure 4-12C) indicates when equipment is in POLL XMT mode.

MANUAL TRANSMIT INDICATOR. The MNL XMT indicator (4, figure 4-12C) indicates when equipment is in MNL XMT mode.

TEXT DISPLAY. The TEXT display (5, figure 4-12C) is 5-character alphanumeric display used as an aid by the operator during compose and edit operations. The display provides the operator with a readout of the five most recently entered keyboard characters. The characters displayed can be backspaced or forward spaced under control of the edit keys on the keyboard. The most recent character entered from the keyboard appears in the rightmost character location of the display.

KEYBOARD. The keyboard (6, figure 4-12C) is capable of generating a 49-ASCII-character set as follows:

26 alpha	. (period)
10 numeric	,
ETX	?
ACK	#
CAN	SPACE
NAK	CR
SOH	LF
/(slash)	

AUTOMATIC TRANSMIT KEY. The AUTO XMT key (7, figure 4-12C) enables a message from the selected memory for subsequent transmission as controlled by the external bit clock. At the end of message transmission, the ASR equipment goes to a message hold status; the AUTO XMT indicator is then disabled. Keyboard inputs to memory are disabled in the auto transmit mode and during message hold status. The AUTO XMT indicator is turned on by the logic/power supply when the auto transmit mode is in effect. At the end of message transmission, the AUTO XMT indicator is turned off.

RECEIVE PRINT KEY. The RCV PRT key (8, figure 4-12C) permits the gunner to control page printer operation from the keyboard. When enabled, the printer prints only received messages, or messages from memory for verification during compose and edit. When the control is not enabled, the printer prints messages being composed, verified, or received, and prints transmitted messages at the time of actual transmission. The RCV PVT indicator is enabled in this mode.

VERIFY KEY. Operation of the VRFY key, (9, figure 4-12C) causes the selected memory contents (to ETX) to be printed on the printer and displayed on the keyboard character display. Keyboard inputs to memory are disabled during verification. Printing occurs regardless of the setting of the receive print only. The verify key is operative only in the compose and edit mode.

CONTROL INDICATOR. The CONT indicator (10, figure 4-12C) indicates when the keyboard is in the control mode.

CONTROL KEY. The CONT key (11, figure 4-12C) permits the operator to utilize the uppercase symbols or control codes on the keyboard. The control key/indicator is enabled when the keyboard unit is in the control mode. The control mode is entered by pressing the CONT key on the keyboard. The CONT key must be depressed a second time to remove the control mode.

FORWARD SPACE KEY. The FWD SP key (12, figure 4-12C) provides forward spacing within the character memory for character correction.

BACK SPACE KEY. The BACK SP key (13, figure 4-12C) provides backspacing within the character memory for character correction.

RESET KEY. The RESET key (14, figure 4-12C) permits the gunner to halt any operation of the ASR equipment and causes it to be placed in the receive mode. Pressing this key also initiates a lamp test of all indicators on the keyboard. Pressing this key also turns off the printer ready light.

COMPOSE EDIT KEY. The COMP EDIT key (15, figure 4-12C) when pressed, places the ASR equipment in the compose edit mode. The COMP EDIT indicator is enabled in this mode.

MANUAL TRANSMIT KEY. The MNL XMT key (16, figure 4-12C) permits direct on-line message transmission at the manual typing rate. This mode is enabled from the keyboard. In this mode, the memory is bypassed so that no change or loss of any stored character occurs. The MNL XMT indicator is enabled in this mode. The indicator is turned on upon receipt of the transmit bit clock from the external system.

POLLING TRANSMIT KEY. The POLL XMT key (17, figure 4-12C) enables a message transmission from the selected memory for subsequent transmission in response to a polling inquiry. Keyboard inputs to memory are disabled in this mode. The ASR equipment remains in the poll transmit mode until another operating mode is selected by the gunner. The POLL XMT indicator is turned on by the logic/power supply when the poll transmit mode is in effect.

RECEIVE PRINT INDICATOR. The RCV PRT indicator (18, figure 4-12C) indicates when equipment is in receive print mode.

CLEAR MEMORY KEY. The CLR MEM key (19, figure 4-12C) is used to remove any stored message from the selected character memory. This control is operative only when the device is in the compose and edit mode and when a character memory has been selected. The CLR MEM key is interlocked with the keyboard CONT key.

RECEIVER BUSY INDICATOR. The RCVR BUSY indicator (20, figure 4-12C) will illuminate when a message is being received. A sync message in time slot 60 will also illuminate the indicator, although no other indications will be observed by the operator if the system was previously placed in the Timed Access Mode (Framed).

COMPOSE EDIT INDICATOR. The COMP EDIT indicator (21, figure 4-12C) indicates when equipment is in compose edit mode.

MESSAGE SENT INDICATOR. The MSG SENT indicator (22, figure 4-12C) is enabled by the logic/power supply at the conclusion of automatic transmit. The indicator is turned off when the next operating mode of the device is selected.

Printer AU

The TT-712/A printer is a high speed page printer that prints one character at a time on full page format. The printer is controlled by the microprocessor located in the logic/power supply and provides a hard copy of received, composed, or transmitted messages as determined by the selected operating mode. The printer receives data automatically in the receive mode which has priority over all other operating modes. The printer may also be programmed to recognize certain incoming messages, interrupt current operations, and print the message. The printer controls power to the keyboard.

POWER SWITCH. The PWR ON--OFF switch (2, figure 4-12D) applies power to all of the ASR units. When the switch is in the ON position, the green PWR light (3, figure 4-12D) is on.



To prevent receiver-transmitter lock-up, turn printer power on prior to SATCOM control turnon.

VIEWING WINDOW. The viewing window (1, figure 4-12D) permits the gunner to view the printed copy. Low paper is indicated by a mark on the paper.

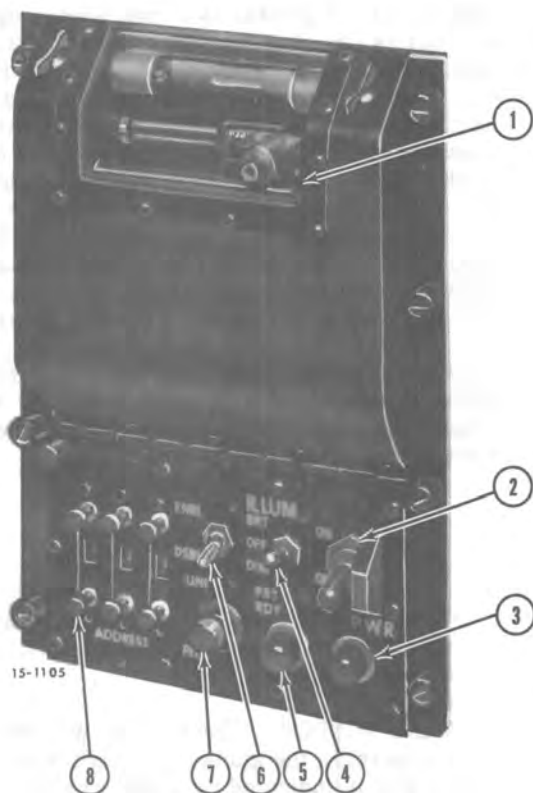
ILLUMINATION SWITCH. The ILLUM BRT--OFF--DIM switch (4, figure 4-12D) provides illumination for the paper without external light. The illumination switch also controls the light level on the printer. This switch also controls the light level of the MEM and TEXT indicators on the keyboard.

PRINTER READY LIGHT. The green PRT RDY light (5, figure 4-12D) comes on when the printer is ready for operation.

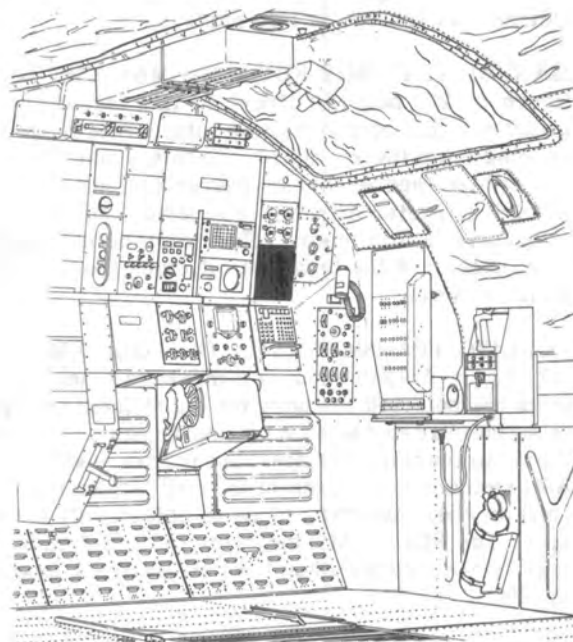
ADDRESS ENABLE-DISABLE SWITCH. The ENBL--DSBL switch (6, figure 4-12D) disables the address function when desired.

LINE FEED SWITCH. The LINE FEED switch (7, figure 4-12D) is a momentary pushbutton switch that advances paper on the printer when pressed.

ADDRESS SELECT SWITCHES. The three ADDRESS switches (8, figure 4-12D) provide selection of a unique hexadecimal number for the ASR units address.



1. VIEWING WINDOW
2. POWER SWITCH
3. POWER LIGHT
4. ILLUMINATION SWITCH



5. PRINTER READY LIGHT
6. ADDRESS ENABLE-DISABLE SWITCH
7. LINE FEED SWITCH
8. ADDRESS SELECT SWITCHES

Printer AU

Figure 4-12D

Automatic Send Receive Modes Of Operation

RECEIVE. This is the normal operating mode of the automatic send receive (ASR) equipment. The equipment monitors all incoming signals. Upon recognition of a valid address, the printer module prints the incoming message, including the message header. Receive mode operation has priority usage of the printer over all other operating modes. If the printer is operating in another mode, a received message preempts the operation. The printer executes a carriage return and two line feeds, prints the received message, executes another carriage return and two line feeds, and returns to the previous operating mode.

ADDRESS RECOGNITION. The ASR equipment is capable of address recognition in conjunction with receive mode operation. If the equipment recognizes the address of an incoming message, the printer prints that message. If the equipment does not recognize the address, the message is not printed. Messages without an address are considered to be addressed to all receivers, and are printed.

RECEIVE PRINT ONLY. The RCV PRT (receive print only) button on the keyboard gives the gunner an option for use of the printer. Pressing the button enables the receive print only mode. When this mode is enabled, the printer prints only incoming messages or messages from memory for verification during compose and edit mode operation. Receive print only mode is terminated by pressing the RESET key on the keyboard. When the receive print only mode is not enabled, the printer prints received messages, messages from memory for verification, messages from keyboard input during compose and edit mode operation, and transmitted messages at the time of actual transmission. Received messages have priority usage of the printer.

RESET. Pressing the RESET button on the keyboard cancels the previously selected mode of operation and returns the ASR equipment to the normal receive only mode. Pressing the RESET button also initiates a lamp test of all indicators and displays on the keyboard. As long as the button is held depressed, all indicators and displays are lit and the printer ready light is out.

COMPOSE AND EDIT. The compose and edit mode permits off-line composition and editing of messages for later transmission at a fixed data rate of 75 bits per second. This mode is selected by pressing the COMP EDIT switch on the keyboard. Composition is accomplished as the message is typed into memory. Editing is accomplished by forward spacing or backspacing, character correction, and continuation of message composition. Compose and edit mode inputs from the keyboard are displayed on the five-character TEXT display on the keyboard.

The message is also printed on the printer if the receive print only option is not activated, and if the printer is not preempted by an incoming message. In compose and edit mode operation, the keyboard inputs are entered into the selected memory, regardless of the state of the receive print only option.

VERIFY. The memory readout, or verify function, allows the gunner to view an entire message on the printer at any time between composition and memory clear, provided printer operation has not been preempted by an incoming message. The function is enabled by pressing the CONT (control) button on the keyboard, pressing the key that corresponds with the numeric identifier of the desired memory, then pressing the VRFY button on the keyboard.

CANNED MESSAGES. The ASR equipment has read only memory (ROM) storage facilities for four predefined (canned) messages of 40 characters each. Any one of the messages can be read from memory for verification, editing, or transmission, as selected by the gunner. Selection of the canned message buffer is accomplished by pressing the CONT (control) button, then pressing the key that corresponds with the numeric identifier of the desired message (numbers 6 through 9).

PRECOMPOSED MESSAGES. The ASR equipment has provisions for composing and storing five messages (four of 40 characters each and one of up to 160 characters in increments of 20 characters). Any one of the messages can be composed, edited, verified, or transmitted, as selected by the operator. Selection of one of the 40-character buffers is accomplished by pressing the CONT (control) button, then pressing the key that corresponds with the numeric identifier of the desired message (numbers 2 through 5). Selection of the 160-character message buffer is accomplished by pressing the CONT button and the (number) 1 key. If no message has been entered into the memory, the MEM (selected memory) display alternately flashes the number 1 and a c. The message can be loaded by selecting the compose and edit mode, setting the message length, then typing the message on the keyboard. Message length is set by selecting buffer number and inserting the desired message length. Message length can be set from 20 to 160 characters, in increments of 20; the selected message length is displayed in the first 3 positions of the five (5) - character TEXT indicator.

CONTROL. Pressing the CONT (control) button on the keyboard allows the operator to use the upper case characters and special function keys. Once the control function has been activated, the CONT key must be pressed again to release the function.

AUTOMATIC TRANSMIT. The automatic transmit mode, when enabled, permits the ASR equipment to automatically read a message from a selected memory location, and to transmit the message at a fixed rate of 75 bits per second. Operation in this mode is accomplished by pressing the AUTO XMT (automatic transmit) key on the keyboard, then selecting the canned or precomposed message for transmission. When the mode is activated, message transmission is initiated upon receipt of the external bit clock signal. If the receive print only function is not activated, and if page printer usage is not preempted by an incoming message, the message is printed on the printer simultaneously with transmission. Upon completion of transmission, the MSG SENT (message-sent) indicator lights, and remains lit until a new mode is selected. The message is not destroyed by transmission, but cannot be sent again unless the gunner presses the AUTO XMT button again. Automatic transmit mode can be effectively used in: random access (satellite operation with no timed access control), TDM-1 (timed access mode), or TDM-2 (timed access mode, frequency shifting). Maximum message length is 160 characters in random access and 40 characters in TDM-1 or TDM-2.

MANUAL TRANSMIT. The manual transmit mode permits direct, on-line transmission via manual keyboard entry. Operation in this mode is activated by pressing the MNL XMT (manual transmit) button on the keyboard. When the mode is activated, synchronous idle (SYN) characters are continuously generated to maintain bit and character synchronization. Each keyboard input character replaces the next SYN character and is sent to the external data line at the manual typing rate. The receive print only and receive message preempt features are applicable. To ensure against unrecognized character loss, the printer does not print a character until it is sent to the external data interface. Transmission can be terminated by an end-of-text (ETX) character keyboard input, or by a 50-character timeout feature. If a time interval, equivalent to 50 character keyboard input, or by a 50-character timeout feature. If a time interval of approximately 10 seconds lapses between keyboard inputs, the ASR equipment transmits four ETX characters. When the ETX characters have been sent, the transmit keyline is deactivated and transmission ceases. Manual transmission cannot be continued or repeated unless the gunner presses the MNL XMT button again. Manual transmit can be effectively used only in random access.

POLL TRANSMIT. Polling mode operation provides automatic reply transmission in response to an incoming polling inquiry message. Poll transmit mode operation is initiated by pressing the POLL XMT button on the keyboard. Each valid poll inquiry message initiates an automatic reply transmission. The MSG SENT (message sent) indicator is turned on for ten seconds following each reply transmission. The ASR equipment remains in poll transmit mode, with the POLL XMT indicator lit, until the gunner selects a new mode. Poll mode can

be effectively used only when a valid address is inserted and enabled. This must be accomplished in order to receive and respond to a poll inquiry. Maximum message length for poll XMT is 160 characters in random access and 40 characters in TDM-1 or TDM-2. Normally, polling mode will be done in random access.

Normal Operation of AFSATCOM Terminal

To turn the AFSATCOM on:

1. Power switch on printer to ON. Power light comes on.



To prevent receiver-transmitter lock-up, turn printer on prior to SATCOM control turn on.

2. Mode selector switch on the SATCOM control panel 1B to ON/on SATCOM control panel 1BX to OPR 1.

To turn the AFSATCOM off:

1. Mode selector switch on the SATCOM control panel to OFF.
2. Power switch on printer to OFF.

To transmit in manual transmit mode using ASR equipment:

1. Position function selector switch on the LOS control panel to OFF or SATL.
2. Press MNL XMT key on keyboard. MNL XMT indicator will come on.
3. Type message. Message is transmitted as it is typed.

To set message length for Buffer No. 1 using ASR equipment:

1. Set message length as follows:
 - a. Press COMP EDIT key on keyboard. COMP EDIT indicator will come on. MEM indicator will display a dash (-).
 - b. Press CONT KEY. Control indicator should be on.
 - c. Press 0 key. MEM indicator will display 0 and TEXT indicator will display 040 (or previous message length).
 - d. Type message length required for message (20 to 160 in increments of 20). TEXT indicators will display number typed.

To transmit in the compose and edit mode using ASR equipment:

1. Press CONT KEY, COMP EDIT, and desired buffer number. CONT indicator and COMP EDIT indicator will be on and MEM indicator will alternate the selected buffer number (1 through 9) and C.
2. Type message. Press CONT KEY. Last five (5) characters typed will appear in TEXT display as the message is typed.

3. Press VRFY key. Message will be printed out on the printer for verification.
4. Position function selector switch on the LOS control panel to OFF or SATL.
5. Press CONT KEY and AUTO XMT key. AUTO XMT indicator will come on.
6. Press selected buffer number. At end of transmission, AUTO XMT light will go out and MSG SENT light should come on.

NOTE

Use of RCV PRT is not recommended during AUTO XMT. This method of operation insures the correct message has been transmitted. It will also provide a copy of the actual message transmitted.

LIAISON RADIO AN/ARC-65 W173 W180 Less BL

This radio provides long range communication on voice in the high frequency range. The radio operates over a frequency range of from 2 to 23.995 megahertz in 500 Hertz steps, giving a total of 44,000 available frequencies. The set is located on the copilot's side panel (figure 4-13) and uses both TR power and 118-volt single-phase a-c power for operation.

NOTE

No transmission will be made on emergency (distress) frequency channels except for emergency purposes. For test, demonstration, or drill purposes, this radio equipment will be operated in a shielded room to prevent transmission of messages that could be construed as actual emergency messages.

Liaison Radio Controls (ARC-65)

LIAISON RADIO CONTROL KNOB. A rotary control knob (2, figure 4-13) located on the liaison radio control panel has ON--OFF positions. ON position supplies power to all of the system circuits. OFF position removes all power from the set.

VOLUME CONTROL KNOB. A volume control knob (1, figure 4-13) on the liaison radio control panel provides a means of adjusting the audio output during voice operation and signal sensitivity during CW operation from the liaison radio to the interphone system.

CHANNEL SELECTOR SWITCH. A channel selector switch (5, figure 4-13) on the liaison radio control panel has channel positions numbered from 1 to 20, providing selection of any of the preset channel frequencies.

POWER SWITCH. A two-position switch (6, figure 4-13) marked "Power" is located on the liaison radio control panel. The switch has HI and LOW positions and provides a means of selecting the power output in a 10 to 1 ratio. HI position normally will be used for maximum range transmissions and LOW for short range.

NOISE CONTROL KNOB. A control knob (7, figure 4-13) marked "Noise" is located on the liaison radio control panel. The knob allows adjustment of the background noise level of the receiver for best voice reception.

PRESETTING DRUMS. Two drums (4, figure 4-13) located on the liaison radio control panel provide means for manually presetting the frequency of each

channel to be selected by the channel selector switch. Each drum is protected by a hinged cover. A special presetting tool is stowed inside the top drum cover which also contains a card for recording the preset frequencies.

CW TUNING KNOB. A CW tuning knob (3, figure 4-13) on the master control panel is used to adjust the CW beat frequency.

LIAISON OPERATION SELECTOR SWITCH. A rotary selector switch (8, figure 4-13) located on the master control panel has AME--CW--SSB--FSK positions. Positioning this switch to AME places the liaison radio in equivalent amplitude modulation operation for voice communication with stations not equipped for single sideband operation. Positioning this switch to CW provides for continuous wave communication with a 7-kilocycle bandwidth. Positioning this switch to SSB places the liaison radio in single sideband voice operation. FSK position is provided for teletypewriter operation; however, this equipment is not installed in the aircraft.

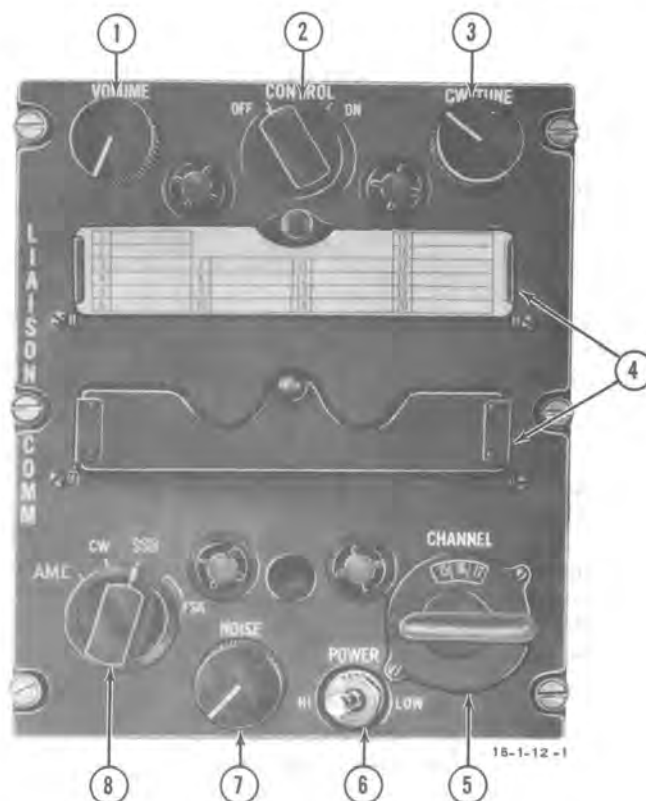
Normal Operation of ARC-65 Liaison Radio

CAUTION

Operating the AN/ARC-65 during periods of high voltage or fluctuating power will decrease the operational life of the equipment or can cause materiel failure.

FREQUENCY PRESETTING. The frequency presetting operation is accomplished on the master control panel with the equipment turned off. Presetting is normally done before flight but may be done in flight if necessary and is accomplished as follows:

1. Loosen the two screws holding drum covers in position and open covers.
2. Remove presetting tool from clip inside top drum cover.
3. Rotate the channel selector switch until the number of the channel to be preset appears at the left end of the selector drum.
4. Using the presetting tool, move the four buttons, one at a time, to a position under the respective numbers. This is done by sliding the socket end of the tool over the buttons and moving them along the drum to coincide with the desired numbers.
5. Move the top drum left button to coincide with the figure representing thousands of kilocycles.
6. Move the top drum right button to coincide with the figure representing hundreds of kilocycles.
7. Move the bottom drum left button to coincide with the figure representing tens of kilocycles.
8. Move the bottom drum right button to coincide with the figure representing units and halves of kilocycles.
9. Record the frequency adjacent to the applicable channel number on the card mounted on the top drum cover.



1. VOLUME CONTROL KNOB
2. LIAISON RADIO CONTROL KNOB
3. CW TUNING KNOB
4. PRESETTING DRUMS
5. CHANNEL SELECTOR SWITCH
6. POWER SWITCH
7. NOISE CONTROL KNOB
8. LIAISON OPERATION SELECTOR SWITCH



AN/ARC-65 Liaison Radio

..... Controls W173 W180 Less BL I

Figure 4-13.

10. Turn the channel selector switch to the next channel number to be preset and repeat steps "4" thru "9." Preset remaining channels in the same manner.

11. Close drum covers and tighten screws.

NOTE

If the drum cover doors on the master control panel are not securely closed, a door interlock switch will remain open and prevent operation of the liaison radio.

VOICE COMMUNICATION. Liaison radio voice communication can be accomplished as follows:

1. Place interphone selector switch in LIA to receive and transmit liaison radio signals.
2. Place liaison radio control knob to ON.

NOTE

A 40-second warmup period is required. The first 30 seconds allow for tube warmup and the remaining 10 seconds allow for automatic tuning. If automatic tuning is not accomplished in the normal 40-second period, the control switch will go to OFF and must be returned to the ON position.

CAUTION

Do not hold liaison radio control knob to ON position.

3. Turn the channel selector switch to the desired frequency and rock the knob slightly to feel the switch click into its seat. The channel in use will be shown in the center of the selector window.
4. Rotate the liaison operation selector switch to the desired position.
5. Place the power switch in HI or LOW. Operate transmitter in low power except when necessary to use high power to insure communications.

NOTE

Should the air pressure within the equipment be reduced by leakage, an aneroid switch will automatically shift the set to low power to reduce the possibility of electrical arcing within the equipment. No indication is given when this occurs.

6. Momentarily depress mike switch to initiate the transmit tune cycle. Completion of the transmit tune cycle is indicated by the return of the receiver background noise. The transmitter is now ready for transmission. Adjust the volume control for proper audio level and the noise control for a slight background noise in absence of signals. A sidetone will be heard in the headset when talking if the transmitter is on the air.

WARNING

- Ground transmissions of the AN/ARC-65 liaison radio are prohibited on aircraft within 200 feet of any of the following:
 1. Unloaded nuclear weapons or warheads.
 2. Aircraft with external weapons with nuclear warheads installed.
 3. Nuclear weapons loaded in an aircraft (transmitting or adjacent) with its bomb bay doors open.
- Hazardous RF voltages can exist between the aircraft skin and ground when transmissions are being made with the liaison radio.

NOTE

This does not prohibit AN/ARC-65 receiver operation on the ground.

7. Turn the set off by rotating the liaison radio control knob on the panel to OFF.

Emergency Operation of ARC-65 Liaison Radio

When a frequency selection cycle is not completed in the normal time interval, causing the liaison radio control knob to return to OFF position, a second try on another channel is recommended. If tuning is normal, return to the initially selected channel. Malfunction within the equipment is indicated by the control knob moving to the OFF position. If damage to the equipment is less important than getting the message through, transmission or reception can be resumed by holding the knob in ON position. If no sidetone is heard when attempting to transmit, the transmitter is not on the air.

LIAISON RADIO AN/ARC-190(V) W173 W180 BL

This liaison radio provides long-range voice communications in the high-frequency range. The radio operates over a frequency range of 2.0000 to 29.9999 MHz in 100-Hz steps, giving 280,000 available frequencies. The radio operates in the USB, LSB, AM, and CW modes. It used 115-volt, 3-phase ac power for operation. The radio controls are located on the copilot's side panel (figure 4-13A).

NOTE

No transmission will be made on emergency (distress) frequency channels except for emergency purposes. For test, demonstration, or drill purposes, this radio equipment will be operated in a shielded room to prevent transmission of messages that could be construed as actual emergency messages.

Liaison Radio Controls (AN/ARC-190(V))

CHANNEL SWITCHES. The two CHAN thumb-wheel switches (1, figure 4-13A) select preset channels 00 thru 29. The CHAN switches are enabled only when the MODE switch is in P position. Both frequency and mode of operation are preassigned to each preset channel.

MODE SWITCH. The MODE thumb-wheel switch (2, figure 4-13A) selects the following modes of operation:

- UV - Upper sideband voice
- LV - Lower sideband voice
- AM - Amplitude modulation
- P - Preset channel
- UD - Upper sideband data (not used)
- LD - Lower sideband data (not used)
- CW - Continuous wave (not used)
- A - Unassigned

FREQUENCY SWITCHES. The six FREQ thumb-wheel switches (3, figure 4-13A) select operating frequencies from 2 to 29.9999 MHz in 100-Hz steps. A frequency higher than 29.9999 cannot be selected. If a frequency lower than 2 is selected, the CONTL FAULT indicator will light. Any time a new frequency is selected, a receiver tune cycle is initiated. The next time the microphone PTT pushbutton is pressed, a transmit tune cycle is initiated.

POWER ON INDICATOR. The ON indicator (4, figure 4-13A) lights whenever the liaison radio is energized.

TAKE COMMAND-OFF SWITCH. The TAKE CMD-OFF switch (5, figure 4-13A) is a 3-position, spring-return to center switch. When momentarily operated to TAKE CMD (up) position, primary power is applied to the liaison radio, the control is enabled, and the TAKE CMD and ON indicators light. When momentarily operated to OFF (down) position, primary power is removed from the liaison radio and the TAKE CMD and ON indicators go off.

TAKE COMMAND INDICATOR. The TAKE CMD indicator (6, figure 4-13A) lights whenever the control has command of the liaison radio. It is intended for systems that have more than one control location. Since the B-52G installation has only one control, the TAKE CMD indicator will light whenever the ON indicator lights. Failure to do this indicates a malfunction.

LOAD SWITCH. The momentary-action, pushbutton LOAD switch (7, figure 4-13A) causes mode and frequency data to be stored in the receiver-transmitter preset channel memory. Data is stored in the memory location indicated by the preset CHAN switches. Mode and frequency data is obtained from MODE and FREQ switches.

WARNING

Do not initiate a transmit self-test unless transmit rf radiation is authorized.

TEST SWITCH. The momentary-action, pushbutton TEST switch (8, figure 4-13A) initiates a receive self-test cycle. When TEST switch is pressed, all FAULT indicators light, and, when released, all FAULT indicators go out. If the receive test fails, one of the FAULT indicators lights. After pressing the TEST pushbutton, the next time the microphone PTT switch is pressed, a transmit self-test is initiated. The transmit self-test is performed on upper sideband with 1000-Hz CW tone. If the test fails, one of the FAULT indicators will light.

SQUELCH CONTROL. The SQL control (9, figure 4-13A) is a 4-position switch that selects the squelch level. In the fully ccw position, the squelch is disabled.

SQUELCH DISABLE. The SQL DSBL switch (11, figure 4-13A) is an alternate-action pushbutton switch. When out, the squelch level is selected by the SQL control. When in, the squelch is disabled.

COUPLER FAULT INDICATOR. The CPLF FAULT indicator (10, figure 4-13A) lights when a fault occurs in the antenna coupler.

RECEIVER-TRANSMITTER FAULT INDICATOR. The R/T FAULT indicator (12, figure 4-13A) lights when a fault occurs in the receiver-transmitter.

CONTROL FAULT INDICATOR. The CONTL FAULT indicator (14, figure 4-13A) lights when a fault occurs in the radio set control, the FREQ switches are set below 2 MHz, the CHAN switches are set to an unloaded preset channel with the MODE switch set to P, or the MODE switch is set to A.

VOLUME CONTROL. The VOL control (13, figure 4-13A) is an 8-position switch that adjusts the receiver audio output level.

Normal Operation of AN/ARC-190(V) Liaison Radio

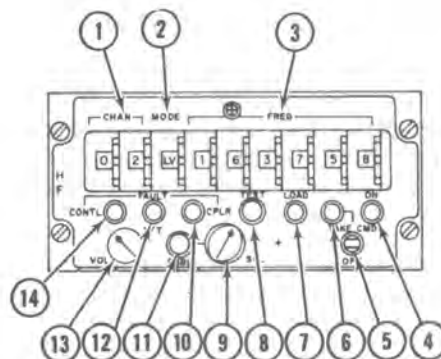
POWER TURN ON. The liaison radio is energized by momentarily operating the TAKE CMD-OFF switch to TAKE CMD. The ON and TAKE CMD indicators will light. If the MODE switch is set to P and the CHAN switch is set to an unloaded channel, frequency is set below 2 MHz or the MODE switch is set to A, the CONTL FAULT indicator will light.

POWER TURN OFF. The liaison radio is deenergized by momentarily operating the TAKE CMD-OFF switch to OFF. The TAKE CMD and ON indicators will go off.

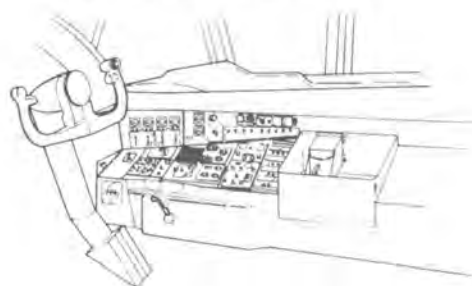
MODE AND FREQUENCY PRESETTING. The AN/ARC-190(V) liaison radio has 30 preset channels. These channels are numbered 00 through 29. Mode and frequency information for each preset channel is stored in a nonvolatile memory located in the receiver-transmitter. Presetting is accomplished on the master control panel with the equipment turned on. Presetting is normally done before flight but may be done in flight, if necessary, and is accomplished as follows:

1. Momentarily operate TAKE CMD-OFF switch to TAKE CMD.
2. Set MODE switch to desired mode.
3. Set FREQ switches to desired frequency in the range of 2 through 29,9999 MHz. If frequency is set below 2 MHz, the CONTL FAULT indicator will light.
4. Set CHAN switch to desired channel. Channels are numbered from 00 through 29.
5. Press LOAD pushbutton. This causes the mode and frequency information to be loaded into the receiver-transmitter nonvolatile memory.
6. Repeat steps 2 through 5 for each preset channel required.

MODE SELECTION. In the B-52G installation, the AN/ARC-190(V) liaison radio can operate in the upper sideband voice (UV), lower sideband voice (LV), amplitude modulation (AM), or preset (P) modes. The UD, LD, CW, and A positions of the MODE switch are not used. When the MODE switch is set to UV, LV, or AM, the mode and frequency of the liaison radio is determined by the MODE and FREQ switches. When the MODE switch is set to P, the mode and frequency of the liaison radio is determined by the preset CHAN switch. If an unloaded preset channel is selected, the CONTL FAULT indicator will light.



1. CHANNEL SWITCHES
2. MODE SWITCH
3. FREQUENCY SWITCHES
4. POWER ON INDICATOR
5. TAKE COMMAND-OFF SWITCH
6. TAKE COMMAND INDICATOR
7. LOAD SWITCH
8. TEST SWITCH
9. SQUELCH CONTROL
10. COUPLER FAULT INDICATOR
11. SQUELCH DISABLE SWITCH
12. R/T FAULT INDICATOR
13. VOLUME CONTROL
14. CONTROL FAULT INDICATOR



AN/ARC-190 (V) Liaison Radio

Controls W173 W180 BL

Figure 4-13A

VOICE COMMUNICATION. Liaison radio voice communication is accomplished as follows:

1. On interphone control panel, set interphone selector switch to LIA.
2. On radio set control, momentarily operate TAKE CMD-OFF switch to TAKE CMD. TAKE CMD and ON indicators will light.

3. Set CHAN, MODE, and FREQ switches as authorized.

4. Adjust VOL and SQL controls as desired.

WARNING

- Ground transmissions of the AN/ARC-190 liaison radio are prohibited on aircraft within 200 feet of any of the following:
 1. Unloaded nuclear weapons or warheads.
 2. Aircraft with external weapons with nuclear warheads installed.
 3. Nuclear weapons loaded in an aircraft (transmitting or adjacent) with its bomb bay doors open.
- Hazardous RF voltages can exist between the aircraft skin and ground when transmissions are being made with the liaison radio.

NOTE

This does not prohibit AN/ARC-190 receiver operation on the ground.

5. Momentarily depress mic switch to initiate transmit tune cycle. The first time a preset channel is tuned, the antenna coupler tunes on an RF signal from the receiver-transmitter. A 1000-Hz audio tone will be heard on the headset when the RF signal is present. After tuning is complete, the antenna coupler tuning information is stored in the preset nonvolatile memory of the receiver-transmitter, thereafter, each time the preset channel is selected, the antenna coupler is pre-positioned to the preset

channel frequency. The first-time tuning cycle requires approximately 1 second. The pretuned tuning cycle requires 35 ms. Completion of the transmit tune cycle is indicated by return of receive audio or receiver background noise.

6. The liaison radio is now ready for operation. To transmit, depress mic switch and speak into mic. The transmit audio sidetone will be heard in the headset. To receive, release mic switch.

7. Turn the liaison radio off by momentarily operating TAKE CMD-OFF switch to OFF. TAKE CMD and ON indicators will go off.

LIAISON RADIO AN/ARC-58 W181

This radio provides long range plane-to-ground communication on voice in the high frequency range. Single sideband transmission is the main feature of this set. In addition, the set retains its AM transmission capability to make it compatible with existing AM ground stations. Single sideband voice, amplitude-modulated voice, or tone modes of operation may be used. The set operates over a frequency range of 2 to 29,999 megacycles with 28,000 directly selectable frequency channels. The set is located on the copilot's side panel (figure 4-14) and uses TR power supplied through a circuit breaker marked "AN/ARC-58 Cont" located on the copilot's circuit breaker panel and 118-volt three-phase a-c power for operation.

Liaison Radio Controls (ARC-58)

LIAISON RADIO POWER SWITCH. A rotary power switch (4, figure 4-14) located on the liaison radio control panel has ON--OFF positions. ON position supplies power to all system circuits. OFF position removes all power from the set.

VOLUME CONTROL KNOB. The function of the volume control knob (2, figure 4-14) is different from conventional volume controls since it adjusts the sensitivity of the receiver. Full clockwise rotation gives maximum sensitivity. In this position, the receiver can detect and reproduce weak signals that would not be picked up with the knob at lower settings.

NOTE

Background noise will be heard at all times. If the volume control is turned down to reduce the noise, the sensitivity of the receiver may be lowered too far to pick up communications from distant stations.

MODE SELECTOR SWITCH. A mode selector switch (1, figure 4-14) on the liaison radio control panel has AM--U--L--TWIN positions. Placing the selector switch in AM position provides a means of transmitting amplitude-modulated voice in order that existing AM ground stations may receive the communication. In U position, transmission and reception are accomplished on the upper sideband of the selected frequency. In L position, transmission and reception are accomplished on the lower sideband of the selected frequency. Placing the selector switch to TWIN position provides a means by which both upper and lower sidebands are transmitted or received, the audio output of each sideband being combined as one audio source.

NOTE

The TWIN function may be inoperative since there is no requirement for maintaining this mode operational.

FREQUENCY SELECTION KNOBS. Four frequency selection knobs (5, figure 4-14) on the liaison radio control panel provide a means by which the desired frequency may be selected. The kilocycle units of selection vary from 1000 down to 1 kc. The knob on the left is the 1000 kc knob, while the knob on the extreme right is the 1 kc selection knob.

Liaison Radio Indicators (ARC-58)

FREQUENCY SELECTION INDICATOR. A frequency selection indicator (3, figure 4-14) provides a direct indication of the operating frequency of the set.

Normal Operation of ARC-58 Liaison Radio

The normal operation of the AN/ARC-58 liaison radio is accomplished as follows:

1. Place the liaison radio power switch to ON.

NOTE

The AN/ARC-58 transmitter frequency may not be stable immediately after turn-on. To insure stable frequencies, the warmup times shown below are necessary. This warmup delay should normally cause no operating

problem when the set is turned on in accordance with the normal checklist procedures.

Ambient Air Temp

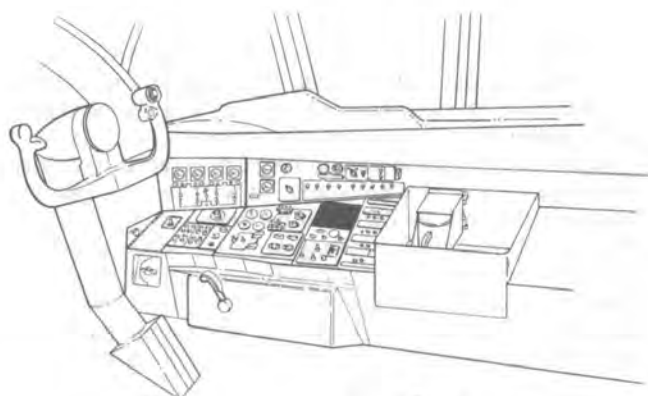
Warmup Time

30° C (+86° F) and above
0° to 30° C (32° to 86° F)
Below 0° C (32° F)

7 minutes
15 minutes
20 minutes



1. MODE SELECTOR SWITCH
2. VOLUME CONTROL KNOB
3. FREQUENCY SELECTION INDICATOR
4. LIAISON RADIO POWER SWITCH
5. FREQUENCY SELECTION KNOBS



AN/ARC-58 Liaison Radio Controls W181

Figure 4-14.

2. Select the desired frequency by turning the frequency selection knobs until the frequency appears on the frequency selection indicator.

NOTE

If frequency selections of 3.7, 3.8, 3.9, 7.7, 7.8, 7.9, 15.7, 15.8, or 15.9 megacycles are made, the 1000 kc frequency selector knob must be moved momentarily to another frequency and returned to the desired frequency to insure system tuning for these frequencies. If the operating frequency to be used is the same as that previously selected before turn-on, the thousand kilocycle knob should be momentarily rotated to insure proper fine tuning of the system.

When a frequency change is made, the following step is necessary to insure that the transmitter is properly retuned on new frequency: Depress the mike switch and, when the audible tune tone stops (60 seconds max), the transmitter is ready for operation.

NOTE

If tuning is not completed in specified time, the system will go into fault and will turn off. If the system fails to tune in one minute and does not go into fault, turn the power switch OFF. After two minutes, select a frequency at the other end of the desired frequency range and return the power switch to ON. If the system still fails to tune properly, change frequency from the range in use (ranges are 2.0 to 3.699, 3.7 to 7.699, 7.7 to 15.699, and 15.7 to 29.999 megacycles) to one of the other frequency ranges.

Avoid long transmissions, as they could cause an overheating condition, which will result in reduction of output power.

3. Place the mode selector switch to the desired position.
4. Place interphone selector switch in LIA.
5. Depress the mike switch to transmit and release to receive. A sidetone will be heard in the headset when talking if the transmitter is on the air. The volume control knob should be positioned to give best reception. For weak signals, it will be necessary to position the line on the knob between the 1 and 5 o'clock positions; for strong signals, some position in the counterclockwise direction will give the best reception. The audio level of the received signal should be adjusted by use of the interphone panel volume control knob at the individual crew position.

WARNING

- Ground transmissions of the AN/ARC-58 liaison radio are prohibited on aircraft within 200 feet of any of the following:
 1. Unloaded nuclear weapons or warheads.
 2. Aircraft with external weapons with nuclear warheads installed.
 3. Nuclear weapons loaded in an aircraft (transmitting or adjacent) with its bomb bay doors open.
- Hazardous RF voltages can exist between the aircraft skin and ground when transmissions are being made with the liaison radio.

NOTE

This does not prohibit AN/ARC-58 receiver operation on the ground.

6. Turn the set off by rotating the liaison radio power switch to OFF.

WARNING

If making an automatic coupled ILS approach or a manual ILS approach under other than VFR conditions, do not transmit on the AN/ARC-58.

Emergency Operation of ARC-58 Liaison Radio

If the set fails to tune properly, attempt operation at different frequencies and modes of operation.

TACAN RADIO AN/ARN-118(V)

The AN/ARN-118(V) TACAN (Tactical Air Navigation) radio is provided to operate in conjunction with surface navigation beacons and suitably equipped aircraft. The TACAN radio and surface beacons form a radio navigation system which enables the aircraft to obtain continuous indications of its range and bearing to any selected surface beacon located within line-of-sight distance from the aircraft up to 300 nautical miles, depending on aircraft altitude. The B-52 TACAN installation is not designed for air-to-air operation, however, the aircraft can obtain range and bearing indications from other air-to-air equipped aircraft when they are at altitudes lower than the B-52. The ARN-118 will provide only range to other aircraft when interrogated.

The TACAN will perform an automatic self test of its units whenever signals become lost or unreliable, or if an internal malfunction occurs. If the TEST light comes on at the end of the test, a malfunction may have occurred and the test should be repeated manually by pressing the TEST switch. The test takes approximately 20 seconds and is indicated by a distance reading of zero miles, a relative bearing pointer indication of $180^{\circ} \pm 3^{\circ}$, course deviation bar centered, and TO-FROM arrow indicating TO. At the beginning of the test the relative bearing pointer may slew to 270° for 2 to 4 seconds prior to slewing to the 180° test position. The test may be terminated at any point by changing the TACAN channel or changing the mode selector.

Bearing and range information is displayed on the horizontal situation indicator (HSI) located on the pilots' instrument panel (figure 4-31). The receiver-transmitter of the TACAN radio initiates the interrogation process by radiating pulse signals. These signals, known as distance interrogation pulses, are detected at the particular surface beacon installation or cooperating aircraft to which the TACAN radio is tuned, causing the station to respond with its own transmitted pulses. These response pulses are received by the receiver portion of the TACAN radio and are converted into a range indication which is displayed on the range indicator of the HSI. In addition, the station transmits a reference signal which can be received by the TACAN radio anytime the receiver portion is in operation. This reference signal is displayed as a bearing indication on the HSI. Bearing information may be received even though interrogation pulses are not being transmitted by the TACAN radio. Each station may be identified by a tone identification signal in International Morse Code. Placing the TACAN-ODR (VHF Omnidirectional Range) marker mixer switch to ON position provides the tone identification signal in the crew member's headset. The TACAN control panel is located on the pilots' overhead panel. The system is supplied 118-volt single-phase a-c power through a circuit breaker marked "AN/ARN-118 AC" located on the left load central circuit breaker panel. A circuit breaker marked "AN/ARN-118 DC" located next to the a-c circuit breaker provides d-c power for the system.

TACAN Radio Controls

NAV MODE SELECT SWITCH. A nav mode select switch (20, figure 4-31) is located on the navigation system select panel. The rotary switch has TACAN--VOR--ILS--ILS APP positions. In TACAN position the TACAN system may be placed in operation in the normal manner as outlined under "Normal Operation of TACAN Radio." For VOR-ILS-ILS APP positions see "Flight Director System Controls," this section.

TACAN CHANNEL SELECTOR KNOBS. Three rotary knobs, located on the TACAN control panel, provide a means by which a desired TACAN channel

may be selected. Channels are equally divided between X and Y channels and are spaced at one megahertz to provide a total of 252 operating channels available. The X-Y channel selector knob (9, figure 4-30) is used to set the X or Y function on the channel indicator window (13, figure 4-30). The Tens channel selector knob (12, figure 4-30) is used to set the first two digits of the channel display, and the third digit is set with the units channel selector knob (8, figure 4-30).



The channel selector knobs used on these control heads contain built-in mechanical stops to prevent rotation past the nine (9) position on the units (ones) digit channel setting and the (12) position on the hundredth/tenth digit channel settings. Do not attempt to override this mechanical stop. Direction of knob rotation must be reversed when the stop is reached.

FUNCTION SELECTOR SWITCH. A 5-position rotary switch (7, figure 4-30), located on the TACAN radio control panel has OFF--REC--T/R--A/A REC--A/A T/R positions. In the OFF position, the system is deenergized. In the REC position, bearing information from a selected surface beacon is received. This fundamental bearing is the angle to the surface beacon referenced to magnetic north. In the T/R position, relative bearing is calculated and slant range distance to the surface beacon is measured. In the A/A REC position, a suitably-equipped, cooperating aircraft must be contacted to establish proper operating channel spacing (to simulate a surface beacon signal) before bearing information can be obtained. In the A/A T/R position, both distance and bearing information can be received from a suitably-equipped aircraft after proper operating channels have been established.

VOLUME CONTROL KNOB. A volume control knob (3, figure 4-30) marked "Vol" located on the TACAN control panel is used to adjust the volume of the audio identification signal received from the beacon/aircraft through the headset.

TEST SWITCH. A momentary TEST switch (11, figure 4-30), located on the TACAN radio control panel, is used to initiate a confidence test to determine if an internal fault has occurred in the TACAN units. Pressing the switch in the T/R (transmit) mode initiates a test of the TACAN units. If the TEST light (10, figure 4-30) is on after 20 seconds (end of the test cycle), a malfunction is indicated and all range and bearing information should be disregarded. If the test is repeated in the REC (receive) mode and the TEST light goes out, bearing information is valid.

TEST LIGHT. A red TEST light (10, figure 4-30) located on the TACAN radio control panel, will come on to indicate a malfunction in the TACAN units. When the light comes on, the TEST switch (11, figure 4-30) should be pressed to initiate a test of the TACAN units. If the light goes out at the end of 20 seconds, all bearing and distance information is valid. The light flashes at the beginning of each test cycle to indicate the bulb is operational.

TACAN Radio Indicator

HORIZONTAL SITUATION INDICATOR (HSI). The horizontal situation indicators (figure 4-31) located on the pilots' instrument panel provide range, bearing, and selected course deviation indications of the cooperating aircraft or selected surface beacon to which the system is tuned. Distance in nautical miles is provided by the range indicator (1, figure 4-31). Magnetic bearing is provided by the bearing pointer (3, figure 4-31). Deviation from a selected course is provided by the course deviation indicator (12, figure 4-31).

Normal Operation of TACAN Radio

The following procedure is used to place the TACAN system in operation:

1. Place NAV MODE select switch to TACAN position.
2. Set channel selector knobs to desired channel.
3. Set function selector switch to desired mode of operation (allow 2 minutes for receiver-transmitter warmup).
4. Place TACAN-ODR switch ON to identify selected beacon. Adjust volume of audio signal with the volume knob (3, figure 4-30) on TACAN control panel.
5. To turn the TACAN system off, place the function selector switch to OFF position.

Integrated TACAN Omni-Range Operation

1. Nav mode select switch in TACAN position.
 - a. With TACAN function selector switch in T/R and omni-range power switch in OFF position, bearing and range to the selected TACAN beacon will be indicated on the HSI, and the course deviation indicator (CDI) on the HSI will indicate deviation

from the selected course to the TACAN beacon. (If the TACAN system goes into search, the CDI will go to the null or zero position and remain until TACAN once again locks onto the station.)

- b. With function selector switch in T/R, the omni-range power switch in ON position, and the set tuned to an ILS frequency, the HSI will indicate bearing and range to the TACAN beacon and deviation from the selected course to the TACAN beacon (except for zero position during TACAN search).

WARNING

If TACAN is being used for an approach and the range indicator warning flag comes into view or the TACAN TEST light comes on, the approach should be abandoned and changed to a reliable instrument approach system.

NOTE

- In TACAN mode of operation, the TACAN radio AN/ARN-118 28-volt d-c circuit breaker also provides power for relay switching the course deviation indicator warning flag and course warning flag functions. Should this circuit breaker pop out, control of the warning flags reverts to VOR regardless of the position of the nav mode select switch. In TACAN mode, when the TACAN radio is inoperative due to this circuit breaker being out, the warning flags will remain out of sight if the VOR is receiving a reliable signal. However, the appearance of the TACAN range indicator warning flag, loss of TACAN aural signal, and TEST indicator light coming on are available indications of loss of TACAN.
- If TACAN indicators readouts appear unreliable during flight, perform self test of TACAN system by pressing self test button on control unit and note readouts for proper indications.

2. Nav mode select switch in VOR position:
 - a. With function selector switch in T/R and omni-range power switch in OFF position, the HSI will provide range to the TACAN beacon only.
 - b. With function selector switch in T/R and omni-range power switch in ON position, the HSI will indicate omni bearing and TACAN range. The CDI of the HSI will respond to the omni station except when an ILS station is selected, then the CDI will provide localizer information.

NOTE

With autopilot energized and engaged, the localizer switch cannot be engaged as long as the nav mode select switch is in TACAN or VOR position.

TACAN Air-to-Air Operation**NOTE**

Due to antenna configuration, air-to-air operation may be impaired or inoperative unless the cooperating aircraft is at altitudes lower than the B-52 aircraft.

1. Contact cooperating aircraft to establish operating channels.

NOTE

- The channel of the receiving aircraft must be either 63 channels above or 63 channels below the cooperating aircraft channel and within the 1 through 126 X- or Y-channel range.
- To prevent possible interference from IFF or transponder signals, channels 1 through 11, 58 through 74, and 121 through 126 should not be used.

- The use of Y channels is recommended to reduce the possibility of DME interference (if cooperating aircraft is equipped with Y-channel capabilities).

2. Set function selector switch to A/A REC position for bearing information or A/A T/R position for range and bearing information if cooperating aircraft has bearing-transmit capabilities.

3. Read bearing and/or range display on HSI after 5 seconds.

NOTE

If HSI bearing pointer rotates continuously clockwise, check if TEST light is on. If light is on, momentarily depress TEST switch to initiate a test cycle. If light goes out after 20 seconds, distance-bearing information is valid.

OMNI-RANGE RADIO AN/ARN-14

The omni-range radio provides a very high frequency receiver for navigation over land and for runway localizer instrument approaches. The omni-range radio includes a receiver, a control panel on the pilots' overhead panel, and shares the HSI with the TACAN system. The HSI (figure 4-31) is located on the pilots' instrument panel. The omni-range radio uses TR power for both control and operation. To start the omni-range radio, position the power switch to ON. To turn off the omni-range radio, position the switch to OFF. For additional information on the indicators, see "Instrument Landing System Indicators," this section.

GLIDE SLOPE EQUIPMENT AN/ARN-31

This equipment indicates glide angle of the aircraft with relation to the runway for instrument approach. The controls and indicators are common to the omni-range radio. A glide slope indicator on the radio course indicator (figure 4-30) and the glide slope indicator on the attitude-director indicator (14, figure 1-47) indicate aircraft position relative to a glide slope beam. A warning flag on the left side of the indicator moves out of sight when a glide slope signal is being received. The equipment operates on 118-volt single-phase a-c power provided through a circuit breaker marked "Glide Slope" located on the right load central circuit breaker panel. To start the glide slope equipment, position the omni-range radio power switch to ON. To stop operation, position the power switch to OFF.

MARKER BEACON RECEIVER AN/ARN-32

This receiver is used both as a navigational and as a landing aid. When flying over a beacon, a signal is heard on the interphone and observed as a light illumination just above each AQU-4/A HSI (11, figure 1-15). The receiver operates on TR power.

NOTE

W181

The marker beacon indicator light may illuminate while transmitting on the AN/ARC-58 liaison radio. Do not transmit on this radio when accurate marker beacon indications are desired.

RADAR ALTIMETER AN/APN-150

A Type AN/APN-150 radar altimeter (figure 4-15) is located on both sides of the pilots' forward instrument panel (17, figure 1-15). The instrument provides for measuring absolute altitude from 0 to 5000 feet. An altitude indicator needle (3, figure 4-15) indicates altitude from 0 to 1000 feet in 20-foot increments and from 1000 to 5000 feet in 100-foot increments. When power is not being supplied to the radar altimeter system, the altitude indicator needle disappears behind a black mask (4, figure 4-15) painted on the indicator cover glass. When the altitude indicator needle is in this position, an internal mechanical linkage positions a red function flag (6, figure 4-15) on the indicator face to FAIL. This action is also prevalent when system power is on and the aircraft absolute altitude is above 5000 feet. When the aircraft absolute altitude is below 5000 feet and power is on, the indicator needle will point to the respective altitude and the function flag will show ON. An adjustable index or cursor (5, figure 4-15) is provided on the circumference of the



1. ON-ALT CONTROL KNOB
2. RADAR ALTIMETER CAUTION LIGHT (TYPICAL)
3. ALTITUDE INDICATOR NEEDLE (BEHIND MASK)
4. MASK
5. CURSOR
6. FAIL/ON FUNCTION FLAG

..... Radar Altimeter

Figure 4-15.

indicator dial. This index can be manually set between indicator altitudes of 0 and 5000 feet and serves as a reference point to the altitude indicator needle when the system is in operation. The radar altimeter has a single operating control. This is a knob (1, figure 4-15) located on the upper right corner of the instrument and is marked "ON-ALT." The ON-ALT control knob turns the system on and off and also provides a means of setting the cursor at any desired altitude. A barometric pressure switch is incorporated to control the on-off function of the radar altimeter at 30,000 feet pressure altitude. Above 30,000 feet, power is removed from the system except for warmup power supplied to the klystron filament. Below 30,000 feet, power is supplied to the system and the radar altimeter will indicate accurate altitude (between 0 and 5000 feet absolute) within 45 seconds. The radar altimeter weighs all samples within its extremely broad beam widths (approximately 60° by 60°) and reaches a statistical average altitude within that beam. When the aircraft is in a bank or roll, a similar averaging procedure occurs. The area scanned by the antenna is extended in one direction and diminished in the other. At large pitch or bank angles, the 60° beam will extend farther from the aircraft and a false sense of height will occur. The radar altimeter system is provided aft TR power through a circuit

breaker marked "Radar Altimeter" in the aft dc power box and 118 volt ac power through a circuit breaker marked "Radar Altimeter" in the aft ac power box.

WARNING

- The radar altimeter FAIL/ON function (warning) flag does not indicate all failures of this system.
- Over rough terrain, the radar altimeter has been observed to indicate the crossing clearance as much as 30% higher than actual clearance.
- During the operation of various lower aft body ECM transmitters, interference to the APN-150 radar altimeter may occur. This interference may or may not be accompanied by a coincidental display of the fail flag. Indications of interference include but are not limited to the altitude indicator needle masking, driving to zero, vibrating, freezing or changing altitude indications with no actual change in aircraft altitude.
- If the aircraft exceeds 25 degrees of pitch or 30 degrees of roll, the radar altimeter is unreliable.

NOTE

- At terrain clearance altitudes above 5000 feet, the altimeter may accomplish lock-on. In this event, the function flag will indicate ON and the indicator needle will move from behind the mask to a false altitude. Movement of the indicator needle may be opposite to movement of the aircraft as it changes altitude. Ignore all altimeter readings when the aircraft is more than 5000 feet above terrain. The radar altimeter should remain on during the entire flight even though fluctuation of the FAIL/ON function flag and intermittent re-appearance of the altitude indicator needle above 5000 feet may prove distracting to the pilot. This is due to the fact that if the system is turned off for a period of time and then turned on just prior to a rapid descent, an insufficient warmup period could seriously impair the accuracy of the system.
- When the radar altimeter is operated on the ground and the aircraft is parked, or during taxiing, takeoffs, and landings, the altimeter may not maintain a continuous ground lock-on. This results from the multiple bounce paths between the systems transmitting and receiving antennas during operation in close proximity to the ground. After takeoff, the radar altimeter should regain lock-on within

1 minute and will then indicate the proper altitude. Also, when on the ground and in the vicinity of reflective objects, the altimeter may lock on returns from these objects and indicate an erroneous altitude. This condition is a normal function of the altimeter.

Radar Altimeter Tie-In

The radar altimeter provides radar altitude inputs to the BNS low altitude calibrator (LAC) for calibration of BNS H_A while at APN-150 operational altitudes. In addition, radar altimeter inputs are provided through an APN-150 AGM-69A tie-in control switch to the AGM-69A missile system. The radar altimeter also provides radar altitude inputs to the EVS which are displayed on the EVS monitors. For additional information, see "EVS Monitor" under "Electro-Optical Viewing System (EVS)," this section.

Radar Altimeter Caution Light

An amber press-to-test radar altimeter caution light (2, figure 4-15) is located adjacent to each pilot's radar altimeter. Each caution light illuminates when its associated radar altimeter indicated altitude is below the altitude at which its cursor is set. The radar altimeter caution light receives aft TR power through a circuit breaker marked "Radar Altimeter" in the aft d-c power box.

Normal Operation of Radar Altimeter

The radar altimeter is to be used in conjunction with the terrain avoidance system and will be included in the pilot's normal instrument scanning pattern for a continuous cross-check with other terrain clearance information. The following procedure is used to place the radar altimeter in operation and may be accomplished in one continuous action.

CAUTION

If the system is turned OFF for any reason after the two minute warmup period, wait 1 minute prior to returning the system to operation.

NOTE

The copilot has no control of system turn-on. However, by rotating the ON-ALT knob, he may set the cursor on his indicator to any desired altitude.

1. Rotate ON-ALT knob to its limit stop in the counterclockwise direction.
2. Rotate ON-ALT knob approximately 8° in the clockwise direction or enough to move the cursor to an indication between 0 and 5000 feet. This will supply power to the system.

3. Allow approximately 2 minutes for warmup and for the system to search for and lock on a return signal from the ground. At the end of this period, the following will occur:

a. The altitude indicator needle will appear from under the mask and rotate in a counterclockwise direction toward 0-foot altitude. Full tracking from 5000 feet to 0 feet will take approximately 12 seconds.

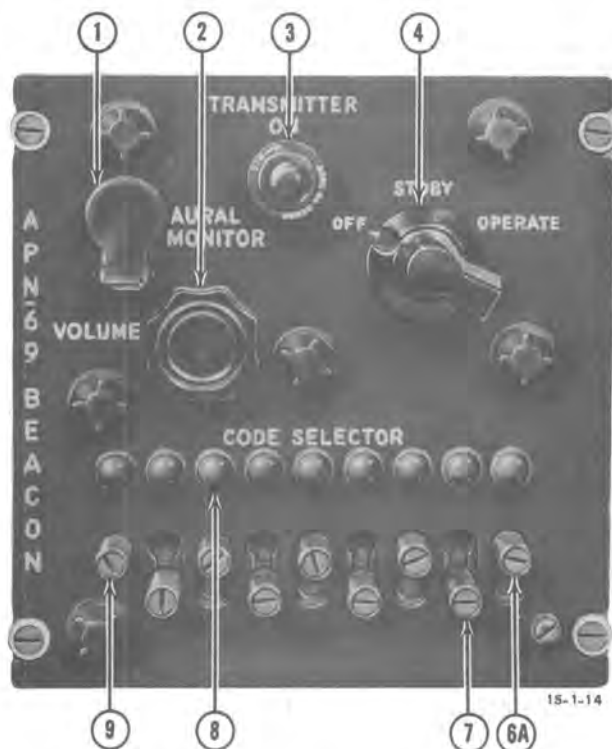
b. With the appearance of the altitude indicator needle, the red FAIL flag will be removed from view on the instrument face and be replaced by the system ON flag.

4. Check caution light operation by adjusting the pilot's cursor to an altitude greater than indicated by pointer. Pilot's caution light should illuminate. Repeat for copilot's instrument.

5. To turn system off, rotate ON-ALT knob counterclockwise to its limit stop.

RENDEZVOUS RADAR AN/APN-69

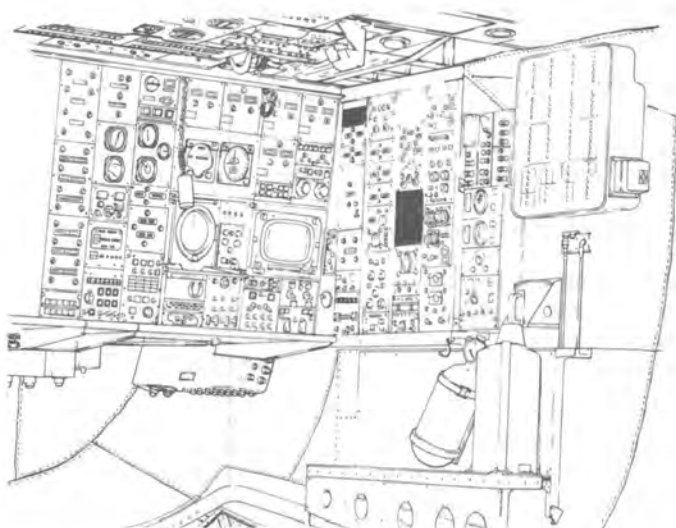
The APN-69 radar is used for air refueling rendezvous. The set includes a receiver, transmitter, and a control panel (45, figure 4-41) which is located at the



1. MONITOR JACK
2. VOLUME KNOB
3. TRANSMITTER-ON INDICATOR LIGHT
4. POWER SWITCH
5. LOW PRESSURE WARNING LIGHT
6. APN-69 PRESSURIZATION SWITCH
- 6A. CODE 9 SELECTOR SWITCH
7. CODE SELECTOR SWITCH
8. CODE SELECTOR INDICATOR LIGHTS
9. COMMON CODE SELECTOR SWITCH



15-1-315



.....Rendezvous Radar Control Panels

Figure 4-16.

navigator's station. The beacon responds automatically when interrogated by the APS-42 (KC-97), APN-59 (KC-135), or APS-108, ASB-4A, ASB-9A, or ASB-16 (B-52) search radars, providing range and bearing information for the interrogating aircraft to "home" on the beacon signal. Transmissions are coded to permit positive identification between aircraft. The set operates on TR power and 118-volt single-phase a-c power. A pressurization kit provides pressurization for the system waveguide. The controls for operating the pressurization kit are located at the navigator's station.

Rendezvous Radar Controls

POWER SWITCH. A rotary-type power switch (4, figure 4-16) on the rendezvous radar control panel has OFF--STDBY--OPERATE positions. STDBY position supplies power to all system circuits except the high voltage circuits. OPERATE position completely energizes the system provided a 3-minute warmup period is observed after turning to STDBY.

OFF position removes all power from the set.

CODE SELECTOR SWITCH. Eight code selector slide switches (7, figure 4-16) on the rendezvous radar control panel are used to set up the code combinations in the response transmission. The code element corresponding to an individual switch can be included in the reply by pulling out on the spring-loaded knob and sliding the switch to ON (up) position. The code 9 selector switch (6A, figure 4-16) being placed in the ON position causes the transmission of a special response when the BNS system is in operation.

COMMON CODE SELECTOR SWITCH. A common code selector switch (9, figure 4-16) on the rendezvous radar control panel which corresponds to the first code element is stationary. This code element is common to all code combinations.

VOLUME KNOB. A volume knob (2, figure 4-16) located on the rendezvous radar control panel is used to adjust the audio signal level when monitoring the set over the interphone. See figure 4-10 for proper mixer toggle switch selection.

MONITOR JACK. A jack (1, figure 4-16) on the rendezvous radar control panel is used for test purposes. When a headset is connected to the jack, random noises (or periodic triggering of the system) may be heard and is indicative of set operation.

Rendezvous Radar Indicators

TRANSMITTER-ON INDICATOR LIGHT. A green indicator light (3, figure 4-16) on the rendezvous radar control panel illuminates when high voltage has been applied to the transmitter and indicates that the set is ready for operation.

CODE SELECTOR INDICATOR LIGHTS. Nine indicator lights (8, figure 4-16) located on the rendezvous radar control panel indicate when the respective code element is included in the radar response.

AN/APN-69 Pressurization Panel

The APN-69 pressurization panel located at the navigator's station contains a red low pressure warning light (5, figure 4-16) and a two-position pressurization switch (6, figure 4-16) with COMPRESSOR ON--OFF positions. The switch controls a pressurization kit used to pressurize the APN-69 rendezvous radar waveguides. In normal operation, the pressurization kit holds the pressure between 7.2 and 8.88 inches Hg (38,000 and 33,000 feet pressure altitude). If the pressure is allowed to decrease to 6.17 inches Hg (41,500 feet pressure altitude), the red low pressure warning light will illuminate, indicating damage to the rendezvous radar set which may occur if it is operated, and remain illuminated until the pressure is returned to 8.35 inches Hg (35,000 feet pressure altitude).

CAUTION

If the warning light remains illuminated for a period of more than 15 minutes, the switch should be placed to OFF position as the motor and pressurization pump are designed to operate not more than 15 minutes each hour.

The pressurization kit is provided with a relief valve that allows the exterior and interior pressures of the APN-69 waveguide to equalize during descent from altitude. Control power is supplied to the system through a circuit breaker marked "AN/APN-69 and AN/APN-69 Press Pump" on the auxiliary BNS circuit breaker panel. The pump motor and low pressure warning light receive power through a circuit breaker marked "ECM Receiver Press Kit" in the aft d-c power box.

Normal Operation of Rendezvous Radar

The following procedure is used to place the rendezvous radar in operation.

1. Place the power switch to STDBY
2. Place pressurization switch to COMPRESSOR ON.
3. Allow approximately 3 minutes for warmup and place power switch to OPERATE. After the warmup period, the transmitter-on light will come on indicating that the set is ready for automatic operation and will reply to interrogating pulses of the proper characteristics.
4. Select code. As an example of a 3-2 code, the first (which is stationary and common to all code combinations), second, third, fifth, and sixth code selector switches would be in the up (ON) position; all other code selector switches would be in the down (OFF) position. Do not insert more than six code elements, including the stationary element, at one time.
5. The operation of the rendezvous radar may be monitored over the interphone by placing the proper interphone mixer switch to ON position.
6. If it is desired to discontinue operation temporarily, place the power switch to STDBY. In this manner, the equipment is kept ready for immediate use.

CAUTION

Place power switch to STDBY if the low pressure warning light associated with the pressurization kit illuminates when above 35,000 feet pressure altitude. This will prevent damage to the receiver-transmitter set.

7. To deenergize the equipment, place the power switch to OFF and the pressurization switch to OFF.

IFF TRANSPONDER SET AN/APX-64 (AIMS)

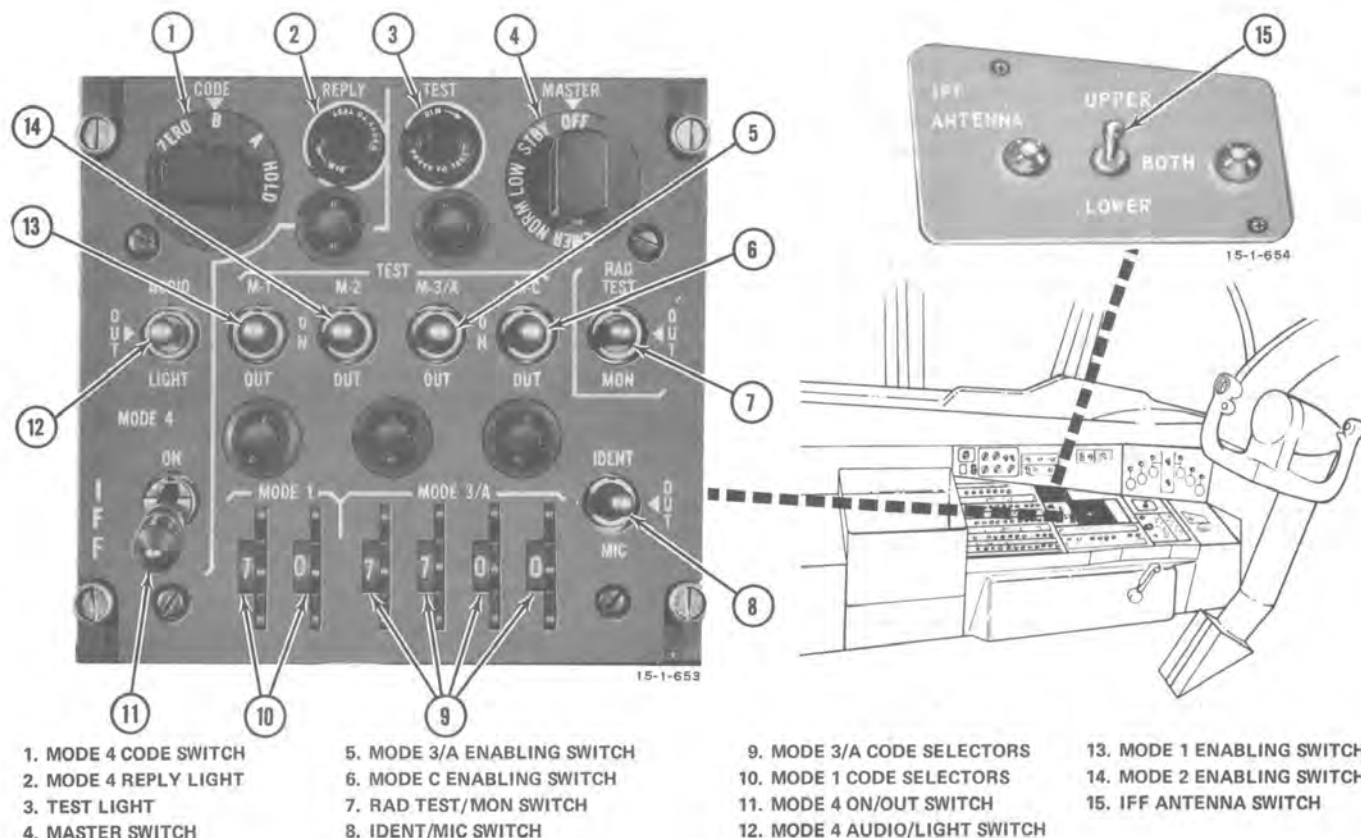
NOTE

AIMS includes the features of and is derived from:

- A - Air Traffic Control Radar Beacon System
- I - Identification Friend or Foe
- M - Mark XII Identification
- S - System

The transponder set AN/APX-64 (AIMS) provides for Mark X IFF with selective identification feature (SIF), automatic altitude reporting, and Mark XII (Mode 4) encrypted IFF. The transponder set is the airborne portion of a two-way link between the aircraft and ground radar installations. The ground radar station sends an interrogation signal which is received by the aircraft; the aircraft transponder (reply system) then replies with coded signals which are received on the ground and displayed on the radar scope as unique identification and altitude signals. The ground station may interrogate in more than one mode. However, the transponder will only

Figure 4-17 (Deleted)



■■■■■■■■■■AN/APX-64 IFF Control Panels

Figure 4-17A.

reply in those modes that are enabled. In addition to the normal replies listed above, the transponder contains provisions for a special emergency mode of operation (EMER position of the master switch), and for transmission of an "identification of position" (IDENT) signal. The transponder receives coded altitude information from the CPU-66 altitude computer (see Instruments, Section I). Modes 1, 2, 3/A, and C have a self-test capability with either internally generated test interrogations or ground station interrogations. Mode 4 operation requires that the mode 4 transponder computer be physically installed in the aircraft and, when installed, operation is continuously monitored by a caution light. The transponder receives TR power and 118-volt a-c power from circuit breakers located on the left load central circuit breaker panel, marked "IFF DC" and "IFF AC" respectively. The IFF test set is provided TR power by a circuit breaker marked "IFF Test Set" on the left load central circuit breaker panel. The mode 4 computer is provided power by the transponder.

The interrogation and reply modes are as follows:

INTERROGATION	REPLY
MODE 1	Any one of 32 possible codes, as set on IFF panel
MODE 2	Any one of 4096 possible codes, as set on APX-64 transponder
MODE 3/A	Any one of 4096 possible codes, as set on IFF panel
MODE C	Standard ATC code for altitude reporting
MODE 4	As determined by mode 4 transponder computer

AN/APX-64 IFF Transponder Set Controls

MASTER SWITCH. The master switch (4, figure 4-17A) is a rotary switch with OFF--STBY--LOW--NORM--EMER positions. In OFF position, all power is removed from the set. STBY position places the transponder in warmup condition. Warmup requires approximately 3 minutes. LOW position places the transponder in operation with reduced receiver sensitivity. NORM position results in operation with normal receiver sensitivity. EMER position causes automatic transmission of emergency reply signals when interrogated by mode 1, mode 2, or mode 3/A. The switch must be pulled out to turn to OFF or EMER.

NOTE

- The master switch must be in the NORM position for self-test with mode enabling switches.
- OFF position will zeroize mode 4 code settings.
- The mode 4 computer door must be closed firmly in one continuous motion or zeroize will result.

MODE ENABLING SWITCHES. Four mode enabling switches (13, 14, 5, and 6, figure 4-17A) are marked "M-1," "M-2," "M-3/A," and "M-C" and have positions of OUT-ON--TEST with momentary TEST position. The OUT position prevents the transponder from replying to interrogation signals in that mode. The ON position enables operation in the selected mode. The momentary TEST position provides for a self-test of the selected mode. When the switch is held to the TEST position, test interrogations are generated, the transponder response is analyzed, and results are indicated by the test light.

TEST LIGHT. A green press-to-test test light (3, figure 4-17A) illuminates when the transponder is responding correctly to mode 1, 2, 3/A, or C interrogations. Source of interrogations is controlled by the mode enabling switch TEST positions or by the RAD TEST/MON switch.

RAD TEST/MON SWITCH. The RAD TEST/MON switch (7, figure 4-17A) has three positions marked RAD TEST--OUT--MON and is spring-loaded from RAD TEST to OUT. RAD TEST position is not used by the flight crew. MON position enables the test light to monitor modes 1, 2, 3/A, and C replies generated by the transponder to ground interrogations. This switch must be positioned to OUT when using the mode enabling switch TEST positions.

IDENT/MIC SWITCH. The IDENT/MIC switch (8, figure 4-17A) provides for special identification features which are of use to the air traffic controller. The switch has three positions marked IDENT--OUT--MIC and is spring-loaded from IDENT to OUT position. Momentarily actuating the switch to the IDENT position initiates the identification response. When the switch is placed in the MIC position, identification response is initiated whenever the pilot's or copilot's microphone trigger switch is depressed provided the command radio is on and the interphone selector is in the respective COMM position. The response will continue for 30 seconds after the IDENT/MIC switch or the trigger switch is actuated, and consists of a double reply, depending upon which modes are enabled.

NOTE

The proper mode enabling switch must be turned on (to match the interrogation mode) to allow identification operation.

CODE SELECTORS. Mode 1 code selectors (10, figure 4-17A) are eight-position thumbwheel type selectors with integral indicators. The first digit selector is numbered from 0 thru 7, and the second digit selector is numbered from 0 thru 3. A total of 32 mode 1 code combinations is available. Mode 3/A code selectors (9, figure 4-17A) are thumbwheel type selectors with integral indicators numbered from 0 thru 7. The mode 3/A selectors allow selection of any base eight code from 0000 to 7777, for a total of 4096 different codes. Mode 2 and mode 4 codes are preset.

MODE 4 ON/OUT SWITCH. The mode 4 on/out switch (11, figure 4-17A) has two positions marked ON--OUT. With the transponder functioning, mode 4 operation is selected by placing the switch to ON. Transponder functioning is controlled by the master switch for mode 4 as for other modes. Placing the mode 4 on/out switch to OUT disables mode 4 operation. Accidental selection of OUT is prevented by the switch design, which requires the operator to pull out on the toggle lever before it can be moved to the OUT position.

MODE 4 CODE SWITCH. The mode 4 code switch (1, figure 4-17A) has four positions marked HOLD--A--B--ZERO. Positions A and B select the preset code for the present and succeeding code period, respectively. ZERO position will zeroize both code settings at any time aircraft power is on and the master switch is in any position other than OFF. Inadvertent selection of ZERO is prevented by switch design which requires that the knob be pulled out before it can be turned to ZERO. Both code settings

normally will be zeroized when power is turned off after the aircraft has landed. The code settings can be retained by momentarily placing the mode 4 code switch in the spring-loaded HOLD position while the aircraft is on the ground. The HOLD function is controlled by the landing gear safety switches and requires transponder power to remain on for at least 15 seconds to mechanically latch the code settings.

MODE 4 AUDIO/LIGHT SWITCH. The mode 4 audio/light switch (12, figure 4-17A) has three positions marked AUDIO--OUT--LIGHT. In the LIGHT position, the mode 4 reply light will illuminate when mode 4 replies are transmitted. In the AUDIO position, an audio signal in the pilot's headset indicates interrogations are being received and illumination of the mode 4 reply light indicates when replies are transmitted. The audio signal is controlled by a separate mixer switch channel on the pilot's interphone panel. In the OUT position, both light and audio indications are inoperative.

MODE 4 REPLY LIGHT. The mode 4 reply light (2, figure 4-17A) is a green press-to-test light controlled by the mode 4 audio/light switch.

IFF MODE 4 CAUTION LIGHT. The amber IFF mode 4 press-to-test caution light (7, figure 1-15) is located on the pilots' instrument panel. The caution light illuminates whenever an inoperative mode 4 capability is detected, provided that (1) the mode 4 transponder computer is installed (2) aircraft power is on, and (3) the master switch is not OFF. Specific discrepancies monitored by the caution light are:

- Mode 4 codes zeroized.
- Transponder failure to reply to proper interrogation.
- Automatic self-test function of the computer reveals a faulty computer.

To attempt correction when the caution light is illuminated, reposition the master switch to NORM (if in STBY or LOW), check that the mode 4 on/out switch is ON, and check that the proper A or B code has been selected.

NOTE

Since power for the caution light is routed through the mode 4 transponder computer, this unit must be physically installed in the aircraft to render the caution light operative.

IFF ANTENNA SWITCH. A three-position IFF antenna switch (15, figure 4-17A) on the pilot's side

panel allows selection of UPPER, BOTH, or LOWER IFF antennas. When the IFF antenna switch is positioned to BOTH, the transponder alternates between antennas.

Normal Operation of AN/APX-64 IFF

Normal operation is as follows:

1. Position master switch to STBY for warmup. Warmup requires about 3 minutes.
2. Set mode 1 and mode 3/A code selectors as briefed.
3. Position IFF antenna switch to BOTH.
4. Position IDENT/MIC switch to OUT.
5. For system self-test:
 - a. Position master switch to NORM.
 - b. Position RAD TEST/MON switch to OUT.
 - c. Momentarily hold each mode enabling switch to TEST, then return to OUT. Illumination of test light for each mode indicates satisfactory operation.

NOTE

If test light does not come on when switch is held in TEST position, but blinks when switch is released, a malfunction of that mode is indicated.

6. Position master switch to LOW or NORM as desired.
7. Position mode enabling switches to ON as briefed.
8. Position RAD TEST/MON switch to OUT or MON as desired.
9. Perform mode 4 operations as briefed.
10. To turn off equipment, place the mode 4 code switch momentarily to ZERO then position the master switch to OFF.

NOTE

If it is desired to retain the mode 4 code after mission termination, momentarily place the mode 4 code switch to the HOLD position after the aircraft has landed. Aircraft electrical power must be left on for 15 seconds to lock the code in.

Emergency Operation of AN/APX-64 IFF

For emergency operation, pull outward on the master switch and rotate to the EMER position. Modes 1, 2, and 3/A are automatically enabled. The set will respond to modes 1 or 2 interrogations with the reply code determined by the mode 1 and mode 2 code selectors followed by three sets of pulse pairs. Mode 3/A reply code will be 7700, regardless of the position of the mode 3/A code selectors, and will be followed by three sets of pulse pairs.

FIRE CONTROL RADAR

The fire control radar of the fire control system provides the necessary information to insure a positive and almost automatic defense of the aircraft. For further information, see "Gunnery System," this section. Also refer to T.O. 1B-52G-1-5.

BNS RADAR

For description of this equipment, see "Weapons Control System - Offensive," this section; also refer to T.O. 1B-52G-1-6-1.

ECM EQUIPMENT

The ECM equipment is located at the EW officer's station (figure 4-18). For further information on this equipment, refer to T.O. 1B-52D-1-2.

LIGHTING EQUIPMENT

EXTERIOR LIGHTING

Exterior lighting consists of landing lights, navigation lights, terrain clearance light, taxi lights, air refueling lights, crosswind landing light, anticollision lights, and a signal light. The lights utilize 28-volt a-c power reduced from 118-volt ac by auto-transformers.

Landing Lights

A fixed landing light is installed in each forward landing gear door for use during approach and landing. The landing lights are controlled by an ON--OFF switch (figure 4-19) on the aisle stand and will not illuminate when the landing gear is up and locked. D-C power is provided through circuit breakers marked "Normal Control Right Fwd" on the "Landing Gear" portion of the right load central circuit breaker panel, and marked "Normal Control Left Fwd" on the "Landing Gear" portion of the left load central circuit breaker panel.

Navigational Lights

The navigation lights consist of a red light on the left wingtip, a green light on the right wingtip, two white lights on each tip of the horizontal stabilizer, and three white lights, one on top of the fuselage and one on each side above the bomb bay doors. The lights

are controlled by two toggle switches (figure 4-19) on the pilots' overhead panel. One switch has STEADY --OFF--FLASH positions. STEADY position selects steady illumination of all lights. FLASH position selects a flashing of the wing and tail lights with steady illumination of the fuselage lights, while the OFF position turns the lights out. The other switch has BRIGHT--DIM positions and selects bright or dim illumination of all navigation lights. Power is provided through a circuit breaker marked "Nav Pwr" on the "Exterior" portion of the left load central circuit breaker panel.

Anticollision Lights

Three rotating anticollision lights, one on each side of the fuselage and one on the bottom of the fuselage, are used to safeguard against midair collision. The lights are controlled by an ON--OFF switch (figure 4-19) on the pilots' overhead panel. On aircraft **W173** **W180**, d-c power is provided through circuit breakers marked "Anti-Collision LH Upper," "Anti-Collision RH Upper," and "Anti-Collision Lower." On aircraft **W181**, d-c power is provided through circuit breakers marked "Anti-Collision LH Upper" and "Anti-Collision Lower." All circuit breakers are on the "Exterior" portion of the left load central circuit breaker panel.

Crosswind Landing Light

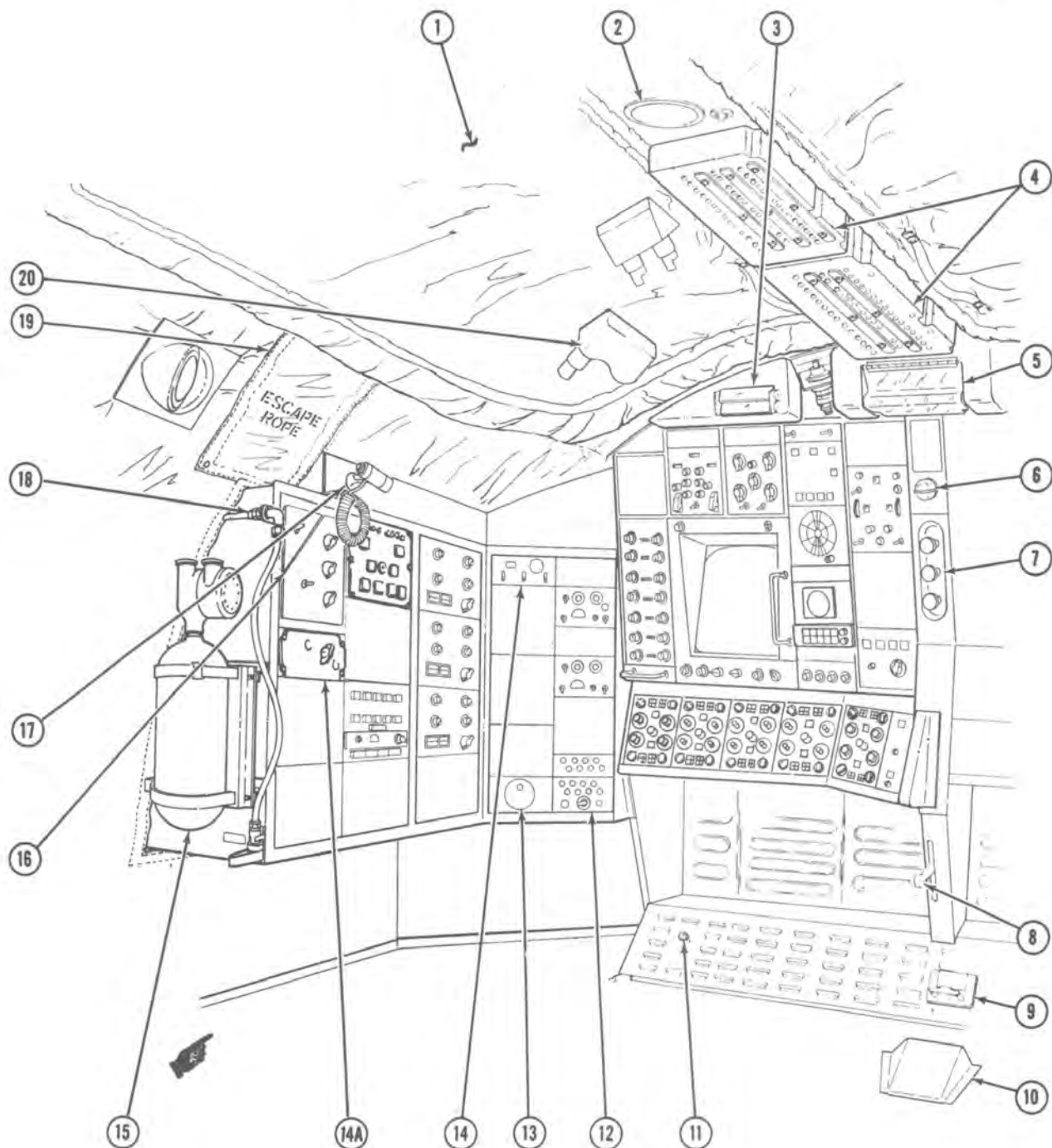
A crosswind landing light is installed on the right forward landing gear to provide lighting on the landing area during crosswind landings. The light is controlled by an ON--OFF switch (figure 4-19) marked "Crosswind" on the aisle stand. Also, the light may be controlled by a switch marked "Taxi" on the aisle stand. D-C control power is provided through a circuit breaker marked "Taxi and Crosswind Contr" on the "Exterior" portion of the left load central circuit breaker panel. The crosswind landing light will not illuminate unless the landing gear lever is in DOWN position.

Terrain Clearance Light

A retractable terrain clearance light installed on the forward bottom fuselage will provide illumination during a night crash landing. In addition, the light may be used on night takeoffs since the landing lights will not illuminate after the landing gear has been retracted. See "Emergency Equipment," Section I.

Taxi Lights

Three taxi lights and the crosswind landing light provide lighting for taxi operation. One light is installed on the leading edge of each wing just outboard of the



1. ESCAPE HATCH
2. UPPER AISLE AND ENTRY LIGHT
3. UPPER AIR OUTLET
4. ECM CIRCUIT BREAKER PANEL
5. AGM-69A LOCK-UNLOCK SWITCH PANEL
6. EMERGENCY ALARM LIGHT
7. TEMPERATURE CONTROL PANEL
8. REFUEL VALVE EMERGENCY CONTROL LEVER

9. SPECIAL WEAPONS MANUAL LOCK HANDLE STOWAGE BRACKET
10. SPECIAL WEAPONS MANUAL LOCK HANDLE
11. INTERPHONE FOOT SWITCH
12. INTERPHONE CONTROL PANELS
13. ASHTRAY
14. OXYGEN REGULATOR
- 14A. MAIN CONSOLE LIGHT CONTROL PANEL **AL**

15. PORTABLE OXYGEN BOTTLE
16. LIGHTING CONTROL PANEL
17. SPOTLIGHT
18. OXYGEN BOTTLE RECHARGER
19. ESCAPE ROPE CONTAINER
20. SIDE PANEL FLOOD LIGHTS

EW Officer's Station (Typical)

Figure 4-18.



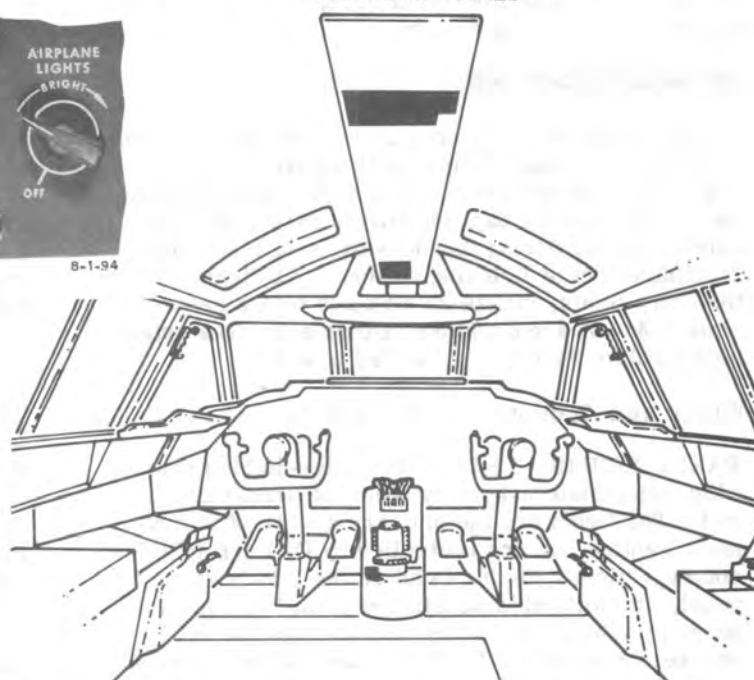
AISLE STAND



OVERHEAD PANEL



8-1-94



■■■■■■■■■■ Exterior Lighting Controls (Typical)

Figure 4-19.

outboard pods. A crosswind taxi light and a crosswind landing light are installed on the right forward landing gear and will not illuminate unless the landing gear lever is in DOWN position. The lights are controlled by an ON--OFF switch on the aisle stand. D-C control power is provided through a circuit breaker marked "Taxi and Crosswind Contr" on the "Exterior" portion of the left load central circuit breaker panel.

Air Refueling Lights

Air refueling lights consist of five white lights, one installed in the receptacle and two in each slipway door. The lights illuminate the receptacle, slipway, and wing areas during night air refueling operations. In addition, the lights aid the tanker boom operator in checking the receiver aircraft. The lights in the slipway doors may be used for scanning the wing

leading edges, nacelles, struts, and spoilers. The lights are controlled by two OFF--BRIGHT rotary switches (figure 4-19) on the pilots' overhead panel. The slipway lights rotary switch controls the receptacle light and slipway lights. The aircraft lights rotary switch controls the left and right wing illuminating lights. The air refueling lights will not illuminate unless the master refuel switch is ON and either the slipway door normal or alternate switch is in OPEN position. D-C control power is provided through a circuit breaker marked "Ext Light" on the "Inflight Refueling" portion of the right load central circuit breaker panel.

Signal Light

For information on the signal light, see "Miscellaneous Equipment," this section.

INTERIOR LIGHTING

Interior lighting is provided by red and white lights. Red lights are used during night flights since red color does not adversely affect night vision. White lights are used for daytime flights during dull light conditions and during thunderstorms to lessen the blinding effect of lightning flashes. All lights, except the entry lights, utilize 28-volt a-c power reduced from 118-volt a-c by autotransformers. The entry lights utilize 24-volt d-c battery power.

Pilot's and Copilot's Station Lighting

PANEL LIGHTS. Lights within edge-lighted panels, which illuminate indirectly from the underside, are red. The lights are the primary source of instrument lighting and are controlled by OFF--BRIGHT rotary switches (figure 4-20) on the pilot's side panel, copilot's side panel, and pilots' overhead panel. Light power is supplied through circuit breakers marked "Pilot Panel" and "Copilot Panel" on the "Interior" portion of the left and right load central circuit breaker panel respectively.

INSTRUMENT LIGHTS. Red lights in the instrument hoods provide illumination for individual instruments. The lights are controlled by OFF--BRIGHT rotary switches (figure 4-20) on the pilot's side panel and copilot's side panel. Light power is received through circuit breakers marked "Pilot Instr" and "Copilot Instr" on the "Interior Lighting" portion of the left and right load central circuit breaker panels respectively.

ESSENTIAL FLIGHT INSTRUMENT LIGHTS. The essential flight instrument lights provide lighting for the pilot's pitot-static altimeter, pilot's radar al-

timeter, clock, vertical velocity indicator, standby compass, turn-and-slip indicator, airspeed indicator, standby attitude indicator, and heading indicator (gyro). These lights normally operate on 28-volt ac power from engine No. 3 generator bus through a circuit breaker marked "Pilot Instr" on the "Interior" portion of the left load central circuit breaker panel, but in the event of complete ac power failure, the lights would receive dc power from the emergency instrument power bus through a circuit breaker marked "Emer Flight Instr Lights" on the "Miscellaneous" portion of the pilot's circuit breaker panel. The pilot's attitude indicator lights normally receive 28-volt ac power from engine No. 3 generator bus through a circuit breaker marked "Pilot Instr" on the "Interior" portion of the left load central circuit breaker panel. In case of complete ac power failure, the lights would receive 28-volt ac emergency inverter power. See "Complete AC Power Failure," Section III.

FLOODLIGHTS. Floodlights are a secondary source of instrument lighting and are mounted in a manner so as to provide illumination on a group of instruments located in the same area. The pilots' station floodlights are controlled by OFF-BRIGHT rotary switches (figure 4-20) on the pilot's side panel and copilot's side panel. Floodlights for the right and left load central circuit breaker panels are controlled by an ON-OFF switch on the pilot's side panel. Light power is provided through circuit breakers marked "Remote Flood" and "Copilot Flood" on the left load central circuit breaker panel and "Pilot Flood" on the right load central circuit breaker panel.

SPOTLIGHTS. Two adjustable spotlights, one on the pilot's glare shield and one on the copilot's glare shield, provide a means of supplying light on any object desired by the pilot or copilot. The lights are controlled by a rheostat switch on the individual light. Light power is provided through a circuit breaker marked "Aisle and Spot" on the "Interior Lighting" portion of the left load central circuit breaker panel.

DOMELIGHTS. One red and one white domelight are located by the pilot's and copilot's escape hatches. The lights are controlled by an OFF--BRIGHT rotary switch (figure 4-20) and the light color is selected by a RED--WHITE toggle switch (figure 4-20). Both switches are on the pilots' overhead panel. Light power is provided through a circuit breaker marked "Pilot and Copilot Dome" on the "Interior Lighting" portion of the right load central circuit breaker panel.

THUNDERSTORM LIGHTS. Two white thunderstorm lights in the pilots' compartment provide illumination during thunderstorms to lessen the blinding effect of lightning flashes. The lights utilize 28-volt a-c power through a circuit breaker marked "Thunderstorm" on the left load central circuit breaker panel. The lights are controlled by a switch on the pilots' overhead panel.

STANDBY COMPASS LIGHT. The standby compass and light are on the eyebrow instrument panel. The light is controlled by an OFF--BRIGHT rotary switch (figure 4-20) on the pilot's side panel. Light power is provided through a circuit breaker marked "Pilot Instr" on the "Interior Lighting" portion of the left load central circuit breaker panel.

WARNING LIGHT DIMMING CONTROL SWITCH. A warning light dimming switch (figure 4-20) on the pilot's side panel controls the brightness of all indicator and warning lights at the pilot's and copilot's station with the exception of the fire warning, autopilot disengaged, and landing gear lights. The switch has DIM--BRIGHT at the extreme positions respectively and is spring-loaded to NEUTRAL position. When the switch is placed to BRIGHT position, all indicator lights are at their brightest illumination. Momentarily moving the switch to DIM position will energize the dimming control relay to dim all lights with the exception of the fire warning, landing gear, a-c circuit breaker, master caution, and oxygen low level warning lights. The rotary flight instruments switch on the pilot's side panel provides for additional dimming control. The rotary control switch is mechanically linked to the dimming circuit, and the warning lights are automatically reset to bright whenever flight instruments lights have been turned to OFF position. The thunderstorm light control switch cuts out the dimming control circuit when positioned ON. Energizing the thunderstorm lights resets all indicator and warning lights to bright. Light control power is provided through a circuit breaker marked "Dim Contr Pilot Copilot" on the "Interior Lighting" portion of the left load central circuit breaker panel.

Radar Navigator and Navigator Station Lighting

PANEL LIGHTS. Lights within all of the edge-lighted panels are controlled by OFF--BRIGHT rotary switches (figure 4-20) on the BNS light control panels. The lights are provided power through circuit breakers marked "Panel Front," "Panel LH Open," and "Panel RH Oper" on the "BNS Compartment Lights" portion of the auxiliary BNS circuit breaker panel.

FLOODLIGHTS. Floodlights for the entire compartment are controlled by an OFF--BRIGHT rotary switch on the BNS light control panel. The lights are provided power through a circuit breaker marked "Flood BNS" on the "BNS Compartment Lights" portion of the auxiliary BNS circuit breaker panel.

INSTRUMENT LIGHTS. Red lights in the instrument hoods provide illumination for individual instruments. The lights are controlled by an OFF--BRIGHT rotary switch on the BNS light control panel. A-C power is supplied to the lights through a circuit breaker marked "INST" on the "BNS Compartment Lights" portion of the auxiliary BNS circuit breaker panel.

SPOTLIGHTS. Spotlights for the entire compartment are controlled by a rheostat switch on each individual light. The lights are provided power through a circuit breaker marked "Aisle and Spot" on the "Interior Lighting" portion of the left load central circuit breaker panel.

DOMELIGHTS. Two domelights, one red and one white, are located above each navigator's seat. The lights are controlled by an OFF--BRIGHT rotary switch (figure 4-20) and the light color selected by a RED--WHITE toggle switch (figure 4-20). Both switches are on the BNS light control panel. Light power is provided through a circuit breaker marked "Dome BNS" on the "BNS Compartment Lights" portion of the auxiliary BNS circuit breaker panel.

BNS TABLE LIGHTS. Two white table lights over the navigator's table are controlled by an OFF--BRIGHT rotary switch (figure 4-20) on the right BNS observer's pressure suit control panel. The lights are provided power through a circuit breaker marked "Table" on the "BNS Compartment Lights" portion of the auxiliary BNS circuit breaker panel.

EVS INDICATOR LIGHTS. The EVS indicator lights are controlled by a BRIGHT--DIM toggle switch (figure 4-19) on the navigator's table light control panel. TR power is supplied to the switch through a circuit breaker marked "EVS Indicator Dimming" on the "DC" portion of the EVS circuit breaker panel.

AGM-69A PANELS. Indicator lights on the AGM-69A weapon status and control panel, mission data control panel, and the mission data display panel are of variable intensity and are controlled by the "AGM-69A Panels" rotary rheostat switch (figure 4-20). This switch is installed to the left of the BNS light control panel. Intensity control (dimmer) power is furnished by an "AGM-69A INDICATOR DIMMING" circuit breaker.

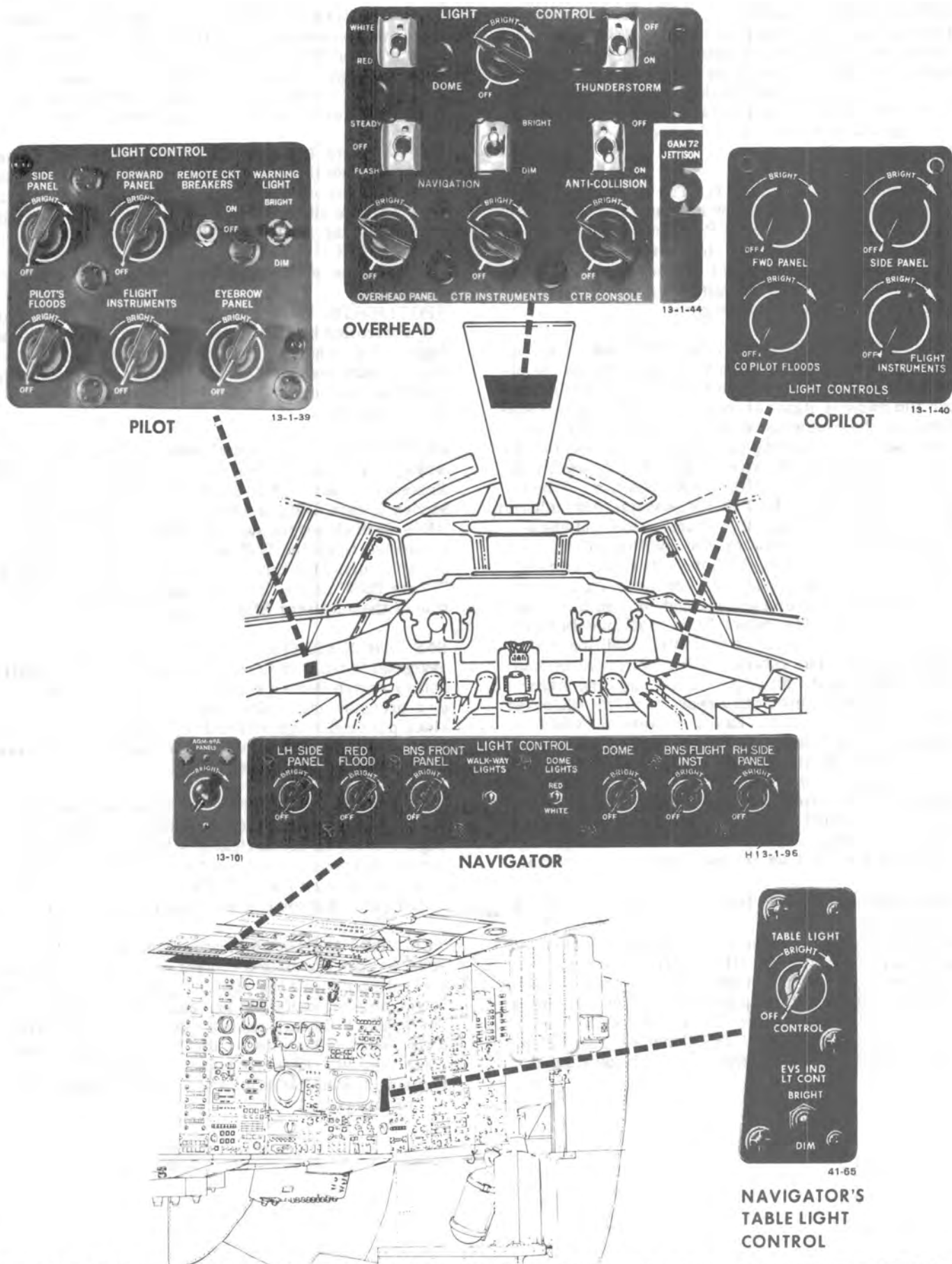
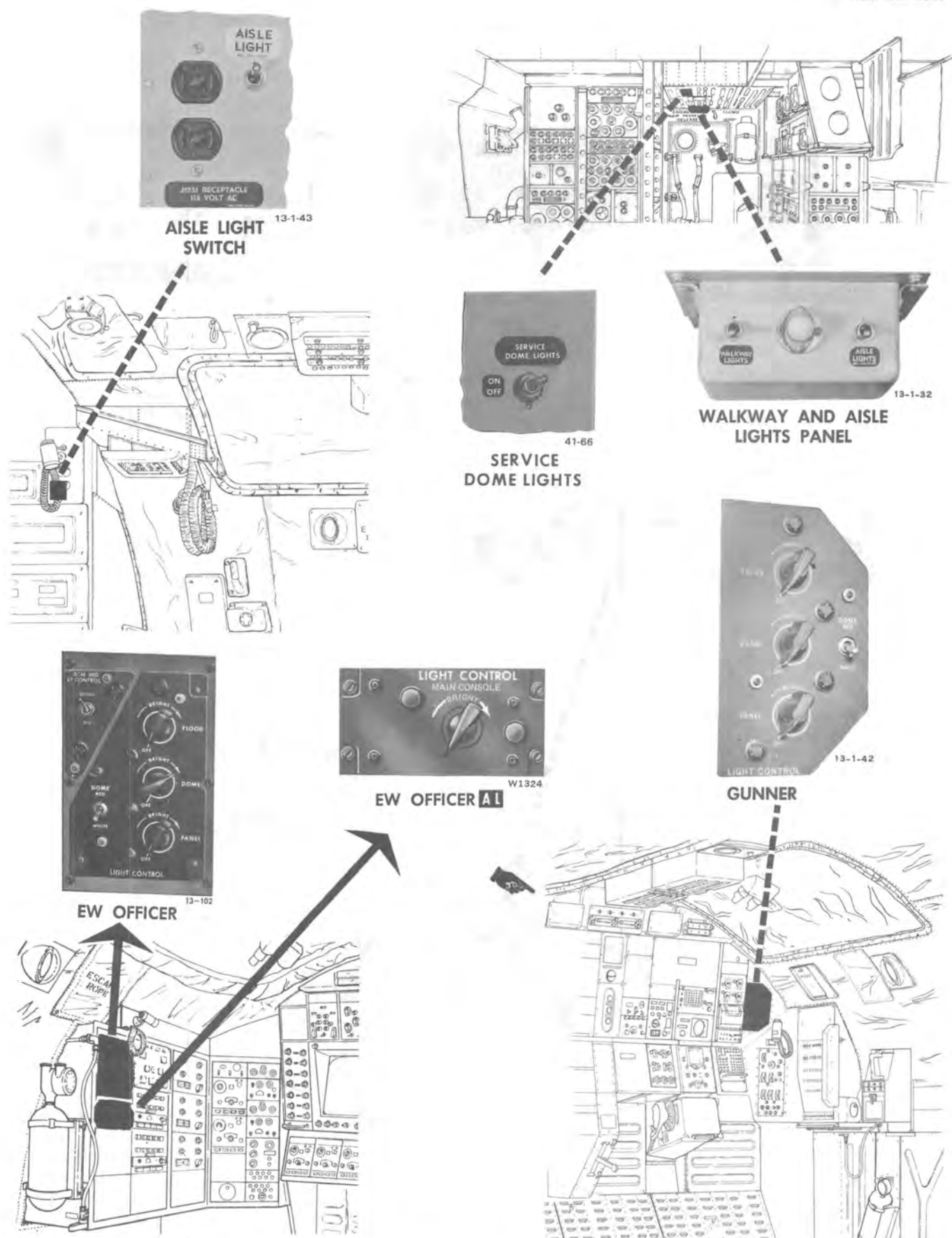
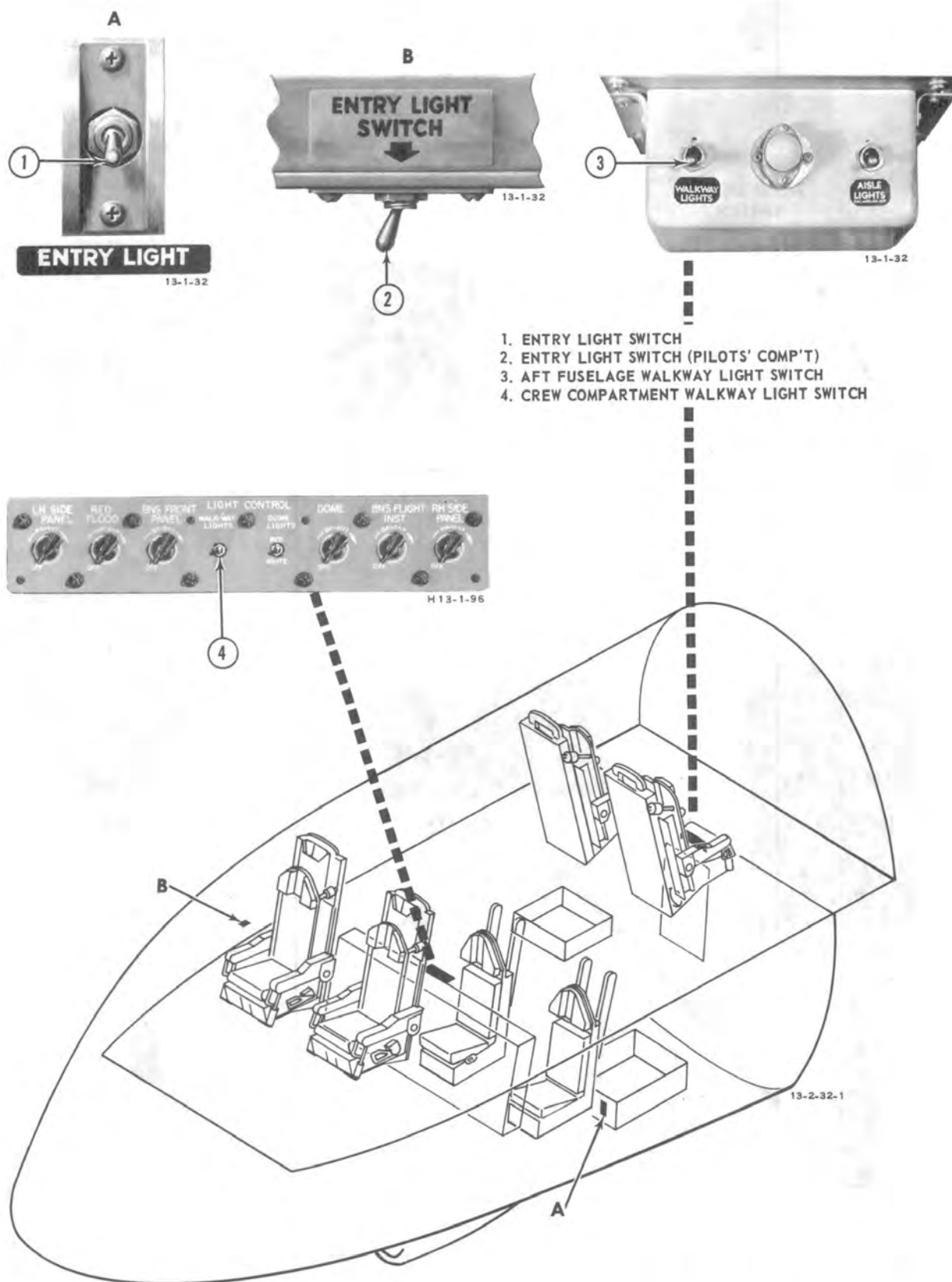


Figure 4-20 (Sheet 1 of 2).



Interior Lighting Controls (Typical)

Figure 4-20 (Sheet 2 of 2).



Entry and Walkway Light Switches

Figure 4-21.

EW, DI, and Gunner's Station Lighting**Less AI**

EW OFFICER'S PANEL LIGHTS. Lights within all of the edge-lighted panels at the EW officer's station are controlled by an OFF--BRIGHT rotary switch (figure 4-20) on the ECM light control panel. The lights are provided power through a circuit breaker marked "DECM Lights - Panel" on the ECM circuit breaker panel.

AI

EW OFFICER'S PANEL LIGHTS. Lights within the edge-lighted panels on the side walls at the EW officer's station are controlled by an OFF--BRIGHT rotary switch (figure 4-20) on the ECM light control panel. Lights within all of the edge-lighted panels on the front (main) console of the EW officer's station are controlled by an OFF--BRIGHT rotary switch (figure 4-20) on the main console lights control panel. All lights are provided power through a circuit breaker marked "DECM Lights - Panel" on the ECM circuit breaker panel.

DI AND GUNNER'S PANEL LIGHTS. Lights within all edge-lighted panels at the DI's and gunner's stations except the AFSATCOM printer and keyboard on aircraft **AU** are controlled by an OFF--BRIGHT rotary switch (figure 4-20) on the gunner's light control panel. These two panels' lights are controlled by the illumination switch on the printer. The lights are provided power through circuit breakers marked "FCS Lights - Panel" on the FCS circuit breaker panel.

FLOODLIGHTS. Red floodlights in the EW officer's and gunner's stations are controlled by OFF--BRIGHT rotary switches (figure 4-20) on the EW officer's light control panel and gunner's light control panel. The lights are provided power through circuit breakers marked "DECM Lights Flood" and "FCS Lights Flood" on the ECM circuit breaker panel and the FCS circuit breaker panel respectively.

SPOTLIGHTS. Two adjustable spotlights, one at the EW officer's and one at the gunner's station, provide a means of supplying light upon any object desired by either operator. The lights are controlled by a rheostat switch on each individual light. The lights are provided power through a circuit breaker marked "Aisle and Spot" on the "Interior Lighting" portion of the left load central circuit breaker panel.

DOMELIGHTS. Two red and two white domelights located at the EW officer's and gunner's stations are controlled by OFF--BRIGHT rotary switches (figure 4-20) and light color selected by a RED--WHITE toggle switch (figure 4-20). One rotary and one toggle switch is located on the EW officer's light control panel and another set of switches is located on the gunner's light control panel. The lights are provided power through circuit breakers marked "DECM Lights Dome" and "FCS Lights Dome" on the ECM circuit breaker panel and FCS circuit breaker panel respectively.

ECM INDICATOR LIGHTS . Dimming of indicator lights on the master expendables panel and the ALT-28 antenna selector panel is controlled by an ECM indicator light control switch (figure 4-20) adjacent to the light control panel on the left sidewall of the EW officer's station. The switch has BRIGHT--DIM positions spring-loaded to a center neutral position. The bright or dim light level of the indicator lights is obtained by actuating the switch to the desired position. Dimming control power for the switch as well as power for the indicator lights is left TR power provided through the circuit breaker marked "ECM Ind Dimming" on the ECM circuit breaker panel.

Passageway Lights

ENTRY LIGHTS. White entry lights are located on the copilot's glare shield, pilots' overhead panel, in deck above entry ladder, and in deck above entry door. The lights are controlled by a switch (2, figure 4-21) on the copilot's glare shield and a switch (1, figure 4-21) by the entry door. The lights are provided 24-volt d-c battery power through a circuit breaker marked "Entry Light" on the right forward BNS circuit breaker panel.

WALKWAY, CRAWLWAY, AND BOMB BAY LIGHTS. White lights are located along the walkway and crawlway through the equipment deck, wheel wells, bomb bay, and aft equipment compartment. The lights are controlled by a switch (4, figure 4-21) on the BNS light control panel and a switch (3, figure 4-21) above the crawlway entrance. The lights receive power through circuit breakers marked "Walkway Lights Fwd Pwr" and "Walkway Lights Aft Contr" on the "Miscellaneous" portion of the auxiliary BNS circuit breaker panel.

AISLE LIGHTS. Two white aisle lights, one located right of entry ladder in the lower crew compartment and one in ceiling of upper crew compartment, are controlled by a switch (figure 4-20) by the lower aisle light and a switch (figure 4-20) above entry ladder on the right equipment rack. The lights are supplied power through a circuit breaker marked "Aisle and Spot" on the "Interior Lighting" portion of the left load central circuit breaker panel.

Electronic Rack Lighting

LOWER RACKS. Lighting for the lower electronic racks is supplied by service domelights and spotlights. The domelights are controlled by an ON--OFF switch (figure 4-20) on the overhead panel above instructor navigator's seat, while the spotlights have an individual rotary switch on each light. The service domelights are supplied power through a circuit breaker marked "Misc Dome Lt" on the auxiliary BNS circuit breaker panel, while the spotlights receive power through a circuit breaker marked "Aisle and Spot" on the "Interior Lighting" portion of the left load central circuit breaker panel.

UPPER RACKS. Lighting for the upper electronic racks is supplied by service domelights and spotlights. The domelights are controlled by a switch (figure 4-20) on the overhead panel above instructor navigator's seat, while the spotlights are controlled by an individual rotary switch on the lights. The domelights are supplied power through a circuit breaker marked "Misc Dome Lt" on the auxiliary BNS circuit breaker panel while the spotlights receive power through a circuit breaker marked "Aisle and Spot" on the "Interior Lighting" portion of the left load central circuit breaker panel.

OXYGEN SYSTEM

The aircraft is provided with a 300 psi liquid oxygen system. This system supplies all crew stations and the portable oxygen bottle rechargers. An automatic pressure breathing diluter demand oxygen regulator is provided at all crew stations. Either Type CRU-68/A, CRU-69/A, or CRU-73/A oxygen regulators are used at all crew stations.

The instructor pilot, defense instructor, and instructor navigator stations each have an alternate load panel with a Type CRU-68/A, CRU-69/A, or CRU-73/A regulator installed. The pilot instructor station also accommodates the mattress station. A pressure breathing portable oxygen bottle recharger (figure 4-22) is located near each of the six regular crew stations. The oxygen system is supplied by three 25-liter 300 psi liquid oxygen converters (6, figure 1-55). Converter No. 1 is located on the forward left side of the aft equipment compartment. Converter No. 3 is located aft of converter No. 1 on the left side of the aft equipment compartment. Converter No. 2 is located on the right side of the aft equipment compartment directly opposite converter No. 3. A supply line from each converter connects with all oxygen regulators and portable oxygen bottle rechargers. However, converter No. 1 normally supplies oxygen to all stations on the left side of the aircraft, while converter No. 2 supplies those stations on the right side. Flow equalizer check valves are provided in the interconnecting lines between the two converter supply lines to balance the demand on each converter, thus creating two separate systems. Check valves at each regulator iso-

late a ruptured line or converter to minimize the amount of oxygen which will be lost. Converter No. 3 is connected to the supply lines of converters No. 1 and 2 to provide additional oxygen in accordance with mission requirements. Also, in the event of malfunction in either or both systems, converter No. 3 will provide oxygen to all stations connected to either or both systems. When converter No. 3 is not installed, a simulator is installed in the gaging circuit to simulate zero liters of liquid oxygen at the No. 3 position. See figure 4-23 for oxygen duration. An oxygen converter and/or its fittings may frost over under certain conditions. When a converter is being filled, the body of the converter and overboard vent line may be covered with frost or moisture due to the converter being warm or high moisture content in the air. This frost or moisture should dissipate after the converter has stabilized. If the converter is malfunctioning due to no vacuum between the converter walls, the frost will remain until all liquid oxygen is lost. After a converter has been filled and stabilized, the allowable leakage due to evaporation loss is 2 liters per converter per 24-hour period. Frost should not appear on the body of the converter but may appear on the boss where the pressure, pressure vent, and supply lines connect to the converter. This frost would appear due to liquid oxygen being supplied to the supply lines or oxygen being vented overboard due to excessive pressure.

NOTE

Pressure indications as high as 420 psi may be attained due to pressure buildup in the heat exchanger line downstream of the liquid oxygen converter and check valve prior to use of oxygen. A relief valve having a high pressure setting of 395 (± 25) psi governs system pressure.

OXYGEN SYSTEM CONTROLS

Regulator Diluter Lever

A regulator diluter lever (4, figure 4-24) located on each oxygen regulator has NORMAL OXYGEN--100% OXYGEN positions. With the lever in NORMAL OXYGEN position, the regulator automatically supplies

the proper mixture of oxygen and air at all altitudes. With the lever in 100% OXYGEN position, the air intake port is closed and pure oxygen is supplied for emergencies regardless of the altitude. At cabin altitudes above 30,000 feet, the lever should be placed in 100% OXYGEN position as a safety precaution. The lever should be left in 100% OXYGEN position at the end of a flight to prevent dust and lint from entering the regulator. If a CRU-73/A regulator is installed, it will incorporate an interlock between the oxygen supply shutoff lever and the regulator diluter valve. The interlock feature automatically places the diluter valve in the 100% OXYGEN position when the supply lever is positioned to OFF.

CAUTION

When the oxygen supply shutoff lever is positioned OFF, on the CRU-73/A, the regulator diluter lever should automatically move to 100% OXYGEN position or it may only move halfway between the NORMAL and 100% OXYGEN positions. When the supply shutoff lever is positioned OFF, do not force regulator diluter lever to NORMAL as this will break the diluter lever.

NOTE

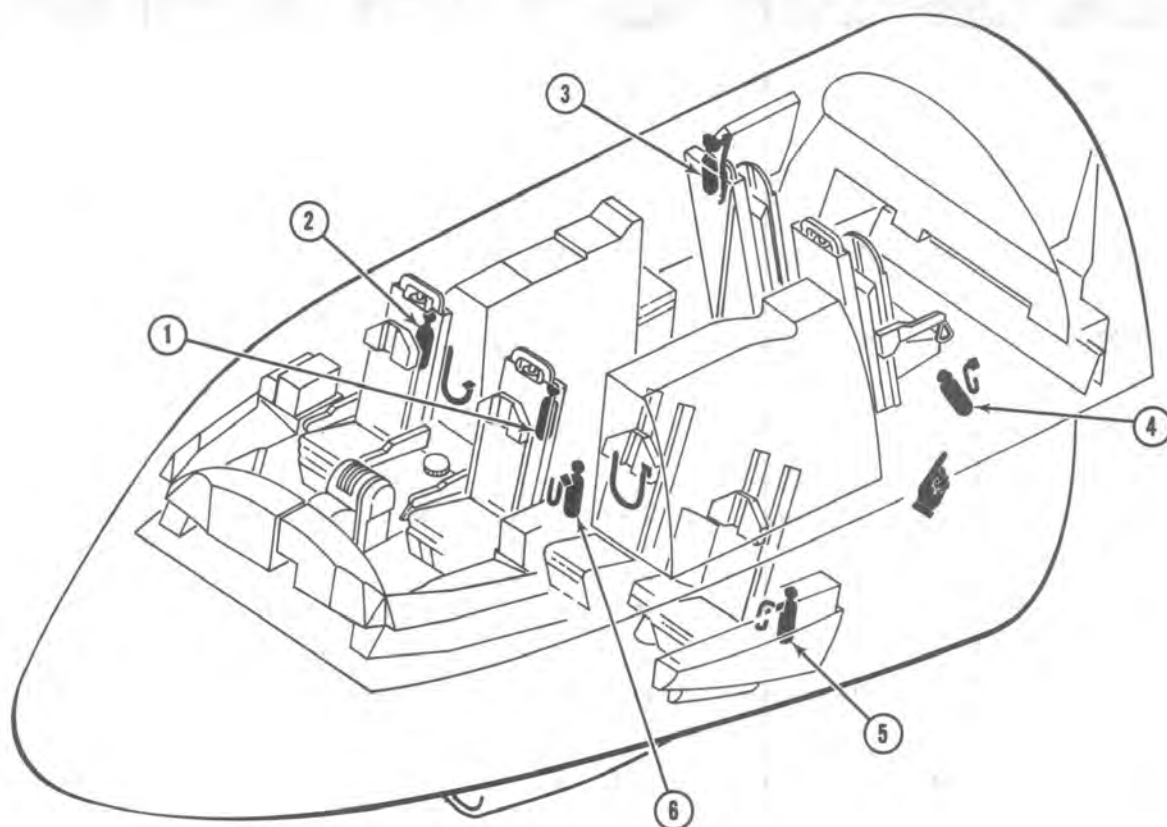
For regulators other than the CRU-73/A, if the oxygen supply lever is off and the diluter lever is in normal, there is no restriction to breathing, but the crewmember will be breathing cabin air only and hypoxia will occur as cabin altitudes that require oxygen are reached. With the diluter lever in 100% (CRU-73/A regulator off) neither cabin air nor oxygen will be available at the mask.

Oxygen Supply Shutoff Lever

An oxygen supply shutoff lever (3, figure 4-24) provided on each oxygen regulator has ON--OFF positions. With the lever in ON position, oxygen is supplied to the regulator. With the lever in OFF position, the oxygen supply to the regulator is shut off to prevent any flow of oxygen from the regulator when not in use.

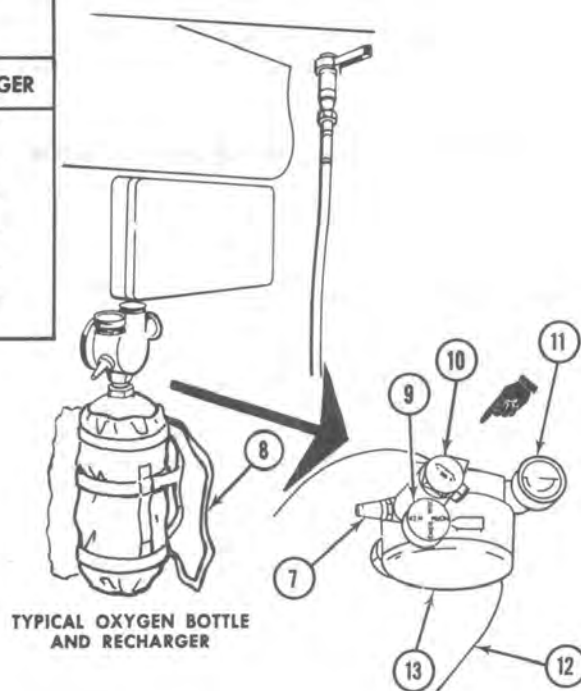
NOTE

Due to the automatic pressure breathing feature of the oxygen regulator, a continuous flow of oxygen will result if the oxygen regulator is not being used and the oxygen supply shutoff lever is left in ON position above 30,000 feet cabin altitude. This condition will cause a rapid loss of oxygen.



OXYGEN BOTTLES AND RECHARGER POINTS		
STATION	BOTTLE	RECHARGER
1. PILOT	✓	✓
2. COPILOT	✓	✓
3. EW OFFICER	✓	✓
4. GUNNER	✓	✓
5. RADAR NAVIGATOR	✓	✓
6. NAVIGATOR	✓	✓

- 7. OXYGEN BOTTLE FILLER PORT
- 8. CARRYING SLING
- 9. ALTITUDE SELECTOR KNOB
- 10. OXYGEN MASK HOSE CONNECTION
- 11. OXYGEN PRESSURE GAGE
- 12. A-6 OXYGEN BOTTLE
- 13. PRESSURE DEMAND REGULATOR



Oxygen Bottles and Recharger Points

Figure 4-22.

CREW MEMBER OXYGEN DURATION—HOURS

CREW: 6

CABIN ALTITUDE — FEET	TOTALIZER GAGE QUANTITY — LITERS														
	70	65	60	55	50	45	40	35	30	25	20	15	10	5	BELOW 5
40,000	<i>73.4</i>	<i>68.1</i>	<i>62.9</i>	<i>57.6</i>	<i>52.4</i>	<i>47.1</i>	<i>41.9</i>	<i>36.8</i>	<i>31.4</i>	<i>26.2</i>	<i>21.0</i>	<i>15.7</i>	<i>10.5</i>	<i>5.2</i>	EMERGENCY — DESCEND TO ALTITUDE NOT REQUIRING OXYGEN
	73.4	68.1	62.9	57.6	52.4	47.1	41.9	36.8	31.4	26.2	21.0	15.7	10.5	5.2	
35,000	<i>73.4</i>	<i>68.1</i>	<i>62.9</i>	<i>57.6</i>	<i>52.4</i>	<i>47.1</i>	<i>41.9</i>	<i>36.8</i>	<i>31.4</i>	<i>26.2</i>	<i>21.0</i>	<i>15.7</i>	<i>10.5</i>	<i>5.2</i>	
	73.4	68.1	62.9	57.6	52.4	47.1	41.9	36.8	31.4	26.2	21.0	15.7	10.5	5.2	
30,000	<i>53.0</i>	<i>49.2</i>	<i>45.4</i>	<i>41.6</i>	<i>37.8</i>	<i>34.0</i>	<i>30.2</i>	<i>26.4</i>	<i>22.7</i>	<i>18.9</i>	<i>15.1</i>	<i>11.3</i>	<i>7.5</i>	<i>3.8</i>	
	54.4	50.5	46.6	42.7	38.8	35.0	31.0	27.2	23.3	19.4	15.5	11.6	7.7	3.9	
25,000	<i>40.8</i>	<i>37.9</i>	<i>35.0</i>	<i>32.2</i>	<i>29.2</i>	<i>26.2</i>	<i>23.3</i>	<i>20.4</i>	<i>17.5</i>	<i>14.6</i>	<i>11.6</i>	<i>8.7</i>	<i>5.8</i>	<i>2.9</i>	
	51.5	47.8	44.1	40.5	36.8	33.0	29.4	25.7	22.0	18.4	14.7	10.5	7.3	3.7	
20,000	<i>31.0</i>	<i>28.8</i>	<i>26.6</i>	<i>24.4</i>	<i>22.4</i>	<i>19.9</i>	<i>17.7</i>	<i>15.5</i>	<i>13.3</i>	<i>11.1</i>	<i>8.9</i>	<i>6.6</i>	<i>4.4</i>	<i>2.2</i>	
	56.7	52.6	48.6	44.4	40.5	36.4	32.4	28.3	24.3	20.2	16.2	12.1	8.1	4.0	
15,000	<i>24.9</i>	<i>23.1</i>	<i>21.3</i>	<i>19.5</i>	<i>17.7</i>	<i>16.0</i>	<i>14.2</i>	<i>12.4</i>	<i>11.6</i>	<i>8.9</i>	<i>7.1</i>	<i>5.3</i>	<i>3.5</i>	<i>1.8</i>	
	70.6	65.5	60.5	55.5	50.4	45.4	40.4	35.2	30.2	25.2	20.2	15.1	10.1	5.0	
10,000	<i>20.0</i>	<i>18.5</i>	<i>17.1</i>	<i>15.6</i>	<i>14.2</i>	<i>12.8</i>	<i>11.4</i>	<i>10.0</i>	<i>8.5</i>	<i>7.1</i>	<i>5.7</i>	<i>4.3</i>	<i>2.8</i>	<i>1.4</i>	
	70.6	65.5	60.5	55.5	50.4	45.4	40.4	35.2	30.2	25.2	20.2	15.1	10.1	5.0	

NOTE

Duration for crew of N men = $\frac{6}{N} \times$ duration for 6 men.

ITALICS INDICATE DILUTER LEVER "100% OXYGEN"

BOLD FIGURES INDICATE DILUTER LEVER "NORMAL OXYGEN"

LIQUID OXYGEN CONVERTERS — THREE 25-LITER

Oxygen Duration

Figure 4-23.

Oxygen Emergency Toggle Lever

An emergency toggle lever (5, figure 4-24) is provided on each regulator for manually supplying a positive oxygen pressure to the mask for emergency use. The lever has EMERGENCY--NORMAL--TEST MASK positions. TEST MASK position supplies positive oxygen pressure for checking the oxygen mask. EMERGENCY position supplies oxygen at a continuous positive pressure for emergency use. In NORMAL position, oxygen flow is controlled automati-

cally by the regulator. The emergency toggle lever should remain in NORMAL position at all times unless an unscheduled pressure increase is required. When positive pressures are required, it is mandatory that the oxygen mask be well fitted to the face. Unless special precautions are taken to insure no leakage, continued use of positive pressure under these conditions will result in the rapid depletion of the oxygen supply. This condition could also result in extremely cold oxygen flowing to the mask.

Buildup and Vent Valve Handle

A buildup and vent valve handle (figure 4-25) located in three places on the underside of the aft equipment compartment controls a dual-purpose two-position three-port valve. Two types of valves are optional on the aircraft. On one type valve, the handle rotates in a horizontal plane (to the centerline of the valve) through 120° from SERVICE to FILL position. With this valve installed, the exterior surface of the aircraft is appropriately stenciled with SERVICE and FILL positions. The other type valve is different in that the handle rotates in a vertical plane (to the centerline of the valve). The handle of this valve is stamped with PULL TO VENT - PUSH TO BLD-UP. When this handle is installed, exterior aircraft markings are not required. Functionally however, the valves are the same. With the appropriate valve handle in either FILL or PULL TO VENT position, the converter is vented to the atmosphere when being filled from the oxygen service cart. Any excess oxygen introduced during filling or excess oxygen pressure will escape through the vent. When the handle is in SERVICE or PUSH TO BLD-UP position, the vent line is blocked, the converted gas and liquid lines are connected, and system pressure builds up to deliver oxygen to each of the crew station regulators. Both types of valves are spring-loaded in such a manner that as the handle is moved over center, the handle will travel to stop in the direction of travel.

NOTE

Oxygen system buildup requires approximately 30 minutes for system stabilization. Servicing should be accomplished at least 30 minutes prior to engine start.

OXYGEN SYSTEM INDICATORS

Oxygen Converter Quantity Gage

An oxygen quantity gage (figure 4-26) is located on the pilots' instrument panel. The gage indicates the total quantity of liquid oxygen in the converters. The dial is graduated from 0 to 75 liters in increments of 5 liters. The gage is operated by single-phase a-c electrical power. Capacitance probes in the converters are utilized in a manner similar to the capacitance probes in the fuel quantity gaging system. The system is powered from the "Oxygen Quantity Indicator" circuit breaker located on the pilot's circuit breaker panel. A capacitance simulator is installed in the system to provide an empty capacitance reading from the No. 3 converter position when that converter is not installed in the aircraft. Power failure

will render the gaging system inoperative. In this case, the power failure indicator (3, figure 4-26) will indicate OFF with a red flag so marked.

Oxygen Quantity Gage Press-To-Test Switch

The oxygen quantity system is provided with a press-to-test switch (2, figure 4-26) located beside the quantity gage on the pilots' instrument panel. The quantity gage indicator should move to the 0 liter position when the press-to-test switch is held depressed and should return to the initial position when the switch is released.

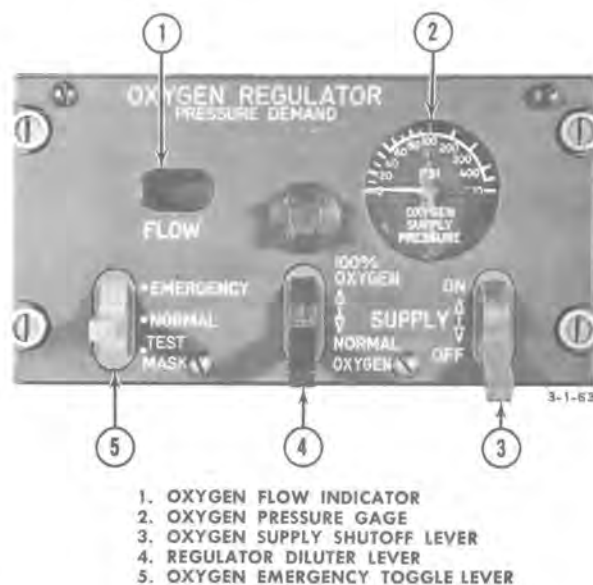
Oxygen Low Level Warning Light

W173 W309

A red low level warning light (1, figure 4-26) which is an integral part of the oxygen quantity totalizer gage is set to illuminate when the total liquid oxygen quantity is less than 7.5 liters. When the press-to-test switch has been depressed, the low level warning light should illuminate when the quantity gage pointer reaches 7.5 liters and should remain illuminated while the pointer is below that amount.

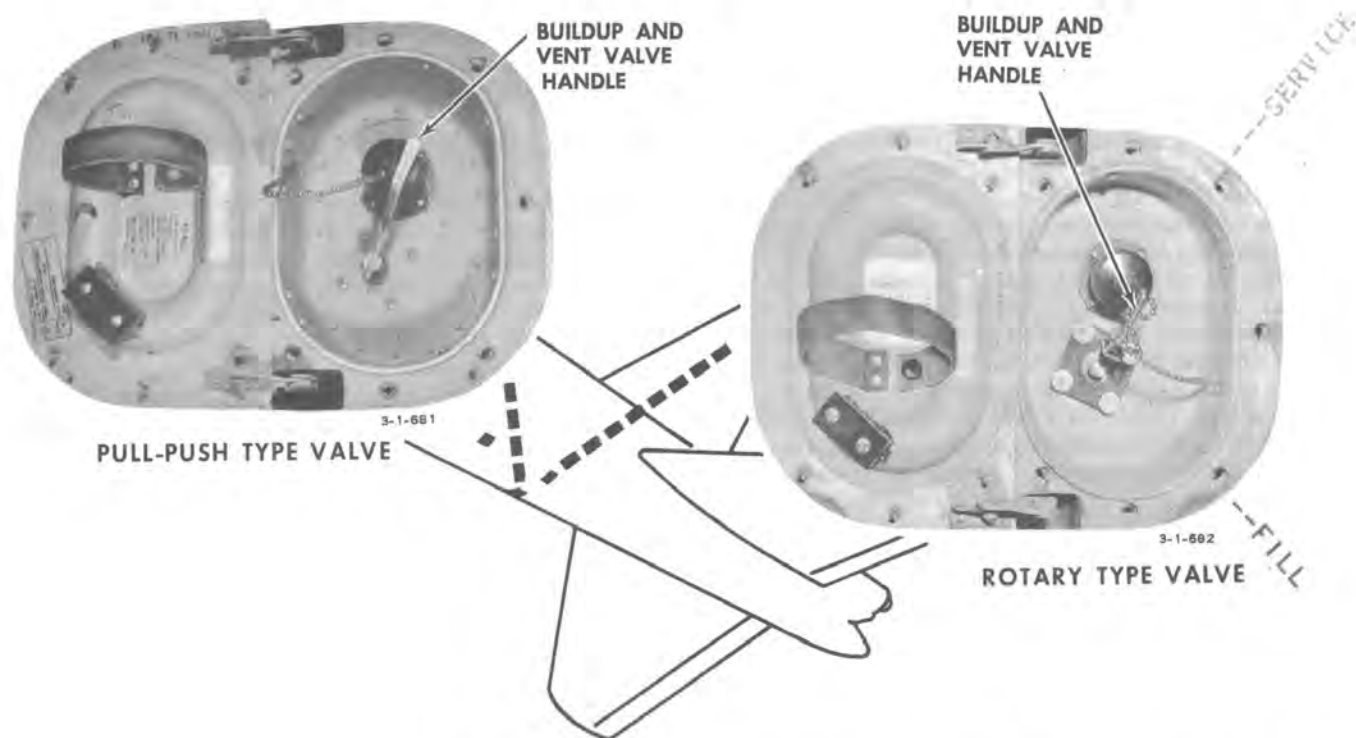
Oxygen Pressure Gage

An oxygen pressure gage (2, figure 4-24) on each regulator indicates oxygen system pressure in pounds per square inch regardless of supply lever position.



Oxygen Regulator (Typical)

Figure 4-24.



Buildup and Vent Valve Handles

Figure 4-25.

Oxygen Flow Indicator

A blinker-type oxygen flow indicator (1, figure 4-24) is provided on each regulator unit to show the crew member he is receiving oxygen. Luminescent segments indicate that oxygen is being dispensed.

PORTABLE OXYGEN BOTTLES

A portable oxygen bottle and recharger are located near each of the regular crew stations (figure 4-22). The portable oxygen bottle assembly consists of a low pressure cylinder (12, figure 4-22), cylinder carrying sling (8, figure 4-22), and a pressure demand regulator (13, figure 4-22). The regulator consists of an oxygen pressure gage (11, figure 4-22), altitude selector knob (9, figure 4-22), and may have a clothing clip. The pressure gage is calibrated from 0 to 500 psi and is red-lined at 450 psi. The altitude selector knob has NORM--30M--42M--EMER positions. The pressure demand regulator delivers 100% oxygen on all positions. The NORM position is used on all cabin altitudes up to 30,000 feet and delivers

oxygen only on demand. The 30M position is used at cabin altitudes from 30,000 to 42,000 feet. This position delivers oxygen under a slight positive pressure which is intended to combat mask leaks and possible altimeter lag. From 42,000 to 45,000 feet, the 42M position is used. This position delivers oxygen under the higher pressure required to sustain life at these altitudes. The EMER position further increases the pressure of the oxygen and should be used any time the cabin altitude exceeds 45,000 feet. Regulator position, cabin altitude, and physical activity will affect the duration of the oxygen supply. This time can vary from a minimum of 4 minutes at a cabin pressure of SL to 12,000 feet, regulator position of NORM, to a maximum of 14 minutes at cabin pressure of 30,000 to 40,000 feet, regulator position of 30M- all with moderate physical activity. Passive physical activity provides approximately twice this duration. Therefore, the pressure gage should be monitored continuously when the bottle is in use.

NORMAL OPERATION OF OXYGEN SYSTEM

In Flight

The following procedure should be followed when oxygen is used during flight:

WARNING

Crew members using upward ejection seats will insure that oxygen supply hose is under seat armrest before hookup with the oxygen mask hose.

NOTE

Requirements for use of oxygen while performing various activities will be in accordance with current directives. Use of 100% oxygen will be as outlined in Sections II, III, IV, and VIII. Pilot will insure that oxygen is used as required.

1. Check connection of oxygen mask hose to oxygen supply hose and bailout bottle hose.
2. Place oxygen supply shutoff lever in ON position.
3. Place oxygen regulator diluter lever in NORMAL or 100% (as required).

NOTE

At cabin altitudes above 30,000 feet, the lever should be placed in 100% OXYGEN position as a safety precaution.

4. Frequently check the oxygen flow indicator.

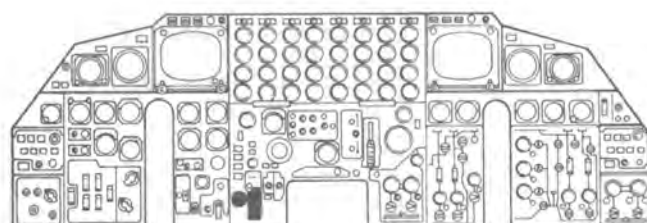
WARNING

Before smoking, the crewmember will position the oxygen supply shutoff lever OFF and the regulator diluter lever to the 100% OXYGEN position. This will eliminate the possibility of accelerated combustion and will also prevent forgetting to turn the supply lever back ON when resuming use of the system.

NOTE

During turbulent flight conditions, liquid oxygen sloshes inside the converter. This cools the gas and allows part of it to return to the liquid state, resulting in a lowered gas pressure. Lowering of the gas pressure is not detrimental to crew consumption as long as the pressure remains above 150 psi.

5. When flight is completed, turn oxygen supply shutoff lever OFF and push the regulator diluter lever to the 100% OXYGEN position.



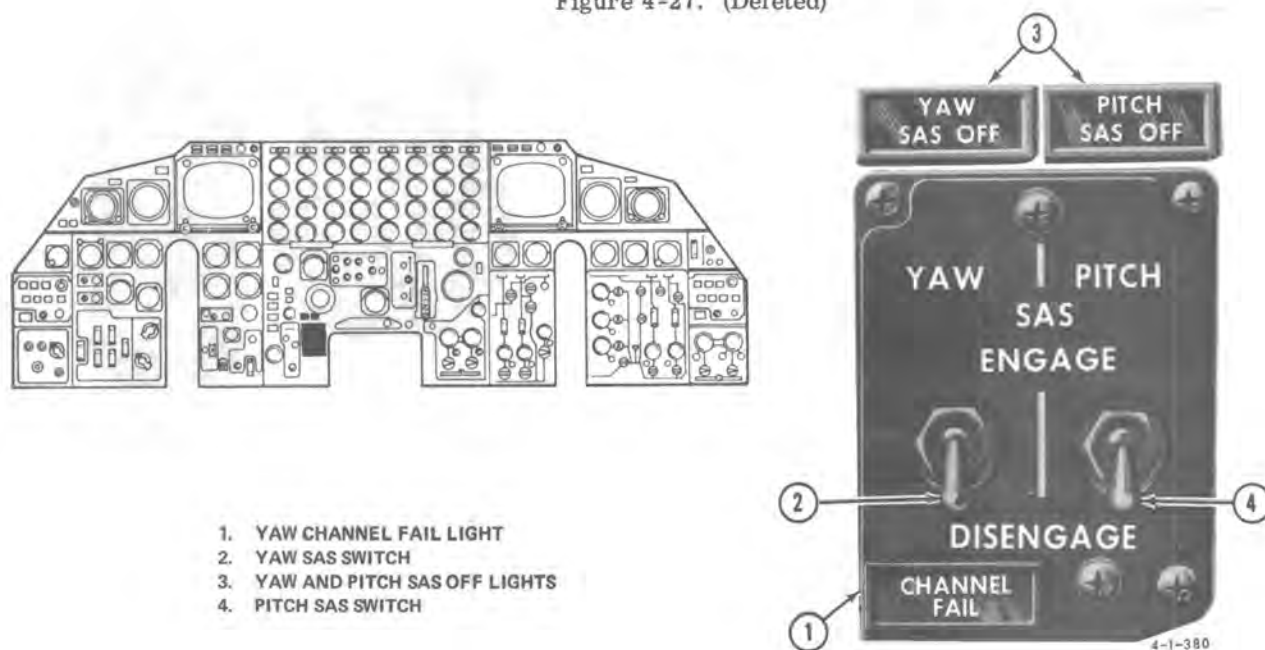
Oxygen Quantity Gauge

Figure 4-26.

STABILITY AUGMENTATION SYSTEM (SAS)

A Stability Augmentation System (SAS) has been installed in the aircraft to substantially reduce structural fatigue damage rates and peak loads, to provide improved Dutch roll damping, and to improve controllability of the aircraft under turbulent flight conditions. The SAS is an electrohydraulic two-axis (pitch and yaw) system which replaces the presently installed magnetic and electromechanical yaw dampers along with other associated changes. The system utilizes three hydraulic actuators; one for the rudder and two for the elevators. Each actuator responds to mechanical and electrical input commands. The mechanical commands come from the pilot or autopilot. Electrical input signals come from the SAS electronic control units. Each actuator has dual electrohydraulic flow control valves. The electrohydraulic flow control valve is the point where electrical signals become proportional hydraulic signals. Each servo unit provides its related control valve. The flow control valve is an electrohydraulic unit which receives SAS generated electrical signals. Electrical commands from the SAS transmitted to the electromechanical flow control valve are in series with the mechanical commands. For this reason, electrically commanded surface displacement of the rudder and elevators is not reflected by

Figure 4-27. (Deleted)



Yaw and Pitch SAS Control Panel

Figure 4-27A.

movement of the rudder pedals or control column. Mechanical inputs to the rudder and elevators are limited to 19°. Electrical commands are limited to 10° authority in yaw and 5° authority in pitch. For information concerning SAS flight characteristics, see "Flight Controls," Section VI. For additional information on associated hydraulic and mechanical changes to the aircraft, see "Hydraulic Power Supply Systems" and "Powered Rudder/Elevator System," Section I.

SAS CONTROLS

SAS Control Panel

The SAS control panel (figure 4-27A) is located on the pilots' forward instrument panel. The panel contains two switches (2 and 4, figure 4-27A) labeled "Yaw SAS" and "Pitch SAS" respectively. The switches have two positions, ENGAGE--DISENGAGE. The ENGAGE position of the switches supplies power to the engage valves in the hydraulic actuators and places the system in operation. It also supplies a reset pulse to the comparators when placed in the ENGAGE position. The DISENGAGE position removes power from the hydraulic actuator engage valves. Both engage switches are solenoid locking type switches and are held in the ENGAGE position by dual coil electromagnets. If the logic

circuitry determines that the switch contacts should be broken, the electromagnets are released, allowing the spring-loaded switches to return to the DIS-ENGAGE position. The yaw and pitch SAS electronic systems receive power through four d-c circuit breakers and six a-c circuit breakers. The four d-c circuit breakers are located on the "Flight Controls" portion of the left load central circuit breaker panel and are marked "DC Yaw SASS" and "DC Pitch SASS" respectively. The six a-c circuit breakers are located on the left load central circuit breaker panel and are labeled "Pitch SASS '1, '2, '3" " and "Yaw SASS '1, '2, '3. ' "

SAS INDICATORS

Yaw and Pitch SAS Off Lights

Two amber push-to-test lights (3, figure 4-27A) marked "Yaw SAS Off" and "Pitch SAS Off" are located just above the yaw and pitch SAS control panel. These lights serve to warn the pilot that two associated channel failures of the yaw and/or pitch SAS have occurred and that the holding coils for one or both switches have been released returning the switch to the DISENGAGE position. Simultaneously with the illumination of either yaw or pitch SAS off lights, the master caution light on the pilots' panel will illuminate.

Yaw Channel Fail Light

An amber push-to-test yaw channel fail light (1, figure 4-27A) is located on the yaw and pitch SAS control panel below the yaw SAS switch. The light serves to warn the pilot that a single rate channel of the SAS yaw axis has failed.

NORMAL OPERATION OF SAS

Pilot operation of the electronic portion of the SAS consists essentially of engaging or disengaging the yaw and pitch SAS switches. The yaw and pitch SAS switches should not be engaged when transitioning from ground power to aircraft power. This is necessary to avoid giving erroneous information to the maintenance crew since the power changeover with the switches engaged trips the maintenance warning indicators on the electronic units in the 47 section. If the yaw channel fail light comes on during flight, the operation of the system is not impaired, but the failure of one rate channel is indicated. If it is a nuisance failure indication due to electrical power transients, it may be possible to return the questionable channel to operation by disengaging the yaw SAS switch and then returning it to the ENGAGE position.

EMERGENCY OPERATION OF SAS

For emergency procedures concerning the SAS, see "Powered Rudder/Elevator Hydraulic Malfunctions" and "Stability Augmentation System Switch Disengagement" under "Flight Control System Emergency Operation," Section III.

AUTOPILOT

Also see "Stability Augmentation System," this section, and "Powered Rudder/Elevator System," Section I.

WARNING

- The autopilot will be used with caution during any critical phase of flight (i.e., instrument approach, low level, air refueling, or combat breakaway maneuvers). All disengagements of the autopilot by means of the pilot's or copilot's release button on the control wheel will be followed immediately by checking that the servos engage switch has disengaged.
- The trim condition of the aircraft should be closely monitored at all times when using the autopilot, but particularly so in the critical phases mentioned above. In the event of automatic trim system failure,

large amounts of stabilizer trim can be compensated for by the autopilot. This can result in severe pitchdown (up) when either a change in attitude or power setting causes an automatic disconnect or when a manual disconnect is accomplished. To minimize the effect of an automatic trim system failure, the trim meters and fore and aft position of the control column should be monitored closely. If several units of nosedown stabilizer trim and aft position of the control column are detected while flying with autopilot altitude hold engaged, be aware that autopilot disengagement by any means will cause abrupt pitchdown unless proper preventive steps are taken. Disengaging the autopilot, retrimming, and reengaging at frequent intervals is recommended.

AUTOMATIC FLIGHT CONTROL SYSTEM

The word "autopilot," as used in this manual, consists of the entire A/A-42G-11 automatic flight control system which includes autopilot nonsteering mode and pitch and roll steering modes.

AUTOPILOT — NONSTEERING MODES

The aircraft is provided with an autopilot which is used to maintain a reference attitude, heading, and altitude; to provide a stable bombing platform; and to provide an accurate flight path control when used with the instrument landing system (ILS). During normal flight, the autopilot holds the aircraft in a straight and level attitude at a constant heading provided by the N-1 compass system unless otherwise commanded by a crewmember using the autopilot flight controller, the bombing navigational system, or the automatic approach system. Altitude control is also provided to maintain constant barometric pressure altitude. Servo motors operate the lateral control spoiler control valves and stabilizer jack-screw which in turn control the lateral control spoilers and stabilizer respectively. Servo motors also control the rudder and elevator mechanical control systems. The mechanical systems control the mechanical inputs to the rudder and elevator hydraulic actuators. Force switches are installed in control column and control wheel linkage to disengage the autopilot if a certain control column or control wheel force is exceeded by either pilot. When the autopilot is ON but disengaged, the followup system continually aligns with the flight attitude and heading of the aircraft so that smooth engagement may be made at any time. Pitch control is such that the aircraft pitch attitude at the time the autopilot is engaged will be maintained. An interlock system is provided as protection against improper operation of the autopilot and to insure the pilot of primary control at all times. The autopilot operates on TR power and 118-volt single-phase a-c power.

Six circuit breakers are on the "Autopilot" portion of the left load central circuit breaker panel.

NOTE

If d-c or all a-c power to the N-1 compass is lost, the autopilot will disengage immediately. Loss of a single a-c phase will not degrade the heading information from the N-1 compass; therefore, the autopilot will not disengage. Loss of a single phase will not indicate on the protective fuses. The loss of a single phase may be detected only by removing and testing the fuses. If a fault occurs in the N-1 compass circuitry, two or all of the protective fuses will blow and may be detected by the blown fuse indicators lighting on the fuse holders. In the case of such a fault, the autopilot will disengage.

AUTOPILOT PITCH AND ROLL STEERING MODES

Aerial refueling and low level modes of the autopilot are designed to substantially reduce the loads imposed during aerial refueling and to reduce pilot fatigue during low level mode of flight. When using the aerial refueling and low level modes, the pilot flies the aircraft through the autopilot by control column and control wheel inputs in the same manner that he flies without the autopilot except that control column and wheel forces are considerably reduced. Inputs of the pilot through the column and wheel generate electrical signals proportional to the force applied through force transducers in and below the control columns. These signals to the autopilot are used to command the aircraft in pitch and roll in lieu of signals from the autopilot pitch, turn, and roll trim knobs. Turn and roll trim knobs are disabled and the pitch trim knob is mechanically stiffened to provide higher rotational forces than required when aerial refuel, low level, or altitude hold modes are not engaged. (Do not attempt to overpower the pitch trim knob.) The maximum bank angle in both modes is 33°. Lateral control force stiffens when this bank angle is approached. Attempts to increase the bank angle beyond 33° will result in an autopilot disconnect. Aerial refueling and low level modes differ in that during aerial refueling mode, the autopilot will maintain a constant attitude and will resist attempts to change that attitude. The autopilot will return the aircraft to its original attitude unless the pilot holds a particular change to pitch or bank angle for a sufficient period of time to allow the autopilot to adjust. Once the autopilot adjusts, it will aid the pilot in maintaining the new attitude. During low level mode, any bank angle up to 8° initiated by the pilot, by turbulence, etc, will result in a "roll-to-level" action by the autopilot. The pilot will feel very little resistance in the lateral controls for bank angles up to 8°. Any bank angle between 8° and 33° established by the pilot will be held by the autopilot regardless of changes to power or airspeed. Changes in pitch attitude will also be maintained by the autopilot in low level mode regardless of changes in

thrust or airspeed. The rudder axis of the autopilot is automatically disengaged when selecting the aerial refueling or low level mode of operation. A reduction of manual rudder requirements is realized through use of the yaw axis of the stability augmentation system and the hydraulically powered rudder system. The pilot trims the aircraft laterally but need not apply any stabilizer trim. The autopilot will automatically trim the aircraft to assist the pilot in maintaining a pitch attitude and will trim to compensate for any gross weight or cg change. See "Pitch and Roll Steering Flight Characteristics," this section.

AUTOPILOT CONTROLS

Autopilot Flight Controller

The autopilot flight controller (1, figure 4-28) is located on the aisle stand. When the autopilot is engaged, the flight controller provides a means for maneuvering the aircraft from the pilot's or copilot's position through the turn knob, pitch knob, and roll trim knob.

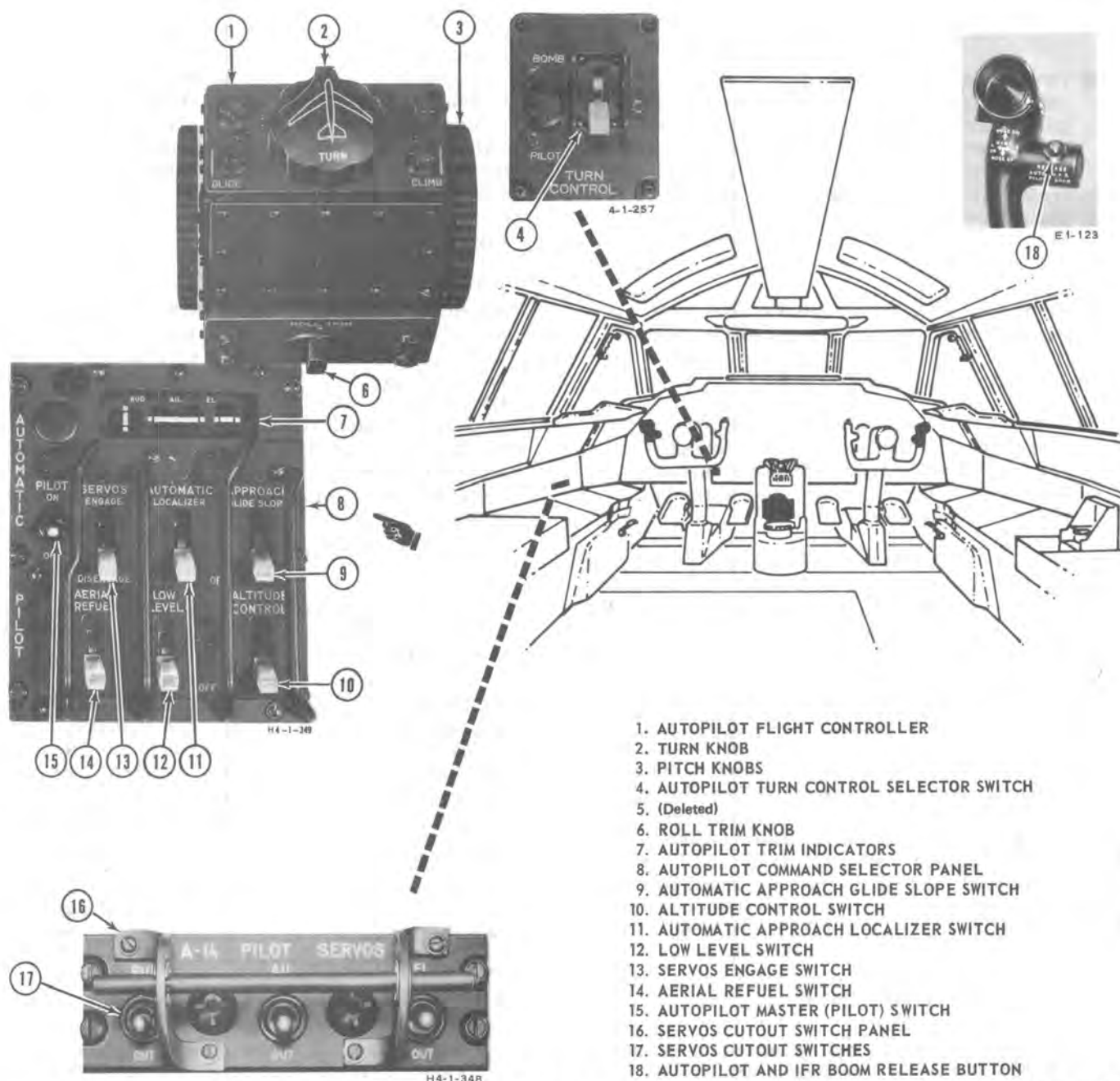
TURN KNOB. A turn knob (2, figure 4-28) on top of the flight controller provides coordinated turns in autopilot nonsteering modes. Rotating the turn knob results in an aircraft turn in the same direction as the knob is rotated. The rate of turn is proportional to the speed of the aircraft and amount of bank commanded with the turn knob. Moving the turn knob out of center detent puts turn control back to the pilot regardless of the setting of the autopilot turn control selector switch or the automatic approach localizer switch. Additional detents are located at points in the turn knob rotation corresponding with approximately 10° less than the maximum bank capability of 50°. The turn knob is disabled during aerial refuel and low level modes of operation.

NOTE

When the turn knob is not in use, it should be in the detent at center position of total knob rotation.

PITCH KNOBS. Interconnected pitch knobs (3, figure 4-28) are located on each side of the flight controller. The pitch knobs control the elevators for climb or glide in autopilot nonsteering configurations. Forward rotation of the pitch knobs results in descent; aft rotation results in climb. The degree of aircraft climb or dive is proportional to the amount of rotation of the pitch knobs. The pitch knob signal is always aligned to the existing aircraft pitch attitude when the autopilot is engaged. With the altitude control or automatic approach glide slope switch in ON position, rotating the pitch knob will cause either of the above switches to drop to OFF position, disengaging either of these functions.

ROLL TRIM KNOB. A roll trim knob (6, figure 4-28), located on the front of the flight controller, is



1. AUTOPILOT FLIGHT CONTROLLER
2. TURN KNOB
3. PITCH KNOBS
4. AUTOPILOT TURN CONTROL SELECTOR SWITCH
5. (Deleted)
6. ROLL TRIM KNOB
7. AUTOPILOT TRIM INDICATORS
8. AUTOPILOT COMMAND SELECTOR PANEL
9. AUTOMATIC APPROACH GLIDE SLOPE SWITCH
10. ALTITUDE CONTROL SWITCH
11. AUTOMATIC APPROACH LOCALIZER SWITCH
12. LOW LEVEL SWITCH
13. SERVOS ENGAGE SWITCH
14. AERIAL REFUEL SWITCH
15. AUTOPILOT MASTER (PILOT) SWITCH
16. SERVOS CUTOFF SWITCH PANEL
17. SERVOS CUTOFF SWITCHES
18. AUTOPILOT AND IFR BOOM RELEASE BUTTON

Autopilot Controls (Typical)

Figure 4-28.

used principally to correct localizer standoff error when making an automatic ILS approach, or to correct FCI standoff error in bomb mode. The roll trim knob is disabled during aerial refuel mode of operation. It is disabled during low level mode except when the autopilot turn control selector switch is in BOMB position. Use of the roll trim knob for lateral trim will deflect a spoiler and increase drag. Lateral trim should normally be accomplished by fuel management.

Autopilot Command Selector Panel

The autopilot command selector panel (8, figure 4-28) is located on the aisle stand. It contains the

autopilot trim indicators, autopilot master switch, servos engage switch, altitude control switch, and automatic approach switches. The autopilot command selector panel also contains an aerial refuel switch and a low level switch.

AUTOPILOT MASTER (PILOT) SWITCH. An autopilot master (pilot) switch (15, figure 4-28) on the autopilot selector panel has ON--OFF positions. ON position puts power to the servo control drive motor and permits ready engagement of the servos. OFF position cuts off power to the servo control drive motor and also disengages the autopilot.

NOTE

- Power is applied to the autopilot system regardless of the position of the autopilot master (pilot) switch. Autopilot operation is prevented during the automatic warmup period of 3 to 5 minutes after power is on the aircraft. After this initial warmup period, placing the autopilot master (pilot) switch to ON and waiting 5 seconds will permit autopilot operation.
- Prior to placing the autopilot master switch to ON, the servos engage switch will be checked to the DISENGAGE position and all mode switches will be checked to OFF.
- In the event of any indication of malfunction in the autopilot disengagement by autopilot release button, place the autopilot master switch to the OFF position, thus assuring positive disengagement.

SERVOS ENGAGE SWITCH. A solenoid-locking type servos engage switch (13, figure 4-28) on the autopilot command selector panel has ENGAGE--DISENGAGE positions. ENGAGE position engages all servos simultaneously. However, any axis whose servos cutout switch is in OUT position will not be engaged. DISENGAGE position will disengage all servos. The servos engage switch cannot be moved to ENGAGE if the autopilot master (pilot) switch is OFF or the roll trim knob or turn knob is out of detent. If engaged, interlocks will return this switch to DISENGAGE when 1) the autopilot release buttons are pressed, 2) the autopilot master switch is turned OFF, 3) if engaged, either the LOW LEVEL switch or the AERIAL REFUEL switch is turned OFF, 4) the a-c power, filament, fields engage, interlock, or servo control circuit breakers are tripped, or 5) one of the protective systems is tripped.

NOTE

- If the servos engage switch fails to return to DISENGAGE when disengaging with the autopilot release buttons, place the autopilot master switch to the OFF position, thus assuring positive disengagement.
- A minimum of 5 seconds waiting period will be allowed after autopilot master switch turn-on before the servos engage switch is placed to ENGAGE.

ALTITUDE CONTROL SWITCH. An altitude control switch (10, figure 4-28) located on the autopilot selector panel has ON--OFF positions. In ON position, the elevator servo is controlled by a barometric pressure control unit. Rotating the pitch knob drops the altitude control switch to OFF and deactivates altitude control operation. Moving the

glide slope switch to ON will drop the altitude control switch to OFF position. The altitude control switch will remain locked in OFF as long as the glide slope switch is in ON position. The altitude control switch will drop to OFF position when the aerial refueling switch or the low level switch is engaged. The altitude control switch cannot be turned to ON with the elevator servo cutout switch in OUT position. In OFF position, the constant altitude control is made inoperative.

AUTOMATIC APPROACH LOCALIZER SWITCH. An automatic approach localizer switch (11, figure 4-28) on the autopilot selector panel has ON--OFF positions. The localizer switch is locked OFF unless the radio receivers are on and tuned to a localizer frequency. ON position allows the lateral controls of the autopilot to be controlled by the localizer beam after it has been intercepted. In OFF position, no signal from the beam is received by the autopilot. The localizer switch will go to OFF if the turn knob is moved out of detent.

NOTE

The localizer switch is locked OFF when the nav mode select switch is positioned to TACAN or VOR.

AUTOMATIC APPROACH GLIDE SLOPE SWITCH. An automatic approach glide slope switch (9, figure 4-28) on the autopilot selector panel has ON--OFF positions. ON position allows the pitch controls of the autopilot to be controlled by the glide slope beam after it has been intercepted. In OFF position, no signal from the glide slope is received by the autopilot. The automatic approach glide slope switch cannot be turned ON unless the automatic approach localizer switch is in ON position and will go to OFF position if the pitch knobs are rotated or when the localizer switch is turned OFF.

NOTE

Placing the automatic approach glide slope switch to ON position modifies the system response to localizer signals to compensate for the narrow localizer beam near the station. Attempting to continue the approach with the automatic approach localizer switch in ON and the automatic approach glide slope switch in OFF position after the glide slope has been intercepted will probably result in the aircraft bracketing the localizer beam.

AERIAL REFUEL SWITCH. A solenoid-locking aerial refuel switch (14, figure 4-28) has AERIAL REFUEL -- OFF positions. In AERIAL REFUEL position, signals are supplied from the force transducers which allow the pilot to control the aircraft through the autopilot. Turn and roll trim knobs are

disabled and the pitch trim knob is mechanically stiffened to provide higher rotational forces than required when aerial refuel, low level, or altitude hold modes are not engaged. (Do not attempt to overpower the pitch trim knob.) In OFF position, power is removed from the aerial refuel portion of the autopilot. The aerial refuel switch will automatically return to OFF position when the autopilot is disengaged for any reason.

LOW LEVEL SWITCH. A solenoid locking low level switch (12, figure 4-28) has LOW LEVEL--OFF positions. In LOW LEVEL position, signals are supplied from the force transducers which allow the pilot to control the aircraft through the autopilot. The turn knob is disabled and the pitch trim knob is mechanically stiffened to provide higher rotational forces than required when aerial refuel, low level, or altitude hold modes are not engaged. (Do not attempt to overpower the pitch trim knob.) In OFF position, power is removed from the low level portion of the autopilot. The low level switch will automatically return to OFF position when the autopilot is disengaged for any reason.

Servos Cutout Switches

A servos cutout switch (17, figure 4-28) is provided for each of the three control axes. Each switch located on the servos cutout switch panel has IN--OUT positions. This switch must be in IN position before the individual servo can be engaged by the servos engage switch. OUT position is used to cut the servo out of operation.

NOTE

- The servos engage switch may move to DISENGAGE, disengaging the autopilot whenever any one of the servos cutout switches is placed in OUT position. The servos engage switch will move to DISENGAGE disengaging the autopilot whenever any one of the servos cutout switches is placed from OUT to IN position. In either case, the servos engage switch may be returned to the ENGAGE position.
- Either the aerial refuel or low level switch, if engaged, will drop to OFF if any of the servos cutout switches are placed in OUT position. The elevator cutout switch must be IN before the servos engage switch and aerial refuel or low level switches are reengaged. The aerial refuel and low level modes may be operated with the aileron cutout switch in OUT but for full utilization of the system, the aileron cutout switch should also be placed to IN position.
- Engaging the aerial refuel or low level switches will automatically disengage the rudder axis of the autopilot although the servo cutout switch will remain IN.

Autopilot and Air Refueling (IFR) Boom Release Buttons

Autopilot release buttons (18, figure 4-28) are provided on both control wheels. Pressing either one of these pushbutton switches disengages all autopilot servo motors, thereby eliminating autopilot control. The autopilot will be disengaged at all times when either autopilot release button is depressed. If the servos engage switch does not drop to DISENGAGE position because of a malfunction, the autopilot will be reengaged upon release of the button. For further use of these release buttons, see "Air Refueling System," this section.

WARNING

All disengagements of the autopilot by means of the pilot's or copilot's autopilot release button will be followed immediately by checking the servos engage switch to DISENGAGE.

Autopilot Turn Control Selector Switch

The autopilot turn control selector switch (4, figure 4-28) is located on the pilots' instrument panel. This switch is of the solenoid locking type and has PILOT--BOMB positions for selecting either the autopilot flight controller (PILOT) or the BNS (BOMB) respectively for turn command of the autopilot. Interlocks will return the turn control selector switch from BOMB to PILOT position without disengaging the autopilot when the pilots' turn knob is rotated out of center detent or if any of the following changes occur during BNS operation of the autopilot:

1. Changing to memory point mode while in track mode
2. Changing to autofix mode (search or track)
3. Changing position of the bomb control heading switch (search or track)
4. Changing destination switch
5. Changing from bomb to search or track mode
6. Changing from search or track to bomb mode

Force Switches

The control rods between the pilot's and copilot's control columns and the forward elevator cable quadrants each include a force switch assembly which is actuated by a predetermined control column force initiated by either pilot in opposition to autopilot or unscheduled stabilizer trim movement. (See "Force Switches," Section I.) Actuation of either force switch will completely disengage the autopilot and electrically interrupt the stabilizer trim circuit in the pitch direction opposing control column force. In addition, a roll force switch will disengage the autopilot if either pilot exerts a predetermined control wheel force in opposition to the autopilot.

AUTOPILOT INDICATORS

Autopilot Disengaged Light

- An amber autopilot disengaged warning light (13, figure 1-15) on the pilots' instrument panel flashes whenever the servos engage switch is disengaged after having once been engaged. The flashing may be stopped by reengaging the servos engage switch or by momentarily shutting off the autopilot master switch.

Autopilot Trim Indicators

Three autopilot trim indicators (7, figure 4-28) are located on the autopilot selector panel and are marked "Rud," "Ail," and "El" according to the autopilot servo with which each is used. The trim indicators provide a visual indication of the electrical power input to the autopilot servos. The indicator bar will be displaced when the servo is exerting force on the control surface actuator and the bar will be displaced in proportion to the amount of force exerted. During flight, the indicators will fluctuate constantly and their actual indication must be determined by interpreting their average displacement. The centered indicator bars indicate no electrical power input to the autopilot servos. Before autopilot engagement, a displaced trim indicator bar indicates incorrect power input to the autopilot servo and, upon autopilot engagement, the autopilot servos will deflect the aircraft control surfaces to change aircraft attitude in the direction of indicator bar displacement. After autopilot engagement, a displaced trim indicator bar indicates that the autopilot servo is exerting force on the control surface to compensate for an out-of-trim condition and upon autopilot disengagement, the servo will release the force allowing the control surface to return to the manual trimmed position and the aircraft attitude will change in the opposite direction of indicator bar displacement.

CAUTION

An abrupt control surface displacement will occur if the autopilot is engaged or disengaged with a trim indicator steadily displaced more than one bar width.

BNS Steering (Autopilot) Light

A green BNS steering (autopilot) light on the radar navigator's panel, will illuminate when the autopilot turn control selector switch is placed in BOMB position.

AUTOPILOT SAFETY FEATURES

Pitch Protection

A safety monitor system provides protection on the pitch axis against excessive angular accelerations. When such accelerations are encountered, this system disengages the autopilot. Protection against possible servo or accelerometer malfunctions is also provided by this system. As an additional safety feature, the pilot can overpower the stabilizer trim servo manually with the stabilizer trim wheels. A force switch will disengage the autopilot if the pilots apply a force to the control column opposing autopilot-induced stabilizer trim actuation.

NOTE

The stabilizer trim function of the lateral trim and stabilizer trim buttons will be inoperative when the elevator servo cutout switch is positioned to IN and the servos engage switch is positioned to ENGAGE.

Roll Protection

BNS controlled turns are limited to 39° in the bomb mode and to 15° in search or track mode. When the bomb mode and low level mode are selected together, the bank angle is limited to 15°. Turns commanded by the pilot's turn knob when rotated to the detent are limited in bank angle to approximately 39°. However, rotation of the turn knob past this detent will allow up to 50° of bank angle to facilitate a breakaway maneuver.

WARNING

See "Combat Breakaway Maneuvers," Section VI, for maximum recommended bank angles applicable to existing gross weight, altitude, and Mach number.

In both aerial refuel and low level modes, turns commanded by the pilot's control wheel are limited in bank angle to 33°. Attempts to increase the bank angle beyond 33° will result in an autopilot disconnect. Roll trim knobs are effective only in BOMB and ILS modes. Diode limiters in the automatic approach amplifier limit the bank angle to 25° when the localizer switch is in ON position or 10° when the glide slope switch is in ON position. Limit switches provide roll axis protection in case of an autopilot failure resulting in hard-over signals. These switches are effective in all flight conditions except when a bank angle in excess of approximately

4 1/2° is commanded by bombing computer, ILS coupler, or crew member. In addition, a force switch will disengage the autopilot if either pilot exerts a control wheel force of approximately 40 pounds.

"G" Limiter

When using the low level steering function, control column force requirements are considerably reduced by servo assistance from the autopilot. Consequently, it would be possible for the pilot to inadvertently exceed the normal acceleration (load) limits of the aircraft in a pull-up, pushover, turn, or combination of pull-up and turn. To prevent this, a "g" limiter function has been incorporated in the system to limit the normal acceleration obtainable with pitch and roll steering. The "g" limiter function is set to limit "g" loads from a minimum of 0.2 to a maximum of 1.8. As the pilot maneuvers the aircraft through any longitudinal attitude change, an accelerometer senses the variation in acceleration and causes the autopilot servo torque assistance to reduce, with a corresponding increase in pilot required force. If the pilot or copilot continues to increase the applied force, the autopilot will finally disengage. However, the disconnect will be smooth and the first indication to the pilot will be an illumination of the autopilot disengaged light. The smooth disconnect results from the logic that is built in the system. The logic requires that the following two conditions exist before the autopilot is disengaged: 1) The applied column force is greater than 30 (±6) pounds of push or pull force and 2) the elevator servo is opposing the applied column force by approximately 3 pounds. This requirement means that the pilot will be applying approximately 3 pounds more force than is required to hold the same column displacement manually. Since these two conditions must be satisfied for all flight conditions, the transition from autopilot operation to manual operation is smooth.

NOTE

The "g" limiter does not affect the disconnect logic but is merely a method of increasing the pilot's applied force up to the manual force level.

An operational ground check of the disconnect logic circuit is made by applying a sharp push or pull force

to the column and then rapidly reversing the direction of the applied force. Since the servo cannot reverse its direction of rotation as rapidly as the force is changed, both disconnect requirements will be met, assuming that the force applied exceeds 30 pounds.

Rudder Limiting

On aircraft BA, an Electronic Autopilot Rudder Limit Switch (EARLS) has been installed to reduce the autopilot authority in the yaw axis to achieve a safety margin and preclude structural overload as a result of sudden gust side loads. The EARLS monitors the rudder servo control signal and feedback. When a defined overcurrent condition is sensed, the limit switch disengages the autopilot rudder command prior to a possible structural overload condition.

PITCH AND ROLL STEERING FLIGHT CHARACTERISTICS

Aerial Refueling Mode

The aerial refueling mode of the autopilot was designed primarily to substantially reduce the loads imposed on the aircraft during air refueling and will be utilized for all air refueling operations with KC-135 tanker aircraft, when the equipment is operative, unless specific directives dictate otherwise.

NOTE

The aerial refueling mode is not recommended for formation flying other than that required for air refueling operations.

The pilot will find that using the aerial refueling mode will improve manual proficiency. This mode provides stability in pitch and roll which will resist attitude changes due to tanker downwash or turbulence. The aircraft responses in the aerial refueling mode differ from the low level mode in that more rapid aircraft responses are obtained when wheel or column force is applied. This characteristic allows smoother control inputs to maneuver the aircraft in the small envelope behind the tanker and also allows use of more of the envelope, thus reducing aircraft loads. When the pilot relaxes wheel or column force following momentary corrections, the autopilot will restore the aircraft to the attitude existing prior to the correction.

NOTE

The characteristics of the following pitch and roll maneuvers while in aerial refueling mode may be observed by the pilot without the aid of a tanker.

PITCH MANEUVERS. The attitude hold and pitch attitude reference change features of the autopilot while in aerial refueling mode may be demonstrated by the following maneuvers. Momentarily pitch the aircraft up or down approximately 2° and relax force on the control column. When force is relaxed, the aircraft will return to the original flight attitude. A change to the pitch attitude reference may be accomplished by maintaining column force for some period of time. As an example, with the servos engage switch engaged, establish an approximate 2° noseup pitch attitude by rotating the pitch knob. Place aerial refuel switch to AERIAL REFUEL and push the column forward until the aircraft rotates to level flight. Relax column force and observe that the aircraft starts recovery to the original 2° noseup attitude. Maintain level flight and observe that the restraining force necessary to maintain level flight gradually decreases until column force is zero. When column force reaches zero, the aircraft attitude reference will have changed from 2° noseup to level flight. Thus, a change in pitch attitude reference is accomplished automatically by the autopilot when column force is maintained for a specific period of time. The amount of reference change is dependent on the length of time column force is maintained. Automatic stabilizer trimming occurs during autopilot aerial refueling operation whenever a column force is applied.

ROLL MANEUVERS. The attitude hold and roll attitude reference change features of the autopilot when in aerial refueling mode may be demonstrated by the following maneuvers. Momentarily roll the aircraft left or right, establishing a shallow bank angle and relax force on the control wheel. When force is relaxed, the aircraft will return to the original flight attitude. Reestablish the bank angle, restrain the wheel, and note that the wheel force will gradually decrease until the aircraft roll attitude is maintained at the new reference with zero wheel force. Turns are accomplished by changing the roll attitude reference but the roll characteristics of the aerial refueling mode require a special technique. The change in roll reference from wings level to a 30° bank angle, for example, may require maintaining a wheel force as long as 1 1/2 minutes. However, the time required to change the roll reference may be shortened by slight overcontrolling. That is, after the desired bank angle is established, a slight increase in wheel force (through the use of cross-control) will increase the roll reference rate of

change. Returning to wings level after turning requires a similar procedure.

RECEIVER-TANKER CONTACT TECHNIQUES. The aerial refueling mode of the autopilot is designed to be compatible with refueling altitude, airspeeds, and downwash characteristics of the KC-135 tanker. Generally, each pilot must perform several contacts with the tanker before the optimum air refueling technique is developed and full confidence in this mode of the autopilot is realized. The autopilot master switch should be ON, all other mode switches OFF or DISENGAGED, and the servos cutout switches IN.

NOTE

The pilot should be prepared to initiate a switch or force disconnect prior to engaging the servos engage switch or the aerial refueling switch since some autopilot failures (e.g., a vertical gyro failure) are not detectable by the trim indicators and may result in a hard-over pitch and/or roll servo action. Force disconnects during this condition are easily initiated by resisting column or wheel movement until force builds up to the force switch disconnect value.

The air refueling system should be ready for contact. At approximately 10 knots above refueling airspeed, engage the servos switch and, in turn, the aerial refuel switch. Engaging the servos engage and aerial refuel switches in sequence should be accomplished as rapidly as possible to minimize the time when the autopilot is in a nonsteering mode. The autopilot is now ready for contact.

NOTE

When engaging the aerial refuel switch, if the signal amplifier cycles from ready to disconnect, push the reset button and return air refueling system to ready condition.

Low Level Mode

The low level mode of the autopilot was designed to aid the pilot in flying the aircraft at low altitudes and to reduce pilot fatigue during this type of flying.

NOTE

The low level mode is not recommended for penetrations, takeoffs, formation flying, holding patterns, instrument approach procedures, landing, or flight at any altitude other than that required for low level or low altitude missions.

The low level mode should be engaged after stabilizing at an altitude, consistent with the start of a low level flight phase. The aircraft should be trimmed properly and the trim indicators should be centered prior to engaging the servos engage switch. The low level switch should be placed to LOW LEVEL immediately after engaging the servos engage switch to avoid low level flight in a nonsteering mode.

NOTE

The pilot should be prepared to initiate a switch or force disconnect prior to engaging either the servos engage switch or the low level switch since some autopilot failures (e.g., a vertical gyro failure) are not detectable by the trim indicators and may result in a hard-over pitch and/or roll servo action. Force disconnects during this condition are easily initiated by resisting the column or wheel until force builds up to the force switch disconnect value.

PITCH MANEUVERS. After engaging the low level mode, pitch maneuvers are commanded through the autopilot by applying force to the control column. Pitch characteristics may be observed by gradually increasing control column force. As force is increased, the column starts to move with a corresponding change in aircraft pitch attitude. Allow the aircraft attitude to change a few degrees by applying column force. The column will return approximately to neutral as stabilizer trim occurs and the aircraft will be maintained in the new attitude. This attitude will be maintained by the autopilot. Automatic trimming may be observed during changes in aircraft speed due to climbing or descending flight or by advancing or retarding the throttles. Apply a column force and observe that trimming occurs whenever such a force is applied.

ROLL MANEUVERS. Bank the aircraft left or right to a bank angle of 8° or less. When wheel force is relaxed, the autopilot will return the aircraft to wings level and the heading will be maintained. Bank the aircraft left or right to a bank angle greater than 8° . When wheel force is relaxed, the autopilot will maintain the aircraft in the new bank angle. Continue the bank angle to approximately 30° and note that wheel force must be increased in order to keep the wheel displaced at this bank angle. The increase in wheel force is called wheel stiffening and autopilot disconnect will occur at approximately 33° of bank angle or when approximately 40 pounds of wheel force is reached. This roll force disconnect feature is available in all modes.

OUT-OF-TRIM EFFECTS. Effects of an out-of-trim aircraft may be noted by disengaging the autopilot, slightly reducing power on engines 7 and 8, and re-engaging the autopilot low level mode. The control wheel will be displaced to the left. This exaggerated out-of-trim condition illustrates the necessity of trimming the aircraft before engaging the low level mode. Wheel displacement may be decreased by advancing throttles for engines 7 and 8. Note that the aircraft also remains on heading. Heading hold in the low level mode is accomplished by lateral control surface displacement since the rudder is disengaged. If the heading is drifting at the time the low level mode is selected, the lateral control surfaces will displace to compensate for drift, resulting in wheel displacement.

BNS TIE-IN. The BNS tie-in (second station) mode may be selected while in low level mode by positioning the autopilot turn control selector switch to BOMB. The pilot retains pitch and rudder control but roll and heading control responds to BNS commands. Bank angle is limited to 15° in the NAV mode of the BNS. The autopilot will disconnect if the pilot restrains the wheel movement that accompanies second station roll control. Pilot-initiated pitch control through the control column simultaneously with second station roll control may appear awkward at first and will necessitate coordination between the pilot and radar navigator. Manual control of the aircraft may be regained by overpowering the autopilot in roll or pitch or by pressing the disengage button. Second station control may be disengaged and autopilot roll steering control returned to the pilot by rotating the flight controller turn knob out of detent or returning the autopilot turn control selector switch to PILOT.

NORMAL OPERATION OF AUTOPILOT

Preflight of the Autopilot



During the following checks, do not allow the stabilizer trim to drive more than $1/2$ unit at a time when operating on standby pumps. Hydraulic power is necessary at the stabilizer jackscrew to allow the mechanism to operate without slipping of the autopilot stabilizer trim servo override clutch.

NOTE

This check may be performed after a reported malfunction has occurred, time and conditions permitting, and at the discretion of the flight crew.

1. Place body standby pump switches to STBY.
2. Place turn knob and roll trim knob in detent and synchronize the N-1 compass.
3. Check all servos cutout switches to IN.
4. Place autopilot master switch ON.
5. Note that autopilot trim indicators are centered and place servos engage switch in ENGAGE.
6. Check autopilot disengage functions:
 - a. Disengage autopilot by pressing pilot's release button; reengage autopilot and check by pressing copilot's release button.
 - b. Apply approximately 40 pounds lateral force on the pilot's control wheel to the right; autopilot should disengage. Reengage autopilot and repeat to the left. Reengage autopilot and repeat lateral force disconnect both right and left for copilot's control wheel.

NOTE

It may be necessary to move the control wheel to the stops to apply sufficient force to disconnect the autopilot.

c. Push forward on the pilot's control column until the servos engage switch moves to DISENGAGE, reengage the autopilot and pull back on the control column until the servos engage switch moves to DISENGAGE, and again reengage the autopilot. Repeat control column force disconnect both fore and aft for the copilot's control column.

d. Place the aileron servo cutout switch to OUT. Place servos engage switch to ENGAGE. Rotate control wheel clockwise. Autopilot should disengage at approximately 75° of control wheel rotation.

e. Place servos engage switch to ENGAGE. Rotate control wheel counterclockwise. Autopilot should disengage at approximately 75° of control wheel rotation.

7. Place elevator servo cutout switch to OUT. Return servos engage switch to ENGAGE if it moved to DISENGAGE. Operate the pilot's or copilot's stabilizer trim button to NOSE UP and NOSE DN; the manual trim wheels should rotate in the direction of the commanded trim.

8. Place elevator servo cutout switch to IN. Return the servos engage switch to ENGAGE if it moved to DISENGAGE. Operate the pilot's or copilot's stabilizer trim button to NOSE UP and NOSE DN; the manual trim wheels should not rotate.

9. With the autopilot master switch ON, servos engage switch in ENGAGE, and ILS receiver inoperative, the automatic approach localizer switch should be locked OFF. Turn nav mode select switch to ILS. With the ILS receiver on and tuned to an approach localizer frequency, turn the automatic approach localizer switch and altitude control switch to ON.

10. With the automatic approach localizer switch ON, place nav mode select switch to ILS APP and turn the automatic approach glide slope switch to ON. Altitude control switch should drop to OFF.
11. Rotate the roll trim knob clockwise; the pilots' control wheels should rotate clockwise. Repeat for the counterclockwise direction, then return the roll trim knob to detent.
12. Rotate the pitch knob; the automatic approach glide slope switch should drop to OFF.
13. Rotate the turn knob out of detent; the automatic approach localizer switch should drop to OFF. Return the turn knob to detent.
14. Place the altitude control switch in ON. Rotate the pitch knob; altitude control switch should drop to OFF.

NOTE

It should be considered normal, when engaging the altitude control on the ground, for the "engage error" of the altitude control to originate a signal to which the aircraft at rest on the ground cannot respond, causing the elevator and stabilizer trim to be driven to their limits.

15. Rotate the turn knob clockwise; the pilots' control wheels should rotate clockwise. Repeat for the counterclockwise direction, then return the turn knob to detent.

NOTE

Rotating the turn knob rapidly may result in disengagement of the autopilot. This occurs because the servo will drive the control surface to the limit (opening the limit switch) before the roll followup amplifier can make the circuit that bypasses the limit switch.

16. Rotate the pitch knobs in the climb direction; the control columns should move aft and the manual trim wheel should rotate for noseup trim. Rotate the pitch knobs in the dive directions; the control columns should move forward and the manual trim wheel should rotate for nosedown trim.

17. Place the autopilot turn control selector switch in BOMB. The BNS steering indicator should indicate ON provided the BNS power switch is ON and the bomb control heading switch is on NAV or the bomb (mode) button is depressed.

18. Command a right turn with the bombing navigational system; the pilots' control wheels should rotate clockwise. Command a left turn with the bombing navigational system; the pilots' control wheels should move counterclockwise.

19. Return the autopilot turn control selector switch to PILOT.

20. Place low level mode switch to LOW LEVEL.

NOTE

The rudder axis of the autopilot will automatically disengage although the servo cutout switch will remain in.

a. Disengage autopilot by pressing pilot's release button; reengage autopilot and check by pressing copilot's release button.

b. Apply approximately 40 pounds lateral force on the pilot's control wheel to the right; autopilot should disengage. Reengage autopilot and repeat to the left. Reengage autopilot and repeat lateral force disconnect both right and left for copilot's control wheel.

NOTE

It may be necessary to move the control wheel to the stops to apply sufficient force to disconnect the autopilot.

c. Apply a sharp push-pull force to pilot's control column; autopilot should disconnect. Reengage and repeat using a sharp pull-push force. Repeat using copilot's control column.

d. Move control column forward. Control column should move easily and remain where displaced by the pilot. The stabilizer trim should move while force is being applied to the control column and should drive in the nosedown direction, possibly driving to the limit. Limit stabilizer trim movement to 1/2 unit of displacement. While stabilizer trim is moving, apply a 5-pound force to control column in the opposite direction of trim movement and note that the stabilizer trim follows the force change.

e. Repeat step "d" using an aft control column displacement.

f. Displace control wheel right using varying amounts of displacement up to full travel. Note that control wheel returns approximately to neutral when force is released. (The aileron limits are bypassed in low level mode.) Repeat using left control wheel displacement.

g. Place autopilot turn control selector switch to BOMB.

h. Command a right turn with the BNS; pilots' control wheels should rotate clockwise. Command a left turn with the BNS; pilots' control wheels should rotate counterclockwise. During bomb mode of operation, the pilot will have the overpower feature on lateral control to disconnect the autopilot. The pilot will have pitch control through the control column. Switching between pilot and bomb modes of operation should not disconnect the autopilot.

NOTE

The roll trim knob may be used to reduce standoff error as observed on the FCI when the autopilot turn control selector switch is in BOMB position.

i. Return autopilot turn control selector switch to PILOT. Return low level switch to OFF.

21. Place master refuel switch ON.

22. Place normal slipway door switch to OPEN.

23. Place aerial refuel mode switch to AERIAL REFUEL.

NOTE

The rudder axis of the autopilot will automatically disengage when placing aerial refuel switch to AERIAL REFUEL, although the servo cutout switch will remain in.

a. Disengage autopilot by pressing pilot's release button; reengage autopilot and check by pressing copilot's release button.

b. Apply approximately 40 pounds lateral force on the pilot's control wheel to the right; autopilot should disengage. Reengage autopilot and repeat to the left. Reengage autopilot and repeat lateral force disconnect both right and left for copilot's control wheel.

NOTE

It may be necessary to move the control wheel to the stops to apply sufficient force to disconnect the autopilot.

c. Apply a sharp push-pull force to pilot's control column; autopilot should disconnect. Reengage and repeat using a sharp pull-push force. Repeat using copilot's control column.

d. Move pilot's control column forward and release; column should return to neutral. Move control column aft and release; column should return to neutral. Repeat using copilot's control column.

e. Move pilot's control column forward and hold in displaced position for 20 to 30 seconds. The control column should remain in displaced position. Repeat procedure by moving control column aft. Repeat using copilot's control column.

NOTE

● If stabilizer trim drives, limit movement to 1/2 unit by using approximately 5 pounds of force in the opposite direction of trim movement.

● Control column forces may appear higher when using aerial refueling mode than when using low level mode.

f. Rotate pilot's control wheel right and release; wheel should return to neutral. Rotate wheel left; wheel should return to neutral. Rotate control wheel right and hold in displaced position for 20 to 30 seconds; wheel should remain in displaced position when released by pilot. Rotate control wheel left and hold in displaced position for 20 to 30 seconds; wheel should remain in displaced position when released. Repeat using copilot's wheel.

24. Return the autopilot master switch to OFF.
25. Check all servos cutout switches to IN.

Pilot's Operation of the Autopilot

Pilot's inflight operation of the autopilot may be accomplished by the following procedure:

1. Check autopilot master switch ON.
2. Trim aircraft wings level and ball centered.
 - a. The aircraft should be trimmed by fuel management and thrust adjustments as much as possible since manual trim will deflect the spoilers and create drag. See "Fuel Management for Lateral Trim" under "Climb," Section II.
 - b. Use rudder trim as required to obtain straight and level flight. Observe "Rudder Trim Limitations," Section V.
3. Check all servos cutout switches to IN.

NOTE

- With the aileron servo cutout switch in OUT position, the aircraft will not hold heading; however, the rudder servo will continue to provide Dutch roll damping.
- If the N-1 compass fails completely, the rudder servo cutout switch should be positioned to OUT to prevent erratic heading signals. All modes except heading hold are still available.
- With only the rudder servo cutout switch in OUT position.
 - a. The aircraft will not hold heading unless coupled to the BNS or automatic approach equipment.
 - b. Turns can be made with the turn knob.
 - c. A slight decrease in Dutch roll damping may be noted.
- 4. Check autopilot flight controller for:
 - a. Turn knob in detent.
 - b. Roll trim knob in detent.
- 5. Check that autopilot trim indicator bars are in center reference positions.

CAUTION

- An abrupt control surface displacement will occur if the autopilot is engaged or disengaged with a trim indicator steadily displaced more than one bar width.
- Steady displacement of one or more of the autopilot trim indicator bars on the autopilot selector panel indicates a lack of autopilot-aircraft synchronization. If this condition or abnormal/stop-to-stop oscillations are observed, the autopilot should not be engaged unless the malfunctioning axis is cut out, using the applicable servo cutout switch.

6. Place servos engage switch to ENGAGE.

WARNING

The pilot should be prepared to immediately disengage the autopilot in the event of a hard-over signal following engagement.

NOTE

- Upon engagement, there should be no engage transient in the control axes exceeding $1/2^\circ$ of pitch or yaw and 1° of roll.
- Servos may be engaged in a normal climb or descent and the aircraft will continue to fly that attitude until the pilot moves his pitch knob.
- If the autopilot is engaged when the aircraft is banked for a turn, it will automatically roll the aircraft to a near wings-level attitude.
- The autopilot will not completely compensate for all lateral mistrim. If the aircraft is not properly trimmed before autopilot engagement or becomes out of trim after engagement, the aircraft may fly slightly wing low until the aircraft is retrimmed by fuel management and thrust adjustments.
- 7. Place altitude control switch to ON if constant altitude control is desired. The aircraft is now under autopilot control on all three axes.

NOTE

- The aircraft should, with no more than two overshoots, stabilize out on a "reference" altitude within the following stated tolerances from "engage" altitude:

Bombing condition	± 300 feet
Hi-speed condition	± 175 feet
Approach condition	± 100 feet

Then variation from "reference" altitude should not exceed ± 50 feet during any 15-minute interval with no continuous oscillation after the engage transient has damped out. Long term wander (slow, steady change in altitude) may occur but shall not exceed 200 feet maximum altitude change. Gust response shall not exceed one overshoot in smoothly returning the aircraft to controlled altitude. Recovery from a turn should be within ± 70 feet of the altitude indicated before the turn.
- Pitch oscillations or erratic operation may occur while in altitude control near maximum level flight airspeeds above 20,000 feet altitude. In such cases, disengage the altitude control until airspeed is reduced.

8. Standard maneuvers may be executed with the pitch and turn knobs. Climb and descent are accomplished with the pitch knob; turns are made with the turn knob. A climbing or descending turn is made with a combination of the two knobs.

9. During flight, check that the autopilot trim indicator bars remain in the near centered position. Steady displacement of the "Ail" and/or "Rud" trim indicator bars and the control wheel indicate asymmetrical fuel load or engine thrust requiring appropriate fuel management and/or thrust adjustment to center the control wheel and return the "Ail" and "Rud" trim indicator bars to near center (see "Fuel Management for Lateral Trim" under "Climb," Section II). Steady displacement of the "E" trim indicator bar appreciably more than a bar width indicates a malfunction. The elevator axis must be disengaged using the procedure under "Individual Servo Disengagement." Rudder and aileron axes normally will not require retrimming while on autopilot.

NOTE

- During operation on autopilot, airbrake operation should be performed with caution to avoid an excessive longitudinal out-of-trim condition and to prevent possible automatic pilot disengagement.
- During autopilot control with altitude control engaged, operation of the wing flaps is permissible. While operating flaps, a large but not dangerous indicated altitude change will result due to a change in airflow across the static source. Lowering flaps results in a gain in altitude; raising flaps will result in a loss of altitude.
- 10. The low level mode may be engaged under the following conditions:
 - Autopilot master switch is ON
 - Elevator servo cutout switch is IN
 - Aileron servo cutout switch is IN
 - Servos engage switch is in ENGAGE
 - No other autopilot mode is engaged (if altitude hold is engaged, it will drop out)
 - Normal and alternate slipway door switches are CLOSED
 - Roll trim and turn knob in detent.

NOTE

- In the event of a malfunction of the slipway door system, the low level switch may be engaged if the master refuel switch is OFF or is cycled from ON to OFF after the slipway door switches are in CLOSED position.

- When engaging either the low level or aerial refuel mode switches, the pilot and copilot should not be exerting any force on the control column or wheel. If either pilot is exerting a force on his respective controls when the low level or aerial refuel mode switch is engaged, an engage transient will occur. The action will be observed as a short pulse action on the wheels or columns but will not drive the control to the limit.

11. The aerial refueling mode is placed in operation while approaching the precontact position and will be engaged under the following conditions:

- Autopilot master switch is ON
- Elevator cutout switch is IN
- Aileron cutout switch is IN
- Servos engage switch is in ENGAGE
- Slipway doors are open
- No other autopilot mode is engaged (if altitude hold is engaged, it will drop out)

NOTE

During aerial refueling, boom disconnects caused by excessive pressure, exceeding the boom envelope limits, or boom operator initiated disconnects, will not disengage the autopilot.

12. Automatic approach operation is given in Section IX.

Radar Navigator's Operation of the Autopilot

The bombing navigational system has no pitch control over the aircraft. Turn control of the autopilot is transferred to the BNS when the autopilot turn control selector switch is placed in the BOMB position. The radar navigator can then command autopilot turns manually with the tracking handle or set up the BNS for automatic operation of the autopilot.

NOTE

Intercardinal heading overcontrol exists in the NAV mode from the AN/ASB-9 steering signal. This overcontrol is visible as a control wheel response and it will increase in severity until at approximately 45 miles from the target it may cause the autopilot to disconnect. To prevent intercardinal heading overcontrol and possible autopilot disconnect, the final 50 miles of the navigation leg should be flown manually or with the autopilot in first station in accordance with visual correction requirements from the flight command indicator (FCI).

Autopilot Disengagement**CAUTION**

- Check elevator and rudder systems for artificial feel after autopilot disengagement if flying in or leaving an icing condition. Icing of the Q-spring ram air duct may result in loss of artificial feel. If abnormally light rudder or elevator control forces are encountered, abrupt control displacements should be avoided to prevent overstressing the aircraft. See "Elevator and Rudder Control Malfunction," Section III.
- If a constant large displacement of the elevator trim indicator bar indicates failure of the automatic stabilizer trim system during flight on autopilot, maintain column position manually after autopilot disengagement and retrim.

DISENGAGEMENT FOR OUT-OF-TRIM CONDITION. If large amounts of stabilizer out-of-trim and displaced control column conditions are observed when flying with autopilot altitude hold engaged, disengagement should be accomplished using the following procedure:

1. To prevent an abrupt pitchdown (up) upon disengagement, restrain control column movement by attempting to maintain column in position observed.
2. Disengage autopilot by pressing release button. Expect sudden and possibly heavy elevator forces to be encountered to keep the control column from snapping to neutral or "hands-off" position.
3. Immediately apply stabilizer trim.
4. Use airbrakes if required.

NOTE

If elevator authority is insufficient to control a nosedown mistrim, airbrake extension should be used as a backup to the elevator for pitch authority.

INDIVIDUAL SERVO DISENGAGEMENT. Individual servo disengagement is accomplished by the following procedure:

1. Disengage autopilot by means of the autopilot release button on the pilot's or copilot's control wheel.
2. Disengage desired individual servo by placing the proper servo cutout switch in OUT.
3. Reengage remaining servos by placing the servos engage switch in ENGAGE.

NOTE

The aerial refueling and low level modes cannot be used unless the elevator cutout switch is IN.

COMPLETE DISENGAGEMENT. Complete disengagement may be accomplished at any time by pressing

the pilot's or copilot's autopilot release button on the respective control wheel, placing the servos engage switch in DISENGAGE, or placing the autopilot master switch in OFF position. The pilot or copilot may apply sufficient force on the control column or control wheel to actuate the force switches and completely disengage the autopilot.

WARNING

One or more of the switches on the autopilot command selector panel (servos engage, automatic localizer, approach glide slope, altitude control, aerial refuel, and low level) can fail to trip off when the autopilot is disengaged by the pilot's or copilot's autopilot release button. To preclude automatic reengagement of the autopilot upon release of the button, button should be held in continuously until servos engage switch is observed to be disengaged.

EMERGENCY OPERATION OF AUTOPILOT

There are no special operating procedures to be used during an emergency. However, if the autopilot is engaged and manual flight control is desired, press the pilot's or copilot's autopilot release buttons for immediate autopilot disconnect. If the methods outlined under "Autopilot Disengagement" fail, pull the six autopilot circuit breakers located on the left load central circuit breaker panel.

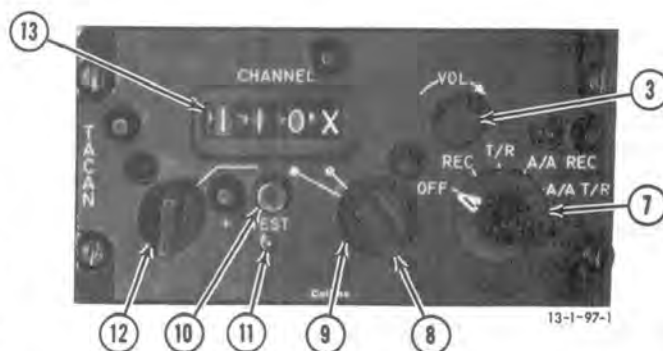
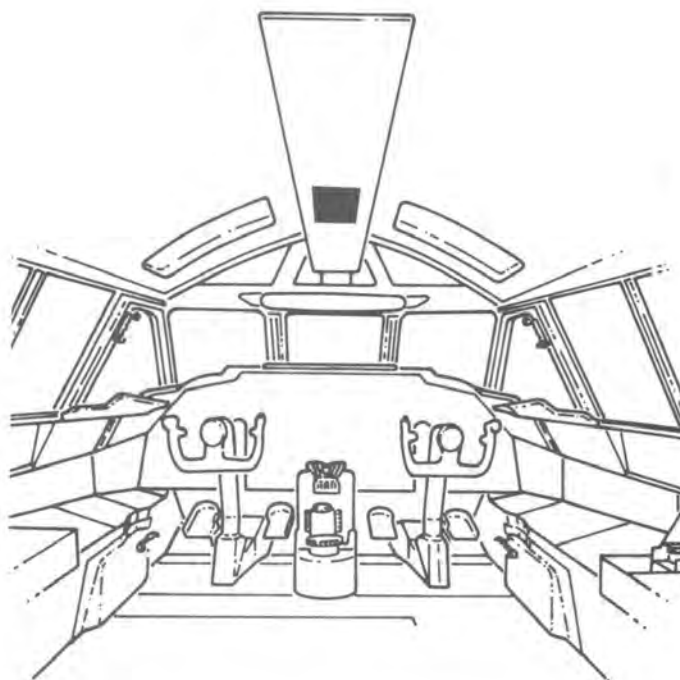
WARNING

If a malfunction or erratic behavior is experienced in any mode of the autopilot, the air refueling, low level, and automatic approach modes will not be used for the remainder of the flight. If a malfunction or erratic behavior is experienced in the normal mode (other than air refueling, low level, or automatic approach), disengage the autopilot and investigate the cause of the malfunction. The pilot will determine whether the malfunction in the normal mode precludes further use of this mode of the autopilot; however, if abnormal oscillations about the yaw axis are encountered, place the rudder servo cutout switch to OUT and do not reengage it. Normal autopilot disengagements as discussed in this section, such as those occurring due to turbulence, improper pilot technique, or electrical system malfunctioning should not be considered an autopilot malfunction.

INSTRUMENT LANDING SYSTEM (ILS) EQUIPMENT

The instrument landing system (ILS) provides the pilots with a straight line glide slope and a localizer or on-course guidance. The ILS system is used both as

Figure 4-29. (Deleted)



TACAN CONTROL PANEL

1. (DELETED)
2. (DELETED)
3. TACAN VOLUME KNOB
4. OMNI-RANGE SELECTOR SWITCH
5. OMNI-RANGE POWER SWITCH
6. OMNI-RANGE VOLUME KNOB
7. FUNCTION SELECTOR SWITCH
8. UNITS CHANNEL SELECTOR KNOB
9. X-Y CHANNEL SELECTOR KNOB
10. TEST LIGHT
11. TEST SWITCH
12. TENS CHANNEL SELECTOR KNOB
13. CHANNEL INDICATOR WINDOW

■■■■■■■■ Tacan and Omni-Range Radio Controls

Figure 4-30.

a means of navigation and as an aid to assist the pilots when landing in inclement weather. The ILS consists of the glide slope equipment (AN/ARN-31), omni-range radio (AN/ARN-14), the pilots' control panel, and the marker beacon receiver (AN/ARN-32). For further information on this equipment, see "Communication and Associated Electronic Equipment" and "Flight Director System" this section.

INSTRUMENT LANDING SYSTEM CONTROLS

Omni-Range Selector Switch

A selector switch (4, figure 4-30) on the pilots' control panel provides manual selection of the desired frequency. Tuning the receiver to the proper localizer channel will automatically tune the glide slope receiver to the proper glide slope channel frequency. The selector is calibrated from 108.0 to 135.9 megacycles.

Omni-Range Power Switch

The receiver is turned on and off by a two-position ON--OFF power switch (5, figure 4-30) on the pilots' control panel. ON position provides operation of the tone comparison glide path and omni-range operation. OFF position turns off the equipment.

Omni-Range Volume Knob

A volume knob (6, figure 4-30) on the pilots' control panel is used to adjust the receiver audio to the interphone system.

Course Set Knob

A course set knob (13, figure 4-31) located on the horizontal situation indicator is used to set the course arrow and the course display to the desired course on three tab indicators in the course selector window. See "Flight Director System," this section.

INSTRUMENT LANDING SYSTEM INDICATORS

Course, bearing, and range indicators are integrated in the AQU-4/A horizontal situation indicator. See "Flight Director System" this section.

Marker Beacon Indicator Light

Two marker beacon indicator lights located on the pilots' instrument panel (11, figure 1-15) are used as a navigational and landing aid. The lights are green with translucent-colored lettering "Marker Beacon" on a black background. Both lights are tested by pushing the press-to-test button (8, figure 1-15) on the pilots' instrument panel.

FLIGHT DIRECTOR SYSTEM

NOTE

Some of these instruments have red warning flags which may be difficult to see at night.

ATTITUDE-DIRECTOR INDICATOR

See "Instruments," Section I.

HORIZONTAL SITUATION INDICATOR (HSI)

A flight director system instrument, Type AQU-4/A HSI (figure 4-31), is located on both the pilot's and copilot's instrument panels (10, figure 1-15). It is an electrically operated instrument and replaces the bearing-distance indicator, the radio course indicator, and the directional indicator (heading system). The HSI receives 115-volt a-c power through a circuit breaker marked "Radio Nav Ind AC" and 24-volt d-c power through a circuit breaker marked "Radio

Nav Ind DC." Both circuit breakers are located on the "Flight Indicators" portion of the pilot's circuit breaker panel. In the event of loss of all a-c power, no information will be available from either the pilot's or copilot's HSI. A power off flag (9, figure 4-31) on the right side of the HSI has black letters on a red background and will indicate OFF when power is not being supplied to the instrument. A description of the various components of the AQU-4/A is as follows:

- A rotating compass card (6, figure 4-31) and a lubber line (5, figure 4-31) that provide an indication of aircraft heading.
- A bearing pointer (3, figure 4-31) that indicates the bearing heading to a URN-3 surface beacon or to an omni-range station. The bearing pointer indicates bearing to a URN-3 surface beacon when the nav mode select switch (20, figure 4-31) is in TACAN position (the TACAN radio system must be tuned to the surface beacon and the surface beacon must be within 300 nautical miles of the aircraft). The bearing pointer indicates bearing to an omni-range station when the nav mode select switch is in VOR position and then only if the omni-range radio (ARN-14) is tuned to that station. The bearing pointer is inoperative when the omni-range receiver (ARN-14) is tuned to an ILS station.
- A range indicator (1, figure 4-31) will give a digital display of the line-of-sight distance (up to 300 nautical miles) to a URN-3 surface beacon. The display will be covered by a range indicator warning flag (2, figure 4-31) if the TACAN radio system is not tuned to a surface beacon that is within 300 nautical miles of the aircraft and will also be covered if the TACAN station is not transmitting a signal of dependable strength.
- A course arrow (10, figure 4-31) that indicates the desired course selected by the course set knob during ILS, ILS APP, VOR, and TACAN modes. The course arrow will rotate (in step) with the compass card.

- A course selector window (8, figure 4-31) that gives a digital display of the desired course selected by the course set knob.

NOTE

The digital display in the course selector window should be checked and, if necessary, re-set with the course set knob when changing the instrument control switch position from the pilot's or copilot's setting.

- A course set knob (13, figure 4-31) used to set the course arrow and the digital display in the course selector window to the desired course. When the nav mode select switch is in VOR position and the ARN-14 is tuned to an ILS frequency, the course set knob will have no functional effect on the course deviation indicator; however, the course deviation indicator will rotate in conjunction with the course set knob.

NOTE

To prevent course counter malfunctions the course set knob should not be moved or spun in a rapid jerky motion.

- A course deviation indicator (12, figure 4-31) referenced to the course arrow that indicates whether the aircraft is left or right of the desired course or localizer beam. The equally spaced dots that are perpendicular to the course arrow represent 5° of course deviation and 1/4 of localizer width. The deviation indicator provides information relative to the localizer beam when the nav mode select switch is in ILS or ILS APP and the ARN-14 is on and tuned to an ILS frequency. For all other conditions, the course deviation indicator provides information relative to the desired course provided TACAN radio or ARN-14 is tuned to the respective surface beacon or omni-range station.

- A red course deviation indicator warning flag (7, figure 4-31) will come into view during TACAN, VOR, ILS, or ILS APP mode of operation when the TACAN or ARN-14 fails or signals from the URN-3 beacon or the VOR or ILS stations are lost or become unreliable.

NOTE

When in TACAN mode of operation, the course deviation indicator warning flag will appear when TACAN signals are lost or unreliable. When this occurs, the ARN-118 will automatically switch to self test causing the HSI to slew to 270- and 180-degrees.

- A To-From indicator (11, figure 4-31) that indicates whether the selected course, if intercepted and flown, will take the aircraft to the selected facility,

or vice versa. The pointer references the URN-3 surface beacon if the nav mode select switch is in TACAN. For all other positions of the nav mode select switch, the pointer references the omni-range station; however, if the ARN-14 is tuned to an ILS frequency, the pointer is not visible.

- A heading marker (4, figure 4-31) that indicates a desired heading. The heading marker will rotate with the compass card after the desired heading has been selected by the heading set knob.

- A heading set knob (14, figure 4-31) that is used to set the heading marker to the desired heading.

NOTE

- The course set knob and the heading set knob will be quite warm to the touch when the system is operated for extended periods of time in moderately high ambient temperatures.
- Aircraft headings indicated by the compass card will be related to magnetic north or gyro north depending on whether the N-1 compass system is in magnetic or gyro operation. Bearings indicated by the bearing pointer will always be magnetic.

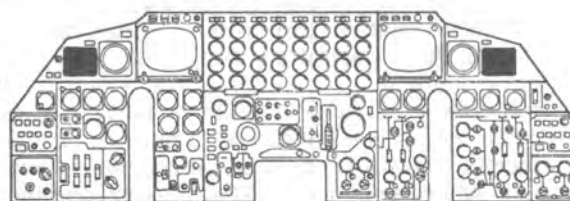
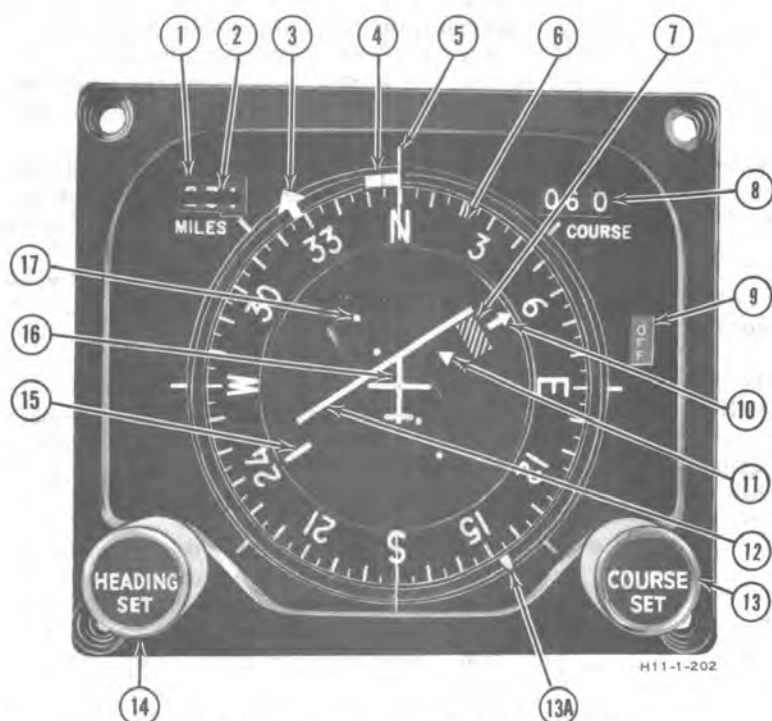
FLIGHT DIRECTOR SYSTEM CONTROLS

Nav Mode Select Switch

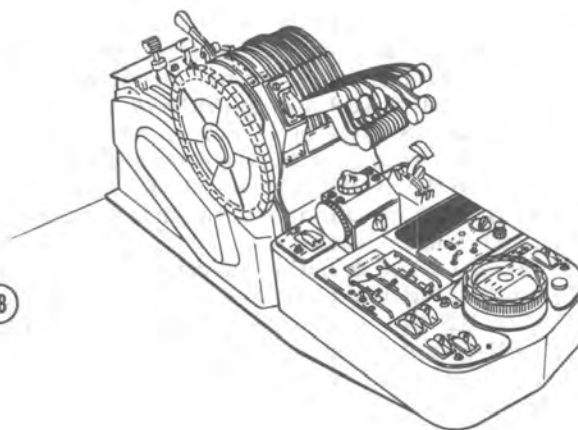
A nav mode select switch (20, figure 4-31) marked "Mode Select" is located on the navigation system select panel. The rotary switch has TACAN--VOR--ILS--ILS APP positions. In TACAN position, the TACAN system may be placed in operation in the normal manner as outlined under "Normal Operation of TACAN Radio." In VOR position, the omni-range radio navigation system is selected and may be placed in operation as noted under "Omni-Range Radio AN/ARN-14," this section. In ILS position, the instrument landing system mode of navigation is selected; for further information, see "Instrument Landing System (ILS) Equipment," this section. In ILS APP position, the instrument landing system-approach mode of navigation is selected; for further information, see "Automatic Approach Equipment," this section. The autopilot localizer and glide slope can be energized only when the nav mode select switch is in ILS or ILS APP position respectively and the omni-range radio system is on and tuned to an ILS frequency.

Heading Selector Switch

A heading selector switch (19, figure 4-31) located on the navigation system select panel is marked "Hdg Select." The switch has MAN--NOR positions and controls the input source for signals to the bank steering bar on the attitude-director indicator. In NOR (normal) position, the information displayed on the flight director indicator will be determined by the



HORIZONTAL SITUATION INDICATOR

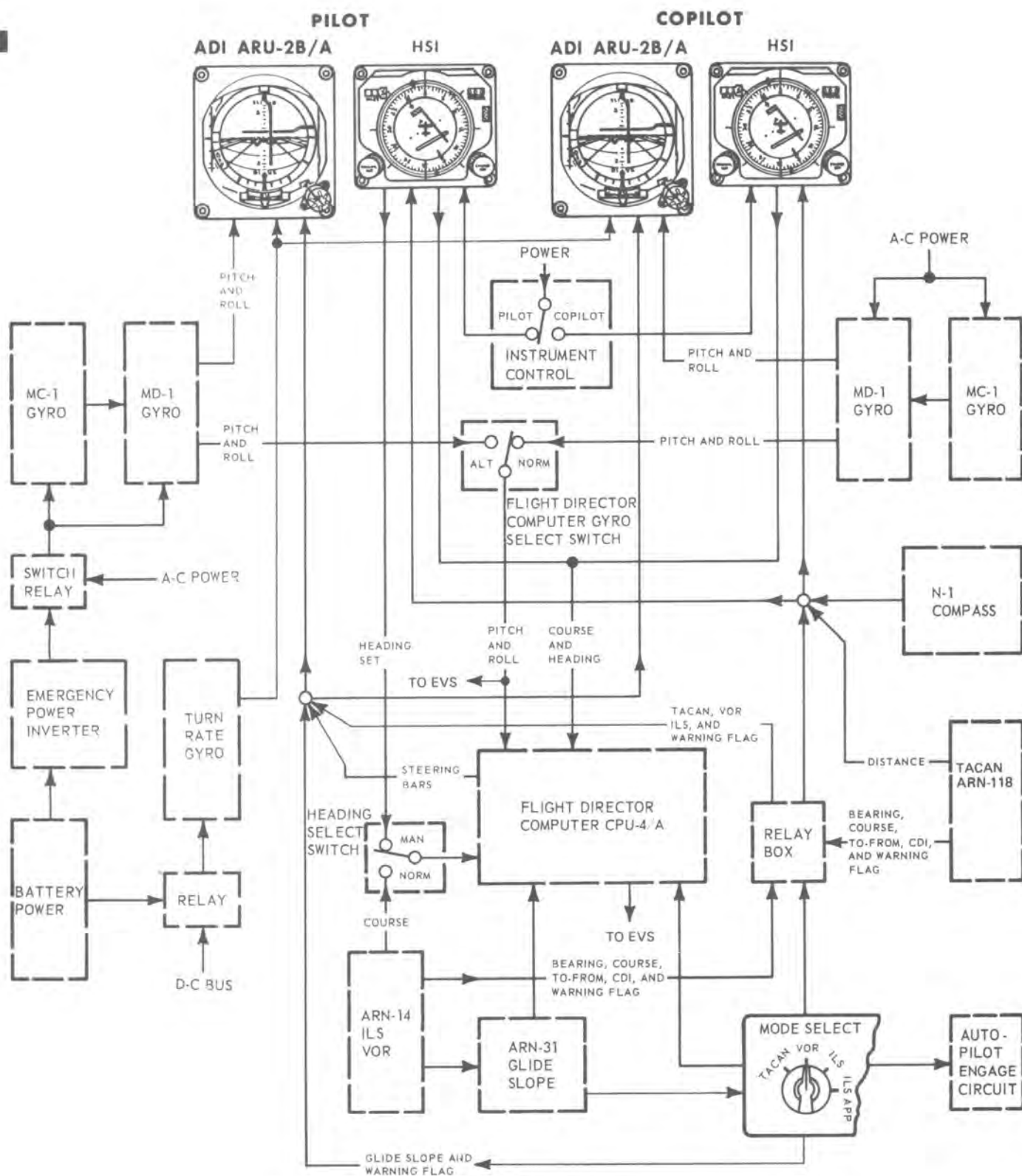


1. RANGE INDICATOR
2. RANGE INDICATOR WARNING FLAG
3. BEARING POINTER (HEAD)
4. HEADING MARKER
5. LUBBER LINE
6. COMPASS CARD
7. COURSE DEVIATION INDICATOR WARNING FLAG
8. COURSE SELECTOR WINDOW
9. POWER OFF FLAG
10. COURSE ARROW (HEAD)
11. TO-FROM INDICATOR (TO SHOWN)

12. COURSE DEVIATION INDICATOR
13. COURSE SET KNOB
- 13A. BEARING POINTER (TAIL)
14. HEADING SET KNOB
15. COURSE ARROW (TAIL)
16. AIRCRAFT SYMBOL
17. COURSE DEVIATION SCALE
18. INSTRUMENT CONTROL SWITCH
19. HEADING SELECT SWITCH
20. NAV MODE SELECT SWITCH

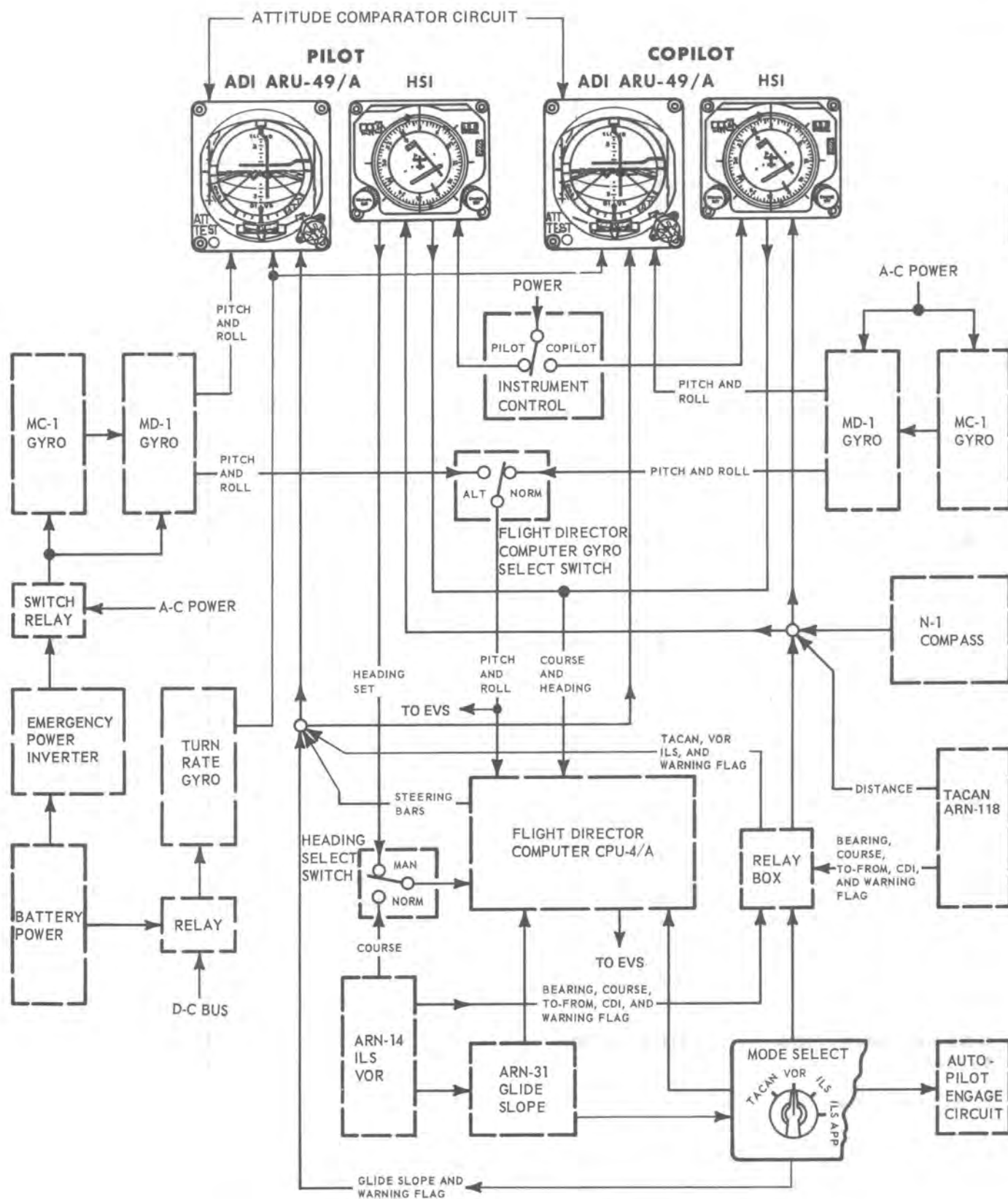
Horizontal Situation Indicator and Controls

Figure 4-31.



Less BB

Figure 4-32. (Sheet 1 of 2)



BB

Flight Director System Data Flow

Figure 4-32. (Sheet 2 of 2)

position of the nav mode select switch. In MAN (manual) position, the flight director system will operate the same as when the switch is in NOR position with the exception of the bank steering bar. The bank steering bar will come into view and will respond to the heading set by the heading set knob on the HSI. The bar will indicate zero deflection when the aircraft has the correct bank angle to arrive at the selected heading. The heading can be maintained by keeping the bank steering bar at zero deflection.

NOTE

- When in TACAN, VOR, ILS, or ILS APP mode of operation, the course warning flag (3, figure 1-47) and course deviation warning flag on HSI will appear when the TACAN or ARN-14 fails or signals from the URN-3 beacon or the VOR or ILS stations are lost or become unreliable. Continued display of this warning flag after the heading select switch has been positioned to MAN does not indicate faulty operation of the bank steering bar.
- If the heading select switch is in MAN position, the selected heading rather than the selected course will be commanded by the bank steering bar. When it is desired to fly a specific course rather than heading, check that the heading select switch is in NOR position.

Instrument Control Switch

An instrument control switch (18, figure 4-31) located on the navigation system select panel has PILOT--COPLT positions and selects whether the pilot or copilot has control of the course and heading set knobs on the AQU-4/A indicator. When the switch is in PILOT position and the pilot rotates his course and heading set knobs, the corresponding information will be displayed on the copilot's AQU-4/A indicator and the copilot will not be able to change these settings. The reverse of the above condition will be true when the instrument control switch is in COPLT position. Both pilot's and copilot's horizontal situation indicators and attitude indicators are fully operative regardless of the position of the instrument control switch.

NORMAL OPERATION OF FLIGHT DIRECTOR SYSTEM

Turns to and Maintaining Heading

To select and fly a particular magnetic heading using the bank steering bar or heading marker, proceed as follows:

1. Place nav mode select switch to VOR or TACAN.
2. Place heading selector switch to NOR or MAN as desired.
3. Rotate heading set knob to align heading marker with desired magnetic heading on compass card.

4. Turn aircraft to desired heading.

a. If heading selector switch is in NOR, turn aircraft to center heading marker under lubber line, rolling out of turn as heading marker centers under lubber line.

b. If heading selector switch is in MAN, bank aircraft to center bank steering bar. Reduce bank angle as necessary to keep bank steering bar centered. Roll-out will be complete when desired heading is reached. Maintain heading by keeping bank steering bar centered.

NOTE

In this submode of operation, the indications given in step "4. a." also will occur.

TACAN or VOR Navigation

To fly a selected TACAN or VOR course, proceed as follows:

1. Select desired frequency on TACAN or VOR receiver.
2. Place nav mode select switch to TACAN or VOR.
3. Place heading selector switch to NOR.
4. Set course set knob. Rotate course set knob until head of course arrow is aligned with desired course on compass card. The course window should indicate the same course, and the CDI should show the aircraft deviation from the selected course.
5. Establish intercept heading. The intercept heading to be flown should be determined on the basis of prescribed instrument flying techniques.
6. Monitor course deviation indicator. Check CDI movement toward aircraft symbol. As CDI approaches aircraft symbol, turn aircraft to heading of selected course.
7. Check position of course deviation indicator. If CDI is offset, indicating overshoot or undershoot, steer aircraft toward CDI to center it.

NOTE

If desired, the bank steering bar may be used to maintain aircraft heading after wind drift correction has been established.

ILS Approach

The following operating procedure shows the normal method of using the flight director system to intercept a localizer course and glide slope in conjunction with an ILS approach. Specific instrument flight procedures, which vary from base to base, are not considered.

1. Select localizer frequency on VOR/ILS receiver and identify station.
2. Place heading selector switch to NOR.

NOTE

Failure to place the heading selector switch to NOR will cause the bank steering bar to command headings toward the selected heading rather than the ILS approach course.

3. Set course set knob. Rotate the course set knob to set localizer front approach course in the course selector window. The head of the course arrow should point to the same course on the compass card.

NOTE

The published front approach course must be set in the course selector window for all ILS approaches to obtain accurate directional indications on the HSI course deviation indicator.

4. Place nav mode select switch to ILS to obtain steering information from bank steering bar.

5. Center bank steering bar. When the aircraft heading is within 90° of the published front approach course, steer aircraft as necessary to keep bank steering bar centered. The steering bar should provide an intercept angle to localizer course of up to 45° and, when the course is approached, command a turn inbound to place the aircraft on the localizer course.

WARNING

The flight director will command up to a 45° angle of intercept to the localizer course without regard to the location of the outer marker. Therefore, the pilot is responsible for properly positioning the aircraft by use of the other nav aids or radar before following the bank steering bar commands to the localizer course.

NOTE

● If the published front course has not been set in the course selector window, the bank steering bar will be unreliable.

● In the ILS mode of operation, the flight director computer does not compensate for wind which may cause localizer standoff. Therefore, it might be necessary to complete the intercept without using the bank steering bar in strong crosswinds.

6. Check course deviation indicator. When roll-out on localizer front approach course is complete, check that CDI is centered under aircraft symbol, indicating aircraft is on localizer course.

7. Place nav mode select switch to ILS APP. When the nav mode select switch is moved from ILS to ILS APP, the maximum bank angle required to center the bank steering bar is reduced from 30° to 15°. This bank angle limit will automatically restrict corrective maneuvering which may be required to keep the aircraft on the localizer approach course. The aircraft should be on course and nearly aligned with the inbound heading before using the bank steering bar in the ILS APP mode. This should prevent bracketing and apparently large intercept angles during the ILS approach. If bracketing occurs, disregard the bank steering bar and use the CDI as reference to align

the aircraft on the localizer. Then use the bank steering bar to complete the approach.

NOTE

● In ILS APP mode, wind drift corrections will be accomplished automatically. Consequently, centering the bank steering bar will result in an aircraft flight path along the centerline of the localizer approach course.

● The pitch steering bar will come into view when switching to ILS APP. However, pitch steering corrections should not be made at this time.

8. When flying aircraft on localizer approach course, monitor glide slope indicator. When indicator approaches center, proceed to step "9." (The position of the glide slope indicator when pitch steering is initiated will depend primarily on pilot technique.)

9. Adjust aircraft pitch attitude to center pitch steering bar.

10. Keep pitch and bank steering bars centered. The pitch and bank steering bars command attitude corrections directly proportional to glide slope and localizer deviations to correct to or maintain the ILS flight path.

NOTE

The pitch and bank steering bars do not indicate direct ILS localizer nor glide slope information. Crosscheck as necessary the glide slope indicator and CDI to ensure the aircraft is on course and glide slope.

AUTOMATIC APPROACH EQUIPMENT

NOTE

The autopilot components of the automatic ILS approach equipment are no longer maintained. Therefore, the automatic approach localizer and glide slope modes of the autopilot are considered unusable.

The automatic approach equipment includes the instrument landing system equipment and the autopilot. The automatic approach equipment is the same as the ILS equipment except that the flight path of the aircraft is controlled automatically rather than manually as in ILS. The localizer switch controls the on-course path and the glide slope switch controls the angle of approach. For more information on this equipment, see "Communication and Associated Electronic Equipment," this section, and "Instrument Flight Procedures," Section IX.

NAVIGATION EQUIPMENT

Although the bombing navigation system of the aircraft provides complete electronic navigation equipment, other equipment, which is used separately or

can be used separately, is provided to aid in navigating. These items are the automatic astrocompass system, periscopic sextant, N-1 compass system, AJA-1 true heading computer system, doppler radar, true airspeed computer, altimeter, outside air temperature gage, and clock.

NOTE

The AGM-69A carrier equipment may be used as a navigational aid. Refer to T.O. 1B-52G-30-2 for additional information.

AUTOMATIC ASTROCOMPASS SYSTEM (MD-1)

For description of this equipment, refer to T.O. 1B-52G-1-6-1.

PERISCOPIC SEXTANT

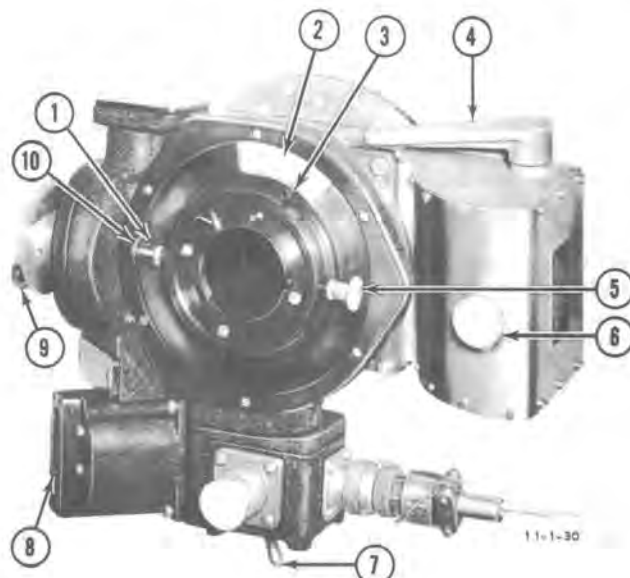
A periscopic sextant (figure 4-33) and periscopic sextant carrying case are located just behind the copilot's seat. This bubble-type periscopic sextant operates through a full 360° in azimuth and -10° to +92° in elevation. This sextant is provided with an automatic averager assembly which plots minor variations in altitude readings versus length of observations. Lighting is provided to read the counters and dials and illuminate the bubble during sightings. The 28-volt a-c power is provided through the "Periscopic Sextant Recp" circuit breaker on the right load central circuit breaker panel.

Periscopic Sextant Mount

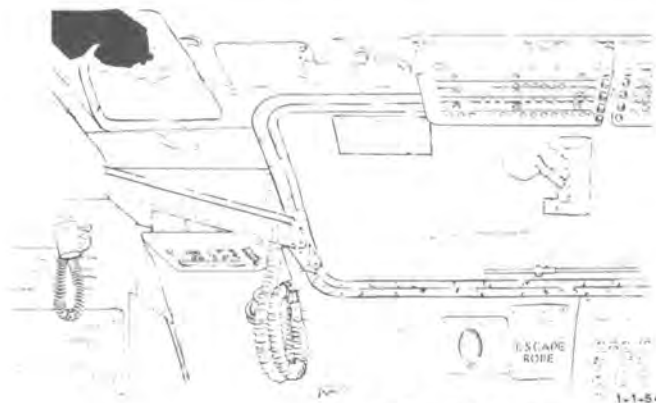
A periscopic sextant mount (figure 4-34) is provided to hold the periscopic sextant for celestial observations and to indicate the azimuth of the sighting. When the sextant is not in use, the mount may be sealed by a shutter which is flush with the aircraft skin. When the sextant is to be used, the sealing shutter is drawn aside and the sextant extended so that the tip of the tube is exposed 1 1/2 inches. The shutter chamber drain plug permits the draining of water from the chamber to prevent the formation of ice at altitude. If lack of time prevents draining the chamber before takeoff, it is advisable to leave the drain plug open as it may be difficult or impossible to open the shutter after passing through freezing level. Provisions must be exercised to insure that excessive moisture does not enter cabin area if drain plug is left out.

CAUTION

- When the aircraft is pressurized, do NOT open the shutter of mount until AFTER the sextant has been inserted to its "retracted" position.
- The provision of stops in the retracted position of the sextant is intended only to prevent



1. AZIMUTH INDEX (LUBBER'S LINE)
2. HEADING SCALE
3. LINE OF SIGHT LOCKING LEVER
4. SEXTANT PORT SHUTTER LEVER
5. RETRACT SEXTANT PULL KNOB
6. SHUTTER CHAMBER DRAIN PLUG
7. ILLUMINATION SWITCH
8. AZIMUTH COUNTER
9. AZIMUTH KNOB
10. INSERT-REMOVE SEXTANT PULL KNOB



Periscopic Sextant Mount

Figure 4-34.

its being dropped during insertion or removal. It is not advisable to leave the sextant in the retracted position for any extended period, particularly during rough weather, since damage may occur. When the sextant is removed from the mount, it should be returned to the carrying case.

An independently rotatable compass rose, engraved in increments of $1/2^\circ$, is provided. A lubber's line which may be aligned with the aircraft longitudinal axis to establish a reference point provides indications of azimuth on the scale. For manual setting of true azimuth 0.1° , a counter is synchronized with the lubber's line indication. The direction of numbering the graduations is so arranged that relative bearing is subtracted. Thus, when the azimuth of an observed body is set against the lubber's line and the sighting mechanism is aligned on that body, the true heading of the aircraft is indicated by the sextant vertical line of the reticles as read against the azimuth scale.

Optics

The optical system of the sextant is a two-power telescope with a true field of 15° . This wide field facilitates the location and identification of celestial bodies. Coating of optical elements serves to minimize light losses caused by reflections, although "ghost" images of the sun are inherent in the design of the optical system. These images usually occur when the sextant altitude is set several degrees above the true altitude of the sun. The image may be identified by tilting the sextant forward and back. If the body and the artificial horizon (bubble) move in opposite directions, it is an image. Images of the moon may be observed but they will not be visible for stars. The eyepiece is adjustable for focusing. Filters of varying densities are provided for selective use in the optical system so that the intensity of the sun's light may be adequately reduced.

Bubble Horizon

The air bubble artificial horizon is formed from an air chamber located at the top of the body of the sextant. The bubble may be formed and adjusted in size, while in the field of view, by means of the bubble adjustment knob on the left side of the chamber. If a bubble is not present in the sextant, the knob must be rotated to the minimum position, the sextant tilted to the right, and the knob rotated toward maximum until the proper size bubble is formed. Bubble size is maintained by moving the sextant to the vertical position and positioning the bubble adjustment knob to the maximum position. If a bubble is already present, it may be adjusted by moving the knob in the desired direction while holding the sextant tilted to the right, keeping the bubble centered in the notch in the air chamber.

NOTE

Except when adjusting the bubble, the bubble adjustment knob is to be kept at full INCREASE at all times.

The lens mounted above the bubble chamber may prevent the entrance of sufficient daylight for direct illumination; therefore, artificial illumination provided by a 28-volt lamp with controllable intensity is usually required.

Projection Lens

Supported on the bubble chamber is a small optical system which superimposes the relevant portion of the true heading scale on the same plane as that of the bubble. The magnified scale is therefore visible in the eyepiece together with the bubble, celestial objective, and reticle. When the objective and bubble are collimated near the center of the field, the vertical line of the reticle acts as an index against the scale so that when the true azimuth has been correctly set and the sextant aligned, true heading is immediately indicated. A diffuser may be inserted in the system to obstruct the image of the scale when true heading readings are not required. However, this does not detract from the effective illumination of the mount scale. Provision is also made for adjusting the projection lens to remove parallax and allow for alignment of the sextant and mount. The lens is held stationary by a locking ring which may be loosened to allow the lens to be turned in order to position lubber's line, vertical line of the reticle, and the alignment objective in coincidence.

NOTE

Rotation of the projection lens will cause the image of the azimuth scale and the lubber's line to appear to move in an elliptical path, giving two settings (high and low) where coincidence will occur. The higher of the settings should be selected.

Averager

In the periscopic sextant, the averaging is performed by a ball integrator which effects a continuous moving average over any observation period up to 2 minutes. A single lever sets and winds the averager. No other presetting of sextant, timing mechanism, or averager is necessary.

NOTE

At least 4 seconds should be allowed for the averager to run to its starting position after being wound.

Because it is continuously integrating altitude against elapsed time, after at least 30 seconds, it may be stopped at any time up to 2 minutes as circumstances dictate. The average altitude angle is obtained at the end of an observation by recentering the averager.

indices by means of the altitude knob. The averager altitude may then be read directly from the counter. A time dial graduated in seconds indicates the half time of the observation, thus the maximum dial reading of 60 indicates 120 seconds of time. At the end of 2 minutes of observation, the averager actuates a lever which drops a shutter across the field of view, indicating that the observation has been concluded. The shutter (and filter assembly) is mounted on the left side plate which is removable in flight. The shutter is raised, clearing the field of view when the averager rewind lever is pressed.

CAUTION

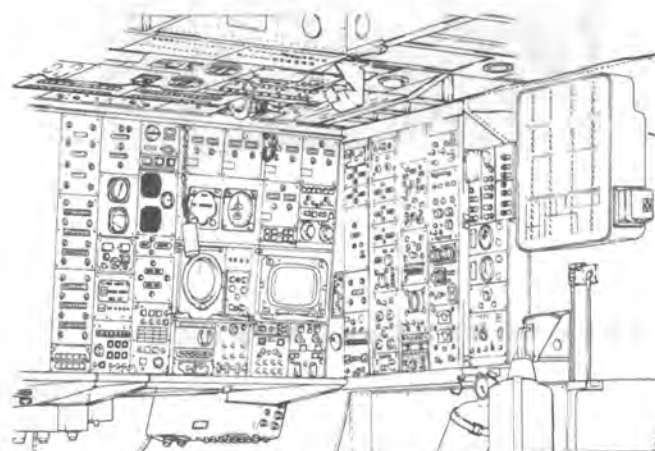
The averager actuating button (lever) should always be depressed to allow the averager to run down when the sextant is not being used for an observation.

Lighting

An ON-OFF illumination switch on the mount controls illumination. The illumination of the bubble and azimuth scale of the mount is adjustable by a rheostat. No adjustment is provided to control the illumination of the mount counter, sextant counter, averager indices, or the navigator's watch. Electrical connection is made from the aircraft 28-volt a-c power supply to an AN receptacle on the mount.

N-1 COMPASS SYSTEM

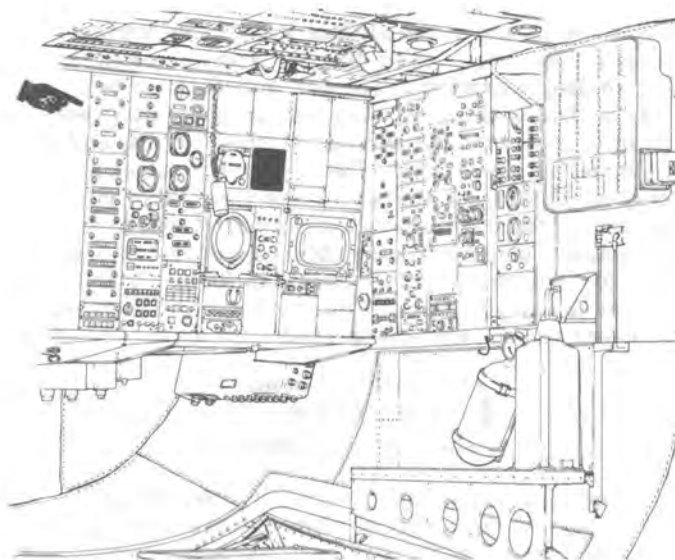
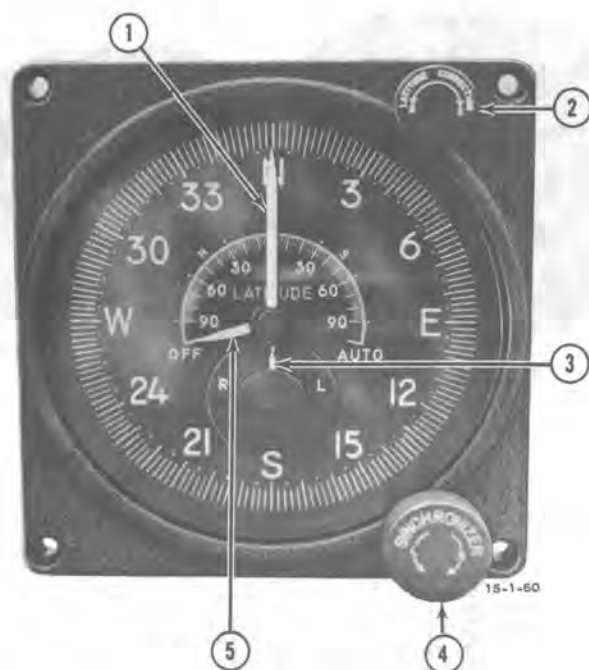
The N-1 compass system is a remote indicating gyro stabilized compass system designed for use in all latitudes. It may be operated to provide gyro stabilized magnetic reference headings (magnetic mode) or latitude corrected directional gyro reference headings (gyro mode). Operation as a magnetic (slaved) compass may be used in any locality except near the poles or in areas where severe magnetic distortion occurs. Operation as a directional gyro may be used in any latitude but is especially useful where the magnetic field is weak or distorted or when used for grid navigation in the polar regions. The N-1 compass master indicator (figure 4-36) located on the navigator's front panel contains the controls and indicators for the system. The N-1 compass system provides gyro or magnetic reference signals for directional control directly to the autopilot. The direction displayed by the heading pointer on the N-1 compass master indicator is the heading supplied the true heading system, the pilot's heading indicator, the heading pointer on the pilot's radio course indicator, and the pilot's radio magnetic indicator, whether operating the system in magnetic or gyro



Navigation ■ Instruments (Typical)

Figure 4-35.

mode. A latitude correction knob (2, figure 4-36) on the N-1 compass system panel allows selection of magnetic slaved or directional gyro operation. The latitude correction knob is mechanically connected to the latitude correction pointer (5, figure 4-36). When operating the system in the magnetic mode, the N-1 compass latitude correction pointer is positioned to OFF. When operating in the gyro mode, the pointer is positioned to the local latitude or to AUTO. When in AUTO, a correction for apparent drift of the gyro is provided automatically, based on the latitude displayed by the BNS present position latitude indicator. When the correction for apparent drift of the gyro is set manually, the latitude indicated by the correction pointer is the latitude for which correction is applied to the heading pointer. A synchronizer knob (4, figure 4-36) located on the lower right side of the N-1 compass system panel provides a manual means to rapidly synchronize the heading



1. HEADING POINTER
2. LATITUDE CORRECTION KNOB
3. ANNUNCIATOR POINTER
4. SYNCHRONIZER KNOB
5. LATITUDE CORRECTION POINTER

■■■■■■■■■■■■■■■■■■■■ N-1 Compass Master Indicator

Figure 4-36.

pointer to the correct magnetic heading when the system is in magnetic slaved operation, or to set the heading pointer to a desired gyro heading when in directional gyro operation. The heading pointer (1, figure 4-36) and scale indicate the correct magnetic heading of the aircraft when the system is in slaved magnetic operation and gives the aircraft heading reference to the preselected gyro heading datum when the system is in directional gyro operation. An annunciator scale and pointer (3, figure 4-36) indicate the direction in which to rotate the heading pointer to synchronize it while in magnetic slaved operation. The heading is synchronized when the annunciator is on the center index mark. The N-1 compass system is supplied 205-volt three-phase a-c power through indicating-type fuses marked "N-1 Compass Sys." Single-phase 118-volt a-c power is supplied through a circuit breaker marked "N-1 Compass System Ampl" and 28-volt d-c power is supplied through a circuit breaker marked "N-1 Compass System DC." These fuses and circuit breakers are located on the aft BNS circuit breaker panel. A guarded to ON compass and true heading computer system cutoff switch (76, figure 4-40) is installed in the overhead panel at the radar navigator's station to facilitate removing power from N-1 and AN/AJA-1 components during ground operations. The heading signal for the heading pointer of the pilot's radio course indicator and the pilot's radio magnetic indicator passes through the compass synchro signal amplifier (ME-1)

which is supplied 118-volt single-phase a-c power through the "ME-1 Ampl" circuit breaker on the aft BNS circuit breaker panel whenever power is on the aircraft.

NOTE

- The N-1 compass system becomes inoperative immediately upon failure of d-c power or all a-c power and the autopilot will disengage. See "Autopilot," this section.
- When the autopilot is connected to the BNS, rapid changes in heading could result from varying the heading by means of the N-1 compass synchronizer knob. For this reason, the autopilot should be disconnected from the BNS before actuating the N-1 compass synchronizer knob.

AN/AJA-1 TRUE HEADING COMPUTER SYSTEM

For description of this equipment, refer to T.O. 1B-52G-1-6-1.

DOPPLER RADAR

For description of this equipment, refer to T.O. 1B-52G-1-6-1.

TRUE AIRSPEED COMPUTER

The aircraft is equipped with a true airspeed computer which uses static pressure, pitot pressure, and temperature to compute true airspeed and Mach information. True airspeed information is supplied to the gunnery system and to the true airspeed indicators on the radar navigator's front panel and the pilots' instrument panel (18, figure 1-15). Mach information is computed from pitot and static pressure and is supplied to the Mach indicator on the pilots' instrument panel. Power of 118-volt single-phase ac is supplied to the computer through the "TAS Ind" circuit breaker on the "Miscellaneous" portion of the left load central circuit breaker panel.

True Airspeed Indicator(s)

A true airspeed indicator located on the radar navigator's front panel (figure 4-35) and the pilots' instrument panel (18, figure 1-15) is a remote indicating unit. A main dial and subdial in the true airspeed indicator repeat airspeed information transmitted from the true airspeed computer. A cutout and reference mark on the main dial permit reading of the subdial. The power to operate this indicator is supplied by the true airspeed computer.

NAVIGATION INSTRUMENTS

Altimeters

A Type AAU-8/A altimeter (figure 4-35) is located on the navigator's instrument panel. Three concentrically mounted pointers indicate hundreds, thousands, and ten thousands of feet with reference to a single dial scale uniformly graduated from 1 to 10. The long pointer indicates 1,000 feet in one revolution, the intermediate pointer 10,000 feet in one revolution, and the small pointer 10,000 feet for each major graduation on the dial up to the maximum possible altitude reading of 80,000 feet. The small 10,000-foot pointer is part of a black disc next to the main dial with a 60° low altitude warning symbol segment cut out of the side opposite the pointer. At zero altitude indication (and below), the 60° low altitude warning symbol in the disc is filled with alternate diagonal fluorescent and black stripes. With increasing altitude, the diagonal stripes are progressively covered until, at 16,000 feet, no stripes are showing. This provides a conspicuous warning of approaching lower altitudes when descending from operational altitudes. The cutout filled with the diagonal stripes is also used as an indication of a correctly zeroed altimeter during the preflight check. The zero setting knob on the front of the instrument sets the pointers to read from any ground pressure altitude between 28.1 and 31.0 inches of mercury as displayed in the Kollsman window located between the "2" and "3" on the main dial. Positive stops are provided at or near the extremes of the

barometric scale so that the scale cannot be misset by excessive rotation.

NOTE

A Type MA-1 altimeter may be installed in the aircraft although it is not recommended. The MA-1 is identical and performs in the same manner as the AAU-8/A altimeter except that positive stops are not provided on the barometric scale to preclude missetting the scale by excessive rotation.

Outside Air Temperature Gage

The outside air temperature gage (8, figure 4-41) is located on the navigator's front panel. For further information, see "Instruments" in Section I.

Watch Holders

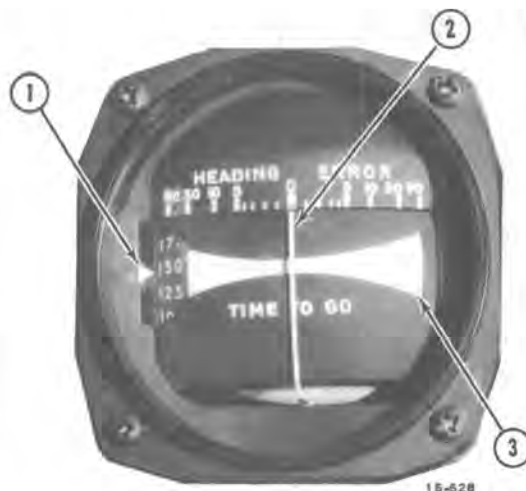
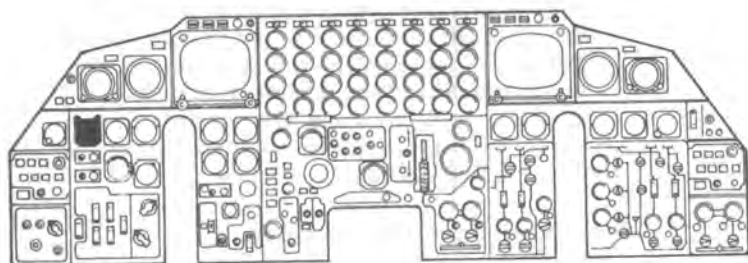
Two watch holders are provided at the navigators' station. One on the radar navigator's front panel and one on the navigator's front panel.

Flight Command Indicator (FCI)

The AN/ASQ-38(V) BNS flight command indicator (FCI) (figure 4-37) located on the pilot's side of the pilots' instrument panel provides time-to-go and heading error reference information for bomb runs and destination point homing. A bombing data indicator (BDI) located on the radar navigator's front panel displays the same information as the FCI. The same information displayed on the FCI is also displayed on the EVS monitors. For additional information, see "EVS Monitor" under "Electro-Optical Viewing System (EVS)," this section.

TIME-TO-GO INDICATOR. The time-to-go indicator (1, figure 4-37) displays the remaining time to go in seconds before the BNS provides a bomb release pulse. When the BNS is in search or track modes and the bomb control heading switch on the bomb control panel is in BOMB, the reading displayed is time to go to the crosshair geographical position (offset out) but adjusted for ballistics data settings. The time-to-go readings are displayed on a drum which rotates past the fixed index pointer.

HEADING ERROR INDICATOR. The heading error indicator (2, figure 4-37) displays the angular difference between the current aircraft heading and the heading necessary to make good the true course to the bomb release point (BNS in bomb mode), the heading to the crosshair position (offset out, BNS in search or track modes, and the bomb control heading switch in BOMB), or the heading to a preset destination (BNS in search or track modes and bomb control switch in NAV). The heading error sensitivity is increased at low values by use of logarithmic pointer displacement and error scale markings.



1. TIME-TO-GO INDICATOR
2. HEADING ERROR INDICATOR
3. WHITE BAND

Flight Command Indicator

Figure 4-37.

NORMAL OPERATION. The zero heading error mark represents the current value of true heading. The heading error pointer displacement thus indicates the direction and magnitude of turn required to bring aircraft and desired heading into coincidence. A white band (3, figure 4-37) rotates beneath the heading error pointer on the time-to-go drum. This moving band narrows as time to go approaches zero to assist in judging turn correction rates. The error pointer should be maintained within the white area at all times to avoid the necessity for excessive turn rates as time to go nears 0 second. With the automatic pilot turn control selector switch in BOMB position, BNS heading error is furnished the autopilot as well as the FCI. This automatic steering removes heading errors as they are generated, thus maintaining the FCI error pointer at 0°. The FCI display is readily adapted for precise control of complex time-track problems during airborne radar approach, penetrations, holding patterns, or special flight patterns where other reference aids are not usable. The BNS computers and radar sighting furnish continuously updated steering and timing information to a selected radar or geographical coordinate reference point.

AIRCRAFT WEAPONS CONTROL SYSTEM MONITORING SET (AN/AJM-14(V)) (MADREC)

The monitoring set (AN/AJM-14(V)) provides a means for inflight recording of malfunctions which

cannot be duplicated on the ground, detecting marginal circuits which do not present symptoms severe enough for operator or flight line personnel to discover, revealing the location of a malfunction thus decreasing maintenance manhours for trouble shooting, and for ground checkout for proper system operation. The monitoring set samples 200 voltages of the components of the AN/ASQ-38 bombing navigation and autopilot systems and records this information on a light-sensitive continuously moving paper tape. The 200 test voltages sampled include 50 test voltages of each BNS function (bomb, navigation, heading, and radar). Eleven of the BNS recording channels are assigned for monitoring of critical generator voltages, AN/APN-150 radar altimeter parameters, and autopilot signal voltages. Two modes of operation are available, manual and automatic. Manual mode provides manual selection of the BNS function to be monitored. Automatic mode provides continuous cycling of the monitoring system through all four functions of the BNS. Automatic mode provides a complete cycle every 12 minutes allowing a 3-minute monitoring period for each BNS function. The monitoring set is composed of three basic components: the signal isolator which adjusts the sample voltages to the proper level for recording, the signal data recorder containing the recording paper, and the monitoring set control panel marked "Recorder Control" (figure 4-39) located at the navigator's station. The system is supplied 118 volt single phase ac power through a circuit breaker marked "AN/AJM-14()" located on the "Miscellaneous" portion of the right load central circuit breaker panel. The

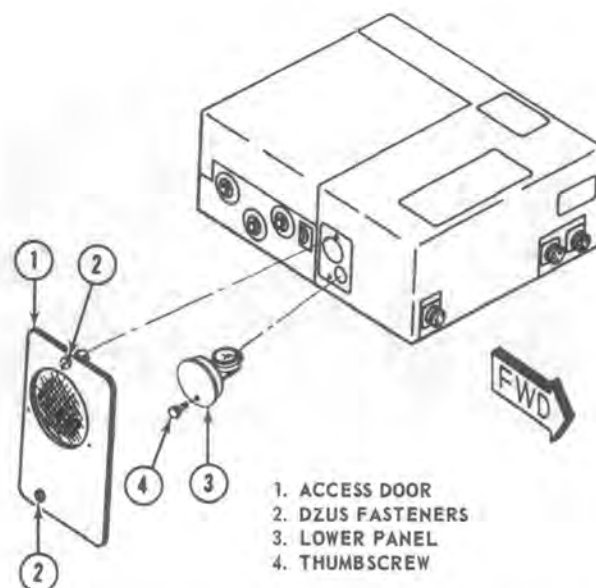


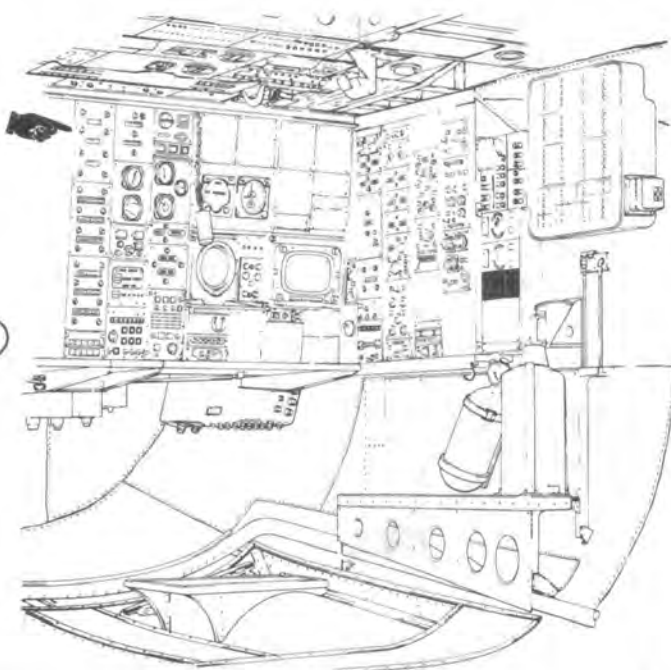
Figure 4-38.

NOTE

SIGNAL ISOLATOR

SIGNAL DATA RECORDER

monitored. The record is made on a 12-inch wide photosensitive recording paper, exposed at a speed of 0.22 inch per second. The paper is exposed by high intensity light reflected from the mirrors of 50 galvanometers, which are operated by the sampled signals. Timing lines occur every 10 seconds (2.2 inches on the paper) and extend the entire width of the paper. These lines, when used with galvanometer zeroing and clock image indications, enable the time of a trace indication to be determined to the nearest second. The galvanometers are "zeroed" (shorted out) every 60 seconds in coincidence with every 6th timing line for a period of 0.4 second. In addition, the galvanometers are zeroed for 1.5 seconds every 3 minutes when operating in automatic mode. Each roll of recording paper (475 feet thin-base paper) provides approximately 7 hours and 12 minutes of recorder operation. The 24-hour clock image is impressed on the recording paper automatically every 60 seconds. The record identification clock is accessible for resetting and winding prior to or during flight to insure an accurate time correlation of systems monitoring data. The lamp and clock access door (1, figure 4-38) may be removed by loosening the two captive dzus fasteners (2, figure 4-38). Two panels are located on the chassis beneath the access door. The lower panel (3, figure 4-38), to which the identification clock is attached, is secured to the recorder chassis by a knurled thumbscrew (4, figure 4-38).



Monitoring Set Control Panel

Figure 4-39.

MONITORING SET CONTROL PANEL

This unit contains all controls and indicators necessary for operation of the monitoring set.

MONITORING SET CONTROLS

System Select Switch (MADREC)

A system select switch (2, figure 4-39) located on the monitoring set control panel has OFF--STDBY--AUTO--BOMB--NAV--HDG--RADAR--AGM-28 positions. This switch is identified as MADREC in the checklist. STDBY position energizes the monitoring set warmup circuits. AUTO position energizes the timing and recording circuits which provide automatic mode of operation. BOMB, NAV, HDG, or RADAR position will select their respective BNS function for manual mode of operation. AGM-28 position is not used. During the automatic mode of operation, the monitoring set cycles through the BOMB, NAV, HDG, and RADAR functions with each function being monitored for 3 minutes during each cycle. With the system select switch positioned to AUTO and BOMB mode of the BNS selected, the monitoring set will cycle to bomb function and remain in this function until the BNS changes modes.

Selection of BOMB position also provides for recording the field excitation voltage from the regulator for each of the four generators. RADAR selection activates two channels for recording AN/APN-150 radar altimeter absolute altitude signal level and the failure/low level warning signals. A single channel in HDG mode records operation of the autopilot aerial refueling and low level relays.

Code Button

A code button (5, figure 4-39) located on the monitoring set control panel is provided so that the recording tape may be coded at any time that a special event is observed. Depressing the code button prints a picture of the recorder clock on the tape and zeroes the galvanometer (removes the signal from the tape for a short period of time).

Press-to-Test Button

A press-to-test button (4, figure 4-39) located on the monitoring set control panel provides a means of testing the recorder failure and ready indicator lamps. Pressing the press-to-test button, when the system select switch is in STDBY, should cause the recorder failure and ready indicator lamps to illuminate.

MONITORING SET INDICATORS

Ready Indicator

A ready indicator (3, figure 4-39) is located on the monitoring set control panel. The word "Ready" will illuminate when the system has completed its warmup period and is ready for operation.

Recorder Failure Indicator

A recorder failure indicator (1, figure 4-39) is located on the monitoring set control panel. The words "Recorder Failure" will illuminate whenever the tape magazine runs out of recording tape, the system blower motor is operating below normal speed, the automatic timing circuit malfunctions, or when the recording light goes off.

Index Indicators

Index indicators are provided with each position of the system select switch (2, figure 4-39). The STDBY, AUTO, BOMB, NAV, HDG, or RADAR index indicator will illuminate when the monitoring set is operating in that particular function.

NORMAL OPERATION OF MONITORING SET

NOTE

The MADREC should be turned off when not in use for an extended period of time.

1. Position system select switch to OFF.
2. Position system select switch to STDBY.
3. Test the ready and recorder failure indicator lamps by pressing the press-to-test button.

NOTE

- The recorder failure indicator will normally illuminate momentarily, immediately after applying power. It should extinguish when the blower is up to speed.
- A 90-second warmup period is required before selecting an operating mode. The ready indicator should illuminate at completion of warmup period.

4. Position system select switch to the desired operating mode or function.

CAUTION

If the recorder failure indicator illuminates (other than momentarily) during system operation, the system select switch should be positioned to OFF.

NOTE

- If the recorder failure indicator illumination is caused by a timing circuit malfunction,

operation of the system may be continued using monitoring set emergency operation procedures.

- Should an event of special importance occur during operation, pressing the code button will cause the recorder clock image to be impressed on the tape, thereby providing later identification of the event.
- During automatic mode operation (AUTO index indicator illuminated continuously), the index indicators should illuminate in the following sequence: BOMB, NAV, HDG, and RADAR with each indicator remaining illuminated for 3 minutes.

5. The system is turned off by placing the system select switch to OFF. All indicator lamps should extinguish.

EMERGENCY OPERATION OF MONITORING SET

During automatic mode, if the automatic system switching circuits fail (indicated by a BNS function index indicator remaining illuminated longer than 3 minutes and/or the recorder failure indicator illumination), the system should be operated in manual mode or turned off for 1 minute, then recycled to AUTO. If the automatic mode is still not functioning properly, all operation should be limited to manual mode until the malfunction is found and corrected.

WEAPONS CONTROL SYSTEM — OFFENSIVE (AN/ASQ-38 (V))

The aircraft is equipped with a Type AN/ASQ-38(V) Bombing Navigational Integrated System (BNIS). On this aircraft, the system is composed of the following auxiliary systems:

- AN/ASB-16 Bombing Navigation System
- BNS Radar System
- AN/APN-89A Doppler Radar System
- MD-1 Automatic Astrocompass System
- AN/AJA-1 True Heading Computer System
- Radar Recording Camera

The BNIS is designed to be highly automatic in operation by interconnection of the various auxiliary systems. The doppler radar system feeds ground speed and drift data to the bombing navigation system. The bombing navigation system in turn supplies data to the other components of the BNIS. Latitude and longitude data is supplied to the true heading computer system and to the automatic astrocompass system. Latitude data is supplied to the N-1 compass and roll-pitch stabilization is supplied to the doppler radar system. ECO signals are supplied to the automatic astrocompass system and triggering impulses are supplied to the radar recording camera. The bombing navigation system can be operated independently. For all except the terrain avoidance system which is a part of the BNS radar system, refer to T.O. 1B-52G-1-6-1.

1. BNS POWER PANEL
2. EVS OPTICAL LIGHT FILTER STOWAGE
3. EVS ENVIRONMENTAL CONTROL PANEL
4. IFC POWER SELECT PANEL
5. TERRAIN RADAR CONTROL PANEL
6. AFT BNS CIRCUIT BREAKER PANEL
7. BOMB DOOR CONTROL VALVE CHECK PANEL
8. BNS TEMPERATURE SENSING INDICATOR
9. TOPOCOMP (TOPOGRAPHICAL COMPARATOR)
10. BNS OVERHEAT POWER SUPPLY AND RADAR LOW PRESSURE LIGHTS
11. BNS AIRFLOW LOW LIGHTS
12. EXTERNAL MISSILE RELEASE SWITCHES
13. BDI (BOMBING DATA INDICATOR)
14. AGM-69A SELECTIVE JETTISON PANEL
15. RELEASE CIRCUITS DISCONNECT
16. ALTITUDE PANEL
17. REAR SPECIAL WEAPON MANUAL RELEASE HANDLE
18. LEFT FORWARD BNS CIRCUIT BREAKER PANEL
19. LATITUDE PANEL
20. FORWARD SPECIAL WEAPON MANUAL RELEASE HANDLE
21. RIGHT FORWARD BNS CIRCUIT BREAKER PANEL
22. BNS AND AGM-69A LIGHT CONTROL PANELS
23. EVS MONITOR
24. BNS DATA PRESET PANEL
25. CROSSHAIR CONTROL
26. EVS VIDEO SELECT PANEL
27. STV CONTROL PANEL
28. BNS HAND CONTROL SENSING SWITCH
29. APN-150/AGM-69A TIE IN CONTROL PANEL
30. LOW ALTITUDE CALIBRATOR CONTROL PANEL
31. WATCH HOLDER
32. BNS DESICCATOR
33. STC PANEL
34. INTERPHONE MIKE FOOT SWITCH
35. TARGET SCALE PANEL
36. RANGE SELECTOR PANEL
37. PRESENTATION GAIN PANEL
38. BOMB CONTROL PANEL
39. RADAR ANTENNA TILT PANEL
40. D-2 BOMB RELEASE SWITCH

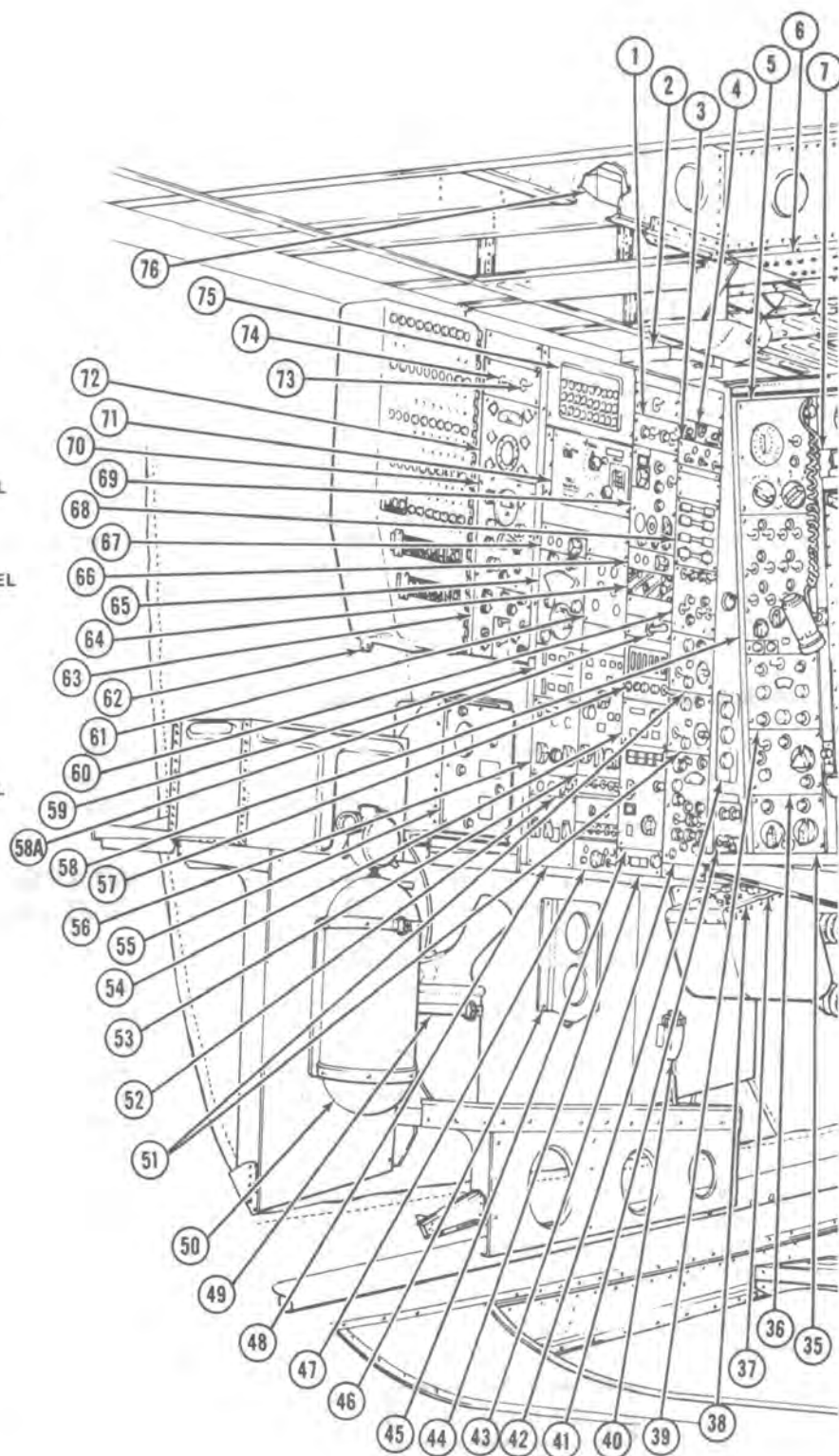
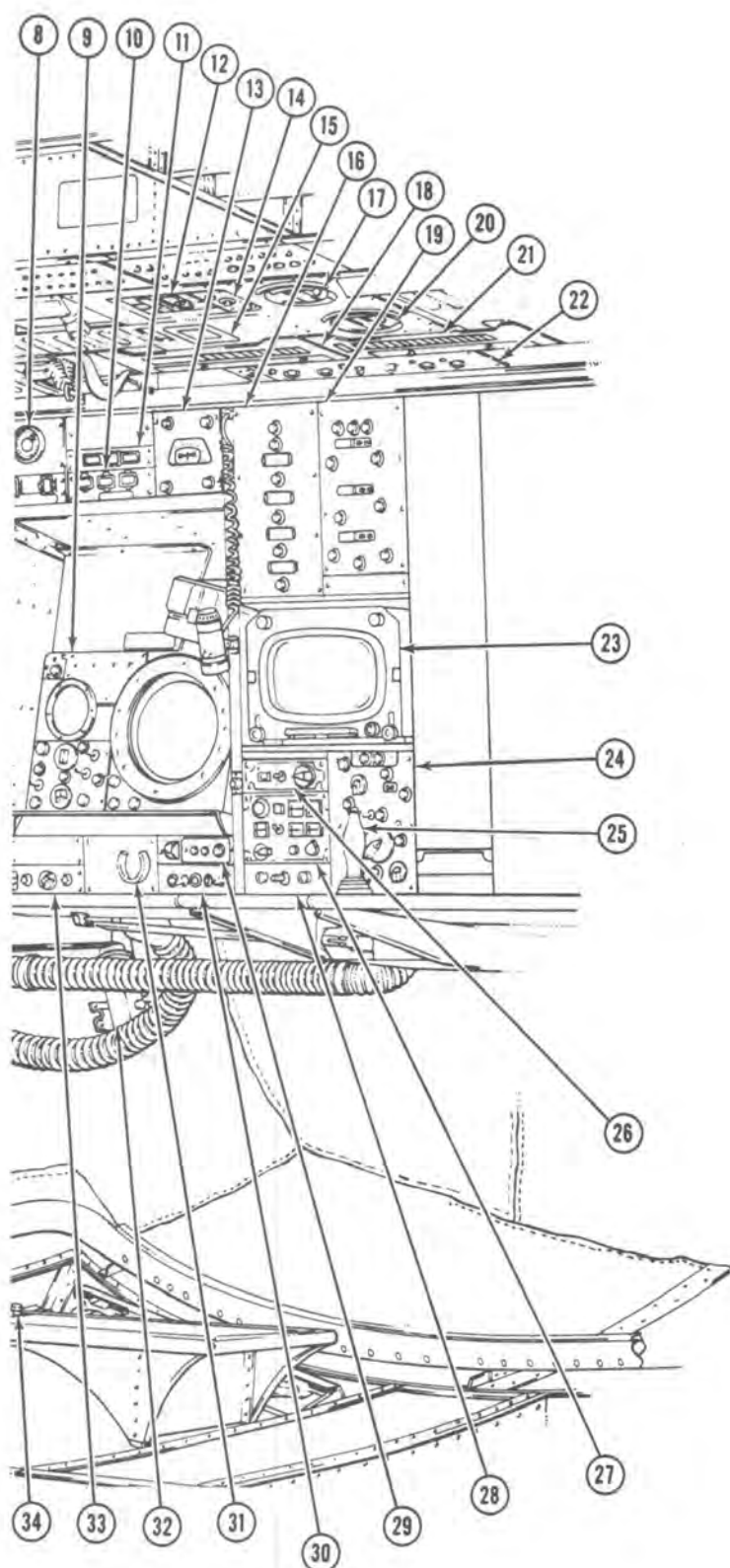


Figure 4-40 (Sheet 1 of 2).



41. TIME DELAY BYPASS AND BOMB TONE SCORING PANEL
42. AIR OUTLET KNOBS AND AUXILIARY HEAT KNOB
43. RADAR PRIMARY PANEL
44. AGM-69A OTL STATUS AND CONTROL PANEL
45. AGM-69A WEAPON STATUS AND CONTROL PANEL
46. BOMB INDICATOR CARDS HOLDER
47. RADAR NAVIGATOR'S INTERPHONE CONTROL PANEL
48. ADM-20 EXERCISE CONTROL PANEL
49. STATION URINAL
50. PORTABLE OXYGEN BOTTLE
51. DCU/9A CONTROL MONITOR UNITS/SWK BOXES
52. ADM-20 TRAINING PANEL
53. ADM-20 LAUNCH CONTROL PANEL
54. OXYGEN REGULATOR (RADAR NAVIGATOR'S)
55. AZIMUTH AND ELEVATION PANEL
56. ADM-20 PROGRAM PANEL
57. CODED SWITCH SET CONTROL PANEL
58. EMERGENCY CONTROLS PANEL
- 58A. ALQ-117 TO BNS BLANKING SWITCH
59. ADM-20 PROGRAM TURN PANEL
60. SPECIAL WEAPONS CONTROL PANEL
61. SPECIAL WEAPONS AND ASM LOCK INDICATOR PANEL
62. AUXILIARY BNS CIRCUIT BREAKER PANEL
63. PRESENTATION ADJUST PANEL
64. JETTISON CONTROL PANEL
65. RADAR TEST PANEL
66. BOMB RELEASE MODE CONTROL PANEL
67. TERRAIN COMPUTER POWER PANEL
68. SPECIAL WEAPONS INDICATOR LIGHTS PANEL
69. MASTER BOMB CONTROL PANEL
70. TERRAIN TEST PANEL
71. BRIC (BOMB RELEASE INTERVAL CONTROL UNIT)
72. DISPLAY PANEL (GROUND RANGE AND AZIMUTH)
73. GROUND BLOWERS SWITCH
74. BNS EXTERNAL POWER SWITCH
75. BOMB INDICATOR LIGHTS
76. COMPASS AND TRUE HEADING COMPUTER CUTOFF SWITCH

■■■■■■■■■■ Radar Navigator's Station (Typical)

Figure 4-40 (Sheet 2 of 2).

Figure 4-40A (Deleted)

1. LEFT FORWARD BNS CIRCUIT BREAKER PANEL
2. BNS LIGHT CONTROL PANEL
3. DRIFT ANGLE INDICATOR
4. GROUND SPEED INDICATOR
5. AIRSPEED PANEL
6. ALTIMETER
7. TRUE AIRSPEED INDICATOR
8. OUTSIDE AIR TEMPERATURE GAGE
9. RELEASE CIRCUITS DISCONNECT
10. BOMBING MODE INDICATOR PANEL
11. EMERGENCY ALARM LIGHT AND BNS STEERING PANEL
12. RIGHT FORWARD BNS CIRCUIT BREAKER PANEL
13. AJA-1 TRUE HEADING COMPUTER SYSTEM PANEL
14. EXTERNAL MISSILE RELEASE SWITCHES AND AGM-69A SELECTIVE JETTISON PANEL
15. FORWARD SPECIAL WEAPON MANUAL RELEASE HANDLE
16. (DELETED)
17. SPARE LAMP CONTAINER
18. REAR SPECIAL WEAPON MANUAL RELEASE HANDLE
19. (DELETED)
20. (DELETED)
21. N-1 COMPASS MASTER INDICATOR
22. AFT BNS CIRCUIT BREAKER PANEL
23. (DELETED)
24. (DELETED)
25. (DELETED)
26. (DELETED)
27. (DELETED)
28. (DELETED)
29. (DELETED)
30. APN-69 PRESSURIZATION PANEL
31. ASTROCOMPASS MANUAL PRESET POSITION DISPLAY PANEL
32. ASTROCOMPASS LINE OF POSITION DISPLAY PANEL
33. EVS OPTICAL LIGHT FILTER STOWAGE
34. DOPPLER POWER AND DRIFT CONTROL PANEL
35. ASTROCOMPASS MANUAL SET PANEL
36. ASTROCOMPASS START DATA 3 PANEL
37. BALLISTICS DERIVATIVES PANEL
38. VERTICAL CAMERA CONTROL PANEL
39. RADAR RECORDING CAMERA CONTROL PANEL
40. DOPPLER INTERCONNECTING BOX (FUSE PANEL)
41. EVS CIRCUIT BREAKER PANEL
42. ASTROCOMPASS STAR DATA 2 PANEL
43. ASTROCOMPASS STAR DATA 1 PANEL
44. FIRST AID KIT
45. RENDEZVOUS RADAR CONTROL PANEL
46. RADAR PRESSURE CONTROL PANEL
47. ASTROCOMPASS INDICATOR DISPLAY PANEL
48. MONITORING SET CONTROL PANEL
49. VERTICAL CAMERA INTERVALOMETER
50. HOT CUP
51. (DELETED)
52. (DELETED)
53. (DELETED)
54. ASTROCOMPASS MASTER CONTROL PANEL
55. SPARE DRINKING WATER CONTAINER
56. NAVIGATOR'S INTERPHONE CONTROL PANEL
57. TIME-OF-FALL PANEL
58. PORTABLE OXYGEN BOTTLE
59. ANTENNA CONTROL PANEL
60. TRAIL PANEL
61. OXYGEN REGULATOR (NAVIGATOR'S)
62. AUTO-NAV RADAR PANEL
63. TABLE LIGHT AND EVS INDICATOR LIGHT CONTROL PANEL
64. (DELETED)
65. (DELETED)

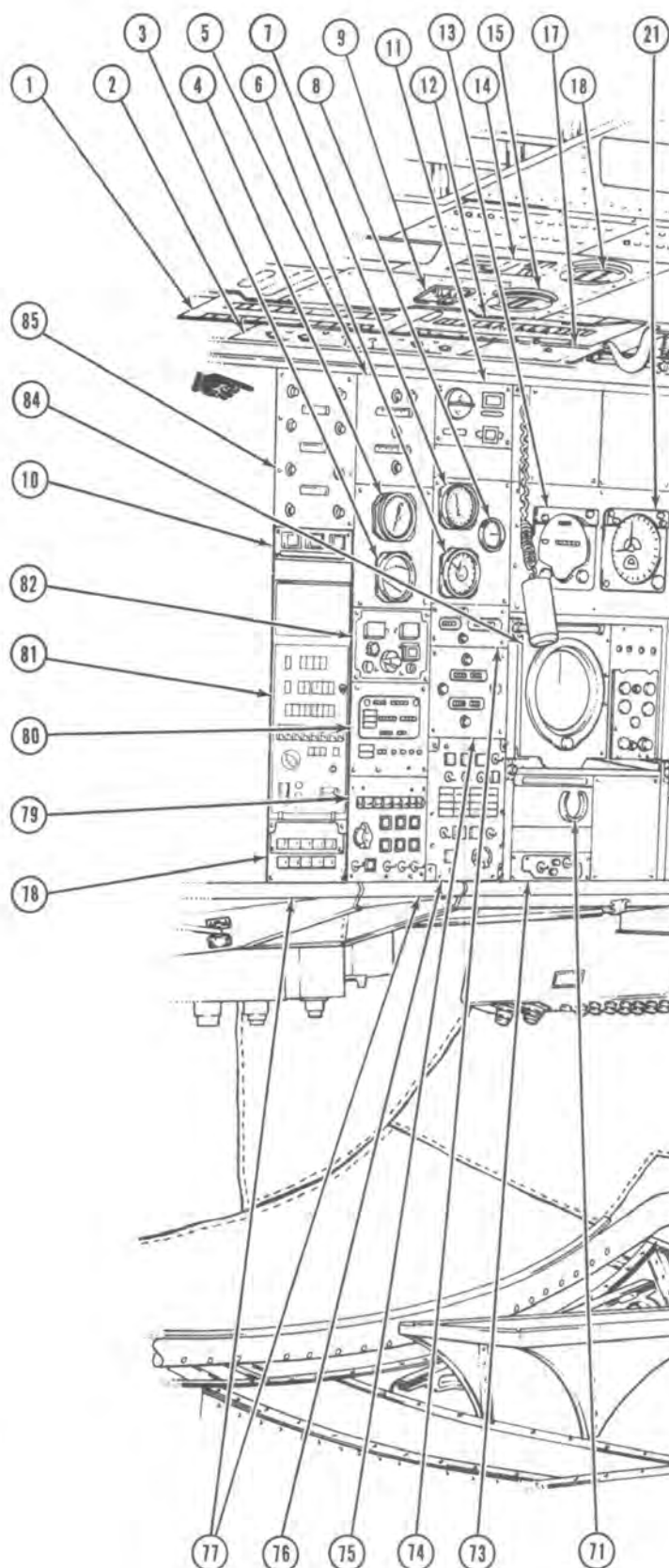
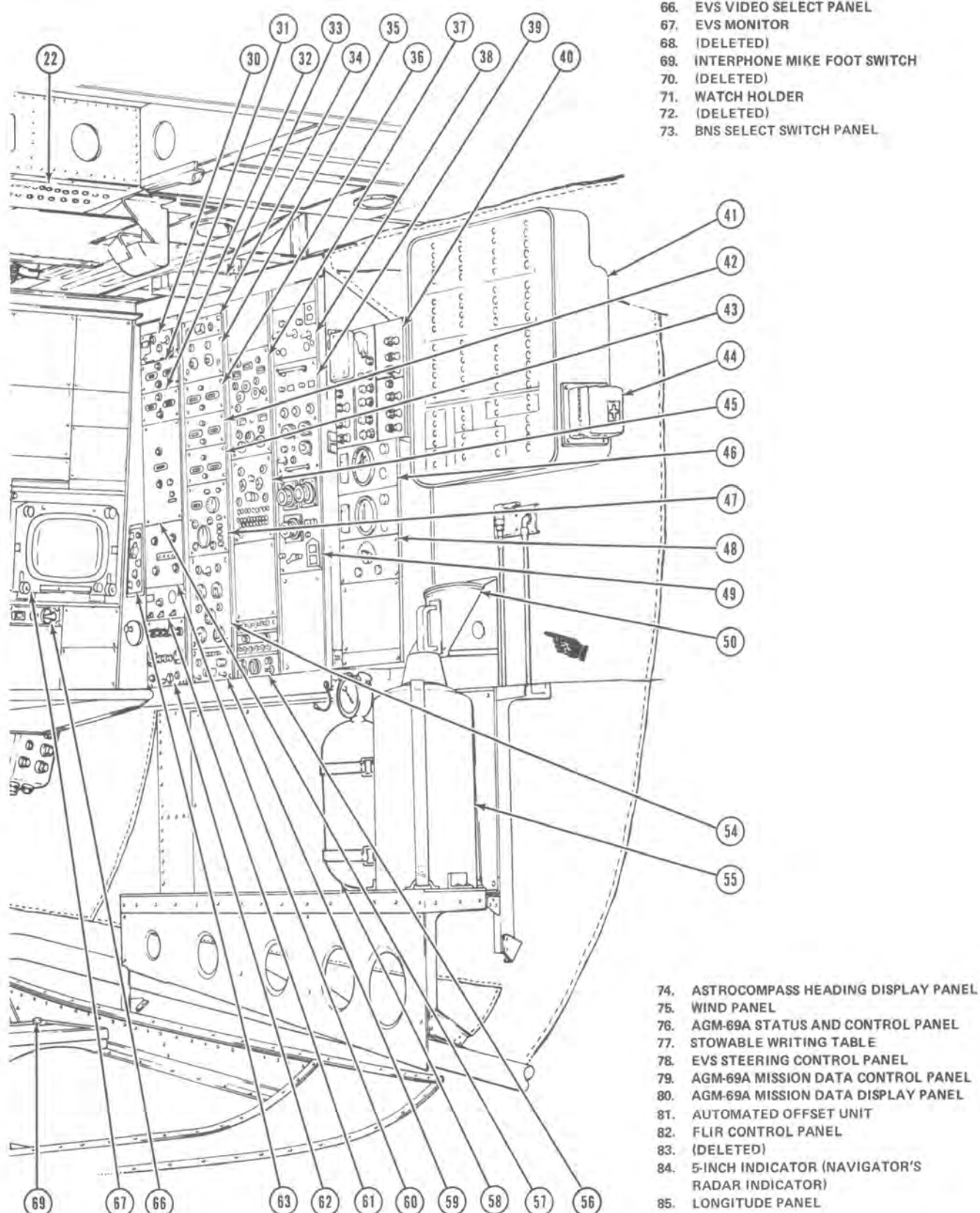


Figure 4-41 (Sheet 1 of 2).

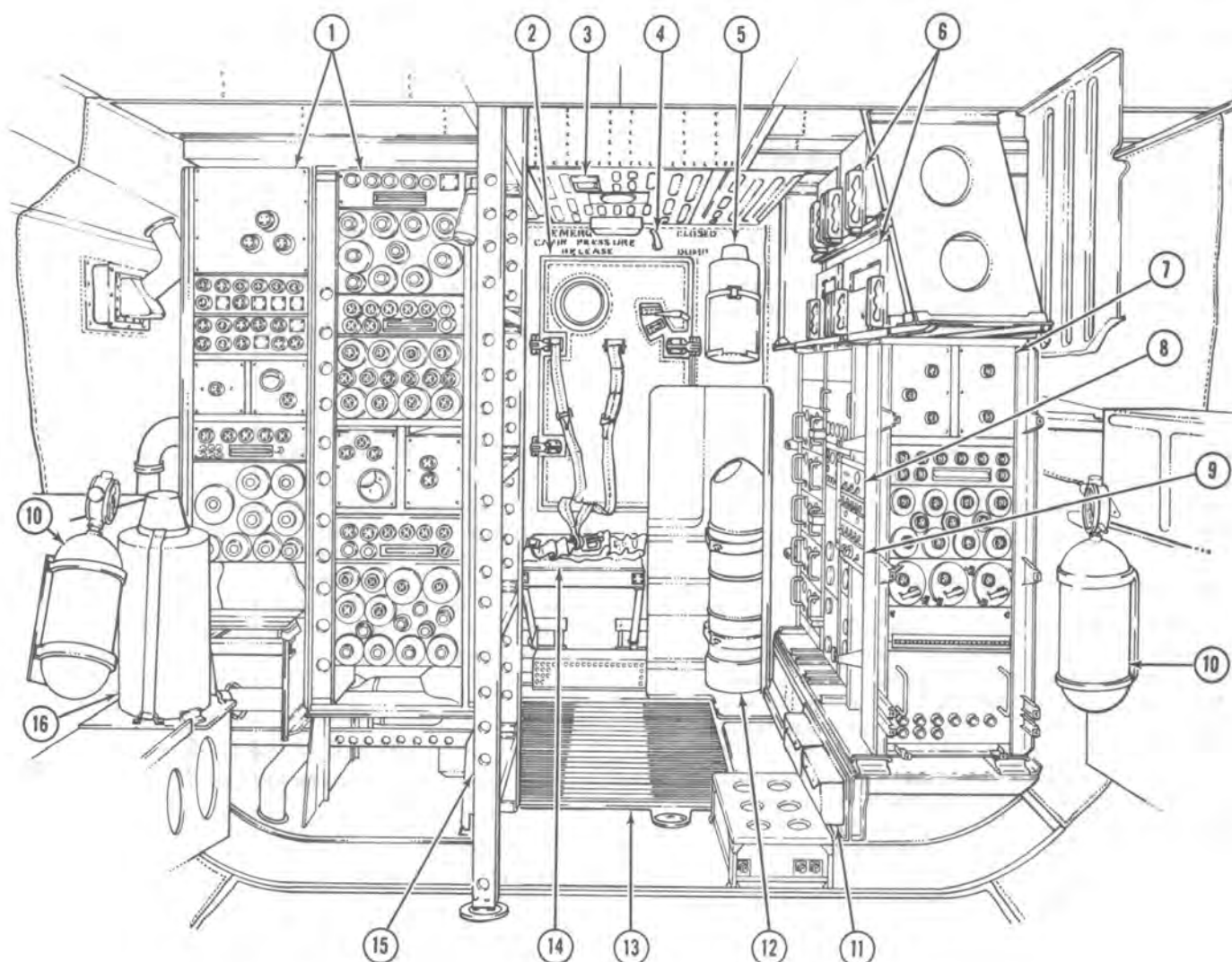


Navigator's Station (Typical)

Figure 4-41 (Sheet 2 of 2).

All data on pages 4-98 thru 4-144, including figure 4-41A (Deleted)

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- | | |
|--|--|
| 1. RIGHT SIDE REMOTE BNS MODULES | 9. INSTRUCTOR NAVIGATOR'S INTERPHONE CONTROL PANEL |
| 2. PRESSURE BULKHEAD DOOR | 10. PORTABLE OXYGEN BOTTLE |
| 3. SERVICE DOMELIGHT | 11. LANDING GEAR GROUND LOCK STOWAGE |
| 4. EMERGENCY CABIN PRESSURE RELEASE HANDLE | 12. CENTRAL URINAL |
| 5. DRINKING WATER CONTAINER | 13. LOWER DECK FOLDING HATCH |
| 6. EVS COMPONENTS | 14. INSTRUCTOR NAVIGATOR'S TAKEOFF AND LANDING STATION |
| 7. LEFT SIDE BNS POWER SUPPLY MODULES | 15. LADDER |
| 8. OXYGEN REGULATOR (INSTRUCTOR NAVIGATOR'S) | 16. SPARE DRINKING WATER CONTAINER |

■■■■■■ Navigators' Compartment-Aft (Typical)

Figure 4-42.

TERRAIN AVOIDANCE SYSTEM

DESCRIPTION

The terrain avoidance (TA) system comprises a special mode of the BNS radar, an electronic terrain computer, radar scan converter, video distribution unit, and the pilot's and copilot's terrain display indicators (EVS monitors) and their associated electronic components. The TA system provides a radar profile display of the terrain along the flight path of the aircraft. By interpreting the display and maneuvering the aircraft accordingly, the pilot is able to fly the aircraft at low absolute altitudes (aircraft to terrain separation distance).

Power Source

Power is supplied to the TA system through circuit breakers located on the left forward BNS circuit breaker panel, right forward BNS circuit breaker panel, EVS circuit breaker panel, and the auxiliary BNS circuit breaker panel.

Pilots' Controls and Indicators

TA CONTRAST KNOB. This knob (1, figure 4-43) is marked "Indicator Intensity" and is located on the pilot's and copilot's terrain display control panel. This knob is used to vary the contrast between the TA displays and STV or FLIR video and is enabled when the terrain display mode selector switch is placed to any position other than OFF. Rotating the knob in the clockwise direction will increase the intensity of the TA display and decrease the intensity of the FLIR or STV video. Conversely, counter-clockwise rotation will increase the intensity of the STV or FLIR video and decrease the intensity of the TA display.

TERRAIN DISPLAY MODE SELECTOR SWITCH. A terrain display mode selector switch (2, figure 4-43) located on the pilot's and copilot's terrain display control panel has OFF--PROFILE CAL--PROFILE 3--PROFILE 6--PROFILE 10--PLAN positions. The TA system is placed in operation when the selector switch is moved out of OFF position. PROFILE CAL position selects profile manual minimum range mode which provides profile 10 display with a fixed minimum range of approximately 5000 feet. PROFILE 3 position provides a silhouette outline display on the pilots' EVS monitors of the highest terrain between minimum range and 3 nautical miles. PROFILE 6 position provides a silhouette outline display on the pilots' EVS monitors of the highest terrain between minimum range and 6 nautical miles. PROFILE 10 position provides a silhouette outline display on the pilots' EVS monitors of the highest terrain between minimum range and 10 nautical miles. PLAN position is tied to profile 10 select circuits, therefore placing the switch to PLAN will select profile 10 mode.

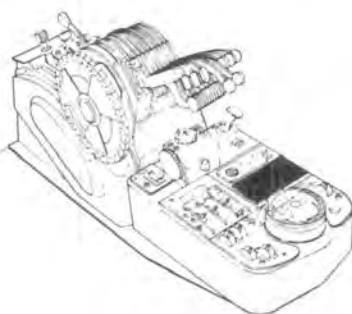
STABILIZATION REFERENCE SELECTOR SWITCH. A stabilization reference selector switch (4, figure 4-43) located on the pilot's and copilot's terrain display control panel has FVR--HOR--FRL positions. The clearance plane is oriented to the selected stabilization reference. In FVR (flight vector reference) position, the clearance plane is maintained parallel to the flight path of the aircraft. In HOR (horizontal) position, the clearance plane is maintained horizontal within the pitch and roll limits of the vertical gyro. In FRL (fuselage reference line) position, the clearance plane is maintained at a preset angle which is nearly parallel to the longitudinal axis of the aircraft.

CLEARANCE PLANE CONTROL SWITCH. A clearance plane control switch (5, figure 4-43) is located on the pilot's and copilot's terrain display control panel and provides a means of varying the clearance plane. An open-type guard discourages inadvertent actuation of this switch. The switch has RAISE--OFF--LOWER positions, is spring-loaded to OFF position, and is independent of the radar navigator's clearance plane. Holding the switch to LOWER position lowers the clearance plane with respect to the aircraft and will be reflected on the clearance plane indicator. Holding the switch to RAISE position raises the clearance plane and will be reflected on the clearance plane indicator. The clearance plane can be set from 0 to 3000 feet below the aircraft.

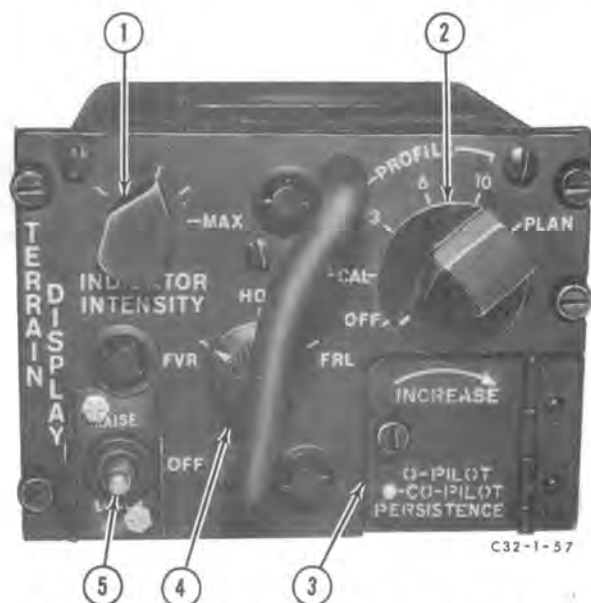
WARNING

Under no circumstances will TA flight be conducted with clearance plane settings between 0 and 200 feet.

TERRAIN DISPLAY (EVS MONITORS). The pilot and copilot each has an EVS monitor (figure 4-67), which is used to display TA video. A "profile display" of the approaching terrain is presented by means of the TA profile terrain trace (14, figure 4-67). The terrain trace is a continuous line (consisting of small horizontal elements) giving a profile video presentation of radar computed terrain azimuth-versus elevation data. The terrain trace displays the profile of the highest terrain in a selected 3-, 6-, or 10-mile range in front of the aircraft, within a $\pm 45^\circ$ sector relative to ground track. The TA horizontal reference line (15, figure 4-67) is an electronically generated cursor which represents the clearance plane and is used with the terrain trace to establish aircraft and terrain separation. The horizontal reference line (HRL) defines a ground track corridor ahead of the aircraft in which terrain above the clearance plane can be hazardous. The extremities of the HRL define the limits of the corridor. When flying terrain avoidance, maintain the terrain trace at or below the entire HRL including the gap. The gap in the HRL allows unrestricted forward visibility when used with the EVS sensors. The verticals at the inner ends of HRL facilitate recognition of the



1. TA CONTRAST CONTROL
2. TERRAIN DISPLAY MODE SELECTOR SWITCH
3. TERRAIN DISPLAY PERSISTENCE CONTROL (INOPERATIVE) ACCESS FLAP
4. STABILIZATION REFERENCE SELECTOR SWITCH
5. CLEARANCE PLANE CONTROL SWITCH



C32-1-57

Pilot's and Copilot's Terrain Display Control Panel

Figure 4-43.

HRL when used with the EVS sensors. Fill-in of the gap and loss of the verticals is an indication of malfunction in the radar scan converter and the terrain avoidance system.

WARNING

- If the horizontal reference line becomes an unbroken line (gap fills in and verticals disappear) or is not present, the TA system should be used with caution and only when visual contact with the ground can be maintained.
- The vertical dimension of the terrain trace is based on an angular computation and consequently the EVS monitor, for TA purposes, contains no vertical scaling for height.

In addition to the terrain trace and horizontal reference line, the EVS monitor also displays other flight aid symbology which is described in "EVS Monitor" under "Electro-Optical Viewing System (EVS)," this section.

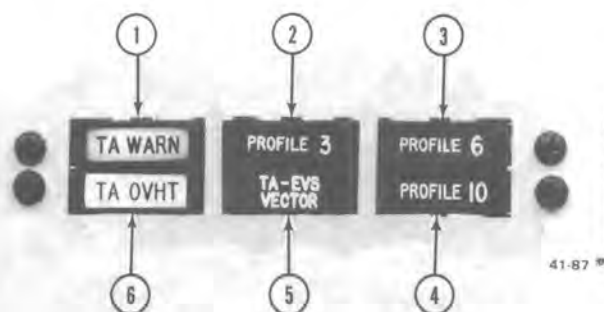
TA WARNING LIGHT. A red TA warning light (1, figure 4-44) located above each pilot's and copilot's monitor provides a means of indicating a failure of some but not all critical circuits in the TA system.

The light is a word warning light showing "TA WARN" in black letters on a red background when on. The brightness of the TA warning light is controlled by the warning light dimming control switch on the pilot's light panel. The light may not be visible under some conditions with the warning light dimming control switch in the DIM position. This light is used in conjunction with the TA test button to check failure warning circuits.

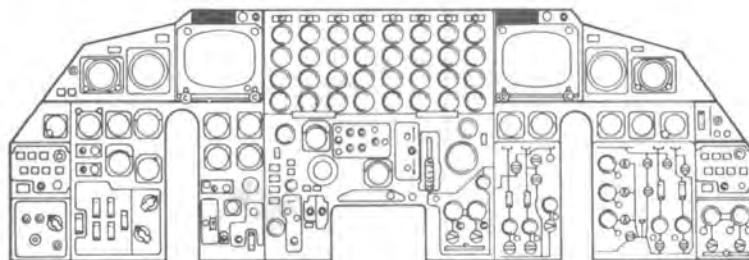
WARNING

If this light illuminates except for bank angles greater than approximately 15°, the TA system should be used with caution and only when visual contact with the ground can be maintained.

TA TEST BUTTON. A TA test button located above each pilot's and copilot's EVS monitor (14, figure 1-15) provides a means of testing the TA warning light, the TA failure warning circuits, the radar scan converter, the range gate indicator lights, and the TA overheat light. Pressing the button with the terrain display mode selector switch in an active mode, will cause the TA warning, TA overheat, TA-EVS vector, and range gate indicator lights to illuminate, the terrain trace to disappear, and the TA test pattern to appear (figure 4-53).



41-87



1. TA WARNING LIGHT
2. PROFILE 3 RANGE GATE INDICATOR LIGHT
3. PROFILE 6 RANGE GATE INDICATOR LIGHT
4. PROFILE 10 RANGE GATE INDICATOR LIGHT
5. TA - EVS VECTOR INDICATOR LIGHT
6. TA OVERHEAT LIGHT

TA Operating Condition Indicators

Figure 4-44.

TA OVERHEAT LIGHT. A red TA overheat light (6, figure 4-44) is located above each pilot's and co-pilot's EVS monitor and provides a means of monitoring overheat conditions in the radar scan converter. The light is a word warning light showing "TA OVHT" in black letters on a red background when on. When the light is on, the TA system should be shut down.

RANGE GATE INDICATOR LIGHTS. Three green range gate indicator lights (2, 3, and 4, figure 4-44) are located above each pilot's and copilot's EVS monitor. The lights are word warning lights and show "PROFILE 3," "PROFILE 6" and "PROFILE 10" in green letters on a black background when on. The light on indicates the TA range selected.

TA-EVS VECTOR INDICATOR LIGHT. A TA-EVS vector indicator light (5, figure 4-44) is located above each pilot's and copilot's monitor. The light is a word warning light showing "TA-EVS VECTOR" in amber letters on a black background when on. The lights will come on when the angle of attack system is in a limit if FVR is selected in the TA system or vector mode is selected in the EVS. This indicates that FRL stabilization of the TA system and/or fixed stabilization of the EVS should be selected. The lights are supplied left TR power by a circuit breaker marked "Vector Warn Light" on the pilot's circuit breaker panel.

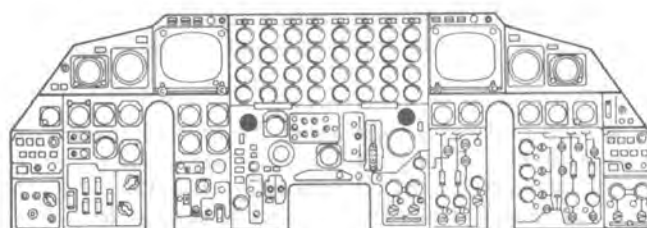
CLEARANCE PLANE POSITION INDICATORS. The pilot and copilot each has a clearance plane position indicator (figure 4-45) located on the forward instrument panel. The indicators show the position of the clearance plane in feet below the aircraft.

NOTE

The clearance plane indicator dial is graduated from 1000 feet above the aircraft to 3000 feet below the aircraft; however, the clearance plane cannot be set above the aircraft as the setting limits are 0 to 3000 feet below the aircraft.



11-1-147



Pilot's and Copilot's Clearance Plane Position Indicators

Figure 4-45.

Navigators' Controls and Indicators

For information on the navigators' equipment, refer to T.O. 1B-52G-1-6-1.

THEORY OF OPERATION

The TA system utilizing the BNS radar operates on the monopulse radar concept. The system provides range, azimuth, and height data on each target from a single transmitted pulse, hence the term "monopulse," using a terrain computer, two radar receivers, a conventional transmitter, and a dual antenna. The transmitter is connected to the antenna and generates a short high-energy pulse which illuminates the terrain ahead of the aircraft. The antenna is then disconnected from the transmitter and connected to the receivers. This switching cycle is repeated for each transmitter pulse. A delay prevents detection of radar echoes from objects which are so close to the aircraft (area A, figure 4-46) that their echo is received before switching is complete. This switching delay plus other characteristics results in a short range blind zone which affects the terrain displays. In a profile mode (pilots only), obstacles within approximately 3/4-mile range will not be displayed. In LO ALT TA mode (navigators only), the obstacle may be visible until slightly less than 1-mile range. The dual antenna contains the usual reflector dish and is equipped with two pairs of feed horns (radiators), one located directly above the other (figure 4-47). For simplicity, each horizontal pair can be considered as a single feed horn. Returns from high obstacles tend to focus more energy into the lower feed horn while returns from low obstacles tend to focus more energy into the upper feed horn. An obstacle located midway will reflect equal energy into each horn and is said to be located on boresight; that is, on the principal axis of the antenna electric field. The antenna design enables accurate height computation of obstacles within the 8° primary area shown in figure 4-46. Obstacles which protrude into the primary area are computed accurately and displayed until they are within area A (the short range blind zone) or are within the minimum range limits. Returns from obstacles within area B of figure 4-46 are removed electronically to provide profile mode capability (for the pilots only) and to prevent a blooming vertex while operating in LO ALT TA mode (navigators only); consequently, the display will present a premature disappearance (dropout) of the terrain obstacle if the obstacle is within area B of figure 4-46 regardless of clearance plane setting. When range and azimuth, obtained by conventional means, are added to height information, a good description of the obstacle position is available to the pilot. The computation cycle is repeated continu-

ously with the net output of the terrain computer being a chain of longitudinal terrain profiles spaced about 1/7° in azimuth. Since the width of each profile is about 1°, complete overlapping coverage of the terrain is provided within the line-of-sight limitation. Terrain obstacles are displayed in azimuth with respect to aircraft ground track using a drift angle correction signal provided by the doppler radar. The terrain computer generates a clearance plane (figure 4-48) which can be thought of as a surface positioned at the desired clearance altitude below the aircraft. All terrain obstacles are displayed relative to the clearance plane. Noting the position of an obstacle on the flight path, the pilot maneuvers the aircraft in pitch to maintain the clearance plane coincident with the top of the obstacle. He will then pass over the object at the desired clearance altitude. The clearance plane remains parallel with the reference plane which is oriented with respect to the horizon, aircraft fuselage, or flight path, depending on the stabilization mode chosen.

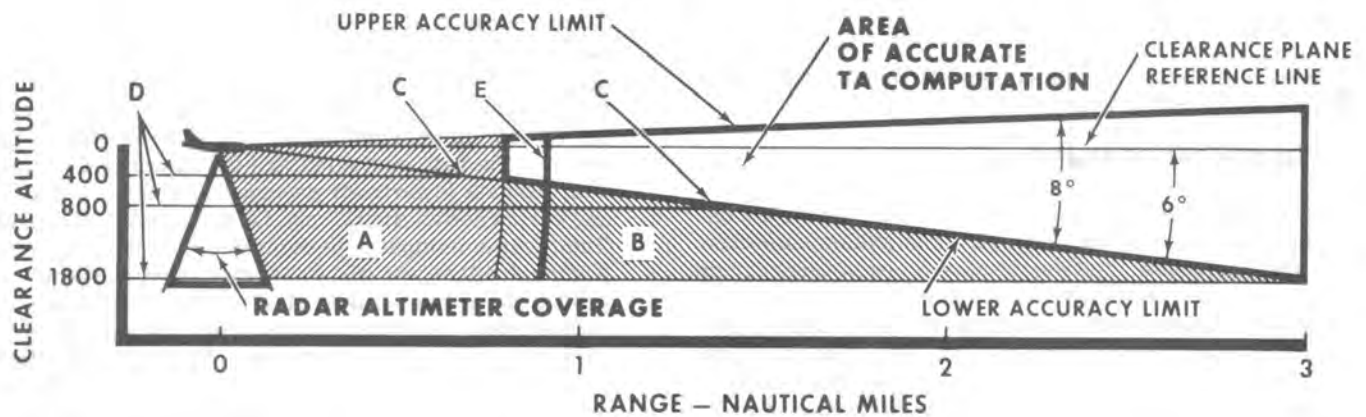
Stabilization Modes

Three stabilization modes are provided; fuselage reference line (FRL), flight vector reference (FVR), and horizontal (HOR). In all three modes of stabilization, a roll correction is applied to the antenna to compensate for bank angles. This correction maintains the system accuracy up to 12° of bank, beyond which the antenna strikes the stops on the down wing side. The distorted display thus produced is restored as soon as the bank angle is reduced. Bank angles above approximately 15° may cause the TA warning lights to illuminate but do not damage the system physically or electrically. (If the radar navigator selects emergency stab bypass, this roll correction is lost.)

NOTE

The presentation on the terrain display indicators may be affected during abnormal ECO light indications; therefore, during TA system operation, the radar navigator should notify the pilots if the ECO light remains illuminated during straight and level flight or does not illuminate during bank angles exceeding 4°.

FRL MODE. In FRL stabilization, the clearance plane is established approximately parallel to the flight path of the aircraft. The accuracy of FRL stabilization is dependent on a correct FRL angle of attack setting. The FRL angle of attack is set by the navigator, for the given conditions, using the angle of attack adjust control on the antenna control panel and the angle of attack chart (figure 4-51).



AREA A SHORT RANGE BLIND ZONE

AREA B NONLINEAR PORTION OF ANTENNA PATTERN. (RETURNS FROM THIS AREA REMOVED)

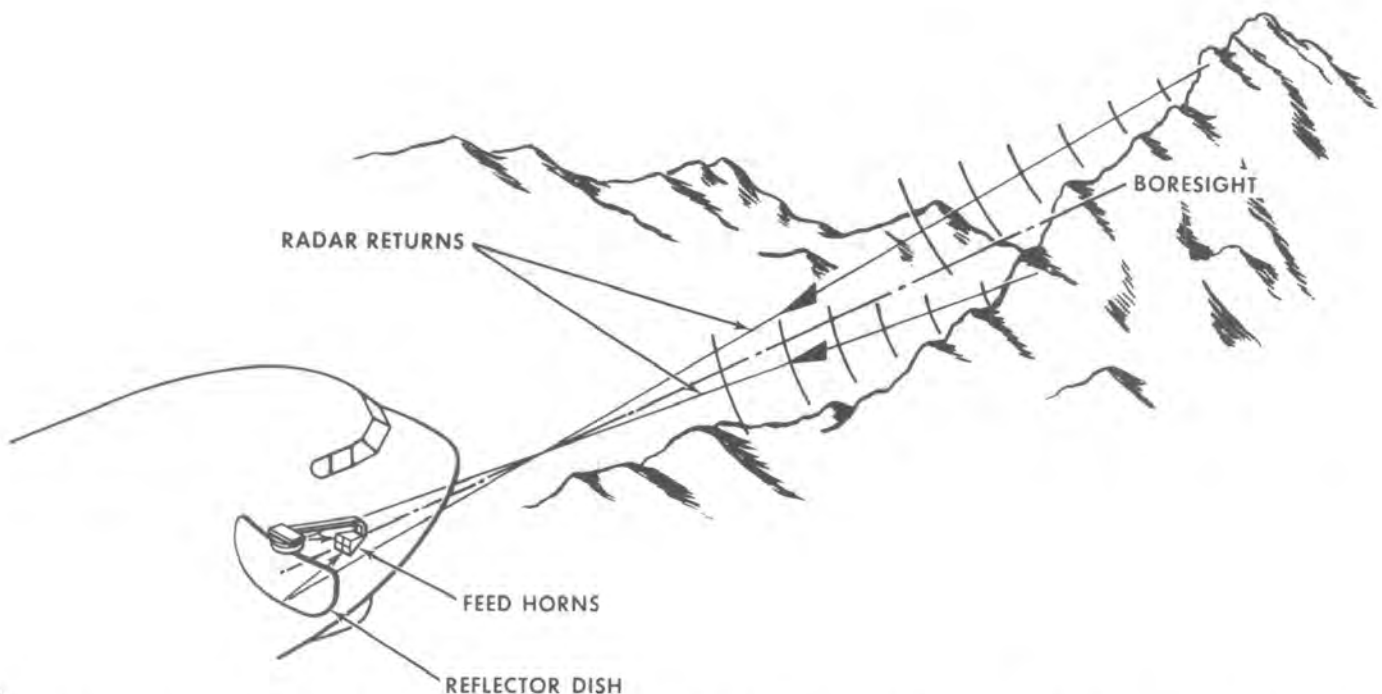
C CLEARANCE PLANE INTERSECTION WITH THE LOWER ACCURACY LIMIT LINE (FOR TWO CLEARANCE PLANE VALUES):

D SAMPLE CLEARANCE PLANES

E MINIMUM RANGE LIMIT (FIXED AT APPROXIMATELY 5000 FEET IN PROFILE CAL AND VARIES WITH CLEARANCE PLANE SETTING IN PRO 3, 6, AND 10)

Terrain Avoidance System Geometry

Figure 4-46.

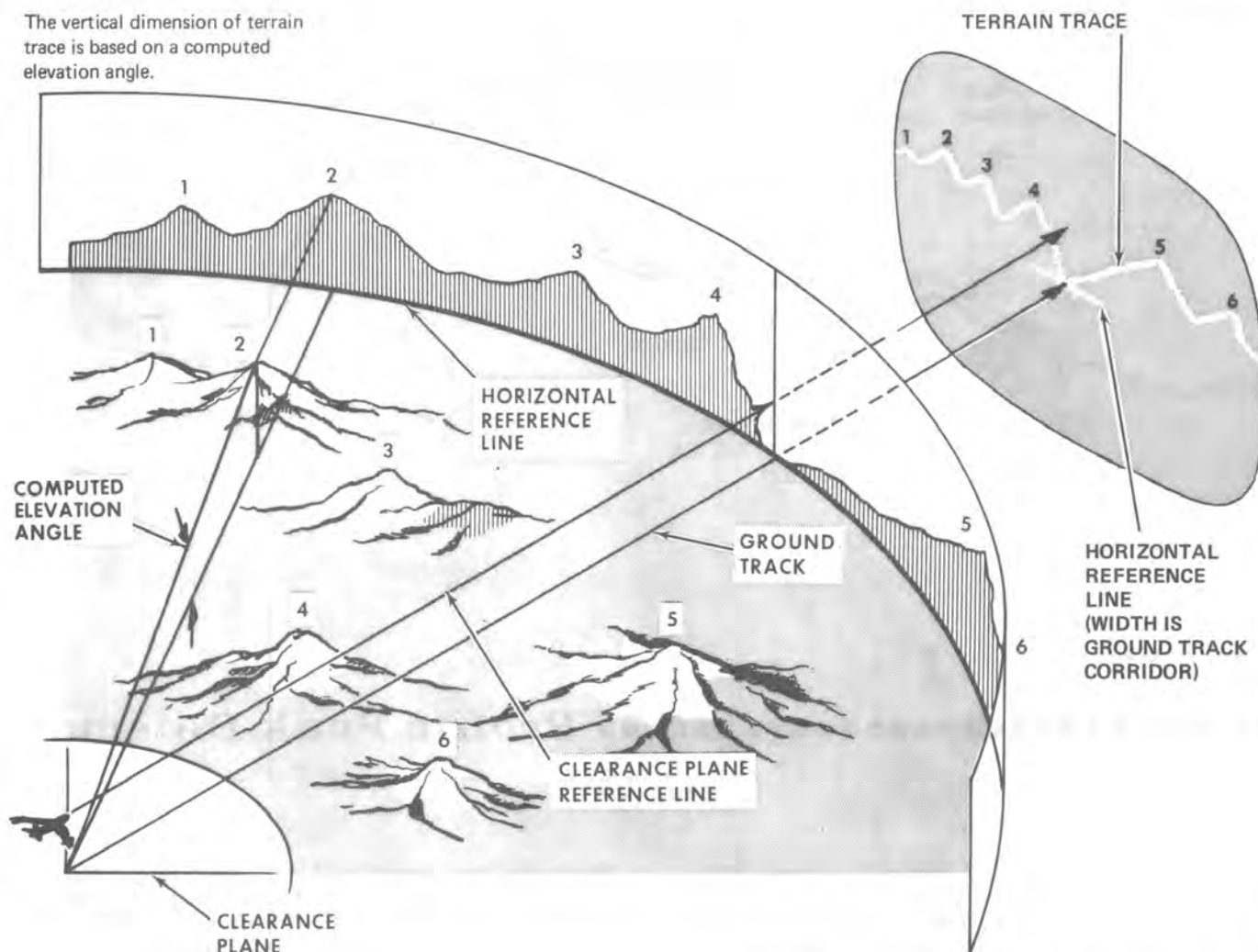


Terrain Avoidance Dual Antenna

Figure 4-47.

NOTE

The vertical dimension of terrain trace is based on a computed elevation angle.



TA Display

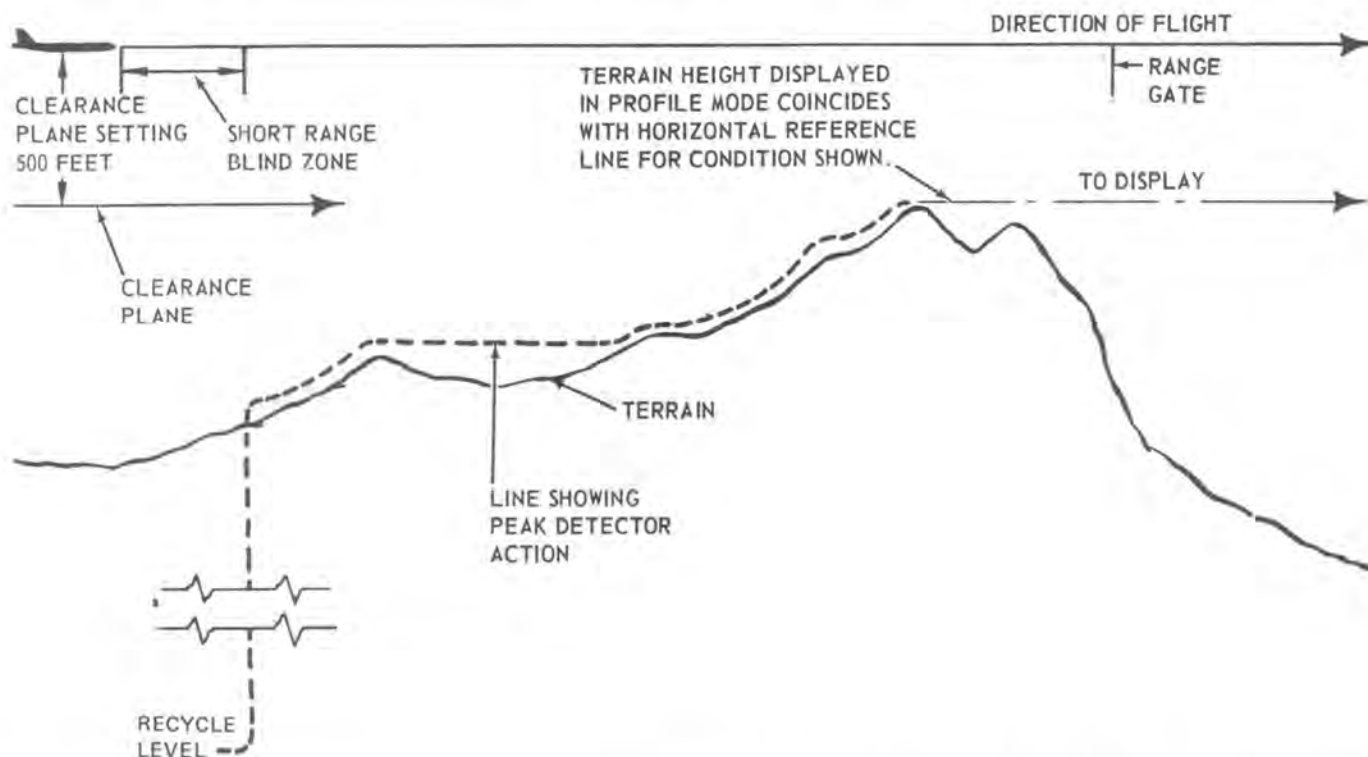
Figure 4-48.

In the FRL mode of stabilization, as the aircraft pitch attitude is changed, the clearance plane also pitches to remain approximately parallel with the flight path. This enables the pilot to cause obstacles to appear or disappear by merely pulling the nose of the aircraft up or pushing it down. Using this technique with an obstacle displayed, the pilot can change the aircraft attitude and determine how much performance is necessary to clear the obstacle.

FVR MODE. In FVR stabilization, the clearance plane is automatically established parallel to the flight path of the aircraft for all angles of attack. FVR stabilization is provided by the angle of attack system which consists of two angle of attack transducers (vanes), one on each side of the aircraft, and

an angle of attack computer. The vanes sense slipstream direction and supply it to the angle of attack computer which averages, corrects, and provides a proper signal to the TA system. This signal is used to maintain the clearance plane parallel to the flight path, making FVR the most desirable stabilization for TA operation.

HORIZONTAL MODE. In horizontal stabilization, the clearance plane is established parallel with the horizon, using a correcting signal obtained from the emergency BNS stabilization reference. (If the radar navigator selects emergency stab bypass, the system is effectively FRL stabilized with the FRL angle equal to zero.) This mode is used principally to check the TA system accuracy and is of limited



Profile Peak Detector

Figure 4-49.

use in contour following. A change in aircraft altitude is the only way to change the presentation in horizontal stabilization. This characteristic causes excessive clearance altitude when approaching obstacles in a climb and insufficient clearance when approaching or crossing obstacles in a descent.

Pilots' Displays

The TA system is equipped with profile -3, -6, and -10 display ranges, which can be used with any of the three modes of stabilization. The display presents a view looking forward and displays the azimuth position and elevation angle of terrain features relative to the clearance plane (figure 4-48). The elevation angle represents the change required in the aircraft flight vector to clear a given terrain feature by amount of clearance plane setting. The vertical displacement of the displayed terrain obstacle from the horizontal reference line increases as the range decreases (figure 4-52). The clearance plane is represented on the display by an electronically generated cursor known as the horizontal reference line. The term "horizontal" refers only to the cursor position of the line relative to the tube face. There are three selectable range gates: 3, 6, and 10 miles. Only radar echoes from targets within the range selected are accepted for processing or display. The highest computed terrain obstacle be-

tween minimum range and the selected range gate (3, 6, or 10 miles) is sensed and retained in a peak detector module in the following manner. The profile mode peak detector senses the highest terrain computation within the range gate selected at each degree of azimuth and causes the computed elevation angle to be displayed. The peak detector senses and retains the highest terrain within the range gate, represented by the dashed line in figure 4-49. (The peak detector is recycled between radar cycles.) The peak detector output is smoothed and reproduced on the TA display; thus, only a silhouette of the highest obstacles is seen. Sweep circuits slaved to the antenna generate the left-right scan of the trace.

NOTE

Based on past experience with the TA system and because all errors and distortions are greatest at the longer ranges, profile 10 will usually cause the aircraft to fly too high.

PRO CAL selects profile manual minimum range mode (profile 10 with minimum range fixed at approximately 5000 feet). The purpose of this mode is to prevent anomalous (false) returns on the display indicators when flying above "low level" altitudes. This mode therefore can be useful for low level descent and during peak calibration.

Navigators' Displays

For information on the navigators' displays, refer to T.O. 1B-52G-1-6-1.

Failure Warning

The TA system is equipped with a self-test feature called "failure warning." Failure warning indications will be noted by TA warning light illumination. Although the failure warning circuit does not include every system component from the input to the output, it does check the accuracy of a majority of the TA system electronics. Examples of items checked are terrain computation circuits, gross antenna tilt errors, clearance plane settings less than 200 feet, sum and difference crystal currents, magnetron current, course local oscillator control voltage, and certain computer circuits. The items not checked include antenna microwave components and a portion of the receiver-transmitter. Furthermore, errors or malfunctions can exist in the components checked which may produce abnormal or erroneous displays but not cause a failure warning indication.

Test Pattern

The TA system is equipped with a self test feature for the radar scan converter. Pressing the TA test button will cause the terrain trace to disappear and the TA test pattern (figure 4-53) to appear on the pilot's and copilot's EVS monitor indicating that the radar scan converter is functioning properly. If the TA test pattern does not appear, the TARSC BIT button on the radar scan unit in the navigator's compartment performs the same function as the pilot's TA test button and can be used during the Inflight TA Functional Check to validate the radar scan converter.

NORMAL OPERATION

System Characteristics

GROUND TRACK ERROR DUE TO DOPPLER. Drift angle signals are supplied to the TA system to orient the actual ground track in the ground track corridor (A, figure 4-50). With the doppler drift switch OFF, the ground track corridor will represent the projected longitudinal axis of the aircraft and will not represent the actual ground track (B, figure 4-50). If the doppler radar system is providing erroneous drift information, the actual ground track line will be displaced from the corridor ground track line an amount equal to the drift error (C, figure 4-50). This error may also shift back and forth in respect to the ground track corridor. The doppler radar is more likely to be unreliable in a descent.

TERRAIN VIDEO TRACE BREAKUP. The solidity or continuity of the terrain video trace is affected to some extent by antenna scan speed, PRF, drastic

terrain profile slope changes (i.e., canyon walls, steep hills, etc), and the rate of TA solution and display. Abrupt changes in transverse slope of the terrain profile is the greatest cause of normal profile video trace breakup. Basically the magnitude of profile video trace breakup depends on the magnitude and duration of the terrain profile transverse slope changes. This condition will not prevent operational use, since it is possible to distinguish between normal trace breakup due to the above combination of factors and abnormal breakup due to system malfunction.

SCAN TO SCAN DISPARITY. Two types of TA presentation disparity may exist in the BNS:

1. Vertical disparity may occur in that the terrain trace may appear higher on one scan than on the reverse and/or successive scans.
2. Azimuth disparity may occur in that the terrain trace may appear at a slightly different azimuth on one scan than on the reverse scan.

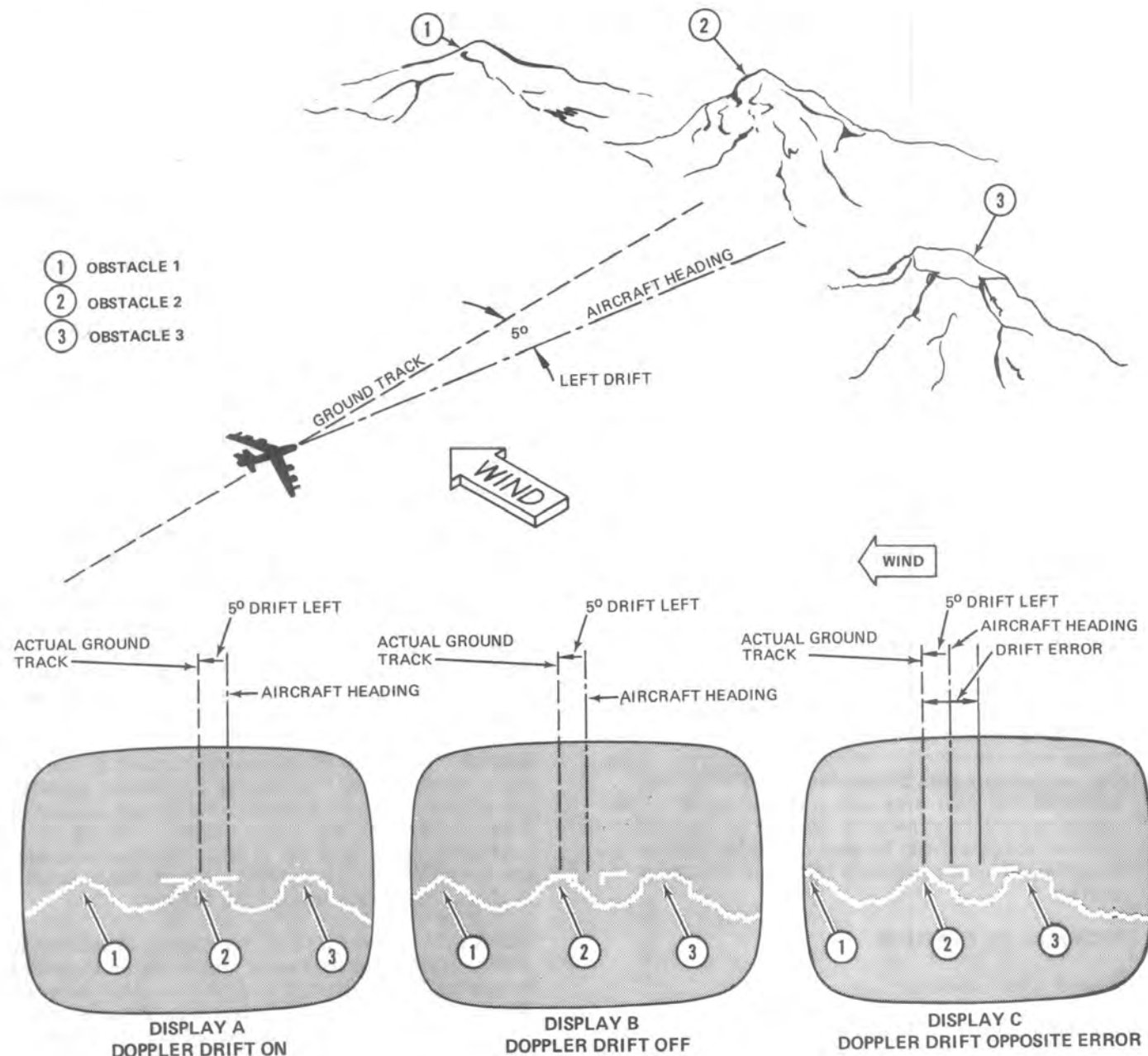
SHORT RANGE/MINIMUM RANGE BLIND ZONE.

The radar utilized in the TA system is blind at close ranges with the outer limit established by either the short range or minimum range blind zone boundary (figure 4-46) whichever is greater. There is no indication of any target within the short range/minimum range blind zone although a radar shadow may be observed occasionally from a target known to be within this zone.

RADAR SHADOWS. Radar energy travels in line of sight. Only targets "visible" to the antenna are displayed; other targets which are hidden are located in the area known as the "radar shadow." As the aircraft progresses over the ground, the shadow areas are progressively illuminated provided the aircraft is above the terrain causing the shadow.

POOR DISPLAY OF SHEER TARGETS. The system is not capable of consistently displaying or accurately computing the height of TV or radio antenna towers, power transmission lines, suspension bridges, very tall office buildings, straight-sided cliffs or peaks, etc. These obstacles may be displayed at partial height with improving accuracy as range decreases, producing a rapidly rising terrain trace on succeeding scans of the display. If the target is displayed close to ground track, the pilot should consider such a sequence as an emergency and immediately initiate a climbing steep turn.

POOR DISPLAY OF SMALL TARGETS. The returns from small objects (small buildings, boats, etc) are very weak and are not computed or displayed accurately, even though they may be discernible to the radar navigator.



NOTE

DRIFT REPRESENTATIONS NOT TO SCALE.

Ground Track Error

Figure 4-50.

WEATHER SENSITIVITY. The TA system will display returns from dense clouds, moderate rain or snow, etc. The total contrast feature of this display prevents the pilot from differentiating between weather returns and valid obstacles. Weather has been observed to make the terrain trace appear jagged (having an irregular sawtooth shape composed of many horizontal elements). Areas of precipitation should be avoided because these returns mask the ground returns and will cause the pilot to climb above the desired clearance altitude. The climb command in this case can exceed the climb performance of the aircraft. The radar navigator can often provide guidance through areas of scattered precipitation. When TA capability is degraded by weather effects, the pilot should climb to IFR altitude.

BANK ANGLE. The TA display will present a distorted display on the wing down side when the bank angle exceeds 12° . The short range blind zone affects the display of targets at close range off the wingtip as well as in front of the aircraft. These combined effects will prevent display of important targets during turns if the bank angle exceeds 12° .

DISPLAY IRREGULARITIES. Invalid spiking in profile 6 or profile 10 mode may appear. Evasive action should be initiated unless visual observation determines otherwise.

Planning Considerations

All B-52 low altitude training flights are planned and flown in accordance with Command Directives. Careful planning is essential for safety and effectiveness. The following TA characteristics should be considered.

1. Plan all turns for 12° bank. (Turn short to make good the planned track.) If the bank angle must be increased beyond 15° , do not depend on the TA display for terrain clearance. Maintain visual clearance or climb to a safe altitude.
2. The system is not capable of consistently displaying radio and TV towers. An increased clearance plane setting can be used if circumnavigation is not feasible.
3. The TA system will display returns from dense clouds and precipitation. When TA capability is degraded by weather effects, the pilot should climb to

IFR altitude. Do not rely on TA system displays for weather penetration.

4. Radar returns from water depend on sea state and are usually of such low value that erroneously high clearance indications are displayed. Use of the radar altimeter is recommended when over water.

WARNING

Do not depend on the TA display for letdown or low absolute altitude operation over water.

5. Airspeeds will normally be as dictated by the needs of the mission and may be adjusted in flight for control time purposes.

6. Preparation during mission planning includes review of clearance plane setting for each low level route.

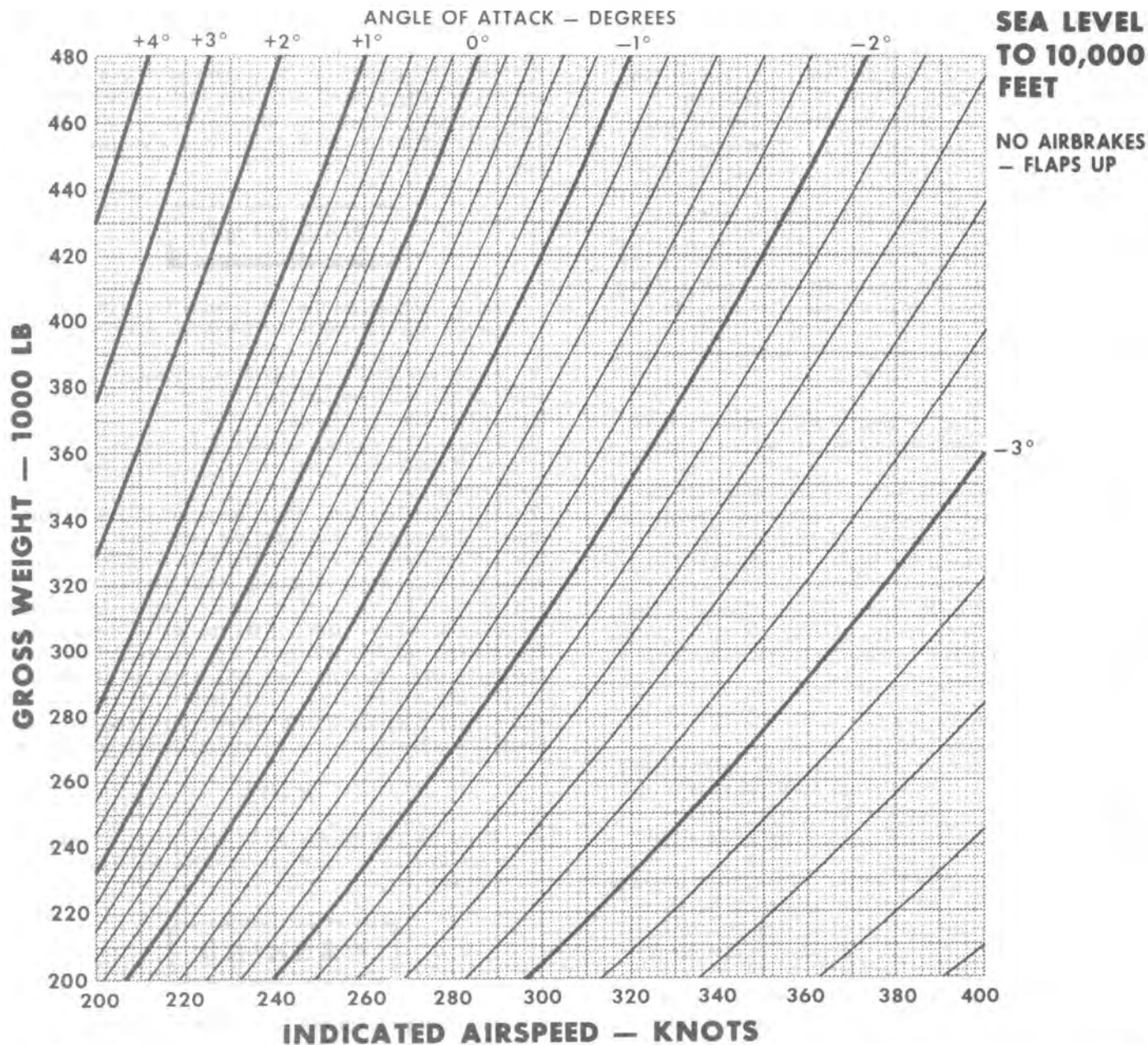
7. FRL stabilization. Determine the gross weight, indicated airspeed, and airbrake positions. Using this information, determine the FRL angle of attack value from the angle of attack chart (figure 4-51) and set the FRL angle of attack into the system using the antenna control panel at the navigator's station. **EXAMPLE:** At 280,000 pounds gross weight and 260 knots IAS, the computed FRL angle of attack is -1.4° without airbrakes, -1.1° with airbrake position 2 (or position 4 with inboard airbrake circuit breakers pulled), and -0.8° with airbrake position 4.

NOTE

The FRL setting should be updated as necessary to maintain the set-in value accurate within 0.2° .

WARNING

Positive procedures must be established to insure that the FRL angle is reset when airspeed is changed during terrain avoidance operations. Failure to do so will result in serious clearance plane errors.

**NOTE**

- Use airbrake corrections in airbrake position 2 column when the inboard airbrake circuit breaker is pulled out and airbrake position 4 is selected per low altitude tactic in Section II.
- When flying with constant airspeed and a gross weight less than that used to compute the FRL settings, the use of airbrakes will tend to improve the accuracy of the TA system display by providing a more nose-up angle of attack. At heavier gross weights, the use of airbrakes will tend to degrade the accuracy of the TA system display.
- There is no angle of attack correction required with AGM-69A wing pylons installed without missiles.
- Less than 7 external AGM-69A missiles or 7 or more external AGM-69A missiles installed on the aircraft wing pylons changes the angle of attack 0.1° and 0.2° respectively in the positive direction due to aircraft loss of lift when missiles are installed.
EXAMPLE:
If the aircraft gross weight (including 12 AGM-69A missiles) is 300,000 pounds, the angle of attack value at 260 knots indicated airspeed from the chart is -1.2° then add $+0.2^\circ$ correction for the missiles which results in an angle of attack setting of -1.0° .

INDICATED AIRSPEED KNOTS	AIRBRAKE CORRECTION	
	ADD THIS CORRECTION TO THE ANGLE OF ATTACK FROM THE CHART	
	AIRBRAKE POSITION 2	AIRBRAKE POSITION 4
200	$+0.4^\circ$	$+0.8^\circ$
250	$+0.3^\circ$	$+0.6^\circ$
300	$+0.3^\circ$	$+0.6^\circ$
350	$+0.3^\circ$	$+0.5^\circ$
400	$+0.3^\circ$	$+0.3^\circ$

**Aircraft Body
Angle Of Attack - Level Flight**

Figure 4-51.

8. FVR stabilization. The FVR stabilization mode allows choice of any reasonable airspeed/gross weight combination without TA system accuracy penalty. The FVR stabilization mode utilizes an angle of attack computer which automatically senses changes in angle of attack and supplies the proper correcting signal to the TA system.

Operating Techniques

WARNING

TA operation without a properly operating radar altimeter is extremely hazardous if visual terrain clearance cannot be maintained.

NOTE

- The radar altimeter is to be used in conjunction with the TA system. It will be included in the pilot's normal instrument scanning pattern for continuous cross-check with other terrain clearance information and for observing peak passage before following a fly-down command.
- The EVS symbology is solely for aiding the pilot during use of the EVS system. The aircraft flight instruments remain the primary flight reference.

In flight, TA operation is essentially an extension of instrument flying with the TA system displays included in the cross-check. The TA display does not provide any direct indication of pitch or roll, although an approximate indication of pitch changes can be obtained by noting the scan-to-scan changes in the position of the profile terrain trace. It has been found helpful to assign airspeed (throttles) control to the safety pilot, who then maintains the desired airspeed without further direction. Frequent use of airbrakes for deceleration is not recommended. The climbing portions of TA operation require close monitoring of airspeed in rough terrain. Pilots should overshoot throttle settings by early advancement to higher settings than required, then retard throttles as required to maintain desired airspeed. It is especially important to maintain correct airspeed when in the FRL stabilization mode because airspeed reduction causes lower than desired crossing altitudes. Turns are possible during terrain following provided good judgment is applied. The radar navigator must verbally clear the proposed flight path prior to all turns greater than 10°. Blank, missing, or ragged (saw-toothed) areas of the terrain may be caused by radar shadow from a large obstacle at very close range. Plan turns so that no more than 15° bank angle is used. Use slow rate of roll-in, not to exceed 3° per second. The copilot must monitor all the instruments and provide visual clearance of the aircraft. The radar navigator provides terrain assessments beyond the pilot's range.

When hazardous terrain is observed, the radar navigator will continue to advise pilot until pilot is tracking obstacle on his indicator. The radar navigator using LO ALT GM can normally see out as far as 35 NM ahead of the aircraft and provides information on large obstacles and weather beyond the range selected by the pilot. Using ranges greater than 75 miles may result in retraces and other interference effects. The radar navigator may recommend small course changes to utilize terrain cover or for weather. The navigator sets the destination indicators to the turn point coordinates which enable the pilot to use the flight command indicator (FCI) as the primary heading instrument. The pilot may use the bank steering bar as primary heading instrument during TA operation. When this procedure is used, the pilot/copilot must reset the heading marker, as required, during heading correction or when azimuth deviations are noted on the flight command indicator (FCI). BNS steering may be used to maintain correct aircraft heading while the pilot maintains pitch control. The navigator must also monitor the doppler radar and, in the event of a doppler malfunction, notify the pilot and place the radar and heading drift switch to OFF. If the doppler radar will not return to normal operation, the navigator will place the doppler radar silence switch to SILENT. After the radar navigator has accomplished a memory point wind run, the doppler drift switch should be positioned back to ON. This will align the TA presentation about ground track derived from the BNS memory point winds. All subsequent wind runs will be made with the doppler or radar and heading drift switch in OFF position. Inform the pilot before making any changes in the doppler or radar and heading drift switch position. The navigator will monitor minimum safe altitudes for the low altitude leg.

FVR STABILIZATION. During contour flight (especially over rolling terrain), the pilot may notice a tendency to overcontrol the aircraft. This results from the time lag between elevator command input and the corresponding flight path change. This condition may be overcome by making only part of the indicated pitch correction after each sweep appears on the display. If the angle of attack system malfunctions, resulting in a very large TA system error or when the angle of attack of the aircraft exceeds the limits, the TA-EVS vector indicator light located on the pilots' instrument panel will illuminate continuously. The pilot should then select FRL stabilization. Erroneous angle of attack system (FVR) operation can be caused by ice formation on the vanes if the vane heaters are not energized. To assure that the vanes are free from ice, the vane heaters should be energized prior to and during icing conditions in flight. See "Angle of Attack Vanes Anti-Icing," this section, for operation.

WARNING

Failure of the BNS radar tilt circuitry will create an inaccurate TA display.

HORIZONTAL STABILIZATION. In the horizontal stabilization mode, the terrain is displayed relative to its vertical distance below the aircraft. Horizontal stabilization mode is considered only a backup in TA operations and should only be used when FRL and FVR stabilization modes are inoperative or unreliable and then only for calibration checks or for combat TA altitude operations.

WARNING

Use of horizontal stabilization will result in inconsistent peak crossings at very low clearance altitudes when peaks are crossed in a descending attitude. Confine descent rates to less than 1000 feet per minute. Insure active safety pilot monitoring. A rapidly rising terrain trace, even though the trace may be well below the horizontal reference line, provides a visible indication of an impending low crossing or collision.

NOTE

When the terrain avoidance system is in horizontal mode of operation and the stabilization select switch is placed to EMERGENCY position, the pilots' and navigators' scope presentation may change slightly.

TA System Failure Detection

Timely recognition of TA system failures is essential to safe contour following operations. A failed condition may be detected using any of the following methods:

- The TA failure warning lights (actuated by the TA failure warning circuits) illuminate.

WARNING

The failure warning circuits do not detect every failure of the TA system but do check the accuracy of the majority of the electronics involved.

- The horizontal reference line on the monitor indicates a malfunction when it becomes an unbroken line (the center gap fills in and the verticals disappear).
- The radar altimeter indicates unsatisfactory terrain clearance.
- Comparison with pressure altitude and known terrain elevation indicates unsafe or abnormal terrain clearance.
- Safety pilot detects impending collision.
- When, in the radar navigator's judgment, the radar system appears abnormal or the display indicates impending ground collision (based on the shadow characteristics of terrain along the ground track).

Upon suspicion or recognition of TA system failure, the pilot should initiate immediate pull-up to safe altitude. Since the TA failure warning does not detect every type of TA failure, the radar altimeter must be monitored for indication of TA failures and so must be included in the pilot's normal cross-check. In the event of failure of the radar altimeter, the safety pilot must be ready and able to recognize a TA failure and be prepared to take necessary action to assure safety.

Failure Verification

WARNING

If the horizontal reference line becomes an unbroken line (gap fills in and verticals disappear) or is not present, the TA system should be used with caution and only when visual contact with the ground can be maintained.

The general rule when observing a failure warning indication is to climb to a safe altitude and investigate.

The failure warning circuits may also be actuated by excessive bank angle which is inconsequential unless it remains after reducing the bank angle.

TA System Calibration

A TA system calibration check provides a means of determining TA system errors. A calibration check should be accomplished prior to flying at TA low level altitudes and also, when low level tactics are not scheduled, to evaluate the TA system for maintenance purposes. The data recorded during the check may be used to determine the existing error in the system and make any necessary compensations prior to the final descent to TA altitude. There are two methods which can be used to evaluate TA system accuracy. The method used will depend on particular circumstances and conditions prevailing. One method requires use of a peak, a peak fly-over, and the other method flat or rolling terrain.

PEAK OR PROMINENT FEATURE FLY-OVER. The "TA System Calibration Checklist" in Section II will be used for this method of evaluation. The altitude of the peak or prominent feature must be known, from a map or other means. The calibration run is made at 800 feet constant pressure altitude above the selected feature, maintaining straight and level flight starting at least 10 miles from the feature until cross-over. The run is normally started in PROFILE 10 with FRL stabilization. Between 9- and 6-mile range, compare stabilization modes as follows: Adjust the clearance plane until terrain trace is coincident with the horizontal reference line then record clearance plane setting. Switch to the other stabilization modes and repeat the check. The purpose of the stabilization cross-check is to determine

the difference in tilt error of the three stabilization modes. After completing the stabilization check, return to the primary calibration stabilization mode and obtain 6-, 5-, 4-, 3-, and 2-mile clearance plane settings. At the crossover point, note the minimum reading on the radar altimeter.

NOTE

- Care must be taken to fly the aircraft directly over the feature being tracked in order to obtain a valid radar altimeter reading.
- Calibration over sloping terrain is not desirable; however, if necessary calibration can be accomplished over upsloping terrain using the above procedure. Calibration over downsloping terrain with gradient in excess of 200 feet in 10 miles should not be attempted.

FLAT OR ROLLING TERRAIN WITHOUT A PROMINENT TERRAIN FEATURE. The "TA System Calibration Checklist" in Section II will be used for this method of calibration. This is a coordinated check between the pilot and the navigator. The calibration run is made at 800 feet constant pressure altitude above the immediate terrain, maintaining straight and level flight starting at least 10 miles from the preselected calibration area. The run is made in PROFILE 3 with FRL stabilization. The navigator will introduce a negative 0.8° error into the TA system. This predetermined value (from average system errors) causes the TA system to compute only near range targets so that clearance plane bias error and a compensation value can be determined. The clearance plane is adjusted by the pilot to position the terrain trace on the horizontal reference line (HRL). The clearance plane reading is then compared to the radar altitude to determine the required clearance plane bias correction to be used for the remainder of the flight. Clearance plane tilt error and a compensation value is determined by the pilot setting the clearance plane to 550 feet (corrected for bias error) and the navigator adjusting the FRL angle of attack control until the terrain trace is positioned on the HRL. Ideally, this geometric condition represents an angular error of positive 0.8° . (With a clearance plane reading of 550 feet, a positive 0.8° tilt error gives an aircraft altitude of 800 feet.) The actual system tilt error and compensation value to be used during the remainder of the flight are determined by correcting the final FRL reading for the known angular error of positive 0.8° and comparing this value to the chart FRL value. A known angular error is utilized during the check to increase the TA system display sensitivity and thereby improve the accuracy of the computed FRL tilt compensation value. Flat or rolling terrain calibration procedures should not be attempted over sloping terrain with gradient in excess of 200 feet per 10 miles. Refer to "Peak or Prominent Feature Fly-Over" procedures to accomplish calibration over sloping terrain with gradient in excess of 200 feet in 10 miles.

Pilots' Inflight Procedures (FRL or FVR Stabilization)

Three selectable range gates are provided for different flight conditions and for pilot training. The longer range gates permit the pilot more time to adjust power and attitude during TA operations. Profile 3 mode is recommended for all normal conditions. When in extremely rough terrain at high gross weights and low airspeeds or partial power, the profile 6 mode may be more desirable. Flight operations are straight forward. If an obstacle is displayed above the horizontal reference line within its extremities, a climb is initiated. The climb attitude is then adjusted to maintain the terrain trace coincident with the horizontal reference line. This attitude is maintained until the obstacle is passed by utilizing the radar altimeter or dropout techniques. The TA display is considered a command display using the rule "terrain up, fly up; terrain down, fly down." The technique is similar to that used in following ILS glide slope.

NOTE

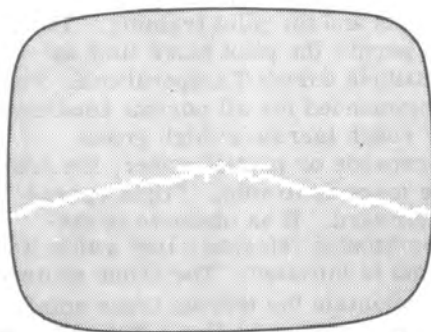
PROFILE CAL position selects profile manual minimum range mode (profile 10 with minimum range fixed at approximately 5000 feet). Use of this mode will help to eliminate beta anomalies (false returns) when aircraft altitude above surrounding terrain exceeds "low level" altitudes.

Since the vertical displacement of the terrain trace from the horizontal reference line represents the elevation angle between the clearance plane (figure 4-48) and the highest point of the obstacle, it can readily be seen that the elevation angle will increase (except for obstacle features located directly at clearance plane elevation) as the range to the obstacle decreases and consequently the vertical displacement of the terrain trace from the horizontal reference line will increase in size accordingly as shown in figure 4-52).

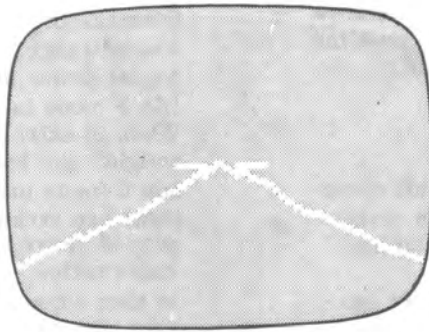
NOTE

Obstacles located directly at clearance plane elevation will have an elevation angle of 0° at all ranges and will appear coincident with the horizontal reference line.

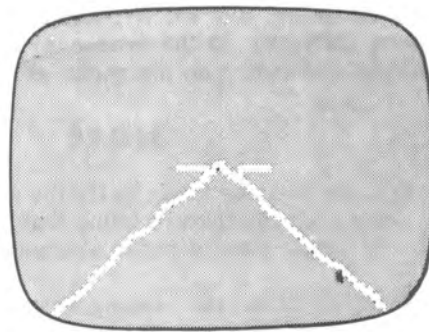
When viewed at ranges from five to ten miles, the change in the aircraft flight vector required to clear most peaks by the clearance plane setting will be small. Thus, at these ranges the peaks in many instances will appear very small on the ground trace. As the range to these peaks decreases, they will appear to grow with respect to the ground trace. This occurs for the same reason that the errors are magnified as the range decreases.



5-MILE RANGE DISPLAY



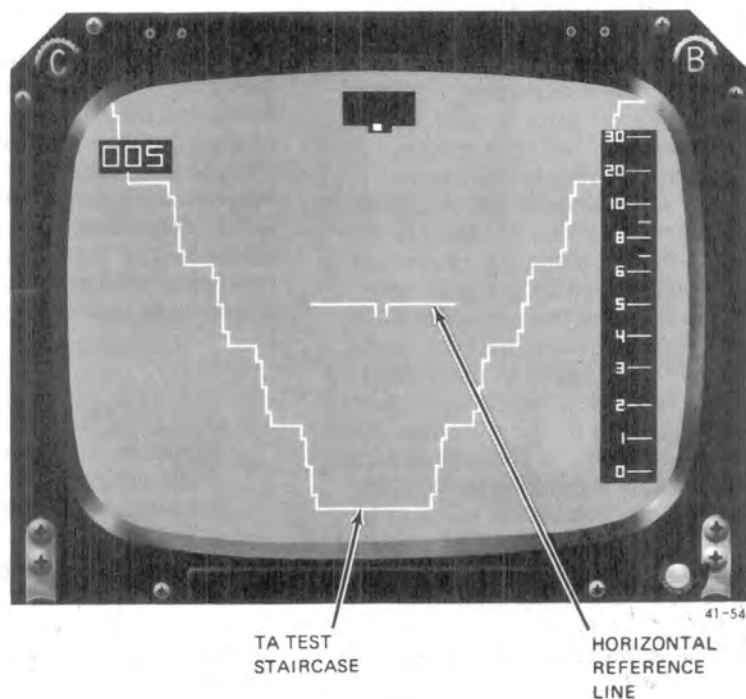
3-MILE RANGE DISPLAY



1-MILE RANGE DISPLAY

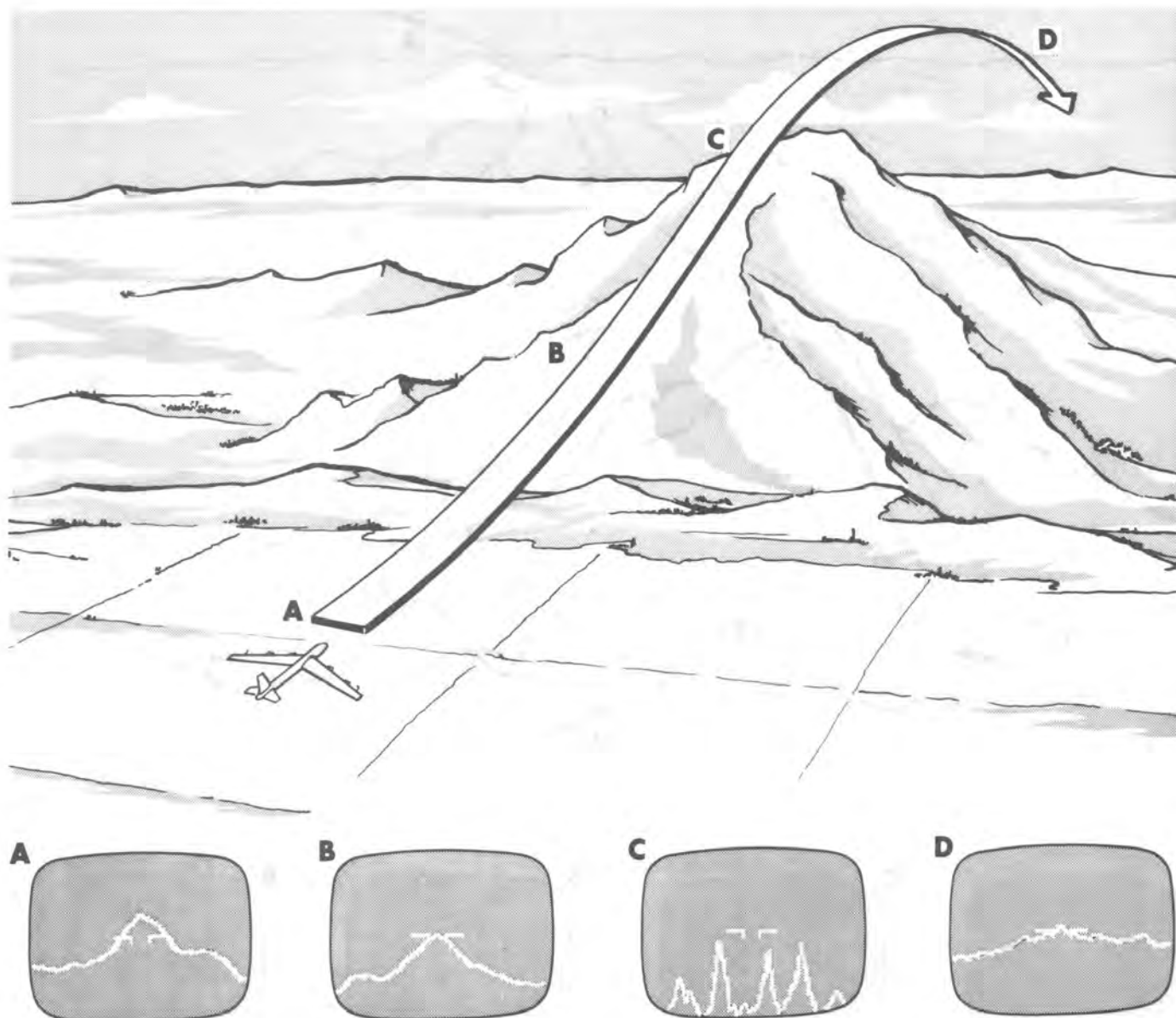
TA Display Sequence

Figure 4-52.



TA Display Test Pattern

Figure 4-53.

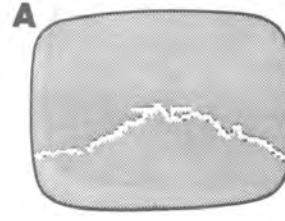
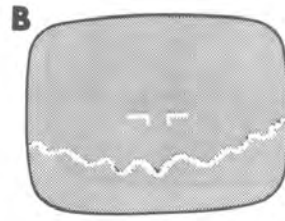
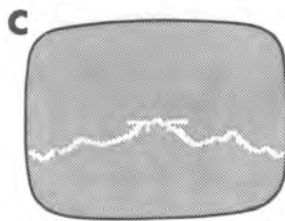
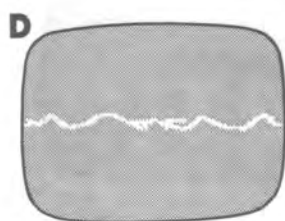
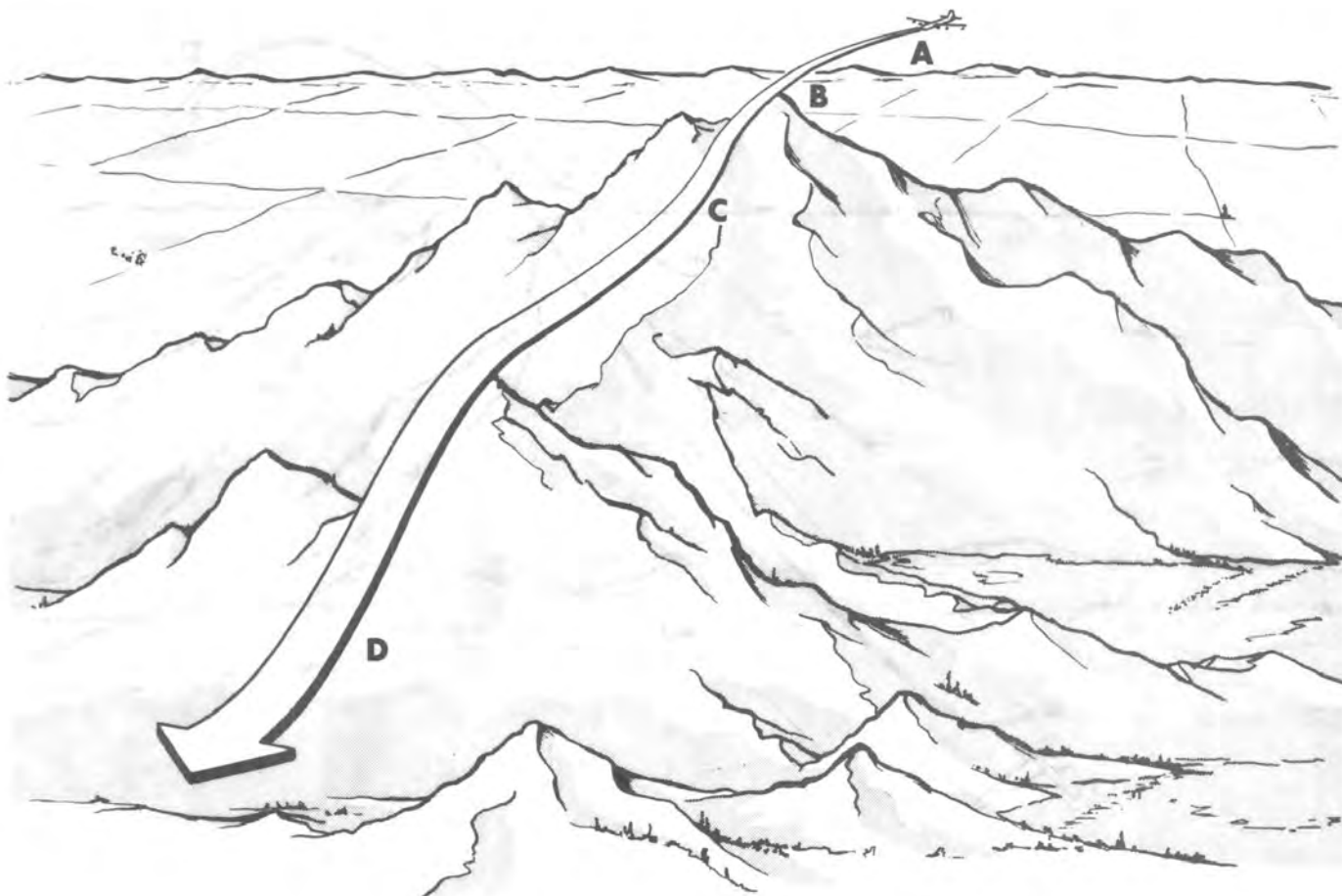


■■■■■■■■■■ TA Display Complete Dropout ■■■■■■■■■■

Figure 4-54.

COMPLETE DROPOUT SEQUENCE. When approaching an obstacle, it will be displayed as valid terrain video as long as the obstacle remains in the primary area (area of accurate TA computation) (figure 4-46). When the obstacle enters area A, minimum range limit, or area B, the obstacle will no longer be displayed as reliable video. This characteristic is defined as dropout and is very noticeable as shown in the picture sequence in figure 4-54. Note that the peak is displayed as solid video in displays A and B, drops down and becomes ragged and dotted

(dropout) in display C, and returns to correct position after passing the peak in display D. If the pilot should fail to recognize this complete dropout, he would initiate descent in accordance with the display producing a low crossing. The proper technique is to note and maintain the aircraft pitch attitude until, about 10 seconds later, the peak passage is observed on the radar altimeter (the altitude indicator needle indicates a decrease in altitude, then stops and indicates an increase in altitude) and then resume following the terrain trace.

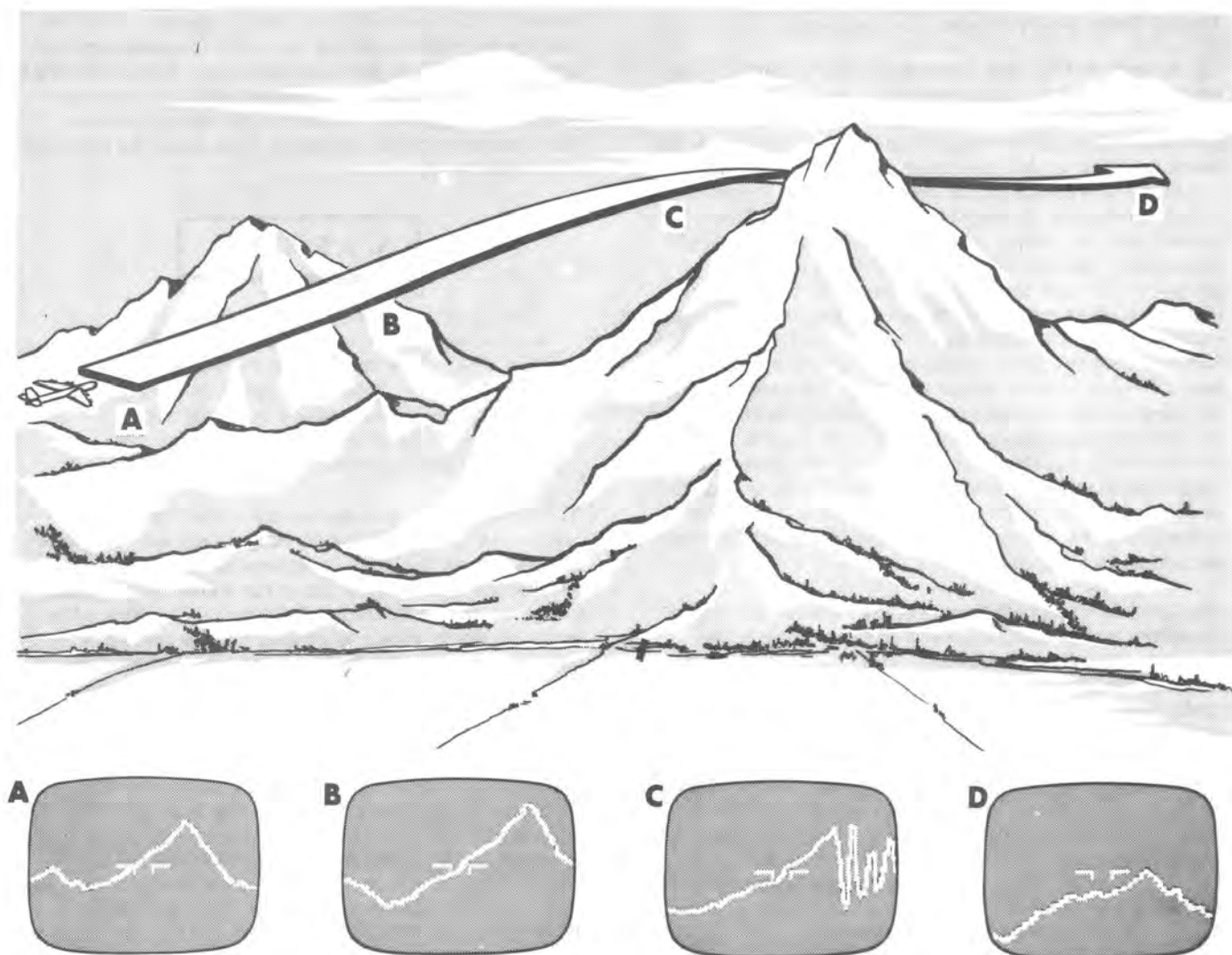


TA Display Partial Dropout

Figure 4-55.

PARTIAL DROPOUT SEQUENCE. Frequently a situation occurs in which the terrain trace drops an inch or so on the display without the ragged and dotted symptoms of a complete dropout. This characteristic is shown in figure 4-55 and indicates a minor ridge (mesa, peak behind peak, small peak, or ridge) is about to be crossed. The same peak cross-

ing technique, as described under the complete dropout sequence, should be applied if the dropout is recognized, but if the pilot continues to follow the trace and uses gradual and gentle forward wheel pressure to ease into the descent, a satisfactory, although lower than planned, crossing will be observed in about 10 seconds.



■■■■■■■■■■■■■■■■■■■■■TA Display Side Dropout■■■■■■■■■■

Figure 4-56.

SIDE DROPOUT SEQUENCE. The side dropout occurs as the aircraft passes across the shoulder of a ridge or peak. This characteristic is shown in figure 4-56. The dropout symptom appears at the side because high terrain, right or left of ground track, is within the short range blind zone or within the minimum range limit and the shadowing effect prevents reception of returns outside the blind zone. Therefore, the video on the peak side drops down or "out" until the aircraft passes beyond the obstacle. When the shadowing effect no longer blocks return from other obstacles, the system displays these obstacles as usual.

WARNING

Dropouts are important because they represent a circumstance in which the terrain display is inaccurate, displaying obstacle height much lower than actual height.

WEATHER EFFECTS SEQUENCE. The TA system may react unfavorably to certain types of clouds or rain in the flight path. This characteristic is shown in figure 4-57. The terrain trace may provide some symptom indications if the trace becomes very ragged and gives a fly-up command. The only safe procedure is to climb to safe altitude and prepare for weather penetration. Weather effects not seen by the radar navigator have been observed to affect the pilots' terrain display.

System Error Analysis and Compensation

TA system errors are caused by malfunctions, poor ground alignment, alignment drift due to aging or temperature, etc. The two basic types of errors are bias error and tilt error, which may occur singly or in combination. A bias error is one of essentially the same magnitude at all ranges. A tilt error is one which increases in magnitude with range. These errors may be either negative or positive. A positive error will cause the flight path to be higher above the terrain than desired because the terrain is computed erroneously high. A negative error will cause the flight path to be closer to the terrain than desired because the terrain is computed erroneously low. Situations may arise when the TA system must be used even though the system exhibits errors. The TA system calibration checklist in Section II is provided to help the flight crews obtain the necessary data to evaluate the system error. It will be possible in most cases to continue TA operations if the TA system errors are determined and appropriate compensation is applied.

The terrain computer incorporates auto-correction circuitry which utilizes two synthetic terrain obstacles generated electronically at different ranges and supplied to the radar receivers. These synthetic terrain obstacles are processed in the terrain computer and the computed obstacle elevation is compared to a known solution. In the event errors are detected, correction voltages are generated and applied to the computational loop to eliminate the error. The longer range synthetic target is used for correction of angular errors in the computational loop. The near range synthetic target is used for correction of bias errors in the computational loop. This bias error auto-correction circuit is disabled at clearance plane settings above 1200 feet. In the event an error is detected which cannot be corrected within safe operating limits, a failure warning indication will be actuated.

BIAS ERRORS. Figure 4-58 detail A illustrates a display having negative bias error in the TA system. The terrain is erroneously computed too low by a constant amount at all ranges. The terrain trace would appear below the horizontal reference line when the clearance plane setting is equal to absolute altitude. This error will cause the flight path to be nearer to the terrain than desired. Compensation for a negative bias error is easily applied by increasing the clearance plane setting by the amount of error.

NOTE

Bias errors in excess of 100 feet require compensation to obtain satisfactory TA operation.

Figure 4-58 detail B illustrates a display having positive bias error in the TA system. The terrain is erroneously computed too high by a constant

amount. The terrain trace would appear above the horizontal reference line when the clearance plane setting is equal to absolute altitude. A positive bias error is compensated by decreasing the clearance plane setting; however, for flight safety reasons, the clearance plane setting is decreased by only one-half of the error.

WARNING

The clearance plane after compensation cannot be set to more than 1000 feet in PROFILE 3 or more than 2000 feet in PROFILE 6. This restriction is necessary because near range video is lost for clearance plane settings greater than the specified values.

TILT ERRORS. A negative tilt error exists when terrain is computed low at long range but the error decreases as the peak is approached or as range decreases until almost no error exists at minimum range as shown in figure 4-58 detail C. Since the error at short range is small, the clearance altitudes over peaks or flat terrain will be near the desired altitude. The large error at long range, however, will prevent timely warning of approaching obstacles; therefore, increased aircraft power is required to clear high obstacles at the desired altitude. If the calibration check is made over flat terrain with a negative tilt error, the terrain trace will display the terrain which is at minimum range, since it would be the highest terrain computed within the range gate. This error cannot be detected since the trace position would not change when switching from PROFILE 3 to PROFILE 6 or PROFILE 10. A positive tilt error exists when terrain is computed erroneously high at long range but the error diminishes as range decreases as shown in figure 4-58 detail D. The error is small at short range and clearance altitudes will be essentially as desired; however, the long range error will cause excessive clearance altitudes over valleys due to erroneous long range fly-up commands. The terrain trace displays the terrain which is at maximum range for the range gate selected (PROFILE 3, 6, or 10) since this would be the highest terrain computed within the range gate. This error could be detected by selecting a different range gate, since the trace would rise as the range gate was changed from 3 to 6 to 10 miles. The tilt correction required to compensate the system tilt error can be determined during the TA calibration run. The system tilt correction is equal and of opposite polarity to system tilt error. For example, a positive tilt correction will be required when a negative tilt error exists. Tilt errors are compensated by adjusting the FRL angle of attack indicator on the antenna control panel.

COMBINED TILT AND BIAS ERRORS. Combinations of tilt and bias errors will exhibit symptoms of both types of errors. The different combinations are illustrated in details "E" thru "H" of figure 4-58. The data recorded on SAC Form 449a can be used to determine compensation for any combination of these

errors. Detailed procedures for determining the required tilt and bias corrections and for accomplishing the error compensation are included in the "TA System Error Compensation Procedures", below, and on the calibration worksheet (SAC Form 449a).

TA SYSTEM ERROR COMPENSATION PROCEDURES

These procedures should be used in conjunction with SAC Form 449a to determine TA system errors from data obtained during the TA system calibration check. Actual plotting and computation should be accomplished on SAC Form 449a. These compensation procedures are given on Form 449a.

Peak Tilt Computation

Plot the profile fade points on the chart and draw the best fit straight line for the points. Determine the 10 mile (CP_{10}) and the zero range (CP_0) clearance plane values from the straight line. Algebraically subtract the CP_0 from CP_{10} to compute tilt correction. Multiply tilt correction by 0.001 to obtain FRL correction in degrees. FRL correction will have same sign as tilt correction. Algebraically add the FRL correction to the FRL chart value to obtain the required FRL angle for operation.

Peak Bias Computation

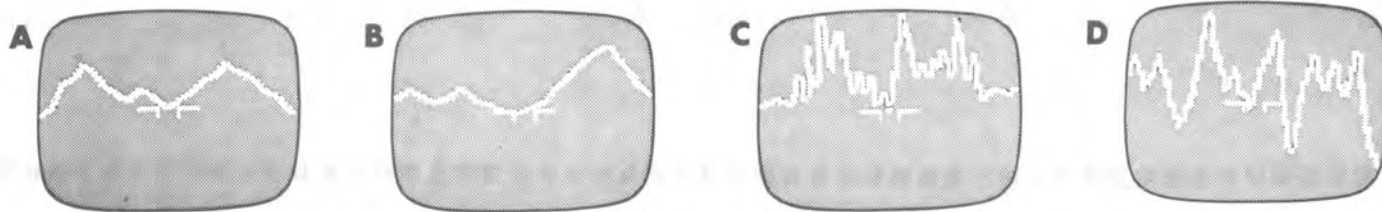
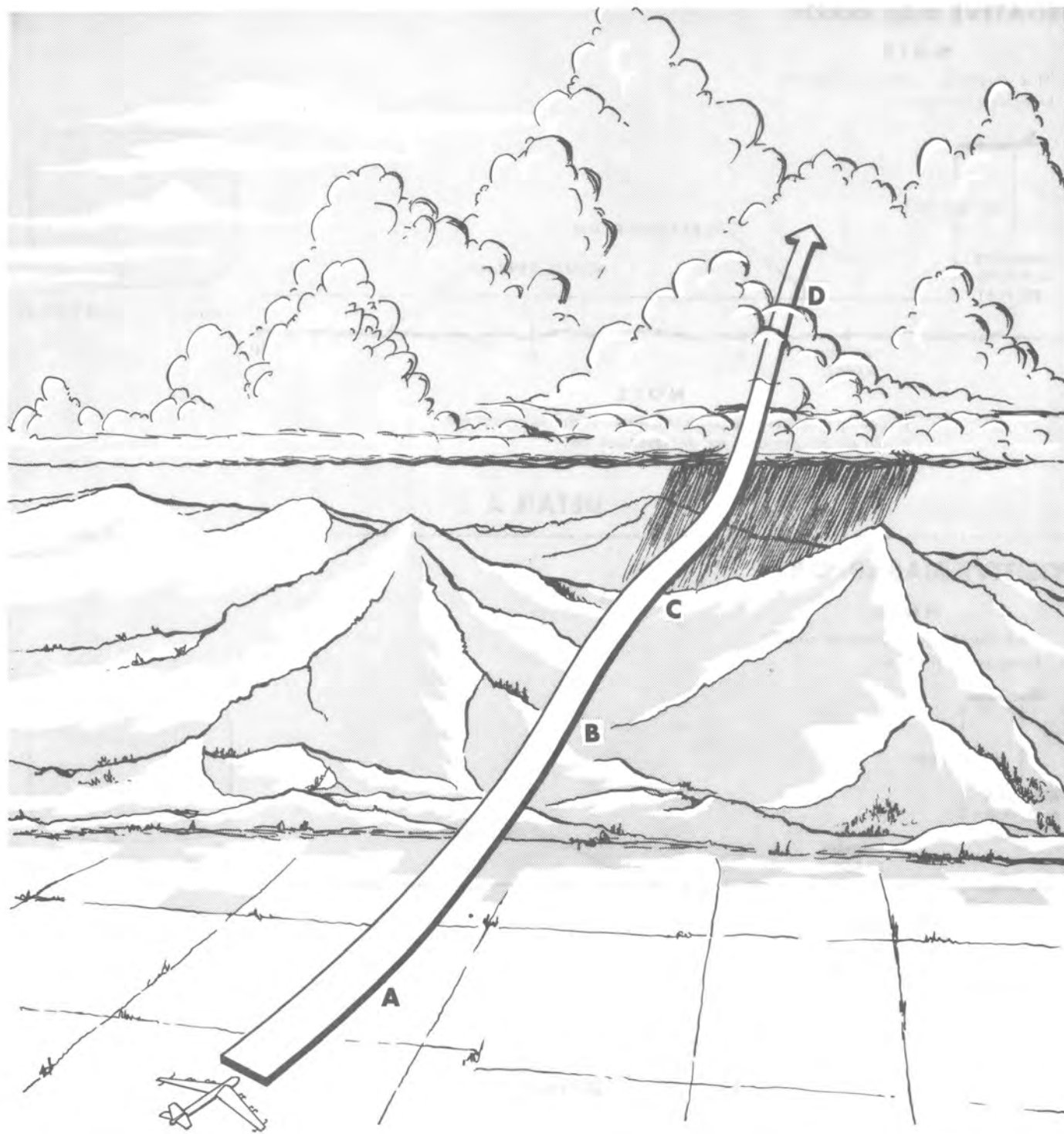
Algebraically subtract CP_0 from the zero range absolute altitude to compute the bias error. If bias error is positive, decrease briefed clearance plane setting by $1/2$ of bias error value. If bias error is negative, increase briefed clearance plane setting by amount of bias error.

Flat and Rolling Bias Computation

Algebraically add Chart FRL Value to -0.8° . This value is set into the Angle of Attack indicator for the calibration run. The pilot selects profile 3 mode and adjusts clearance plane until terrain trace is coincident with the horizontal reference line (HRL). Record the clearance plane value and radar altimeter altitude. Algebraically subtract radar altimeter altitude from clearance plane value, then divide by 2. Result is clearance plane bias compensation value to be applied directly to clearance plane settings throughout the remainder of flight. Reduce clearance plane settings for negative values and increase settings for positive values.

Flat and Rolling Tilt Computation

Algebraically add clearance plane bias compensation value to 550. Set clearance plane to calibration value. (This value only used for calibration run purposes.) The navigator will then adjust the FRL Angle of Attack control until terrain trace is coincident with the horizontal reference line (HRL). Record Final FRL Reading (from dial). Algebraically add Final FRL Reading to -0.8° . Then algebraically subtract Chart FRL Value, the result is Tilt Compensation Value. This value will be added algebraically to Chart FRL settings throughout the remainder of flight.



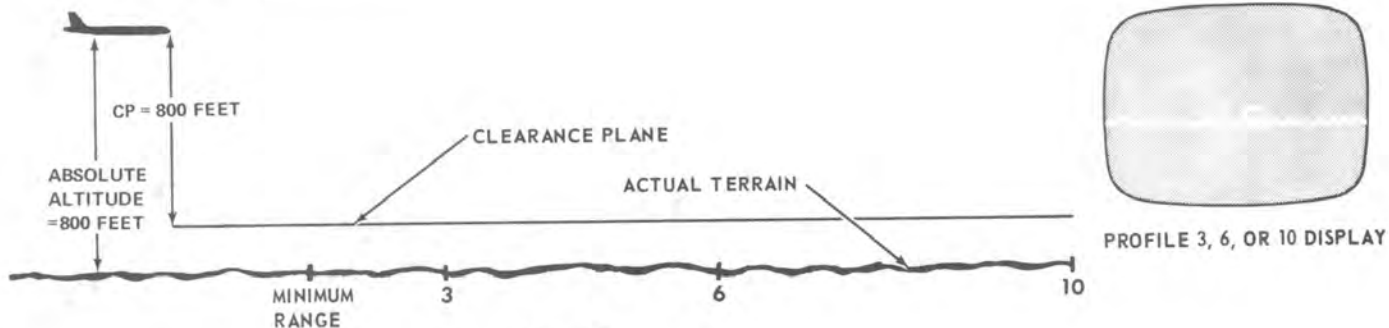
.....TA Display Weather Effects

Figure 4-57.

NEGATIVE BIAS ERROR

NOTE

This illustration is based on aircraft being over flat terrain.



NOTE

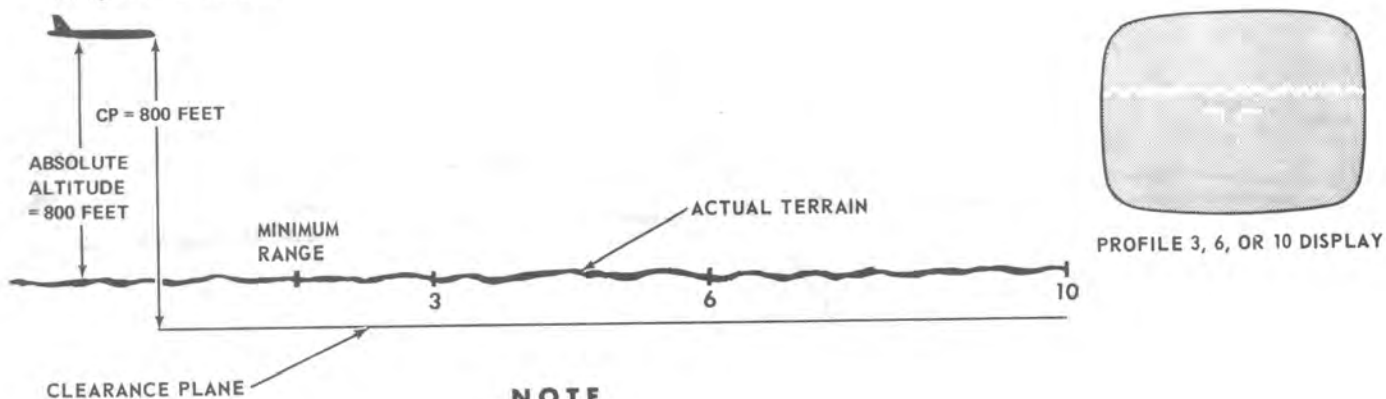
This detail illustrates a negative bias error. With this type of error, terrain will be computed and displayed too low.

DETAIL A

POSITIVE BIAS ERROR

NOTE

This illustration is based on aircraft being over flat terrain.



NOTE

This detail illustrates a positive bias error. With this type of error, terrain will be computed and displayed too high.

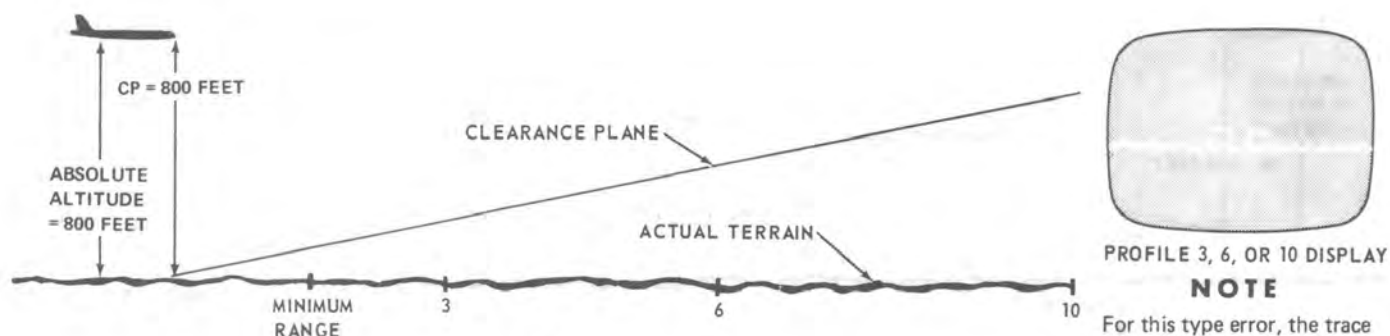
DETAIL B

Figure 4-58 (Sheet 1 of 4).

NEGATIVE TILT ERROR

NOTE

This illustration is based on aircraft being over flat terrain.



NOTE

This detail illustrates a negative tilt error. With this type of error, increasing clearance plane setting or decreasing absolute altitude will cause the terrain trace to rise.

DETAIL C

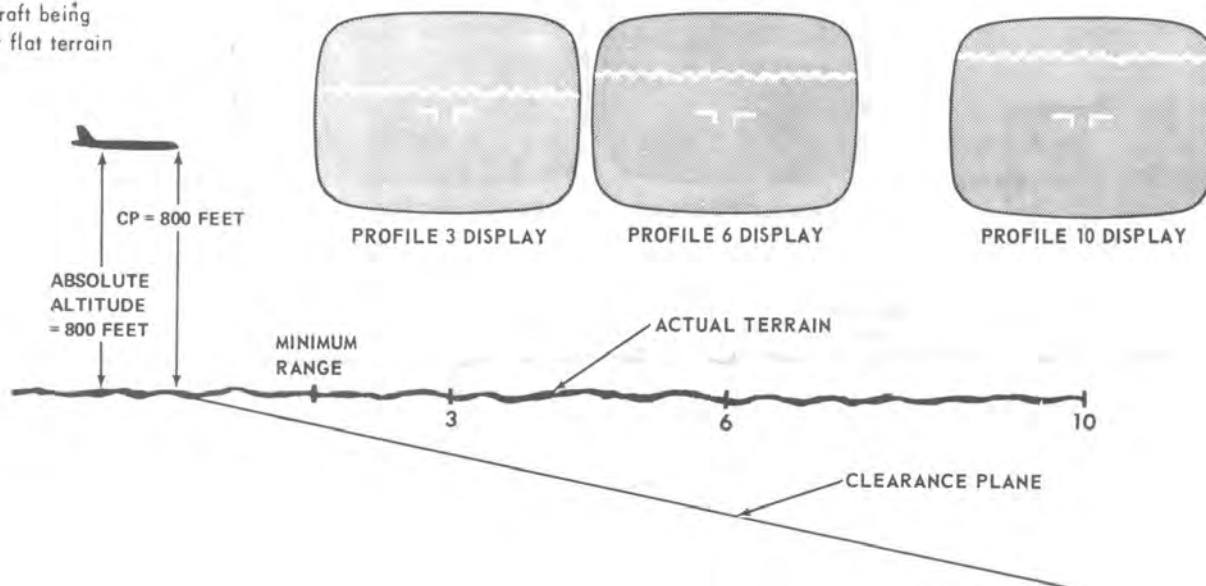
POSITIVE TILT ERROR

NOTE

This illustration is based on aircraft being over flat terrain.

NOTE

For this type of error, the trace represents terrain at maximum range selected.



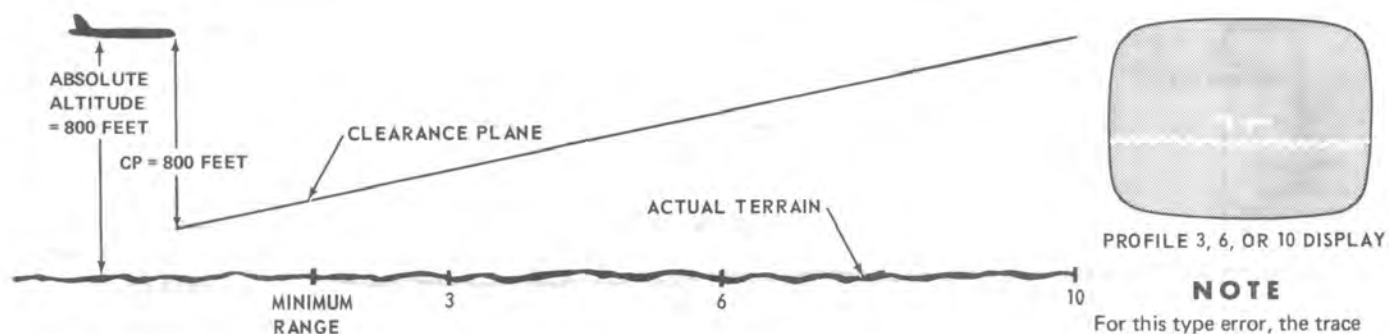
DETAIL D

TA System Errors

Figure 4-58 (Sheet 2 of 4).

COMBINED NEGATIVE TILT AND NEGATIVE BIAS ERRORS**NOTE**

This illustration is based on aircraft being over flat terrain.

**NOTE**

This detail illustrates combined negative tilt and negative bias errors. With this type of error, increasing clearance plane setting or decreasing absolute altitude will cause the terrain trace to rise.

NOTE

For this type error, the trace represents terrain at minimum range, regardless of profile mode selected.

DETAIL E**COMBINED POSITIVE TILT AND POSITIVE BIAS ERRORS****NOTE**

This illustration is based on aircraft being over flat terrain.

NOTE

For this type error, the trace represents terrain at maximum range selected.

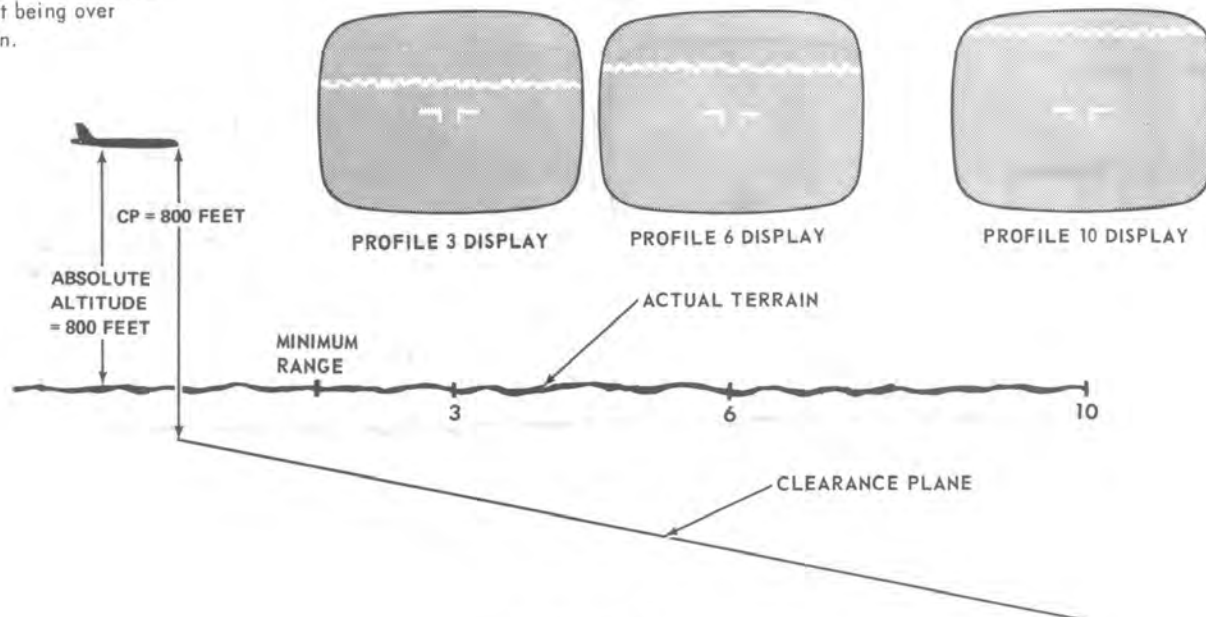
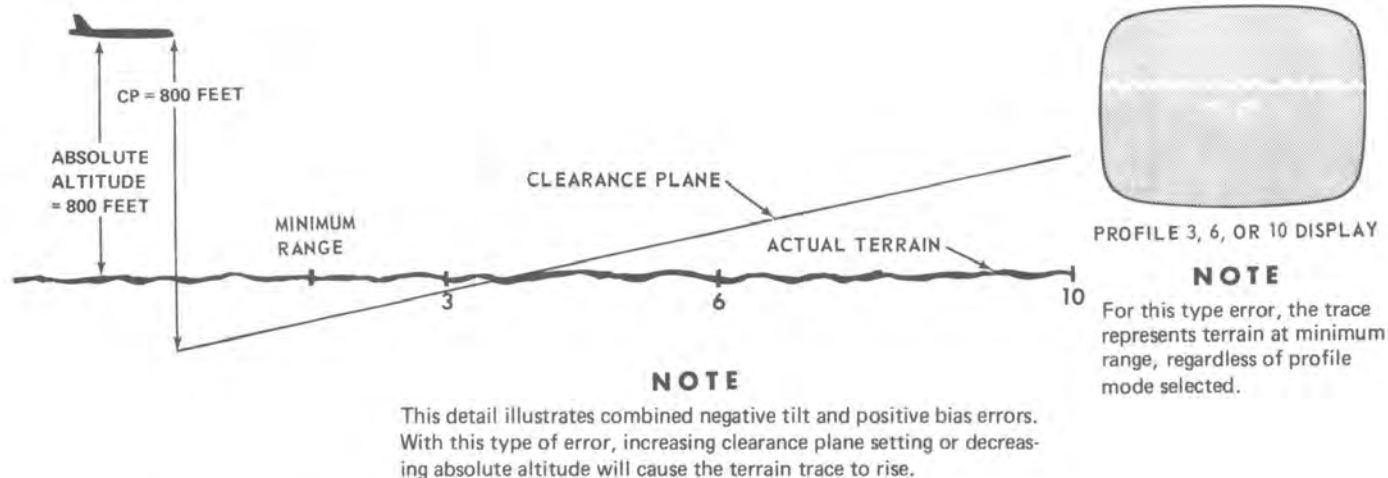
**DETAIL F**

Figure 4-58 (Sheet 3 of 4).

COMBINED NEGATIVE TILT AND POSITIVE BIAS ERRORS

NOTE

This illustration is based on aircraft being over flat terrain.



DETAIL G

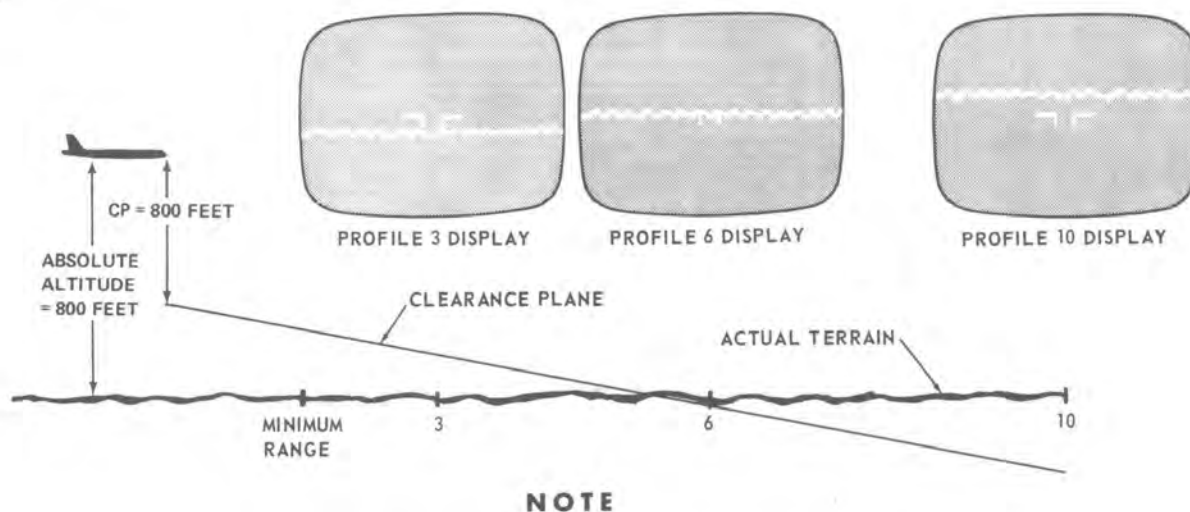
COMBINED POSITIVE TILT AND NEGATIVE BIAS ERRORS

NOTE

This illustration is based on aircraft being over flat terrain.

NOTE

For this type error, the trace represents terrain at maximum range selected.



DETAIL H

TA System Errors

Figure 4-58 (Sheet 4 of 4)

- ACTUAL COMPUTATION IS ACCOMPLISHED ON SAC FORM 449A AND IS INCLUDED AS DETAIL A FOR PEAK COMPUTATIONS AND DETAIL C FOR FLAT AND ROLLING COMPUTATIONS.

Classified by B-52 Security Classification Guide, 1 Oct 72.
Subject to General Declassification Schedule of Executive Order 11652. Automatically downgraded at two year intervals.
Declassified on 31 December 1994.

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SAC FORM 449B REVISED
OCT 74

DETAIL A — PEAK

Figure 4-59 (Sheet 1 of 4).

● **AN EXAMPLE OF METHODS TO USE WHEN FILLING OUT THE FORM DURING A PEAK RUN IS INCLUDED IN THE FOLLOWING PROCEDURE:**

1. Record Initial Conditions:

Aircraft Tail No.= 00-0000
 Crew No. -Navigator= E-20, York
 Date/Time= 4 Jul/1500
 Functional Check= Satisfactory
 IAS= 270 Knots
 Gross Weight= 310,000 pounds
 AGM Correction for external AGM-69A= Zero
 Airbrake Position= Zero
 FRL Setting= -1.4°
 Low Level Route= OB-1/WILDER
 Type Terrain and Elevation= Peak and 6410 feet
 Pressure Altitude= 7210 feet
 Stab Mode= FRL (Stabilization mode used for system calibration)

2. Record TA System Calibration Data:

a. Stabilization Mode Check:

FRL= +750 feet
 HOR= +800 feet
 FVR= +850 feet

b. Profile Fade Points:

RANGE (MILES)	CLEARANCE PLANE SETTING (FEET)
6	950
5	850
4	850
3	800
2	750

3. Computation and Compensation:

a. Peak Tilt Computation:

- (1) Plot the profile fade points on the chart (detail A) and draw the best fit straight line for the points with the method shown in detail B.
- (2) Determine and Record CP_{10} and CP_0 :
 CP_{10} is the clearance plane value read at the intersection of the 10-mile range line and the best fit straight line.
 CP_{10} = 1100 feet
 CP_0 is the clearance plane value read at the intersection of the 0 (zero) range line and the best fit straight line. CP_0 = 650 feet
- (3) Compute and Record Tilt Correction:
 Clearance plane tilt correction is computed by algebraically subtracting CP_0 from CP_{10} .
 Tilt correction= $CP_{10}-CP_0=1100-(650)=+450$ feet
- (4) Compute and Record FRL Correction:
 FRL correction is the number of feet of tilt correction converted to degrees.
 FRL Correction= Tilt Correction $\times 0.001=+450 \times 0.001=+0.45^\circ$.
- (5) Compute and Record Corrected FRL Angle:
 Corrected FRL Angle= FRL Angle Chart Value plus FRL Correction= $-1.4^\circ + (+0.45^\circ)=-0.95^\circ$.
 The FRL correction must be algebraically added to the current FRL angle of attack chart value with the result set into the TA system. All subsequent FRL angle settings must include the FRL correction.

b. Peak Bias Computation:

- (1) Determine and Record CP_0 :

CP_0 is the clearance plane value read at the intersection of the 0 (zero) range line and the best fit straight line.

CP_0 = 650 feet

(2) Compute and Record Bias Error:

Bias error is obtained by algebraically subtracting CP_0 from zero range absolute altitude.

Zero Range Absolute Altitude= 900 feet

CP_0 = 650 feet

Bias Error= Absolute Altitude - $CP_0=900-(650)=+250$ feet

(3) Compensation for Bias Error:

Bias error compensation, in this case, is accomplished by decreasing the clearance plane by one-half of the bias error (1/2 of 250= 125 feet).

4. Record TA Low Level Data:

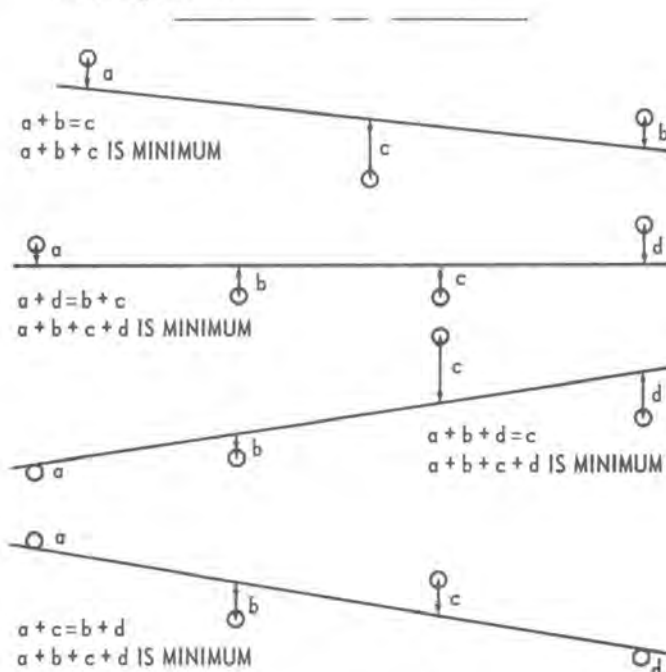
Briefed Clearance Plane Setting - 800 feet and 1000 feet

(NOTE: This route has two Clearance Plane Settings)

Computed Profile Clearance Plane Setting= 675 feet and 875 feet

Final Profile Clearance Plane Setting Used= 600 feet and 800 feet

FRL Setting Used= -0.95°



BEST FIT STRAIGHT LINE

NOTE

A "best fit" straight line is the straight line which has the least total deviation from all of the plotted points. This condition will be approximated if the deviations of the plotted points above the line equal the deviations of the points below the line and the sum of all the deviations of the points from the line is a minimum as shown above. (It is not necessary to compute the line; it can be established with acceptable accuracy by estimation.)

DETAIL B

TA System Error Computation and Compensation Example

Figure 4-59 (Sheet 2 of 4).

Classified by B-52 Security Classification Guide, 1 Oct 72.
 Subject to General Declassification Schedule of Executive
 Order 11652. Automatically downgraded at two year intervals.
 Declassified on 31 December

B-52 EYS TERRAIN AVOIDANCE CALIBRATION WORKSHEET												
SECTION I	AIRCRAFT TAIL NO	CREW NO - NAV	DATE, TIME (Z)	FUNCTIONAL CHECK	IAS	GROSS WEIGHT	AGM CORR	FRL SETTING				
	00-0000	E-20	4 JUL 1500	☒ SATISFACTORY ☐ UNSATISFACTORY	270	310,000	0	-1.4				
SECTION II	LOW LEVEL ROUTE/AREA			TYPE TERRAIN AND ELEVATION		AIR BRAKE POSN		PRESS ALTITUDE				
	08-29 / BAYSHORE (WEST)			FLAT AND ROLLING 1700		ZERO		2500				
	ZERO RNG ABS. ALT			CLEARANCE PLANE READINGS		STAB MODE CHECK		STAB MODE				
						CP SETTING STAB MODE 750 FRL 800 HOR 850 FVR		FRL				
SECTION III	RANGE	0	1	2	3	4	5	6	7	8	9	10
	3000											3000
	2900											
	2800											
	2700											
	2600											
	2500											2500
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TA SYSTEM ERROR COMPENSATION												
SECTION IV	PEAK TILT COMPUTATION		PEAK BIAS COMPUTATION		FLAT AND ROLLING BIAS COMP		FLAT & ROLLING TILT COMP					
	CP ₁₀		ZERO RANGE ABS. ALT		CHART FRL	+ 1.4 °				550		
	CP ₀ (-)		CP ₀ (-)			-0.8 °		CP BIAS COMP VALUE		125		
			BIAS	+	FRL CAL VALUE	+ 2.2 °		CAL CP SETTING		675		
	CORR FEET	+	+ BIAS X 1/2 (Decr. CP)	-	CP READING	1050		FINAL FRL READING		0.2 °		
	CORR ANGLE X .001 FRL	+	- BIAS X 1.0 (incr. CP)	-	RADAR ALT (-)	800				-0.8 °		
					250		CHART FRL (-)		+ 1.4 °			
				+2 = CP BIAS COMP VALUE	125		TILT COMP VALUE		-0.4 °			
TA CONTOUR FLYING												
SECTION V	BRIEFED CP SETTING			FRL SETTING USED			PROFILE CP SETTING COMPUTER		625		675	
	500 / 550			- 1.0			PROFILE CP SETTING USED		650		700	
REMARKS												
GENERAL INSTRUCTIONS												
1. Operations Instructions for use of this form are contained in T.O.'s 1B-52G/H-1, Sections II and IV. Maintenance Instructions are contained in T.O. 1B-52G-2-26, Section V.												
2. This form is designed to be filled out in sequence from top to bottom.												
3. Only data in Section I need be completed for terminal area check.												
4. <u>CLASSIFICATION</u> : This form is <u>Confidential</u> when filled in.												
NOTE: See reverse for TA System Error Compensation Procedures.												
SAC FORM OCT 74 449a REVISED												

DETAIL C — FLAT AND ROLLING

Figure 4-59 (Sheet 3 of 4).

● **AN EXAMPLE OF METHODS TO USE WHEN FILLING OUT THE FORM DURING A FLAT AND ROLLING TERRAIN RUN IS INCLUDED IN THE FOLLOWING PROCEDURES:**

1. Record Initial Conditions:
 - Aircraft Tail No. = 00.0000
 - Crew No. – Navigator = E-20, York
 - Date/Time = 4 Jul/1500
 - Functional Check = Satisfactory
 - IAS = 270 Knots
 - Gross Weight = 310,000 pounds
 - AGM Correction for external AGM-69A = Zero
 - Airbrake Position = Zero
 - FRL Setting = -1.4°
 - Low Level Route = 08-29/BAYSHORE (WEST)
 - Type Terrain and Elevation = Flat and Rolling and 1700 feet
 - Pressure Altitude = 2500
 - Stab Mode = FRL (Stabilization mode used for system calibration)
2. Record TA System Calibration Data:
 - a. Stabilization Mode Check:
 - FRL = +750 feet
 - HOR = +800 feet
 - FVR = +850 feet
 - b. Flat and Rolling Bias Computation:
 - (1) Compute and Set FRL Angle for Calibration Run:
 - Algebraically add Chart FRL Value to -0.8° . This value is set into the Angle of Attack indicator for the calibration run.
 - Calibration FRL Value = Chart FRL Value $-(0.8^{\circ}) = -1.4^{\circ} - (0.8^{\circ}) = -2.2^{\circ}$
 - (2) Record Clearance Plane Reading and Radar Altimeter Altitude:
 - Clearance Plane Reading = 1050 feet
 - Radar Altimeter Altitude = 800 feet
 - (3) Compute and Record Clearance Plane Bias Compensation:
 - Algebraically subtract radar altimeter altitude from the clearance plane reading, then divide by two. Result is clearance plane bias compensation value to be applied directly to clearance plane setting throughout the remainder of flight.
3. Computation and Compensation:
 - a. Flat and Rolling Bias Computation:
 - (1) Compute and Set FRL Angle for Calibration Run:
 - Algebraically add Chart FRL Value to -0.8° . This value is set into the Angle of Attack indicator for the calibration run.
 - Calibration FRL Value = Chart FRL Value $-(0.8^{\circ}) = -1.4^{\circ} - (0.8^{\circ}) = -2.2^{\circ}$
 - (2) Record Clearance Plane Reading and Radar Altimeter Altitude:
 - Clearance Plane Reading = 1050 feet
 - Radar Altimeter Altitude = 800 feet
 - (3) Compute and Record Clearance Plane Bias Compensation:
 - Algebraically subtract radar altimeter altitude from the clearance plane reading, then divide by two. Result is clearance plane bias compensation value to be applied directly to clearance plane setting throughout the remainder of flight.
 - b. Flat and Rolling Tilt Computation:
 - (1) Compute Clearance Plane Value for Calibration Run:
 - Algebraically add clearance plane bias compensation value to 550. This value is only used for calibration run purposes.
 - Clearance Plane Value for Calibration Run = $550 + \frac{\text{Clearance Plane Bias Compensation Value} \times 2}{2}$
 - $550 + (125) = 675$ feet.
 - (2) Adjust FRL Angle of Attack Control and Record Final FRL Reading:
 - Final FRL Reading = -0.2° .
 - (3) Compute and Record Tilt Compensation Value:
 - Algebraically add Final FRL Reading to -0.8° . Then algebraically subtract Chart FRL Value, the result is Tilt Compensation Value.
 - Tilt Compensation Value = Final FRL Reading $+ (-0.8^{\circ}) - \text{Chart FRL Value} = -0.2^{\circ} - 0.8^{\circ} - (-1.4^{\circ}) = +0.4^{\circ}$.
 - This value must be added algebraically to the current FRL angle of attack chart value with the result set into the TA system throughout the remainder of flight.
4. Record TA Low Level Data:
 - Briefed Clearance Plane Setting = 500 feet and 550 feet.
 - (NOTE: This route has two Clearance Plane Settings)
 - Computed Profile Clearance Plane Setting = 625 feet and 675 feet
 - Final Profile Clearance Plane Setting Used = 650 feet and 700 feet
 - FRL Setting Used = -1.0°

TA System Error Computation and Compensation Example

Figure 4-59 (Sheet 4 of 4).

ELECTRO-OPTICAL VIEWING SYSTEM (EVS) (AN/ASQ-151)

The EVS provides the crewmembers with a visual presentation of the area ahead of the aircraft for low level penetration during both day and night missions. To accomplish this function, the EVS utilizes a steerable low light level television camera (STV) and a steerable forward looking infrared sensor (FLIR) to supply video, which is then displayed on monitors at the pilot's, copilot's, navigator's, and radar navigator's positions. The EVS also receives input signals from other aircraft ancillary systems, which are converted to symbology suitable for TV display and are displayed on the EVS monitors. The bombing-navigational system (BNS) furnishes terrain avoidance profile (TA) video information for display on the EVS monitors. For complete information on TA displays, see "Terrain Avoidance System," this section. The sensors for the STV and FLIR are mounted within steerable turrets on the underside of the aircraft just aft of the forward radome. The STV turret (31A, figure 1-2) is on the left side of the aircraft and the FLIR turret (33A, figure 1-2) is on the right. Each turret rotates in azimuth to follow the position of its sensor when that sensor is being used, but rotates to the aft or stow position when the sensor is not in use. The turrets are provided with optical windows to protect the sensors and have window wash facilities to remove debris from the windows during flight. The EVS is composed of three major electronic/electrical subsystems; the Steerable Television Set (STV) AN/AVQ-22, the Forward Looking Infrared Set (FLIR) AN/AAQ-6, and the Data Presentation Group OD-86/ASQ-151. The components are located in three major areas of the aircraft; the forward radome area, the pilots' area, and the navigators' area.

STEERABLE TV (STV) SYSTEM

The STV consists of a camera assembly, camera electronics unit, and a control panel at the radar navigator's station. It provides high quality video information over a wide range of ambient light levels, from bright sunlight to starlight. The night scenes closely approximate daylight operation for target location and identification, which enables the STV to serve as a low light level sensor for the EVS. The STV can view selected areas within $\pm 45^\circ$ in azimuth, referenced to the centerline of the aircraft. In the elevation plane, the STV can view scenes within $\pm 15^\circ$ and $\pm 45^\circ$ referenced to the camera mounting surface. Either the video in the entire field of view, or in the center 1/3 of the field of view can be selected by the operator to enhance the presentation on the display. Automatic light control circuits are used to maintain a relatively constant video signal over a wide range of lighting conditions. The automatic light control circuits can be disabled and manual control initiated, if desired. Under extremely

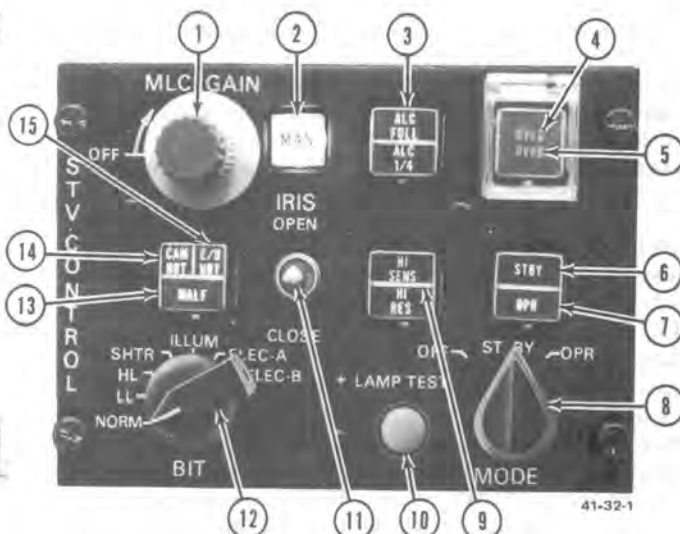
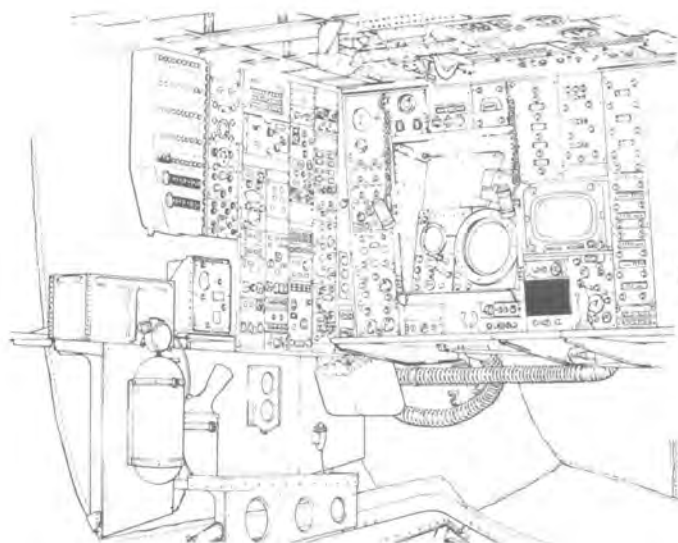
low ambient lighting, a high sensitivity mode of operation provides additional gain, but with some loss in resolution. A flash protector detects extremely bright flashes of light and closes a shutter in the camera for the duration of the flash; the automatic light control circuits are adjusted to be compatible with shutter opening and the system resumes operation automatically. Built-in test (BIT) circuits perform three major functions: (1) continuously monitor critical equipment parameters, (2) enable the operator to perform "front-to-rear" checks to detect degradation, and (3) a means of isolating a fault to an LRU (line replaceable unit). Failures in BIT monitored functions generate a malfunction signal. The video output BIT circuit monitors for loss of video and video saturation. If loss of video occurs, the BIT circuit causes the system to go to standby and a malfunction signal is given. If video saturation occurs, the BIT circuit causes the system to go to ALC FULL; then, if saturation persists, the system goes to standby and a malfunction signal is given. The STV receives single phase 118 volt a-c power and TR power through circuit breakers located on the EVS circuit breaker panel at the navigator's station.

CAUTION

Point sources of high intensity illumination, relative to the overall scene illumination, which remain stationary within the field of view of the STV, may cause damage to the STV camera assembly. During operation on the ground, precautions should be taken to eliminate stationary sources of high intensity illumination (ramp lights, reflections from objects, vehicle headlights, etc.) from within the field of view prior to continued operation of the STV in the operate mode. The camera assembly is protected from this type of damage in standby mode.

STV System Controls and Indicators

MODE SWITCH. The mode switch (8, figure 4-65) on the STV control panel is a rotary selector switch having OFF--STBY--OPR positions and controls the primary operating modes of the STV system. In OFF position the STV system is deenergized and the STV camera iris is closed. In STBY position power is supplied to all STV system circuits except the high voltage power supply and the camera iris light control circuits. Also the standby light (6, figure 4-65) is illuminated to show the letters "STBY" in green. In OPR position the entire STV system is energized for operation and the operate light (7, figure 4-65) will show the letters "OPR" in green provided there



- | | |
|----------------------|-------------------------------------|
| 1. MLC GAIN KNOB | 9. HI SENS/HI RES SWITCH |
| 2. MAN LIGHT | 10. LAMP TEST SWITCH |
| 3. ALC SELECT SWITCH | 11. IRIS SWITCH |
| 4. OVLD/OVRD LIGHT | 12. BIT SWITCH |
| 5. OVLD/OVRD SWITCH | 13. MALFUNCTION LIGHT |
| 6. STBY LIGHT | 14. CAMERA OVERHEAT LIGHT |
| 7. OPR LIGHT | 15. ELECTRONICS UNIT OVERHEAT LIGHT |
| 8. MODE SWITCH | |

STV Control Panel

Figure 4-65.

are no system malfunctions monitored by the built-in-test circuits. The standby light will go out when the operate light comes on.

NOTE

If the built-in-test circuits detect a malfunction, the system will be returned to standby, the standby and malfunction lights will come on, and the operate light will go out. When this occurs the system can be reset by rotating the mode switch to OFF, back to STBY and then to OPR. If the detected malfunction is no longer present, the standby and malfunction lights should go out and the operate light come on.

HI-SENS/HI-RES SWITCH. The HI-SENS/HI-RES switch (9, figure 4-65) on the STV control panel is a pushbutton switch used to switch between high sensitivity and high resolution of the STV camera. The condition of the switching circuits is indicated by illumination of the green letters "HI-SENS" or "HI-RES" on the switch face. The normal condition is HI-RES which provides maximum resolution under normal lighting. HI-SENS condition is used when poor lighting conditions exist to improve contrast, however, some loss in resolution occurs.

MLC GAIN KNOB. The MLC gain knob (1, figure 4-65) on the STV control panel is used to select automatic light control (ALC) or manual light control (MLC). OFF (detent) position enables ALC sensing

circuits and disables the iris switch. In the event the ALC sensing circuits fail, the knob may be moved out of the OFF position to disable the ALC circuits, enable the iris switch, and manually control the remaining light control circuits. Clockwise rotation of the knob increases the gain of the STV sensor.

The iris switch must be used in conjunction with the MLC gain control to control the STV iris opening when manual light control is necessary. When the MLC gain control is moved out of the OFF position, the IRIS switch is enabled. Holding the switch in CLOSE position will drive the iris closed, and conversely, holding the switch in OPEN position will drive the iris open.

IRIS SWITCH. The iris switch (11, figure 4-65) on the STV control panel has CLOSE--OFF--OPEN--positions and is spring-loaded to the center OFF position. This switch is used in conjunction with the MLC gain control to control the STV iris opening when manual light control is necessary. When the MLC gain control is moved out of the OFF position, the IRIS switch is enabled. Holding the switch in CLOSE position will drive the iris closed, and conversely, holding the switch in OPEN position will drive the iris open.

ALC SELECT SWITCH. The ALC select switch (3, figure 4-65) is a pushbutton switch on the STV control panels used with the automatic light control system and provides a means of switching between ALC FULL and ALC 1/4. In ALC FULL mode, the ALC sensing circuits operate on the video from the total field of view. In ALC 1/4 mode, the ALC

sensing circuits operate on the video from only the center 1/4 of the field of view to optimize the display of that portion of the field. Pressing the switch will switch the system to the other mode. The switch contains two integral lights illuminating the words "ALC FULL" or "ALC 1/4" in green. The respective indicator light will illuminate indicating the mode selected.

OVLD/OVRD SWITCH. The OVLD (overload)/OVRD (override) switch (5, figure 4-65) is a pushbutton switch on the STV control panel used to override ALC protection circuits and is guarded with a transparent guard. With the system operating in the ALC 1/4 mode and the video signal from the outer 3/4 of the field of view saturated, the system will automatically switch to the ALC FULL mode. If the signal remains saturated, the system will immediately revert to STBY mode. Under emergency conditions, the OVLD/OVRD switch can be used to restore the system to the ALC 1/4 mode. An integral indicator light (4, figure 4-65) will illuminate showing the words "OVLD OVRD" in amber when the OVLD/OVRD function is selected and will extinguish automatically if the video signal saturation condition clears.

CAUTION

Use of the OVLD/OVRD switch disables the camera tube assembly protection circuits and can result in permanent damage to the sensor tube.

BIT SWITCH. The BIT (built-in test) switch (12, figure 4-65) is a selector switch on the STV control panel used to select the various built-in-test functions of the STV system, and to isolate faults. Switch positions are NORM--LL--HL--SHTR--ILLUM--ELEC-A--ELEC-B.

NOTE

Switch positions SHTR, ILLUM, ELEC-A, and ELEC-B provide fault isolation capability only and should not be used unless a fault exists. Switch positions other than NORM rotate the camera to stow position.

NORM position must be selected for normal STV operation. This position enables continuous monitoring of various electronic circuits by the system. LL position provides a low light level by the camera illuminator for testing. HL position provides a high light level by the camera illuminator for testing. SHTR position closes the camera shutter to simulate a sun sense or flash protection ALC shutdown. ILLUM position checks the camera illuminator test light, the malfunction light will illuminate if the camera light is bad. ELEC A position checks out the system in a minimum gain condition. ELEC B position checks out the system on a maximum gain condition.

MALFUNCTION LIGHT. The malfunction light (13, figure 4-65) on the STV control panel shows the letters "MALF" in amber when one or more of the built-in-test functions fail.

CAMERA OVERHEAT LIGHT. The camera overheat light (14, figure 4-65) on the STV control panel shows the letters "CAM HOT" in amber when an overheat condition exists in the camera assembly.

ELECTRONICS UNIT OVERHEAT LIGHT. The electronics overheat light (15, figure 4-65) on the STV control panel shows the letters "E/U HOT" in amber when an overheat condition exists in the camera electronics unit.

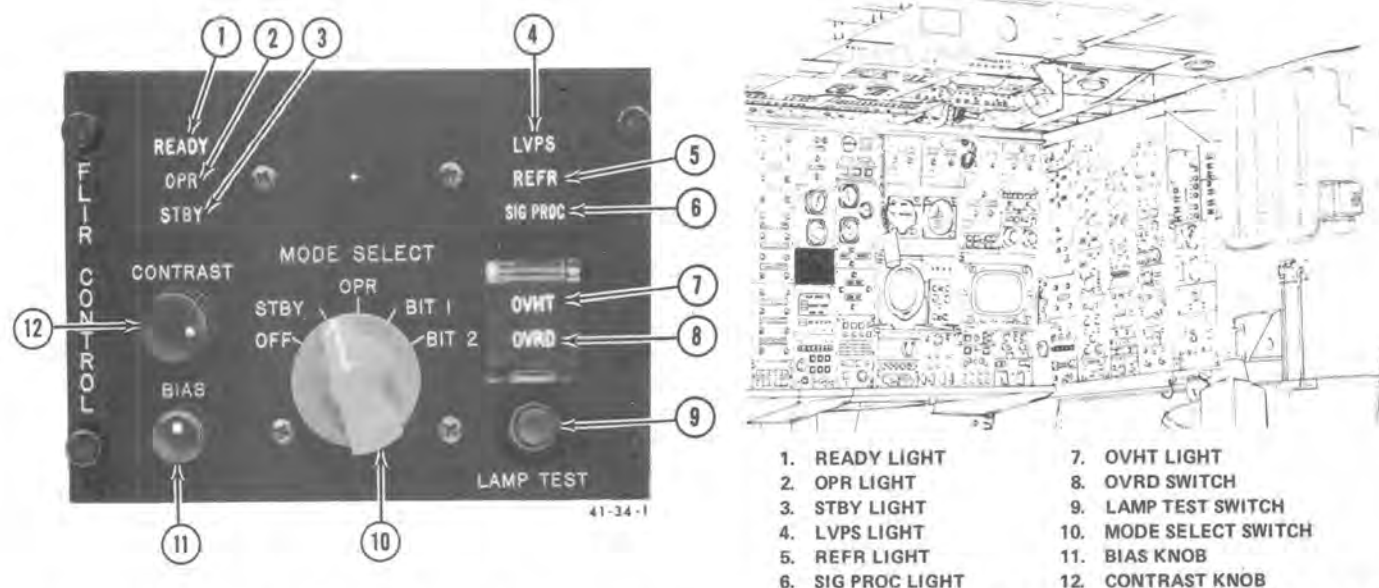
LAMP TEST SWITCH. The lamp test switch (10, figure 4-65) on the STV control panel is a pushbutton switch used to test all STV control panel indicator lights. The mode switch must be in STBY or OPR to enable the test function.

FORWARD LOOKING INFRARED (FLIR) SYSTEM

The FLIR consists of a scanner assembly, signal processor, and control panel at the radar navigator's station. The function of the FLIR is to convert infrared radiation that is not visible to the unaided eye into real-time information for display on the EVS monitor. The FLIR is especially useful for target location and identification through cloud coverage and in complete darkness. The scanner assembly detects thermal radiation and converts the energy into electrical signals. The signal processor converts the IR video into video suitable for presentation on the monitors. A refrigerator system in the scanner assembly provides the extremely low temperatures required by the IR detectors and is controlled by the FLIR panel located on the radar navigator's forward panel. The FLIR system receives 205/118-volt 3-phase a-c power and TR power through circuit breakers located on the EVS circuit breaker panel.

FLIR System Controls and Indicators

MODE SELECT SWITCH. A five-position rotary mode select switch (10, figure 4-66), is located on the FLIR control panel. The switch has OFF--STBY--OPR--BIT 1--BIT 2 positions and selects the mode of operation of the FLIR system. In the OFF position, the FLIR system is completely inoperative with the exception that the turret stow command will be operative. In the STBY position the FLIR system is prepared for full operation except the azimuth scan mirror, thus video signals are not available to the monitors. Status indicators are either armed or operative and the STBY light is on. Overheat failure circuits are operative but cannot be overridden. In the OPR position, the FLIR system is completely operational and the OPR light will come on. After refrigerator cool-down, the READY light will come on and a display is available to the monitors. Refrigerator cool-down may take up to 30 minutes, depending on ambient conditions in the sensor. Overheat failures can be overridden in the



FLIR Control Panel

Figure 4-66.

event of an urgent requirement for uninterrupted FLIR system operation. In BIT 1 position, the built-in test (BIT) that determines the operational capability of the low-level multiplexers and sync driver are operative. This test position also determines if any of the IR detector element channels are noisy by displaying a series of vertical alternate black and white lines on the monitors. BIT 2 position provides a built-in test (BIT) that determines the operational capability of the signal processor. This test position should cause two horizontal lines closely spaced in the upper half of the vertical field to be displayed on the monitors.

STBY LIGHT. A standby light (3, figure 4-66) on the FLIR control panel will show the letters "STBY" in green when the FLIR system is in standby mode. The light will go out when the operate light is on.

OPERATE LIGHT. An operate light (2, figure 4-66) on the FLIR control panel will show the letters "OPR" in green when the FLIR system is in operate mode and low voltage power supply, refrigerator system, and signal processor have power applied and are operating correctly. In case of any unit failure and resultant shutdown, the OPR indicator will extinguish.

READY LIGHT. A ready light (1, figure 4-66) on the FLIR control panel will show the word "READY" in green when the FLIR system is capable of detecting a target. The light will come on in standby or operate mode when the refrigerator system has cooled down to operating temperature of 26° K (-247°C or -413°F).

LVPS LIGHT. An LVPS light (4, figure 4-66) on the FLIR control panel will show the letters "LVPS" in amber in the event of a FLIR low-voltage power supply failure or overheat. When LVPS failure occurs, the LVPS will automatically shut down, the OPR and READY lights will go out, and the LVPS and STBY lights will come on. The power supply may be reset by positioning the mode select switch to OFF and then back to STBY. If the failure was due to a transient, the system will restart. If the LVPS light remains on, the FLIR system should be turned off and not operated until appropriate maintenance is performed.

REFR LIGHT. A refrigerator light (5, figure 4-66) on the FLIR control panel will show the letters "REFR" in amber in the event of a failure or overheat in the refrigerator compressor or detector assembly.

SIG PROC LIGHT. A signal processor light (6, figure 4-66) on the FLIR control panel will show the letters "SIG PROC" in amber in the event of a signal processor overheat or failure. When the signal processor fails, the signal processor high voltage power supply automatically shuts down and the SIG PROC light comes on. The signal processor may be restarted by placing the mode select switch to OFF and then back to STBY. If the failure was due to a transient, the system will operate normally. If the SIG PROC light remains on, the FLIR system should be turned off and not operated until appropriate maintenance is performed.

OVHT LIGHT. An overheat light (7, figure 4-66) on the FLIR control panel will show the letters "OVHT" in amber simultaneously in conjunction with the LVPS, REFR, or SIG PROC lights, indicating an overheat condition exists in the equipment monitored by the light. After a delay of 120 seconds, the system will automatically shut down as evidenced by the READY and OPR indicators going out and the STBY indicator illuminating. This 120-second delay in shutdown allows the operator to decide whether the situation warrants the risk of possible equipment damage or whether to turn the system off.

OVRD SWITCH. A pushbutton override switch (8, figure 4-66) on the FLIR control panel is used to override an automatic shutdown of the FLIR circuits monitored by the LVPS, REFR, SIG PROC, and OVHT lights. An overheat condition arms the override circuits providing the mode select switch is in OPR position. When an overheat condition occurs, the OVRD switch may be used to continue system operation with the possibility of equipment damage.



Use of the override feature may cause FLIR system damage. The override feature should only be used in case of urgent need for uninterrupted FLIR system operation.

The OVRD switch incorporates a transparent hinged guard that must be raised before actuating the switch. In addition, an integral light is provided to indicate "OVRD" in amber letters when the override function has been selected. Pressing the switch will energize the override function and cause the OVHT light to go out and the OVRD light to come on. Prior to an overheat condition, the override circuits are electrically interlocked to prevent inadvertent operations that would jeopardize the thermal protection. The system is also interlocked in a manner that sets the system to the standby mode from the operate mode and causes the operation status lights to switch from OPR to STBY if a shutdown occurs. In the event that the overheat condition is due to a transient, the system reverts to normal operation, the operation status lights switch from STBY to OPR, and the OVHT/OVRD lights go out.

LAMP TEST SWITCH. A lamp test switch (9, figure 4-66), located on the FLIR control panel, is used to test all indicator lights on the FLIR control panel. The mode select switch must be in STBY or OPR position for this switch to be operative.

CONTRAST KNOB. A contrast knob (12, figure 4-66), located on the FLIR control panel, permits the operator to adjust the video gain (contrast) of the FLIR signal. Clockwise rotation increases the contrast.

BIAS KNOB. A bias knob (11, figure 4-66), located on the FLIR control panel, is used to vary the brightness (bias) of the FLIR signal. Clockwise rotation increases the brightness.

DATA PRESENTATION

The data presentation group consists of a servo control unit (SCU), video distribution unit (VDU), symbol signal generator (SSG), the various video control panels, and the four EVS monitors. The data presentation group provides STV and FLIR sensor video and steering control priority, navigation and attitude symbols, video and symbol mixing and visual display of the selected scene with appropriate symbology. The data presentation group also receives inputs from other aircraft systems for display on the EVS monitors.

The BNS furnishes time-to-go, heading error, and TA profile video information. It also provides azimuth and elevation steering and roll stabilization for the STV and FLIR sensors when a BNS steering mode has been selected. The aft landing gear furnishes a crab steering signal to align the STV and FLIR sensors with the landing gear when crab steering mode has been selected. The angle of attack computer and the AN/APN-89A doppler radar furnish angle of attack and drift signals, respectively, to position the STV and FLIR sensors in elevation and azimuth, respectively, when vector mode of steering has been selected. The pilot's and copilot's pitch and roll gyros, Type MD-1, furnish pitch and roll signals that are converted to a pitch and roll bar for display on the pilot's and copilot's monitors. When the BNS is not in bomb mode, a bank/steering marker, developed from the bank/steering error signal from the flight director computer is displayed on the EVS monitor. The IAS transducer produces an indicated airspeed signal, which is displayed in numerical value on all monitors. A radar altitude signal from the AN/APN-150(V) radar altimeter, is used to develop a radar altitude ribbon, which is in turn displayed on all monitors.

NOTE

The EVS symbology is solely for aiding the pilot during use of the EVS system. The aircraft flight instruments remain the primary flight reference.

Types of Presentation

PILOTS. Provided that the STV and FLIR systems are in an operating mode and that all ancillary systems are operating, the pilot and copilot have a choice of display on their respective monitors. Either a FLIR, STV, or terrain avoidance (TA) presentation may be selected individually or the TA presentation may be viewed in conjunction with either TV or FLIR. If any of the above are being viewed and the pilot or copilot have selected a steering command, the pilot's and copilot's monitors will also display symbols developed from inputs from ancillary systems. These symbols include indicated airspeed blanking box and numerics, time-to-go blanking box and numerics, radar altitude blanking box, indices, scale numerics, and altitude ribbon, heading reference marker, heading error or bank/steering marker, and pitch and roll bar. Azimuth and elevation short scales and azimuth and elevation line-of-sight (LOS) markers are also displayed if either STV or FLIR steering is selected. See figure 4-67 for a typical pilot/copilot display on the EVS monitor. If the navigator or radar navigator have command and the pilot or copilot have elected to view the FLIR or STV, the pilot's and copilot's monitors will display azimuth and elevation long scales with numerics and azimuth and elevation LOS markers along with the FLIR or STV video, but no other symbols will be displayed.

NAVIGATORS. The navigator's or radar navigator's monitor displays either an STV or FLIR video presentation with azimuth and elevation long scales and numerics and azimuth and elevation LOS markers. If either the navigator or radar navigator elects, he may select symbols for display on his individual monitor. These symbols will be the same as the pilot's and copilot's symbols, except his monitor will not display the pitch and roll bar. Also the TA trace is not available for display on the navigator's or radar navigator's monitor.

FIELDS OF VIEW. The STV or FLIR presentation is selectable in either wide field of view (WFOV) or narrow field of view (NFOV). The STV WFOV covers a viewing area $16.8 \pm 1^\circ$ vertical and $22.4 \pm 1^\circ$ horizontal. The STV NFOV covers a viewing area $5.6 \pm 1^\circ$ vertical and $7.5 \pm 1^\circ$ horizontal. The FLIR viewing area is slightly smaller, covering $15 \pm 0.6^\circ$ vertical by $20 \pm 0.6^\circ$ horizontal in WFOV and $5 \pm 0.2^\circ$ vertical by $6.7 \pm 0.2^\circ$ horizontal. In WFOV, the fiducial marks cover approximately the center 1/3 of the presentation, and indicate the viewing area that will be presented when switching to NFOV. In NFOV, the fiducial marks extend to the sides and the bottom of the presentation.

Steering Priority

Since the primary function of the EVS is to provide steering information to the pilot for low level pene-

tration, a steering priority has been established within the system. The priority is pilot, copilot, navigator or radar navigator in that order, meaning that the pilot can override any other crewmember in control of either sensor. If the pilot has not selected a steering command, the copilot can assume steering command, although the pilot can still view on his monitor the video the copilot has selected to observe. If neither the pilot nor the copilot has selected a steering command, the navigator or radar navigator may assume command through use of a common steering control panel. The pilot and copilot may still view whatever the navigator or radar navigator have selected to observe.

POWER SUPPLIES

The system incorporates isolated power supplies for increased reliability. The eight servo control unit (SCU) power supplies are interconnected with the system such that pilot and navigator only utilize one power supply and the copilot and radar navigator utilize the other. The remaining six power supplies separately supply power to the TV and FLIR steering servo components. Four video distribution unit power supply assemblies are utilized in a similar manner as the SCU power supplies. The control circuit breakers for EVS are contained on the navigator's EVS circuit breaker panel (figure 1-26).

EVS MONITOR

The EVS monitor (figure 4-67) is located at both pilot stations (14, figure 1-15) and at both navigator stations (23, figure 4-40) and (67, figure 4-41). The monitor provides TV format displays of FLIR and STV sensor video. In addition the monitors at each pilot station provide profile mode display of the terrain avoidance radar system.

NOTE

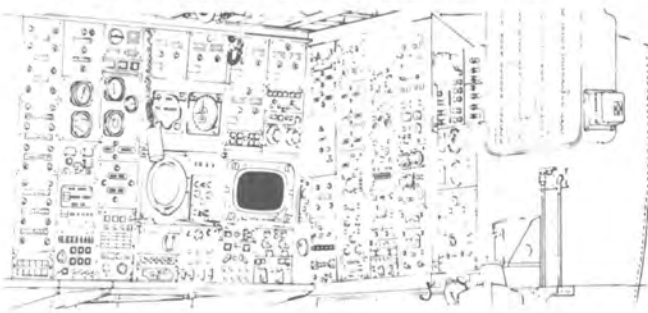
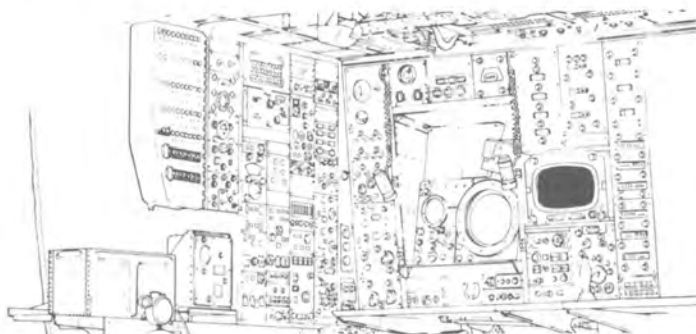
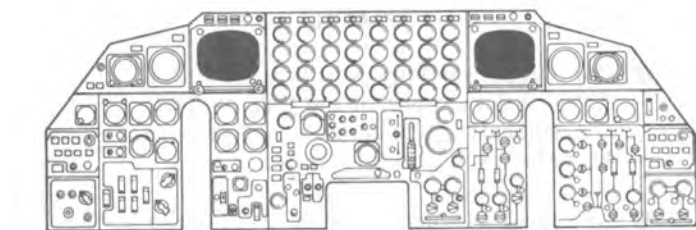
- The EVS symbology is solely for aiding the pilot during use of the EVS system. The aircraft flight instruments remain the primary flight reference.
- Individual monitors should be adjusted for brightness and contrast before the system is readjusted, particularly for the FLIR system. Adjustments for reverse FLIR should be the same as for normal video.

EVS Monitor Controls and Indicators

CONTRAST KNOB. The contrast knob (3, figure 4-67) marked "C" and on front of the monitor is used to vary the gain of the video amplifier circuit thereby controlling the image contrast of the monitor. Clockwise rotation of the knob increases the image contrast. The contrast knob is turned clockwise, after the brightness knob has been set, until a satisfactory display is obtained.



1. EVS MONITOR
2. EVS SENSOR ELEVATION INDICATOR
3. CONTRAST KNOB
4. INDICATED AIRSPEED INDICATOR
5. TIME-TO-GO INDICATOR (BOMB MODE ONLY)
6. HEADING REFERENCE MARKER
7. HEADING ERROR MARKER OR BANK/STEERING MARKER
8. PITCH AND ROLL INDICATOR
9. BRIGHTNESS KNOB
10. RADAR ALTITUDE INDICATOR
11. OVERHEAT LIGHT
12. EVS SENSOR AZIMUTH INDICATOR
13. FIDUCIAL MARKS
14. TA TERRAIN TRACE (PILOTS ONLY)
15. TA HORIZONTAL REFERENCE LINE (PILOTS ONLY)



..... EVS Monitor

Figure 4-67.

BRIGHTNESS CONTROL. The brightness knob (9, figure 4-67) marked "B" and on front of the monitor varies the illumination of the monitor. Clockwise rotation of the knob increases illumination. This knob is normally turned counterclockwise (with the contrast knob fully counterclockwise) until the monitor illumination is not visible. This provides the proper brightness knob setting for normal ambient lighting conditions.

OVERHEAT LIGHT. This amber light (11, figure 4-67) on front of the monitor is connected to an overheat sensor in the monitor and will come on when the overheat sensor signals an overheat condition and will remain on until the overheat condition is corrected. This light incorporates an integral press-to-test feature for testing the light bulb.



If this light cannot be extinguished by providing increased cooling air etc in 5 minutes after initial illumination, the monitor should be turned off or equipment damage can be expected.

EVS Monitor Symbolology

EVS SENSOR ELEVATION INDICATOR. The EVS sensor elevation indicator (2, figure 4-67) is made up of an elevation reference scale and an elevation marker. The scale will be a "long" scale or a "short" scale depending on whether pilots' or navigators' have steering control. The "long" scale consists of index marks numbered in degrees, whereas the "short" scale consists only of index marks. Both navigators' monitors will always display "long" scale. Both pilots' monitors will display "long" scale only when navigators have steering control and will always display "short" scale when either pilot has steering control. The elevation marker will move vertically along the elevation scale in direct proportion to elevation angular positioning of STV and FLIR sensors.

INDICATED AIRSPEED (IAS) INDICATOR. The indicated airspeed indicator (4, figure 4-67) provides a numeric indication of aircraft indicated airspeed in knots. The indicator is a box with three enclosed digits that vary from 000 to 450 in 1-knot increments. The numerics are updated every 1/6-second to provide continuously corrected airspeed information.

TIME-TO-GO INDICATOR. The time-to-go indicator (5, figure 4-67) provides an indication of time in seconds remaining before the BNS provides a bomb release pulse. The indicator is a box with three enclosed digits that vary from 000 to 200. The time-to-go indicator is functional only when BNS is in bomb mode.

NOTE

EVS time to go indicator should not be considered reliable for weapon release.

HEADING REFERENCE MARKER. The heading reference marker (6, figure 4-67) consists of two vertical black bars separated by a white bar, and provides a fixed zero-degree azimuth reference for the movable heading/bank steering marker.

HEADING ERROR MARKER. The heading error marker (7, figure 4-67) indicates bomb mode heading error while in bomb mode or navigation heading error when the BNS is not in bomb mode and either of the navigators have actuated the BNS heading switch on his video select panel. When time-to-go numerics are displayed this indicator is showing BNS heading error and conversely when the time-to-go numerics are not displayed, this indicator is showing bank/steering.

BANK/STEERING MARKER. The bank/steering marker (7, figure 4-67) indicates bank/steering signal when the BNS is not in bomb mode and neither navigator has selected BNS heading on his video select panel when not in bomb mode. When bank/steering bar is displayed, time-to-go numerics will be removed.

PITCH AND ROLL INDICATOR. The pitch and roll indicator (8, figure 4-67) is a line of eight white and six black dashes and provides pitch and roll attitudes of the aircraft. The indicator indicates zero pitch and roll when it is level aligned in the center of the monitor. The indicator functions as an artificial horizon, moving up and down an imaginary vertical axis of the display, and rotating left or right about the center point of the line. Vertical excursions represent pitch angle, while rotating around center point of line provides a visual reference of bank angle.

NOTE

A pitch bar adjustment knob located above the pilot's and copilot's monitors provides a means of vertically positioning the respective pitch and roll indicator to the desired location.

RADAR ALTITUDE INDICATOR. The radar altitude indicator (10, figure 4-67) consists of an altitude scale and a white ribbon indicator. The scale is made up of 13 fixed index lines, 11 (fixed numerics), and a blanking box. Each numeric indicates a scale factor representing hundreds of feet above terrain. The white ribbon indicator moves vertically along the scale and represents radar altitude determined by the radar altimeter. The indicator is scaled from 0 to 3000 feet. The white ribbon indicator will blink at a 3 cycle-per-second rate whenever indicated altitude is below the lower cursor setting on the pilot's radar altimeter for the pilot's and navigator's monitors and on the copilot's radar altimeter for the copilot's monitor. In addition the white ribbon indicator will disappear from the monitor whenever the radar altimeter is not functional (radar altimeter fail/on function flag reads FAIL).

EVS SENSOR AZIMUTH INDICATOR. The EVS sensor azimuth indicator (12, figure 4-67) is made up of an azimuth reference scale and an azimuth marker. The scale will be a "long" scale or a "short" scale depending on whether pilots' or navigators' have steering control. The "long" scale consists of index marks numbered in degrees, whereas the "short" scale consists only of index marks. Both navigators' monitors will always display "long" scale. Both pilots' monitors will display "long" scale only when navigators have steering control and will always display "short" scale when either pilot has steering control. The azimuth marker will move horizontally along the azimuth scale in direct proportion to azimuth angular positioning of STV and FLIR sensors.

FIDUCIAL MARKS. Fiducial marks (13, figure 4-67) are inscribed on the STV sensor optics and are electronically generated in the FLIR sensor. The fiducial marks are in the form of an interrupted "T" in which the gap between the horizontal bars denotes the center of field of view. The length of the fiducial marks will be magnified three times when switching from wide angle field-of-view to narrow angle field-of-view. The inner ends of the fiducial marks form a 2° cone in the center of the field of view. The outer ends define the limits of the narrow angle field-of-view.

NOTE

The projected intersection of the STV or FLIR fiducial marks is the true line of sight (boresight) of the respective sensor and may be off center in the monitor in some aircraft due to system design tolerances. This misalignment of the fiducial marks will not affect the boresight of the respective system. This intersection of the fiducial marks may be displaced from the center of the monitor as much as 1/2 the distance between the horizontal fiducial marks in WFOV (1/4 of distance in NFOV). The STV/FLIR marks may be rotated up to 2°.

TA TERRAIN TRACE. The TA terrain trace (14, figure 4-67) on the pilots' monitors only is used with the terrain avoidance system and is described under "Terrain Avoidance System" this section.

TA HORIZONTAL REFERENCE LINE. The TA horizontal reference line (15, figure 4-67) on the pilots' monitor only is used with the terrain avoidance system and is described under "Terrain Avoidance System" this section.

EVS Monitor Optical Filters

Red and green EVS monitor optical light filters stowed on the pilot's and copilot's escape hatches (figure 1-51) and a red filter only on the radar navigator's and navigator's overhead panel (2, figure 4-40 and 33, figure 4-41 respectively). The red filter is to be installed over the face of each monitor during darkness or other low light conditions. The

green filters are to be installed over the pilots' monitors during bright light conditions. The filter is installed by placing the bottom edge of the filter into the groove on the housing located just below the bottom of the CRT and above the handle. The snap fasteners on the top corners of the filter must be pushed into matching holes on the monitor case until they are firmly secured. The filter is removed by pulling out the snap fasteners and lifting the filter up and out of the groove.

CAUTION

Do not install the external glare filter (green) over the new dark green colored CRT screen as too high a gain control setting would be required. This high gain setting would decrease the service life of the CRT.

Data Presentation Controls and Indicators (Pilots)

POWER SWITCH. The power switch (8, figure 4-68) on the pilots' EVS control panel is a push-on/push-off type switch having an ON position (depressed) (switch face flush with switch housing) and an OFF position (extended) (switch face extends approximately 1/8 inch from switch housing) which is mechanically latched in each position. The switch is used to turn on and place the respective EVS monitor in standby mode and to provide power for turret and sensor drive and other electronic circuits. When depressed in ON position, the word "ON" in green is illuminated on the switch face provided power is on in the aircraft. When the switch is pressed again and the switch face extends from its housing, the switch is OFF and the respective EVS monitor is deactivated and power is removed from the other circuits provided through the switch.

TA VIDEO SWITCH. The TA video switch (1, figure 4-68) on the pilots' EVS control panel is a momentary pushbutton switch which provides selection of the TA terrain trace on the respective pilot's EVS monitor. The TA video may be selected alone or in dual mode with FLIR or STV displays. When TA video is selected by pressing the switch, the word "ON" in green is illuminated on the switch face. When TA is selected with FLIR or STV, the system is automatically placed in vector steering mode. Other modes may subsequently be selected. The TA video switch must be momentarily depressed again to deactivate the TA circuits.

FLIR VIDEO SWITCH. The FLIR video switch (2, figure 4-68) on the pilots' EVS control panel is a momentary pushbutton switch which provides selection of the FLIR video on the respective pilot's EVS monitor. The FLIR video may be selected alone or in conjunction with TA display. When FLIR video is selected by pressing the switch, the word "ON" in green is illuminated on the switch face. The FLIR circuits may be deactivated by momentarily depressing the FLIR video switch or STV video switch. In either case the ON light will go out.

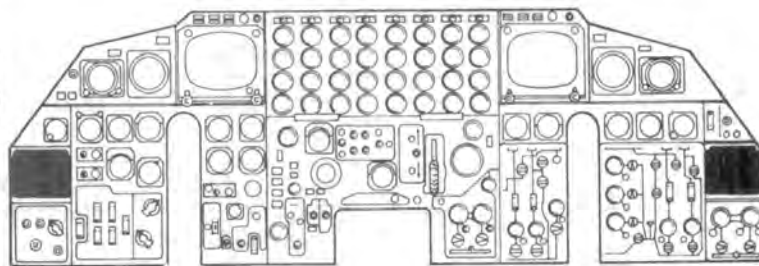
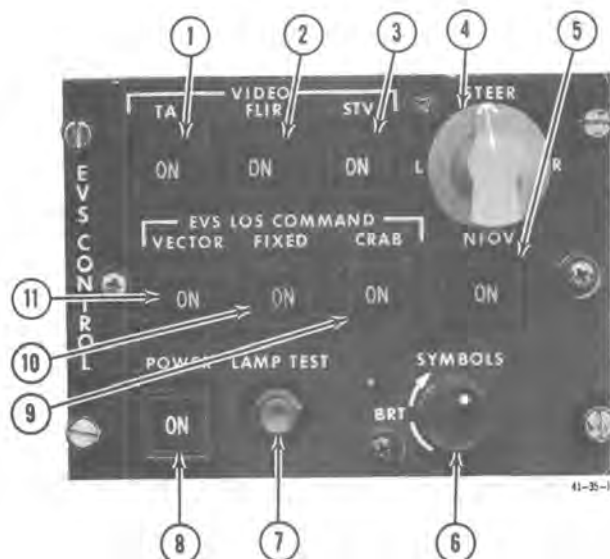
STV VIDEO SWITCH. The STV video switch (3, figure 4-68) on the pilots' EVS control panel is a momentary pushbutton switch which provides selection of the STV video on the respective pilot's EVS monitor. The STV video may be selected alone or in conjunction with TA display. When STV video is selected by pressing the switch, the word "ON" in green is illuminated on the switch face. **The STV circuits may be deactivated by momentarily depressing the STV video switch or FLIR video switch. In either case the ON light will go out.**

VECTOR STABILIZATION SWITCH. The vector stabilization switch (11, figure 4-68) on the pilots' EVS control panel is a momentary pushbutton switch which provides selection of flight vector stabilization of the line-of-sight (LOS) of the selected sensor.

When vector LOS stabilization is selected by pressing the switch, the word "ON" in green is illuminated on the switch face. In vector stabilization, the selected sensor and turret are driven in azimuth to a position corresponding to the drift angle output of the BNS and the sensor driven in elevation according to the output of the angle of attack computer. See figure 4-69 for additional stabilization information. The vector stabilization may be deactivated by depressing the vector, fixed, or crab stabilization switches.

NOTE

If doppler is malfunctioning, vector stabilization should not be used since azimuth position may be unreliable.



1. TA VIDEO SWITCH
2. FLIR VIDEO SWITCH
3. TV VIDEO SWITCH
4. MANUAL STEERING CONTROL
5. NFOV INDICATOR LIGHT
6. SYMBOL DIMMING CONTROL
7. LAMP TEST SWITCH
8. POWER SWITCH
9. CRAB STABILIZATION SWITCH
10. FIXED STABILIZATION SWITCH
11. VECTOR STABILIZATION SWITCH

EV S Control Panel

Figure 4-68.

TA-EVS VECTOR INDICATOR LIGHT. A TA-EVS vector indicator light (5, figure 4-44) is located above each pilot's and copilot's EVS monitor. The light is a word warning light showing "TA-EVS VECTOR" in amber letters on a black background when on. The lights will come on when the angle of attack system is in a limit if vector mode is selected in the EVS or FVR is selected in the TA system. This indicates that fixed stabilization of the EVS and/or FRL stabilization of the TA system should be selected. The lights are supplied left TR power by a circuit breaker marked "Vector Warn Light" on the pilot's circuit breaker panel.

FIXED STABILIZATION SWITCH. The fixed stabilization switch (10, figure 4-68) on the pilots' EVS control panel is a momentary pushbutton switch which provides selection of fixed stabilization of the line-of-sight (LOS) of the selected sensor. When fixed LOS stabilization is selected by pressing the switch, the word "ON" in green is illuminated on the switch face. In fixed stabilization, the selected sensor and turret are driven in azimuth to a position corresponding to zero degrees or the centerline of the aircraft and the sensor driven in elevation to 2° above the waterline of the aircraft if TA is not selected or to the waterline of the aircraft if TA is selected. See figure 4-69 for additional stabilization in-

formation. The fixed stabilization may be deactivated by depressing the fixed, vector, or crab stabilization switches.

CRAB STABILIZATION SWITCH. The crab stabilization switch (9, figure 4-68) on the pilots' EVS control panel is a momentary pushbutton switch which provides selection of crab stabilization of the line-of-sight (LOS) of the selected sensor. When crab LOS stabilization is selected by pressing the switch, the word "ON" in green is illuminated on the switch face. In crab stabilization, the selected sensor and turret are driven in azimuth to a position corresponding to the crab angle position of the rear landing gears and the sensor driven to 2° above the aircraft centerline. See figure 4-69 for additional stabilization information. The crab stabilization may be deactivated by depressing the crab, vector, or fixed stabilization switches.

MANUAL STEERING KNOB. The manual steering knob (4, figure 4-68) on the pilots' EVS control panel has L--OFF--R positions and is spring-loaded to the center OFF (unmarked) position. The knob must be depressed before it can be rotated out of the center position. Provided a steering mode is selected (vector, fixed, or crab switch lights on), the selected sensor and turret may be manually steered in azimuth left (L) or right (R) by use of the steering

MONITOR DISPLAY	SENSOR LOS	LOS COMMAND		
		VECTOR	FIXED	CRAB
STV or FLIR	Az	Flight Vector (Drift)	Centerline	Crab Angle (Aft Gear)
	EI	Flight Vector (Angle of Attack) +Roll Stabilization	2° Above Waterline +Roll Stabilization	2° Above Waterline +Roll Stabilization
STV or FLIR With TA	Az	Flight Vector (Drift)	Centerline	Crab Angle (Aft Gear)
	EI	Flight Vector	Waterline +Roll Stabilization	2° Above Waterline +Roll Stabilization

NOTE
Waterline is parallel
to the ground when
on ground.

.....EVS Sensor Stabilization Modes

Figure 4-69.

knob. When the knob is released it will return to the center position and sensor and turret control reverts to the steering mode selected.

WARNING

This knob should only be used while the aircraft is on the ground while stopped or during a slow speed maneuver such as taxiing, etc since disorientation may result.

NARROW FIELD OF VIEW (NFOV) SELECT SWITCH.

The NFOV select switch (4A, figure 1-31) is a push-button switch on each pilot's control wheel and permits either pilot or copilot, while he has steering command, a means of selecting NFOV of the selected sensor without removing his hands from the aircraft control wheel. Pressing and releasing the button will cause the sensor to switch to the other field of view.

NFOV LIGHT. The NFOV light (5, figure 4-68) is on the pilots' EVS control panel and will indicate the word "ON" in green when narrow field of view has been selected on the respective EVS monitor.

SYMBOLS KNOB. The symbols knob (6, figure 4-68) on the pilots' EVS control panel is a rotary knob used to set the brightness of the symbols on the respective EVS monitor. Clockwise rotation of the knob, as marked, will brighten the symbols and counterclockwise rotation will dim the symbols.

LAMP TEST SWITCH. The lamp test switch (7, figure 4-68) on the pilots' EVS control panel is a pushbutton switch used to test all the indicator lights on the respective EVS control panel.

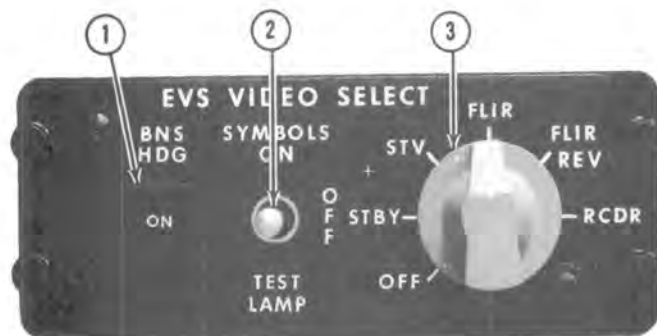
Data Presentation Controls and Indicators (Navigators)

EVS VIDEO SELECT SWITCH. The EVS video select switch (3, figure 4-70) is a six-position rotary switch on the navigator's and radar navigator's EVS video

select panels. The switch has OFF--STBY--STV--FLIR--FLIR REV--RCDR positions and is used to select video for display on the respective EVS monitor. In OFF position power is removed from the respective EVS monitor and the other circuits provided through this switch. In STBY position power is supplied to the respective EVS monitor to place it in standby condition but prevents video from being displayed. Power is supplied to other electronic circuits. In STV position the STV video will be displayed on the respective EVS monitor if the STV system is operating. In FLIR position the FLIR video will be displayed if the FLIR system is operating. In FLIR REV position the FLIR video will be displayed in reverse pattern (light areas become dark and dark areas become light). RCDR position is inoperative.

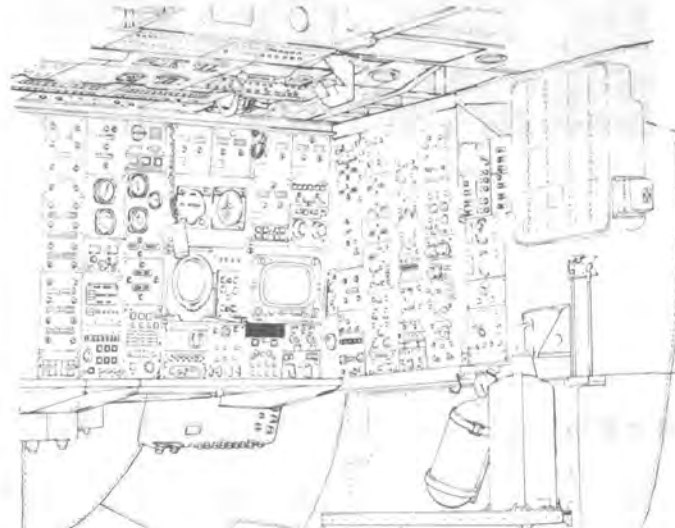
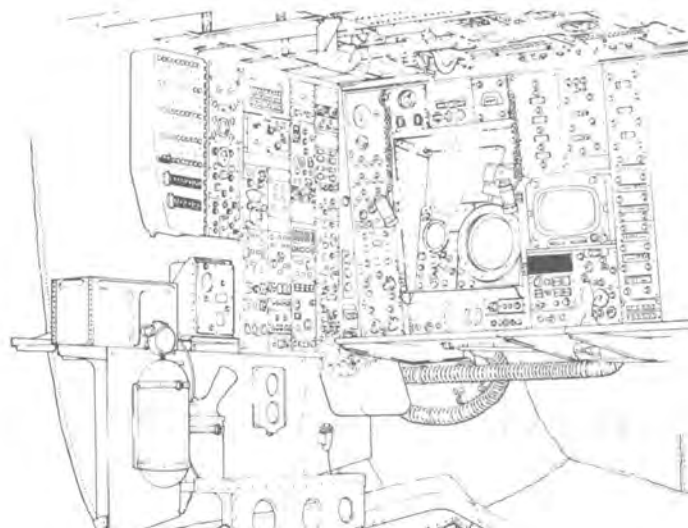
SYMBOLS SWITCH. The symbols switch (2, figure 4-70) on the navigators' EVS video select panel has SYMBOLS ON--OFF--TEST LAMP positions. SYMBOLS ON position will cause EVS symbols to be displayed on the respective navigator's monitor. TEST LAMP position is a momentary position which provides a means of testing the respective BNS heading select switch indicator light. OFF position will remove the symbols from the respective monitor or terminate the light test function whichever has been selected.

BNS HDG SWITCH. The BNS heading switch (1, figure 4-70) on the navigators' EVS video select panel is a push-on/push-off type switch used as a "three-way" switch with the BNS heading switch on the other navigators' panel. Each switch is mechanically latched in each position. The switch is used to select BNS heading error for display on all EVS monitors when the BNS is not in BOMB mode. (BOMB mode automatically selects BNS heading error.) When one switch is pressed and the BNS heading error is selected, the letters "ON" in green will illuminate on both navigators' panels. When either switch is depressed again, the BNS heading error function is removed and the lights will go off. When the BNS heading error is used, the bank steering marker is replaced on all active EVS monitors.



1. BNS HEADING SELECT SWITCH
2. SYMBOLS SWITCH
3. EVS VIDEO SELECT SWITCH

41-37-1



EVS Video Select Panel

Figure 4-70.

FLIR AND STV STEERING COMMAND LIGHTS. The FLIR and STV steering command lights (2 and 9, figure 4-70A) are on the navigators' EVS steering control panel and show whether pilot or copilot has steering command of the respective sensors. If the pilot has command of the sensor, the letters "PLT" are illuminated in green. If the copilot has command of the sensor, the letters "COPLT" are illuminated in green. If neither light is on, the pilots have relinquished steering control and the navigators can steer the respective sensor.

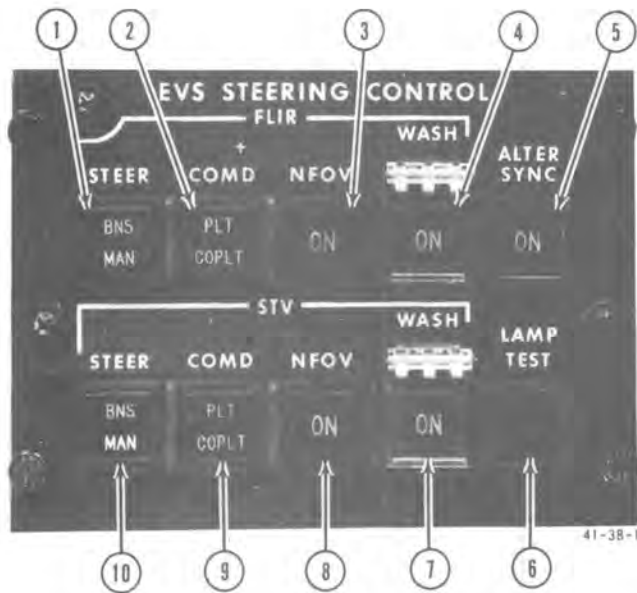
FLIR AND STV STEERING SWITCHES. The FLIR and STV steering switches (1 and 10, figure 4-70A) are on the navigators' EVS steering control panel and allow the navigator or radar navigator (as selected by the EVS video select switches) to control steering of the respective sensor by the BNS or manually with the BNS tracking handle. The switch is a push-in/push-out switch which is mechanically latched in the selected position. When in the BNS steering mode, the green BNS light illuminates and the selected sensor tracks the BNS crosshair position providing the crosshairs do not exceed the sensor steering range. Should the BNS crosshairs exceed the sensor steering range, the sensor will assume the pilot **FIXED LOS** position until the BNS crosshairs are again within the sensors steering range, then will return to tracking the BNS crosshair position. When

in the manual steering mode, the green MAN light illuminates and the crosshair control signals are switched by relay from the BNS to the EVS servo control unit to allow the sensor LOS to be positioned by inputs from the BNS tracking handle.

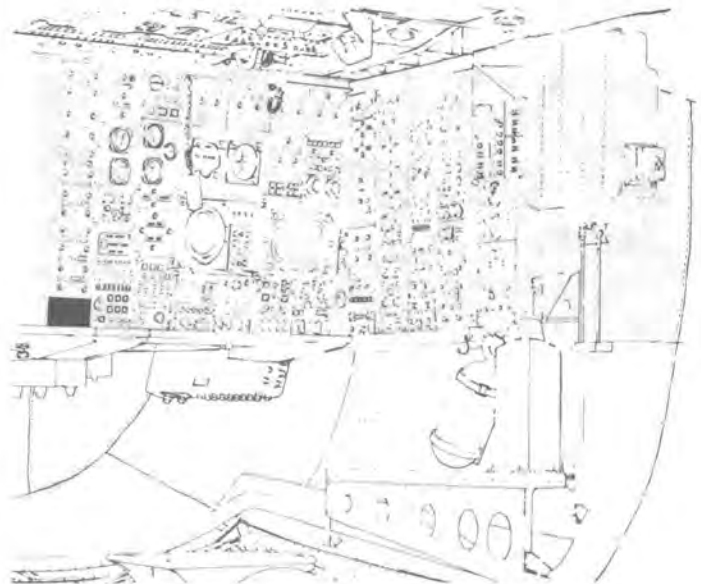
NOTE

- This switch will only function when the pilots do not have steering command. When the navigators have steering control, the pilots' symbols will be removed from their monitors.
- The BNS crosshairs will not move when either or both sensors are in the manual steering mode.

FLIR AND STV NARROW FIELD OF VIEW (NFOV) SWITCHES. The FLIR and STV NFOV switches (3 and 8, figure 4-70A) are on the navigators' EVS steering control panel and allow the navigator or radar navigator to place the respective sensor (if he has control) into narrow field of view (NFOV). The switch is a push-in/push-out switch which is mechanically latched in the selected position. When pressed in to NFOV position, the word "ON" will be illuminated in green. When the switch is pressed again to the out position, the field of view will return to normal wide condition and the light will go out.



1. FLIR STEERING SWITCH
2. FLIR STEERING COMMAND INDICATOR
3. FLIR NFOV SWITCH
4. FLIR WASH SWITCH
5. ALT SYNC SWITCH



6. LAMP TEST SWITCH
7. STV WASH SWITCH
8. STV NFOV SWITCH
9. STV STEERING COMMAND INDICATOR
10. STV STEERING SWITCH

..... EVS Steering Control Panel

Figure 4-70A.

ALTER SYNC SWITCH. The ALTER SYNC (alternate synchronization) switch (5, figure 4-70A) is on the navigators' EVS steering control panel and allows selection of redundant synchronization circuits if the primary synchronization circuits were to fail as indicated by loss of video on all EVS monitors. The switch is a push-in/push-out switch which is mechanically latched in each position. When pressed in to the alternate synchronization position, the word "ON" will be illuminated in green. When the switch is pressed again to the out position, the primary synchronization circuits are selected and the light will go out.

LAMP TEST SWITCH. A lamp test switch (6, figure 4-70A) is on the navigators' EVS steering control panel and is used to test all the indicator lights on that panel. The switch is a pushbutton switch which, when pressed, will cause all indicator lights on the navigators' EVS steering control panel to come on if not previously on.

EVS ENVIRONMENTAL CONTROL SYSTEM

The EVS environmental control system circulates cabin air through the FLIR signal processor for cooling and through electric heaters and the STV camera and FLIR scanner components in the EVS turrets for prevention of moisture condensation.

The return air from these components is exhausted into the pressurized compartment by electric fans. The turret windows are electrically heated to prevent fogging and icing. Environmental control system components are divided into two separate independent subsystems, one for FLIR and one for STV. The EVS environmental control system is designed to be operated at all times during flight and is controlled from the environmental control panel on the left side-wall at the radar navigator's station. Heating duct and window heat temperatures in each subsystem are automatically controlled. In each subsystem, air heater or window heat shutdown with power lockout may occur due to overheat, short circuits, or faulty controller and the only indication would be fogging of the view on the monitor later in flight. Resetting each subsystem is accomplished by cycling the respective power control switch to OFF then ON. Each window heat system is controlled by the same switch that controls the air heater subsystem. Since there is a lethal voltage on the surface of the FLIR window when in operation, the landing gear squat switch is included in the circuit to prohibit operation of the window heat on the ground. The STV window surface is insulated from this lethal voltage and therefore does not exhibit a hazard. Heating and fan power is ac and system control is TR power, all except FLIR window heat through circuit breakers on the EVS circuit breaker panel.

EVS Environmental System Controls

WARNING

Beryllium used as the STV mirror backing is toxic if particles enter the skin. If STV mirror breakage is suspected the radar navigator will place the STV turret air switch OFF and the MODE SWITCH on the STV CONTROL PANEL to OFF for the remainder of the mission. After landing, notify ground crew of suspected breakage.

STV TURRET AIR SWITCH. The STV turret air switch (1, figure 4-70B) is a two-position toggle switch having ON--OFF positions. ON position energizes the STV fan, duct heater and controller, and the STV turret window heater and controller. A controller can experience a power lockout and deenergize the heater while in ON position. OFF position deenergizes the STV turret environmental equipment and will reset the heater controller if locked out. The switch should be ON at all times in flight (except for resetting a locked out heater controller) to prevent condensation from forming on STV components.

FLIR TURRET AIR SWITCH. The FLIR turret air switch (3, figure 4-70B) is a two-position toggle switch having ON--OFF positions. ON position energizes the FLIR fan, duct heater and controller, and the FLIR turret window heater and controller (except while on the ground the squat switch prevents operation of the window heat). A controller can experience a power lockout and deenergize the heater while in ON position. OFF position deenergizes the FLIR turret environmental equipment and will reset the heater controller if locked out. The switch should be ON at all times in flight (except for resetting a locked out heater controller) to prevent condensation from forming on FLIR components.

WARNING

Lethal voltage exists on the surface of the FLIR turret window during normal EVS flight operations. This voltage should be inhibited during ground operations by action of the forward landing gear squat switch. However, as an added precaution, insure FLIR turret air switch on the environmental power control panel is in OFF prior to performing any maintenance, other than operational checkout on or near FLIR turret,

EVS TURRET WINDOW WASH SYSTEM

The EVS turret window wash system provides a method of cleaning the FLIR and STV turret windows of insect residue and other foreign objects while in flight. The window wash system washes the turret windows by directing high pressure jets of warm water on the window as the turret head slews to allow

washing of the entire width of the window. A wash cycle is completed in 30 seconds and uses approximately 1 1/2 gallons of water. Approximately 14 gallons of demineralized water are stored in an electrically heated water tank located in the FLIR turret fairing and is enough for nine wash cycles.

NOTE

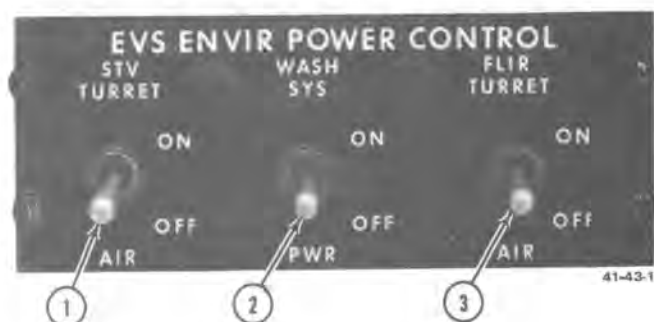
Since water capacity is limited, care should be taken that water is not depleted unnecessarily. Coordination between navigators may be necessary to insure sufficient wash water remains for critical phases of the mission. Fogging of window because of improper turret air system operation should not be misconstrued as requiring wash operation.

The tank is designed to withstand freezing of the water if it is left at below freezing temperatures without electric power. A low temperature thermal switch prevents wash action until a water tank temperature of 100° F is attained. Water tank insulation minimizes ambient condition effects on water and tank temperatures. Wash action may be delayed if initial water temperature is low or water is frozen since heating action is relatively slow.

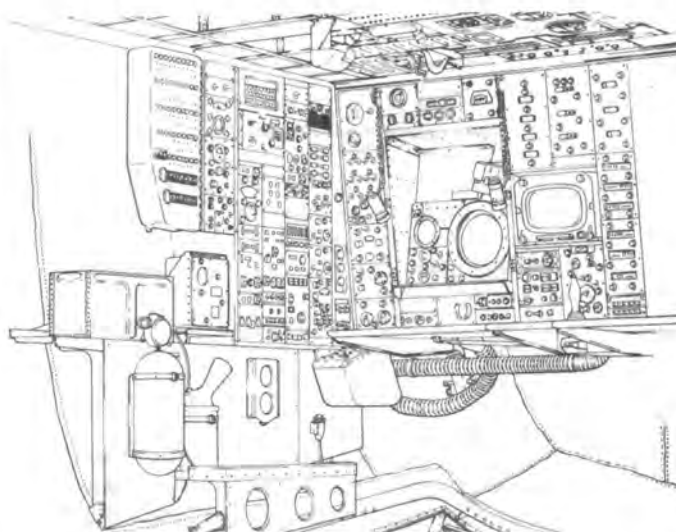
NOTE

Since several hours may be required to heat ice to the low temperature switch setting, it may be desirable to supply electrical power for heating prior to preflight for some missions.

An a-c powered electric pump pumps the wash water to the selected turret nozzles during the wash cycle. Power control of the turret window wash system is on the environmental power control panel at the radar navigator's station. The system is designed to have power on at all times during aircraft operation. Wash water is heated by an electric blanket bonded to the water tank. The heater blanket is thermostatically controlled to maintain the water at an average temperature of 145° F. Overheat protection for the heater blanket is provided by a thermal switch which cuts off power to the heater when overheat is detected. Power to the heater blanket is locked out until the "Window Wash Control" circuit breaker is pulled and reset or power is removed on the ground. Control of the window wash cycle is from the EVS steering control on the navigators' front panel. Window wash cannot be commanded when the pilot or copilot have command of the turret sensors. When the wash switch is depressed, the servo control unit commands the selected turret to be placed in the stowed position and issues a window wash command. The turret then slews for the duration of the wash cycle. After 30 seconds, the turret returns to the stow position and the servo control unit removes the



1. STV TURRET AIR SWITCH
2. WASH SYSTEM POWER SWITCH
3. FLIR TURRET AIR SWITCH



..... EVS Environmental Power Control Panel

Figure 4-70B.

wash command signal. When the wash command signal is removed, bleed air from the aircraft air conditioning pack purges the window wash system plumbing and valves after each washing to prevent freezing damage. Only one window can be washed at a time.

CAUTION

When EVS window washing action is initiated during RAM operation, the lines and pump will remain full of water until the cabin is pressurized. Line freeze should be expected if the aircraft is exposed to a low temperature environment prior to cabin pressurization.

NOTE

The system is designed to be used below 19,000 feet altitude and above 2° C (35° F) true temperature. The system will function at higher altitudes and lower temperatures. However, at altitudes above 19,000 feet, the water as it leaves the nozzles turns into steam in the low pressure environment and is ineffective for window washing. At temperatures below 2° C, water spray from the windows may freeze on the fairing areas.

Water tank heater and pump power is ac while control power is dc, all through circuit breakers on the EVS circuit breaker panel.

EVS Turret Window Wash System Controls and Indicators

WASH SYSTEM POWER SWITCH. The wash system power switch (2, figure 4-70B) is a two-position toggle switch having ON--OFF positions. ON position energizes the window wash system tank heaters and arms the wash command control circuits. The switch should be ON at all times in flight and during air-

craft ground operation to facilitate system readiness. With this switch in ON, a wash cycle can be commanded for either the FLIR or STV windows by actuating the respective wash switch on the navigators' steering control panel provided the navigators' have control of the sensor and the water is of proper temperature. OFF position deenergizes the water tank heaters and all wash control circuits.

WASH SWITCHES. Two wash switches (4 and 7, figure 4-70A), one for STV and one for FLIR, are on the navigators' steering control panel. Each switch is a momentary pushbutton which, when pressed, will initiate the wash cycle for the respective turret. The wash cycle cannot be interrupted and will cause the green letters "ON" on the switch face to be illuminated and remain on during the wash action. A wash cycle cannot be initiated on a turret if the pilot or copilot is in command of the sensor, wash water temperature is below the low temperature thermal switch setting, or the other turret is in a wash cycle. Each switch is covered by a hinged transparent guard which must be raised before actuating the switch.

NOTE

- At first actuation of the wash switch, associated command indications on the navigators' steering control panel for the selected turret will go out while the turret rotates to stow. The green "ON" indication will come on when the wash action begins. Under normal conditions, initial turning action of the turret can be seen on the monitor.
- If a wash cycle cannot be initiated while either navigator is in command of the sensor, pull and reset the "Window Wash Control" circuit breaker to eliminate a possible overheat lockout. Allow time for water warmup before initiating another wash cycle.

EVS OPERATING TECHNIQUES FOR CONTOUR FLIGHT

EVS contour flight is essentially an extension of visual contour flight. Both have a near range blind zone and require the visualization of an extended flight path. The point where the flight path intercepts terrain/obstacles is called the impact point. During a landing from a visual traffic pattern, the pilot visualizes the landing area by establishing an aim point. The aim point uses the same principle as an impact point. It is a point where the terrain/obstacles remain in a stationary position on the EVS monitor or windscreen and appear to grow larger as range is decreased. EVS video expansion of the impact area becomes very prominent at near ranges. In areas of rugged terrain relief, the expansion of the impact area video can occur at such a close range that a high "g" maneuver will be required to clear the terrain/obstacle. The pilot must monitor shear terrain and initiate clearance procedures prior to entering the area where pilot reaction and aircraft capabilities become critical.

WARNING

- EVS only contour flight, in shear terrain (i.e. cliffs and straight-faced mountains), is extremely hazardous since near range video expansion does not occur until very close range. When below the crossover altitude, pilot reaction and aircraft response time will become critical if the flight profile into shear terrain/obstacles is allowed to progress to a critically near range.
- The pilot must continually scan the EVS monitor for shear terrain and initiate a climb, prior to entering the area where pilot reaction time and aircraft capabilities become critical.

It has been found helpful to assign airspeed (throttles) control to the pilot not flying the aircraft, who maintains the desired airspeed without further direction. Climbs and descents over rough terrain during EVS operation require close monitoring of airspeed. Pilots should anticipate airspeed changes and actually begin throttle movement as aircraft pitch change is initiated. Large and rapid throttle movements may

be required. After the desired pitch altitude is established, the throttle setting can be refined to maintain airspeed. Frequent use of airbrakes for deceleration is not recommended. The impact point should be monitored throughout EVS flight. This will eliminate the potential errors in pitch and drift reference caused by the use of fixed references on the EVS monitor. Turns are possible during terrain following provided good judgment is applied. The radar navigator must verbally clear the proposed flight path prior to all turns greater than 10°. Since the EVS monitor field of view is approximately 10-11° left and right of centerline, turns should be planned so that no more than 15° angle of bank is used. The pilot not flying the aircraft must monitor all the instruments and provide visual clearance of the aircraft. The radar navigator provides terrain assessment beyond the pilots range. When hazardous terrain is observed, the radar navigator will continue to advise the pilot until the pilot is tracking the obstacle on his monitor.

During the EVS only flight, the desired flight profile for safety and maximum terrain masking, is obtained by flying a flight profile which closely resembles that of TA only flight. It is obtained by smoothly employing instrument flight techniques to periodically adjust the impact point: (1) Further downrange to maintain the desired clearance on unsloping terrain, (2) near the horizon for level terrain, (3) to near range during descent to the desired clearance altitude. Flat and rolling, or sloping terrain can be flown at desired clearance altitudes relatively easily. Terrain with rapid transverse slope profiles demand a high degree of crew experience to clear at specified clearance altitudes. There is no scaling of vertical height on the EVS monitor to guarantee specified clearances; therefore, actual crossing altitudes will be determined by crew experience and proficiency. An EVS flight profile, using shallow pitch angles to place the impact point above terrain/obstacles, will provide the highest degree of safety, particularly during peak and shear terrain crossovers, and provide the maximum terrain masking by keeping the aircraft near the specified clearance altitude, without ballooning. As soon as crossover has occurred; as determined by crew experience, timing procedures, or radar altimeter indications; an immediate descent should be initiated. Crossover and descent should be monitored with wide field of view selected, since it provides a larger look-down angle to monitor near

range video. It is possible to impact terrain, during crossover maneuvers, with no terrain on the EVS monitor, due to a combination of EVS sensor looking angle and flight path vector.

WARNING

- Any attempt to set and maintain an angular relationship of terrain on the EVS monitor will result in progressively less terrain clearance as range is decreased. If this angular relationship is maintained the aircraft will impact the terrain at zero range. (i.e. Maintaining terrain on the EVS monitor by constantly reducing pitch angle until zero range will cause the aircraft to impact.)
- It is imperative that the pilot evaluate near range video to determine actual altitude clearance during terrain feature crossings. If any doubt exists, as to final clearance crossings, the pilot will initiate a rapid climb to a safe altitude.

NOTE

EVS only terrain clearance can be accomplished by keeping the impact point clear of terrain/obstacles and monitoring near range video for terrain/obstacle movement. To assure terrain clearance, the pitch angle should be maintained until near range terrain video disappears and crossover has been verified.

The area covered by the near range blind zone varies with aircraft height above terrain, sensor looking angle, and aircraft pitch angle. The pilot will learn to determine actual crossover by evaluating the movement of near range video. As experience increases, this may alleviate the necessity to have an operative radar altimeter, or use of timing if the RN cannot provide range information. There is no provision to accurately determine range information from the EVS monitor.

To initiate a descent, during low level at high speeds and high power settings, it may be necessary to reduce the power setting to decrease the pitch angle when flying with the low level autopilot off, since it requires moderate pressure to reduce the pitch. This tendency is much less noticeable when the low level autopilot is on. If the pilot not flying the aircraft is maintaining airspeed with the throttle, he must anticipate the pilot's pitch inputs and adjust power as required.

It is not necessary to have a visible horizon to fly EVS only. The pilot must determine the amount of EVS monitor visual range required (by considering aircraft performance requirements and crew proficiency) for the terrain relief which will be encountered. EVS monitor visual range can be determined by timing or radar ranging.

The pilot should be aware of pitch angles and/or climb/descent rates while flying EVS only. While flying through rugged terrain it is absolutely necessary to be aware of aircraft pitch angles and/or climb/descent rates in order to fully understand remaining aircraft performance capabilities. During mission planning, the crew should review the maximum climb angle speeds and climb rates for the aircraft configuration to determine aircraft safety margins.

During EVS only descents, the pilot should gradually decrease his rate of descent as he approaches the desired clearance altitude. This will provide a longer reaction time to near range video expansion and allow the aircraft to be leveled off without abrupt maneuvering. The EVS sensor should not be completely filled with terrain, since this eliminates the capability to determine height of terrain at the top of the EVS monitor.

Experience has shown that detection of towers, antennas, cables, etc, by use of EVS equipment is not reliable and cannot be depended upon. During low level operation, a periodic check for obstacles in NFOV will enhance resolution in a direct line with the flight path of the aircraft; however, resolution may not occur until the aircraft has closed to such a position that collision is imminent. It is absolutely necessary that the crew fly at a safe altitude, which will insure clearance of man-made obstacles, or plan to circumnavigate these obstacles, since obstacle detection is not reliable.

LOW LEVEL OPERATION WITH OPERATIVE TA-EVS EQUIPMENT

The TA-EVS systems are complimentary. Integrated system usage greatly enhances low level capabilities. While flying TA-EVS, the aircrew should use the terrain trace for precise instrument flight pitch inputs to maintain the desired clearance altitudes. The EVS sensor will be used to monitor approaching high terrain and as an additional means to provide terrain/obstacle clearance. When terrain trace break-up is caused by normal system characteristics (i.e. over water, short range blind zone, high altitude dropout, etc.), flight may be continued at terrain avoidance altitudes by reverting to EVS only flight. Terrain trace video break-up will be verified by assessing terrain information from an EVS sensor. To prevent any delays encountered in following valid terrain trace information, trace break-up should be anticipated by evaluation of EVS video information prior to actual break-up.

The terrain trace scan and EVS monitor field of view do not present the terrain information in the same perspective. The terrain trace scans across the EVS monitor, covering a field of view of approximately 45° left and right of centerline. The EVS sensor covers an approximate field of view of 10 - 11° left and right of centerline.

It should be noted, that flight profiles may vary slightly between EVS only and terrain trace only flight. The tendency will be to maintain a lower profile with the EVS, since the pilot will descend to obtain an absolute altitude which will be determined from radar altimeter readings directly beneath the aircraft. The terrain trace, however, will maintain a flight profile which will keep the aircraft at the clearance plane altitude for the highest terrain within the range gate selected. Therefore, the absolute altitude will normally be equal to or higher than the desired clearance of the terrain directly below the aircraft.

BOMBING SYSTEM

The bombing system provides the aircraft with a means of carrying, pre-arming, and releasing nuclear and nonnuclear weapons. The bomb bay has provisions for carrying clip-in and cluster suspension systems. Single carriage clip-in racks are used exclusively for nuclear weapons while multiple carriage clip-in racks may be used for either nuclear weapons or the larger type nonnuclear weapons. Release methods associated with the suspension systems are BNS, D-2, jettison, and special weapons manual release. BNS, D-2, and jettison systems are applicable to all suspension systems. The special weapons manual release will effect a release from the clip-in system only. Information on the bombing system is contained in T.O. 1B-52D-25-1, "Nuclear Bomb Delivery Technical Manual" and T.O. 1B-52D-34-2-1, "Aircrew Weapons Delivery Manual (Nonnuclear)." The aircrew must be familiar with these manuals to insure an adequate knowledge of the requirements, limitations, and restrictions of the system.

BOMB RELEASE PULSE INDICATING SYSTEM

The bomb release pulse indicating system may be installed as a training device to provide a means of indicating bomb release when bombs are not loaded on the aircraft. The system consists of A-5 release units installed in the bomb bay and connected to the bomb release circuits. When a release circuit is energized, the release pulse actuates the A-5 which in turn energizes the applicable weapon released light (single carriage) or bomb indicator light (multiple carriage). The special weapon manual lock handle must be unlocked to provide power for the system.

AUTHORIZED WEAPONS

Only those weapons listed in figure 4-71 are authorized for carriage and delivery in the configuration and quantity shown. Additional information on nuclear weapons is contained in T.O. 1B-52D-25-1.

BOMB TONE SCORING SYSTEM

A bomb tone scoring system is installed in this aircraft to provide a means of simulated bomb drops whereby the accuracy of the bomb run can be determined using a radio signal. When initiated, the bomb tone scoring system causes a continuous tone to be transmitted by the UHF radio set(s) on the selected frequency(ies). A bomb release pulse from either the BNS or the bomb release switch (but not the salvo system) stops the tone, simulating bomb release. The bomb tone scoring system must be reinitiated in order to simulate another bomb run. Voice communications cannot be transmitted by means of either UHF radio set when the bomb tone scoring system is energized. A bomb tone scoring panel (41, figure 4-40) is provided at the radar navigator's station. An AGM-69A bomb tone scoring relay will interrupt the continuous bomb tone scoring during a training launch sequence.

Bomb Tone Scoring System Controls

BOMB TONE SCORING SWITCH. A bomb tone scoring switch (3, figure 4-72) on the bomb tone scoring panel at the radar navigator's station provides a means of energizing the bomb tone scoring system. The switch has INITIATE--NORMAL--CUTOFF positions and is spring-loaded to the unmarked NORMAL position. Actuating this switch momentarily to INITIATE position will energize the circuit, causing the tone-on indicator light to illuminate and both UHF radio sets to transmit a steady tone provided both UHF radio sets are turned on. Actuating this switch momentarily to CUTOFF position will deenergize the circuit, causing the bomb tone indicator light to go out and the tone transmission to stop.

Bomb Tone Scoring System Indicators

TONE-ON INDICATOR LIGHT. A tone-on indicator light (2, figure 4-72) located on the bomb tone scoring panel is illuminated when the bomb tone scoring system has been energized. This light is supplied TR power through the bomb tone scoring switch.

Normal Operation of Bomb Tone Scoring System

The bomb tone scoring system operates whenever the command or No. 2 UHF transmitter is on and the bomb tone scoring master switch has been positioned momentarily to INITIATE. The tone is stopped by a

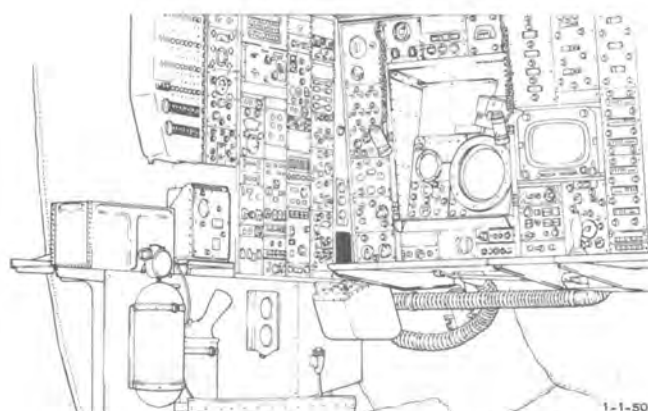
MUNITION TYPE	NO. LOADED	RACK CONFIGURATION	WEIGHT CLASS/ACTUAL
NONNUCLEAR			
CLUSTER RACKS			
CBU-24B/B Cluster	27		750/830 pounds
CBU-49B/B Cluster	27		750/830 pounds
CBU-52B/B Cluster	27		750/785 pounds
CBU-58/B	27		750/820 pounds
CBU-71/B	27		750/820 pounds
M36 Cluster	27		750/900 pounds
MK82 GP	27		500/531 pounds
M117 GP 	27		750/823 pounds
M124 Practice	27		250/264 pounds
M129/M129E1 Leaflet	18		750  pounds
MJU1/B	27		750  pounds
MK52 Mine  	18		1,000/1,190 pounds
CLIP-IN (TWO)			
MK84 GP Bomb	8	All Stations	2,000/1,970 pounds
MK55 Mine	8	All Stations	2,000/2,120 pounds
MK56 Mine	8	All Stations	2,000/2,055 pounds
MK60 Mine	8	All Stations	2,000/2,399 pounds
NUCLEAR			
CLIP-IN			
B-28 FI			
B-43			
B-53			
B-61			
BDU-8/B Practice			2,000/1,990 pounds
BDU-38 Practice		Fwd Bay Only	
 Weights will depend on filler material used.  Rapid release not authorized.			
 With MK10 fin the maximum release altitude is 3,000 feet.  M131 or MAU-103A/B fin.			
 Minimum weight is 250 pounds			

Authorized Weapons

Figure 4-71.



1. EMERGENCY TIME DELAY BYPASS SWITCH
2. TONE-ON INDICATOR LIGHT
3. BOMB TONE SCORING SWITCH



Time Delay Bypass and Bomb Tone Scoring Panel

Figure 4-72.

bomb release pulse from the BNS or bomb release switch through the bomb intervalometer or by momentary actuation of the bomb tone scoring switch to CUTOFF position.

NOTE

The bomb tone scoring system will cause the No. 1 UHF and No. 2 UHF radios to transmit

a tone if both are turned on. A garbled transmission will result if both UHF radios are tuned to the same frequency; therefore, it is recommended that one UHF radio be tuned to an unused frequency during TONE operation.

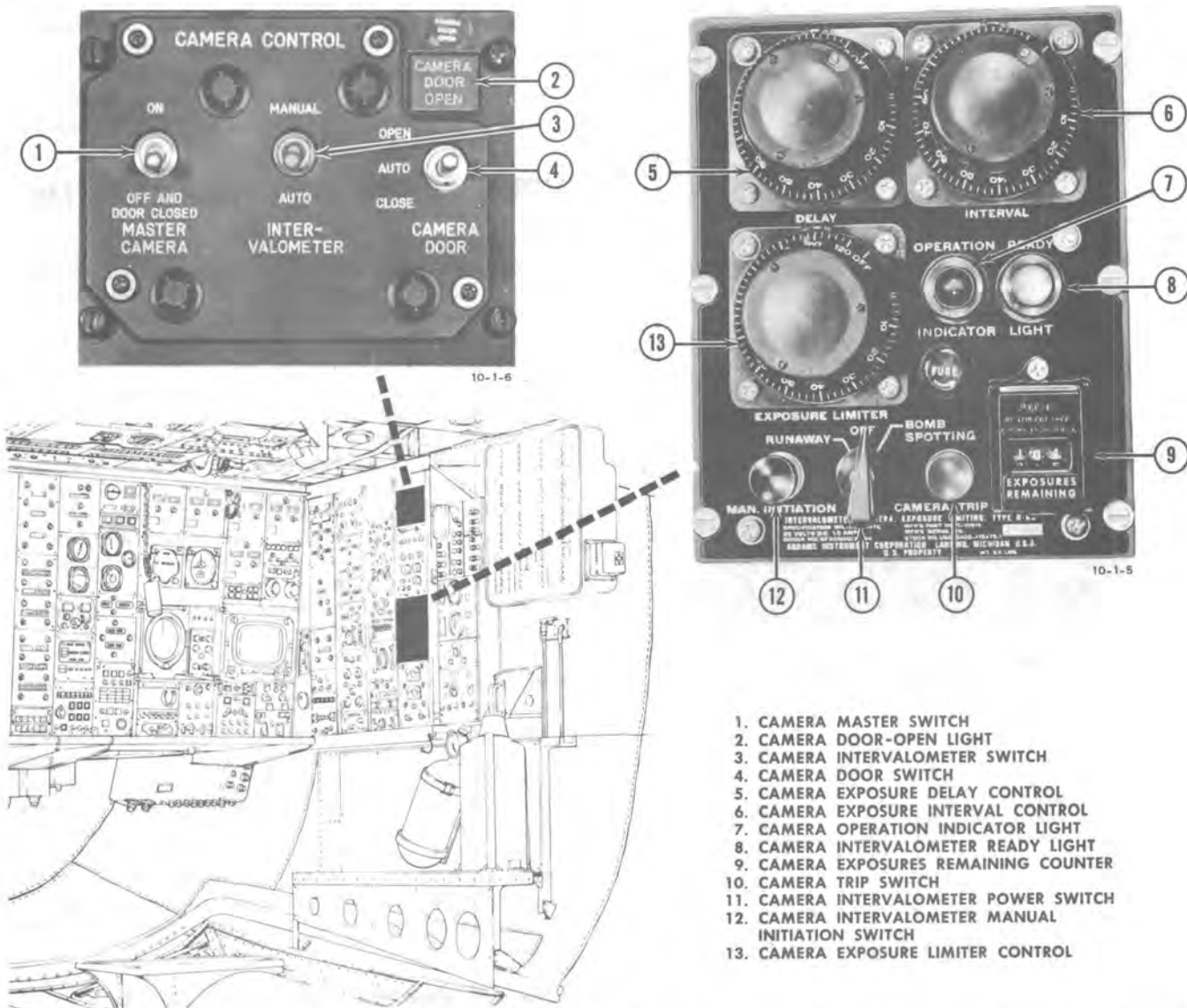
VERTICAL (STRIKE) CAMERA SYSTEM

The vertical camera photographic system provides a photographic record of the bombing run. A compartment at the forward end of the aft unpressurized section houses the strike and orientation camera. A vacuum pump, which operates constantly when the master camera switch is in ON position, supplies vacuum for camera operation. An automatic electrical heating system heats the camera compartment. On aircraft **W181**, a motor-driven blower provided on the aft wall of the camera compartment is actuated automatically by a thermo switch in the camera compartment. Aircraft **W181** are provided with a squat switch that deenergizes the blower and heating system circuits while on the ground. The camera can be operated by manual operation of switches or automatically by means of the bomb intervalometer or camera intervalometer. When the camera is being operated automatically, it will reset itself whenever power is removed from the intervalometer or at the completion of a set sequence. The camera can be operated by manually positioning the camera door switch, or by means of a handcrank, or opened automatically when the bomb doors open. Controls for the photographic system are located on the side panel at the navigator's station. Salvo release of the bombs causes the camera door to operate in accordance with intervalometer settings, provided the camera master switch is ON and the camera intervalometer power switch is in BOMB SPOTTING position.

VERTICAL CAMERA SYSTEM CONTROLS

Vertical Camera Master Switch

A vertical camera master switch (1, figure 4-73) on the vertical camera control panel has ON--OFF AND DOOR CLOSED positions. ON position supplies 118-volt single-phase a-c power to operate the camera doors. In addition, TR power is provided through two circuit breakers marked "Door Control" and "Master Power" and are located on the aft BNS circuit breaker panel. These two circuit breakers supply power to the camera door indicating lights, camera operating light, camera intervalometer, and camera initiation when salvo or normal bomb release occurs. If the camera doors are open and this switch is placed to OFF AND DOOR CLOSED position, the camera doors will close if the bomb doors are closed. Moving this switch from OFF AND DOOR CLOSED to ON position will allow the camera intervalometer to reset itself.



1. CAMERA MASTER SWITCH
2. CAMERA DOOR-OPEN LIGHT
3. CAMERA INTERVALOMETER SWITCH
4. CAMERA DOOR SWITCH
5. CAMERA EXPOSURE DELAY CONTROL
6. CAMERA EXPOSURE INTERVAL CONTROL
7. CAMERA OPERATION INDICATOR LIGHT
8. CAMERA INTERVALOMETER READY LIGHT
9. CAMERA EXPOSURES REMAINING COUNTER
10. CAMERA TRIP SWITCH
11. CAMERA INTERVALOMETER POWER SWITCH
12. CAMERA INTERVALOMETER MANUAL INITIATION SWITCH
13. CAMERA EXPOSURE LIMITER CONTROL

Vertical Camera System Controls

Figure 4-73.

Vertical Camera Door Switch

A vertical camera door switch (4, figure 4-73) on the vertical camera control panel has OPEN--AUTO--CLOSE positions and is spring-loaded to AUTO position. OPEN position will open the camera door and CLOSE position will close the camera door provided the camera master switch is ON and the bomb doors are fully closed. In AUTO position, the camera doors will open automatically when the bomb doors are opened; however, the camera doors will not close automatically when the bomb doors are closed. The camera doors may be closed by placing the camera door switch to CLOSE or by placing the camera master switch to OFF AND DOOR CLOSED position.

Vertical Camera Door Handcrank

A handcrank stowed on the forward side of the vertical camera compartment cover is provided for emergency operation of the camera door. The socket for the camera door is located on the door motor mechanism on the left side of the walkway forward of the camera.

WARNING

To prevent injury to personnel resulting from the handcrank being driven by the motor, remove electrical power from the circuit while the crank is in the mechanism.

Vertical Camera Intervalometer Switch

A vertical camera intervalometer switch (3, figure 4-73) on the vertical camera control panel has MANU--AL--AUTO positions and is spring-loaded to AUTO position. TR power from the camera master switch is provided to the camera intervalometer switch through a circuit breaker marked "Auto Power" located on the aft BNS circuit breaker panel. The power is used to operate the camera intervalometer. In AUTO position, the camera intervalometer controls operation of the camera. In MANUAL position, the camera intervalometer is inoperative, the camera takes pictures at the maximum rate, and the camera operation indicator light will flash once for the last exposure only. Turning this switch to MANUAL then AUTO position will allow the camera intervalometer to reset itself.

Vertical Camera Intervalometer

A vertical camera intervalometer (49, figure 4-41) located on the navigator's side panel controls the initial delay, exposure interval, and number of exposures which may be taken automatically. Automatic operation of the camera by the camera intervalometer can be initiated by means of a bomb release pulse from the bomb intervalometer, the camera intervalometer manual initiation switch, or the bomb salvo switches. Initiation of the camera intervalometer will cause it to operate as preset if the camera master switch is ON, the camera intervalometer switch is in AUTO, and the camera intervalometer power switch is in BOMB SPOTTING position. The initiation pulse will cause the camera to take one exposure which will not affect the camera exposure limiter; the pulse will register on the camera exposure counter. At the completion of a set sequence, the intervalometer will reset itself and the camera intervalometer "Ready" light will illuminate. When the camera intervalometer has reset, it must be initiated before it will transmit camera trip pulses. The camera intervalometer will also reset itself whenever power is removed from the intervalometer as when the camera master switch is positioned to OFF AND DOOR CLOSED, the camera intervalometer switch is positioned to MANUAL, or the camera intervalometer power switch is positioned to OFF.

Vertical Camera Intervalometer Power Switch

A vertical camera intervalometer power switch (11, figure 4-73) on the camera intervalometer has RUN--AWAY--OFF--BOMB SPOTTING positions. In BOMB SPOTTING position, the camera intervalometer will, when initiated, operate the camera as set. In RUN--AWAY position, the camera intervalometer will, when initiated, cause the camera to make exposures at the maximum rate for the length of time set on the camera exposure interval control knob. In OFF position, the camera can be operated only with the

camera intervalometer switch or the camera trip switch. The camera intervalometer will reset at the conclusion of each automatic operation; it can also be reset by turning the camera intervalometer power switch to OFF, then to BOMB SPOTTING or RUN--AWAY position.

NOTE

With the intervalometer power switch in either RUNAWAY or BOMB SPOTTING position, the initiation pulse accomplished either manually or by remote signal may not be of sufficient length to actuate the camera trip.

Vertical Camera Trip Switch

The vertical camera trip switch (10, figure 4-73) on the vertical camera intervalometer is a spring-loaded push-to-actuate type switch. While this switch is depressed, power to operate the camera bypasses the intervalometer circuits, the camera operates at maximum rate, and the camera operating lights will flash at each exposure. The camera exposures remaining counter will also operate but will have no effect on the exposure limiter control. When this switch is released, the camera intervalometer resumes operation as it was set or initiated prior to actuation of the camera trip switch. This switch supplies TR power from the camera master switch and the camera intervalometer switch to the camera.

NOTE

The camera trip switch may have to be pushed more than once to actuate the camera system.

Vertical Camera Intervalometer Manual Initiation Switch

The vertical camera manual initiation switch (12, figure 4-73) on the vertical camera intervalometer is a spring-loaded push-to-actuate type switch. Depressing and releasing this switch will initiate camera operation by the camera intervalometer just as a bomb release pulse would.

Vertical Camera Exposure Delay Control Knob

A vertical camera exposure delay control knob (5, figure 4-73) on the vertical camera intervalometer has OFF and 1- through 120-second interval positions marked in 2-second intervals but with 1-second interval detents. The position selected by this knob controls the amount of delay between the camera intervalometer initiation pulse and operation of the camera by the camera exposure interval control. Once the camera intervalometer has been initiated the only effective repositioning of this control is to decrease the amount of delay set. If this control knob is positioned to OFF, automatic camera operation is not possible even though the camera intervalometer "Ready" light is illuminated.

Vertical Camera Exposure Interval Control Knob

A vertical camera exposure interval control knob (6, figure 4-73) on the vertical camera intervalometer panel has OFF and 1- through 120-second interval positions marked in 2-second intervals but with 1-second interval detents. The camera exposure control spaces the impulses to operate the camera as selected on the dial when the intervalometer power switch is positioned to BOMB SPOTTING. When the intervalometer power switch is positioned to RUNAWAY, this control limits the length of time the camera will make exposures. The setting can be changed at any time. When the camera exposure interval control knob is positioned to OFF, no impulses will be sent to the camera thus preventing normal automatic operation, and the camera intervalometer "Ready" light will not illuminate.

Vertical Camera Exposure Limiter Control Knob

A vertical camera exposure limiter control knob (13, figure 4-73) on the vertical camera intervalometer panel has OFF and 1- through 120-exposure positions marked in 2-exposure intervals but with 1-exposure detents. The desired number of camera exposures to be taken is selected with this knob. Once the camera intervalometer has been initiated, the only effective repositioning of this control is to decrease the number of exposures set. The camera exposure limiter counts the number of camera trip impulses from the camera trip mechanism. When the preset number of exposures have been taken, this control will allow the intervalometer to reset itself. When the camera exposure limiter control knob is in OFF position, the number of exposures is not limited by this control. The exposure limiter control is inoperative regardless of its setting when the camera intervalometer power switch is in RUNAWAY.

VERTICAL CAMERA SYSTEM INDICATORS

Vertical Camera Door-Open Light

An amber vertical camera door-open light (2, figure 4-73) on the vertical camera control panel will illuminate while the camera door is fully open. The light is supplied TR power through the camera master switch and a circuit breaker marked "Ind Lights" located on the aft BNS circuit breaker panel.

Vertical Camera Operation Indicator Light

A green vertical camera operation indicator light (7, figure 4-73) on the vertical camera intervalometer panel will flash each time the camera mechanism is actuated to take an exposure when the inter-

valometer switch is in the AUTO position. The light is supplied TR power through the camera master switch.

NOTE

When the camera is operated by holding the intervalometer switch in the MANUAL position, the operation indicator light will give only a single, final flash as the switch is released.

Vertical Camera Intervalometer Ready Light

An amber vertical camera intervalometer ready light (8, figure 4-73) on the vertical camera intervalometer will be illuminated when the camera intervalometer is receiving power and is ready to be initiated. This light will be out when the camera intervalometer is not receiving power or has been initiated.

NOTE

If the camera exposure delay control knob is positioned to OFF, the camera intervalometer is not ready to be initiated even though the camera intervalometer ready light is illuminated.

Vertical Camera Exposures Remaining Counter

The vertical camera exposures remaining counter (9, figure 4-73) on the vertical camera intervalometer panel will indicate one less exposure remaining each time a picture is taken provided the camera intervalometer switch is in AUTO position.

NOTE

When the camera is operated by holding the intervalometer switch in the MANUAL position, the camera exposures remaining counter will count only a single, final exposure as the switch is released.

NORMAL OPERATION OF VERTICAL CAMERA SYSTEM

The following steps are recommended for the normal operation of the vertical camera system:

1. Vertical Camera Master Switch - ON
No camera operation is possible unless this switch is ON. When this switch is ON the camera door will open when the bomb doors open.
2. Vertical Camera Intervalometer Power Switch - BOMB SPOTTING or RUNAWAY

3. Vertical Camera Intervalometer - Set

a. Vertical Camera Exposure Delay Control

Knob - Set at any desired position but OFF

If this knob is set at OFF, automatic camera operation is not possible, even though the camera intervalometer ready light is illuminated.

b. Vertical Camera Exposure Interval Control

Knob - Set at any desired position but OFF

If this knob is set at OFF, automatic camera operation is not possible.

c. Vertical Camera Exposure Limiter Control

Knob - Set as desired

4. Vertical Camera Door-Open Light - Illuminated

If camera door-open light is not illuminated, open the camera door by means of the camera door switch. Hold the camera door switch in OPEN position until the camera door-open light illuminates.

NOTE

The camera will expose film whether the camera door is open or not.

The camera system is now ready to take pictures. The camera intervalometer can be initiated by a bomb release pulse from the bomb intervalometer, the bomb salvo system, or the manual initiation switch on the camera intervalometer. The camera can be operated by depressing the camera trip switch on the camera intervalometer. The camera can also be operated by positioning the camera intervalometer switch to MANUAL, but this is inadvisable unless the camera intervalometer is inoperative because the exposures remaining counter will not register.

NOTE

If the camera operating light stops flashing, the camera exposures remaining counter stops working, and the camera intervalometer ready light does not illuminate, it is an indication that the camera is no longer taking pictures because: (1) It has run out of film, (2) the film has broken, or (3) the camera is not receiving the impulses from the intervalometer. If it is desired to take more pictures, move the camera intervalometer switch to MANUAL. If the camera operating light on the camera control panel does not flash, the camera probably is not making exposures; shut down the photographic system.

To shut down the photographic system, proceed as follows:

5. Vertical Camera Door Switch - CLOSED

When the bomb doors are fully closed the camera doors can be closed by holding the camera door switch in CLOSED or will be closed automatically when the vertical camera master switch is placed in OFF AND DOOR CLOSED position.

6. Vertical Camera Intervalometer Power Switch - OFF

7. Vertical Camera Master Switch - OFF AND DOOR CLOSED.

BOMB DOOR SYSTEM

The bomb door system (figure 4-74) comprises doors, latches, and the systems which control them. Six double-panel doors cover the bomb bay opening. All actuation by the bomb door system affects the lower panels only. The upper panels are hinged to provide a larger opening for ground service. The doors are latched at the forward and aft bulkheads of the bomb bay. To secure simultaneous action of all doors, the center doors are mechanically linked to the forward and aft doors. The doors can be operated with the bomb door switch on either the pilot's or radar navigator's control panel. The BNS or AGM-69A can operate the doors automatically. The bomb or AGM-69A jettison and ADM-20 launch gear jettison systems will open the doors but will not close them. During ground operation, with no power on the aircraft, the bomb doors may be unlatched by manually pulling the bomb door latch release cable in the aft wheel well. On aircraft W173 W343, the bomb doors are held closed by mechanical latches and held open by hydraulic pressure. The right body hydraulic system supplies normal pressure to operate the forward and aft bomb door actuators and the forward and aft bomb door latch actuators. The left body hydraulic system supplies alternate pressure automatically to the forward bomb door actuator and to the forward bomb door latch actuator whenever the normal pressure is low or fails. On aircraft W344, the bomb door system is the same except that the forward bomb door latch actuator receives normal pressure from the left body hydraulic system and has no alternate source of hydraulic pressure. Both bomb door latch actuators are bussed together by cable so that when hydraulic pressure is available to either or both of the bomb door latch actuators, the forward and aft latches will be released. A forward special weapon manual release handle is connected to the latch actuator cable to provide an emergency means of unlatching the bomb doors. Airloads will then position the bomb doors to some position between closed and full open depending on indicated airspeed. AGM-69A bomb door operation (open/close cycle) (open only for normal jettison) (figure 4-74) is computer controlled for launch or normal jettison of AGM-69A bomb bay missiles. During the AGM-69A computer controlled bomb door open phase, the bomb door safety relay is energized and disables all bomb door close circuits (BNS, manual, etc).

BOMB DOOR SYSTEM CONTROLS

Bomb Door Switches

PILOT'S BOMB DOOR SWITCH. A pilot's bomb door switch (53, figure 1-15) on the pilots' instrument panel provides a means of controlling the bomb doors. The switch has OPEN--OFF--CLOSED positions and is spring-loaded to OFF position. Actuating this switch to OPEN or CLOSED position will energize the bomb doors open circuit or the bomb doors close circuit which positions the bomb

door control valves which in turn direct hydraulic pressure to the bomb door actuators. Actuating this switch to CLOSED position will deenergize the jettison circuits if the jettison circuit is energized and will close the bomb doors. This switch provides the bomb door circuits with right essential d-c power through a circuit breaker marked "Bomb System Door Contr Relays" located on the right forward BNS circuit breaker panel.

RADAR NAVIGATOR'S BOMB DOOR SWITCH. A radar navigator's bomb door switch (4, figure 4-75) on the radar navigator's door and bomb control panel provides a means of controlling the bomb doors. This switch has OPEN--OFF--CLOSE positions and is spring-loaded to the unmarked OFF position. Actuating this switch to OPEN if the bombing system switch is in MANUAL and the master bomb control switch in ON position will energize the bomb doors open circuit. Actuating this switch to CLOSE if the bombing system switch is in MANUAL and the master bomb control switch is in ON position will energize the bomb doors close circuit. Power is supplied to this switch through relay contacts when the bomb doors are open and the bombing system switch is in MANUAL position. This switch provides the bomb door circuits with right essential d-c power through a circuit breaker marked "Bomb System Door Contr Relays" located on the right forward BNS circuit breaker panel.

Bombing System Switch

A Bombing system switch (1, figure 4-75) located on the radar navigator's door and bomb control panel provides a means of transferring control of the bomb doors from the BNS to the radar navigator's bomb door switch. The switch has AUTO--MANUAL positions. AUTO position allows the BNS control of the bomb doors. MANUAL position transfers control of the bomb doors to the radar navigator's bomb door switch. In either position, the BNS is prevented from dropping bombs if the bomb doors are not full open.

NOTE

The bomb doors cannot be operated with the BNS (bombing system switch in AUTO) when the special weapons select switch is in any position other than FWD RACK or AFT RACK.

Bomb Door Close Timer

A bomb door close timer is provided to supply a bomb door close signal when the BNS is operating the bomb doors. The BNS does not actually supply a bomb door close signal following bomb release. The BNS does supply power to close the bomb doors when operating in the bomb mode (and the bombing system switch is in AUTO) and a bomb door open signal at the preset time to go. The bomb door close timer starts to work upon receiving the first bomb release pulse from the bomb release interval control and, approximately 3 seconds after receiving the last bomb release pulse, it causes a continuous door close signal to be sent. The bomb door close timer is sup-

plied TR power through a circuit breaker marked "Bomb Door Control BNS Timer Door Close" located on the aft BNS circuit breaker panel.

BOMB DOOR SYSTEM INDICATORS

Bomb-Doors-Open Lights

One amber bomb-doors-open light (49, figure 1-15) is located on the pilots' instrument panel and one light (3, figure 4-75) is on the radar navigator's door and bomb control panel. When illuminated, they indicate the bomb doors are fully open, that the bomb doors will be held open until the bomb doors close circuit is energized, and that the bomb door safety switches are positioned so that bomb release may be made by either the normal or the jettison system. The lights will remain illuminated as long as the bomb doors are fully open. The bomb-doors-open lights receive TR power through the limit switch actuated by the aft bomb door radius rod on aircraft W173 and by the forward bomb door radius rod on aircraft W181. Power is supplied through a circuit breaker marked "Bomb Door Control Hold Open" located on the aft BNS circuit breaker panel.

Bomb-Doors-Not-Latched Lights

One amber bomb-doors-not-latched light (50, figure 1-15) is located on the pilots' instrument panel and one light (2, figure 4-75) is on the radar navigator's door and bomb control panel. The lights, when illuminated, indicate the forward bomb door latch is unlatched. The lights will remain illuminated until the bomb doors are closed and the forward bomb door latch is latched. The bomb-doors-not-latched lights are supplied TR power through a circuit breaker marked "Bomb Door Control Pos Ind" located on the aft BNS circuit breaker panel.

Bomb Door Control Valve Lights

Two amber bomb door control valve lights are on the bomb door control valve ground check panel (7, figure 4-40) located on the radar navigator's front panel. Each light, when illuminated, indicates hydraulic pressure exists in the respective bomb door close line and that the bomb doors may be damaged if the bomb door open circuit is energized. Each light will illuminate when the hydraulic pressure in the line is above 1500 (± 150) psi and go out when the hydraulic pressure in the line is below 1300 (± 200) psi. Each light receives TR power through a circuit breaker marked "Bomb Door Control Valve Check" located on the aft BNS circuit breaker panel.

CAUTION

Do not attempt to free a bomb door control (four-way) valve by opening the bomb doors as this procedure may damage the bomb door system.

NORMAL OPERATION OF BOMB DOOR SYSTEM

The BNS and bomb door switches at the pilot's and radar navigator's stations are used for normal operation of the bomb doors. Hydraulic pressure is available for bomb door operation when either engine 5 or 4 is in operation. The No. 5 engine hydraulic pump supplies normal bomb door open and close hydraulic pressure. The No. 4 and 5 lights on the pilot's hydraulic control panel will illuminate when the respective system pressure is low. The bomb door control valve lights on the radar navigator's front panel will illuminate if there is pressure in the bomb door close lines. The bomb-doors-not-latched lights will illuminate when the forward bomb door latch is unlatched and they remain illuminated until the forward bomb door latch is latched again. When illuminated, the bomb-doors-open lights indicate the bomb doors are fully open and the bomb door system will now hold the bomb doors open until closing action is initiated.

Bomb Door Operation with BNS

The BNS will automatically open and close the bomb doors at the proper time according to a predetermined setting. When the BNS is operating in the bomb mode and the bombing system switch is in AUTO position, the BNS sends a continuous door close signal to the bomb door system. This door close signal is interrupted only when the BNS sends a door open signal or the jettison circuits are energized. When the bomb door close timer does not receive a bomb release pulse from the bomb intervalometer for approximately 3 seconds following the last bomb release pulse, the bomb door close timer provides a continuous door close signal, closing the bomb doors. To operate the bomb doors and obtain a release with the BNS, proceed as follows:

1. BNS Bomb Mode Button - Depress
2. Engine 5 or 4 in operation
3. Master Bomb Control Switch - ON
4. Bomb Indicator Lights Switch - ON
5. Bombing System Switch - AUTO
6. Special Weapons Select Switch - FWD or AFT RACK
7. Release Circuits Disconnect - Connected
8. BRIC - Set

Bomb Door Operation with Radar Navigator's Bomb Door Switch

To open the bomb doors with the radar navigator's bomb door switch:

1. Engine 5 or 4 in operation
2. Master Bomb Control Switch - ON

3. Bombing System Switch - MANUAL
 4. Radar Navigator's Bomb Door Switch - OPEN
- Hold the switch in OPEN position until the bomb-doors-open lights are illuminated, then release. The bomb doors will remain open. Loss of hydraulic pressure will allow the bomb doors to be positioned by the airstream loads to some intermediate position between full open and closed depending on indicated airspeed.

To close the bomb doors with the radar navigator's bomb door switch:

1. Engine 5 or 4 in operation
 2. Master Bomb Control Switch - ON
 3. Bombing System Switch - MANUAL
 4. Radar Navigator's Bomb Door Switch - CLOSE
- Hold the switch in CLOSE position until the bomb-doors-not-latched lights are out, then release. The bomb doors will remain closed.

Bomb Door Operation with Pilot's Bomb Door Switch

To open the bomb doors with the pilot's bomb door switch:

1. Engine 5 or 4 in operation
 2. Pilot's Bomb Door Switch - OPEN
- Hold the switch in OPEN position until the bomb-doors-open lights illuminate, then release. The bomb doors will remain open. Loss of hydraulic pressure will allow the bomb doors to be positioned by the airstream loads to some intermediate position between full open and closed depending on indicated airspeed.



Do not attempt to open the bomb doors with the pilot's bomb door switch when the bombing system switch is in AUTO position and the BNS is operating in the bomb mode, as the bomb doors will keep cycling (opening partly and then slamming closed) until either the pilot's bomb door switch is positioned to OFF or the bombing system switch is positioned to MANUAL.

To close the bomb doors with the pilot's bomb door switch:

1. Engine 5 or 4 in operation
 2. Pilot's Bomb Door Switch - CLOSED
- Hold the switch in CLOSED position until the bomb-doors-not-latched lights are out, then release. The bomb doors will remain closed.

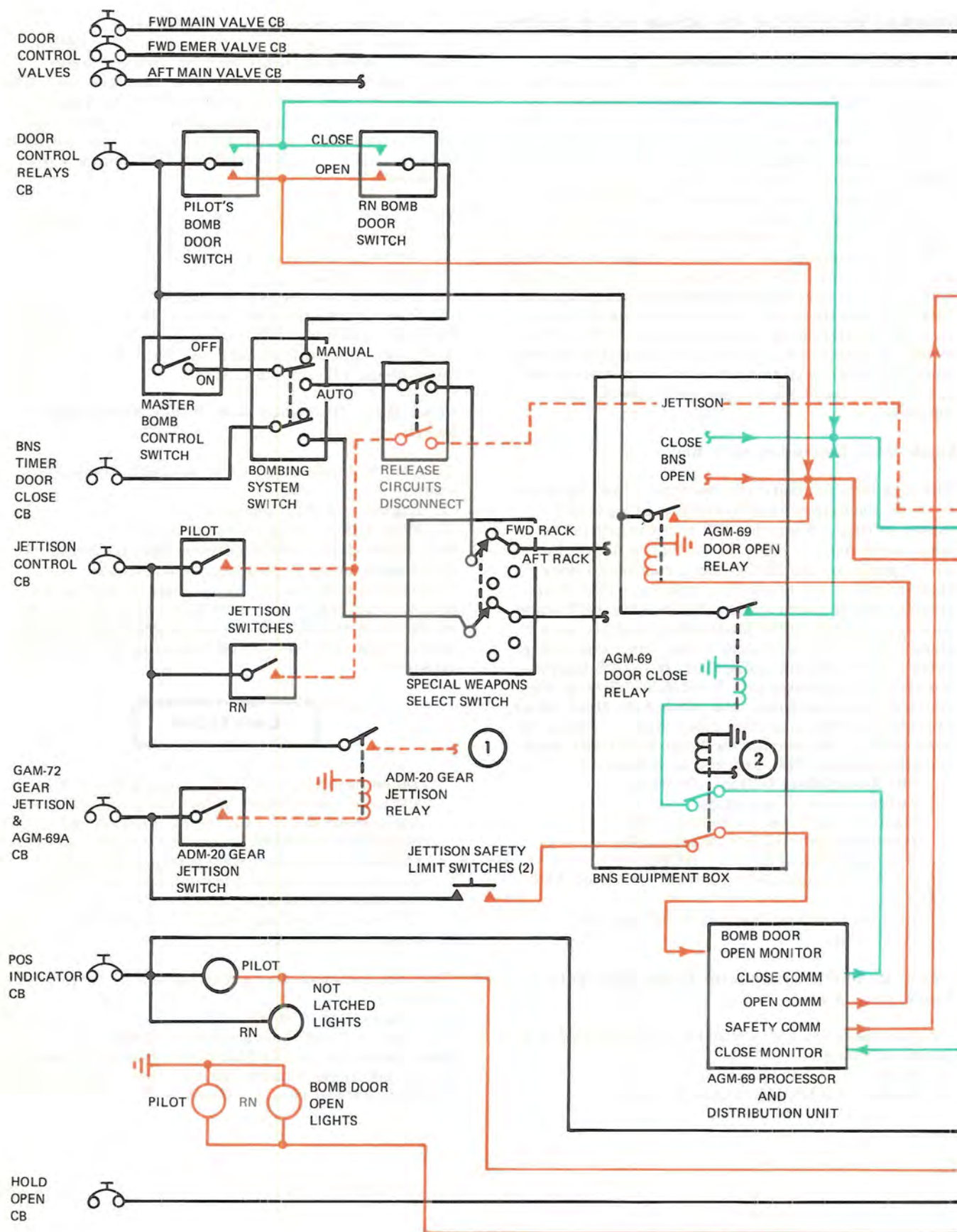
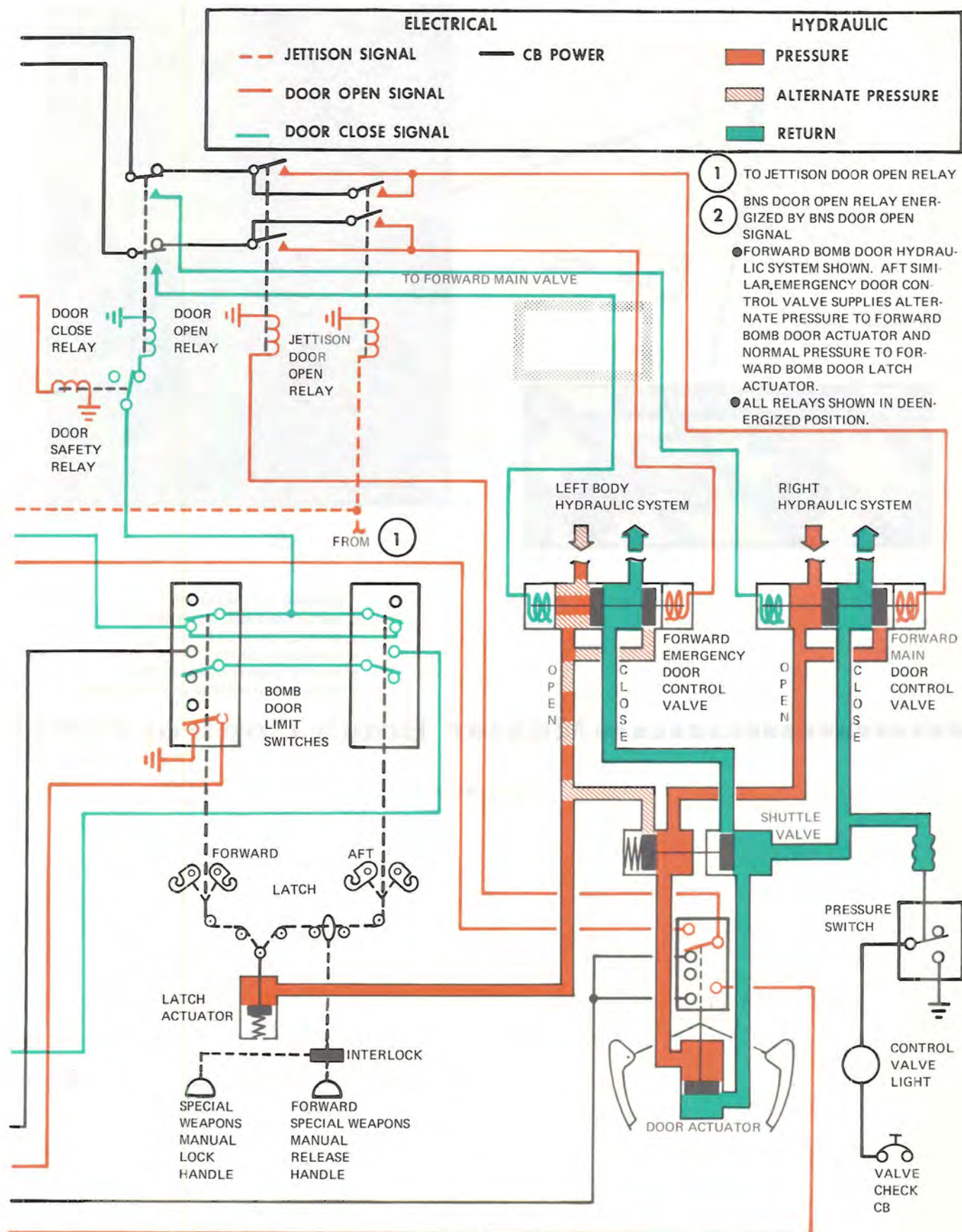
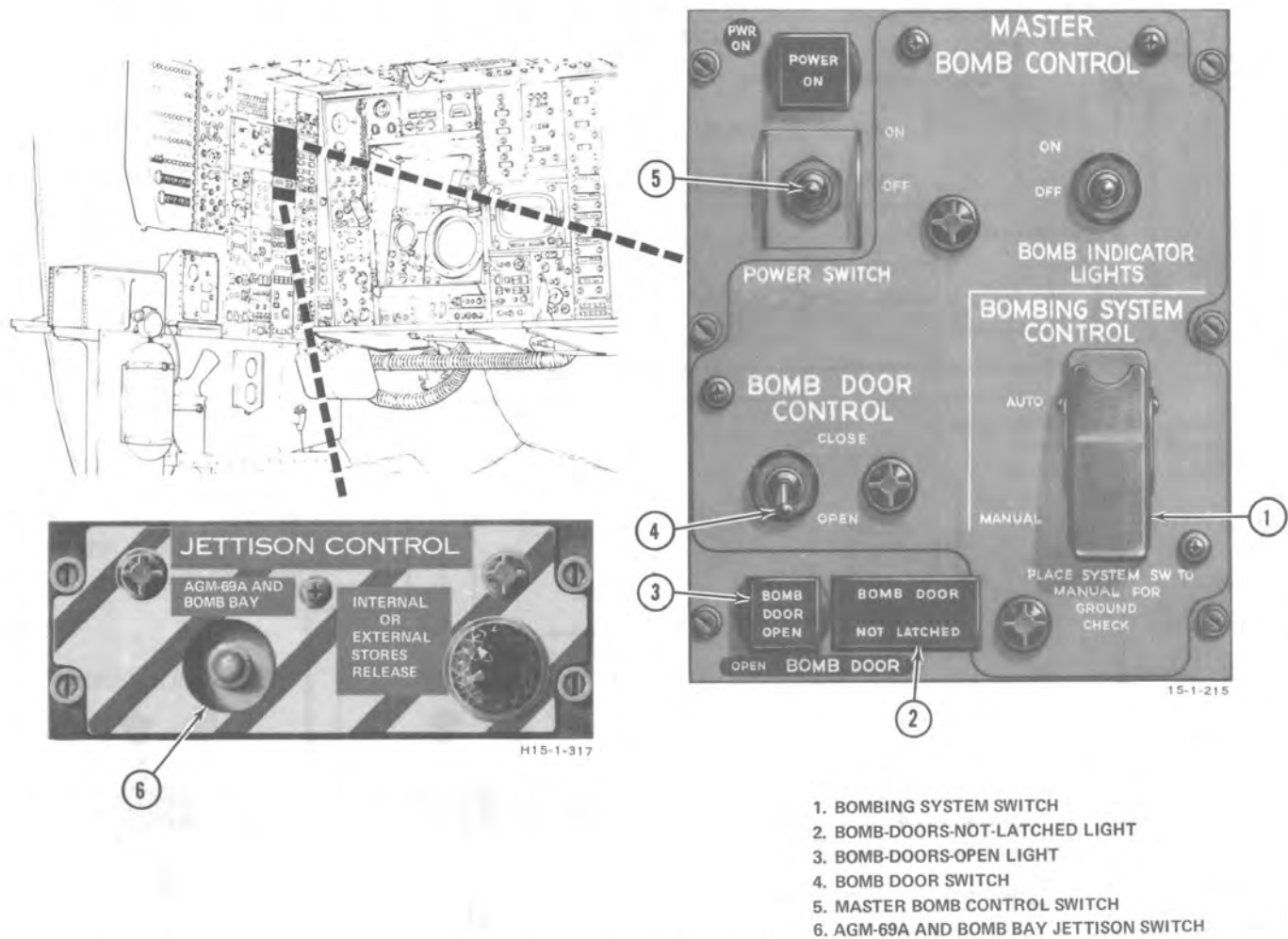


Figure 4-74 (Sheet 1 of 2).



■■■■■■■■■■ Bomb Door System (Typical)

Figure 4-74 (Sheet 2 of 2).



Master Bomb Control Panel

Figure 4-75.

Bomb Door Operation with Failure of the Right Body Hydraulic System

Failure of the right body hydraulic system will not prevent operating the bomb bay doors, since the left body hydraulic system will provide pressure to the forward bomb door actuator and unlatch the doors.

CAUTION

When the bomb bay doors are operated with hydraulic power to only the forward bomb door actuator, aircraft speed should not exceed 325 knots IAS, if practicable, as a precaution against buffeting and structural damage to the doors.

W173 W343

In the event the hydraulic pressure low indicating light for the right body system illuminates, the pilot will notify the radar navigator of the low pressure condition. The radar navigator will pull the "Fwd Main Valve" and "Aft Main Valve" circuit breakers located on the right forward BNS circuit breaker panel before attempting to open the bomb doors either manually or with the BNS system.

CAUTION

W173 W343

Failure to pull the "Fwd Main Valve" and "Aft Main Valve" circuit breakers before opening the bomb doors when the right body system hydraulic pressure is low will result in damage to the aircraft bomb door system.

EMERGENCY OPERATION OF BOMB DOOR SYSTEM

Bomb Door Emergency Operation with Jettison Switches

When the jettison circuits are energized, the bomb doors close signal from the BNS is interrupted and the bomb doors are opened. The jettison circuits can be deenergized by actuation of either bomb door switch to CLOSED if the bombing system switch is in MANUAL and the master bomb control switch is ON. When the bombing system switch is in AUTO, the pilot may deenergize the jettison circuits and close the bomb doors by placing the bomb door switch to CLOSE position.

Bomb Door Emergency Operation with Forward Special Weapon Manual Release Handle

Pulling the forward special weapon manual release handle through the first 9 inches of travel will manually unlatch the bomb doors. After they are unlatched, airloads will position the bomb doors to

some intermediate position between closed and full open, depending on indicated airspeed, provided the bomb door system is not receiving a door close signal from the bomb door switches or the BNS. When the bomb doors are unlatched, the bomb-doors-not-latched lights will illuminate provided TR power is available. To close the bomb doors, use a procedure described under "Bomb Door System Normal Operation" in this section.

NOTE

Due to a mechanical interlock incorporated in the forward special weapon manual release system, the bomb doors cannot be unlatched with the forward special weapon manual release handle without first pulling the special weapons manual lock handle. All special weapon racks are unlocked when the special weapons manual lock handle is actuated.

Ground Manual Unlatching of Bomb Doors

Manual opening of bomb bay door latches may be accomplished using the bomb door latch release cable in the aft wheel well (6, figure 1-2). The cable is the same cable actuated by the aft hydraulic latch actuator and is directly linked to the aft latches and through the coordinating unit to the forward latches.

CAUTION

Unlatching the bomb doors using the aft bomb door latch release cable will not be attempted with power on the aircraft.

Bomb Door Control Valve Lights Illuminated

An illuminated bomb door control valve light indicates the corresponding bomb door control (four-way) valve is directing hydraulic pressure to the respective bomb door close line which may damage the bomb doors if opening is attempted. If a bomb door control valve light is illuminated when there is no pressure on the corresponding hydraulic system, it indicates the corresponding bomb door control valve light pressure switch is malfunctioning because the bomb door control (four-way) valve cannot trap pressure in the hydraulic lines.

BOMBING SYSTEM SWITCH IN THE AUTO POSITION. If both bomb door control valve lights are illuminated when the bomb doors are supposed to be closed and locked and the bombing system switch is in AUTO position, the BNS (when operating in the bomb mode) may be sending a door close signal through a defective door close limit switch which is actuating the door close system. The following steps are recommended to check this condition:

1. Bombing System Switch - MANUAL
Positioning the bombing system switch to MANUAL stops BNS control of the bomb doors.

2. Bomb door system is safe for operation if the bomb door control valve lights are not illuminated and the respective hydraulic systems are pressurized. Care should be taken after the bomb run to position the bombing system switch to MANUAL.

BOMBING SYSTEM SWITCH IN THE MANUAL POSITION. If the bomb door switches are both out of the CLOSE(D) position and the bombing system switch is in MANUAL with the respective hydraulic system pressurized, an illuminated bomb door control valve light may indicate the corresponding bomb door control (four-way) valve is stuck in a position to direct hydraulic pressure to the corresponding bomb door close line. Opening the bomb doors in this condition may cause them to be damaged.



Do not attempt to free a bomb door control (four-way) valve by opening the bomb doors as this procedure may damage the bomb door system.

MISSILE SYSTEM (AGM-69A)

A total of 20 AGM-69A (SRAM) missiles may be loaded internally and externally for launch against

preprogrammed or inflight selected targets. A bomb bay mounted rotary launcher has provisions for eight missiles and each left and right underwing pylon will accommodate six missiles. Missile unlock control requires pilot-EW officer action with missile pre-arm requiring pilot-radar navigator action. Other weapon armament monitor and control functions are provided at the radar navigator station. Missile programming, guidance, and launch are navigator responsibilities. Jettison capability is provided the pilots, radar navigator, and navigator. For further information, refer to T.O. 1B-52G-30-2.

GUNNERY SYSTEM (AN/ASG-15)

The ASG-15 fire control system has the ability to search for, detect, acquire, track, and compute the correct lead angle for any enemy aircraft intent upon attack. At the same time, the system automatically and continuously positions the turret and then provides accurate gunfire against the targets. The gunner has the controls and indicators for operation of the system. For inflight operating procedures and general overall technical information, refer to T.O. 1B-52G-1-5. On aircraft **AU**, in addition to the fire control system, the gunner has the duty of operating the Air Force Satellite Communication System (AFSATCOM) terminal. See "Air Force Satellite Communication System (AFSATCOM) Terminal AN/ASC-19," this section.

AIR REFUELING SYSTEM

An air refueling (IFR, aerial refueling) system makes it possible to refuel the aircraft in flight from a boom-type tanker aircraft. An air refueling slipway and receptacle, which can be covered by hydraulically operated slipway doors when not in use, is located on top of the fuselage slightly aft of the pilots' stations. A refuel system (figure 4-77) makes it possible to fill all the aircraft fuel tanks from the air refueling receptacle or a single point ground refueling receptacle. The refuel system is an extension of the fuel supply system using the same panel to control flow of fuel through the same manifold. See "Fuel Supply System," Section I. A main refuel valve, downstream from the air refuel receptacle and the single point ground refuel receptacle, connects the flow of fuel through the same manifold. A separate refuel panel (figure 4-78A) is installed on the overhead panel adjacent to the air refueling panel and contains the master refuel switch, the refuel valve switch and refuel valve position indicator. See "Fuel Supply System" Section I. A main refuel valve, downstream from the air refuel receptacle and the single point ground refuel receptacle, connects the refuel manifold to the main manifold. The main manifold distributes fuel to each tank through the fuel level control valves which are controlled from the fuel system panel (figure 1-19) located in front of the copilot on the pilots' instrument panel. An air refueling panel (figure 4-78) located on the pilots' overhead panel contains the controls necessary to operate the air refueling hydraulic system and to control a signal amplifier system. The signal amplifier serves to control the refueling sequence and to indicate the sequence conditions of the amplifier to the pilot and copilot.

AIR REFUELING HYDRAULIC PRESSURE

Hydraulic pressure used to operate the slipway door system is normally supplied by the left body hydraulic system. The right body hydraulic system serves as an alternate source of pressure for this purpose. This pressure is controlled by normal and alternate slipway door control valves which are electrically controlled by slipway door switches. A dual shuttle valve, positioned by the pressure source, allows hydraulic pressure to operate the slipway doors actuator and to position the toggle actuator to unlock the toggles. Pressure is also supplied to two electrically operated toggle latching valves. One valve is controlled automatically by the signal amplifier and the other valve is controlled by a manual toggle latching switch. Opening a toggle actuator valve allows hydraulic pressure to lock the latching toggles which hold the air refueling boom in the receptacle.

AIR REFUELING FUEL FLOW

When the air refueling boom nozzle is seated in the air receptacle and held by hydraulically operated latching toggles, fuel is pumped from the tanker to the receiver fuel manifold. Rate of flow is controlled by the tanker crew and number of receiver tanks open. In the receiver, fuel flows from the refuel manifold into the main manifold and into fuel tanks as directed by fuel level control valves which are operated by switches on the fuel system panel (figure 1-19). When a fuel tank is full by weight, the full-by-weight switch, which is an integral part of the fuel quantity indicator, will close the primary and secondary valves in the fuel level control valves in the tank. When a fuel tank is full by volume, float valves will close the primary and secondary valves in the fuel level control valve (the primary and secondary valves in each fuel level control valve are at the same level). When fuel level control valves for all tanks are closed, pressure builds up in the main manifold and refuel manifold and a disconnect is effected when the pressure exceeds a disconnect pressure switch setting of 69 (± 3) psi. A disconnect is also caused by the boom exceeding its envelope limits. A voluntary disconnect may be initiated by either pilot depressing the disconnect switch on his control wheel or by a disconnect signal by the boom operator.

AIR REFUELING SYSTEM CONTROLS

Master Refuel Switch

A master refuel switch (1, figure 4-78A) on the refuel panel has ON--OFF positions. ON position supplies right TR power to the normal and alternate slipway door control switches. In the OFF position, no power is supplied to these units. D-C power is supplied to the master refuel switch through circuit breakers marked "Slipway Door Norm," "Slipway Door Alt," and "Sig Ampl" on the "Inflight Refueling" portion of the right load central circuit breaker panel. The master refuel switch also supplies power to the fuel level control valve circuits through circuit breakers marked "Right Master" on the "Fuel Level Control" portion of the right load central circuit breaker panel and "Left Master" on the "Fuel Level Control" portion of the left load central circuit breaker panel. OFF position of the master refuel switch removes power from the fuel level control valve circuits; the valves will close and refueling through the valves is impossible.

Signal Amplifier Power Switch

A signal amplifier power switch (7, figure 4-78) located on the air refueling panel has MANUAL--NORMAL positions. MANUAL position directs right TR power to the manual toggle latch switch, the manual power light, and the plunger limit switch. NORMAL position directs right TR power to the plunger limit switch, the slipway door limit switches, and the signal amplifier. The signal amplifier power switch receives d-c power from circuit breakers marked "Sig Ampl" and "Man Contr" on the "Inflight Refueling" portion of the right load central circuit breaker panel.

Manual Toggle Latch Switch

A manual toggle latch switch (4, figure 4-78) located on the air refueling panel has RELEASE--HOLD positions. This switch is supplied with right TR power only when the signal amplifier power switch is in the MANUAL position and controls the latching toggles (normally controlled by the signal amplifier). In the HOLD position, power is supplied to the manual toggle latching valve allowing the latching toggles to hold the boom in the air refueling receptacle. HOLD position also supplies power to slipway door limit switches, induction coil, and to the disconnect light. In RELEASE position, the toggles are released and allow the air refueling boom nozzle to be withdrawn from the receptacle. The latching toggles may also be released by pressing the air refueling release button on the pilot's control wheel, copilot's control wheel, by high fuel pressure, or by brute force pull-outs.

Refuel Valve Switch

A refuel valve switch (3, figure 4-78A) on the refuel panel has OPEN--CLOSE positions. This switch controls the main refuel valve located downstream from the air refuel receptacle and the single point refuel receptacle. The valve separates the refuel manifold from the main manifold. In CLOSE position, right TR power is supplied to close the main refuel valve and energize the refuel valve position indicator. In OPEN position, power is supplied to open the main refuel valve and energize the refuel valve position indicator. D-C power is supplied to the refuel valve switch through a circuit breaker marked "Refuel Valve" on the "Fuel Miscellaneous" portion of the right load central circuit breaker panel.

Main Refuel Valve Emergency Control Lever

A main refuel valve emergency control lever (8, figure 4-18) located at the EW officer's station has OPEN--CENTER--CLOSE positions. This lever provides manual control of the main refuel valve which is normally controlled by the refuel valve switch. Moving the lever to OPEN position operates cables to open the valve. Moving the lever to CLOSE position operates cables to close the valve. In CENTER position, no cable tension is applied to the valve. A detent at the CENTER position makes it necessary to pull out on the handle before moving it to either extreme position.



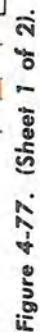
The main refuel valve emergency control lever should be in the CENTER position before the main refuel valve is actuated electrically since OPEN and CLOSE positions of the lever apply cable tension to the valve.

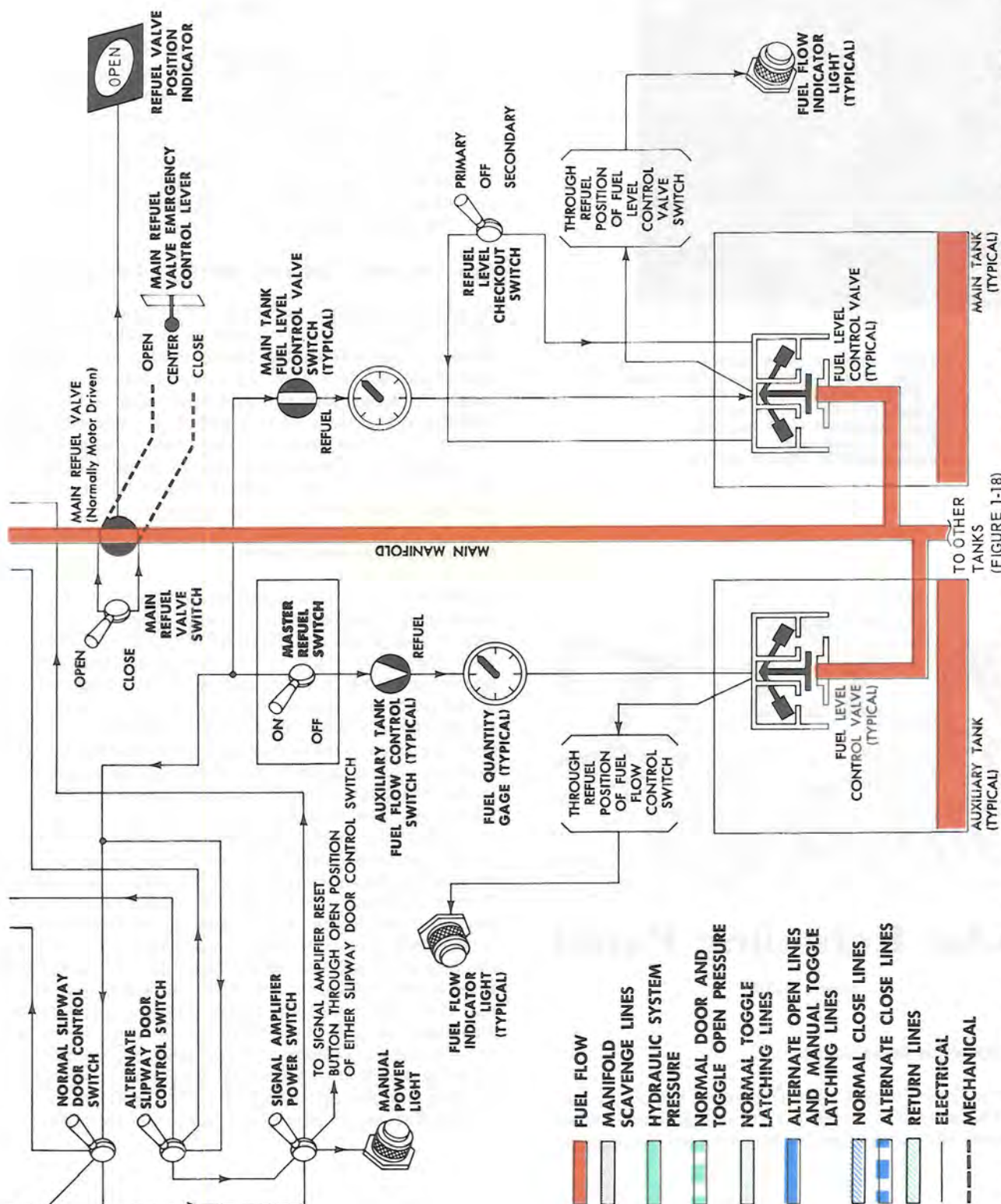
Slipway Door Switches

Normal and alternate slipway door switches (1 and 3, figure 4-78) with OPEN and CLOSED positions are provided on the air refueling panel. Power is supplied to these switches when the master refuel switch is in ON position. When the normal slipway door switch is in OPEN position, right TR power is supplied to the normal slipway door control valve which allows hydraulic pressure from the left body hydraulic system to open the doors. OPEN position also directs right TR power to the signal amplifier power switch. When the normal slipway door switch is placed in CLOSED position, power is supplied to the normal slipway door control valve to close the doors. The alternate slipway door switch functions similarly except that the right body hydraulic system and the alternate slipway door control valve are utilized. The slipway door switches receive d-c power through circuit breakers marked "Slipway Door Norm" and "Slipway Door Alt" on the "Inflight Refueling" portion of the right load central circuit breaker panel.

NOTE

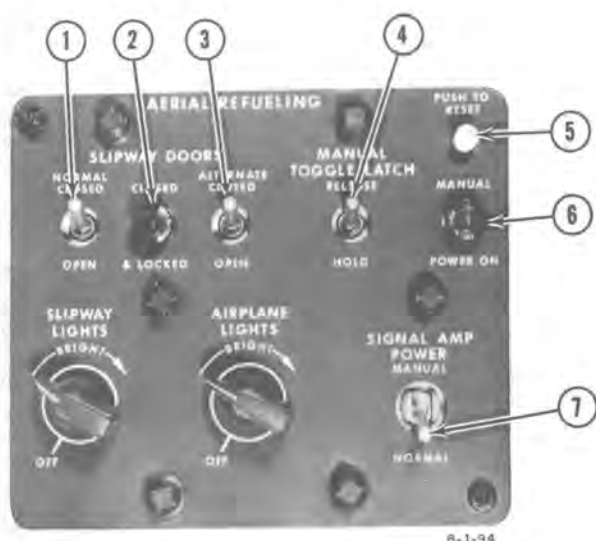
The alternate slipway door switch must be in CLOSED position for the normal slipway door switch to operate the doors properly.



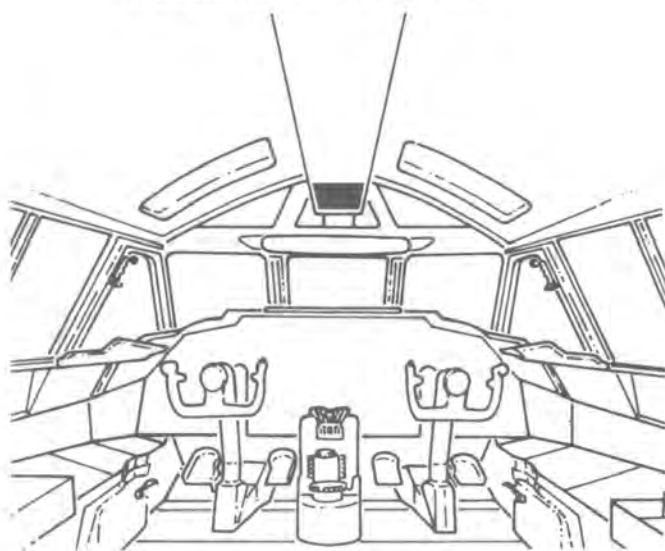


Refuel System (Typical)

Figure 4-77. (Sheet 2 of 2).



1. NORMAL SLIPWAY DOOR SWITCH
2. SLIPWAY DOOR CLOSED-AND-LOCKED LIGHT
3. ALTERNATE SLIPWAY DOOR SWITCH
4. MANUAL TOGGLE LATCH SWITCH
5. SIGNAL AMPLIFIER RESET BUTTON
6. MANUAL POWER LIGHT
7. SIGNAL AMPLIFIER POWER SWITCH



■ ■ ■ Air Refueling Panel

Figure 4-78.

Signal Amplifier Reset Button

A push-to-reset signal amplifier reset button (5, figure 4-78) is located on the air refueling panel. When depressed after a disconnect has been accomplished,

this button resets the automatic control circuit of the signal amplifier. After resetting, the air refueling system is ready for another contact.

NOTE

Upon occasion, the signal amplifier reset button will either fall out of or be pushed inside the air refueling panel when attempting to reset after a disconnect has occurred. Placing the master refuel switch to OFF, then back to ON will accomplish the same thing as pressing the reset button and the signal power amplifier will be in the "ready for contact" position.

Autopilot and Air Refueling (IFR) Boom Release Buttons

An autopilot and air refueling (IFR) boom release button (2, figure 1-31) is located on the pilot's control wheels. Depressing this button during air refueling operations utilizes right TR power to deenergize the toggle latching valve releasing the latching toggles. Additional functions on this switch are covered under "Autopilot," this section. The boom release buttons are supplied d-c power through a circuit breaker marked "Disc" on the "Inflight Refueling" portion of the right load central circuit breaker panel.

Refuel Level Checkout Switch

A refuel level checkout switch (9, figure 1-19) located on the fuel system checkout panel on the copilot's side panel has PRIMARY--OFF--SECONDARY positions. This switch is used to check the operation of the primary and secondary float valves in the fuel level control valves. In order to check the valves in a tank, an auxiliary tank fuel flow control switch or a main tank fuel level control switch must be placed in REFUEL position, the manifold to the tank pressurized, and the master refuel switch on. PRIMARY position of the the refuel level checkout switch deenergizes the primary side of the fuel level control valves (or valve) in the tank. This action permits fuel from the main manifold to flood the primary float chamber in each fuel level control valve in the tank, actuating the float valve to simulate a full-by-volume condition. This causes the fuel level control valves to close. When the fuel level control valves (or valve) in a tank close, the fuel flow indicator light adjacent to the appropriate fuel quantity gage glows steady. Moving the switch to OFF position allows each primary float chamber to drain which allows the fuel level control valves to open and the light to go out. SECONDARY position performs the same function in the secondary

float chamber. The primary and secondary float chambers are at the same level in any one valve. The refuel level checkout switch receives d-c power through a circuit breaker marked "Refuel Valves" on the "Grdchk Out" portion of the left load central circuit breaker panel.

NOTE

The refuel level checkout switch can be used during air refueling to check operation of the fuel level control valves if absolutely necessary. However, their use in flight is not recommended. Use of these switches at such a time might cause a pressure disconnect or might, as a remote possibility, result in a fuel level control valve failing closed. It is recommended therefore that fuel level control valve operation be checked before flight while fueling through the single point ground refueling receptacle.

Main Manifold Interconnect Valves Switch

A main manifold interconnect valves switch (15, figure 1-19) on the fuel system panel has unmarked OPEN--CLOSED positions. This rotary switch is numbered 29 and controls the operation of main manifold interconnect valves No. 29 and 29A. When the white stripe on the switch is aligned with the flow line on the panel, the switch is OPEN and left TR power is supplied to open valve 29 and right TR power is supplied to open valve 29A. Opening these valves interconnects the right and left sides of the main manifold. CLOSED position closes the two valves. D-C power is supplied to the main manifold interconnect valves switch through circuit breakers marked "Crossfeed Valves 29" on the "Fuel Feed Control" portion of the left load central circuit breaker panel and "Crossfeed Valves 29A" on the "Fuel Feed Control" portion of the right load central circuit breaker panel.

Auxiliary Tank Fuel Flow Control Switches

Eight auxiliary tank fuel flow control switches (16, figure 1-19) on the fuel system panel have unmarked REFUEL--OFF--ENGINE FEED positions. These rotary switches are numbered 17, 18, 23, 24, 25, 26, 27, and 28 and control the flow of fuel to and from the auxiliary tanks. A white arrowhead is painted on top of each switch and the direction the arrow is pointing determines the position of the switch. For ENGINE FEED position, the arrow is pointed away from the tank; for REFUEL position, the arrow is pointed toward the tank; and for OFF position, the arrow is pointed perpendicular to the flow line between the tank and the main manifold. REFUEL position causes left and right TR power (left and right TR power circuit breakers are located on the left and right load central circuit breaker panels respectively) to energize the fuel level control valves in the respective tank provided the master refuel switch is ON. ENGINE FEED position of an

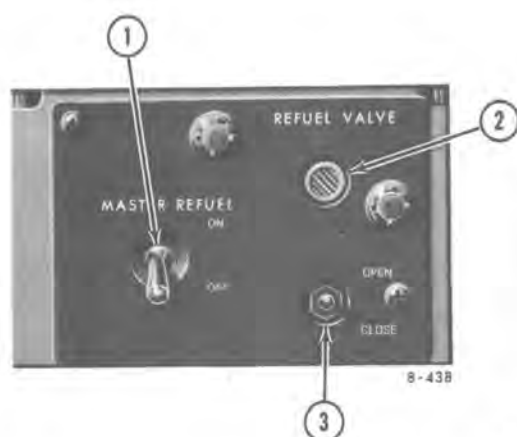
auxiliary tank fuel flow control switch directs 205-volt three-phase a-c power to the boost pumps in the respective tank. See "Fuel Supply System" Section I. OFF position deenergizes the fuel level control valves in the respective tank causing them to close. Fuel level control valves are numbered for ease of identification (figure 7-4). TR power is supplied for REFUEL position of the auxiliary tank fuel flow control switches through circuit breakers on the "Refuel Valves" portion of the left load central circuit breaker panel marked "Ext 17," "Outbd 18 & 18A," and "Aft 28A" and circuit breakers on the "Refuel Valves" portion of the right load central circuit breaker panel marked "Outbd 23 & 23A," "Ext 24," "Fwd 25," "Ctr Wing 26," "Mid 27," and "Aft 28." The circuit breakers are bracketed to indicate whether they are for wing tanks or body tanks.

Main Tank Fuel Level Control Valve Switches

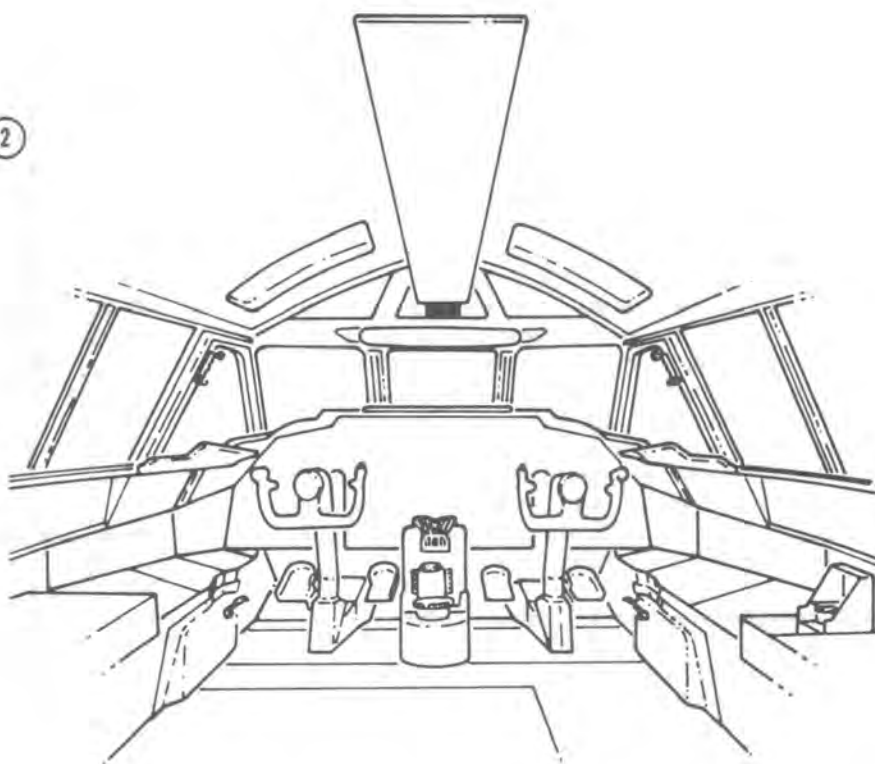
Four main tank fuel level control valve switches (17, figure 1-19) on the fuel system panel have unmarked REFUEL--OFF positions. These rotary switches are numbered 19, 20, 21, and 22 and control the flow of fuel to the main tanks. When the white stripe on a switch is aligned with the flow line on the panel, the switch is in REFUEL position and left and right TR power (left and right TR power circuit breakers are located on the left and right load central circuit breaker panels respectively) is supplied to energize the fuel level control valves in the respective tank provided the master refuel switch is ON. OFF position of a main tank fuel level control valve switch deenergizes the fuel level control valves in the respective tank causing them to close. Fuel level control valves are numbered for ease of identification (figure 7-4). TR power is supplied to the switches through circuit breakers on the "Refuel Valves" portion of the left load central circuit breaker panel marked "1 - 19 & 19A" and "2 - 20" and circuit breakers on the "Refuel Valves" portion of the right load central circuit breaker panel marked "3 - 21" and "4 - 22 & 22A." The circuit breakers are bracketed to indicate that they are for wing tanks.

Defuel Valve Switch

A defuel valve switch on the fuel scavenge system panel (10, figure 1-19) on the right side of the pilots instrument panel in front of the copilot has OPEN--CLOSE positions and is guarded in CLOSE. This switch controls the defuel valve which separates the engine crossfeed manifold from the main manifold. OPEN position supplies right TR power to the valve causing it to open. CLOSE position causes the valve to close. This switch is normally used on the ground for defueling but may be used in flight. Care must be exercised during inflight use because of high fuel flow rates. D-C power is supplied to the switch through a circuit breaker marked "Defuel Valve" on the "Fuel Miscellaneous" portion of the right load central circuit breaker panel.



1. MASTER REFUEL SWITCH
2. REFUEL VALVE POSITION INDICATOR
3. REFUEL VALVE SWITCH



Refuel Panel

Figure 4-78A.

AIR REFUELING SYSTEM INDICATORS

Slipway Door Closed-and-Locked Light

An amber slipway door closed-and-locked light (2, figure 4-78) is located on the air refueling panel. This light is supplied right TR power when the slipway doors are closed and locked, provided the master refuel switch is ON, and the light is off when either door is not closed and locked. D-C power is supplied to the light through a circuit breaker marked "Sig Ampl" on the "Inflight Refueling" portion of the right load central circuit breaker panel.

Refuel Valve Position Indicator

A tab-window type refuel valve position indicator on the refuel panel (2, figure 4-78A) has three markings to register position of the main refuel valve and switch. When the refuel valve switch is placed in OPEN position, right TR power is supplied to open the valve. When the valve is open, a limit switch stops the motor and energizes the refuel valve position indicator to show the OPEN marking. When the refuel valve switch is moved to CLOSE position, the position indicator is deenergized, showing the slanting stripes marking. The indicator remains deenergized until the valve closes and a limit switch stops the motor and energizes the indicator to show the CLOSED marking. The refuel

valve position indicator is supplied d-c power through a circuit breaker marked "Refuel Valve" on the "Fuel Miscellaneous" portion of the right load central circuit breaker panel.

Ready-for-Contact Light

A blue ready-for-contact light is the upper light of the three air refueling lights (26, figure 1-15) on the eyebrow instrument panel. The word READY can be read on the light. The light receives right TR power through the fully open positions of the slipway door limit switches. D-C power is supplied to the light through a circuit breaker marked "Man Contr" or a circuit breaker marked "Sig Ampl" on the "Inflight Refueling" portion of the right load central circuit breaker panel.

Contact-Made Light

A green contact-made light is the center light of the three air refueling lights (26, figure 1-15) on the eyebrow instrument panel. The word CONTACT can be read on the light. The light receives right TR power through the plunger limit switch in the air refuel receptacle. D-C power is supplied to the light through a circuit breaker marked "Man Contr" or a circuit breaker marked "Sig Ampl" on the "Inflight Refueling" portion of the right load central circuit breaker panel.

Disconnect Light

An amber disconnect light is the lower light of the three air refueling lights (26, figure 1-15) on the eyebrow instrument panel. The word DISCONNECT can be read on the light. The light receives right TR power from the signal amplifier or from the HOLD position of the manual toggle latch switch. D-C power for the light is supplied through a circuit breaker marked "Sig Ampl" or a circuit breaker marked "Disc" on the "Inflight Refueling" portion of the right load central circuit breaker panel.

Fuel Flow Indicator Lights

Twelve amber fuel flow indicator lights (18, figure 1-19) are located on the fuel system panel adjacent to the fuel quantity gages. When a main tank fuel level control valve switch or an auxiliary tank fuel flow control switch is placed in REFUEL position, the fuel level control valves in the corresponding tank are opened provided the master refuel switch is ON. When the valves close due to a full tank, either by weight or by volume, contacts are completed allowing right TR power to cause the respective fuel flow indicator light to glow steady, indicating the valves are closed. See "Fuel Supply System," Section I, for additional information on these lights. The fuel flow indicator lights receive d-c power through a circuit breaker marked "Fuel Manag Ind" on the "Fuel Miscellaneous" portion of the right load central circuit breaker panel.

Manual Power Light

An amber right TR powered manual power light (6, figure 4-78) is on the air refueling panel. This light is illuminated when the signal amplifier power switch is in MANUAL position provided the air refueling system master switch is ON. The manual power light is out when the signal amplifier power switch is in NORMAL. D-C power is supplied for the light through a circuit breaker marked "Man Contr" on the "Inflight Refueling" portion of the right load central circuit breaker panel.

AIR REFUELING SCAVENGE SYSTEM

A fuel scavenge system is provided for the refuel manifold and consists of an ac powered pump, float switch and shutoff valve, all under control of the scavenge system switch on the fuel scavenge system panel.

Scavenge System Switch

A scavenge system switch has CABIN--OFF--MAIN positions. If fuel is in the refuel manifold (as determined by a float switch), CABIN position causes right TR power to open a solenoid shutoff valve and

energize a relay which directs 118-volt single-phase a-c power to the refuel manifold scavenge pump. The fuel in the manifold is pumped into No. 2 main tank. As soon as the manifold is scavenged, the float switch breaks contact causing the scavenge pump to stop and the solenoid shutoff valve to close. MAIN position actuates the scavenge operation in the main manifold. See "Fuel Supply System," Section I. OFF position deenergizes the scavenge circuits in the main and refuel manifolds. D-C power is supplied for CABIN position of the scavenge system switch through a circuit breaker marked "Manifold, Fuel Scavenge Control, Cabin" on the "Fuel Miscellaneous" portion of the right load central circuit breaker panel.

Fuel-In-Manifold Lights

Two amber fuel-in-manifold lights (12 and 13, figure 1-19) on the fuel scavenge system panel indicate when fuel is in either the main or refuel manifolds. The lights are located adjacent to MAIN and CABIN positions of the scavenge system switch in order to identify which manifold each light is for. When the scavenge system switch is placed in MAIN position, the "Main" fuel-in-manifold light will glow if fuel is in the main manifold. The light will go out as soon as the manifold is scavenged or the scavenge system switch is turned OFF. On aircraft W173 W259, the "Cabin" fuel-in-manifold light will glow if fuel is in the refuel manifold and the master refuel switch is placed in OFF. After scavenging, the light may blink on and off if residual fuel remains in the manifold. On aircraft W260, the "Cabin" fuel-in-manifold light will glow if fuel is in the refuel manifold and the master refuel switch is placed to OFF or when the scavenge system switch is placed in CABIN position. The light will go out as soon as the manifold is scavenged. The fuel-in-manifold lights receive right TR power through circuit breakers marked "Manifold Fuel Scavenge Control Cabin" and "Manifold Fuel Scavenge Control Main" on the "Fuel Miscellaneous" portion of the right load central circuit breaker panel.

AIR REFUELING SYSTEM CHECK (Pilot reads)

INTERIOR CHECK. The following preflight will be accomplished after external power is connected to the aircraft and the left body hydraulic system standby pump is turned on. No external air is required. This check may be performed after maintenance or a reported malfunction has occurred, time and conditions permitting, and at the discretion of the flight crew.

1. Master Refuel Switch - ON (CP)
2. Refuel Valve Switch - OPEN, refuel valve position indicator - OPEN (CP)
3. Signal Amplifier Power Switch - NORMAL (CP)
4. Normal Slipway Door Switch - OPEN, ready-for-contact light on (CP)

When slipway doors are open, the amber closed-and-locked light will be out and the blue ready light will illuminate when the slipway doors are fully open.

NOTE

The pilot must wait 30 seconds after the blue ready light is illuminated to allow sufficient warmup time for the signal amplifier before proceeding with the next steps.

5. Plunger Limit Switch Actuator - Depressed, toggles engaged (G)

The gunner depresses the plunger limit switch actuator on pilot's request and observes toggle actuator operation. Blue ready light will go out and the green contact-made light will illuminate indicating contact made, and toggles engaged.

NOTE

When operating the plunger limit switch actuator, the gunner should check the actuator and spring for operation by pulling down on the actuator arm. For the remaining checks, the gunner need only push the limit switch.

6. Plunger Limit Switch Actuator - Released, toggles disengaged (G)

Gunner releases signal switch plunger and toggle actuator will return to the release position. Amber disconnect light will illuminate and the green contact-made light will go out.

7. Signal Amplifier Reset Button - Depressed (CP)
Push and release signal amplifier reset button and check ready light illuminated.

8. Plunger Limit Switch - Depressed, toggles engaged (G)

Gunner holds the plunger limit switch in the depressed position and observes toggles actuator operation--blue ready light will go out and the green contact-made light will illuminate indicating contact made and toggles engaged.

9. Pilot's Boom Release Button - Depressed (P), Toggles disengaged (G)

NOTE

Cycling of the toggle latches will occur when the boom release buttons on the pilot's or copilot's control wheels are depressed while the gunner holds the plunger limit switch in the contact-made position.

Pilot depresses boom release button on control wheel. The amber disconnect light will illuminate and the green contact-made light will go out, indicating the

toggles are in the release position. Gunner checks toggle release action and continues to hold the plunger limit switch depressed.

10. Signal Amplifier Reset Button - Depressed (CP), Toggles engaged (G)

Copilot depresses and then releases the signal amplifier reset button. The blue ready light will blink on then will go out and the green contact-made light will illuminate, indicating contact made and toggles engaged. Gunner observes toggle actuator operation.

NOTE

The toggles will engage as soon as the copilot releases the signal amplifier reset button because the gunner is still holding the plunger limit switch depressed.

11. Copilot's Boom Release Button - Depressed (CP), Toggles disengaged (G)

Copilot depresses boom release button on control wheel. The amber disconnect light will illuminate and the green contact-made light will go out, indicating the toggles are in the released position. Gunner checks toggle release action.

NOTE

Cycling of the toggle latches will occur when the boom release buttons on the pilot's or copilot's control wheels are depressed while the gunner holds the plunger limit switch in the contact-made position.

12. Plunger Limit Switch Actuator - Released (G)

13. Signal Amplifier Power Switch - MANUAL (CP)
The amber manual power light will illuminate and the blue ready light will illuminate when the toggle latching switch is in the release position.

14. Manual Toggle Latch Switch - HOLD (CP), Toggles engaged (G)

The blue ready light will go out. Gunner checks toggle engage action.

15. Pilot's Boom Release Button - Depressed (P), Toggles disengaged (G)

Pilot depresses boom release button on control wheel; amber disconnect light will illuminate. Gunner checks toggle release action.

NOTE

If the pilot's and copilot's boom release buttons function properly when the signal amplifier switch is in NORMAL, it is unnecessary to check the copilot's boom release button with the signal amplifier switch in MANUAL.

16. Manual Toggle Latch Switch - RELEASE (CP)
 17. Signal Amplifier Power Switch - NORMAL (CP)
 18. Normal Slipway Door Switch - CLOSED, closed-and-locked light on (CP)
- Amber slipway door closed-and-locked light will illuminate when doors are fully closed.
19. Refuel Valve Switch - CLOSE, position indicator - CLOSE (CP)
 20. Master Refuel Switch - OFF (CP)

CAUTION

If the master refuel switch is turned OFF before the slipway doors closed-and-locked light illuminates, the doors will remain in an unlocked or intermediate position.

21. Air Refueling Accumulator Preload - 1000 ($\pm$ 200) psi (G)

Gunner checks air refueling accumulator located to the right and aft of the air refueling receptacle.

22. Hydraulic Leaks - Checked (G)

Gunner checks for possible hydraulic leaks aft of slipway area. Report to pilot.

BEFORE TAXIING CHECK. The following alternate slipway door switch check will be made after the engines are started. This check could not be made during the "Power On Interior Check" because hydraulic standby pump pressure is not available to the alternate slipway door control valve with the controllable hydraulic check valves CLOSED. This check will normally be made only after maintenance or reported malfunction has occurred.

1. Master Refuel Switch - ON (CP)
 2. Alternate Slipway Door Switch - OPEN, ready-for-contact light on (CP)
- Amber door-locked light will go out and blue ready-for-contact light will illuminate when the doors are fully open.
3. Alternate Slipway Door Switch - CLOSED, slipway door closed-and-locked light on (CP)
- The amber slipway door closed-and-locked light will illuminate when the doors are fully closed.
4. Master Refuel Switch - OFF (CP)

AIR REFUELING FUEL MANAGEMENT

Fuel Distribution Prior to Air Refueling

With the exception of ground operation and takeoff, fuel will generally be used first from the center wing and body tanks. Consequently, mains, outboard and external wing tanks will be full for takeoff and additional fuel required will be distributed between the

center wing and body tanks in accordance with loading data in T.O. 1-1B-40. This results in a desirable distribution of fuel for air refueling since the three body tanks and the center wing tank are capable of taking fuel simultaneously as fast as the tanker can supply it and their combined capacity will normally satisfy any outbound or inbound refueling requirements. As the four tanks fill simultaneously, the cg moves aft remaining well within the flight limit.

Refuel Valves Operating Technique

A typical panel configuration for refueling is shown in figure 4-79.

The tanks in each step will be refueled simultaneously to the prescribed quantities prior to commencing the next step. Where a tank is refueled in successive steps, it may be practical to leave the appropriate valve open at the end of the initial step. Be careful to maintain the proper differential between tanks.

Whenever a main tank is full, its respective refuel valve should be left open during the remainder of the refueling operation in order to replenish fuel used from the main tank for engine feed. Main tank(s) differential fuel load is maintained by opening and closing appropriate refuel valves as required.

Whenever a token off-load has been received and considerable fuel has been used out of the main tanks for pilot air refueling proficiency purposes, the main tanks should be replenished with fuel from the body tanks in normal fuel usage sequence down to ballast requirements. The proper distribution between mains 1 & 2; and 3 & 4 should be maintained.

Air Refueling Procedure - No External Missiles

Enter the refueling procedure at the appropriate gross weight and continue the subsequent steps to the desired fuel load.

1. At gross weights below 255,000 pounds. Refuel mains, outboards, externals, and forward body tanks to the following quantities:

- Forward body to required ballast (figure 7-3A).
- Mains 1 and 4 to the upper limit of green band.
- Mains 2 and 3 to 16,400 pounds each.
- Outboards and externals to full.

NOTE

During this step, the aircraft will be speed restricted until the external wing tanks are full. See Section V for "Wing Flutter Airspeed Limitations."

2. At gross weights between 255,000 and 345,000 pounds. Refuel all main tanks to the following quantities:

- Mains 1 and 4 to full.
- Mains 2 and 3 to 38,700 pounds each.

3. At gross weights between 345,000 and 365,000 pounds. Refuel simultaneously the following tanks to the specified quantities:

- Mains 2 and 3 to full.
- Aft body to 9700 pounds.

4. At gross weights above 365,000 pounds. Refuel all mains, center wing, forward body, aft body, and mid body to full.

NOTE

If main tanks are not full by the end of the refueling operation, replenish the main tanks directly from the center wing and aft body tanks through the main manifold.

The above refueling procedure will keep the cg travel well within the flight limits and will allow the normal fuel usage sequence after refueling.

AIR REFUELING WITH MAIN MANIFOLD INTERCONNECT VALVES FAILED. An alternate method of fuel management is provided to assure safe aircraft operation and permit air refueling in event of failure of the main manifold interconnect fuel valves. The interconnect valves are opened during refueling and during steps 5 - "Mid to All," 6 - "Aft to 1, 2, 7, and 8; No. 2 Main to 3 and 4; No. 3 Main to 5 and 6," and 11 - "Fwd to All." Failure of the main manifold interconnect valves will, in practically all cases, occur when the valves are closed. See "Fuel Management with Main Manifold Interconnect Valves Failed Closed" under "Fuel System Emergency Operation" in Section III. If failure is encountered during air refueling, the forward body and center wing fuel tanks should not be refueled to a total quantity greater than the quantity in the aft body tank at the beginning of the refueling operation. This permits a normal fuel usage sequence, using equally from center wing and aft body and from forward body and aft body tanks. Fuel usage from the mid body tank would be in accordance with the "Fuel Management with Main Manifold Interconnect Valves Failed Closed" procedure. In the event refueling is desired after all aft body tank fuel has been used in the normal sequence (no forward body or center wing fuel remaining), the mid body tank can be filled to capacity.

NOTE

The refueling operations as described above are based on the assumption that the external and outboard wing tanks are full and the main wing tank fuel levels are above the green band marking on the fuel quantity gages.

If the main manifold interconnect fuel valves should fail or ice up in open position, it would affect control of cg during fuel usage following an air refueling. In this case, more fuel will be used from the aft body tank during sequences where it is used along with fuel from other body tanks. Monitoring of the fuel quantity gages will indicate this condition.

Air Refueling Procedure with External AGM-69A Missiles (Two Pylons Symmetrical Loading - Two Thru 12 Missiles)

The following tank refueling sequence is for aircraft carrying external AGM-69A missiles in a symmetrical loading. Refuel the tanks specified in each step (forward body tank is not refueled):

1. Mains, outboards, and externals to the following quantities:

- Mains 1 and 4 to the upper limit of green band.
- Mains 2 and 3 to 16,400 pounds each.
- Outboards and externals to full.

NOTE

During this step the aircraft will be speed restricted until the external wing tanks are full. See Section V for "Wing Flutter Airspeed Limitations."

2. Mains and aft body to the following quantities:

- Aft body to 9,700 pounds.
- Mains to full.

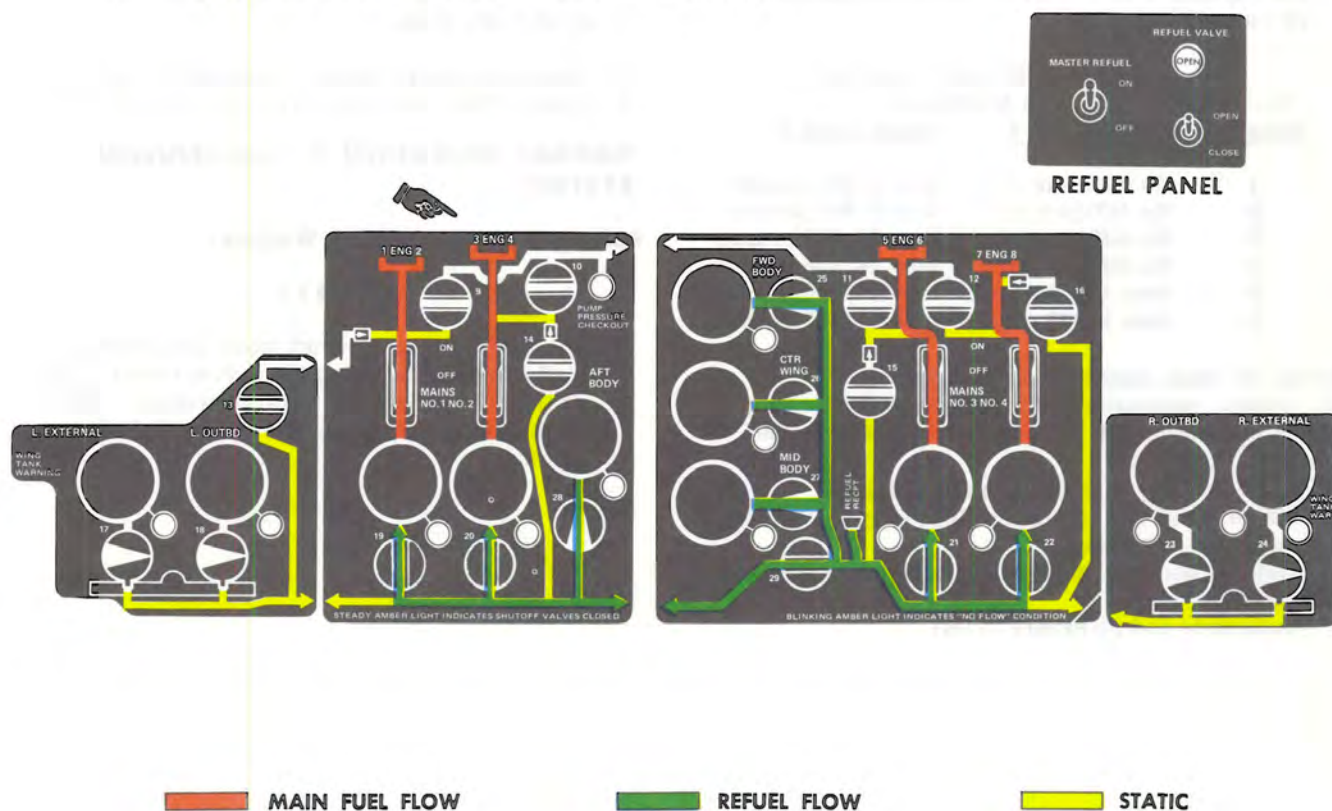
3. Center wing, mid, and aft body to the following quantities:

- Center wing to full.
- Aft body to 47,000 pounds.
- Mid body to desired gross weight.

Air Refueling Procedure with Asymmetrical External AGM-69A Missile(s) (One Pylon - One Thru Six Missiles)

When carrying asymmetrical external AGM-69A missile(s), lateral unbalance and trim requirements are minimized by using a differential fuel load in the main wing tanks. For carrying one, two, three, or four missiles on one pylon, the differential fuel load to counterbalance the asymmetrical missile(s) loading is maintained between main tanks 2 and 3. For carrying five or six missiles on one pylon, the differential fuel load to counterbalance the asymmetrical missiles loading is maintained between main tanks 2 and 3 and main tanks 1 and 4. The following tank refueling sequence is for aircraft carrying asymmetrical external AGM-69A missile(s):

REFUELING FORWARD BODY, CENTER WING, MID BODY, AND AFT BODY TANKS



■■■■■ Air Refueling Fuel Management (Typical)

Figure 4-79.

NOTE

The following is a table of differential fuel loading between main tanks to counterbalance the asymmetrical external AGM-69A missiles on one pylon:

No. of Missiles	Fuel Differential on Side with Missile(s)	
	Mains 1 and 4	Mains 2 and 3
1	No differential	less 6,200 pounds
2	No differential	less 8,900 pounds
3	No differential	less 11,500 pounds
4	No differential	less 14,100 pounds
5	less 1,000 pounds	less 14,100 pounds
6	less 1,900 pounds	less 14,100 pounds

Refuel the tanks specified in each step:

1. Mains, outboards, externals, and if operating weight cg is aft of 24.5%, the forward body to the following quantities.
 - Forward body to 5,000 pounds (ballast).
 - Mains 1 and 4 to the upper limit of green band in tank opposite missiles.
 - Mains 2 and 3 to 20,000 pounds in tank opposite missile(s).
 - Outboards and externals to full.

NOTE

During this step, the aircraft will be speed restricted until the external wing tanks are full. See Section V for "Wing Flutter Airspeed Limitations."

2. Mains until tanks opposite missile(s) are full.
3. Center wing, forward, mid, and aft body to full.

NORMAL OPERATION OF AIR REFUELING SYSTEM**Refueling At Heavy Gross Weights****NOTE**

Pilot fatigue and aircraft loads are substantially reduced by using the aerial refuel mode of the automatic flight control system. For additional information, see "Autopilot" this section.

The most skill required of the pilot for operation at maximum weight will be air refueling. Refueling with the KC-135 should be done smoothly because, at the airspeeds flown, it is possible for the pilot to exceed the "g" limit of the aircraft. In general, if the refueling is done at normal altitudes (that is, above 27,000 feet), the aircraft cannot aerodynamically exceed the 1.8 "g" limit load. If refueling is done at lower altitudes where it is possible aerodynamically to reach limit load, refueling will be smoother because of improved performance and stability characteristics. At maximum weight, the receiver may not have the normal amount of power for maneuvering if refueling at optimum cruise altitude, causing difficulty in maintaining optimum refueling position with the tanker. In this case, the tanker may have to start a slow descent during the last part of the refueling. Although the aft cg flight limit at 488,000 pounds is 35%, the aircraft is easier to handle at high gross weight during a refueling if the cg is maintained forward of 30%. Refueling with the aft cg causes considerable pitching of the receiver which induces pitching of the tanker and the two soon become incompatible. If pitching commences during a refueling hookup, it is recommended that the receiver disconnect, drop back and stabilize, then move in for a new hookup. The cg at maximum gross weight is not always a constant figure. Fuel density, bomb load, chaff load, etc, are variables which can affect the cg location.

For further air refueling information and checklists, refer to T.O.'s 1-1C-1 and 1-1C-1-15.

EMERGENCY OPERATION OF AIR REFUELING SYSTEM

Emergency Operation of Slipway Doors

Failure of the left body hydraulic system will prevent actuation of the slipway doors from the normal system. In such an emergency, place the alternate slipway door switch in OPEN to operate the slipway doors. Hydraulic pressure is supplied from the right body system with the alternate slipway door switch in OPEN position.

Emergency Operation of Main Refuel Valve

The main refuel valve is operated by a d-c motor. If this motor should fail in the closed position, it would be impossible to receive fuel from a tanker until the valve was manually open. If the refuel valve is to be manually operated, pull the "Refuel Valve" circuit breaker located on the right load central circuit breaker panel since the electrical actuator may tend to resist valve movement by the emergency lever cable control system. To manually open the valve, move the main refuel valve emergency control lever to OPEN and to close the valve, move the lever to CLOSE position. An erroneous indication may be obtained when manually operating this valve since the refuel valve position indicator receives d-c power through the "Refuel Valve" circuit breaker, which will be pulled.

SINGLE POINT GROUND REFUELING SYSTEM

A single point ground refueling receptacle (22, figure 1-55) is provided to allow filling of all aircraft fuel tanks from a single point. Single point servicing of the fuel system reduces the time and amount of equipment required during fuel servicing of the aircraft. The receptacle is located forward of the left forward wheel well and is accessible through a filler cap. The nozzle adapter of the receptacle contains a spring-loaded poppet which is opened by the fuel nozzle and seals the filler opening when the nozzle is withdrawn. The single point refueling receptacle is connected directly to the refuel manifold and fuel flows in the same manner as in air refueling (figure 4-77). The refuel panel (figure 4-78A) on the pilots' overhead panel and the fuel system management panels (figure 1-19) on the copilot's instrument panel contain the controls necessary for operation of the refuel system valves. See "Air Refueling System," this section, for information on these controls.

EW OFFICER'S AND GUNNER'S EJECTION SEATS

The EW officer and gunner are provided with upward ejection seats. The seats are located at the aft of the upper deck and face to the aft of the aircraft. The seat controls are operated in the same manner as the pilot's and copilot's seat controls. Sequence of operation of the seat ejection system is the same as the pilots' with the exception of having no control column stowage thruster and having a man-seat separator. A fire control indicator stowage thruster is provided in the gunner's ejection system and is fired simultaneously with the hatch jettison thruster and automatically stows the gunner's stowable control unit if not stowed. A-C power for the operation of the electrical seat actuators for both seats is supplied through circuit breakers marked "Seat Pos - DECM" and "-FCS" on the FCS (gunner's) circuit breaker panel. For a detailed description of the upward ejection seats, see "Upward Ejection Seats," Section I.

DOWNWARD EJECTION SEATS

The navigator and radar navigator are provided with forward facing downward ejection seats (figure 4-80). Each seat is positioned over an escape hatch and has fixed ejection rails. The ejection trigger ring initiates the ejection cycle. One continuous pull on the ejection trigger ring will sequence a series of ballistic devices and mechanical linkages incorporated in the seat to rotate the leg guards, lock the inertia reel, stow the writing table, jettison the hatch, and fire the catapult to eject the seat from the aircraft.

The seat is equipped with a drogue parachute and deployment mechanism to positively separate the seat from the seat occupant after the seat leaves the rails. The parachute is located in a container mounted below the seat on spring-loaded swinging arms. As the seat leaves the rails, the arms and container swing aft of the seat and deploy the drogue parachute, thus separating the seat from the occupant. Restraint straps connected to the arms to limit travel are interconnected with the integrated harness mechanism to mechanically release the parachute and safety belt fittings as the arms are deployed. These actions are fully automatic and require no action on the part of the crew member.

Ankle restraints are provided to keep the legs in position during ejection. The ankle restraints are spring-loaded and may be kicked free any time after they are closed. In event they are accidentally triggered, they may be reset by pushing downward and outward on either restraint until pivot arms and restraints are locked. The seats can be positioned electrically up and down, fore and aft, and tilted by seat positioning switches during normal use. Electrical, oxygen, and ballistics lines are provided with disconnects to permit separation of the lines when the seat is ejected. The seat is equipped with a headrest and an inertia reel which assist the occupant in maintaining position during ejection. The downward ejection seat accommodates a survival kit and a back-type parachute.

Utilizing the wrong seat cushions and/or survival kit or too much cushioning material does not provide comfort, but actually creates a definite injury hazard and may position the seat occupant where it is difficult to reach the controls. Chance of vertebral injury upon impact of crash landing or ditching is increased considerably by sitting on too thick a compressible mass. The added cushioning may also permit the seat occupant to sink far enough down to loosen the shoulder straps, allowing the seat occupant to slump forward, possibly incurring severe back injury. It may raise the seat occupant to such a height that the leg restraints will not restrain his legs, thus exposing them to possible injury from flailing in the windblast following ejection. An integrated harness release mechanism provides a means for separating the safety belt and parachute harness from the seat automatically after ejection of the seat. Manual operation of the integrated harness release will disengage the safety belt and parachute harness and, in addition, will disengage the parachute arming lanyard. A modified parachute and a specially designed safety belt is installed in the harness release fittings. See "Integrated Harness System," this section for additional information.

WARNING

- Should a downward ejection hatch be inadvertently dropped, the ejection seat at that station will be armed and can be fired.
- Do not use any form of shock absorbing device other than the survival kit and/or seat cushion designated as standard equipment for the ejection seat. To do so would create a definite possibility of serious injury during ejection and/or crash landing/ditching.

MAN-SEAT SEPARATOR

The seats are equipped with a man-seat separator that insures positive separation of crew members occupying downward seats during ejection. Two nylon straps are installed in the seat under the survival kit and parachute. A reel-type ballistic actuator and jackshaft is installed on the back of the seat. The nylon straps are attached to the jackshaft driven by the reel-type ballistic actuator. The actuator is connected by ballistic hose to the integrated harness ballistic actuation system. After the integrated harness is released, the straps are pulled tight, forming one side of a triangle, the other two sides of which form the seat back and bottom. As the straps are pulled tight, they throw the man clear of the seat automatically. The man-seat separator separates the man from the seat 0.3 second after ejection. More time than this is needed to decelerate the man to an acceptable parachute deployment velocity and is provided by the parachute timer.

DOWNWARD EJECTION SEAT CONTROLS

Leg Guards

The leg guards (4, figure 4-80) are positioned automatically during the ejection cycle. Pulling the ejection control trigger ring triggers the arming initiator which in turn fires the leg guard thruster which turns the leg guard torque tube and rotates the leg guards into position to protect the legs during ejection.

CAUTION

Do not apply pressure to the leg guards during ground or air operations. A loss of dampening fluid could result, causing rapid movement of the leg guards during ejection sequence. Upward pressure on the leg guards may break the shear pin on the leg guard thruster and render it unserviceable.

Seat Safety Pins and Streamers

Each downward seat is provided with four safety pins. The No. 1 pin marked "Remove Before Flight" is to be installed and removed by the flight crew member. This pin safeties the ejection control firing trigger located at the front of the seat. Pins No. 3, 4, and 5 marked "Use During Maintenance Only" are to be used during maintenance operations only. These maintenance pins are provided for the arming initiator, catapult pin-pull initiator and drogue parachute support arm release initiator respectively. The pins for the arming initiator and drogue parachute support arm release initiator are attached to each end of a single red streamer while the pin for the catapult pin-pull initiator is attached to a separate streamer. The two streamers are attached together with a snap fastener. When the seat is in flight status, these pins are stowed in the box provided on the back of the seat.

Ejection Control Trigger Ring

An ejection control trigger ring (9, figure 4-80) is stowed on the front center of the seat. Prior to flight, the trigger ring is safetied by the ejection control trigger ring release mechanism pin (11, figure 4-80) which in turn is safetied by the No. 1 "Remove Before Flight" safety pin. In order to unstow the ejection control trigger ring, remove the No. 1 "Remove Before Flight" safety pin from the stowage clip on the ejection control trigger ring release mechanism pin, then pull upward in the spring-loaded release mechanism pin. When the release mechanism pin is lifted, the spring-loaded trigger ring will rotate 180° upward, thus providing the seat occupant ready access to grasp the ring. A pull of approximately 35 pounds is required to remove the trigger ring from its retaining detent. After release from the detent, a pull of approximately 40 pounds and a cable travel of approximately 1 inch fire the arming initiator, which locks the inertia reel, stows the writing table, rotates the leg guards, and jettisons the escape hatch. Continued pull on the ejection trigger ring (exerting approximately the same 40 pounds for approximately 4 more inches of cable travel) fires the catapult initiator which fires the catapult to eject the seat.

Ejection Control Trigger Ring Release Mechanism Pin

An ejection control trigger ring release mechanism pin (11, figure 4-80) is installed on the front center of the seat. The release mechanism pin provides a means of stowing and unstowing the ejection control

trigger ring with the parachute and safety belt fastened. In addition, the release mechanism pin provides a stowage clip for the No. 1 "Remove Before Flight" safety pin. The release mechanism pin cannot be operated until the No. 1 safety pin is removed. After removal of pin No. 1, pull upward on the spring-loaded release mechanism pin to release the ejection control trigger ring from the stowed position. To restow the trigger ring, reverse the sequence.

Ankle Restraint Triggers

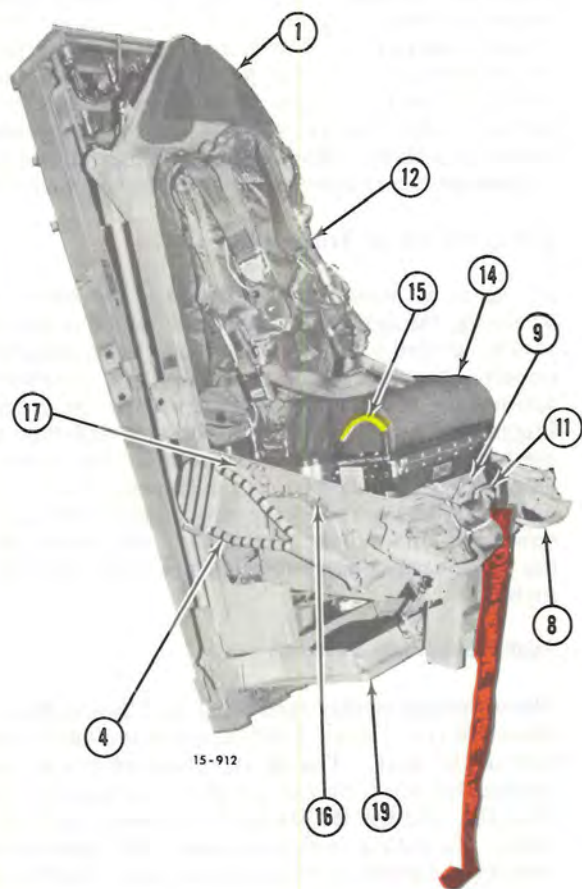
A trigger is located on each side of the seat front. Pressing the triggers causes the ankle restraints to rotate upward and inward to clasp the ankles securely. Normally, the legs should be pressed against the triggers prior to grasping the ejection trigger firing. The ankle restraints will then hold the legs in position during ejection. The ankle restraint triggers are cocked until triggered. If accidentally triggered, they may be reset by pushing downward and outward on either ankle restraint until the pivot arms and restraints are restowed and locked.

Seat Positioning Switches

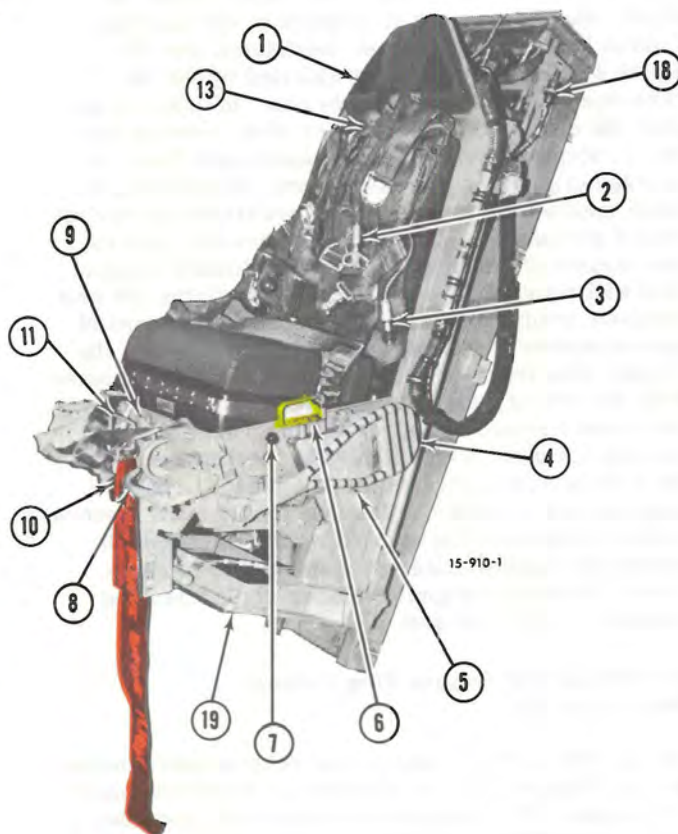
Three independently operating seat positioning switches (16, figure 4-80) are located on the right side of the seat. The up and down switch is mounted vertically, the fore and aft switch is mounted horizontally, and the tilt switch is mounted on a 45° slant. To obtain seat movement, the appropriate switch is pushed in the direction movement is desired to electrically position the seat. The electrical positioning actuators are 118 volt ac powered and contain limit switches to stop motor operation at the extremes of travel. The navigator's and radar navigator's seat actuators are supplied power through circuit breakers on the "Miscellaneous" portion of the aft BNS circuit breaker panel marked "Seat Pos - R BNS" and " - L BNS" respectively.



Excessive operation of the positioning motors will shorten their normal duty cycle. A full actuation in one direction should be followed by at least a 30 second rest. If another full actuation of that positioning motor is required after the 30 second delay, a 5 minute rest must follow before another actuation of any degree.



1. HEADSET
2. RIPCORD T-HANDLE
3. PARACHUTE ARMING LANYARD
4. LEG GUARDS
5. MANUAL CATAPULT INITIATOR SAFETY PIN-PULL HANDLE
6. INTEGRATED HARNESS RELEASE HANDLE
7. INERTIA REEL CONTROL HANDLE
8. ANKLE RESTRAINTS
9. EJECTION CONTROL TRIGGER RING
10. "REMOVE BEFORE FLIGHT" SAFETY PIN NO. 1
11. EJECTION CONTROL TRIGGER RING RELEASE MECHANISM PIN
12. MODIFIED PARACHUTE
13. PARACHUTE SHOULDER STRAPS
14. GLOBAL SURVIVAL KIT
15. SURVIVAL KIT RELEASE HANDLE
16. SEAT POSITIONING SWITCHES
17. INTEGRATED HARNESS RELEASE RESET BUTTON (BEHIND)
18. PARACHUTE CONTAINER ARM RELEASE INITIATOR (ACCOMODATES MAINTENANCE SAFETY PIN NO. 5)
19. DROGUE PARACHUTE CONTAINER



Downward Ejection Seat (Typical)

All data on pages 4-216A and 4-216B (Deleted) **Figure 4-80**

Manual Catapult Initiator Safety Pin Pull Handle

A handle (5, figure 4-80) located on the left side of the seat is provided to manually disengage the catapult pin-pull cylinder and thus pull the safety pin from the catapult initiator. The pin-pull handle should be straight and properly seated parallel to and in close proximity below the left leg guard. No movement of the straight handle up past the stowed leg guard should be possible. If the seat will not fire after pulling the trigger ring, pulling upward on the manual pin-pull handle will allow a spring to force the pin-pull cylinder outward, withdrawing the safety pin from the initiator.

INTEGRATED HARNESS SYSTEM

The integrated harness system provided in the aircraft consists of the integrated harness release mechanism located on the seat, the safety belt, and the modified automatic parachute (figure 4-78). The integrated harness release mechanism includes an integrated harness release initiator with necessary ballistic tubing, an integrated release handle, and an inertia control handle. Firing the ejection seat catapult moves the ejection seat down the rails, which fires the integrated harness release initiator. The initiator fires after a 0.3-second delay to open the integrated harness release fittings on the seat and to allow seat occupant, parachute, and safety belt (along with survival kit) to separate from the seat as an integral unit. A drogue parachute attached to the seat, positively separates the seat from the seat occupant, parachute, and safety belt (along with survival kit). Deployment of the drogue parachute mechanically actuates the integrated harness system (in the same manner as the initiator) to provide additional reliability. (Separation from the seat arms the automatic parachute since the parachute arming lanyard is anchored to the seat.) Pulling the integrated harness release handle on the seat provides for separation of man, parachute (and arming lanyard), and safety belt from the seat following crash landings or ditching.

INTEGRATED HARNESS SYSTEM CONTROLS

Integrated Harness Release Handle

An integrated harness release handle (6, figure 4-80), painted yellow with black stripes, is provided on the left side of the seat to enable the parachute harness and safety belt to be detached from the seat

in lieu of automatic release. Pulling the release handle upward disengages two safety belt fittings, the parachute harness shoulder straps and the parachute arming lanyard, thus completely freeing occupant from the seat. On the downward seats, the release mechanism is reset by pushing the handle down and depressing the reset button (17, figure 4-80) located on the right rear corner of the seat.

WARNING

Lock the inertia reel before actuating the integrated harness release handle to assure complete release of the integrated harness before leaving the seat.

NOTE

- The integrated release handle should not be used to free the occupant from the seat for normal inflight or postflight movement. If the release handle is pulled and the parachute and survival kit are worn during such movement, the parachute will have to be removed to reinstall the shoulder straps in the inertia reel fitting without assistance.
- The integrated harness release handle should be pulled directly upward since any fore, aft, or side loads can cause the handle to bind, resulting in excessive force required to pull the handle.

Inertia Reel Control Handle

A handle (7, figure 4-80) with LOCKED--RELEASED positions is located on the left side of each seat. A detent is provided for retaining the handle at either position of the quadrant. When the handle is in RELEASED position, the reel harness strap will extend to allow the crew member to lean forward; however, the reel harness strap will automatically lock when an impact force of 2 to 3 "g's" is encountered. When the reel is locked in this manner, it will remain locked until the handle is moved to LOCKED and then returned to RELEASED position. When the handle is in LOCKED position, the reel harness strap is manually locked so the crew member is prevented from bending forward. LOCKED position is used for ditching and crash landing. The arming lever used for seat ejection also locks the inertia reel. LOCKED position may be used as an additional safety feature over the automatic operation of the inertia reel system.

MODIFIED AUTOMATIC PARACHUTE

A type BA-27A automatic parachute, developed specifically for use in B-52 aircraft upward and downward ejection seats, modified to utilize the integrated harness release mechanism in the seat is provided in the ejection seats. The automatic parachute is equipped with a faster opening Type C-9 canopy for improved low level escape capability. Modifications include shoulder straps (1, figure 4-81) which are sewn into the parachute harness for attachment to the inertia reel fitting.

The parachute contains the following features:

- A pull-down vent line (PDVL) parachute canopy, designated as a C-9P type, is utilized. The PDVL improves the low speed inflation characteristics of the parachute and improves the consistency of the parachute opening timing.

- An FXC model 11,000 ballistic automatic parachute opening release which incorporates a 0.75 second delay cartridge that automatically opens the

parachute pack 0.75 seconds after seat/man separation occurs or after preset altitude is reached if bailing out above that altitude. The mode 11,000 release is activated when the arming lanyard (6, figure 4-81) is pulled, either manually or automatically by separation from the seat.

NOTE

A zero delay lanyard is not provided on the Type BA-27A parachute.

A bailout oxygen bottle and gage is contained in the parachute and may be inspected by opening the flap located under the right side of the parachute lining. Normal bailout bottle pressure is 1800 psi based on 70°F. A reduction in temperature causes reduction in cylinder pressure of 3.5 psi for each degree of F. The bailout bottle is operated by pulling the green knob (10, figure 4-81) on the right front of the harness. A ripcord T-handle (4, figure 4-81) manually

releases the parachute when pulled. The ripcord T-handle bypasses the automatic release device. An automatic survival kit actuator has also been provided in the parachute pack. This actuator consists of a flexible housing and cable assembly. The housing attaches to the inside of the parachute pack and the CNU-129/P survival kit. The actuation cable passes through the housing attaching to both the survival kit automatic actuation mechanism and one of the parachute risers. When the personnel parachute deploys, the force on the risers pulls the survival kit actuator cable thus firing a delay cartridge in the CNU-129/P survival kit actuation mechanism. Four seconds after parachute deployment the cartridge fires and automatically deploys the survival kit. The parachute actuator is attached to the survival kit when the parachute is installed in the seat. The canopy quick-release fitting(2, figure 4-81) is located on the upper left of the harness to permit release of the left set of risers for spilling the canopy after landing. Two canopy quick-release fittings located on the upper left and right of the harness may be fixed to allow complete release of the canopy after landing. The parachute is installed in the seat as follows:

1. The shoulder strap attaching hardware is inserted into the inertia reel fitting of the seat.
2. The survival kit attachment straps (19A, figure 4-81) are connected to the survival kit strap adjustments. Thread these straps through the loops (18,

figure 4-81) in between the webbing of the safety belt and attach to the parachute accessory rings with the quick-disconnect at the opposite end.

3. Safety belt attachment fittings are inserted into integrated harness release fittings on the seat.

4. The parachute arming lanyard anchor is inserted into the integrated harness release fitting at the left rear corner of the seat.

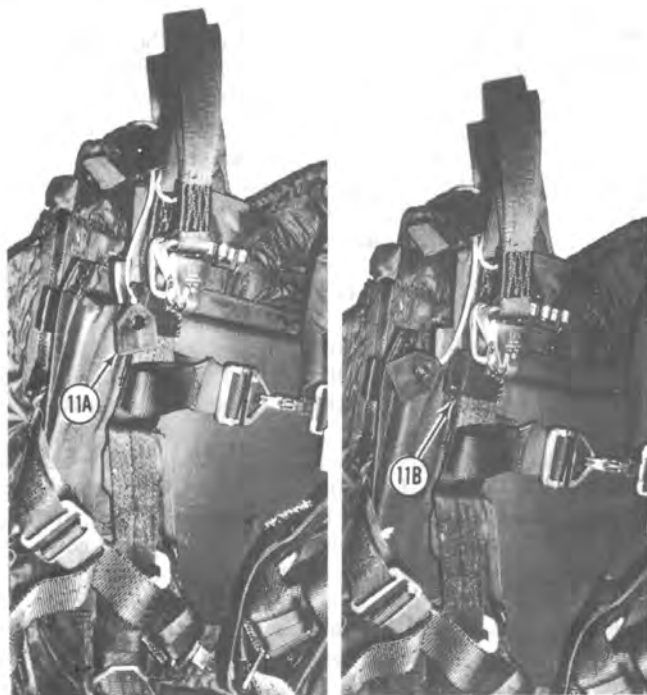
NOTE

The modified automatic parachute, safety belt, and survival kit should first be installed in the seat, then buckled to the crew member.

Since the parachute must be removed by the wearer in order to attach the shoulder straps to the inertia reel fittings unassisted, it is recommended that the parachute and survival kit be left in the seat when the crew member desired to make routine movements about in the aircraft. It is then only necessary to buckle chest strap, leg straps, and safety belt and to connect oxygen mask to prepare for ejection in an emergency.

NOTE

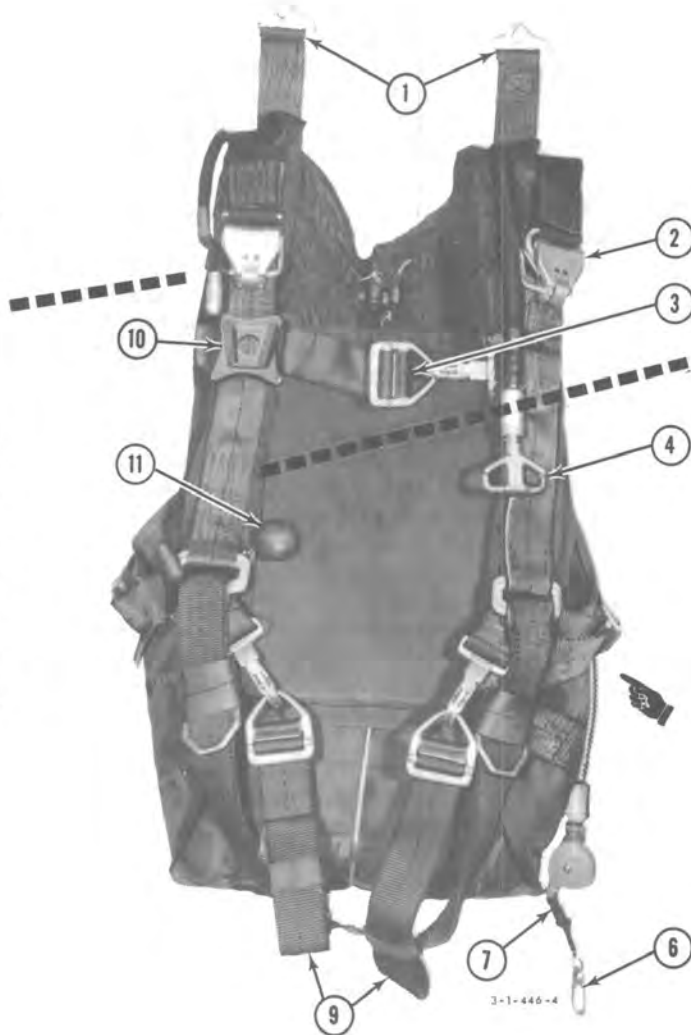
Do not open safety belt to permit unrestrained hip movement. Since the parachute arming lanyard is anchored to the seat, this could spill the parachute in the seat.



Automatic

Nonautomatic

PERSONAL LOCATOR BEACON LANYARD



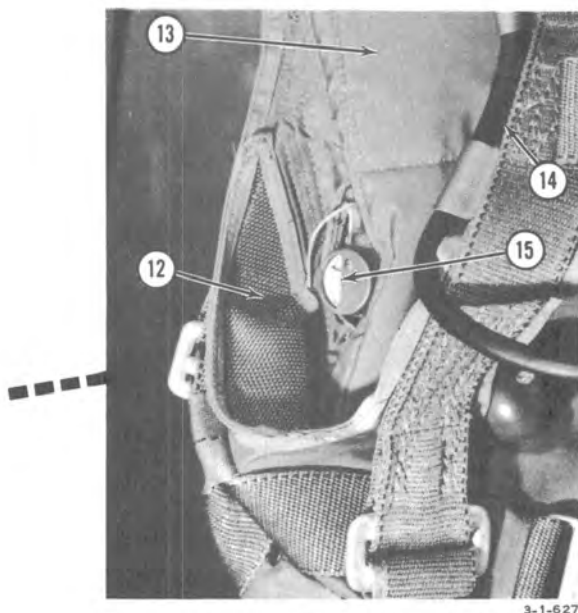
1. SHOULDER STRAPS
2. QUICK-RELEASE
3. CHEST STRAPS
4. RIPCORD T-HANDLE
5. (DELETED)
6. ARMING LANYARD ANCHOR
7. ARMING KNOB
8. (DELETED)
9. LEG STRAPS
10. OXYGEN HOSE CONNECTOR MOUNTING PLATE
11. BAILOUT BOTTLE RELEASE KNOB
- 11A. PERSONAL LOCATOR BEACON LANYARD SNAPPED (AUTOMATIC ACTUATION)
- 11B. PERSONAL LOCATOR BEACON LANYARD UNSNAPPED (NONAUTOMATIC ACTUATION)

12. BAILOUT BOTTLE INSPECTION FLAP
13. PARACHUTE BACKPAD
14. BAILOUT OXYGEN HOSE
15. BAILOUT BOTTLE PRESSURE GAGE
16. (DELETED)
17. SAFETY BELT ATTACHMENT FITTING
18. DOWNWARD EJECTION SEAT ATTACHMENT LOOPS
19. COMPRESSIBLE SPACER
- 19A. SURVIVAL KIT QUICK-DISCONNECT FITTING AND STRAP
20. SEAT CUSHION
21. KIT RELEASE HANDLE
- 21A. MODE SELECTOR LEVER
- 21B. FIRING PIN INDICATOR
22. ARMING PLUNGER
23. MAIN COMPARTMENT

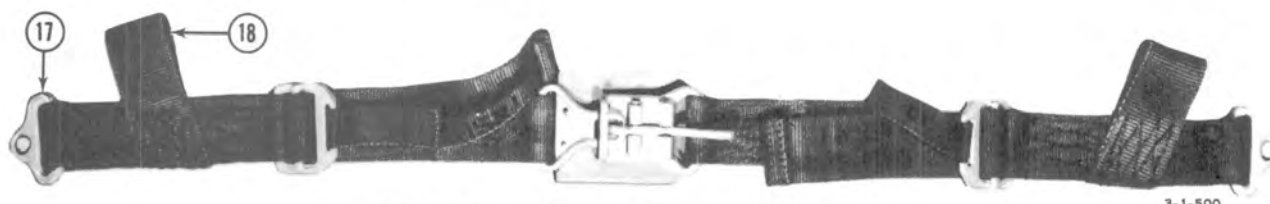
MODIFIED AUTOMATIC PARACHUTE



Figure 4-81 (Sheet 1 of 2)



BAILOUT OXYGEN BOTTLE



BELT FOR DOWNWARD EJECTION SEATS



CNU-129/P GLOBAL SURVIVAL KIT

Bailout Equipment— Downward Ejection Seats

Figure 4-81 (Sheet 2 of 2)

All data on pages 4-222 thru 4-224B (Deleted).

Change 14 4-221/(4-222 blank)

Personal Locator Beacons

Most parachutes are equipped with personal locator beacons. The beacon equipped parachutes may have an AN/URT-21, AN/URT-27, or AN/URT-33 installed. Except for size and range, all three beacons are almost identical. Each beacon is designed to begin transmitting automatically when a plastic plug is pulled from the radio by a lanyard during chute deployment. The beacons are accessible to the crew member after a parachute landing and have complete metalcal instructions for manual operation attached to the unit.

Personal Locator Beacon Lanyards

Parachutes equipped with a personal locator beacon have a nylon cord lanyard with a tab and a female snap fastener. The lanyard can accommodate all three personal locator beacons. For automatic actuation of the beacon, the tab fastener is snapped to a male snap fastener located below the right canopy release. For nonautomatic (manual) operation, the tab is left unsnapped (11B, figure 4-81). For peacetime operations, the personal locator beacon lanyard must be configured for automatic operation. When mission requirements dictate the necessity to avoid detection and automatic actuation of the beacon is not desired, the lanyard must be configured for non-automatic (manual) operation.

NOTE

- The sole purpose of the beacon lanyard is to assure automatic operation (if desired) after bailout in case the crew member is injured or incapacitated during the egress cycle. For this reason, the beacon lanyard must be configured to the desired operation (automatic or nonautomatic) during the interior preflight and rechecked just prior to bailout.
- Recent experience has indicated that some beacons are unreliable when configured for automatic actuation due to lanyard rigging defects. Operation (transmitting) can be readily confirmed after parachute landing by checking that the plastic plug has been pulled from the radio.

SAFETY BELT

A safety belt with standard manual release and lock lever fittings is provided with each ejection seat.

The belt is installed by inserting the attachment fittings in the integrated harness fittings on each side of the seat. The survival kit is then secured to the parachute by threading the parachute attachment fittings through the straps on the safety belt and fastening them to the kit. Thus, seat occupant, parachute, safety belt, and survival kit are released from the seat as an integral unit whenever the integrated harness release fittings are opened. For routine movement about in the aircraft, it is recommended that the crew member unlock and open the safety belt, then disconnect the parachute chest and leg straps, leaving the parachute with survival kit attached to the seat.

WARNING

Do not open the safety belt prior to ejection. Severe injury may be incurred if ejection is performed with any integrated harness attachment fitting disconnected.

MISCELLANEOUS EQUIPMENT

INSTRUCTOR PILOT'S SEAT

The instructor pilot's seat (59, figure 1-2) is located between the pilot's and copilot's seats and aft of the aisle stand. The seat is mounted on tracks and may be stowed by use of a locking lever mounted on the right side of the seat. The seat is equipped with a safety belt and shoulder harness and is stressed for crash landing and ditching.

INSTRUCTOR NAVIGATOR'S SEATS

The instructor navigator's duty seat (80, figure 1-2) is located between and aft of the radar navigator's and navigator's seats. The seat is equipped with a safety belt and seat controls. A vertical adjustment control handle is located on the right side of the seat. The folding back control handle, located on the left side of the seat, locks and unlocks the folding back. The seat is attached to the floor with three quick-disconnect fittings and is locked into position with the seat locking pin control handle located on the right side of the seat base. The instructor navigator's takeoff and landing seat (76, figure 1-2) is located on the aft pressure bulkhead directly below the pressure bulkhead door. The seat is equipped with a seat cushion, safety belt, and shoulder harness. The shoulder harness is mounted on the pressure bulkhead door. The seat is stressed for crash landing and ditching.

DEFENSE INSTRUCTOR'S SEAT

The defense instructor's seat (14, figure 4-83) is located directly forward of the EW officer's seat. The seat is installed on top of the chemical toilet and may be raised and stowed to the right electronic rack. It is equipped with a seat cushion and safety belt and is stressed for crash landing and ditching (figure 3-11).

RELIEF EQUIPMENT

A chemical toilet (44, figure 1-2) is located directly forward of the EW officer's seat and is mounted on the deck floor. By the use of a hinged cover, the toilet is also used as the defense instructor's seat. A toilet paper holder is located outboard of the toilet on the aft end of the right electronic rack. A central urinal container (75, figure 1-2) is located to the left of the pressure bulkhead door. The pilot's and copilot's containers (14, figure 1-2) are located directly behind their seats, the EW officer's (and less **AU** gunner's) containers (41, figure 1-2) are located outboard from their seats, and radar navigator's container (65, figure 1-2) is located to the outboard side from his seat.

WINDSHIELD WIPERS

Electrically operated windshield wipers clear the windows in front of the pilot and copilot. A separate motor drives each of the two blades. Both wipers are controlled by a single rotary-type switch (15, figure 1-15) on the pilots' instrument panel. The switch has PARK--OFF--FULL--3/4--1/2--LOW positions, giving a choice of wiper speeds. The switch is spring-loaded from PARK to OFF position. After use, the switch is held in PARK position until the blades move to the stowed position and stop. The switch is then placed to OFF position. The switch receives d-c power through circuit breakers marked "Pilot Window Wiper" and "Copilot Window Wiper" on the "Miscellaneous" portion of the left and right load central circuit breaker panels respectively.

CAUTION

Do not operate windshield wipers on dry or dirty glass as this can scratch or damage the glass.

NOTE

If rain repellent has been applied to the windshield, hold windshield wiper operation to an absolute minimum as approximately 30 minutes of wiper operation will remove the rain repellent.

ALTITUDE CORRECTION CARD

An altitude correction card and holder (7A, figure 1-9) is located on the pilot's left glare shield. For information concerning the use of the altitude correction card, refer to Part 1 of the Appendix.

MATTRESS PROVISIONS

A mattress (57, figure 1-2) is stowed directly behind the pilot's seat. When the mattress is to be used, it is placed in the aisle between the right and left electronic racks. Fittings are provided in the floor of the aisle for use of a safety belt.

WRITING TABLES AND CLIPS

A writing table and clip are installed at the pilot's, copilot's, and gunner's station. Tables are installed at the navigator's station. A fold-down table and clip (which is an integral part of the table) are stowed above the sidewall panels at the pilot's and copilot's stations. A pullout table and clip (51, figure 1-2) (which is an integral part of the table) are installed forward and right of the gunner's seat. A pullout table is installed directly in front of each navigator. The tables are automatically stowed during seat ejection and may be stowed manually, if desired, by pushing them forward. The tables are stowed underneath the instrument panel.

PERISCOPIC SEXTANT CARRYING CASE

A removable periscopic sextant carrying case (60, figure 1-2) is installed behind the copilot's seat. The case is held in place by a strap fastened to the floor.

LADDER

A five-step metal ladder (71, figure 1-2) is located on the right side in the crew compartment lower deck. The ladder provides access between the upper and lower decks of the crew compartment.

FOOD AND DATA BOX

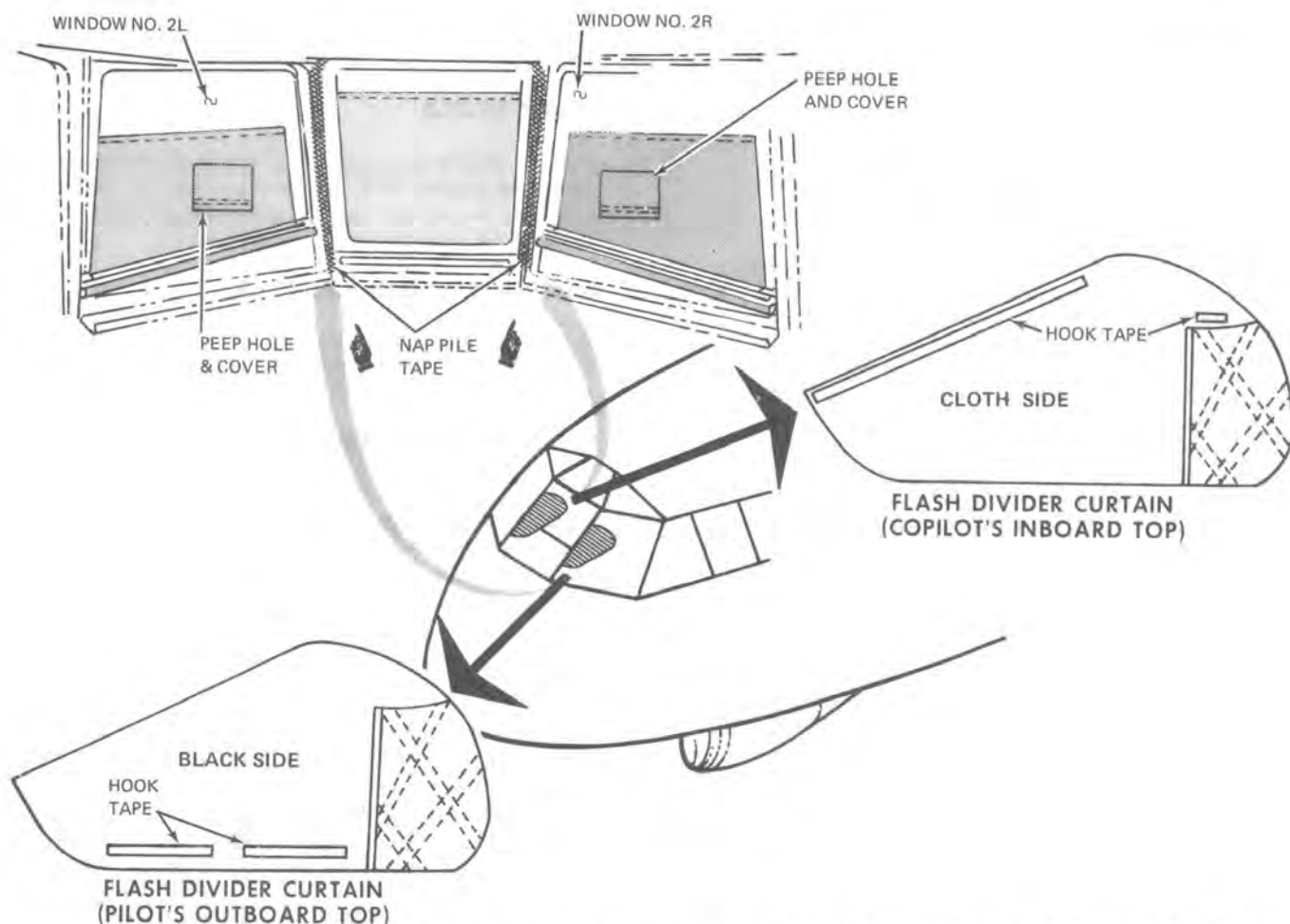
A food and data box (39, figure 1-2) is installed outboard of the pilot's and copilot's seats. The food and data box is used for stowage of food, flight reports, charts, and miscellaneous data. The box is covered with an elastic protective cover and is permanently installed.

INSTRUMENT FLYING HOODS

Instrument flying hoods installed for instrument and low altitude training flights consist of roller-type curtains which can be extended by pulling inboard. To hold in extended position, insert lower end of curtain rod into hole in top of instrument panel, then place upper end of curtain rod into wire retainer located on lower surface of the eyebrow panel. To stow the curtain, reverse the steps.

NIGHT-FLYING CURTAIN

A night-flying curtain (43, figure 1-2) is provided to shut out light between the aft crew station and the pilots station. When not in use, the curtain is pulled back and stowed with a tieback strap.



Thermal Curtains

Figure 4-82.

THERMAL CURTAINS

Aluminized thermal curtains (34, figure 1-2) are provided for each aircraft window to increase the weapons delivery capability. The curtains are provided to cover the windows by using slides, rollers, or snaps attached to the structure surrounding the window. They are designed so that the pilots can cover the windows without leaving their seats. The window curtains are closed by pulling knobs upward and stowing above the windows. The overhead window curtains are closed by pulling the curtain tabs from inboard to outboard and snapping the tabs to the escape hatch structure. Care must be taken to

prevent scuffing, scratching, or otherwise marring the reflective surface of the curtains. The curtains must fit closely enough to prevent direct outside light ray (straight line) from hitting a crew member in his normal sitting position. Window glass must not be visible to any crew member while seated in his normal position. If either of these cases exist, the thermal curtain(s) must be readjusted. Translucent light (bright contrasts of indirect light due to scuffing, etc.) is acceptable. However, pin holes, cuts, tears, or curtains that cannot be adjusted to prevent direct light rays will be cause for rejection or AFTO Form 781 entry. Light ray penetration through curtain stitching holes is not acceptable. Two 5-inch

square peepholes, one for each pilot, are provided for forward visibility with the thermal curtains in place. Covers are provided to cover peepholes when not in use.

WARNING

- Thermal curtains will not be used as a sun shade on crew training missions. Use of the curtains for this purpose subjects the curtains to abnormal wear which will eventually cause deterioration to the point that their effectiveness as a heat shield is materially decreased.
- The thermal curtains will be kept free from grease, oil and mold as any discoloration will seriously impair the value of the curtains. Oil or grease base materials will ignite upon exposure to thermal radiation. Dirty or cracked thermal curtains will be replaced.
- Failure to close thermal curtains (during EWO) may result in flash blindness from nuclear detonation.

NOTE

Thermal curtains will be replaced after each flight on which they are exposed to radiation.

FLASH DIVIDER CURTAINS

Two flash divider curtains, one for each pilot, are provided to shield the pilot or copilot when the opposite thermal curtain peephole is being used. The divider curtains are installed with the cloth side toward the centerline of the aircraft which exposes the black side to the pilot and copilot (figure 4-82). The divider curtains with the aluminized silver metal surface are installed with the gray side toward the centerline of the aircraft which exposes the aluminized silver metal side to the pilot and copilot. The dividers are held in place by use of nap pile tape and hook tape. Pressing the hook tape, which is sewed to the sides of the curtain, into the nap pile tape attached to the top of the instrument panel cover, to each side of the center window frame, and to the eyebrow instrument panel will secure the curtains (figure 4-82). To remove, grasp the curtains at the top and pull down and toward the centerline of the aircraft. The divider curtains, when not in use, are stowed in the food and data box outboard of the pilot's and copilot's seat.

SUNSHADE CURTAINS

Roller-type sunshades are installed on the overhead windows. The sunshades are closed by pulling the

sunshade tab from outboard to inboard and snapping the tab to the escape hatch structure.

GLARE SHIELD

A glare shield is installed on top of the forward instrument panel. The primary purpose of the glare shield is to prevent instrument reflections in the windshield area during night flying.

BNS REMOTE MODULES RACK

A BNS remote modules rack (72, figure 1-2) is located forward and to the right of the pressure bulkhead door.

FOOD STOWAGE BOXES

Food stowage boxes (46, figure 1-2) for the EW officer and **Less AU** gunner) are located outboard from their seats. The radar navigator's food stowage box (69, figure 1-2) is located aft and outboard from his seat. All food and stowage boxes are portable boxes.

HOT CUP

One hot cup unit (38, figure 1-2) is located at pilots' station, BNS station, and defense station. One unit is to the right of the copilot's seat, one outboard of the gunner's seat, and one to the right of the navigator's seat. Each cup has a 4 1/2 cup capacity, AC power is supplied to the pilot, copilot, and defense stations through circuit breakers marked "Hot Cup and Oven Assy - Pilot and Copilot" and "Hot Cup and Oven Assy - DECM" on aircraft **Less AU** and marked "Hot Cup - Pilot and Copilot" and "Hot Cup - DECM & FCS" on aircraft **AU** on the right load central circuit breaker panel. The BNS station receives ac power through a circuit breaker marked "BNS Hot Cup and Oven" on the aft BNS circuit breaker panel.

WARNING

Type B-1 hot cups can explode when operated dry. To avoid injury to personnel, do not allow the hot cups to operate without liquid or semi-solid food.

DRINKING WATER CONTAINERS

A 2-gallon water container is provided for crew members and is located above the central urinal (5, figure 4-42). In addition, provisions for a spare container are provided aft of the navigator's portable oxygen bottle (55, figure 4-41).

ASHTRAYS

An ashtray is conveniently located at each crew member's station.

SIGNAL LIGHT

A 28-volt a-c powered signal light (42, figure 1-2) stowed aft of the copilot may be used as a means of communication between aircraft in flight or as an aid in identification. A power receptacle is located adjacent to the light for plugging in the power cord leading from the light. Power for the light is supplied through a circuit breaker marked "Test Recp Signal Lt" located on the right load central circuit breaker panel.

SPARE LAMPS

Five spare lamp containers provide spare lamps for inflight replacement. The containers hold five different types of lamps. One is located on the circumferential frame of the aircraft to the right of the upstairs entrance hatch forward of the EW officer, one on the circumferential frame of the aircraft above and outboard of the gunner's seat, one forward and overhead of the navigator, and one by the pilot's and copilot's glare shields.

ACCESSORY EQUIPMENT

Each aircraft is provided with stowage facilities for the following accessory equipment for ground use: pitot tube covers, landing gear ground locks, engines tailpipe shields, air intake shields, and miscellaneous external opening plugs.

STARTER CARTRIDGE AND BREECH CAP STOWAGE

A stowage rack (22, figure 1-2) for eight engine starter cartridges is located in the aft wheel well. Breech caps are stowed in the aft fuselage section.

AGM-69A MISSILE GROUND SAFEING EQUIPMENT STOWAGE

Safeing pins and streamers and the ground safety pin installation and removal tool are provided. Provisions for stowage of this equipment are installed in the forward part of the aft wheel well (18A and 18B, figure 1-2).

ACCESSORY RADAR EQUIPMENT

Each aircraft is provided with stowage facilities for the star-tracker dome and stub antennas.

BEST FLARE SPEED INDICATOR

A best flare speed indicator is installed around the outside of the case of the total fuel quantity gage (1, figure 1-19) on the fuel system panel. The indicator is to be used prior to landing to determine the best flare speed when using full flaps. To obtain this information initially, the gross weight must be com-

puted after the aircraft is in a landing configuration based on actual load on board. Then the best flare speed indicator is adjusted so that the computed gross weight value on the gross weight scale is opposite the pointer on the page. The airspeed value adjacent to the computed gross weight value is the best flare speed for that weight with airbrakes in position 4 and full flaps. As fuel is consumed, the total fuel quantity gage pointer will point to the aircraft gross weight and the corresponding best flare speed for airbrakes in position 4.

VGH RECORDER

The VGH recorder has been removed and the system is inoperative.

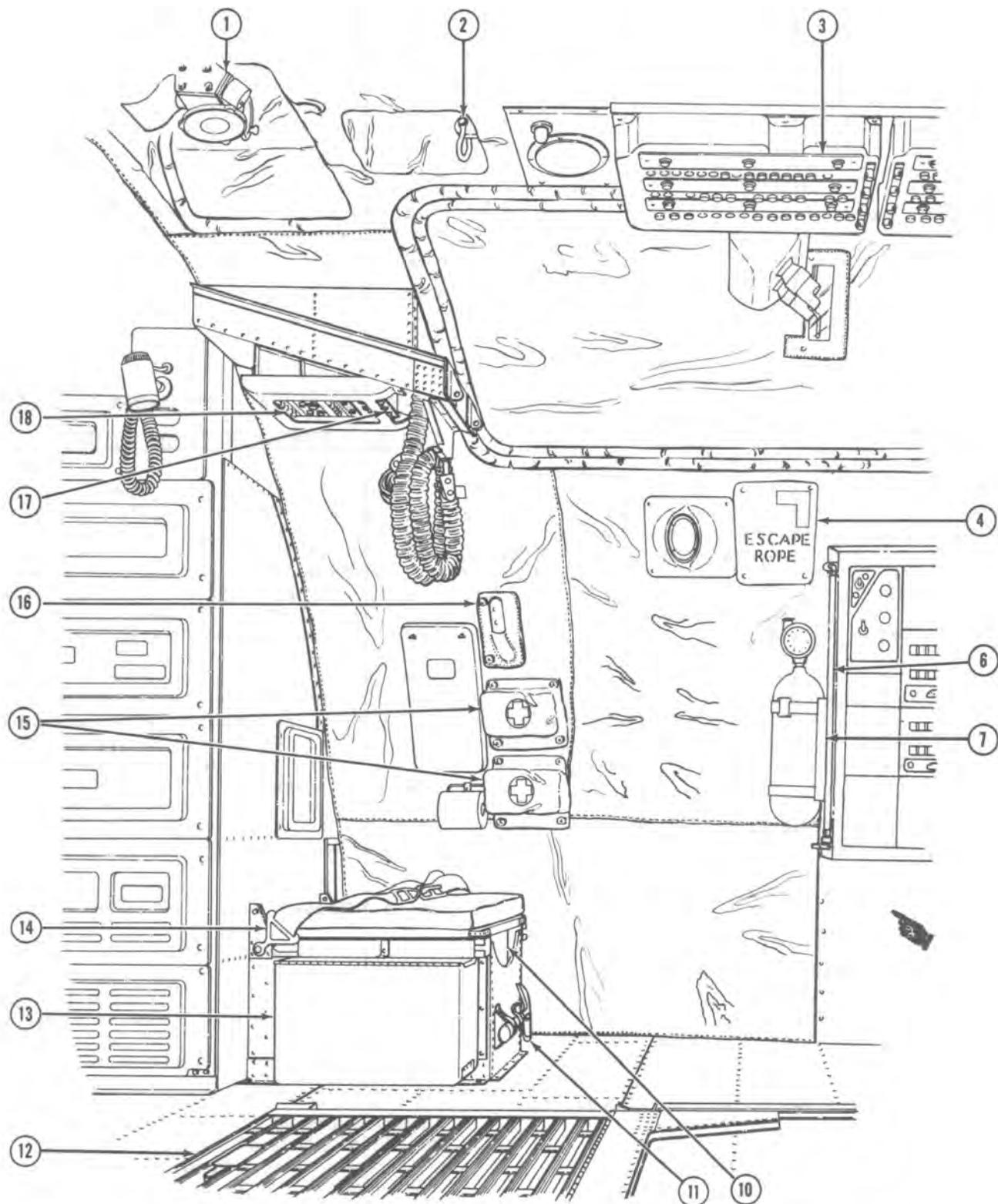
FLIGHT LOADS DATA RECORDER **W180 W182 W191**

W204 W206 W218 W219 W252 W259 W290 W364

A flight loads data recorder is installed to record magnetically on tape the flight loads in selected portions of the aircraft structure. The loads transducers are located on the fin, left horizontal stabilizer, four stations on the left wing and three stations on the body. Only a portion of the transducers can be connected at one time. The system monitors fuel quantity, airbrake position, flap position, and fuel totalizer reading. The recorder is connected to the pitot-static system to record airspeed and altitude. The system is energized when the hatches are all closed and the hatches not closed and locked light is out, however, loads are not recorded until the aircraft is airborne and squat switch is actuated to air position. The recorder utilizes 28 volt ac through a circuit breaker marked "Total Fuel Quantity Recorder" on the right load central for the fuel totalizer function.

CHART HOLDERS

An illuminated chart holder (1A, figure 1-9) can be installed at both pilots' stations. The removable holder can be installed on a bracket on the windshield post at the forward side of the sliding window. A lock on the outboard side of each chart holder must be pulled outboard to release the chart holder so that it may be lifted off of the bracket. An electrical connector is installed at the forward end of each sidewall to provide 28-volt a-c power from the "Remote Flood Lt" circuit breaker on the left load central circuit breaker panel to the connector on the chart holder. A hook on the copilot's side panel holds the cord out of view of the instrument panel. The holder permits illumination of letdown or en-route charts without allowing light to escape into the cockpit. Controls consist of two ON--OFF rheostats at the bottom of the holder which regulate the intensity of white to red light. The left rheostat controls red light intensity and the right rheostat controls white light intensity. When removed, the chart holders are stowed in the respective pilot's food and data box. The chart holders are not interchangeable between pilots.



- | | | |
|--|------------------------------|---|
| 1. PERISCOPIC SEXTANT MOUNT | 7. OXYGEN BOTTLE | 14. DEFENSE INSTRUCTOR'S SEAT |
| 2. DITCHING-CRASH LANDING HAMMOCK ATTACHMENT SHACKLE | 8. (DELETED) | 15. FIRST AID KITS |
| 3. ECM CIRCUIT BREAKER PANEL | 9. (DELETED) | 16. EMERGENCY KNIFE |
| 4. ESCAPE ROPE CONTAINER | 10. CHEMICAL TOILET | 17. OXYGEN REGULATOR (DEFENSE INSTRUCTOR'S) |
| 5. (DELETED) | 11. HAND AXE | 18. DEFENSE INSTRUCTOR'S INTERPHONE CONTROL PANEL |
| 6. PORTABLE OXYGEN RECHARGER | 12. UPPER DECK SLIDING HATCH | |
| | 13. DITCHING HAMMOCK STOWAGE | |

■■■■■■■■■■ Defense Instructor's Station (Typical)

Figure 4-83.

Operating Limitations

section V

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ALTITUDE AND TEMPERATURE LIMITATIONS _____	5-19
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CENTER OF GRAVITY LIMITATIONS _____	5-31
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This section covers the operating limitations of the aircraft that must be observed during normal conditions. Special attention should be given to the instrument markings (figure 5-1) since these limitations are not necessarily repeated under their respective sections in this manual. When necessary, an additional explanation of instrument markings is covered under appropriate headings in this section.

NOTE

- All aircraft instruments will be marked in accordance with the limitations reflected in figure 5-1.
- The term "within limits" as used in the manual pertains to the operating range between the minimum and maximum red line markings on the applicable gage.



**EXHAUST GAS TEMPERATURE
J-57-P-43WB ENGINES**

CAUTION

PROLONGED ENGINE OPERATION AT THE MAXIMUM OPERATING LIMITS WILL SHORTEN ENGINE LIFE.

	300° – 560° C	CONTINUOUS OPERATION (Normal Rated Thrust and Below) 0 – 30,000 feet * 570° C at 45,000 feet * 580° C at 55,000 feet
	560° – 660° C	RANGE OF LIMITED OPERATION Takeoff Rated Thrust (Wet) See figure 5-2 Military Rated Thrust (30 minutes) 610° C from 0 – 30,000 feet * 630° C at 45,000 feet * 640° C at 55,000 feet
	450° C	MAXIMUM FOR STARTING (450° C applies up to the time engine reaches idle rpm. From idle rpm on up, the acceleration EGT limit applies)
	680° C	MAXIMUM DURING ENGINE ACCELERATION (2 Minutes 0 – 30,000 feet) WET OR DRY
	660° C	MAXIMUM DURING ENGINE ACCELERATION (2 Minutes at 45,000 feet)
	650° C	MAXIMUM DURING ENGINE ACCELERATION (2 Minutes at 55,000 feet and above)

* Temperature limit increases directly from 30,000 to 45,000 feet and from 45,000 to 55,000 feet altitude.



OIL PRESSURE

	35 PSI	MINIMUM (FOR IDLE)
	40-55 PSI	NORMAL OPERATION
	55 PSI	MAXIMUM FOR FLIGHT

NOTE

SEE "OIL SYSTEM LIMITATIONS," THIS SECTION, FOR ADDITIONAL INFORMATION.



ENGINE PRESSURE RATIO

	2.78	TARGET EPR FOR WET TAKEOFF
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CAUTION

THIS SETTING MAY NOT BE VALID FOR WET TAKEOFFS AT HIGH ELEVATIONS, HIGH OAT's, OR WITH ANTI-ICING ON



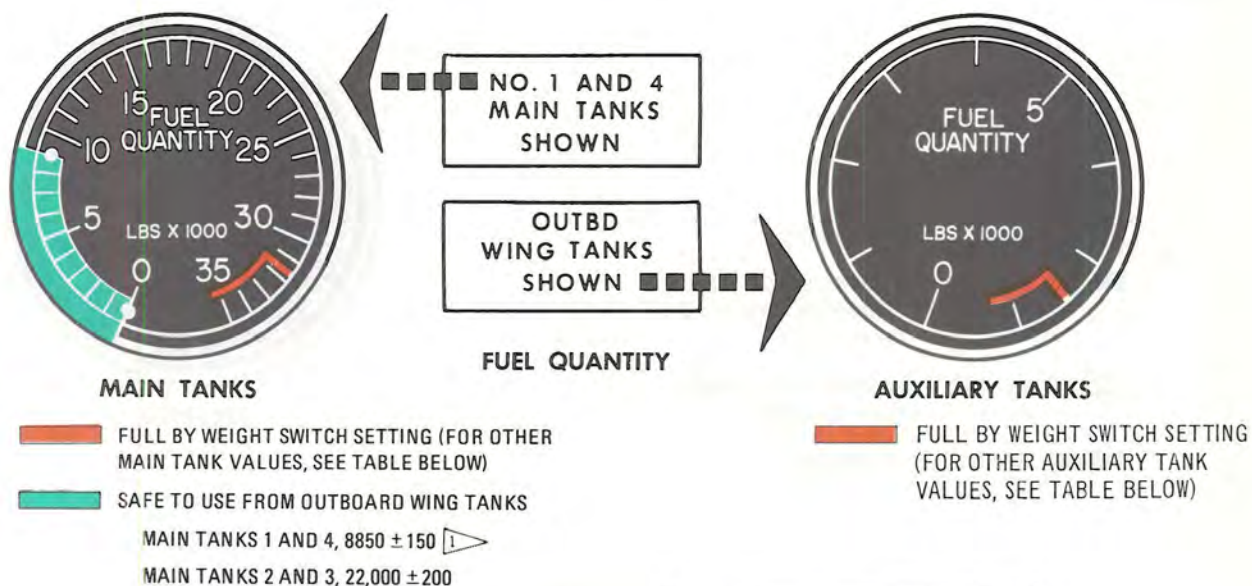
TACHOMETER

	63% RPM	MINIMUM IDLE
	63-65% RPM	IDLE RANGE
	85-97% RPM	RANGE FOR NORMAL CRUISE
	102% RPM	MAXIMUM ALLOWABLE

CAUTION

PROLONGED ENGINE OPERATION AT THE MAXIMUM OPERATING LIMITS WILL SHORTEN ENGINE LIFE.

Figure 5-1 (Sheet 1 of 4).

**NOTE**

ALL FIGURES SHOWN ARE BASED ON A FUEL WEIGHT OF 6.5 POUNDS PER GALLON.

ON AIRCRAFT W173 W289 THE VALUE MAY BE 9550 ± 150

TANK	FULL BY WEIGHT SWITCH SETTING
OUTBD WING	7450 ± 150
1 & 4	$31,800 \pm 400$
2 & 3	$44,100 \pm 200$
CTR WING	$21,000 \pm 200$
FWD BODY	$13,300 \pm 150$
MID BODY	$46,400 \pm 400$
AFT BODY	$55,200 \pm 400$
EXTERNAL	4550 ± 100

**HYDRAULIC PRESSURE**

2400 PSI MINIMUM

2750-3250 PSI NORMAL

3800 PSI MAXIMUM

**MANIFOLD TEMPERATURE**

246° C MAXIMUM

11-1-5

Instrument Markings

Figure 5-1 (Sheet 2 of 4).

- 190 KNOTS FULL FLAPS
- 250 KNOTS MAXIMUM FOR FUEL SEQUENCE DEVIATION See figure 5-5
- 305 KNOTS MAXIMUM WITH LANDING GEAR EXTENDED
- 390 KNOTS IAS MAXIMUM



NOTE

The instrument setting is such that the striped pointer will move to indicate the limiting structural airspeed 390 knots IAS or the airspeed representing a Mach of .84 whichever is less.

MACH INDICATOR



- .84 MACH INDICATED MAXIMUM
- .70 MACH INDICATED MAXIMUM FOR FUEL SEQUENCE DEVIATION See figure 5-5

ACCELEROMETER

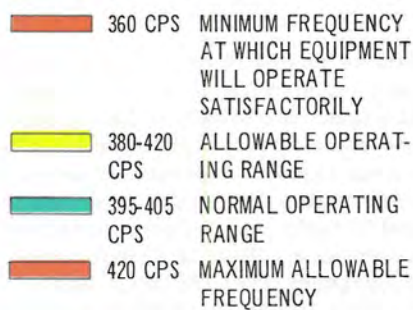


- +1.8g MAXIMUM POSITIVE VERTICAL ACCELERATION AT MAXIMUM GROSS WEIGHT
- .67g MAXIMUM NEGATIVE VERTICAL ACCELERATION

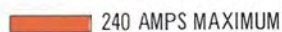
Figure 5-1. (Sheet 3 of 4).



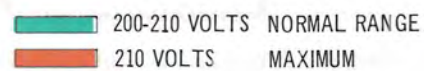
A-C FREQUENCY METER (TYPICAL)



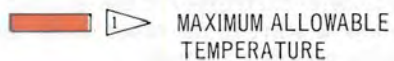
A-C AMMETER



A-C VOLTMETER



BNS TEMPERATURE SENSING INDICATOR
(TYPICAL) **W245**



1 Red line temperature is calibrated for each individual indicator and is in range from 90° to 102°C.

11-1-5

.....Instrument Markings

Figure 5-1 (Sheet 4 of 4).

MINIMUM CREW REQUIREMENTS

A pilot, copilot, and a radar navigator/navigator constitute the minimum crew required for flight in this aircraft.

ENGINE LIMITATIONS

ENGINE RATING DEFINITIONS

The following terms are used to define engine thrust ratings and limitations associated with the ratings:

CAUTION

Thrust ratings are not established by setting EGT.

NOTE

EPR is the only parameter that indicates thrust, therefore the charted EPR value as given in the appendix should not be exceeded. Thrust ratings as defined are subject to the applicable EGT limitations specified in figure 5-2.

1. Takeoff Rated Thrust (TRT) is the highest value of thrust which the engine will consistently deliver at specific ground or flight conditions with water injection. This rating is restricted to 5 minutes of operation on takeoff and is obtained by actuating the water injection system after positioning the throttle to obtain a predetermined EPR reading on the EPR gages. This value is calculated for prevailing conditions of field barometric pressure and runway temperature and is obtained from the "EPR for Takeoff Rated Thrust" chart in Part 2 of the Appendix.

2. Military Rated Thrust (MRT) is the highest value of thrust which the engine will deliver consistently without water injection. This rating is restricted to 30 minutes of operation and is obtained by positioning the throttle to obtain at a predetermined value of EPR for specific ground or flight conditions. The information is obtained from the "Thrust Setting" chart, Part 4 of the Appendix.

3. Normal Rated Thrust (NRT) is the highest value of thrust at which the engine may be operated continuously with the prevailing ground or flight conditions. Throttle position is selected with reference to a predetermined EPR which is obtained from the "Thrust Setting" chart in Part 4 of the Appendix.

4. Idle Thrust is not an engine rating, but rather a throttle position suitable for minimum thrust operation on the ground or in flight; it is obtained by placing the throttle in the IDLE detent on the throttle quadrant. See figure 1-3 for thrust ratings.

ENGINE AND STARTER LIMITATIONS

Engine

Each engine is trimmed when it is installed to assure that it will develop takeoff thrust. As takeoff thrust is set by EPR, the rpm at takeoff may be expected to vary for each engine due to the difference in tolerances between engines. Engine rpm at takeoff

will also increase as ambient temperature increases and will decrease as temperature decreases. Take-off rpm at any temperature should never exceed the operating limit of 102% (10,200 rpm) which can damage an engine. All instances of overspeed or over-temperature will be recorded on Form 781 in order that the engine may be inspected for possible damage before being released for further operation. Figure 5-2 presents the engine limitations in tabular form.

NOTE

- For wet takeoff, refer to Part 2 of the Appendix. If these values are exceeded, a Form 781 entry must be made and the engine re-trimmed.
- Aviation gasoline and JP-4 fuel mixed in any proportion are suitable for continuous operation from an engine performance standpoint. However, the use of aviation gasoline must be restricted to air refueling operations and to emergency evacuation ferry-type missions to minimize undesirable lead deposits in the engines. Furthermore, "Rate of Climb Limitations with Emergency Fuel (Aviation Gasoline)" under "Fuel Grade Properties and Limits," this section, must be observed to prevent overpressurization of the fuel tanks.
- The engine operating limits are the same for all fuel grades; however, with the use of aviation gasoline, the charted EPR values may not be obtained at takeoff rated thrust.

Starter

The pneumatic starters have the following limitations:

CAUTION

In event of failure of a start attempt in one mode (pneumatic/cartridge) of the starter, do not attempt a start in the other mode until the malfunction is determined.

- | | |
|---|------------|
| 1. Maximum continuous operation | 2 minutes |
| 2. Minimum rest after 2-minute continuous operation | 3 minutes |
| 3. Minimum rest after two 2-minute cycles | 10 minutes |

The cartridge-pneumatic starters have the following limitations:

1. Not more than two cartridge starts shall be made in any period of 60 minutes.
2. After normal cartridge firing, at least 5 minutes shall elapse before removing the breech cap, inserting another cartridge, and initiating another cartridge start. If the cartridge malfunctioned (misfired or hangfired), wait at least 5 minutes before attempting to remove the cartridge, except as noted below. The time intervals, based on experience and consideration of safety, have been established to minimize the

ENGINE OPERATING LIMITS				
Operating Condition	Exhaust Gas Temperature Limit*			Time Limit
	SL to 30,000 Ft	45,000 Ft	55,000 Ft	
Takeoff Rated Thrust (TRT) (Wet)	See chart below	—	—	5 minutes
Military Rated Thrust (MRT) (Dry)	610° C	630° C	640° C	30 minutes
Normal Rated Thrust (NRT)	560° C	570° C	580° C	Continuous
Idle	340° C **	—	—	—
Ground Starting	450° C	—	—	****
Air Starting	450° C	450° C	450° C	*****
*** Acceleration (Engine) Wet or Dry	680° C	660° C	650° C	2 minutes

Engine Operating Limit Speed is 102% rpm.

Engine Takeoff Speed nominal spread is 92 to 98% rpm.

*Limits from 30,000 feet to 45,000 feet and from 45,000 feet to 55,000 feet vary between those indicated for the end points in a straight line relation with altitude.

**This temperature is not a limit. It is given as a guide to indicate the exhaust gas temperature which, if exceeded, may signify an engine malfunction. The exhaust gas temperature limits for throttle settings below normal rated thrust are the same as the temperature limit for normal rated thrust.

***The following information is applicable to engine acceleration time and temperature limits:

- Acceleration temperature time limit is defined as the period between advancing the throttle and the time that the EGT is first observed to start falling after reaching its peak.
- Three additional minutes are allowed following an engine acceleration for the EGT to decrease to a stabilized temperature at or below the applicable limit.
- For accelerations from idle to MRT or TRT, the acceleration temperature limit applies.
- For accelerations to a thrust setting below MRT or from an intermediate thrust setting to MRT, use the temperature limit for the desired thrust setting as the acceleration temperature limit.

The 30-minute time limit at MRT includes acceleration time and the 3 minutes allowed for the EGT to stabilize.

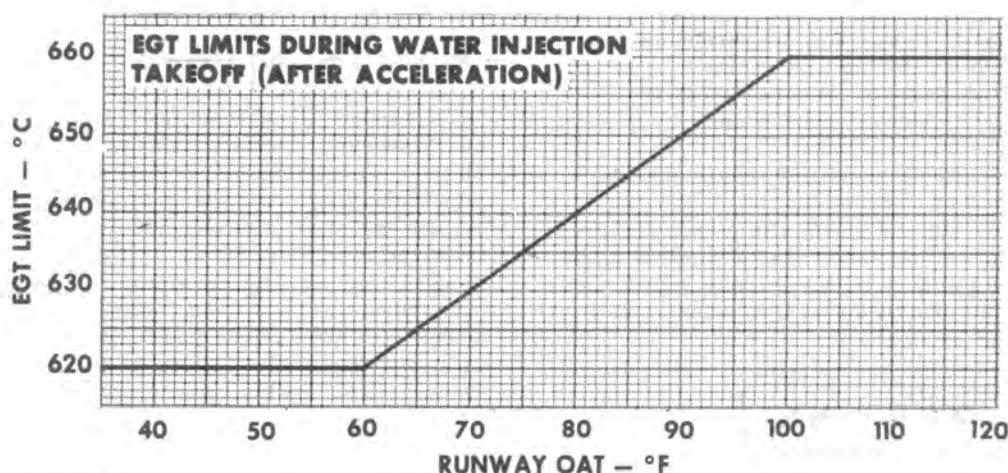
When a tendency to overtemperature is observed, the throttle should be retarded in an attempt to maintain the EGT within limits.

**** Anytime 450° C is exceeded prior to reaching idle rpm during start, the engine must be shut down and the ground crew notified.

***** Anytime 450° C is exceeded prior to reaching idle rpm during start, the engine must be shut down.

NOTE

- For all inflight thrust settings (EPR) above NRT, the MRT limitations will apply.
- In flight, if temperature or rpm cannot be controlled, the engine should be shutdown as soon as possible if the EGT exceeds 730° C for any length of time or the rpm exceeds 104.2%.
- Each time a limit as outlined above is exceeded, it must be recorded accurately on Form 781.
Record the maximum temperature or rpm observed and the length of time the temperature limit was exceeded.



Engine Operating Limitations

Figure 5-2.

danger associated with misfire or hangfire. Cartridge malfunctions are defined as:

a. Hangfire. A delay in the functioning of a propelling charge at the time of firing. The amount of delay is unpredictable, but in most cases will fall within the range of a split second to several minutes. There will be evidence of smoke at the starter exhaust duct. The engine rpm will increase rapidly and the cartridge will give evidence of nearly normal operation. In this type malfunction the energy is expended and presents no hazard to engine operation.

b. Misfire. A cartridge that fails to ignite. There is no physical evidence of smoke at the starter exhaust duct and no engine rotation. This type malfunction presents a potential fire and explosive hazard to engine operation until removed.

WARNING

Do not remove a cartridge that has fired normally, hangfired, or misfired until there is no evidence of exhaust smoke at the starter exhaust duct and minimum time intervals have elapsed since start of initiation. Wear asbestos gloves when removing cartridge. Do not point screened end of cartridge at personnel or equipment.

NOTE

When a hangfire/misfire occurs during EWO conditions, a two minute wait before removal is recommended. However, this time limit may be waived by the unit commander based on his assessment of the situation provided the following conditions are met:

- No smoke can be observed from starter exhaust.
- Starter breech cover is not hot to the bare hand.
- There is no evidence of pressure inside breech chamber (breech cover offers no undue resistance to removal).
- Cartridge screen end is pointed away from aircraft, equipment, or personnel.
- Cartridge is treated as a potential hangfire (fire hazard) for a period of 10 minutes after removal from breech.

3. Not more than three pneumatic starts shall be made in any period of 15 minutes.

4. If cartridge starts and pneumatic starts are interspersed, no more than three starts shall be made within a 15-minute period. Two of these starts may be cartridge starts provided that limitations noted previously are not exceeded.

WARNING

Except in an emergency, engine operation is prohibited when a live or misfired cartridge is installed in the starter. Abnormal cartridge conditions of explosive nature could be

generated due to the combination of vibration and high temperatures that can exist in the engine nacelle.

In the event an unfired cartridge has remained in the breech during engine operation, the cartridge will not be used for a subsequent start.

IGNITION SYSTEM LIMITATIONS

For the purpose of engine starting on the ground, operation of the engine ignition system is limited to 2 minutes followed by a 3-minute cooling period. The system may be energized for another 2 minutes following the 3-minute cooling period; however, during flight, if the system has not been energized, ignition may be used continuously for a period of 10 minutes or in excess of this period during emergencies. The system should not be energized longer than necessary, but with 10 minutes or more of continuous operation, the ignition system must be turned off for a cooling period of at least 10 minutes.

CAUTION

Continuous use of the ignition system for a period in excess of 10 minutes without 10-minute interim cooling periods may damage the ignition system and render it inoperable for subsequent engine restarts.

WATER LIMITATIONS

Normally water with less than 10 parts solid per million parts water will be used in the water injection system. Tap water rarely meets these specifications. Use of water with impurities greater than specified must be restricted to EMERGENCY USE ONLY. Water with impurities exceeding specified limits will coat the compressor blades with deposits which can result in lowering thrust and stall margins of the engine to a dangerous point. This is especially true if the engine is subsequently operated under dry takeoff conditions. When impure water is used, this fact will be entered in the Form 781.

OIL SYSTEM LIMITATIONS

Oil pressure fluctuations up to 5 psi total are allowable; however, the mean should not be lower than 35 psi. These fluctuations are generally in the pressure indicating system and do not indicate abnormal engine operation. Although the minimum oil pressure required for idle is 35 psi, actual pressure may be greater than 55 psi immediately following engine start when the oil is cold. Normal oil pressure for engine operation above idle is 40 to 55 psi. However, oil pressure at idle of 35 to 40 psi is acceptable after ground start, during flight, and after landing.

NOTE

Oil pressure will have a tendency to follow the throttle due to the type of oil pressure relief valve installed. This condition is normal provided the oil pressure stabilizes between the minimum and maximum limits.

USE	FUEL TYPE	GRADE	NATO SYMBOL	U.S. MILITARY SPECIFICATION	SPECIFIC GRAVITY (Max-Min at 60°F)	FREEZE POINT °F °C	LIMITS
RECOMMENDED FUEL	WIDE CUT GASOLINE	JP-4 	F-40 *	MIL-T-5624	.802-.751	-72 -58	
ALTERNATE FUEL	WIDE CUT GASOLINE	COMMERCIAL JET B 	NONE	NONE	.802-.751	-58 -50	 
	KEROSENE	JP-5	F-44 *	MIL-T-5624	.845-.788	-51 -46	
		JP-8	F-34 *	MIL-T-83133	.84-.775	-58 -50	
		COMMERCIAL JET A-1 	F-35	NONE	.839-.775	-53 -47	 
		COMMERCIAL JET A 	NONE	NONE	.839-.775	-40 -40	 
EMERGENCY FUEL	AVIATION GASOLINE (AVGAS) PLUS 3% MIL-L-22851 TYPE II	80/87	F-12	MIL-G-5572	.706 	-76 -60	
		91/96	NONE	NONE	.709 	-76 -60	
		100/130	F-18	MIL-G-5572	.703 	-76 -60	
		108/135	NONE	NONE	.707 	-76 -60	
		115/145	F-22	MIL-G-5572	.703 	-76 -60	

* Fuel identified by NATO symbols F-34, F-40, and F-44 contain a fuel system icing inhibitor.

-  Follow climb restrictions.
-  Avoid flying at altitudes where indicated OAT is below the freeze point of the fuel.
-  Prior to using commercial fuel, obtain freeze point from vendor or airline supplying the fuel, then follow limit 2 above. The pilot should exercise caution if he suspects or observes improper fuel handling procedures. If there is any indication that cleanliness is not up to standard, a fuel sample should be taken in a glass container and observed for foginess, presence of water or rust.
-  Average value-limits are not controlled by specification.
-  See figure 5-4, "Jet Fuel Mixture Freeze Point Charts."

■■■■■■■■■■ Fuel Grade Properties and Limits

Figure 5-3.

FUEL GRADE PROPERTIES AND LIMITS

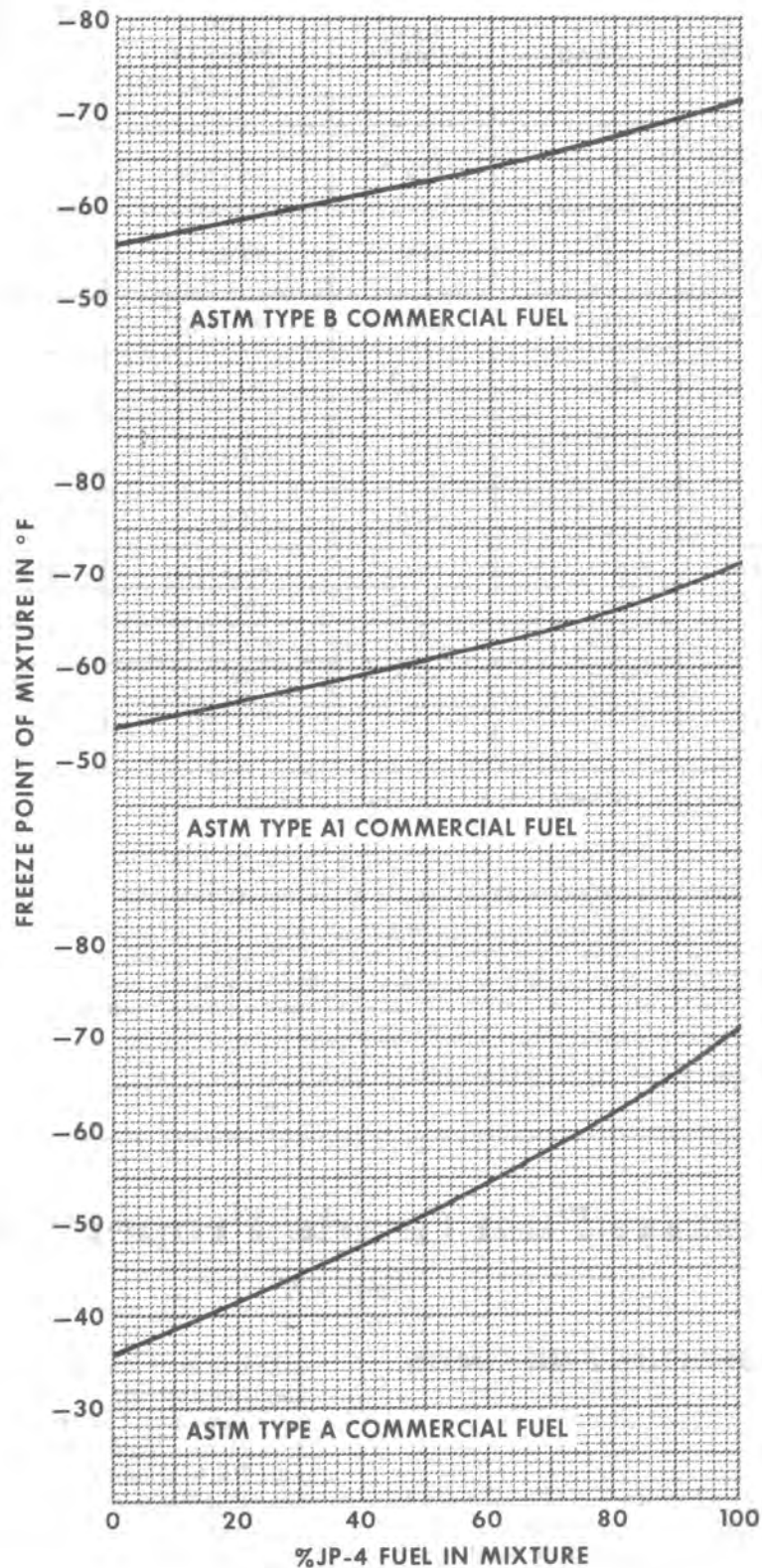
RECOMMENDED FUEL

Recommended fuel is a fuel which has been proven to operate satisfactorily under all conditions. The recommended fuel for the B-52 type aircraft shall conform to Specification MIL-T-5624, Grade JP-4.

ALTERNATE FUEL

Alternate fuel is a fuel which can be used continuously with a possible loss of efficiency and may result in increased maintenance or overhaul costs. The

alternate fuel for this aircraft shall conform to Specification MIL-T-5624, Grade JP-5. Use of alternate fuels may require engine retrimming if takeoff is critical. To determine if trim is required, use the EPR to check rated thrust; i. e., if rated EPR cannot be obtained, retrim the engines. It is recommended that if a landing is made at a base having only alternate grade fuels and no facilities for engine retrimming, only enough fuel be loaded to accomplish a one-time flight to a base where JP-4 is available. Engine thrust settings below takeoff thrust will not be limited. Engines operating on alternate fuels can be trimmed to produce the same thrust as obtained with JP-4. The engine operating limits discussed under "Engine Limitations," this section, also apply to alternate fuels.



Jet Fuel Mixture Freeze Point Charts

Figure 5-4.

EMERGENCY FUEL**CAUTION**

Alternate or emergency fuels may or may not contain icing inhibitor additives. Precautions should be taken to avoid flight conditions which are conducive to fuel icing.

Emergency fuel is a fuel which may cause significant damage to the engines or other systems. Emergency fuel for this aircraft must conform to Specification MIL-G-5572, the lowest grade aviation gasoline available. This fuel is limited to a one-time flight and should be used only if recommended or alternate fuels are unavailable. When using aviation gasoline, the engine-driven fuel pump life becomes critical because of the poor lubricating properties of the gasoline. In addition, the use of aviation gasoline will leave lead deposits in the burners, turbine section, and tailpipe. For these reasons the use of aviation gasoline is to be avoided.

NOTE

Aviation gasoline and JP-4 fuel mixed in any proportion are suitable for continuous operation from an engine performance standpoint. However, the use of aviation gasoline must be restricted to emergency evacuation or ferry-type missions to minimize undesirable lead deposits in the engines.

RATE OF CLIMB LIMITATION WITH EMERGENCY FUEL (AVIATION GASOLINE)

The fuel tank vent system is designed for JP-4 fuel which has a Reid vapor pressure of 3 psi. Aviation gasoline has a Reid vapor pressure of 7 psi. If any tanks are refueled with aviation gasoline and a rapid rate of climb is established at altitudes above the boiling altitude of the fuel, the flow of vapor will exceed the capacity of the tank vent system. This will result in hazardous excess pressures in the tanks and vent system. When aviation gasoline is used, the rate of climb at altitudes above the boiling altitude of the fuel must be reduced. This is required as ap-

proximately 0.5% of the tank fuel quantity will be evaporated overboard per 1000 feet of tank altitude above the boiling point altitude of the fuel. The kerosene-type fuels will not limit aircraft climb rate.

NOTE

Gasoline and JP-4 fuel mixtures that contain less than 10% gasoline in all fueled tanks have no climb rate limitations.

GROUND REFUELING

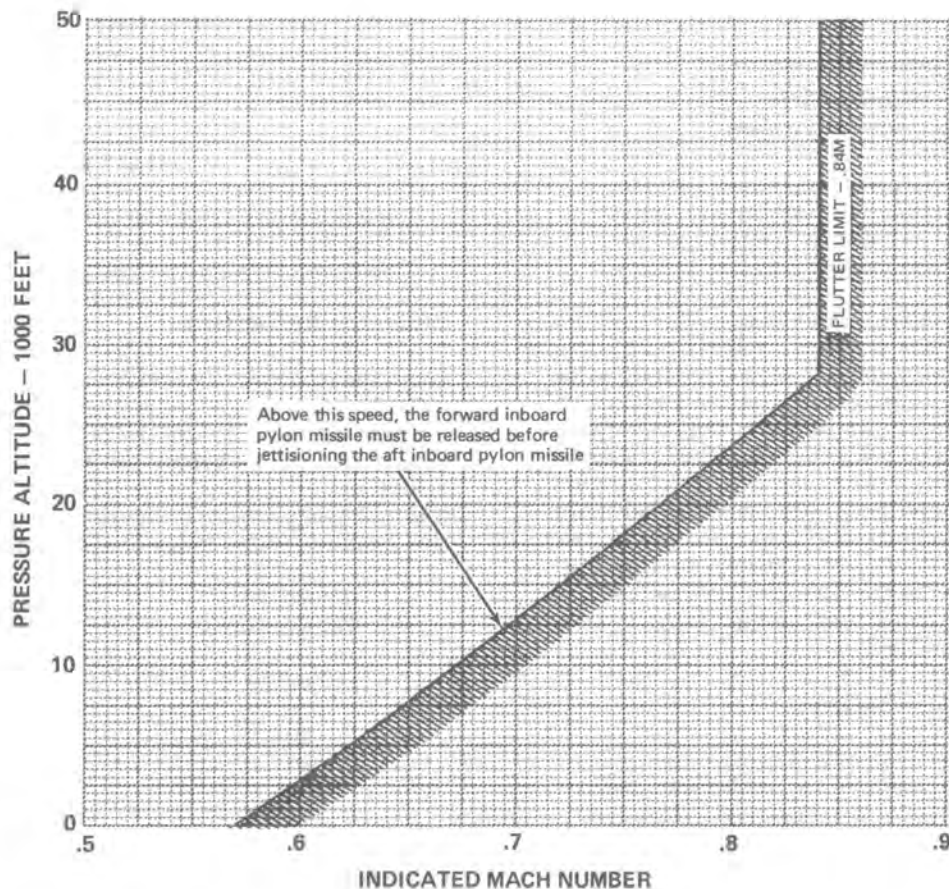
When the aircraft is serviced on the ground with a aviation gasoline and subsequently is flown above the limiting altitudes for the initial fuel temperatures shown in the table below, the rate of climb shall be restricted to not more than 200 feet per minute. Initial fuel temperature is the temperature of the aviation gasoline in the tanks shortly before takeoff time.

Initial Fuel Temperature	Limiting Altitude (Feet)
60° F	53,000
70° F	44,000
80° F	36,000
90° F	30,000
100° F	25,000
110° F	20,000

AIR REFUELING

If the fuel received from the tanker includes a portion of aviation gasoline, no accurate fuel temperature data will be available. The rate of climb restrictions will be determined by altitude and by the percent of aviation gasoline in any of the receiver tanks after refueling. If the aircraft is flown above the limiting altitudes for the percent of aviation gasoline shown in the following table, the rate of climb shall be restricted to not more than 200 feet per minute.

% Aviation Gasoline	Limiting Altitude (Feet)
50	45,000
75	35,000
100	Transfer Altitude



■ AGM-69A Pylon Missile Jettison Restriction

Figure 5-5.

AIRSPEED LIMITATIONS

Mach number limitations shown in this section are indicated unless otherwise noted. The airspeed limitations, other than those shown in figure 5-1, are listed herein and are summarized in figure 5-9.

NOTE

- Significant Mach position errors exist at airspeeds above Mach .81 indicated due to the EVS pod installation. The pods create a region of localized supersonic flow in the vicinity of the pitot tube. This results in sensing a lower pressure and causes the airspeed and Mach indicating systems to read low.

- If an airspeed calibration is made, the aircraft may be flown to 400 knots calibrated and .88 Mach true under conditions allowing 390 knots IAS and .84 Mach indicated.

WARNING

The forward inboard pylon missile must be released prior to jettison of the aft inboard missile on the same pylon at speeds above those indicated on figure 5-5 to avoid possibility of missile/aircraft collision.

WING TANK LOADING — POUNDS			AIRSPEED LIMITATIONS KNOTS OR MACH INDICATED (WHICHEVER IS LESS)	
MAIN TANKS	OUTBOARD WING TANKS	EXTERNAL TANKS	CLEAN (NO EXTERNAL MISSILES)	EXTERNAL AGM-69A INSTALLED
ANY MAIN ABOVE GREEN BAND	7,000 OR GREATER EACH	4,000 OR GREATER EACH	390/.84	390/.84
	LESS THAN 7,000 IN EITHER	LESS THAN 4,000 IN EITHER	*250/.70	*250/.70
ALL MAINS IN GREEN BAND AND ANY GREATER THAN 5,000	ANY OR EMPTY	4,000 OR GREATER EACH	390/.84	390/.84
		LESS THAN 4,000 IN EITHER	ABOVE 30,000 FT *270/.84	ABOVE 30,000 FT *270/.84
			30,000 FT OR BELOW *390/.73	30,000 FT OR BELOW *390/.73
5,000 OR LESS IN EACH	ANY OR EMPTY	4,000 OR GREATER EACH	390/.84	390/.84
		LESS THAN 4,000 IN EITHER	390/.84	ABOVE 21,000 FT 330/.84 21,000 FT OR BELOW 390/.73

***NOTE**

THESE AIRSPEED LIMITATIONS ARE IMPOSED WHEN IT IS NECESSARY TO DEVIATE FROM THE NORMAL FUEL MANAGEMENT SEQUENCE.

Wing Flutter Airspeed Limitations

Figure 5-6.

WING FLUTTER

To avoid wing flutter at speeds less than 390 KIAS or .84 Mach indicated, fuel in the main tanks must be used down to their respective green bands, as marked on the fuel quantity gages, prior to using fuel from full outboard wing tanks. In addition, fuel in each main tank must be used down to 5000 pounds prior to using fuel from full external tanks. When using normal fuel management sequences, the wing flutter airspeed limitations are as follows: (See figure 5-6.)

- Clean Aircraft: Limit speed is 390 KIAS or .84 Mach indicated, whichever is less.
- Aircraft Carrying External AGM-69A Missile(s): Limit speed is 390 KIAS or .84 Mach indicated, whichever is less, if main tank fuel is above 5000 pounds and is as indicated in figure 5-6 if main tank fuel is 5000 pounds or below. When it is necessary to deviate from the normal fuel management sequence, the aircraft is restricted as indicated by asterisks in figure 5-6.

ECM EQUIPMENT

The aircraft should not exceed 300 knots IAS unless one of the following is accomplished:

1. ECM transmitters and heat exchangers are installed in systems 1 thru 8, ALT-16 amplifiers are installed in systems 9 and 10, or ALT-6B transmitter in system 10, ECM transmitters are installed in systems 11 thru 14, ALQ-117 components are installed in systems 15 and 16, and ALT-32 transmitter and power supply are installed in system 20.
2. Dummy boxes or blank adapter plates are installed in lieu of any of the above equipment. (Blank adapter plates are not allowable in lieu of system 15 and 16 components).

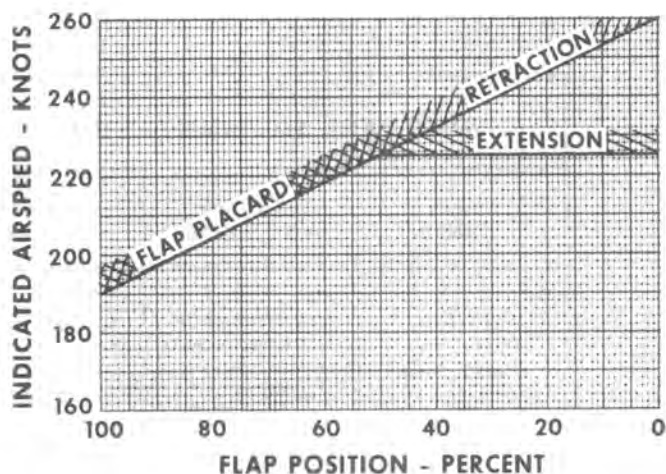
Possible ram air duct, radome, or ECM shroud failures may occur if the aircraft exceeds 300 knots IAS without one of the above installations due to the flow of the unrestricted ram air.

WING FLAPS

Wing flap airspeed limits for extension and retraction are illustrated in figure 5-7. It should be noted that the maximum airspeed to start flap extension is 225 knots IAS. Maximum speed for 50% flaps is 225 knots IAS and the maximum speed for flaps full down is 190 knots IAS.

LANDING GEAR

1. Retraction:
 - Main gear (Maximum) 220 knots IAS
 - Tip gear (Maximum) 305 knots IAS
2. Extension: (Maximum) 305 knots IAS at 30,000 feet and below.
 - Mach .81 indicated at 35,000 feet
 - Mach .82 indicated at 40,000 feet
 - Mach .83 indicated at 45,000 feet
 - Mach .84 indicated at 50,000 feet



■ ■ ■ Wing Flap Airspeed Limits

Figure 5-7.

NOTE

Maximum speed at which all gears will lock down is 305 knots IAS.

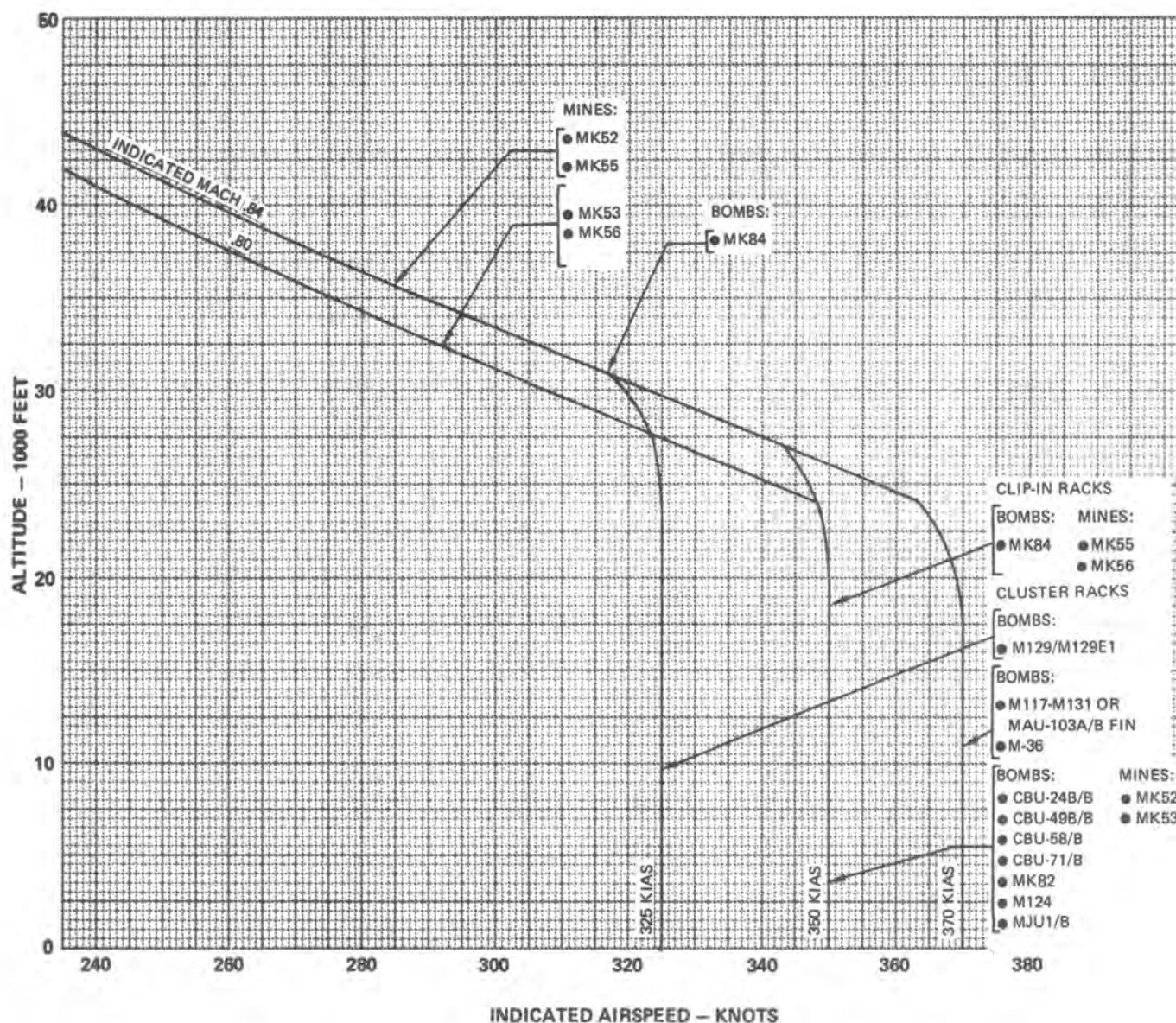
3. Extended: (Maximum) 305 knots IAS or aircraft flutter speed restriction.

AIRBRAKES

At speeds above 305 KIAS, do not select an airbrake position greater than position 4. See "Flight Characteristics," Section VI.

AIR REFUELING SLIPWAY DOORS

Slipway Doors Open: (Maximum) 300 knots IAS



Nonnuclear Weapons Release Airspeed Limitations

Figure 5-7A.

NONNUCLEAR WEAPONS RELEASE AIRSPEED LIMITATIONS

See figure 5-7A for individual weapon indicated airspeed or Mach limitations.

TERRAIN CLEARANCE LIGHT

Terrain Clearance Light Extended: (Maximum) 305 knots IAS

Figure 5-7B. (Deleted)

RUDDER TRIM LIMITATIONS

In order to stay within the structural limits of the fin, the rudder trim limits tabulated below should be observed. These limits will protect the aircraft structure during normal maneuvering and will also allow trimming of single outboard engine failures throughout the normal speed range in the clean configuration. Double outboard engine failures can be trimmed in cruising flight.

IAS (KNOTS)	TRIM UNITS
Under 320	12
320 to 350	10
Over 350	8

NOTE

It should be observed that these limits are not identical to those listed on the rudder trim placard. The placard limits, being more conservative, should be adhered to operationally whenever possible. In any event, the above-listed structural limits shall not be exceeded.

DRAG CHUTE LIMITATIONS

During the deceleration of a landing or refused take-off, the drag chute may be deployed at 135 knots IAS. Deployment at higher speeds may result in failure of the chute or shear pin.

BUFFET BOUNDARY LIMITATIONS**Flight Speed Envelope**

Figure 5-8 represents the flight speed envelope of the aircraft at high altitude. It is possible to fly fast enough to cause a progressive airflow separation over the wing which results in aircraft buffet. Buffet is also encountered at low speeds prior to stalling. The aircraft can be flown safely through the first indication of buffet to the speed for maximum recommended buffet (maximum recommended buffet is defined as a buffet or vibration amplitude of ± 0.1 "g" at the pilots' stations). The MRT lines on figure 5-8 define the level flight speed range at high altitude. See "Wing Buffeting," Section VI.

CONDITIONS:

- CLEAN CONFIGURATION
- NACA STANDARD DAY
- 8 ENGINES AT MRT

EXAMPLE:**GIVEN:**

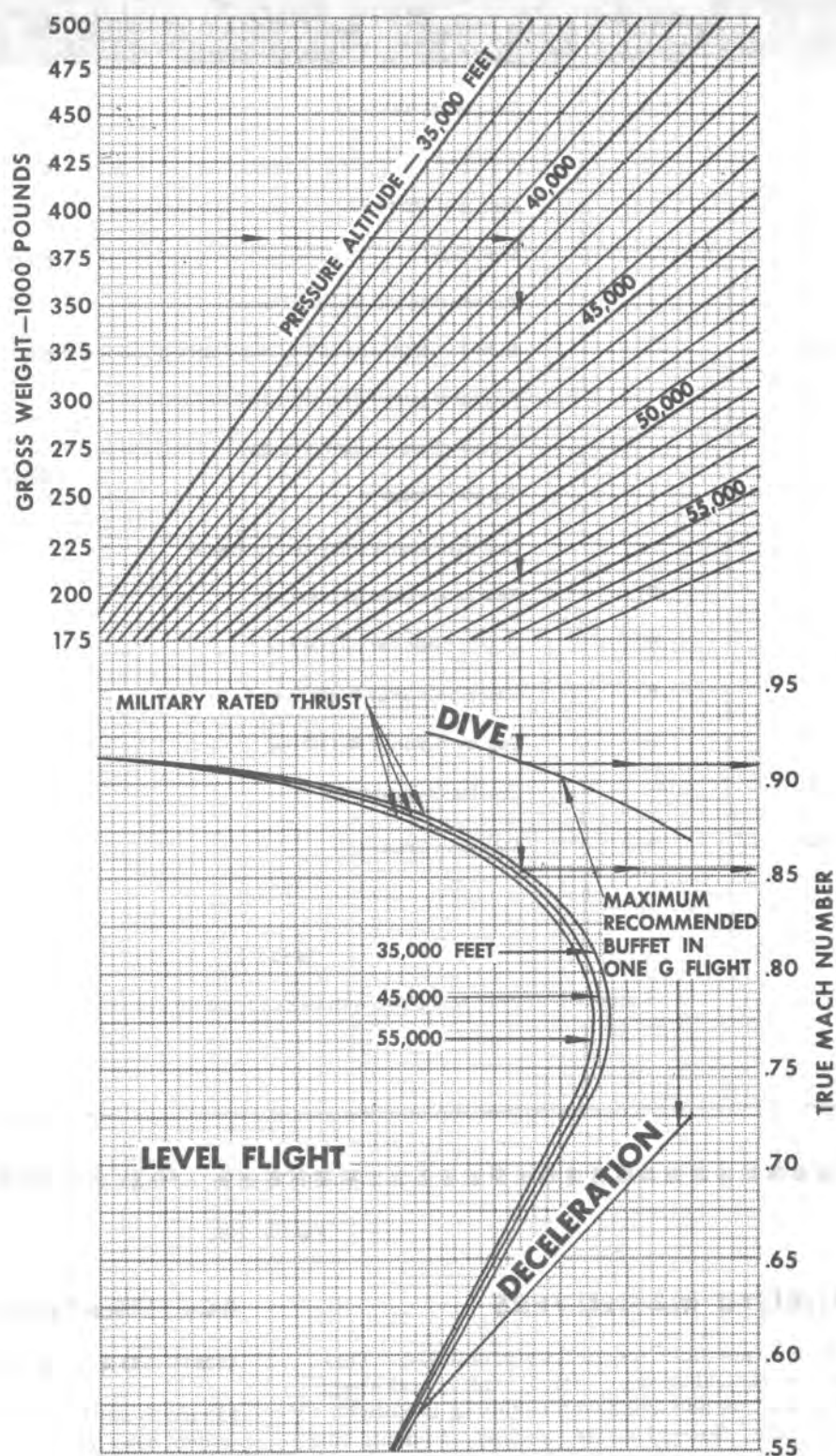
Gross weight = 385,000 lb
Altitude = 40,000 ft

FIND:

Maximum speed in level flight
and maximum permissible dive
speed

SOLUTION:

Max level flight
Mach No. = .853
Max dive speed
Mach No. = .909



DATA BASIS: ESTIMATED
DATE: APRIL 1958

Flight Speed Envelope

Figure 5-8.

pounds. Above 450,000 pounds, the limit maneuver load factor decreases linearly to 1.8 "g's" at 488,000 pounds maximum flight weight. At normal loading, strength has been provided for gust encounters (turbulence) which result in load factors above 2.0 "g's" and up to those shown by figure 5-10. See "Turbulence and Thunderstorms," Section IX, for selection of best speed and altitude in turbulence.

MANEUVER LIMITS — FLAPS DOWN

Figure 5-11 provides curves which may be used to determine the allowable flaps down maneuver limits to avoid stall buffeting, stalls, or exceeding the structural placard limits. This chart is useful in planning the approach.

MANEUVER LIMITS — FLAPS UP

Figure 5-11A depicts the flaps-up maneuvering limits above 10,000 feet. Three reference curves are plotted on the chart to compute minimum recommended speed, initial buffet speed, and strong buffet speed. Strong buffet and maximum recommended buffet are synonymous. The chart may be used to compute high speed initial buffet at a given bank angle by using the top portion of the buffet curve, or the low speed initial buffet at a given bank angle by using the lower portion of the buffet curve. (See example on figure 5-11A.) Maximum bank angle for initial buffet may be computed by establishing the point of convergence of the high speed and low speed buffet curves (note asterisk on figure 5-11A) and following vertically to the intersection of the bank angle curve developed from the gross weight and altitude conditions. The same process would be used for computing strong buffet-maximum recommended. Acceleration "g's" may also be computed for any selected condition from the scale on the left side of the bank angle chart.

ALTITUDE AND TEMPERATURE LIMITATIONS

Although there is no unqualified altitude restriction on the aircraft, the following lists limitations on equipment not designed for operation above the noted altitude or which must be shut down under specific temperature conditions:

- | | |
|--|--------------------------------|
| • Water Injection System | 40°F OAT or 8000 feet altitude |
| • Oxygen Regulator and Oxygen Mask Combination | 42,000 feet (cabin altitude) |

If ECM equipment is to be operated on the ground without ground cooling equipment, specific time and temperature limitations must be complied with to prevent overheating. ALR-46 equipment has no time or temperature limitations. Other ECM equipment

time and temperature limitations are listed in figure 8-4.



Due to probable equipment damage, operation of ECM equipment without complying with proper cooling, time and/or temperature limitations is prohibited.

RATE OF DESCENT LIMITATIONS

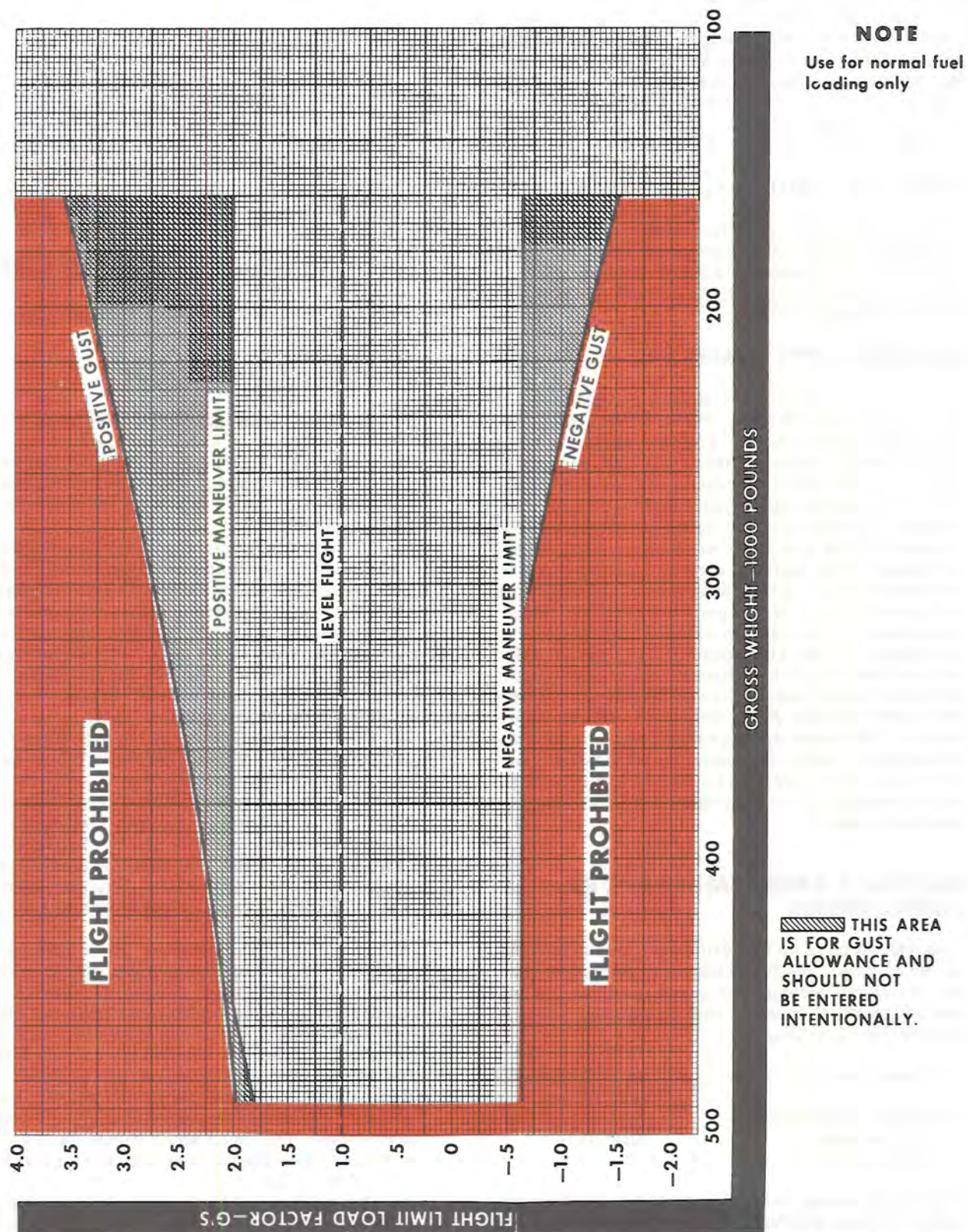
The maximum rate of descent is 25,000 fpm.

SYSTEMS LIMITATIONS

STABILIZER TRIM MECHANISM LIMITATIONS

There are no restrictions on the use of the manual stabilizer trim system. However, when using the electrical portion of the system, observe the following limitations:

1. Do not actuate one trim switch in the NOSE UP position while applying nose down trim with the other trim switch (an exception to this is a runaway trim condition). This operation causes the electric actuator to stall, since one electric actuator clutch cancels the effect of the other. Overheating and eventual failure will result if this condition is maintained for long periods of time (in excess of 2 minutes) due to a stalled actuator rotor.
2. Continuous energizing of the stabilizer trim switch in either the NOSE UP or NOSE DN position for long periods of time can result in driving the electric motor-driven followup screw into its limit stops. This will stall the output shaft of the actuator motor and cause excessive clutch slippage, tending to overheat the clutch and motor and resulting in shortened clutch service life. Extreme trim position may be obtained manually after approaching the extremes electrically.
3. Do not attempt continuous operation of the stabilizer in the air or on the ground, except in emergencies, with standby pump pressure. Operate only by momentary actuation of the trim buttons. High attrition replacement rate of the stabilizer trim electric actuator will result if this practice is not followed due to high wear rate of the actuator clutch.
4. In order to prevent excessive wear on the trim actuator clutch and the hydraulically released motor drive brake, engines 4 and 5 should have a throttle setting of 82% rpm or more during stabilizer operation on the ground.
5. During flight, the stabilizer trim should be operated only in short bursts. This will serve as an aid in recognizing a malfunctioning electrical trim system before an extreme out-of-trim condition is reached.



..... Structural Limitations—Limit Load Factor

Figure 5-10.

DATE: AUGUST 1968

**DATA BASIS:
ESTIMATED****REMARKS:**

This chart may be used to compute the maximum allowable bank angle for the existing gross weight and altitude.

EXAMPLE 1:**GIVEN:**

Gross weight = 375,000 pounds
Altitude = 37,000 feet
Bank angle = 30°

FIND:

Maximum and minimum airspeed for initial buffet

SOLUTION:

Initial buffet low speed = 205 KIAS
Initial buffet high speed = 274 KIAS

EXAMPLE 2:**GIVEN:**

Gross weight = 375,000 pounds
Altitude = 37,000 feet

FIND:

Maximum bank angle limit

SOLUTION:

★ Initial buffet curve convergence = .775 Mach
Maximum bank angle = 48°

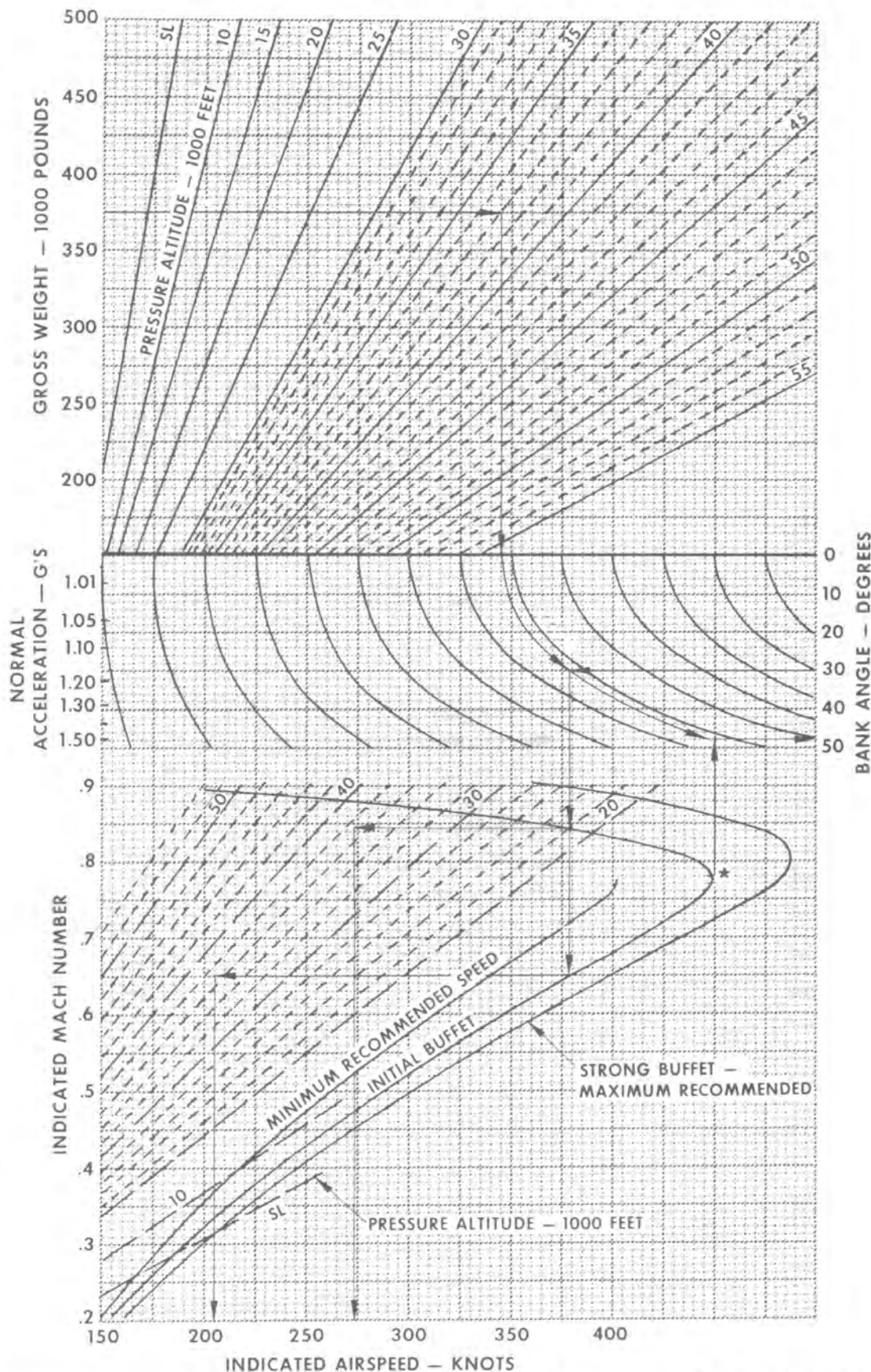
**Maneuver Limits — Flaps Up**

Figure 5-11A.

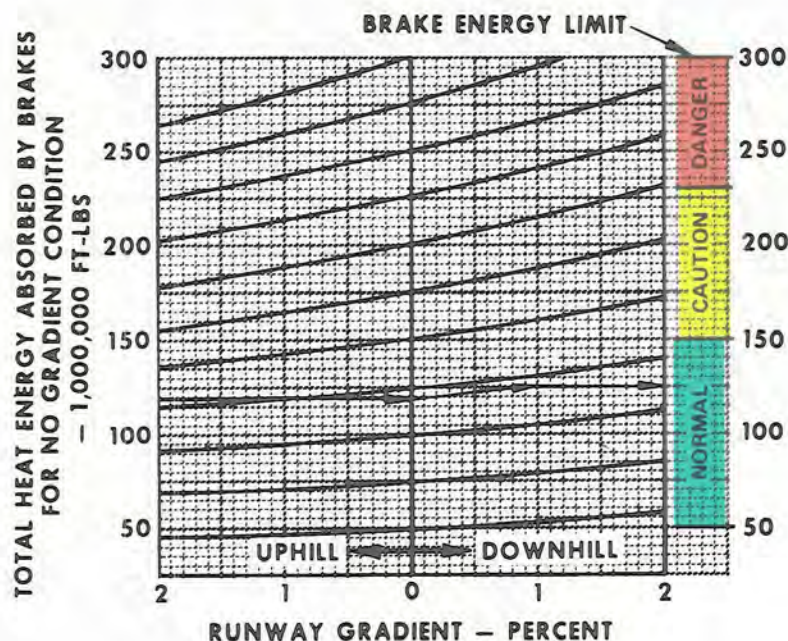
CONDITIONS:

- ANY LANDING CONFIGURATION
- RCR = 23
- NO WIND

REMARKS:

The table is based on maximum ground handling of the aircraft and will be conservative for lesser weights.

DATE: SEPTEMBER 1973

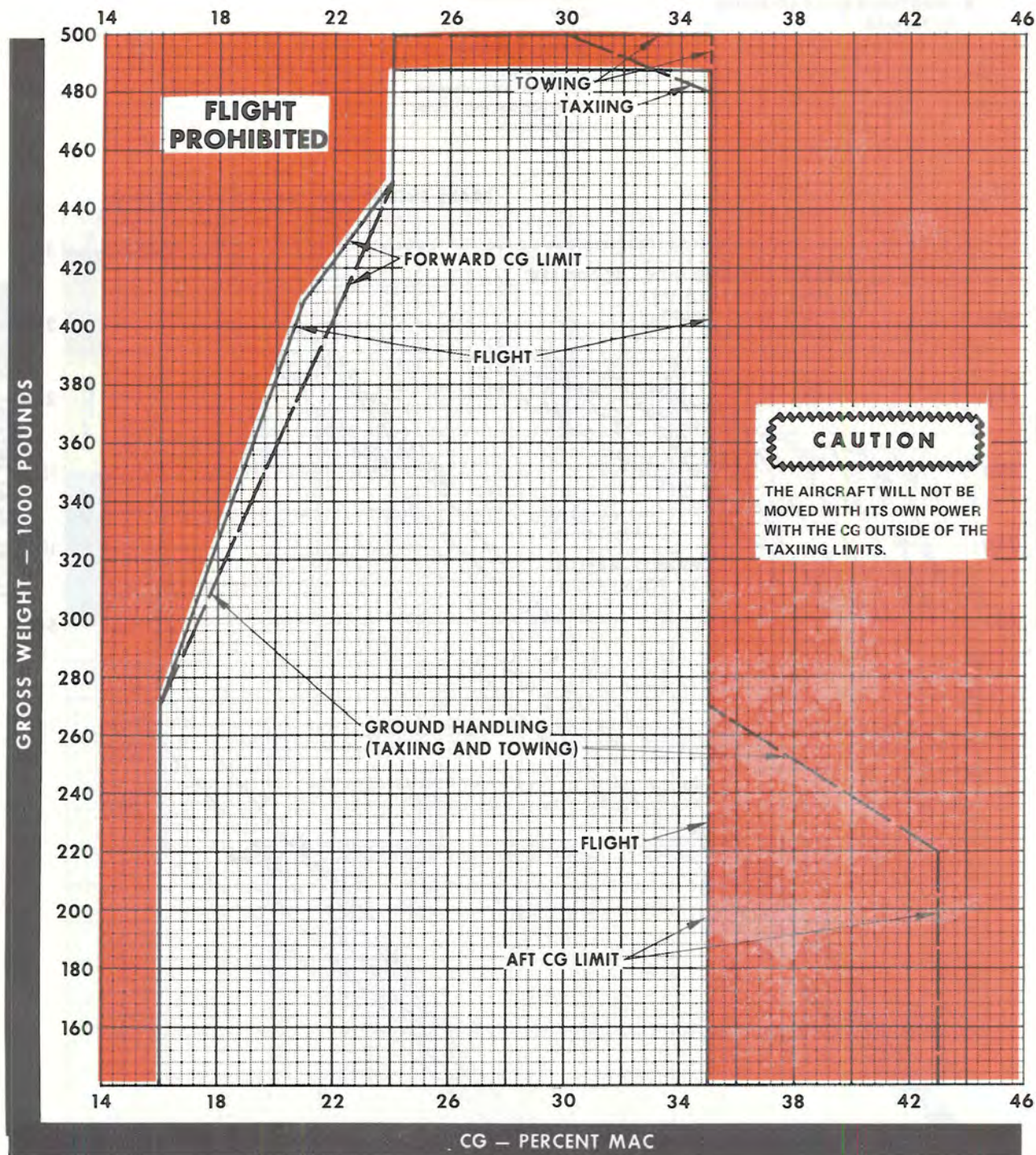
DATA BASIS: ESTIMATED

BRAKE ENERGY CORRECTIONS DUE TO RUNWAY GRADIENT

TAXI SPEED AT BRAKE APPLICATION – KNOTS	FINAL TAXI SPEED – KNOTS							
	–	50	40	30	20	10	5	0
	60	25	45	60	70	77	79	80
	50	–	20	35	45	52	54	55
	40	–	–	15	25	32	34	35
	30	–	–	–	10	17	19	20
	20	–	–	–	–	7	9	10
	10	–	–	–	–	–	2	3
	5	–	–	–	–	–	–	1
	HEAT ENERGY ABSORBED 1,000,000 FT-LBS							

GROUND MANEUVERING BRAKE ENERGY INCREMENT

Figure 5-12 (Sheet 2 of 3).



DATA BASIS: ESTIMATED

DATE: AUGUST 1965

..... Structural Center of Gravity Limits

Figure 5-13.



(5-27 blank)/5-28 Change 6

WING FLAP LIMITATIONS

Wing flap operation shall be discontinued within 10 seconds if the flaps fail to start moving. Slippage of the power unit clutch or malfunction of the wing flap system can be detected by monitoring the wing flap indicator while using the system. Since the friction of braking and continuous operation of the flap motors cause considerable heat, actuation is limited as follows:

1. A 20-second interval is required between braking actions of the flap motors.
2. A maximum of 6 minutes motor operation is allowed in any 30-minute period.
3. A maximum of 10 starts are allowed in any 6-minute period followed by a cooling off interval of not less than 24 minutes.

TERRAIN CLEARANCE LIGHT LIMITATIONS

CAUTION

- Ground operation of the terrain clearance light should not exceed 5 continuous minutes without allowing a 5-minute cooling period before a subsequent operating period. The light should be extended beyond a 30° position (beam from vertical) to allow maximum heat dissipation.
- Inflight operation of the terrain clearance light should not exceed 15 continuous minutes without allowing a 4-minute cooling period before subsequent operating periods.

BOMBING SYSTEM LIMITATIONS

Cluster Bomb Racks

WARNING

Do not land with 1000-pound class munitions in any of the nine bottom stations of the cluster racks. Loads imposed during landing stresses may result in failure of the racks.

Conventional Munitions Jettison

In an emergency, jettison of munitions with the aft gear down may be attempted; however, consideration must be given to possible gear damage. A planned release in this configuration is not authorized.

CAUTION

Jettison of munitions with the aft landing gear in the down position may result in landing gear damage.

BOMB DOOR OPERATION LIMITATIONS

Maximum bomb door open speed is 390 KIAS. Noticeable bomb door fatigue damage (loose rivets, cracked skin and ribs, etc.) can be expected after the doors have been open for 5 minutes at 390 KIAS. Fatigue damage can also be expected at lesser airspeeds if the doors are open for longer periods. If the doors remain open for extended periods due to system malfunction or any limit is exceeded, make a Form 781 entry.

GROUND LIMITATIONS

GROUND TURNING LIMITATIONS

Maximum ground turning speeds with full rudder travel are 5 knots with the steering ratio selector lever in TAXI or 27 knots with the lever in TAKEOFF LAND. For ground turning speeds at gross weights above 450,000 pounds, see "Taxiing," Section II.

WHEEL BRAKE LIMITATIONS

Brake Energy Limits

The brakes are limited in the amount of work they can perform and still function properly because this work must be dissipated in the form of heat. The amount of work performed or heat absorbed by the brakes is the kinetic energy expended, measured in millions of foot-pounds. The amount of heat added to the brakes for each braking effort is cumulative and is determined by the speed of the aircraft and its gross weight at the time the brakes are applied. Sufficient heat energy can be generated by the brakes to cause tire explosion and hydraulic fire. The brake energy limit is 298 million foot-pounds total for eight brakes. This is the maximum energy the brakes can absorb before becoming ineffective and is the stopping capability limit. Tire explosions and hydraulic fire will result at lower levels of brake energy absorption. Above 230 million foot-pounds accumulation, fire and tire explosion are imminent and above 150 million foot-pounds accumulation, fire and tire explosion are possible. Charts are provided in figure 5-12 to determine the amount of

brake energy absorbed. The following operating procedures and restrictions are necessary to preclude possible injury to personnel and damage to equipment from overheated brakes and tires.

NOTE

- Unequal brake energy absorption may result from unequal gear loading due to crosswind conditions. The brake energy charts do not account for such unequal brake energy absorption. Providing realistic data to account for such unequal braking is not practical due to variables in aircraft roll during ground operation. Following procedures in Section II under "Crosswind Landing and Wheel Brake Application," and Section VI under "Landing" will minimize such unequal braking.
- The affect of aerodynamic braking has been considered in the "Brake Energy Limits" charts. This aerodynamic braking will slow the aircraft the same amount whether the brakes are applied steadily or in short applications.
- The same amount of heat is generated by the brakes in stopping the aircraft within a given stopping distance or in deceleration of the aircraft during taxiing or ground maneuvers, regardless of whether the brakes are applied in one steady application or in a series of short applications.
- The internal heat generated by the brakes does not reach the outer surface of the brake assembly for several minutes whereas the ground roll requires only a few seconds; therefore, all but an insignificant amount of the heat generated by the brakes will remain in the brake assembly for the duration of the ground roll. Peak temperatures are reached in the tire bead seat of the wheel as late as 20 minutes after stopping.
- The brake energy charts and procedures are based on equal braking among operable brakes. Accounting for brake energy differences due to brake and antiskid system tolerances, wear, maintenance and pilot technique are not realistic. The brake energy charts should be considered as a best possible estimate in assessing heat energy absorbed and determining necessary action.

DANGER ZONE - OVER 230 MILLION FOOT-POUNDS.

WARNING

Tire explosion and hydraulic fire are imminent.

1. Taxi aircraft clear of runway, other aircraft, and personnel. Taxi distance and braking shall be an absolute minimum. Stop aircraft and release brakes as soon as possible.
2. Request fire fighting equipment.
3. Evacuate aircraft as soon as possible by moving forward or aft from main landing gear wheels.
4. Leave immediate vicinity.
5. Enter computed brake energy in Form 781.
6. Do not make a subsequent takeoff until tires, wheels, and brakes have been replaced.

CAUTION ZONE - 150 to 230 MILLION FOOT-POUNDS.

CAUTION

Tire explosion and hydraulic fluid fire are possible.

1. Taxi aircraft clear of runway, other aircraft, and personnel. Minimize taxi distance and braking. Stop aircraft and release brakes as soon as possible.
2. Request standby fire fighting equipment.
3. Evacuate aircraft as soon as practical by moving forward or aft from main landing gear wheels.
4. Leave immediate vicinity and do not reapproach aircraft until maintenance personnel determine the area is safe for reentry.
5. Enter computed brake energy in Form 781.
6. Do not make subsequent takeoff prior to tire, wheel, brake, and hydraulic leak inspection.
7. Delay subsequent takeoff to allow adequate brake cooling per criteria under "Takeoff Subsequent to a Refused Takeoff or Braked Landing."

NORMAL ZONE - UP TO 150 MILLION FOOT-POUNDS.

1. No special inspection is required.
2. Delay subsequent takeoff to allow adequate brake cooling per criteria under "Takeoff Subsequent to a Refused Takeoff or Braked Landing."

Inoperable Brakes

The brake energy limit and brake energy absorption zones shown in figure 5-12 and under "Brake Energy Limits" are based on operable brakes on each gear. The following values apply when some brakes are known to be inoperable:

Wheel Brakes Operable	Brake Energy - Millions Foot-Pounds			
	Brakes Ineffective	Danger Zone	Caution Zone	Normal Zone
3 Gear	223	172 to 223	112 to 172	Up to 112
2 Gear	149	115 to 149	75 to 115	Up to 75
1 Gear	74	57 to 74	37 to 57	Up to 37

Refer to Section 9 of the Performance Appendix for stopping distances with inoperable brakes.

Takeoffs Subsequent to a Refused Takeoff or Braked Landing

WARNING

Before a second takeoff is attempted the possibility of a refused takeoff must be considered. The cumulative effect of energy absorbed in prior braking and energy required for a refused takeoff may exceed brake energy limits resulting in tire explosions and fire which could endanger the crew and aircraft.

A subsequent takeoff may be made if the total of brake energy already absorbed plus brake energy that will be required in aborting the takeoff at deci-

sion speed does not exceed the brake ineffectiveness limit of 298 million foot-pounds. If the calculated total of brake energy previously used and to be used in a refused takeoff exceeds 298 million foot-pounds, allow brake cooling time of 6 minutes for each 8 million foot-pounds the calculated sum exceeds 298 million foot-pounds. Unless mission requirements dictate otherwise, adequate cooling time should be used to allow dissipation of previously absorbed energy and avoid entering the Caution or Danger brake energy zones where possible. A cooling rate of 8 million foot-pounds per 6 minutes should be used to estimate cooling time required to dissipate absorbed brake energy. Cooling requirements should be timed subsequent to leaving the active runway with additive time for taxi brake energy taken into account. If a stop has been made exceeding 100 million foot-pounds and an immediate takeoff is accomplished, leave the gear extended 2 minutes for each 8 million foot-pounds in excess of 100 million foot-pounds unless climb rate is critical. If it is necessary to retract the gear, extend as soon as practical to meet cooling criteria.

Use of the Brake Energy Charts

The brake energy charts in figure 5-12 should be used whenever a takeoff is aborted, for all flaps up landings, for all normal flaps down landings at gross weights over 300,000 pounds, for takeoffs subsequent to an abort or braked landing, and when the pilot suspects that the combination of gross weight, runway altitude, temperature, runway grade, IAS, and the number of stops and decelerations will result in brake energy reaching the Caution or Danger Zone. To determine the heat energy absorbed, enter the appropriate flaps up or flaps down chart with gross weight, brake application speed, runway pressure altitude, runway temperature, and drag chute configuration. Correct for runway gradient using chart on Sheet 2. For stops and decelerations, determine the heat energy absorbed during each brake application by entering the table on Sheet 2 with the taxi speed at brake application and the final taxi speed. The heat absorbed from each maneuver is totaled as shown per example on the charts.

Landing Gear Oscillation

If landing gear oscillation is experienced, brakes shall be fully released immediately. Brakes may be reapplied as soon as fuselage and landing gear oscillations have ceased.

TIRE LIMITATIONS

Maximum Ground Speed

To prevent main landing gear tire casing failures, all takeoffs and landings will be limited to a maximum ground speed of 217 knots. See Part 9 of the Appendix for tire limit speeds.

CENTER OF GRAVITY LIMITATIONS

The allowable cg limits are shown in the chart on figure 5-13. Maintaining the cg within these limits is required by structural rather than aerodynamic considerations. The cg may easily be maintained within these limits by following the prescribed normal fuel scheduling. Should an emergency situation occur that requires other than normal fuel sequence or loading, every effort should be made to avoid exceeding the cg limits.

WEIGHT LIMITATIONS

MAXIMUM GROSS WEIGHT

The maximum gross weight on the ground is 500,000 pounds. The maximum flight gross weight is 488,000 pounds.

LANDING LIMITATIONS

The normal landing gross weight at the limit contact sinking speed of 470 fpm is 270,000 pounds. It is possible to land the aircraft up to the maximum flight weight limit if the sinking speed is limited (figure 5-15). Landings above 400,000 pounds will be difficult because of the necessary shallow angle of approach, and there will be little power margin for maneuvering or go-around. It is not recommended that landings above 450,000 pounds be attempted except in extreme emergencies.

NOTE

Landings performed above 400,000 pounds must be reported on Form 781 so the landing gear and the support bulkheads can be inspected for possible structural damage.

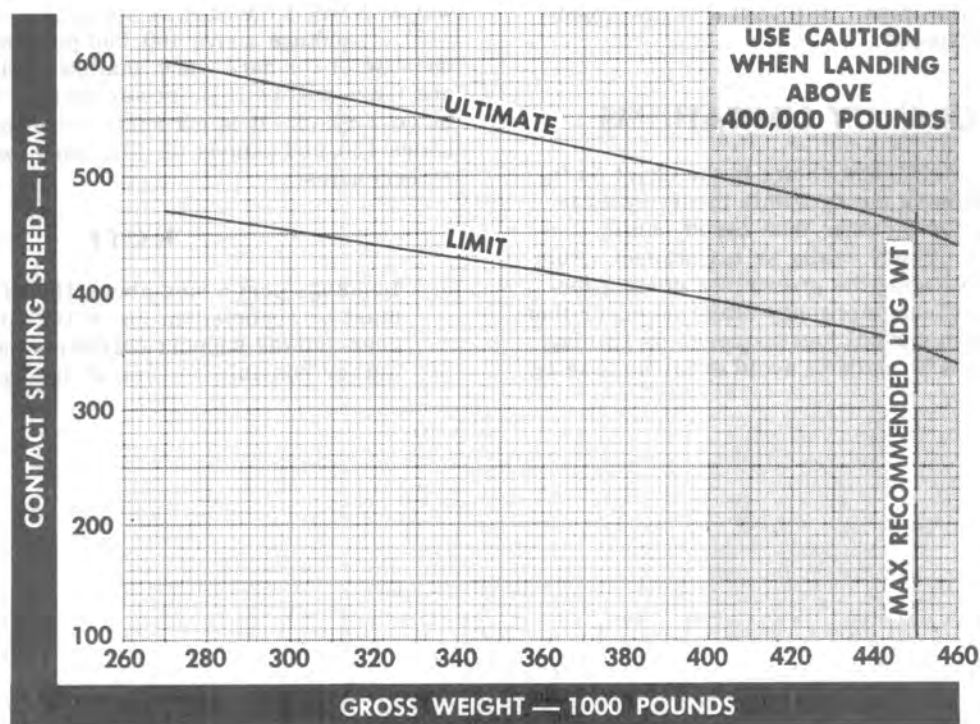
LANDING GEAR LIMITATIONS

The main landing gear is limited structurally in the braked-roll condition. The strength of the body and gear for drag loads will allow application of the brakes for aircraft gross weights up to 500,000 pounds. The hydraulic pressure of the brake system has been limited to preclude gear failure up to 500,000 pounds gross weight.

WEIGHT LIMITATIONS CHART

NOTE

Refer to T.O. 1-1B-40 Chart E and Section VII of this manual for normal fuel usage and loading information pertaining to the weapon configuration involved.



■■■■■■■■■■ Contact Sinking Speed Limitations

Figure 5-15.

Flight Characteristics

section **VI**

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DESIGN CONSIDERATIONS

AERODYNAMIC DESIGN

The following discussions are intended to give some of the aerodynamic design background of the aircraft in order to aid in understanding the aircraft flight characteristics.

Wing Selection

The effects of compressibility are the primary limiting factors on the performance of high speed aircraft. In order that a wing may produce lift, the air must pass over the top surfaces of the wing at a higher speed than the lower surface. As the aircraft speed is increased, the air velocity over the top of the wing reaches the speed of sound much sooner than the lower surface. When the air over the top surface of the wing exceeds the speed of sound, a shock wave is produced resulting in a sharp pressure rise. This, in turn, causes an increase in drag and a decrease in lift because of the airflow separation induced behind the shock wave. Since the air velocity over the top of the wing is greater than the aircraft speed, this condition always occurs at aircraft speeds less than the speed of sound (Mach 1.0). The speed where this effect becomes great enough to be noticeable is termed the critical Mach number.

Elevator and Stabilizer Selection

Because of the large spread between stalling speed and top speed and the overall aircraft aerodynamic characteristics, the longitudinal trim requirements of this aircraft are much greater than would be required for a comparable aircraft of lower performance. An adjustable horizontal stabilizer is utilized for longitudinal trim rather than elevator surfaces for the following reasons:

1. An elevator surface to be used for both primary longitudinal control and for longitudinal trim would be so large that its aerodynamic balancing would present extreme difficulties.
2. The drag of such a control surface held in a displaced position for trim purposes would adversely affect performance.

HIGH SPEED DESIGN FEATURES

Every presently known means for increasing the critical Mach number of this aircraft has been employed in the design. The more important features employed to attain a high critical Mach number are wing and tail surface sweepback, choice of thin high speed airfoil sections, careful selection of wing loading, and smooth clean surfaces with a minimum of protuberances.

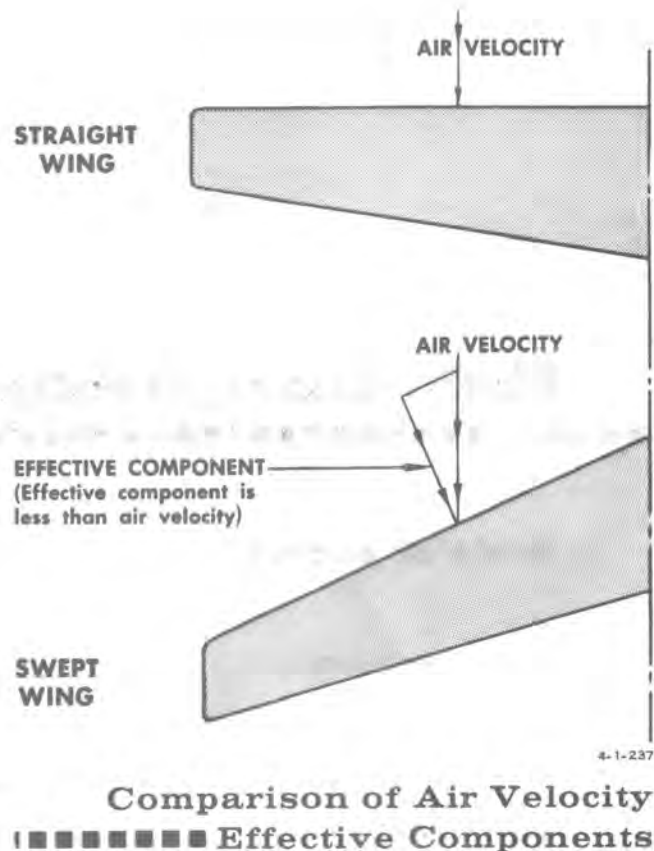


Figure 6-1.

Sweepback

Sweeping back the wing and tail surfaces is one of the most effective methods of increasing the critical Mach number. The lift of a wing is produced from the component of air velocity traveling at right angles to the leading edge of the wing. A swept wing has a smaller effective component as shown in figure 6-1. Since the velocity of the effective air passing over the top of the wing is less on a swept wing than on a straight wing, the aircraft can fly at a higher speed before reaching the critical Mach number. Swept forward wings would be just as effective as swept back wings in producing high critical Mach numbers. However, swept forward wings are seldom used because of stability, control, and structural problems which are more severe than those for swept back wings. The maximum lift of a swept wing is also less than a comparable straight wing. The decreased lift is not detrimental at high speed but it must be offset by the use of efficient flaps in order to have moderate takeoff and landing speeds. This is one of the main reasons when the aircraft is equipped with

large area Fowler-type flaps. The swept wing, in conjunction with its flexibility, also helps to reduce the loads imposed on the wing and body structure at high speeds and gusty conditions. Swept back wings, however, have the disadvantage that sweepback tends to cause a stall progression from the wing tips to the root. This disadvantage was overcome by changing the wing airfoil section at different spanwise locations and providing spoilers for lateral control.

Airfoil Section

The thickness ratio of a wing has an important bearing on its critical Mach number. When the thickness ratio of an airfoil section is decreased, the critical Mach number increases since the air flowing over the top of the wing travels relatively slower, thereby permitting higher aircraft speeds before the wing critical speed is reached. Wind tunnel tests conducted on models showed that the airfoil section at the root of the wing could be quite thick without reducing the critical Mach number. The aircraft has a relatively thick air foil section near the foot of the wing and tapers down to a very thin section at the tip. The outstanding disadvantages of a thin airfoil section as compared to one with more thickness are that there is less space in the wing to house fuel and equipment, a heavier structure is required because of the decreased beam depth of the spars, and the maximum lift is lower.

Wing Loading

The design wing loading (weight per square foot of wing area) is an important parameter in the aerodynamic and performance characteristics of the aircraft. The critical Mach number of the wing is strongly dependent on the magnitude of the wing loading. A decrease in the wing loading of the aircraft (increase in the aircraft's wing area) will generally increase the critical Mach number. This effect can be explained from the fact that for a given speed, altitude and weight, the wing angle of attack is proportionally reduced with a decrease in wing loading. Since the velocity of the airflow over the wing is proportionally less at low angles of attack than at high angles of attack, the aircraft speed corresponding to where the airflow reaches a sonic velocity is increased. This increase in aircraft speed is the change in the critical Mach number of the wing. The increased wing area associated with a reduction in wing loading will improve the takeoff performance but may reduce the range performance of the aircraft due to the additional frictional drag and the heavier structural weight required. A compromised wing loading was necessary in order to achieve an optimum configuration from all design considerations.

STALLS

The stall characteristics of the aircraft will vary with wing flap extension. The following stall characteristics can be expected:

1. With flaps extended, a fair amount of stall warning will exist. The stall is preceded by a mild buffet approximately 5 to 10 knots above the stall, increasing to strong buffeting at the stall.
2. With flaps retracted, the initial buffet occurs at approximately 10 to 15 knots above the stall.
3. There is approximately a 20 to 35 knot difference in the stalling airspeed depending on whether the flaps are extended or retracted. The use of airbrakes has a negligible effect on the stalling speed but full airbrakes will cause the initial buffet to occur at an airspeed approximately 2 to 4 knots higher than if no airbrakes are used.

PRACTICE STALLS

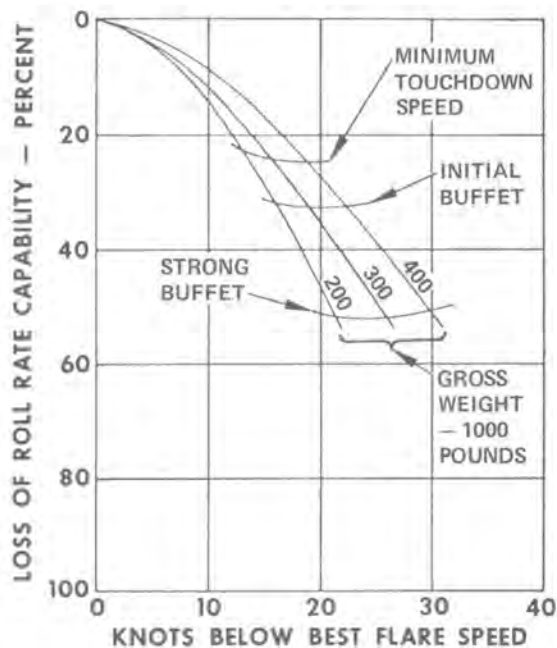
Practice stalls may be executed without difficulty provided the following procedures are observed:

1. Gross weight does not exceed 300,000 pounds.
2. A minimum altitude of 20,000 feet above the terrain.
3. Extend flaps and adjust thrust to allow the aircraft to decelerate while holding a constant altitude. Engine thrust has a negligible effect on the stall characteristics or stall speed; however, high thrust settings in the stall approach will result initially in a fairly large rate of climb.

NOTE

As the aircraft is decelerated in the stall approach, it is essential that it not be trimmed to speeds below best flare speed (approach speed flaps up). The stall recovery should be made using forward elevator control only. If the aircraft has been trimmed below the best flare speed trim setting, stabilizer trim may be used to augment the elevator as required. The use of stabilizer trim in a normal practice stall recovery may result in overcontrolling the aircraft with a resultant potentially dangerous nosedown attitude developing.

4. Continue to decelerate the aircraft using back pressure on the wheel. The amount of force and column movement needed to stall the aircraft will vary with cg position. Maintain wings level attitude with lateral control as the stall is approached. Fairly large lateral corrections may be necessary. Caution should be used because lateral control capability decreases rapidly as the stalling speed is approached. Shown in figure 6-2 is the deterioration of the lateral control effectiveness as the speed is reduced



Decay of Lateral Control Effectiveness

■■■■■■■■■■ From Best Flare Speed

Figure 6-2.

below best flare speed. Rudder may be used to maintain heading; however, during low speed flight, a delay in aircraft response after control input of up to 3 seconds may exist before a roll correction develops.

5. With flaps down, there will be a 5- to 10-knot stall warning buffet which increases as speed is reduced. At the stall, there will be fairly heavy buffeting.

6. The stall should be terminated by sufficient forward control column movement to lower the nose below the horizon, simultaneously advance the throttles to MRT until safe and proper airspeed is attained. Trim the aircraft as required.

7. If practice stalls are performed in the flaps-up configuration, procedures are the same as flaps-down. There will be a 10- to 15-knot stall warning buffet. Generally, there is a reduced tendency for the wing to drop in the flaps up configuration as compared to the flaps down configuration. The stall should be terminated if a wing drops or before heavy buffet is reached.

CAUTION

Under no circumstances should an attempt be made to carry a stall to completion by holding the column back until the nose falls through

the horizon. Any such attempt will result in severe buffeting. Severe buffeting has resulted in damage to secondary structure and aircraft equipment.

8. Accelerated stalls can occur at any speed as a result of pulling excessive "g's" in turns or pull-ups. Generally they are similar to unaccelerated stalls except that speed and altitude changes occur much faster. An accelerated stall will occur if the aircraft is placed in a stalling angle of attack during a pull-up or turn at any speed higher than 1 "g" stalling speed. As a rule at normal cg's, if the aircraft is trimmed for 1 "g" flight, sufficient elevator control is available at high altitudes to produce an accelerated stall at any speed. At low altitudes, the elevators must be augmented by stabilizer trim and, in some cases, the wing structural limits are exceeded to obtain an accelerated stall. Approaches to accelerated stalls requiring flight in the strong buffet region can be safely executed and may be necessary in escape maneuvers at high altitudes. Complete stalls while pulling "g's" are not recommended for the following reasons:

a. The drag associated with accelerated stalls will result in rapid speed and altitude changes.

b. Loss of accurate orientation due to the extreme attitudes which can occur during and following an accelerated stall may delay recovery or jeopardize control of the aircraft so that considerable altitude will be lost in the maneuver.

c. The strong buffeting encountered will have adverse effects on the aircraft structure and equipment.

d. If the accelerated stall occurs at Mach numbers well above the low speed stall, the aircraft can accelerate beyond the flight placards during recovery. Close monitoring of aircraft attitudes in turns should be observed to avoid pitchup into inadvertent accelerated stalls.

RECOVERY FROM INADVERTENT STALLS

Recovery procedures from any stalled condition are standard: stick forward, add thrust, maintain heading with rudder, level wings, recover to level flight with adequate airspeed. Most common of the inadvertent stalled conditions is maneuvering stall or stall during a turn. Turning flight increases stall speed similar to the effect of increased weight. Both require increased lift for level flight. Any steady level turn requires that the vertical component of lift be equal to the weight and the horizontal component be equal to the centrifugal force. Stall speeds increase with bank angles and this increase becomes significantly more rapid at bank angles over 30°. See "Maneuver Limits" charts, Section V. This fact emphasizes the need to avoid steep bank angles at low airspeeds. Approach and entry into a stall is accompanied by mild, moderate, then severe buffeting. Stabilizer trim can be an important factor both in stall entry and stall recovery. An aircraft trimmed into a stall can be difficult or sometimes impossible

to recover unless the mistrimmed condition is corrected. The autopilot can cause a mistrimmed condition if a turn is established on autopilot and thrust is not increased to maintain airspeed. An aircraft trimmed to the best flare speed trim setting can be recovered with elevator only and does not require stabilizer trim until the stall recovery has been completed. An aircraft that has been trimmed into the stall will require proper stabilizer trim application to recover from the stall.

STALL OR CONTROLLABILITY CHECKS

Under some unusual aircraft configurations or conditions, it may be desirable to conduct a stall check or controllability check of the aircraft prior to landing. A check of the stalling speed should be made if the accuracy of the pitot-static system is seriously in doubt or if the fuel quantity indicating system becomes inoperative resulting in an unknown landing gross weight. If the aircraft sustains damage or has a control system malfunction which makes its controllability doubtful, its control characteristics should be determined at a safe altitude prior to descent for landing. It is recommended that a minimum altitude of 10,000 feet above the terrain or cloud cover be used for these checks. At these altitudes, the initial buffet speed will be increased, compared with those shown in figure 2-13, by a factor of 1% per 5,000 feet for altitudes above 10,000 feet pressure altitude.

WARNING

- When any controllability check is made due to doubtful control characteristics of the aircraft, the speed should not be reduced below the best flare speed for the aircraft configuration (approach speed for flaps up) in which the check is to be made. Under these conditions, the check should be discontinued immediately if any buffet or control problem is encountered.
- When the flaps are in a full down or intermediate position and flap damage exists, such as a missing segment, the best flare speed given in the Appendix may no longer apply. In this case, reduce speed slowly until the charted best flare speed is reached or until approximately one-half lateral control authority is required to maintain the wings level. Whichever of these speeds is higher should be used as the best flare speed.

Determination of Stalling Speed

If the airspeed indicators are suspected of giving inaccurate readings or if the fuel quantity gages are inoperative, a check of the initial buffet speed should

be made at an altitude of 10,000 feet above the terrain or cloud cover and the resulting speed compared with the appropriate (flaps up or down) initial buffet curve in figure 2-13. The percentage change in stalling speed can be determined and applied to the charted landing speeds. If the gross weight is unknown, comparing the initial buffet speed found with that shown on the charts will give the approximate gross weight directly. If the landing is to be made in a short period of time, this weight should be used to compute the landing data. Otherwise, the anticipated fuel consumption between the stall check time and the landing time can be subtracted from the weight found by the check.

NOTE

Figure 6-3 shows the increase in stall speed with increase bank angle and also shows the load factor in "g's" for various bank angles.

Determination of Aircraft Controllability

REDUCED LATERAL CONTROL OR LATERAL UNBALANCE. In case of reduced lateral control or of lateral unbalance, a control check may be made at an altitude of 10,000 feet above the terrain or cloud cover by putting the aircraft in the landing configuration and slowing it to the best flare speed (approach speed for flaps up configuration) shown on the **LANDING SPEEDS** charts in Part 9 of the Appendix. As the best flare speed (approach speed for flaps up) is approached, care must be taken to avoid slowing the aircraft to a speed at which full lateral control is required to keep the wings level. If control problems are encountered at a speed higher than best flare speed (approach speed for flaps up), the speed at which control is considered adequate should be noted. The landing approach should be made at 20 knots higher than the noted speed. This speed will allow the same maneuvering capabilities as the speed for a normal approach provides under normal conditions.

REDUCED LONGITUDINAL CONTROL OR LONGITUDINAL UNBALANCE. In cases of reduced elevator and/or stabilizer trim control or of longitudinal unbalance, a control check may be made at 10,000 feet by putting the aircraft in the landing configuration including airbrakes at position 4 and cautiously slowing the aircraft to best flare speed (approach speed for flaps up configuration). If the lowest speed at which the available stabilizer trim will hold the aircraft level without aid of the elevators is above best flare speed (approach speed for flaps up), the trim speed should be noted. The landing approach should be made at 10 knots above this noted speed. This margin will allow sufficient elevator control for the flare but the landing approach should be made as shallow as possible in order to minimize the amount of flare required for landing. Power should not be reduced until after completion of the flare.

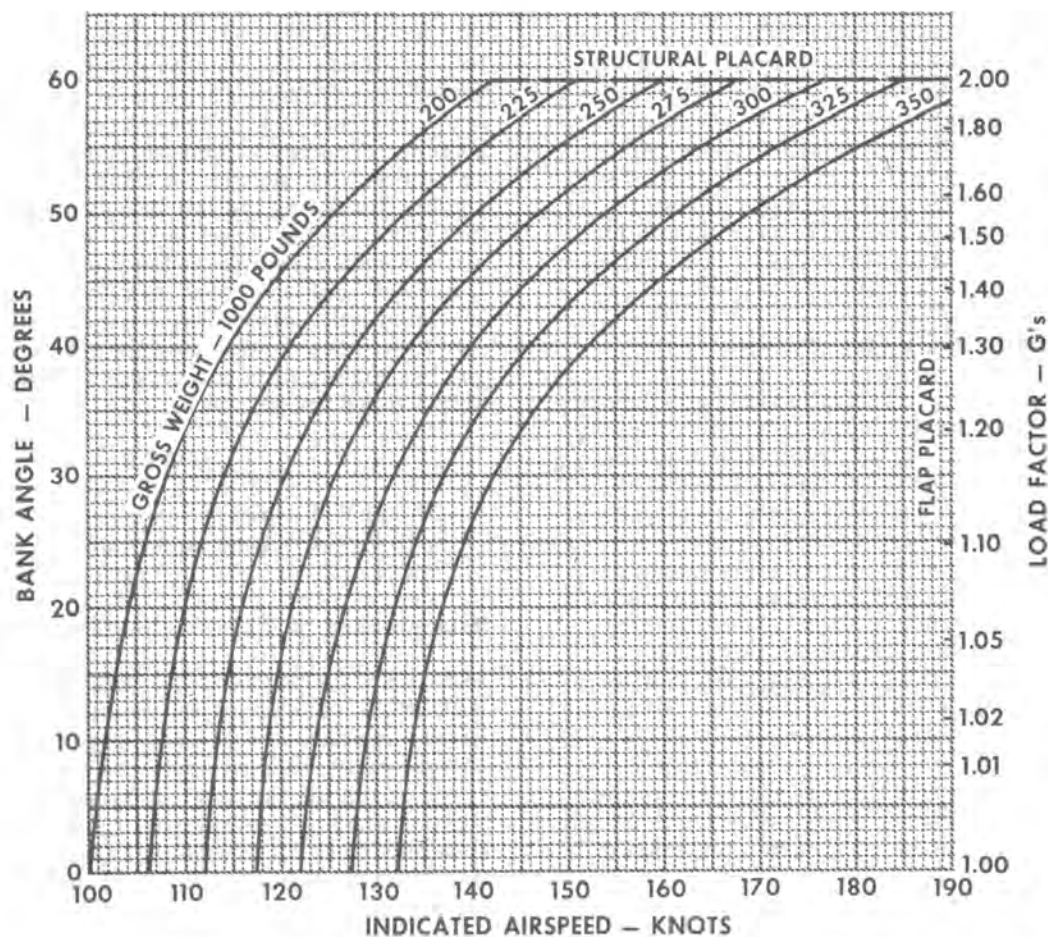
**NOTE**

Chart is valid from sea level to 10,000 feet with flaps down.

■■■■■■■ Airspeed at Initial Buffet vs Bank Angle

Figure 6-3.

AIRCRAFT DAMAGE. In cases where the aircraft has been damaged (such as damage to the wing leading edge, to the control surfaces, or with asymmetrical wing flaps) so that both controllability and stalling speed could be affected, a controllability check should be made prior to landing. The altitude for this check will depend on the extent of damage sustained. In any case, an altitude below 10,000 feet above the terrain or cloud cover is not recommended. The aircraft should be slowed to the minimum speed at which the pilot feels he has adequate control (controllability speed). This speed should not be lower than the speed at which the first indications of buffet are felt. If a pressure altitude above 10,000 feet is used, the airspeeds (for landing) found during the

check may be reduced by 1% for each 5,000 feet above 10,000 feet that the check is made. If the controllability speed is above the charted minimum touchdown speed, the final approach should be made at 20 knots above the controllability speed. If the controllability speed is below minimum touchdown speed, fly the normal final approach speed. For the case where initial buffet speed is reached before a controllability speed and the initial buffet speed checks the charted value, fly the normal final approach speed. If the initial buffet speed is above the charted value, the percentage change should be determined and applied to the normal final approach speed.

SPINS

WARNING

- Intentional spins are prohibited.
- The B-52 is critical in body side loading at high sideslip angles and the possibility of aft fuselage and empennage failure is almost certain for the fully developed spin condition. In the event of structural failure, emergency egress must be accomplished immediately.

The ability of an aircraft to spin is dependent on cg location, distribution of mass, basic aerodynamic configuration, and control deflections. Forward cg's tend to make spinning more difficult while aft cg's promote spinning. Extended gear and/or flaps have no appreciable effect on spin recovery; however, extended gear will reduce speed buildup during dive recovery after spin rotation stops. In a developed spin, an indicated airspeed of approximately 200 to 220 knots can be expected. The pilot should not interpret this as sufficient flying speed but should make certain that angle of attack is reduced to less than stall angle during recovery.

STANDARD SPINS

In case an inadvertent yaw or roll is encountered at low indicated speed, corrective rudder and lateral control plus nose down elevator should be immediately applied. In case a spin is entered accidentally, apply full opposite rudder immediately followed by forward stick to reduce angle of attack with neutral lateral control. Apply nose down trim and close the airbrakes if they are extended. Reduce throttles to idle. Extend the gear. To augment the rudder, apply throttles asymmetrically to develop thrust against the spin. As spin rotation stops, set all throttles in idle and neutralize rudder. Recover from dive attitude by retrimming. If excessive nose down trim was introduced during the spin recovery, airbrakes may be extended as required to effect recovery from the dive attitude.

NOTE

The airbrakes will give the fastest pitch control possible but should be used judiciously and in conjunction with the elevators and stabilizer trim so that design limit "g" forces are not exceeded and buffeting is not encountered. The airbrakes in position 6 produce maximum drag to reduce speed buildup in the steep nosedown attitude required to recover. Recommended dive recovery procedures apply following spin stop.

INVERTED SPINS

Recovery from an inverted spin must be accomplished by the least structurally hazardous method. Full rudder and lateral control against the spin must be applied and held until rotation stops and a zero "g" roll made to "right side up." Airbrake throttle and gear utilization should be accomplished as noted above. A dive recovery then must be made following recommended procedures.

FLIGHT CONTROLS

FLIGHT CONTROL SYSTEM COMPONENTS

The flight controls on this aircraft have been designed to give the aircraft good flying qualities at all speeds, altitudes and aircraft weights. This is accomplished through the use of powered elevator and rudder flight controls and a two-axis (pitch and yaw) stability augmentation system (SAS). The pitch and yaw SAS provides increased aircraft stability and structural life with improved handling qualities over non SAS operation. An artificial feel system is used in the rudder and elevator control systems to provide the desired pilot control forces throughout the speed range. Lateral control is provided by hydraulically operated wing spoilers. Longitudinal trim is provided by a hydraulically driven adjustable stabilizer.

Yaw SAS

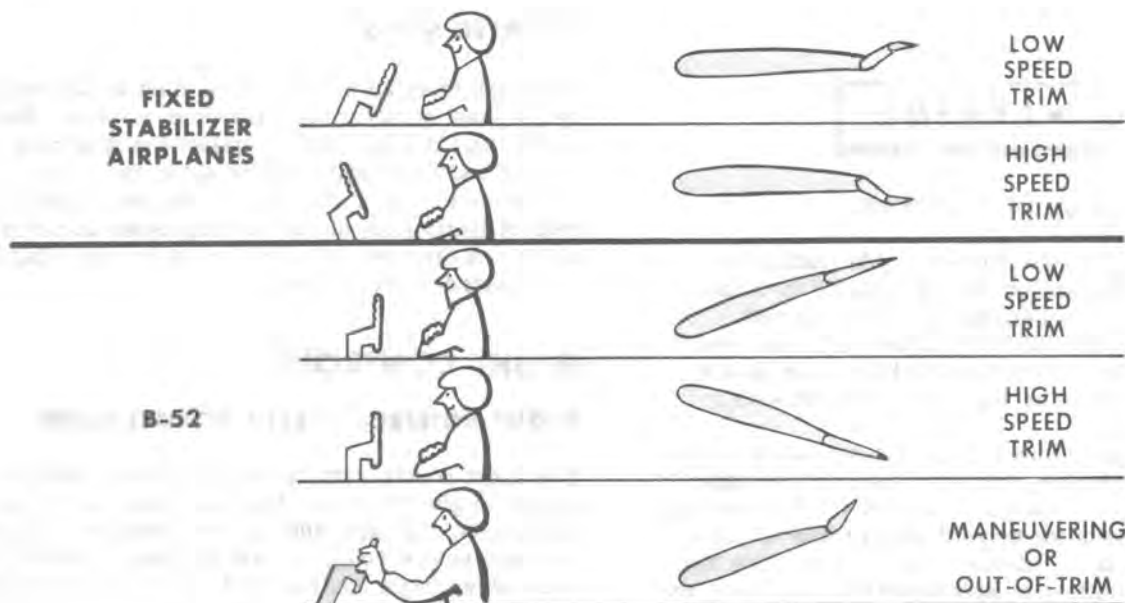
The yaw SAS commands the rudder to dampen aircraft oscillations in yaw as measured by triply redundant yaw rate and lateral acceleration sensors located in the fuselage. Electrical signals from these sensors are fed to the rudder hydraulic actuator. The yaw SAS can command maximum rudder deflections of 10°.

Pitch SAS

The pitch SAS commands the elevator to dampen aircraft oscillations in pitch as measured by triply redundant pitch rate sensors located in the aft portion of the fuselage. Electrical signals from these sensors are fed to the elevator hydraulic actuators. The hydraulic actuators can command maximum elevator deflections through the pitch SAS of 5°.

Artificial Feel System

To provide the pilot with control forces which are proportional to airspeed and control surface deflections, an artificial feel system is used with the rudder and elevator flight controls. This is necessary because the rudder and elevator control surfaces of this aircraft are hydraulically actuated and the aerodynamic forces acting on the control surfaces do not reach the control column and rudder pedals.



Pitch Control Systems

Figure 6-4.

Without the artificial feel system, the rudder and elevator could be moved by the pilot with equal ease at high and low airspeeds which is highly undesirable. The heart of the artificial feel system is a ram air pressure bellows, commonly called a Q-spring. The Q-spring is essentially a bellows which is pressurized from a ram air inlet on the leading edge of the fin. Use of ram air as the pressure source provides an increase in control forces with increased airspeeds which aids the pilot in limiting flight maneuvers at high speeds so that the structural limits of the aircraft will not be exceeded. The desired artificial feel characteristics have been obtained by proper design of the linkage between the Q-spring and the flight control. As with any aircraft, there is a practical limit to the control force which can be added without causing excessive control forces for normal operations. For this reason, no violent control movement should be made at high indicated airspeeds as it is still possible to overstress the aircraft with the artificial feel system installed.

CAUTION

- After disengagement of the autopilot, either automatically or manually, while operating in or after leaving an icing condition, check the elevator and rudder systems for artificial feel.
- Malfunction of the Q-spring system, either due to the inlet being plugged by icing or loss of ram pressure for other reasons, can result in loss of control forces. If, at any time,

abnormally light control forces are encountered in the elevators or in the rudder, abrupt maneuvers should be avoided so as not to structurally overload the aircraft.

- If, at any time, abnormally stiff controls are encountered and icing is suspected, descend to a warmer altitude. Icing or other blockage of the ram air duct can result in a pneumatic lock of the artificial feel system.
- If a landing must be made with stiff controls, see "Elevator Control Malfunction" under "Flight Control System Emergency Operation," Section III.

NOTE

Springs in the mechanical linkage of the artificial feel system will provide partial elevator and rudder feel in the event Q-spring pressure is lost.

Control Column Balance

Balance weights are installed on each control column below the pivot point to automatically dampen unstable oscillations of the longitudinal (pitch) control system which can be induced under certain flight conditions. These oscillations are divergent and if allowed to continue could result in undue stress and/or loss of control of the aircraft. If such oscillations are encountered, they can be stopped by a slight pull force on the control column with a reduction in airspeed. The pendulum action of the balance weights aids in control centering.

FLIGHT CONTROL SYSTEM CHARACTERISTICS

Pitch Control

Pitch control is provided by a 10% chord elevator located on the trailing edge of the stabilizer. The elevator is positioned by hydraulically powered actuators which respond to mechanical control inputs from the column, inputs from the autopilot elevator servo motor, electrical signals from the pitch SAS, and combinations of electrical and mechanical inputs. Longitudinal trim is provided by an adjustable stabilizer. Actuation of the trim switch causes the stabilizer to move at the rate of 0.60° per second. The stabilizer may be actuated also by a manual trim wheel, which results in one degree or unit of stabilizer deflection for each revolution of the trim wheel. In either case, operation of the stabilizer trim system is accompanied by rotation of the manual trim wheel. Basically, the stabilizer is intended as a trimming device while the elevators are intended for maneuvering at a given speed and control for small speed changes. The elevators are adequate for maneuvering purposes and should be used whenever possible. The stabilizer, in conjunction with the elevator, should be used to counteract all trim changes occurring, such as when using the landing gear, flaps, and airbrakes. In general, use of the stabilizer as the primary control is not considered desirable. More specifically, use of the stabilizer as the primary control in steep turns is undesirable because in turn recoveries, the elevators may not be able to counter the combined pitchup used to establish the turn and the pitchup moment produced from the lateral control spoilers.

PITCH SAS. The pitch SAS assists the pilot by automatically providing elevator inputs which help reduce aircraft pitch oscillations. The SAS inputs to the elevator actuators do not result in movement of the control column. A noticeable improvement due to pitch SAS occurs during air refueling where the magnitude of pitch oscillations and aircraft pitchup due to lateral control inputs is reduced with the pitch SAS in operation. Pitch SAS also assists the pilot during configuration changes, such as airbrakes and flaps, if he lags trim changes and allows a pitch rate to develop. In the absence of corrective action by the pilot, the pitch SAS acts to momentarily reduce the pitching induced by these configuration changes.

PITCH CONTROL SYSTEMS. To better understand the difference in trim technique between a fixed stabilizer aircraft and this aircraft, it is necessary to consider one fact; when any aircraft is flying in equilibrium, the pitching moment about the center of gravity is zero and no change in pitch rate can exist. An aircraft in equilibrium does not necessarily have to be trimmed to a "hands off" condition. It means

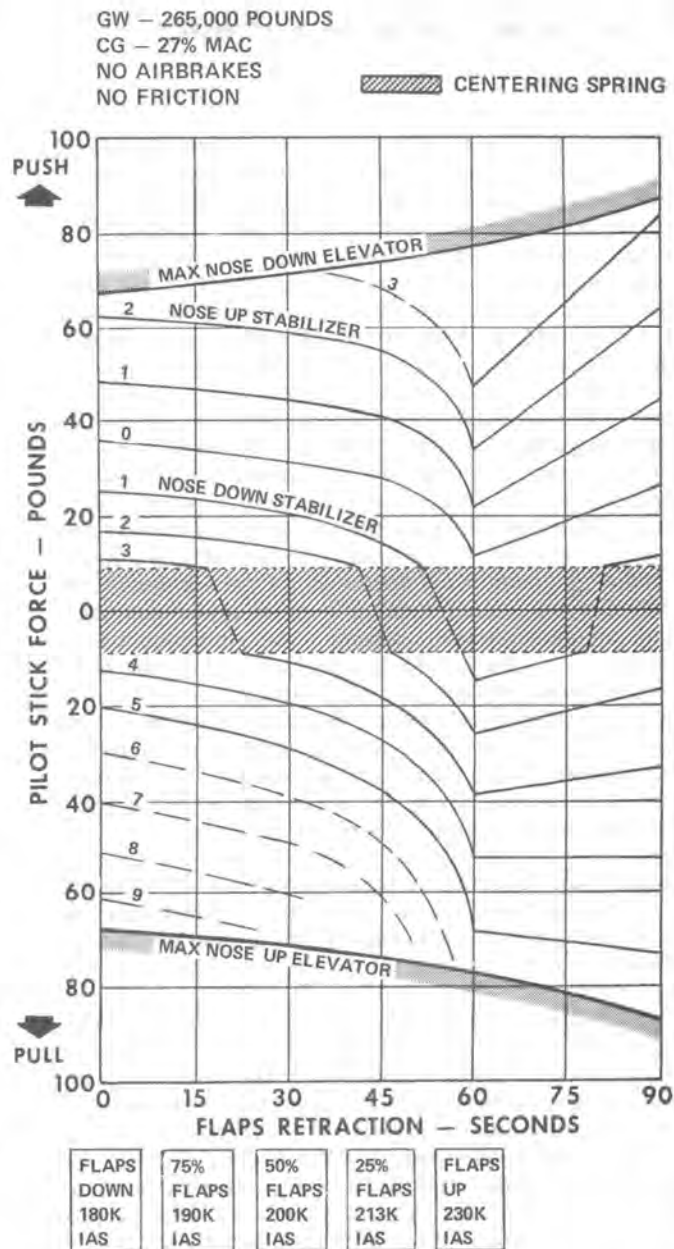
only that a tail load is being developed by the stabilizer and elevator control system that is just sufficient to balance the aircraft and maintain a desired attitude or flight path. An aircraft having a fixed horizontal stabilizer is placed in trim by the pilot positioning the elevator with the control column to maintain the desired attitude as shown in figure 6-4. Any forces the pilot might be holding on the control column can be eliminated by means of the trim tab system but the control column and elevator remain in their original position. The pilot can detect the operation of the trim system by a lightening of forces as control column position is held constant. This aircraft is placed in trim by the pilot positioning the elevator through the control column. When the stabilizer is moved to relieve the force being held, the pilot detects the movement by a change in attitude rather than in reduction of force and must allow the column to return to neutral to prevent an attitude change and realize a force reduction. This aircraft can only be in hands off trimmed flight when the control columns are neutral and the elevators are faired with the horizontal stabilizer as shown in figure 6-4. To sum it up, holding a constant control column position while trimming results in a change in attitude with no change in force--but in a fixed horizontal stabilizer aircraft, this results in a change of force with no change in attitude. This difference in trimming must be thoroughly understood for safe operation of this aircraft.

STABILIZER JACKSCREW CAPABILITY. The structural limits of the horizontal tail and its components will not be exceeded when operating within the flight placards of the aircraft; however, it is possible to exceed the operating capability of the jackscrew hydraulic mechanism if abnormal trim procedures are used. The stabilizer jackscrew mechanism is stalled because of the high forces imposed on it due to abnormal trimming. This takes place only at speeds very near the structural placard speed when large push forces are held on the stick by the pilot. The jackscrew cannot be stalled by a pull force under any circumstances. In case the aircraft is in this very unusual condition (near the placard airspeed with large push stick forces), the pilot can do one of two things to free the stabilizer hydraulic trim mechanism. One is to momentarily reduce elevator deflection while operating the trim button. This reduces the force on the jackscrew and allows the mechanism to start. The other method is to momentarily reverse the trim mechanism by operating the button in the wrong direction before pushing it in the correct direction. This relieves friction and allows starting against a higher load. If placard speeds are inadvertently exceeded, the aircraft must be kept trimmed as closely as possible with the stabilizer, to prevent the stabilizer from being stalled.

ELEVATOR FEEL CHARACTERISTICS. The elevator feel force required to accomplish a maneuver varies with control column deflection and airspeed. The major contribution to stick force is produced by the Q-spring, with secondary forces being contributed by mechanical springs. The mechanical springs are installed to produce a more positive centering of the elevator controls at all airspeeds and to increase trim stimulus through higher stick forces. In the event Q-spring pressure is lost, the tension provided by the mechanical springs will provide partial feel. The outboard sections of elevators have a simple type of aerodynamic balance while the inboard sections have the compound type of aerodynamic balance. The elevator control system provides control force gradients and feel characteristics that should prohibit inadvertent maneuvers. The elevator control force necessary to pull a maximum "g" loading, by performing some normally executed maneuver, is approximately 20 to 40 pounds. Elevator control forces as high as 80 to 120 pounds may be encountered at heavy weights with forward cg locations. At low airspeeds, the pilot can obtain full elevator without encountering excessive stick forces. Therefore at low airspeeds it is important to keep the aircraft in trim with stabilizer because high forces are not present to warn the pilot of a mistrim condition and the resulting loss of elevator authority.

ELEVATOR EFFECTIVENESS. The total elevator authority in the low speed flight regime is essentially independent of the flap configuration and is equivalent to approximately 13 units of stabilizer trim or 100% of the total stabilizer authority. The maximum elevator authority significantly reduces as the aircraft speed is increased. The elevator authority, in terms of equivalent stabilizer travel at the high speed structural placard may be reduced to as little as 1/3 of the authority available in the slow speed flight regime. The elevator authority is essentially the same for the noseup or nosedown direction. A row of vortex generators installed on the upper and lower surface of the stabilizer increases the energy of the air in the boundary layer which passes over the elevators. This results in the relatively high elevator authority for the low speed flight regime.

The longitudinal control power is a function of center of gravity location for an aircraft flying at a constant altitude and airspeed. A lesser amount of elevator is required to maneuver the aircraft at an aft center of gravity than at a forward center of gravity. A noseup mistrim occurring with an aft center of gravity will cause the aircraft to be trimmed into a higher load factor maneuver than for a forward center of gravity. The elevator effectiveness is sufficient to adequately maneuver the aircraft under all conditions for which trim is established by the stabilizer. The elevator is particularly beneficial



Stick Force Required During Flap Retraction

Figure 6-5.

in countering the noseup pitching moments induced by the extension of airbrakes and flaps and the rapid application of thrust such as during go-around. The elevator is also sufficiently effective to permit the aircraft to be landed by means of the elevator system alone should the stabilizer actuating system become

inoperative. See figure 6-5 for an illustration of the stick forces required during flap retraction for different stabilizer trim settings.

WARNING

When holding full noseup elevator, the pilot must be certain that he is engaging the trim button in the noseup position. Due to the position of the control column, he may be pushing in on the trim button or down on the trim button guard.

STABILIZER TRIM FAILURE. See "Flight Control System Emergency Operation," Section III, for detailed instructions pertaining to stabilizer trim failure.

NOTE

A temporary failure may be experienced in the stabilizer trim system under certain conditions of temperature and humidity if the trim followup screw heater elements are inoperative. This condition would result from frost or ice buildup on the followup screws which could jam the followup screw and cause the stabilizer trim system to be inoperative both electrically and manually until the frost or ice had melted.

Lateral Control

Lateral control is provided by seven spoiler segments on each wing. Lateral trim is provided by electrically repositioning the entire lateral control system to a new neutral point of the system centering springs. At normal operating speeds and altitudes, roll rates are quite high (figure 6-6). Care should be exercised that roll corrections during instrument flying are not excessively applied nor in the wrong direction. The highest roll rates at any altitude will occur at approximately 250 knots IAS. Beyond this speed, hydraulic pressure is insufficient to obtain full deflection of the spoilers so that roll rates will decrease. However, because of the location of the spoilers, roll rates will not decrease to zero. (Reversal will not occur at any speed.) Use of rudder in the direction of the roll during initiation of the roll at low speeds tends to improve the roll response characteristics.

A loss of lateral control authority will occur in the low speed flight regime as the aircraft approaches a stall. The decay of lateral control, for the flaps down configuration as the speed is reduced below best flare speed, is shown in figure 6-2. This loss in lat-

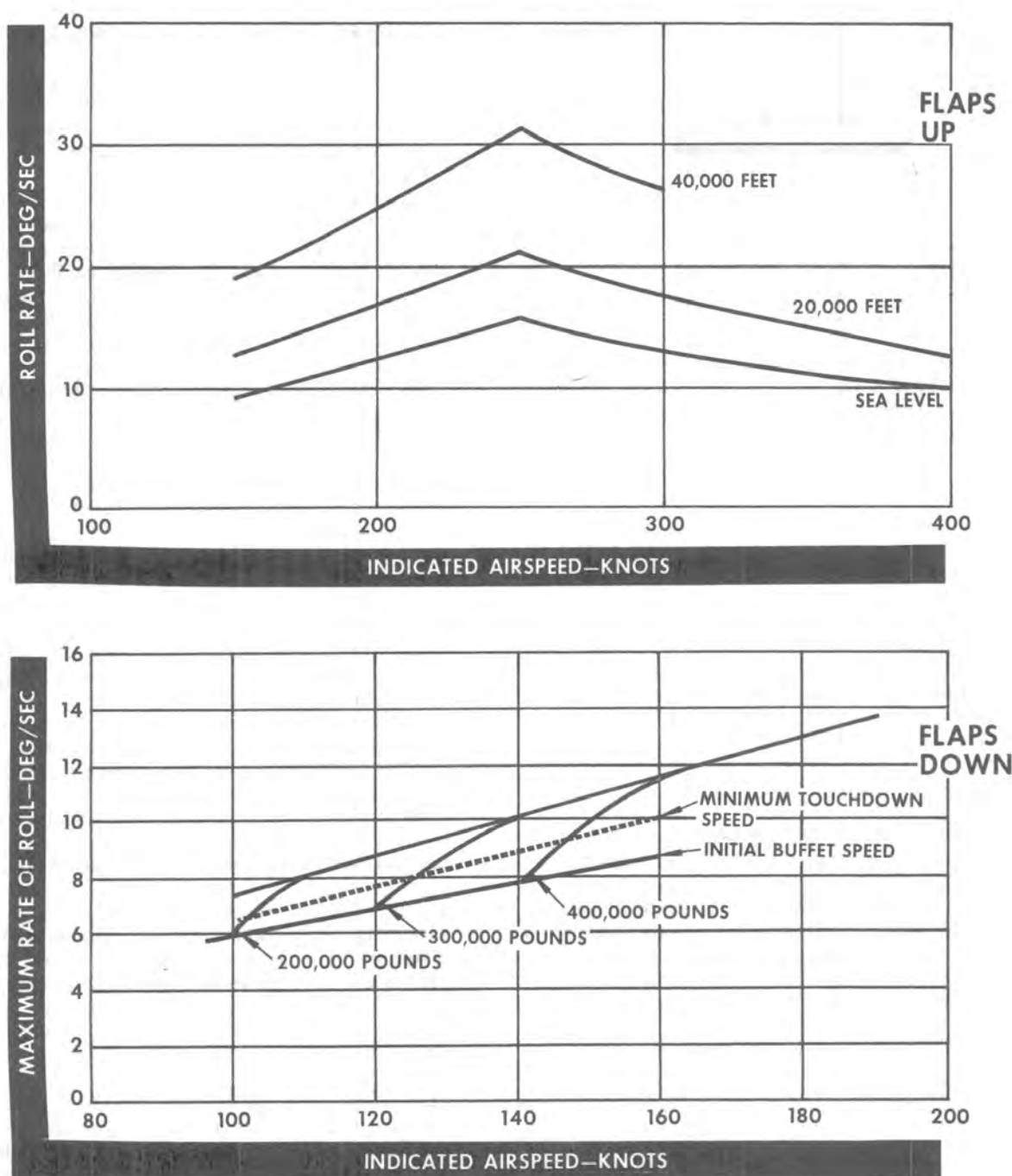
eral control results from airflow separation on the wing ahead of the spoilers at the high angles of attack associated with wing stall. In the low speed flight regime where lateral control authority is severely reduced, control inputs in correcting bank angle should be made primarily with the rudder assisted by whatever lateral control is available.

The maximum roll rate capability of the flaps down configuration is slightly higher than that for the flaps up configuration of the same airspeed and altitude. However, when a landing must be made flaps up, the roll rate capability during the approach will be essentially the same as for a normal flaps down approach due to the effect of the higher flaps up airspeed.

LATERAL UNBALANCE. During the landing operation, roll control can be marginal in at least one direction when large amounts of lateral unbalance exist. There is a minimum speed at which roll control can be maintained. As speed decreases below the point where more than 50% lateral control is required, the lateral control is used up rapidly. Lateral control can be augmented during such conditions through use of rudder which will provide a sizeable rolling moment from the sideslip induced. It is not desirable, during normal operations, to deliberately enter regions where more than 50% of lateral control is required for lateral balance. Part 9 of the Appendix shows minimum landing weight for various amounts of unbalance. This data is based on the use of not more than 50% lateral control and illustrates the advantage of higher touchdown speeds obtained by flaps up landings. Additional advantage can be gained through the use of airbrakes which will allow simultaneous contact of the landing gear at higher than normal touchdown speeds (see figure 6-7A).

SPOILER SYSTEM. Seven spoilers are provided on each wing, each having its own hydraulically operated actuator. The three inboard spoilers are interconnected and operate as one unit and the four outboard spoilers are interconnected and operate as one unit. Wheel travel of 80° will give full extension of the spoilers.

SPOILERS AS A LATERAL CONTROL DEVICE. The extension of spoilers on one wing decreases the lift produced by that wing and also increases the drag. The loss of lift on the wing with the spoilers extended causes it to rotate downward, thereby producing a rolling moment in that direction. The addition of drag causes a slight yawing motion in the direction toward the wing with the spoilers extended which assists the pilot in bringing the wing down or in starting a turn. With application of roll control, a pitchup is induced directly proportional to the amount of spoiler deflection used. This pitchup is favorable during entry into a turn, but unfavorable in coming out of a



Maximum Roll Rates

Figure 6-6.

turn. For large wheel deflections, the pilot will have to make small push corrections at the entry of a bank and large push corrections at the termination of a bank to prevent inadvertent nose high attitudes and

pulling excessive "g's". Spoiler authority for a fixed amount of wheel deflection is dependent on the airbrake position selected. The greatest spoiler authority for a given amount of wheel deflection occurs when the airbrakes are in position 4 (see figure 6-6A).

The main reason for this characteristic is the pickup schedule of the spoilers which allows the spoilers on one wing to reach full deflection nearly simultaneously with spoilers on the opposite wing being fully retracted. This characteristic of the spoiler system is especially important since it allows the pilot to obtain a large portion of the spoiler authority with small control wheel inputs, thereby increasing his ability to make roll adjustments.

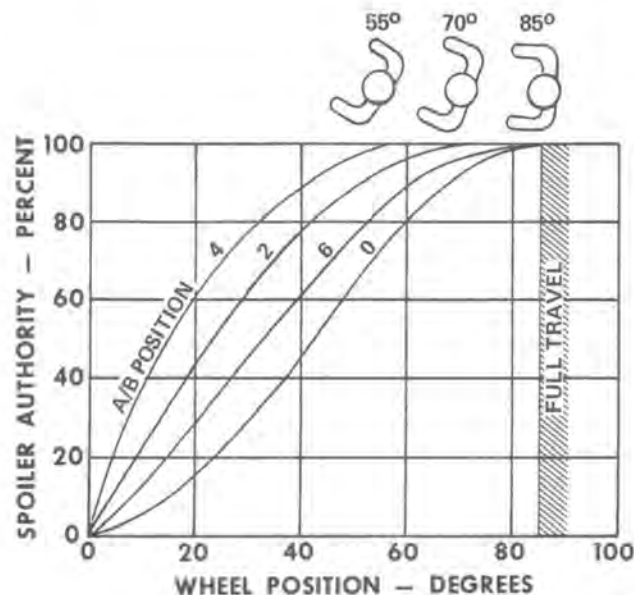
LATERAL TRIM SYSTEM. Control of lateral trim is through a trim button on the control wheel which operates a single electric trim motor. The motor is connected by cables to a trim mechanism and centering spring located in each wing. Actuation of the trim motor repositions the centering springs and the entire lateral control system to a new neutral position.

AIRBRAKES. All of the spoilers are also used as airbrakes. The extension of the airbrakes is controlled by an airbrake lever located at the pilot's station. In the case of simultaneous actuation of spoiler and airbrake controls, the spoiler groups on the wing requiring spoiler action will rise to the angle called for by the spoiler control input, plus the angle called for by airbrake control input up to the maximum. At the same time, the spoiler groups on the opposite wing will rise to the angle called for by the airbrake control input minus the spoiler control input. With airbrakes in position 6, a subsequent application of spoiler control input will result in a proportionate lowering of the spoilers on the wing which will rise and a proportionate raising of the wing which will rise and a proportionate raising of the outboard spoilers on the wing which will lower. A full application of spoiler control will override the airbrake input to the extent of completely lowering the spoilers on one wing. Such action causes a maximum lift differential between the two wings, resulting in a roll in the direction toward the wing producing the smaller lift.

NOTE

Application of airbrakes will tend to pitch the aircraft noseup. The pitching moment produced by airbrake extension can be used to augment elevator authority in counteracting an undesirable nosedown aircraft attitude.

SPOILER AND AIRBRAKE BUFFET. Flight testing with the spoilers and airbrakes in many different configurations and positions has been accomplished over the entire flight envelope of the aircraft and no appreciable buffet has been encountered. Mild buffet will occur at position 2 or 3 with flaps up; therefore, position 4 should be used for all normal descents. At high altitudes, an abrupt buffet may be noted just as the spoilers begin to extend if the control wheel is rotated very rapidly but this opening shock has no damaging effects.



Spoiler Authority
With Wheel Position

Figure 6-6A.

CAUTION

As the airbrakes are extended, a noseup pitching moment is produced. This pitchup tendency is more pronounced when the aircraft is in the clean configuration than when the flaps and gear are down. Therefore, to compensate for this pitchup tendency as airbrakes are extended, nosedown elevator or stabilizer trim must be applied. The amount of corrective action necessary becomes larger with higher altitude and higher indicated airspeeds. Full airbrake application at speeds up to 250 knots IAS requires approximately 3.5 units of nosedown stabilizer trim or a major portion of the available nosedown elevator authority when the aircraft is trimmed hands off prior to the application of full airbrakes. The airbrakes should not be moved rapidly through their full travel since a sufficient amount of elevator may not be available to counteract the spoiler pitching moment produced. The greatest trim change between airbrake positions is between positions 2 and 4. This trim change is equivalent to two units of stabilizer trim and is approximately three times that associated with changing the airbrakes from position 0 to 2 or from position 4 to 6. By moving the airbrake lever not more than two positions without retrimming the aircraft, sufficient elevator will be available to stop the pitching tendency.

SPOILER AND AIRBRAKE BLOWDOWN. At indicated airspeeds in excess of 250 knots, the airloads acting on spoilers raised to the full up position (position 6) are greater than the force available from the spoiler actuators. Obviously, under these conditions, the spoilers will be unable to maintain the normal extension of position 6. This reduction of the spoiler or airbrake angle by airloads is termed "blowdown." The greater the speed above 250 knots IAS, the farther the spoilers will blow down. For example, at the maximum airspeed the maximum extension is reduced to approximately 20°. During blowdown, oil displaced from the hydraulic actuators exits through relief valves. Since it is difficult to adjust several relief valves to open at exactly the same pressure, blowdown may occur in one bank of spoilers sooner than in another. Such an occurrence will cause a rolling moment to be applied to the aircraft which requires compensating lateral control. During asymmetrical airbrake blowdown from the full airbrake position, the pilot will feel a "dead spot" in control wheel movement. The first portion of control wheel travel will have greatly reduced effect and considerable movement will be required to produce roll. A lag between the control wheel position and the spoiler position resulting from blowdown causes the dead spot. The most extreme condition will require control wheel rotation of approximately 55° to obtain lateral control from the spoilers. Depending on aircraft speed, control forces required to reach the required wheel deflection may be greater than that obtainable with one hand operation of the control wheel. By using less airbrake at the higher speeds, the dead spot will be reduced or possibly eliminated. Airbrake position 6 is satisfactory for speeds up to 305 knots IAS.



At speeds above 305 knots IAS, do not select an airbrake position greater than position 4 since an excessive dead spot may occur.

MALFUNCTION OF SPOILERS OR AIRBRAKES. For instructions pertaining to malfunction of spoilers or airbrakes, see "Landing Emergencies," Section III.

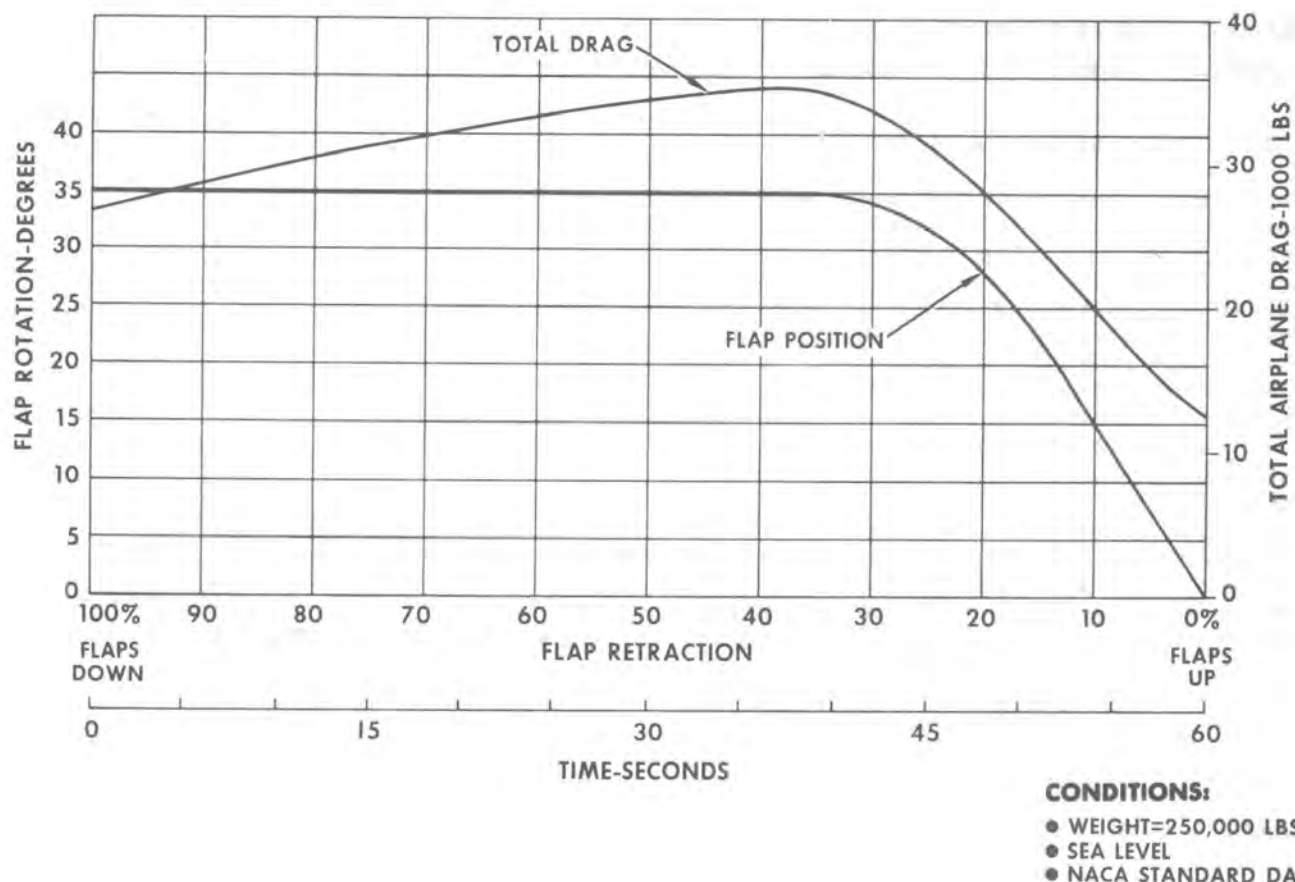
Directional Control

Directional control is provided by a 10% chord rudder located on the trailing edge of the fin. Directional trim is provided by mechanical adjustment of the neutral point of the artificial feel system. The rudder is positioned by a hydraulically powered actuator which responds to mechanical control inputs from the rudder pedals, inputs from the autopilot rudder servo motor, electrical signals from the yaw SAS, and combinations of mechanical and electrical inputs. The rudder feel force is developed by two Q-springs and mechanical linkage. The incorporation of a yaw SAS effectively dampens lateral-directional (dutch roll) oscillations.

RUDDER EFFECTIVENESS. The rudder control forces during normal operations are moderate at all airspeeds and altitudes. At airspeeds approaching minimum touchdown speed, the rudder becomes the primary flight control system to control an asymmetric thrust condition, especially since the lateral control effectiveness deteriorates as speed is reduced below best flare speed. See "Lateral Control" this section. The use of full rudder is mandatory to realize the charted Flight Manual minimum control speeds. Failure to use full rudder to counter an engine out condition can increase the minimum control speed for one outboard engine by approximately 25 knots.

RUDDER LIMITS. Structural strength of the fin is adequate to allow use of rudder trim to accomplish the trimming required for asymmetrical power operations; however, abrupt rudder manipulations must be avoided when using more rudder trim than indicated in "Rudder Trim Limitations," under "Airspeed Limitations," Section V. These limits were to aid the pilot in staying within the structural limits of the vertical fin. The average thickness of the fin is 2% less than the average thickness of the wing. This was done to insure that the fin would not reach its critical Mach number before the wing. Therefore, no buffet will be encountered resulting from the fin at speeds below that at which the wings start to buffet. Any tendencies for the aircraft to get into the steady combined roll and yaw oscillation commonly known as "dutch roll" are adequately canceled by the yaw SAS. If conditions become such that very rough air is encountered, it will be the natural reaction for the pilot to attempt to assist the yaw SAS in making the necessary corrections. This may be done by application of either lateral control or rudder as required. On aircraft BA, an Electronic Autopilot Rudder Limit Switch (EARLS) has been installed to reduce the autopilot authority in the yaw axis which achieves a safety margin to prevent possible structural overload as a result of large rudder commands resulting from sudden gust side loads.

YAW SAS. The yaw SAS provides a very significant improvement in damping the lateral-directional oscillations known as dutch roll. For typical conditions of high altitude cruise, low level high speed, and landing approach conditions, dutch roll oscillations are almost eliminated by the yaw SAS. This is particularly beneficial during air refueling, precision approaches, and whenever precise aircraft control is required. The yaw SAS, unassisted by rudder pedal deflections by the pilot, provides sufficient rudder deflection to coordinate rolls performed with one-half or less control wheel deflection. This is also of particular benefit during instrument approaches and manual air refueling. The yaw SAS also assists the pilot when abrupt loss of engine thrust, particularly outboard engines at high power settings, causes a yaw rate to develop. In the absence of corrective action by the pilot, the yaw SAS acts to momentarily reduce the yawing induced by asymmetric thrust. The SAS inputs to the rudder actuator do not result in movement of the rudder pedals.



Wing Flap Characteristics

Figure 6-7.

Wing Flap Characteristics

The wing flaps are designed so that the highest lift-drag ratio is achieved in the 100% down position. For this reason, full flaps are always used for both takeoff and landing. Extending the flaps causes an increase in lift which required the pilot to lower the nose of the aircraft to hold altitude. The converse occurs when the flaps are retracted. During climb-out while accelerating the aircraft to 180 knots IAS in preparation for flap retraction, a considerable amount of nosedown trim may be required to maintain zero stick force. During the period of flap retraction, trim requirements change in the opposite direction, necessitating noseup trim if zero stick forces are to be maintained. During flap retraction, most of the trim requirement will be noticed between the 37 1/2% extended position and the full up position.

Approximately two units of the trim change occurs during this portion of the flap retraction travel. Only about one unit of trim change occurs during the first 62 1/2% of the flap retraction. An out of trim condition may exist during the last portion of flap retraction if the pilot lags the rapid trim change rate occurring during this period. The elevator is the primary pitch control during flap operation; however, the stabilizer trim should be used to maintain the control column close to a zero stick force position. Figure 6-7 shows the rotational position of the flaps in relation to their percent of retraction. During flap retraction, drag builds up during the retraction of the 37 1/2% position and drops off as flaps are fully retracted. The effect of wing flaps on the stalling characteristics is discussed under "Stalls," this section.

FLIGHT CHARACTERISTICS UNDER VARIOUS SPEED CONDITIONS

THRUST-DRAG SPEED STABILITY

The B-52 has a thrust-drag type speed stability. If the flight condition is such that the aircraft is flying on the front side of the drag curve, i.e., faster than the speed for minimum drag (best endurance) at constant altitude, such as point A on figure 6-7A, then there will be a thrust-drag speed stability. That is, an increase in drag due to a gust or control input will cause a deceleration that will reduce the speed to a new stabilized speed shown as point A'. If the speed is less than the speed for minimum drag, then the additional drag due to gusts or control inputs will again cause a deceleration but a stabilized speed will not be reached because the excess drag gets greater as speed reduces causing the problem to be aggravated. Point B is an example of this case and it illustrates the fact that if flying below the minimum drag speed, the same fuel flow that existed at point A will result in a thrust-drag speed instability. In this situation, the aircraft will continue to decelerate further and stall will result unless power is applied or the nose is lowered enough to develop an accelerating force.

LATERAL TRIM

When all engines are developing the same thrust and there is no lateral unbalance due to fuel load, small amounts of lateral and rudder trim are required to maintain "hands off" in level flight. Normally, a correctly rigged aircraft meeting the above conditions will need no more than 1 unit of rudder and 2° of spoiler deflection during cruise conditions. When the landing gear is extended however, the aircraft will yaw and fly slightly left wing heavy. This is caused by the asymmetrical location of the landing gear doors on the fuselage. Approximately 4 units of rudder trim may be required to retrim the aircraft. If desired, the aircraft may be trimmed by the use of a slight amount of asymmetrical thrust. In the flaps down configuration, the control wheel forces required to balance the wing heavy tendency are so small that the condition may not be noticed. The correction used may vary with pilot preference and flight conditions.

TAKEOFF

Stabilizer Trim

If the normal takeoff procedure is used, no unusual characteristics will be experienced. The stabilizer trim settings as given in Parts 2 and 3 of the Appendix have been calculated so that, with the control column partially back, the aircraft will unstick at the proper speed at the planned ground run distance. With these stabilizer settings, it is assumed that the pilot can use stabilizer trimming at the time when the trim changes are greatest; that is, to hold nose-down trim during landing gear retraction, during climbout of ground effect, and during acceleration to best flaps down climb speed. For dry takeoffs, the

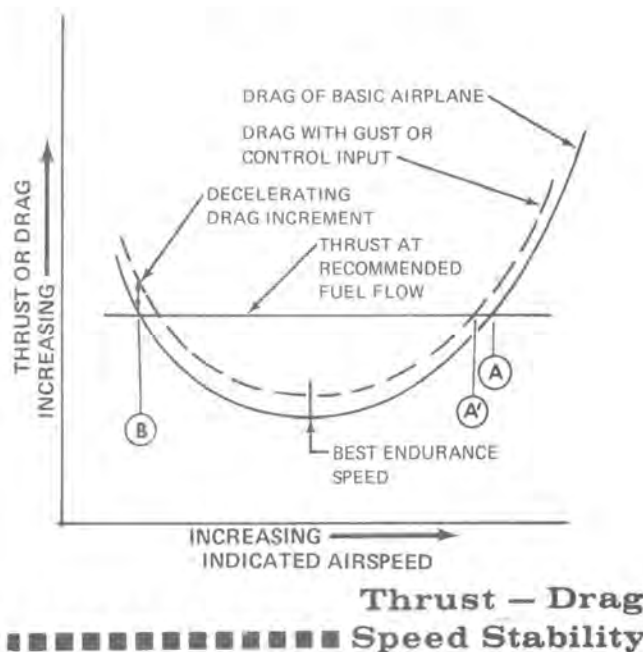


Figure 6-7A.

stabilizer should always be set to the position corresponding to the cg location and the aircraft gross weight at takeoff. For wet takeoffs, the stabilizer should always be preset to the position corresponding to the cg location and the aircraft gross weight after 50% of the water has been used. If too much nose-down trim is used, the aircraft will require a longer ground run and the rear gear will lift off the runway first. This can result in a difficult steering situation, particularly if any crosswind exists. A small amount of additional nosedown stabilizer trim provides a smoother takeoff transition between the ground run and airborne flight and also reduces the stabilizer trimming needed to obtain flaps down climb speed. However, more nosedown stabilizer trim than the manual calls for may result in a ground run penalty of 10% for each additional unit of nose-down trim. It is imperative during flap retraction that the aircraft be kept trimmed to a zero stick force condition. This is especially important during the last 20% of flap retraction. If a nosedown mistrim of 2.5 units of stabilizer (approximately 30 pounds pull column force) is allowed to exist at the start of flap retraction and no retrimming of the stabilizer is made, the elevator authority is marginal until the airspeed is above approximately 250 knots (figure 6-5). During the latter portion of flap retraction, the pilot cannot keep up with the trim requirement changes using the manual trim system. However, the aircraft can quite easily be kept in trim with the stabilizer trim button.

NOTE

Proper pilot technique requires that stabilizer trim be used to reduce stick forces during flap retraction and at any other time when trim is changing rapidly.

Engine Failure

See "Engine Failure," in Section III.

CLIMB

No unusual characteristics should be experienced during the climb. Adequate rudder control is available to handle the loss of one outboard engine with the remaining engines at military rated thrust. During initial climbout at altitudes near sea level, the rudder control in combination with bank angle is sufficiently powerful to maintain zero sideslip with two inoperative outboard engines on the same side at indicated airspeeds of approximately 200 knots and higher, with the remaining good engines at military rated thrust. As much rudder trim and lateral trim as required may be used to trim out the asymmetrical thrust, but abrupt rudder manipulation must be avoided if the trim used is greater than recommended in "Rudder Trim Limitations," Section V.

CRUISE (LEVEL FLIGHT)

During a maximum range cruise operation, no unusual characteristics are to be expected if the recommended speeds and altitudes are maintained. However, if high airspeeds and/or high altitudes are to be flown, then buffeting or "tuck under" may be encountered.

DESCENT

The normal descent procedure will be used for most descents and requires that the landing gear be extended and airbrakes be extended to position 4. During the transition period between cruise and descent, application of airbrakes will cause a pitchup and lowering of the landing gear will cause a slight pitchdown. If the airbrakes are extended to position 4 at a constant cruise speed, approximately 2.6 units of aircraft nosedown trim will be required to compensate for the noseup pitching moment produced. Lowering the landing gear at speeds near the gear extension placard limit requires approximately 1 unit of aircraft noseup stabilizer trim to compensate for the nosedown pitching moment produced. Therefore, if the gear and airbrakes are extended at approximately the same time, less change in stabilizer trim will be required. Airbrakes normally should be extended slowly to allow sufficient time for the stabilizer trim to keep up with the trim requirements. In case the emergency descent procedure is used, the descent speed shown by the chart in Part 8 of the Appendix will take the aircraft down the edge of the buffet region. Caution should be observed not to make any sudden maneuvers which will place the aircraft within the buffet region. See "Buffet," this section, for additional information on this subject.

APPROACH

The main change in aircraft attitude during the approach will be encountered when the flaps are extended. The first 37 1/2% of flap extension causes the greatest trim change. Approximately 2 units of

aircraft nosedown trim is required during this interval and an additional 1 unit of nosedown trim is required during the remainder of the extension. When airbrakes are extended to position 4, an additional noseup pitching moment is produced requiring approximately 2.8 units of nosedown stabilizer trim.

FLARE

The aircraft should be trimmed during final approach so as to maintain near zero control forces on the elevator. Throttles are gradually retarded when flare point is approached and further reduced when over the overrun and flare is being completed. As back pressure is applied to the elevator during flare, stabilizer trim should be utilized to maintain near zero control forces until a landing attitude is attained. The elevator then becomes primary for attitude control to touchdown. Continued application of noseup trim after touchdown attitude has been established is not recommended since it will result in an excessive noseup trim condition in the event of unplanned go-around. In cases of forward cg's and/or heavy gross weights, gradual power reduction should be made as flare is entered and continued until touchdown.

LANDING

After touchdown, adequate directional control can be maintained by the rudder at the higher speeds and by forward wheel steering at the lower speeds. The effectiveness of lateral control for maintaining a wings-level attitude will decrease as the aircraft slows down but the tip gear will maintain adequate clearance for the nacelles and tip tanks. In case a strong crosswind exists, the landing can be accomplished quite easily using the steering and crosswind crab system. In order to obtain most effective braking, it is desirable to keep the wings as level as possible during the braking roll. Limit braking to no more than that required to stop on the available runway so that brake life can be increased. The speed corresponding to a simultaneous gear touchdown attitude, shown in figure 6-7B, is dependent on both the airbrake position and the aircraft gross weight. The speed for simultaneous gear touchdown increases with higher airbrake positions but is always above the minimum touchdown speed. The speed range between the simultaneous touchdown speed and the minimum touchdown speed can be thought of as a touchdown speed margin. For a typical landing gross weight of 250,000 pounds this speed margin, with airbrakes in position 2, is only 5 knots. Selection of airbrake position 4 will increase this speed margin to 11 knots and significantly reduce the possibility of a poor landing due to a forward gear first ground contact. The desirability of having a large touchdown speed margin is one of the main reasons for selection of airbrake position 4 as the normal aircraft landing configuration. The stopping distance charts have been computed based on the minimum touchdown speeds and it should be noted that the actual ground roll will be longer if the touchdown is made at higher speeds.

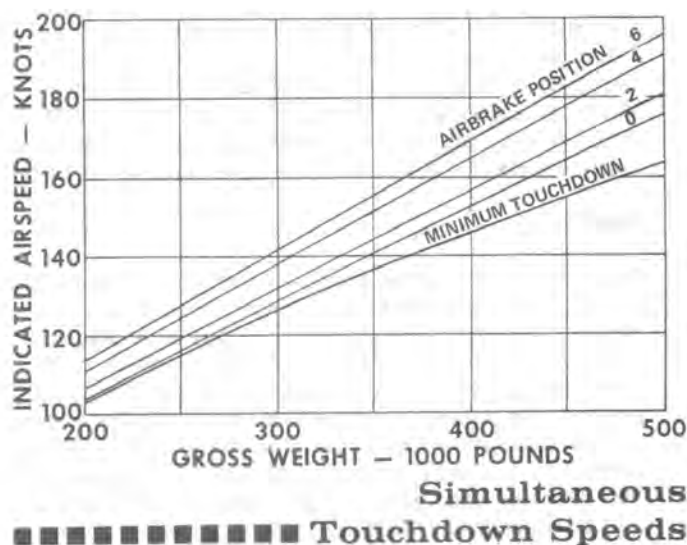


Figure 6-7B.

GO-AROUND

The go-around is similar to a takeoff provided airbrakes are retracted and the aircraft is kept in trim after the decision is made to go-around. Failure to retrim the aircraft to the target trim value noted during the landing approach, along with failure to retract the airbrakes, may result in a noseup mistrim condition of up to 8 units of stabilizer trim during the go-around. Since this mistrim exceeds the total elevator push authority, it is imperative that the stabilizer be returned to the target trim value and the airbrakes be lowered during a go-around.

WARNING

- If the stabilizer trim is not restored to near the target trim value and the airbrakes are not lowered at the initiation of a go-around, the aircraft may pitch up into a stall attitude while in close proximity to the ground. Elevator authority will be severely reduced as a result of the mistrim condition and a recovery may not be successful from low altitude. An aircraft with an aft cg location will have a stronger tendency to pitch up than an aircraft with a mid to forward cg location.
- In cases where a go-around is initiated just prior to or during the landing glare and where adequate runway remains, it may be advisable to maintain a touchdown attitude, contact the runway, then retrim the aircraft during the ground run before initiating a large power application.

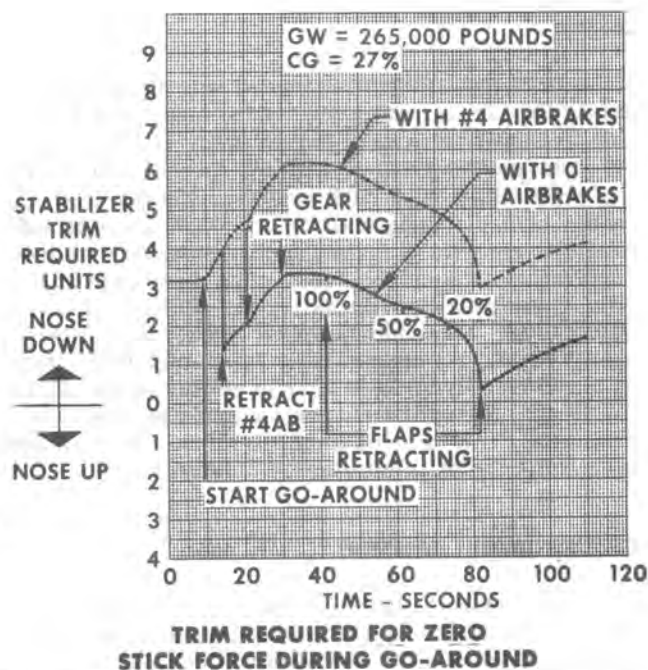


Figure 6-8.

Stabilizer trim requirements change considerably when advancing thrust from idle to MRT. At light gross weight when MRT is rapidly applied, as in an emergency go-around situation, the rapid aircraft acceleration and high rate of climb will cause a pronounced aft center of gravity shift due to fuel shift in the tanks. This effect is most severe at low airspeeds, especially near or below minimum touchdown speed. Under certain fuel distributions the aircraft center of gravity may shift as much as 10% MAC with application of MRT. The greatest tendency for fuel shift occurs when the gross weight is in the normal landing weight range, with partially full wing fuel tanks. The second most severe case is at high gross weights when the body tanks are only partially full; however, this case is considerably less severe. The trim change required to counteract a 10% MAC aft center of gravity shift at landing speeds is approximately 4.8 units of nose-down stabilizer trim. The trim change requirement due to an increase of thrust from idle to MRT is about 1.7 units nosedown stabilizer trim. (This is due to the thrust moment arm alone and not to any fuel shift.) As the aircraft comes into ground effect (about 150 feet above the runway), the downwash at the tail is reduced causing a trim change requirement of approximately 1.8 units noseup. Conversely, on climbing out of ground effects a change of about 1.8 units of nosedown stabilizer trim is required. Retracting the landing gear causes a noseup pitching moment which is equivalent to one unit of stabilizer trim. These trim changes, which may occur almost

simultaneously during a go-around, account for the requirement of resetting the stabilizer trim and retracting the airbrakes during go-around.

NOTE

Retracting the airbrakes from position 4 results in a nosedown pitching moment which is equivalent to approximately 3 units of stabilizer trim. See figure 6-8 for a profile of stabilizer trim requirements during a typical go-around.

During a go-around at speeds near or below best flare, the aircraft control requirements will increase with a decrease in speed while the available control authority generally decreases. A go-around from a speed near or below best flare will require, under these conditions, prompt attention to the directional and roll control requirements in addition to the pitch trim requirements. This is especially important during asymmetric thrust conditions where a significant portion of the total control authority must be applied to control the aircraft. See "Lateral Control" and "Rudder Effectiveness" this section for additional information about low speed control characteristics.

MINIMUM SPEED FOR DIRECTIONAL CONTROL

It has been determined in flight tests that fuel shift can have a significant effect on air minimum directional control speed. When flying in uncoordinated flight, such as multiple engine out flight with a wing low, the fuel does not remain level in the fuel tanks but assumes an equilibrium attitude which depends on the bank angle. This causes the lateral center of gravity to shift from the airplane centerline when the fuel tanks are partially full. In an engine out condition, the primary requirement for lateral control is to balance the roll moment due to sideslip. The sideslip causes a lateral fuel shift that reduces the lateral control requirement. As the center of gravity moves laterally, airplane sideslip can be increased while retaining half lateral control authority. As a result, lower air minimum directional control speeds can be obtained when wing tanks are partially full. The "Minimum Speed For Directional Control" charts (figure 3-13) include the beneficial effects of lateral fuel shift. Chart values are correct for partially full wing tanks for the Flight Manual clean training fuel sequence.

GO-AROUND CHARACTERISTICS WITH ASYMMETRIC THRUST

The proper control technique to achieve maximum performance during an engine out go-around is to use full rudder pedal deflection and wheel deflection only as required to control the rolling moment. The small 10% chord rudder on B-52 aircraft has a negligible drag penalty. The lateral control on B-52 aircraft includes a spoiler control device. The extension of spoilers on one wing decreases the lift produced by that wing and increases the drag. Increasing wheel deflection increases spoiler deflection and in turn increases the aircraft drag. Basically two cases of engine out control exist:

1. Rudder control sufficient to control the yaw asymmetry.
2. Rudder control insufficient to control the yaw asymmetry. Sheet 1 of figure 6-8A is a graphical illustration of Case 1 with the rudder control sufficient to overcome the yaw asymmetry without sideslipping the aircraft. The roll moment due to rudder deflection is small for the 10% chord rudder surface of B-52 aircraft. Small wheel deflections are required to control the roll moment. Sheet 2 of figure 6-8A is a graphical illustration of Case 2 with the rudder control insufficient to overcome the yaw asymmetry. When the yaw asymmetry is greater than the rudder capability, the aircraft will sideslip so the yaw moment due to the engine out condition will be counteracted and balanced by the yaw moment due to the rudder plus the yaw moment due to the vertical tail sideslip. A swept wing in a sideslip condition will experience a large roll moment due to increased wing span effectiveness on the advancing wing and decreased wing span effectiveness on the retreating wing. This lift asymmetry must be counteracted by control wheel deflection. Since lateral control is achieved with the help of spoiler type controls, a spoiler must be raised on the advancing wing so that the lift on both wings is equal during the sideslip. Raising of a spoiler on one wing reduces the lift on that wing, but also creates a drag component. The spoiler drag component assists the rudder and vertical tail in controlling the yaw moment but reduces the aircraft climb performance. If the rudder control is now relaxed from the full control position, the aircraft sideslip will increase requiring an increase in wheel deflection to control the increase in rolling moment. The increased spoiler drag component will further reduce the aircraft climb performance. Figure 6-8B illustrates the reduction in rate-of-climb capability due to control wheel deflection. Retraction of the landing gear during a flaps down go-around will result in a climb performance improvement of approximately 250 fpm.

PRACTICE LANDING PATTERNS AT ALTITUDE

Thrust available decreases rather rapidly with increased altitude. At 7,000 feet altitude, eight engines at MRT produce approximately the same thrust as seven engines at sea level; at 13,000 feet, eight engines are equivalent to six engines at sea level; at 20,000 feet, eight engines are equivalent to five engines at sea level; at 27,000 feet, eight engines are equivalent to four engines at sea level. Aircraft acceleration and trim characteristics are affected by this decrease in thrust with increases in altitude and these characteristics are not directly comparable with those for sea level conditions. Because of altitude effects on initial buffet and aircraft thrust, it is recommended that practice landing patterns be performed at aircraft gross weights below 300,000 pounds and an altitude under 20,000 feet. If the best flare speed with No. 4 airbrake as presented in the Appendix is used, at least 10% cushion between initial buffet and the best flare speed will be available. It should be kept in mind that, as thrust available decreases with altitude, the change in pitch trim required as full power is applied at the best flare speed is less than would be encountered at sea level. Thus,

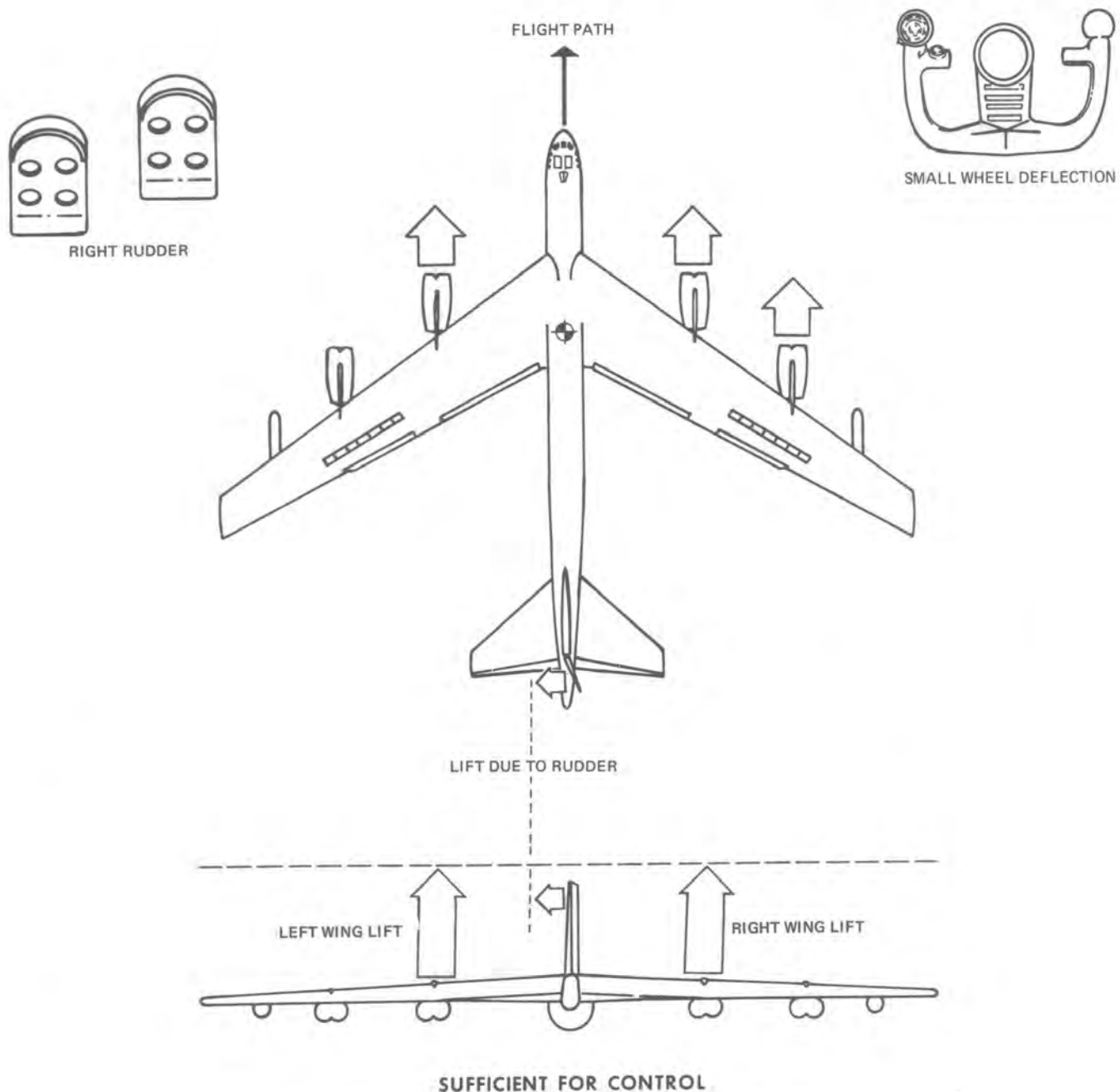
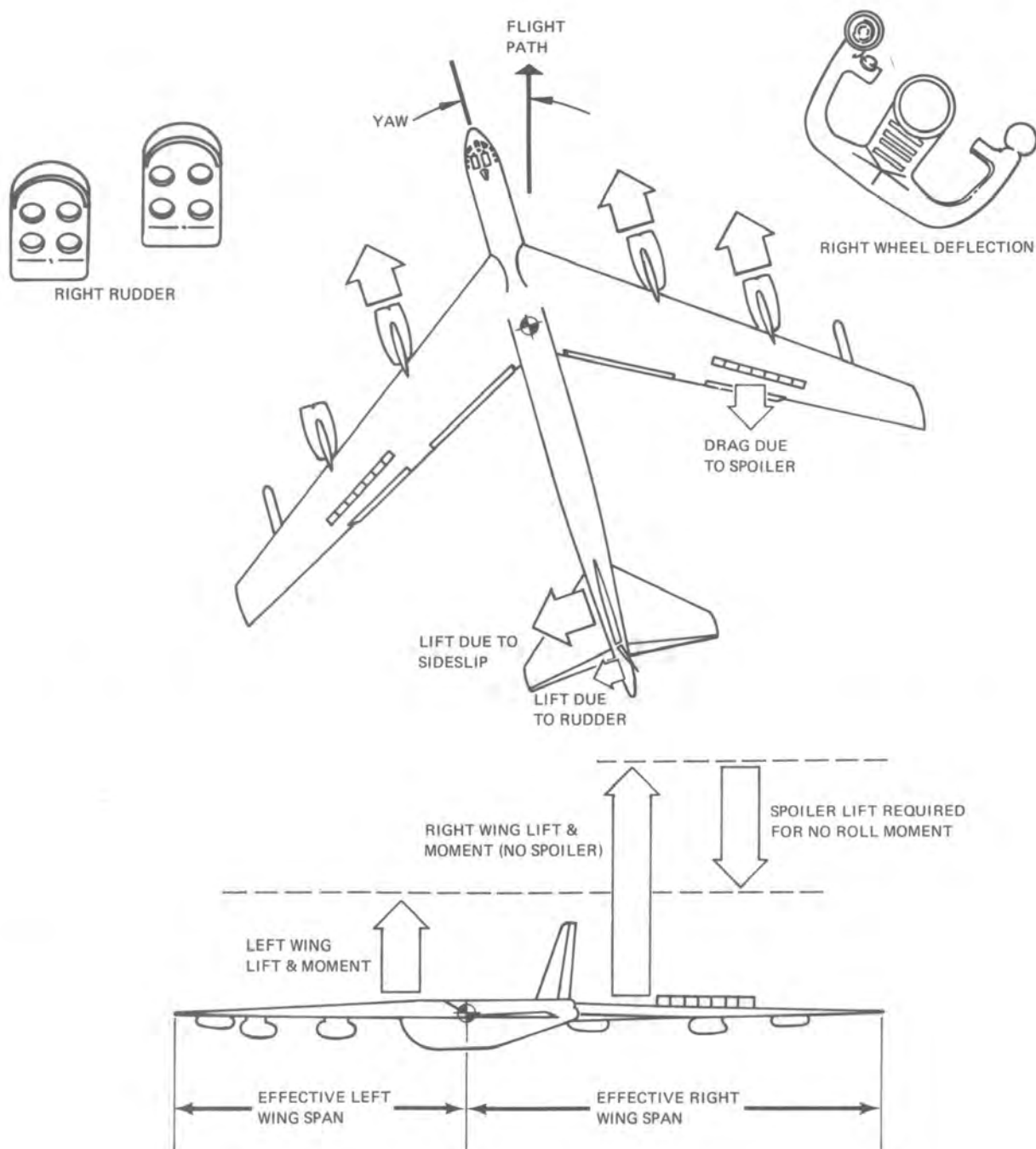


Figure 6-8A (Sheet 1 of 2).

when a go-around is accomplished at sea level, the change in nose down trim required to maintain zero stick force is much more severe than that encountered for a go-around at altitude. The amount of asymmetrical thrust for a simulated engine-out condition decreases with increases in altitude because of thrust decreasing with altitude. Since the thrust of an idling engine increases with altitude, this also further decreases the amount of asymmetry. The loss of No. 1 engine wet during takeoff under standard

sea level conditions can be demonstrated at 10,000 feet by retarding No. 3 and 4 engines to idle and placing all other engines to MRT. The effort to maintain directional control at a given IAS will be the same. Even though an aircraft can be easily controlled at altitude under a given asymmetrical thrust condition, sufficient control may not be available at sea level to maintain aircraft heading under similar engine-out conditions.



INSUFFICIENT FOR CONTROL

■■■■■■■■■■ Rudder Control For Yaw Asymmetry

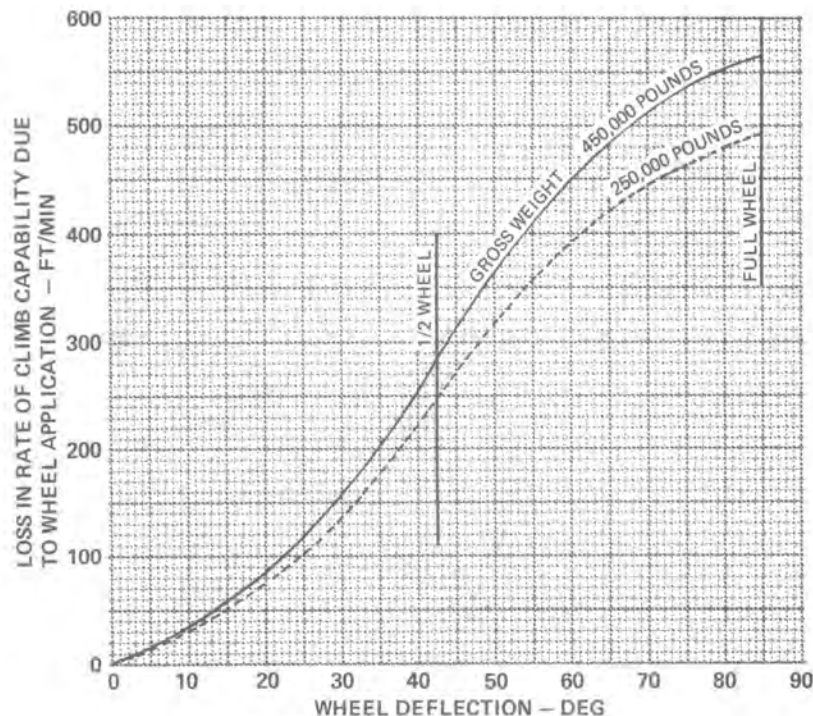
Figure 6-8A (Sheet 2 of 2).

CONDITIONS:

- ALTITUDE = 2,000 FT.
- TEMP. = 85°F
- FLAPS AND GEAR DOWN
- BEST FLARE SPEED + 10 KNOTS
- NO AIRBRAKES
- CONSTANT THRUST
- CONSTANT YAW ANGLE

NOTE

RATE OF CLIMB INCREASES 250 FT/MIN. WHEN LANDING GEAR IS RETRACTED.



Effect of Wheel Application on

Incremental Rate of Climb Capability

Figure 6-8B.

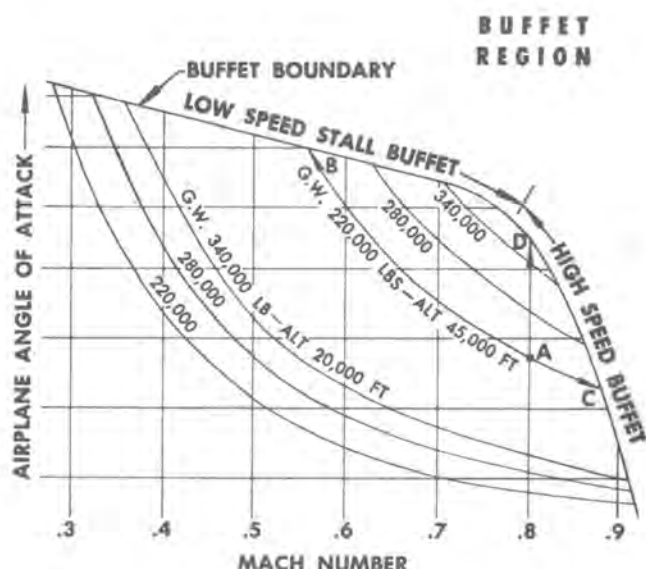
HIGH SPEED FLIGHT

Wing Buffeting

During high speed operations, a slight buffet begins when the aircraft critical Mach number is reached. This is caused by the turbulent airflow behind the shock wave which is established when the airflow over a portion of the top surface of the wing has reached sonic velocity. As the speed of the aircraft increases above this initial buffet speed, additional turbulence of the airflow over the upper surface of the wing is produced which causes a further increase in buffeting resulting in aircraft vibration. Unless some emergency exists, the aircraft should not be flown at speeds greater than that at which light buffeting is encountered. Increasing the altitude or the gross weight will cause buffeting to occur at a lower airspeed since the critical Mach number is reduced when the angle of attack of the aircraft is increased.

BUFFET BOUNDARY. The point where buffeting occurs is called the "buffet boundary" (figure 6-9). Buffet free flight can be conducted in the area below the curve but as the aircraft approaches the buffet boundary, a small gust, maneuver, or slight increase

in the aircraft normal acceleration can cause the buffet region to be entered. Buffeting occurs during flight in any portion of the shaded region. The two types of buffeting encountered at high altitudes are low speed stall buffeting which occurs on the curve in the vicinity of point B and high speed buffeting which occurs in the vicinity of point C. For example, an aircraft weighing 220,000 pounds and cruising at .80 Mach at 45,000 feet altitude would be at point A on the curve. If speed is decreased far enough while maintaining the same altitude, buffeting will be encountered at point B. The buffeting encountered at point B is a low speed stall buffet and is essentially the same in nature as that described in "Stalls," this section. The only difference between high altitude low speed buffeting and that described under "Stalls" is that at high altitude, low speed buffeting occurs at higher indicated airspeeds. If the airspeed is increased from point A while maintaining the same altitude, buffeting will be encountered at point C. The aircraft can be flown past point C in level flight by increasing power to military rated thrust. Therefore, use caution when flying in level flight at MRT since the high speed buffet region might be entered.



■■■■■ Buffet Boundary Limits

Figure 6-9.

RECOVERY FROM BUFFET. Level flight operation near the high speed buffet boundary or in the high speed buffet region is not dangerous provided the aircraft shaking is not great and the pilot understands that the quickest way to get out of the buffet region is to reduce speed or altitude or both. Since the aircraft drag in the buffet region is very high, the most effective method of getting out of this region is by reduction of power without change of trim. This will result in reduction of speed and loss of altitude. A very slight climb produced by slight back pressure on the control column, while momentarily increasing the buffeting, will eventually aid in the loss of speed. While operating at low altitudes in level flight, the low speed buffet region can be entered, but at lower airspeeds than that for higher altitudes. During normal flight operations, the high speed buffet region will never be entered.

Tuck Under

As the speed of any aircraft is increased, the normal requirement is more aircraft nose down trim. However, with this aircraft as with many other high speed aircraft, the trim requirement reverses as the buffet region is entered and nose up trim is required. Such a condition is called "tuck under" and is considered critical on those aircraft which do not provide sufficient longitudinal control or when the trim reversal is large. Since the aircraft is equipped with an adjustable stabilizer, sufficient longitudinal control is available to handle any condition within

structural capabilities. The inboard portion of the wing approaches its critical Mach number first with the result that the center of lift of this area moves rearward with increasing speed. Because of this action, the resultant lift produced from the entire wing moves aft (center of pressure moves aft) which produces an aircraft nose down pitching moment. The trim changes are small and gradual as speed is increased above the critical Mach number. They can be handled easily by use of the stabilizer trim or by use of elevator alone with not more than 50 to 60 pounds of pilot effort. Such a reversal of longitudinal trim is not unusual, but the amount of reversal and the speed at which reversal starts will vary depending on the amount of sweepback used, flexibility of the wing, wing airfoil sections used, and wing taper ratio employed.

MANEUVERING FLIGHT

LOAD FACTOR

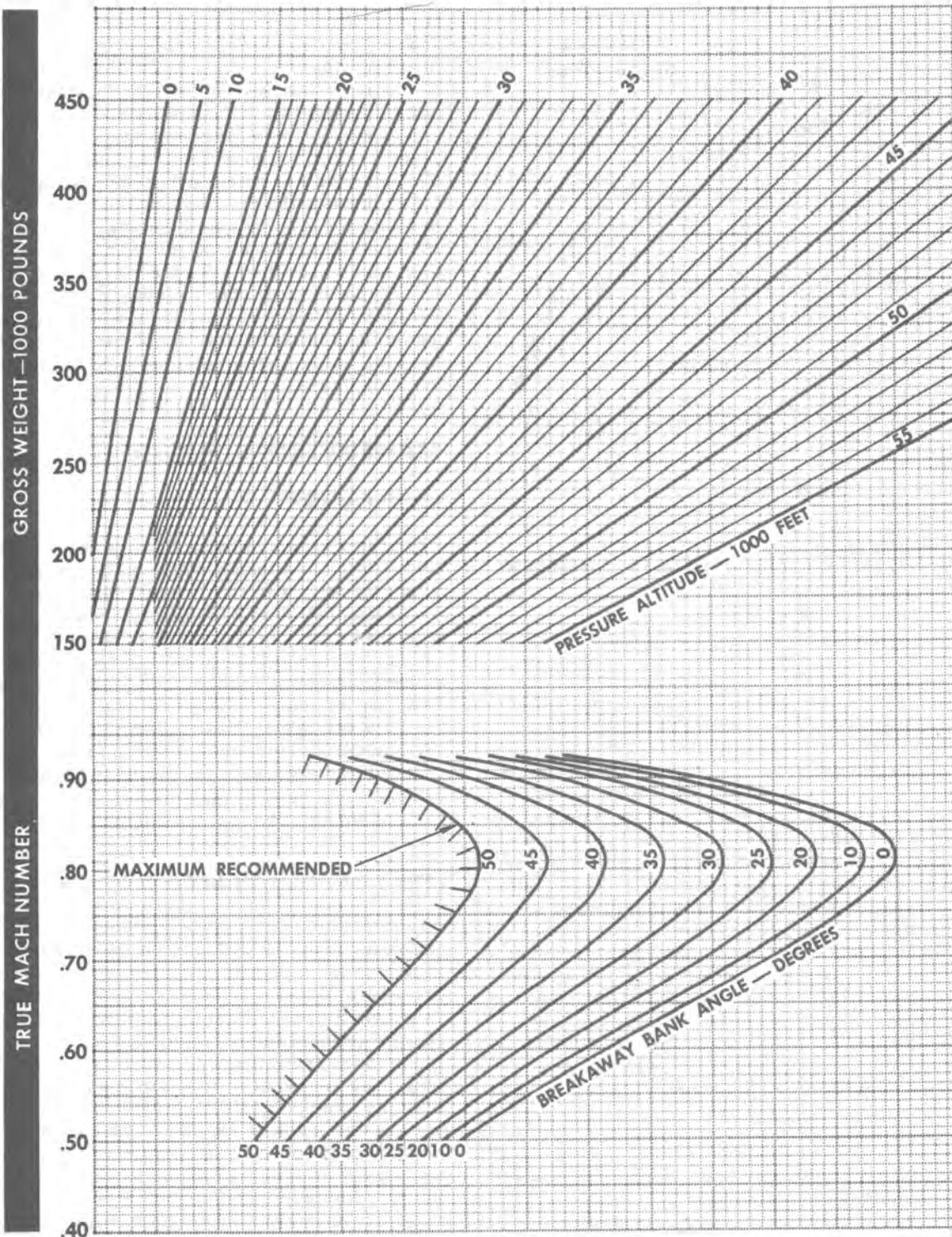
When the aircraft is being flown in level unaccelerated flight, the wings produce sufficient lift to counteract the weight of the aircraft such as a 1 "g" loading (a load factor of 1) is being produced. If the nose is pushed over, the loading decreases to less than 1 "g" during the maneuver, while if a pullup is performed, a loading greater than 1 "g" is produced. If a turning maneuver is accomplished while maintaining the same speed, the wings produce less lift in a vertical direction and the angle of attack must be increased to compensate for this loss of lift if a constant altitude is to be maintained. This increase in angle of attack causes a loading increase greater than 1 "g."

EFFECT OF POSITIVE ACCELERATION

The effect of positive accelerations caused by coordinated turns or pullups is to increase the load factor on the aircraft. Performing any normal maneuver during maximum range cruise flight is generally not critical from buffet considerations. If level flight is being maintained in an area very close to the buffet region, even a small maneuver can cause the aircraft to enter the buffet region. Starting from level flight at point A (figure 6-9), a turn can be made at .80 Mach until buffeting is encountered at point D. A coordinated bank of approximately 53° is required to reach point D for this condition. Recovery from buffeting occurring during a turn or a pullup is best made by rolling out of the turn or nosing over slightly or both.

COMBAT BREAKAWAY MANEUVERS

Techniques for combat breakaway maneuvers may vary depending on the nature of the bomb run and status of equipment being utilized. This maneuver may be accomplished either using automatic pilot or

**NOTE**

BREAKAWAY BANK ANGLE IS 10 DEGREES LESS THAN
THE BANK ANGLE FOR MAXIMUM RECOMMENDED BUFFET.

Maximum Recommended Bank Angle (Breakaway Maneuvering)

Figure 6-10.

by manual controls but a combination of the two is not advised. Prior to the bomb run, consult figure 6-10 to determine the maximum recommended bank angle. It will be noted that the maximum recommended bank angle chart has reduced the bank angle 10° from the maximum recommended buffet and there is no need to further reduce the bank angle if best performance is desired. When making this maneuver on automatic pilot, rotation of the turn knob past the detent will allow up to 50° of bank. Entry into and recovery from the bank angle should be accomplished smoothly to prevent inadvertent disengagement of the autopilot.

NOTE

In the event of autopilot disengagement during breakaway maneuver, be prepared for a pitch-up during manual recovery resulting from the trimming accomplished by the autopilot in the turn.

When performing this maneuver manually, the turn should be completed utilizing little or no stabilizer trim. Constant power and altitude should be maintained with a small resultant loss of airspeed during the breakaway maneuver; power should not be increased over what was maintained during the bomb run.

RECOVERY FROM UNUSUAL POSITIONS

An unusual position is any abnormal bank attitude, pitch attitude, or speed which the aircraft has inadvertently assumed. The recovery from unusual positions may be safe or unsafe, depending on whether or not there is an easily understood and executed procedure assuring straight and level flight without damage to the aircraft. More specifically, an unusual position for this aircraft may be considered as any attitude or speed which results in inadvertent operation outside the following limitations:

1. An unintentional bank angle greater than 45° .
2. A nose high attitude greater than that required for a maximum steady climb angle at aircraft gross weights with which the pilot has had flight experience.
3. A nose down attitude greater than that required for the established descent procedures under conditions with which the pilot has had experience.
4. Maximum placard speed or structural load factor limitations for the particular aircraft configuration.
5. Minimum recommended speed.

Aircraft attitudes that exceed the above listed limits which the pilot has intentionally caused the aircraft to safely assume, such as a combat breakaway maneuver, are not considered unusual positions and the following procedures for recovery from unusual positions will not apply if the aircraft is operating safely after intentionally establishing the aircraft attitudes or speeds. If, after intentionally exceeding the above

limits, the aircraft operation appears to become unsafe, then the recovery from unusual positions procedures will be used. Acrobatic maneuvers in this aircraft are prohibited; however, it is imperative that procedures for recovery from inadvertent unusual positions be understood. During action over a target, it may be necessary to recognize and recover from extreme maneuvers. Incorrect recovery from normal over-the-target maneuvers or incorrect procedures during instrument flight, especially descents, can lead to unusual positions. During recovery from unusual positions, the pilot must be aware of the aircraft limitations and be able to make a decision as to whether to attempt recovery or abandon the aircraft. Recovery from normal over-the-target maneuvers can be safely practiced if ordinary precautions are taken. Any procedure however which requires the pilot to recognize and recover from an unusual position with limits in excess of those established in this paragraph, which he has not observed being established, is not recommended. This is because orientation cannot always be easily established unless the maneuver entry has been progressively observed and incorrect interpretation of attitude may lead to incorrect recovery. Any protracted delay in recovery from an unusual position will result in a dive. The time required to exceed placard speeds from cruise Mach number at 30,000 feet at various dive angles is as follows: In a 13° dive, the flutter placard can be exceeded in less than 20 seconds. In a 25° dive, the structural placard and the flutter boundary can be exceeded in less than 20 seconds. at 45° or more, all placards are exceeded in less than 10 seconds if recovery procedures are not initiated immediately. Basically, the techniques required for recovery from unusual positions are the same as for other aircraft of this class, except that a higher degree of proficiency may be required. The pilot should, however, be familiar with the following pilot techniques and flight characteristics which are peculiar to this aircraft:

1. Although the electrical trim features make it very easy to maintain elevator control forces at a minimum, little or no stabilizer trim should be used during fast rate roll-ups or pull-ups. This assures that release of the controls will return the aircraft toward the original trim condition if rapid recovery is required.
2. Rolling the wings level during a dive recovery can be accomplished at high indicated airspeeds since adequate control exists.
3. If lateral controls are used in the recovery, forward column movement is required to compensate for pitchup due to the lateral control spoilers unless the pitchup is required as part of the recovery procedure.
4. Application of stabilizer trim should very closely follow corrective control column movement. This is desirable in order to keep recovery effort to a minimum and to assure that the stabilizer screw is not

loaded beyond operating capacity if aircraft placard speeds are unintentionally exceeded in the recovery. It is not considered good practice to move the stabilizer ahead of time in anticipation of a certain aircraft response unless it has been previously experienced that this response is certain to occur. This is especially true if placard speeds have inadvertently been exceeded. Control characteristics beyond placard speeds are covered in Section V.

5. Airbrakes can be used in emergencies, such as loss of stabilizer trim, for a pitch trimming device. When used at low airspeeds, incremental extension of the airbrake following application of full noseup elevator will assist in recovering from a nosedown attitude. In addition, they can be used as a drag device at high speeds; however, they should be applied gradually, keeping in mind their strong pitchup effects and blowdown characteristics at speeds above 250 knots IAS. Use of more than airbrake position 2 at high indicated air speeds will make full lateral control more difficult to attain (higher wheel deflections and forces) and result in unpredictable but controllable roll caused by asymmetrical spoiler blowdown.

6. Extension of landing gear as a drag device in recovery from steep nose down attitudes is recommended but every effort should be made to extend the gear as soon as the attitude or the possibility of such an attitude is recognized. At high speeds, however, successful egress of personnel without ejection seats is virtually impossible after gear extension. In addition, if aircraft placard speeds are exceeded, it is likely that gear doors will be lost with possible collision damage to horizontal and vertical tail.

7. Since improper recovery from an unusual position may result in exceeding placard speeds, rudder trim should be returned to zero before initiating a deliberate unusual position in order to preclude structural failure.

WARNING

Rudder deflection can cause structural failure if speeds greater than aircraft placard speeds are inadvertently reached.

8. Aircraft buffet cannot be relied on as an indication that structural limit load factors have been reached since, in most cases, buffet is not reached until after structural load factor limitations have been exceeded. This is shown on the "Normal Acceleration at Maximum Recommended Buffet" chart (see Part 10 of the applicable Appendix). No reliable flight experience exists on the buffet characteristics at combined Mach numbers and indicated speeds above the structural and flutter placards.

WARNING

Instrument misinterpretation during the initial phase of the recovery would result in im-

proper recovery action which could overstress the aircraft. Pilots must be alert to prevent improper recovery action. Caution must also be exercised during recoveries because the accelerometer is not a precise or easily read instrument.

9. Large amounts of lateral and rudder control inputs may be necessary for recovery from certain situations and the pilot must be aware of recovery techniques and aircraft limitations. Improper recovery actions from an unusual position can result in critical structural loads and/or exceeding placard speeds. These loads vary in magnitude depending on indicated airspeed, degree of corrective lateral and rudder input, rate of rudder application, amount of yaw/roll displacement that has taken place prior to rudder application, gross weight, cg, fuel distribution, turbulence, aircraft configuration, missile loading, external tank loading, etc. If these variables occur in certain combinations critical structural loads can result. To minimize the possibility of structural overloads that could occur at other than low speed conditions, any yaw/roll tendency requiring large lateral and rudder displacement should be counteracted initially with lateral control followed by steady rudder application.

Nose High Attitudes

A nose high condition can develop immediately after takeoff or touch and go because of the following conditions:

- Stabilizer trim not set properly for takeoff
- Stabilizer trim not reset properly for touch and go
- Airbrakes left extended
- Unscheduled and/or runaway nose up trim
- Misinterpretation of visual or artificial horizon.

WARNING

- Do not use the stabilizer trim cutout switch until positive that the attitude change is due to runaway trim.
- Recovery from a nose-high attitude immediately after takeoff can best be accomplished with full forward control column, retracting airbrakes if extended, continuous application of nosedown trim and maintaining takeoff thrust and a wings level attitude.

During touch and go, the trim must be reset prior to making the takeoff. If this action is not accomplished immediately following unstick, forward column will be required in order to prevent pitchup and nose down stabilizer trim will have to be initiated to obtain zero stick force.

To be sure that the trim action desired is being accomplished, note that the movement of the manual trim wheel is in the proper direction. If electrical trim appears inoperative, manual trim must be applied as rapidly as possible while holding wings level and the control column full forward. Recovery is still possible but will be slower. The airspeed will fall alarmingly low but lateral control will be good. As the nose of the aircraft drops through the horizon, recovery can be made as the descent is begun by use of trim and thrust as required. Do not release forward pressure on the control column until the desired attitude is established and airspeed increases to a safe value. Because of the tendency to overtrim during the recovery from the nosehigh condition, prompt opposite trim action will be required after the aircraft assumes a nosedown attitude. Caution must be exercised to avoid an accelerated stall. Even though a reduction of thrust will decrease the amount of mistrim in the noseup direction, there are definite advantages to be gained by maintaining thrust. When thrust is maintained, the minimum speed encountered in the recovery will be higher, altitude gained will be greater, and the possibility of a secondary stall in the recovery will be decreased. Do not use a steep turn maneuver for recovery from nosehigh attitudes, one reason being that dangerous sideslip could occur causing structural failure. If nosehigh attitude develops after takeoff, recover straight ahead. Maintain wings level, full takeoff thrust, and full forward control column. Retract airbrakes if extended and apply continuous nosedown trim until recovery is made. The use of a steep bank to control the aircraft can be fatal if at a low airspeed and close to the ground and should not be attempted.

WARNING

Do not attempt to take off unless trim has been properly set for takeoff and airbrakes are down.

A steep turn as a last resort maneuver will compensate for a considerable amount of nose up mistrim; however, if the mistrim condition is undetected until a high nose up attitude and a low airspeed is reached, there is a danger, when entering a turn, of causing an uncontrollable maneuver which may result in structural failure. Two other factors should be considered: 1) While rolling the aircraft, the spoilers aggravate the mistrim and 2) the time taken establishing a turn would be better spent trimming manually. Therefore, a steep turn maneuver to compensate for an excess of nose up trim is not recommended even at high altitude except in the case when both electric and manual trim are inoperative. When starting a steep turn under these circumstances,

alert the crew to "prepare to abandon the aircraft." If unscheduled nose up trim is encountered while in a turn, the best action will be to continue the turn and use the "Runaway or Unscheduled Stabilizer Trim Checklist," Section III. If nose down trim is encountered in a turn, roll wings level while using the "Runaway or Unscheduled Stabilizer Trim Checklist," Section III.

Dive Recovery

Dives can result from stabilizer trim in the nosedown direction, autopilot malfunction, unscheduled loss of airbrakes, or instrument misinterpretation or malfunction. Because of its extremely low drag with landing gear and flaps retracted, this aircraft will increase in speed very rapidly any time the nose is dropped. Therefore, during dive recovery, the application of a positive load factor (back stick) should be made immediately up to the structural limit of 2.0 "g's" or to the point of buffeting, whichever occurs first. In cases where elevator authority alone is found to be insufficient to control the dive or when nosedown mistrim is suspected, airbrake extension should be used as a backup to the elevator for pitch authority. The application of load factor should have precedence over power reduction. See figure 6-11 for altitude loss during a dive recovery.

Spiral Dives

If an aircraft reaches too large a bank angle or falls off on one wing, a spiral dive can result. This maneuver is easily entered when visual orientation is not possible or if instrument orientation is momentarily lost because of distraction or vertigo. To recover from a spiral dive, roll out of the bank and hold wings level while holding a constant heading. At the same time, the recommended procedures for dive recovery should be initiated.

Vertigo

When the pilot becomes disoriented or experiences vertigo, the aircraft can be returned to wings level by engaging the autopilot. It is not necessary for the aircraft to be in trim. If a spoiler is up when the autopilot is engaged, the aircraft will only return to approximately wings level, with the autopilot holding some spoiler and rudder to compensate for an out-of-trim condition. After the pilot is reoriented, it is recommended that the autopilot be disengaged momentarily and then reengaged after trimming aircraft. Recovery from a climb or dive must be commanded through the pitch knob or the altitude control switch. If the autopilot disengages itself when engaged in such an emergency, continuous manual reengagements will introduce signals in a recovery direction.

CONDITIONS:

LOW ALTITUDE (10,000 FT OR LESS)
FLAPS UP
GROSS WEIGHT 300,000 LB

RECOVERY TECHNIQUE:

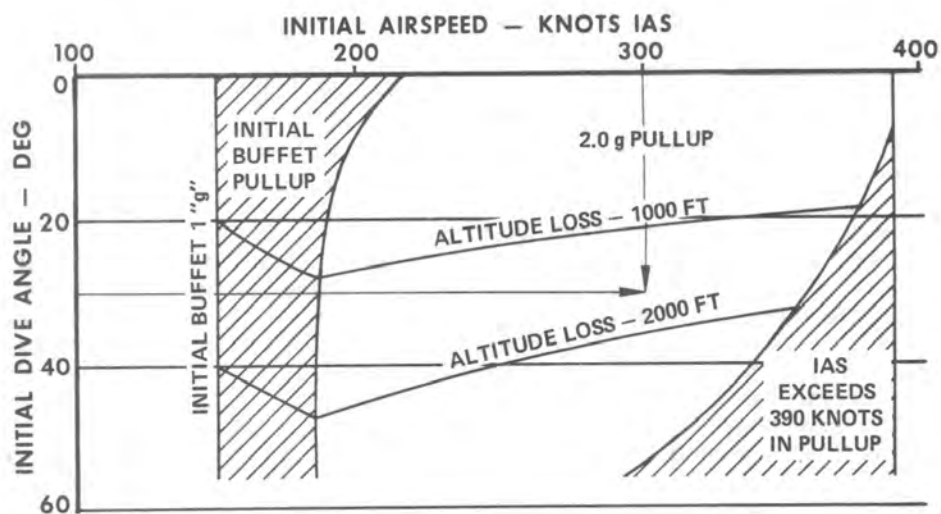
ELEVATOR IMMEDIATELY APPLIED
TO 2.0 g OR INITIAL BUFFET

EXAMPLE:

GIVEN:
Initial dive angle 30° , airspeed 300 KIAS

FIND:
Altitude loss for recovery

SOLUTION:
Approximately 1600 feet



Dive Recovery Capability

Figure 6-11.

Figure 6-11A. (Deleted)

Summary of Causes for Unusual Positions

The following conditions are the most prevalent causes for unusual positions in this aircraft:

1. Pilot disorientation or vertigo.
2. Turbulence or weapons effects.
3. Improper use or malfunction of airbrakes.
4. Improper use or malfunction of stabilizer trim.
5. Split flap operation.
6. Unscheduled autopilot inputs.

Summary of Procedures for Recovery from Unusual Positions

The following procedures will be used for recovery from nose high unusual positions when the bank is less than 45°:

1. Add thrust as required and later adjust as necessary to obtain the desired airspeed.
2. Lower nose of aircraft to slightly below the horizon (approximately 3°) and maintain the original bank angle when lowering the nose. If the wings are level when starting the recovery, maintain wings-level attitude and lower nose to slightly below the horizon. If applicable, use the "Runaway or Unscheduled Stabilizer Trim Checklist," Section III, to help correct the nose high attitude.
3. After obtaining a slightly nose low attitude, roll wings level and establish straight and level flight.

The following procedures will be used for recovery from nose high unusual positions when the bank is more than 45°:

1. Add thrust as required and later adjust as necessary to obtain the desired airspeed.
2. Simultaneously lower nose of aircraft to slightly below the horizon (approximately 3°) and reduce the bank to 45° or less. If applicable, use the "Runaway or Unscheduled Stabilizer Trim Checklist," Section III, to help correct the nose high attitude.
3. After obtaining a slightly nose low attitude, roll wings level and establish straight and level flight.

The following procedures will be used for recovery from nose low unusual positions:

NOTE

A nose low unusual position can be entered as the result of a low speed stall. For recovery techniques from this low speed condition, see "Recovery from Inadvertent Stalls," this section.

1. Back stick, thrust reduced as required, and drag devices such as airbrakes and landing gear should be used as necessary to avoid exceeding airspeed limitations.
2. Simultaneously correct pitch and bank to establish level flight condition. Elevator control should be closely followed by stabilizer trimming in order to keep elevator control forces and jackscrew loads at a minimum. The structural or buffet limits should not be exceeded in an attempt to level off too rapidly. If the wings are level when starting the recovery, maintain wings-level attitude when correcting the pitch attitude so the maximum effectiveness of lift will be available for producing a recovery flight path.

Spins

For spin recovery, see "Spins," this section.

Inverted Attitudes

The best way to recover from an inverted attitude with a minimum loss of altitude is to roll out. Since this aircraft has spoilers there is no problem of lateral control reversal.

FORMATION FLYING

AERODYNAMIC EFFECTS

Aircraft flying in close formation have an aerodynamic effect on each other due to the interaction of the airflow around the two aircraft. This effect, in general, tends to draw the two aircraft together and the strength of this effect is inversely proportional to the distance. The closer the two aircraft are, the stronger the effect. The strength is also directly proportional to the size and weight of the aircraft. For example, a T-33 chase plane would not noticeably affect a B-52 but the T-33 would experience a strong disturbance from the B-52. Two B-52's would experience similar forces but the lighter of the two would be disturbed more. Also, the aerodynamic effect increases with decreasing airspeed since, for the same weight aircraft, the distortion in the airflow is greater at slower speed. The extension of wing flaps distorts the airflow in a manner to increase the disturbance so that it is more hazardous to fly formation at low speeds with the flaps extended on the lead aircraft. In addition, formation flying at high Mach numbers can introduce large unfavorable interactions between the two aircraft. The pilot feels all of these aerodynamic effects as changing control force requirements as the two aircraft maneuver near each other. If the relative position of the two aircraft is changing rapidly, the control force requirements will also change rapidly. For this reason, one of the basic rules for formation flying is to make all position changes slowly. The direction of the disturbing force is different for every relative position, but generally, the force is in the direction to bring the two aircraft closer together. Consider a B-52 underrunning a KC-135 during an attempt to formate for refueling. If the center lines of the two aircraft coincide, they will tend to fly together and the B-52 pilot must push on the control column to maintain clearance. As the B-52 wing passes forward of the KC-135 wing, it passes from a region of downwash to a region of upwash and the lift is suddenly increased; therefore, the B-52 pilot must strongly increase the push force at this time to prevent pitching up into the tanker. If the B-52 were to underrun the tanker to one side so that their wings overlapped on one side only, the pitching tendency would not be quite as strong, but the aerodynamic interaction is such that less lift is generated on the top wing and more lift is generated on the bottom wing. This causes the two aircraft to bank in the same direction with the two wings tending to collide since one goes down and the other goes up.

LIMITATIONS

Prior to participating in air refueling operations or formation flight, all crews will be properly briefed on formation tactics and procedures that will be used and to 1) never fly over or under the other aircraft and 2) maintain safe separation in all directions as specified in the applicable air refueling flight manuals or the major air command formation flying directives. In the event an emergency requires a chase aircraft for airspeed reference or a visual inspection, the pilot of the chase aircraft will be briefed on command chase aircraft procedures prior to engaging chase operations.

DIVING

At cruising altitude, a considerable increase in speed above the maximum range cruise speed may be made before reaching the buffet boundary. Therefore, a shallow dive may be made without entering the buffet region. However, because of the extremely low drag of the aircraft with the gear and flaps retracted, the speed increases very rapidly at any time the nose is dropped or a dive is started. If the buffet region is entered while in a dive, recovery may be made by immediately retarding the throttles to IDLE and leveling out very slowly. Leveling off too rapidly will cause the load factor to increase to a value considerably greater than 1 "g" with the result that buffeting will increase. In cases where a rapid descent is to be accomplished, the landing gear and airbrakes should be extended and the procedures followed as outlined under "Descent," Section II.

FLIGHT WITH ASYMMETRICAL LOADS

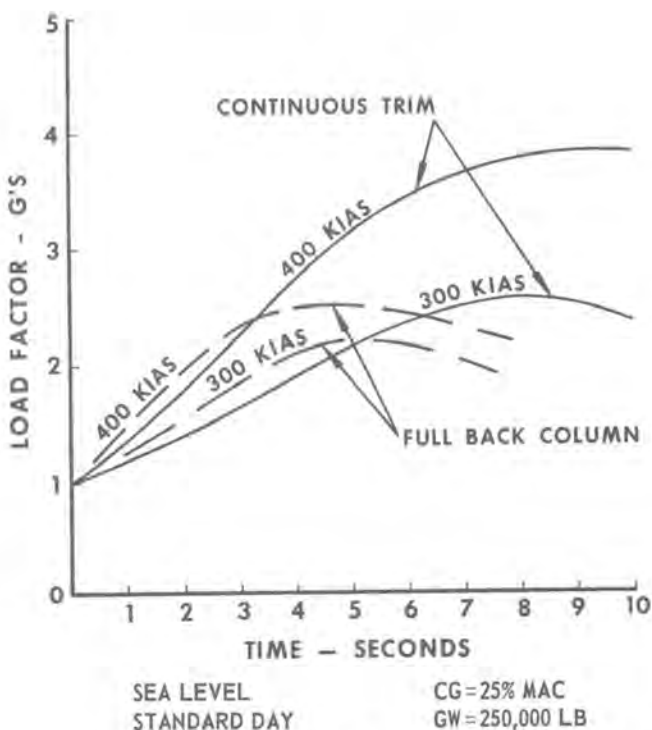
Refer to "Fuel Management for Lateral Trim," Section II; "Fuel System Operation With One Missile," Section VII; and Part 9 of the Appendix for information regarding flight with asymmetrical loads.

LOW ALTITUDE FLIGHT CHARACTERISTICS

NOTE

Due to the wide wing span of the B-52, wing tip terrain clearance at extremely low altitudes can become critical as the bank angle increases during turns, e.g., a 20° bank will place the wing tip approximately 25 feet closer to the terrain than the bottom of the fuselage and a 40° bank approximately 55 feet closer. See following table:

Bank Angle - Degrees	Approximate Distance - Feet
12	11
15	16
20	25
30	40
40	55



**Load Factors During
Low Altitude Pull-Ups**

Figure 6-12.

Considerable motion in the lateral plane from the effects of turbulence and strong or gusty surface winds is apparent while flying at low altitude, especially if the airspeed is above 325 knots IAS. Motion in the lateral plane due to horizontal gusts is similar to earlier series B-52's; however, due to a difference in wing construction and fuel distribution, the B-52G reacts differently to vertical gusts than earlier models. When a vertical gust is encountered, the initial gust input causes the aircraft to bounce vertically but the vertical motion damps out rapidly as the gust dissipates. The effect is to give relatively long periods of time when the flight is quite smooth. Observation of the wing shows very little up and down motion and nacelles move only occasionally. The normal operating limitations contained within Section V apply to low altitude operation. For further information, see "Low Altitude Tactic," Section II, and "Turbulence and Thunderstorms," Section IX.

AIRCRAFT RESPONSE TO FLIGHT CONTROLS

The most significant problem with which the pilot must familiarize himself at high speed is the aircraft control characteristics while encountering severe turbulence at low altitudes.

Aircraft response to use of the elevators only is sluggish, while response to change in stabilizer trim is rapid and positive. However, any change in pitch should be made by leading with the elevators and using stabilizer trim to relieve the physical effort required by the pilot. Fine control is then maintained by use of the elevators. Use of the low level mode of the autopilot will substantially reduce stick forces required and lateral forces will also be lighter than manual. With the yaw SAS engaged, lateral-directional oscillations of the aircraft are sensed and increased positive damping is provided for easier rudder control. The autopilot will also provide automatic stabilizer trim to compensate for any pitch or thrust changes. See "Autopilot," Section IV. Figure 6-12 compares load factors developed during low altitude pull-ups at high and low airspeeds. See "Acceleration Limitations," Section V, for inflight limit load factors. When using the autopilot, a "g" limiter will automatically disengage the autopilot before the pilot inadvertently exceeds the normal acceleration (load) limits. For additional information, see "G Limiter" under "Autopilot," Section IV. The use of airbrakes is not advisable except in maintaining the necessary EPR for anti-icing or under other controlled conditions. The upward pitch change associated with the use of airbrakes (or downward when retracted) can have undesirable effects at extremely low altitudes. The roll-yaw response of a B-52 resulting from a typical asymmetrical thrust condition is shown in figure 6-13. For a particular case where corrective action is applied 4 seconds after thrust loss, the roll rate does not reduce to zero until an additional 3 seconds have elapsed. During this period, the aircraft continues to bank even though full corrective control has been applied. A sensation that the controls are not effective will be felt since the bank angle continues to increase for several seconds when full controls are applied to oppose the roll. The aircraft is, however, in a process of responding by reducing the roll rate. Control inputs must be held in to speed the recovery.

PILOT CONTROL TECHNIQUE

Manual Control

During low altitude operations, pilot technique is extremely important and proper coordination between pilot and copilot is essential. Prolonged low altitude operation may require assistance from the copilot, depending on turbulence level and character of the terrain. An effective method of controlling the aircraft while experiencing difficult control forces may be accomplished by the pilot using both hands on the control wheel while the copilot controls airspeed with the throttles. The aircraft requires constant pilot attention to maintain a wings-level attitude and hold a heading within 2°. However, due to the elimination of ailerons, the lateral control system has a desirable feature in that control forces do not increase with airspeed. This effect-

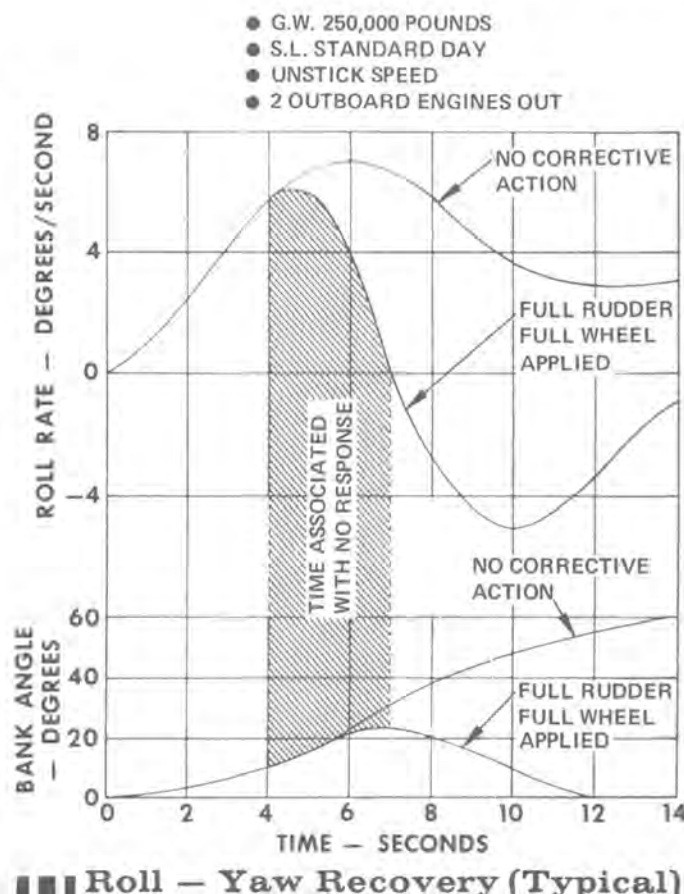


Figure 6-13.

tively reduces pilot effort and makes the low altitude mission much easier even though lateral control inputs are frequently necessary. See "Lateral Control," this section.

Autopilot Control

Autopilot nonsteering modes are not suited to low altitude flying and cannot be relied upon to maintain control. Autopilot response, particularly in using the pitch control knob, is not rapid enough to perform low altitude maneuvers and is subject to disengagement due to turbulence. However, the autopilot low level mode may be used for low altitude operations. This mode reduces loads imposed on the aircraft and also reduces pilot fatigue during low altitude flying by allowing the pilot to command the aircraft through the autopilot. The pilot flies the aircraft through the autopilot by control column and control wheel inputs in the same manner that he flies without the autopilot. Control column and wheel forces are considerably reduced by the "power steering" effect provided by the system because the autopilot is sensing the pilot's force on the controls and provides the necessary action to move the control surfaces. For additional information, see "Autopilot," Section IV.

Systems Operation

section VII

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ENGINE OPERATION

ENGINE LIFE

Time-Temperature-RPM

The "Time-temperature-rpm" relationship within the engine is the main factor in engine life. The most important of these is temperature. The strength of the materials used in the engine decrease as high internal temperatures approach the melting points of the metals, even though the danger point may not be closely approached. There is a tendency for any material to take a permanent set, stretch or bend; this

tendency increases with both the load and the temperature. The amount of permanent set increases with the length of time that the load and/or temperature is applied. After a certain amount of permanent set is attained, the fibers or grains of the material begin to pull apart. Under inspection with a high powered microscope, the beginnings of fine cracks may be seen. With additional time, the material begins to elongate at faster rates as the cracks become bigger and deeper. Finally, the material breaks. This process is so slow that elongation is perceptible only with careful measurement. The term "creep" has been applied to the process because of the length of time required for elongation to become significant. In a turbine engine, high load and high temperature

are usually experienced at the same time. The loading on the turbine and compressor blades is principally the combined result of the centrifugal force, associated with rpm, and some gas or air load, associated with engine internal pressure. When the turbine discharge pressure, which is indicative of other internal pressures, is high, the EGT is also high. This means that when the turbine blades are subjected to their heaviest load, the material of which they are constructed will be at its weakest. The compound effect of high rpm and high temperature results in an astounding increase in the rate of creep at very high thrust settings when the centrifugal load is the greatest. The ends of the compressor blades and the rims of the turbine wheels tend to travel outward. The rate of creep, which is measured in millionths of an inch per hour, increases tremendously as the rpm and EGT approach maximum.

Engine Thrust vs Time

The length of time that an engine may be operated at each of the various thrust ratings, such as takeoff or military, has been established in the interest of conserving the life of the engine and making the time between overhauls predictable. The periods of 5 minutes for takeoff and 30 minutes for military (full dry thrust) has, by universal acceptance of the definitions for the various engine ratings, been deemed adequate to take care of most situations. The real purpose of limiting the time for engine operation at takeoff or military rated thrust is not so much to permit a cooling period between intervals of operation at high thrust (although such a cooling period is very desirable) as it is to provide distribution of the rate of creep and deterioration of hot section parts throughout an engine's normal life. There is no hard and fast rule for reducing the throttle setting to normal rated when operating at military for any specific length of time before the higher thrust rating may be used again. Whenever the situation permits, it is good practice to operate an engine at reduced thrust between periods of operation at military thrust for the same amount of time that the engine has just operated at the higher thrust setting.

ENGINE COMPRESSOR STALL

Engine compressor stall is inherent in a jet engine due to the airfoil characteristics of the compressor blades. Compressor stall is an aerodynamic stall caused by the reduction of airflow through the engine. With reduced airflow through the engine, the compressor blades, which are in effect miniature airfoils, stall in a similar manner to an aircraft wing

during slow flight and, as a result of variations in the pattern of reduced airflow across the compressors, complex differences in stalls are created. Compressor blade stalls vary in severity, depending on whether the stall involves only a portion of a stage, a complete stage, several stages, or an entire compressor. Reduced airflow can occur over the complete engine inlet area and can extend back into all of the compressor stages right up to the diffuser section, or it can happen to only one or two stages, or to any degree between these extremes. The usual causes of compressor blade stall are low temperatures, reduced air densities, engine inlet conditions, and the adjustment and operation of the engine fuel control unit and overboard air bleed valve. The propagation of a stall occurs so rapidly it appears to be instantaneous and results in a complete reversal or breaking down of airflow in the engine. This breaking down of airflow occurs as a result of an imposed pressure rise across a stage of compressor blades. An increased pressure rise across a compressor stage results in an increased angle of attack of incoming air with respect to the compressor blades. This also may be thought of as a reduction in the incoming air velocity component which results when pressure rise is increased. Stalling of a single blade or circumferential row of blades will reduce the pressure rise of that compressor stage. This in turn loads up the remaining stages of compression by requiring them to increase the pressure by the amount lost at the stage which stalled. The stalling of one stage will in turn increase the pressure rise at the next stage and cause it to stall since it also is highly loaded. In addition to the compressor blade design contributing to stalls, the high thrust output and low specific fuel consumption of an axial flow compressor engine necessitates that the engine be operated as close as possible to the stall region of the compressors. Stall can be designed out of an engine operating schedule but only at the expense of efficiency. This loss in efficiency would be so great that it is essential that the engine and fuel flow schedule be designed in such a manner that stall will normally be avoided during periods of acceleration, deceleration, and low thrust operation. The occasional stalls experienced during acceleration and deceleration are caused by blade stall. During acceleration, extra fuel is fed to the burners to provide the extra energy needed to accelerate the rotating masses. If engine inlet conditions cause operation to approach a stall, the process begins with a relatively high internal pressure being built up in the combustion chambers as a result of the extra fuel introduced. This slows down the air coming through the high pressure compressor to the point where the air velocity and the rpm in some part of the compressor no longer match up properly and a stall occurs.

When a throttle is retarded with conditions which will produce stall during deceleration, the high pressure compressor slows first because it has the lightest mass. Slowing of the high pressure compressor, in effect, blocks the airflow through the low pressure compressor and, following blade stall, a stall of the low pressure compressor results when the air velocity through it gets low enough. The reduction of airflow through the engine is induced by rapid engine throttle movements, high angle of attack, extreme altitude operation, and high altitude turns. The most common of these conditions is the rapid advancement or retardation of the throttles and high altitude turns. There is another type of compressor stall which appears to originate with ice crystals in the air at high altitudes and which usually is encountered in and around thunderheads. The crystals apparently go into the engine with the air and ingest the engine with water as they are melted during compression. At high altitudes, the actual weight of airflow into the engine is low, so the amount of water required to mix with the air to establish the necessary water/air ratio for water injection is relatively small. Ice crystal stalls appear to be due to operation of the high pressure compressor approaching a stall condition when water is injected at the time of low air density as encountered at high altitude. Compressor stall is usually associated with unstable engine operation and may in some instances be recognized by compressor pulsations which cause very loud explosive reports to be emitted. This may be startling to a flight crew when a severe engine stall is first experienced. Some stalls do not make themselves known by noise or surges, but simply result in the engine not being able to accelerate or in losing rpm with no change in the throttle position. Incipient stall may produce roughness in engine operation with or without any audible reaction. More pronounced stalls may produce audible pulsations of varying intensity. As a "feel" of the engines is acquired with experience, an instinctive sense of how to handle the air-

craft attitude and the engines in order to avoid possible stall producing conditions becomes almost second nature. With recognition of the operational symptoms, it is possible to take corrective action in time to minimize the possibility of engine damage or to correct an engine malfunction. Stall may be avoided or the intensity of a stall reduced by use of the following procedures:

- Avoid erratic or abrupt throttle movements. Rapid throttle advances during periods of high distortion of the air at the engine inlet are sometimes the cause of acceleration stalls.
- Carefully coordinated flying will increase the efficiency of the air inlet ducts and reduce the tendency of engine stall. Airspeeds should be maintained above the acceptable minimum.
- Operation at a higher airspeed and at a reduced angle of attack or rate of climb of the aircraft may help to eliminate a stall condition.
- When a stall occurs, slowly retard the throttle to IDLE or until the stall ceases, then slowly accelerate the engine until the desired thrust is obtained.
- During periods of compressor stall, observe the exhaust gas temperature closely. Reduce the throttle to avoid overtemperaturing when necessary.
- If a stall occurs at high altitude, reduce the altitude, if necessary, to aid stall recovery. Dropping the nose of the aircraft slightly sometimes produces smoother airflow into the inlet duct, eliminating the stall.
- If the stall condition cannot be controlled, shut down the engine depending on circumstances such as whether or not one or more engines have developed uncontrollable stall. Continued severe compressor stall could conceivably be detrimental to an engine.

The conditions of acceleration hangup, engine surge, and engine flameout are associated with respective characteristics of engine compressor stall and may be either reduced in intensity or avoided by use of applicable procedures.

ENGINE SPEED FLUCTUATIONS

Engine instability may occur because of some malfunction in the engine or fuel control and may be recognized if any of the following are noted:

1. Erratic increase of turbine exhaust gas temperature.
2. Rapid reduction or fluctuation of rpm at constant throttle setting or failure of rpm to continue to increase during acceleration.
3. Shock of compressor pulsations felt in the aircraft structure.
4. Loss of power reflected in aircraft instruments.
5. No response of EPR to throttle movement.

Corrective Measures

ACCELERATION. If erratic engine performance is experienced during acceleration of the aircraft:

1. Retard throttle to IDLE position.
2. Obtain stable operation.
3. Slowly advance throttle to the desired power condition.

STEADY STATE OPERATION. While in a stabilized cruise condition, if erratic engine performance is experienced:

1. Slowly retard or advance throttle to a more stable power range.
2. Reduce altitude.

While in a stabilized climb condition, if erratic engine performance is experienced:

1. Slowly retard or advance throttle to a more stable power range.
2. Increase airspeed by reducing climb.

DECELERATION. During periods of deceleration of the aircraft, if erratic engine performance is experienced:

1. Change the throttle position to obtain stable engine operation.
2. Slowly adjust throttle to the desired power condition.

DECELERATION STALLS ABOVE 30,000 FEET.

The following procedure will be used when retarding throttles above 30,000 feet:

1. Move throttles slowly and smoothly (15 to 30 seconds for full throttle movement).
2. Advance throttles momentarily.
3. Retard throttles to desired setting.

NOTE

A throttle increase immediately speeds up the N-2 rotor. Then, before the N-1 rotor can follow, the throttle decrease cuts fuel

flow causing both rotors to decelerate together thereby reducing stall possibility. Finally, the N-1 and N-2 rotors restabilize at the lower power setting.

4. If stall develops, increase airspeed to correct stall condition.

5. Monitor engine instruments.

6. Shut down engine if EGT approaches maximum limit.

NOTE

Restart may be attempted after engine has been shut down and windmill rpm stabilizes.

7. Make Form 781 entry of all deceleration stalls encountered.

ACCELERATION HANGUP

Acceleration hangup is a type of malfunction in which the engine fails to accelerate past a specific rpm. This hangup sometimes occurs after the throttle has been retarded and an attempt has been made to accelerate to a higher rpm. Acceleration hangup can be attributed to a faulty fuel control unit or to continuous engine stall. In case of a faulty fuel control unit, engine shutdown may be necessary; in the case of continuous engine stall, it may be necessary to reduce power, increase airspeeds, or decrease altitude.

ENGINE SURGE

Engine surge, which is intermittent engine compressor stall, produces thrust variations which may be indicated by fuel flow fluctuations or a marked rise in EGT. Shock and pulsation can frequently be felt, sometimes heard, in the cockpit during flight. Although there have been occasions when engine surge has occurred on the ground, it usually manifests itself above 45,000 feet. It generally occurs with rapid throttle movements during slow speed (high angle of attack) flight or high altitude turns. Surging which occurs during engine acceleration usually ceases as the engine speed increases. If it does not, a power reduction followed by a slower rate of throttle advance will usually give satisfactory results. Surging which occurs during slow speed high angle of attack flight (usually with fixed throttles) may require changing the throttle position of the affected engines and/or an increase in airspeed to furnish relief. Persistent or severe surge occasionally results in engine flameout unless very prompt corrective actions are taken.

ENGINE FLAMEOUT

Engine flameout is the complete loss of combustion. The main causes for flameout are unstable engine operation such as a compressor stall condition and engine fuel starvation. Flameout from compressor stall usually occurs at altitudes above 45,000 feet and results from a change in the inlet air pressure gradient of the engine at high angles of attack. Fuel starvation to the engine generally is associated with low main tank fuel quantity during penetration maneuvers when for a brief period of time all or most of the boost pumps in a main tank may become uncovered. Uncoordinated maneuvers, negative "g's" plus the effects of deceleration, pitch and turbulence increase the possibility of uncovering operable boost pumps. To reduce the possibility of engine flameout, it is recommended that during transition phase of flight (penetration and low approaches) extreme pitch and roll angles and abrupt or uncoordinated maneuvers be avoided whenever possible. If engine flameout does occur, the rpm and EGT will begin dropping at once. Generally engine flameout can be remedied by restarting the engine. For additional information and proper inflight restarting procedure, see "Engine Flameout and Relight" and "Engine Air Starting" under "Engine Failure" in Section III.

PRACTICE ENGINE SHUTDOWN AND AIR STARTING



It is recommended that engine shutdown and air starting be practiced at altitudes between 10,000 and 37,250 feet, one engine at a time. Practice starts should be made in the "Normal Windmilling Start" area of the air start envelope (figure 3-3). Air starts may be demonstrated in the "Probable Start" range but the "Possible Slow or Hot Start" area should be avoided except in an actual emergency. Use of the engine starters for air starts is restricted to emergencies only.

1. Throttle - IDLE for 3 minutes

The throttle for the engine to be shut down should be retarded to IDLE for 3 minutes before the engine is shut down.

2. Generator Switch - OFF (if applicable)

If the engine to be shut down drives a generator, the generator should be taken off the line so that it will not be motored by power from the others in case of high windmill speeds or system malfunction which would not allow the generator to be taken off the line

automatically. Check that the generator circuit breaker position indicator shows open. Make certain that the remaining generators are not overloaded. Reduce loads if necessary.

3. Throttle - CLOSED

4. Restart - See "Engine Air Starting Checklist," Section III

After windmilling rpm has stabilized, the engine will be started using the procedure outlined under "Engine Air Starting," Section III.

VARYING EXHAUST GAS TEMPERATURE

Varying exhaust gas temperature will be accompanied by engine rpm fluctuations that follow the EGT. Depending on the magnitude of the fluctuations, the indications will be the same as an unstable engine speed fluctuation. The same corrective procedures will apply. Monitor the engine operation within operating limits of rpm and EGT.

MONITORING EGT DURING TAKEOFF

The EGT of a normally operating engine will usually peak considerably sooner than the 2-minute engine acceleration time limit. Therefore, it is important that the pilot not physically make the takeoff monitor EGT during the takeoff roll and as soon after unstuck as possible. Throttles should be retarded to maintain the appropriate EGT limits. Normally, a very small reduction in throttle setting will return an EGT to within limits.

ENGINE STARTER HANGUP

Starter hangup is a type of malfunction wherein the starter fails to drop out during engine start. Starter dropout should occur at approximately 35% to 45% rpm. J57-P-43WB engines are subject to "hung" starts, especially at temperatures of 45° F (7° C) and below. In freezing temperature, a hung start may result from improper sensing caused by water or ice formation if there is an accumulation of water in the compressor burner pressure bellows chamber of the engine fuel control unit. On some engines, a drain screw has been installed to provide a means for maintenance personnel to drain accumulated moisture from the compressor burner pressure bellows chamber. During freezing temperature, if ice has formed, it may be melted to allow drainage by directing hot air on the engine fuel control unit. Hung starts may also be prevented by blocking the escape of air from the compressor bleed valve in accordance with applicable maintenance procedures. The escape of compressor bleed air prevents the starter from disengaging due to lack of acceleration in starting rpm. Hung starts are usually characterized by failure of the engine to accelerate beyond 40% rpm. The

EGT may rise slowly but should not be allowed to exceed the starting limit. The engine incorporates a compressor bleed valve which will remain closed during starting to eliminate hung starts caused by lack of acceleration. If an engine does not accelerate to idle rpm within 90 seconds or if a tendency to exceed other limits is observed, proceed with engine shutdown in order to obtain a satisfactory start following applicable maintenance hung start procedures.

ENGINE IGNITION AND STARTING SYSTEM OPERATION

When the engine accelerates above starter cutout speed, the starter relay becomes deenergized. This prevents the starter from reengaging if the engine speed drops below starter cutout speeds, even though the starter switch remains in ON position. However, if the starter switch is returned to OFF position and the engine speed drops below starter cutout speed, the starter relay will become energized. Then if the starter switch is turned ON while the engine is still rotating, starter coupling shaft failure can result.

FUEL SYSTEM OPERATION

A schematic of the fuel system showing the detailed mechanical configuration and function of the various fuel lines is given in figure 7-1.

FUEL SYSTEM CHECKOUT

WARNING

During ground operations do not place the body or external tanks fuel flow control switches to the ENGINE FEED position when these tanks are empty. With the aircraft in a level attitude the tanks are considered empty when the applicable tank gage reading is at or less than 300 pounds in the forward body, 1,000 pounds in the mid body, 1,200 pounds in the aft body, or 100 pounds in an external.

A complete checkout of the fuel feed system for all tanks may be accomplished as follows (figure 7-2):

NOTE

- When pump pressure has caused the pump pressure checkout light to glow, the pressure is trapped in the line and the light will not go out immediately unless the pump pressure checkout press-to-relieve button is depressed. When it is stated in the following steps that the light goes out after a valve is closed or the pumps in a tank are turned off, it is to be understood that after the described action has been accomplished, the press-to-relieve button is depressed until the light goes out.

- Air trapped in the main manifold may cause additional time to be required to relieve pressure in the main manifold when checking auxiliary tank boost pumps. This additional time required can be substantially reduced by turning the master refuel switch to ON, valve 29 to OPEN, and turning the tank switch of any tank that is less than full to REFUEL prior to depressing the press-to-relieve button.

Depress fuel quantity gage press-to-test button to assure proper operation of fuel gages and observe that wing tank warning lights come on.

1. Pump Pressure Checkout Switch - MAINS, light out
2. Fuel System Panel Switches 4 & 12 - ON and OPEN, light on
3. Switch No. 12 - CLOSED, light out
4. Switch No. 4 - OFF
5. Switches No. 3 & 11 - ON and OPEN, light on
6. Switch No. 11 - CLOSED, light out
7. Switch No. 3 - OFF
8. Switches No. 2 & 10 - ON and OPEN, light on
9. Switch No. 10 - CLOSED, light out
10. Switch No. 2 - OFF
11. Switches No. 1 & 9 - ON and OPEN, light on
12. Switch No. 9 - CLOSED, light out
13. Switch No. 1 - OFF
14. Pump Pressure Checkout Switch - AUX
15. Switches No. 17, 13 & 9 - ENGINE FEED, OPEN, and OPEN, light on, left wing tank warning light comes on.
16. Switch No. 17 - OFF, lights out
17. Switch No. 18 - ENGINE FEED, light on
18. Switch No. 13 - CLOSED, light out
19. Switches No. 9 & 18 - CLOSED and OFF
20. Switches No. 28, 14 & 10 - ENGINE FEED, OPEN, and OPEN, light on
21. Switch No. 28 - OFF, light out
22. Switches No. 29 & 27 - OPEN and ENGINE FEED, light on
23. Switches No. 29 & 14 - CLOSED, then OPEN (in order), light out, then on (each time)
24. Switches No. 10, 14, 29 & 27 - CLOSED, CLOSED, CLOSED, and OFF, light out
25. Switches No. 26, 15 & 11 - ENGINE FEED, OPEN, and OPEN, light on
26. Switch No. 26 - OFF, light out
27. Switch No. 25 - ENGINE FEED, light on
28. Switch No. 15 - CLOSED, light out
29. Switches No. 11 & 25 - CLOSED and OFF
30. Switches No. 12, 16 & 23 - OPEN, OPEN, and ENGINE FEED, light on
31. Switch No. 16 - CLOSED, then OPEN, light out, then on
32. Switch No. 23 - OFF, light out
33. Switch No. 24 - ENGINE FEED, light on, right wing tank warning light comes on.
34. Switches No. 12, 16 & 24 - CLOSED, CLOSED, and OFF, lights out
35. Pump Pressure Checkout Switch - OFF

FUEL SYSTEM MANAGEMENT

WARNING

During flight, the body and external tanks, fuel flow control switches will be turned OFF when the gage reads empty or the fuel flow indicator light indicates no fuel flow from the tank. Do not return the switch to ENGINE FEED position while the tank is empty.

The fuel supply system is designed so that the engines receive fuel from the nearest of the four main tanks or from the main manifold. The main manifold is pressurized by the auxiliary tanks. When auxiliary fuel is being used, main tank boost pump switches are ON. The boost pumps in the auxiliary tanks are of higher capacity than the boost pumps in the main tanks thus allowing a pressure override condition to exist. When an auxiliary tank runs dry, the main tank boost pumps take over fuel supply to the engines with no interruption in fuel flow. A crossfeed manifold is provided which makes it possible to interconnect the fuel feed systems to each nacelle. Proper management of the fuel supply system for any step in the fuel usage sequence is given in the following figures:

- With no external missiles - Figures 7-3 and 7-4
- With two thru 12 external AGM-69A missiles-two pylons-symmetrical loading - Figure 7-5
- With one thru four external AGM-69A missiles on one pylon - Figure 7-7
- With five or six external AGM-69A missiles on one pylon - Figure 7-8

At any time an unusual combination of engines is used, care should be taken to manage fuel so as to maintain proper center of gravity and fuel distribution. See Section V for further information on fuel loading, cg location, and aircraft gross weight limitations. Also, see "Fuel Management for Lateral Trim" under "Climb" in Section II.

NOTE

- The aircraft shall be loaded with fuel in accordance with requirements of T.O. 1B-40, Handbook of Weight and Balance Data. Details of fuel loading are given in T.O. 1B-52G-5. The fuel usage sequences given below were designed to be used in conjunction with proper fuel loading procedures and by following these sequences, maximum aircraft service life can be realized.

- When an auxiliary tank fuel flow control switch is in the ENGINE FEED position and the fuel flow indicator light fails to flash when it is anticipated that the tank should be empty, monitor the applicable main tank quantity gage for an indication of fuel use. A decrease in main tank fuel quantity shows that the auxiliary tank is not maintaining pressure (flow); therefore, the next sequence step should be set.

Fuel Scavenging

When all auxiliary fuel has been used (to empty or down to required ballast), the main manifold will be scavenged as follows:

1. Mains to all engines
2. Scavenge system switch to MAIN
3. Main manifold interconnect valve switch No. 29 to OPEN

Turn scavenge system switch OFF and switch 29 to CLOSED as soon as the fuel-in-manifold light goes out.

Fuel Usage Sequence (No External Missiles) — Operating Weight (Basic Weight Plus Crew and Oil) CG from 21% to 28.5% MAC

See figure 7-4 for abbreviated fuel sequence for each of the following steps:

1. TAKEOFF. One of three fuel configurations is used for takeoff, depending on the aircraft fuel loading as described below:

- For takeoff with mains 1 and 4 above green band and center wing and aft body contain 2,000 pounds or more each.

AFT BODY TO 1 AND 2
NO. 2 MAIN TO 3 AND 4
NO. 3 MAIN TO 5 AND 6
CENTER WING TO 7 AND 8

Turn fuel panel switches 1, 2, 3, and 4 to ON, 13 and 16 to OPEN, 26 and 28 to ENGINE FEED, all other switches to OFF or CLOSED. Engines 3, 4, 5, and 6 are being fed directly from the main tanks. Engines 1, 2, 7, and 8 are being fed from the main manifold by the pressure override condition.

- For takeoff with mains 1 and 4 above green band and either center wing or aft body less than 2,000 pounds.

MAINS TO ALL ENGINES

Turn fuel panel switches 1, 2, 3, and 4 to ON, all other switches to OFF or CLOSED. All engines are being fed directly from the main tanks.

- For takeoff with main 1 or 4 in green band.
MAINS TO ALL ENGINES (CROSSFEED VALVES OPEN)

Turn fuel panel switches 1, 2, 3, and 4 to ON, 9, 10, 11, and 12 to OPEN, all other switches to OFF or CLOSED. All engines are being fed directly from the main tanks.

-  **PRESSURE SWITCH**
-  **MANUAL DRAIN VALVE**
-  **RELIEF VALVE**
-  **FUEL FLOW INDICATOR**
-  **CHECK VALVE PRESSURE LOADED**
-  **FUEL LEVEL CONTROL VALVE**
-  **CENTRIFUGAL PUMP**
-  **INLINE FLOAT SWITCH**
-  **FUEL PRESSURE DISCONNECT SWITCH**
-  **SOLENOID VALVE**
-  **SCAVENGE PUMP**
-  **OR VALVE, SWING CHECK**
-  **AUXILIARY TANK ENGINE FEED CONTROL VALVE**
-  **ENGINE CROSSFEED MANIFOLD VALVE**
-  **ENGINE FIREWALL FUEL SHUTOFF VALVE**
-  **MAIN MANIFOLD INTERCONNECT VALVE**
-  **DEFUEL VALVE**

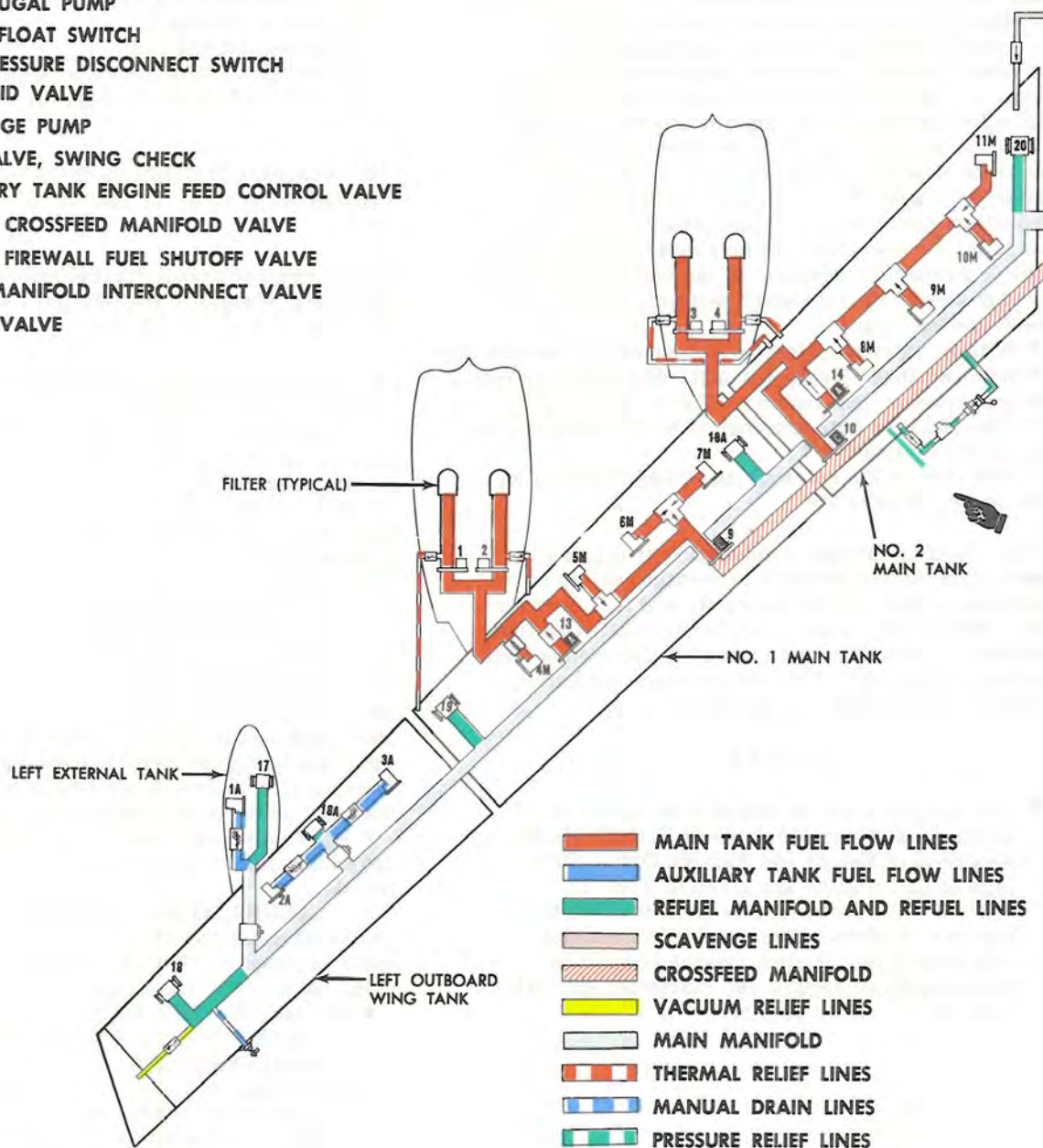
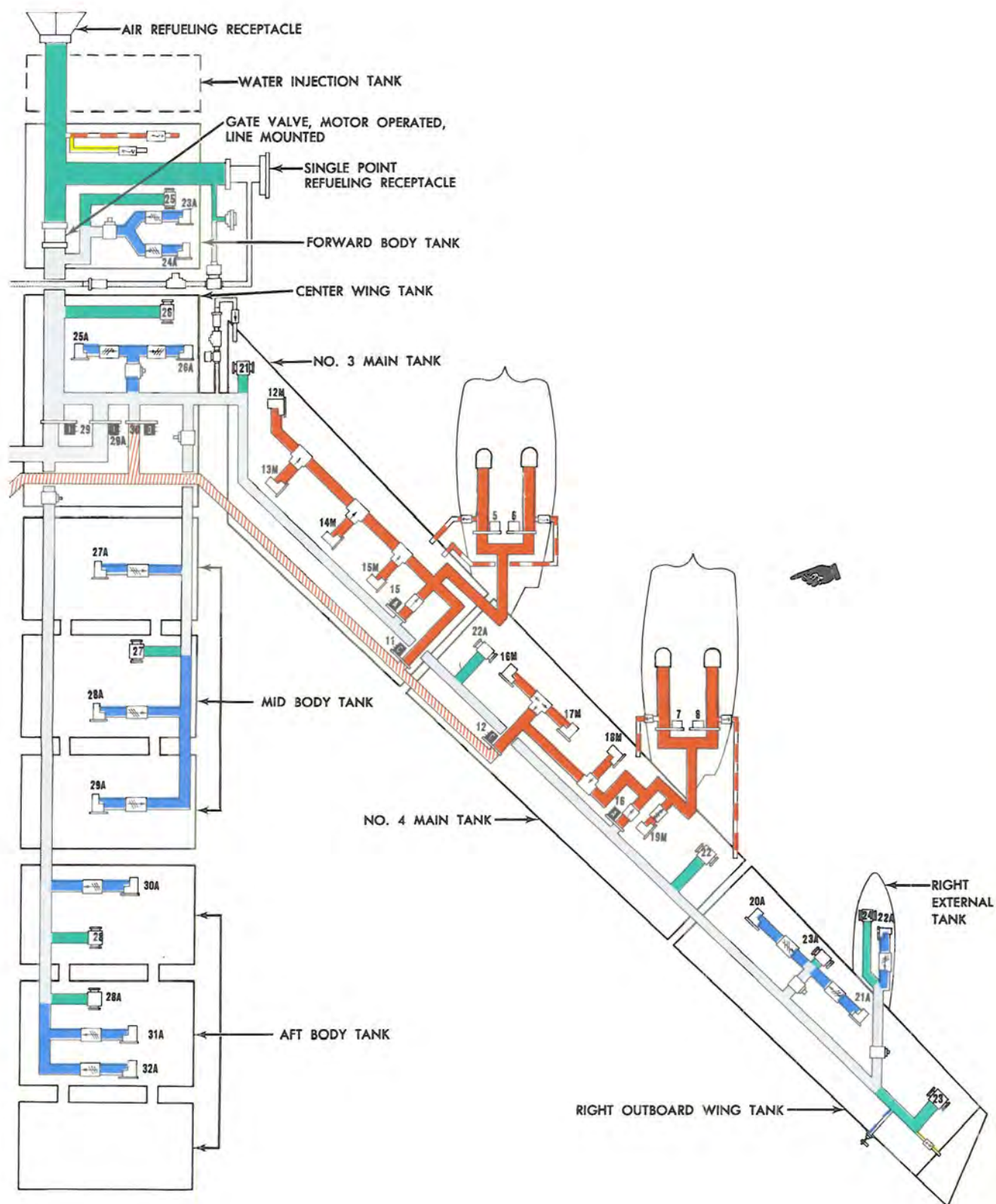


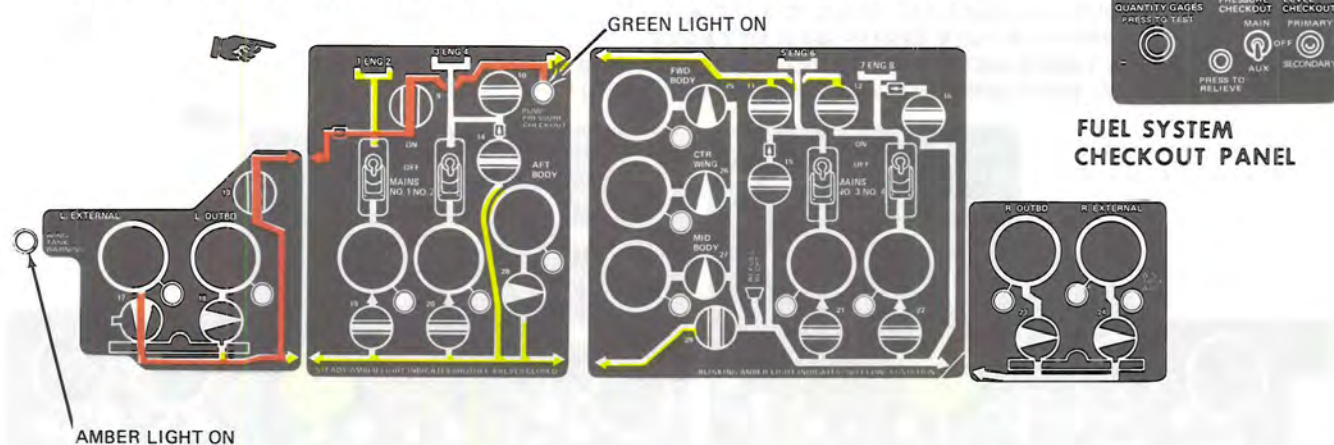
Figure 7-1 (Sheet 1 of 2).



.....Fuel System Composite (Typical)

Figure 7-1.(Sheet 2 of 2).

CHECKOUT OF LEFT EXTERNAL TANK SHOWN (TYPICAL)



FUEL FLOW

STATIC

PUMP PRESSURE CHECK OF FUEL TANKS

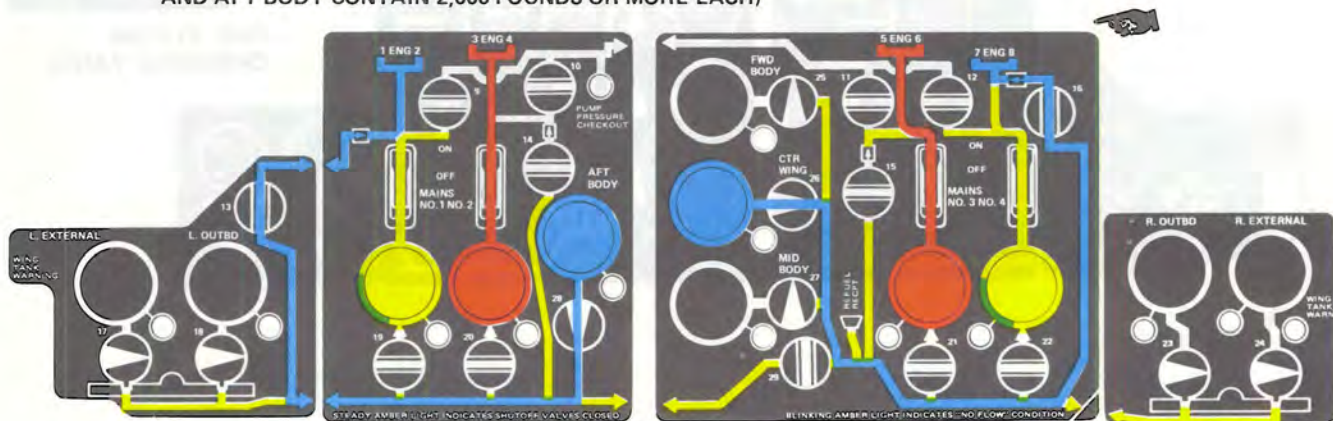
PUMP PRESSURE CHECKOUT SWITCH POSITION	TANK TO BE CHECKED	FUEL MANAGEMENT SWITCHES — ON, OPEN OR ENGINE FEED (All other fuel management switches CLOSED or OFF)
 MAINS OFF AUX.	AUX TANKS: LEFT EXTERNAL LEFT OUTBOARD AFT BODY MID BODY CENTER WING FORWARD BODY RIGHT OUTBOARD RIGHT EXTERNAL	17, 13, and 9 18, 13, and 9 28, 14, and 10 27, 29, 14, and 10 26, 15, and 11 25, 15, and 11 23, 16, and 12 24, 16, and 12
 MAINS OFF AUX.	MAIN TANKS: NO. 4 NO. 3 NO. 2 NO. 1	4 and 12 3 and 11 2 and 10 1 and 9

■■■■■■■■■■ Fuel System Checkout (Typical)

Figure 7-2.

STEP 1: TAKEOFF

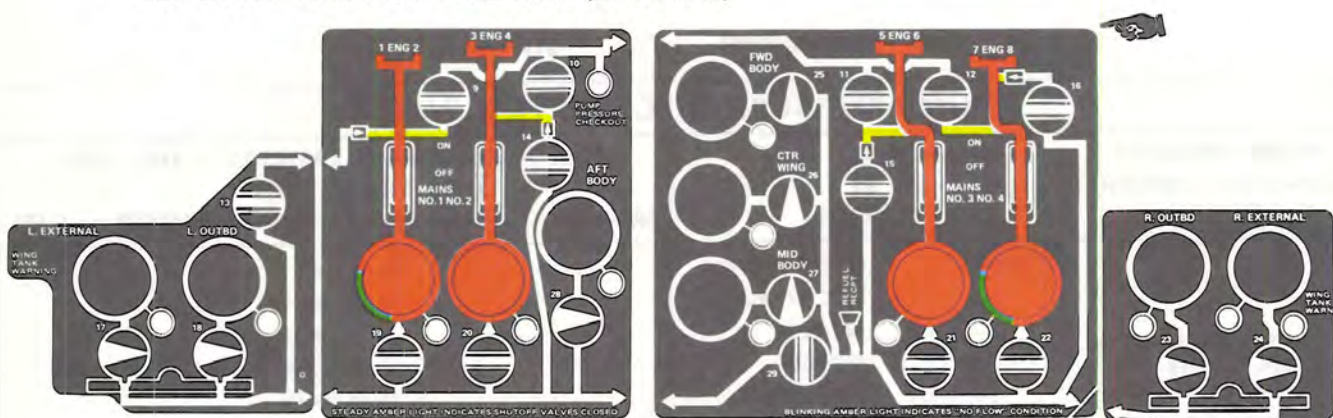
AFT BODY TO 1 AND 2; NO. 2 MAIN TO 3 AND 4;
 NO. 3 MAIN TO 5 AND 6; CENTER WING TO 7 AND 8
 (MAINS 1 AND 4 ABOVE GREEN BAND AND CENTER WING
 AND AFT BODY CONTAIN 2,000 POUNDS OR MORE EACH)



OR _____

MAINS TO ALL ENGINES

(MAINS 1 AND 4 ABOVE GREEN BAND AND EITHER
 CENTER WING OR AFT BODY LESS THAN 2,000 POUNDS)



OR _____

MAINS TO ALL ENGINES (CROSSFEED VALVES OPEN)
 (MAIN 1 OR 4 IN GREEN BAND)

- MAIN FUEL FLOW
- CROSSFEED MAIN FUEL FLOW
- AUXILIARY FUEL FLOW
- STATIC FUEL

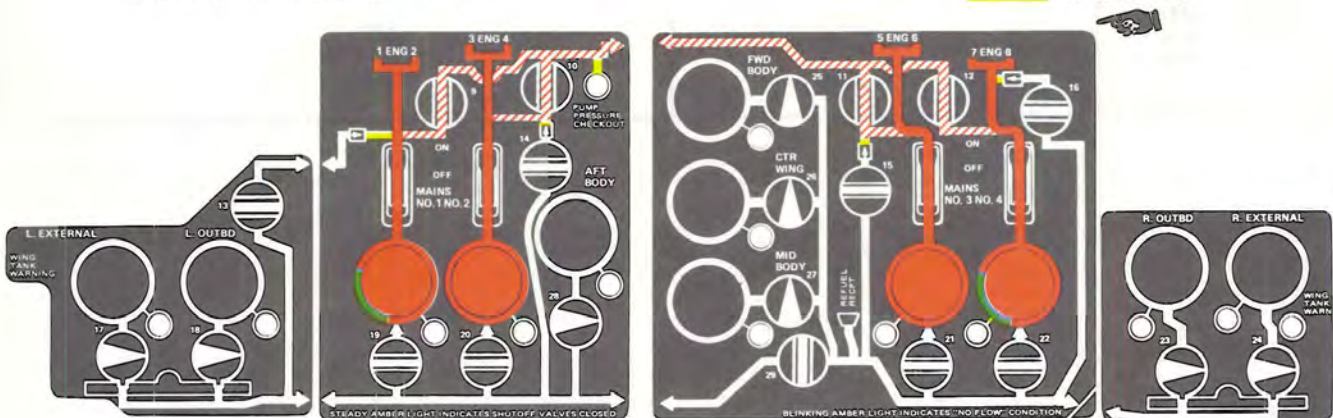
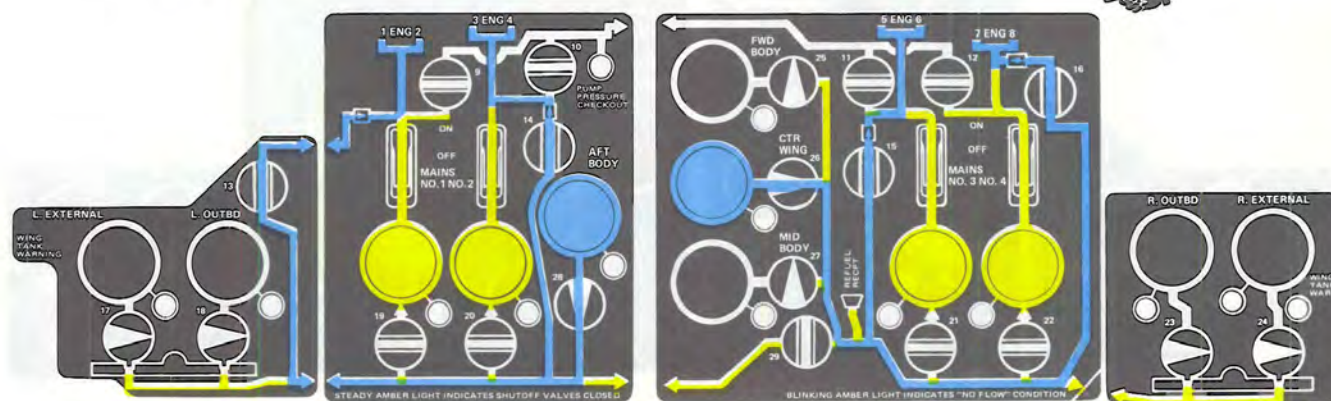
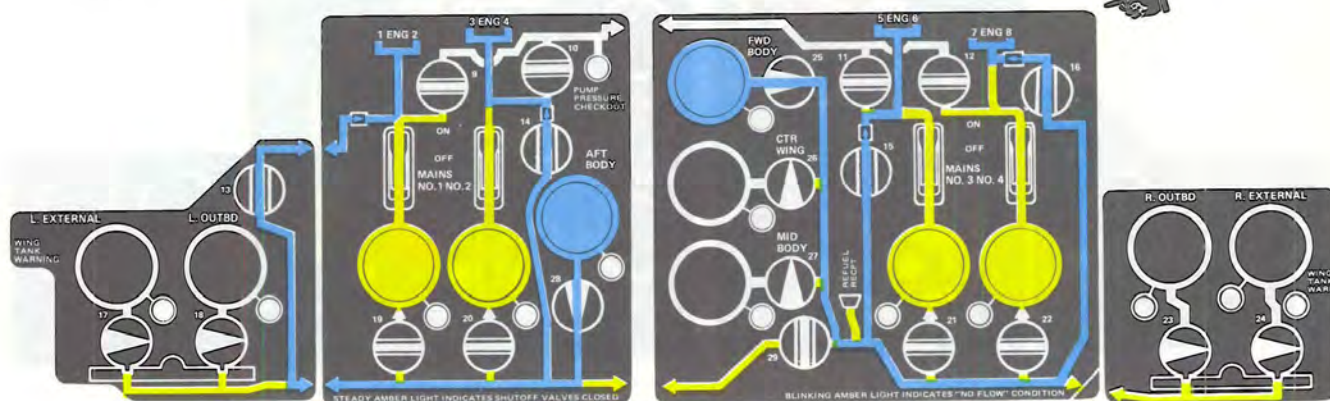


Figure 7-3 (Sheet 1 of 6).

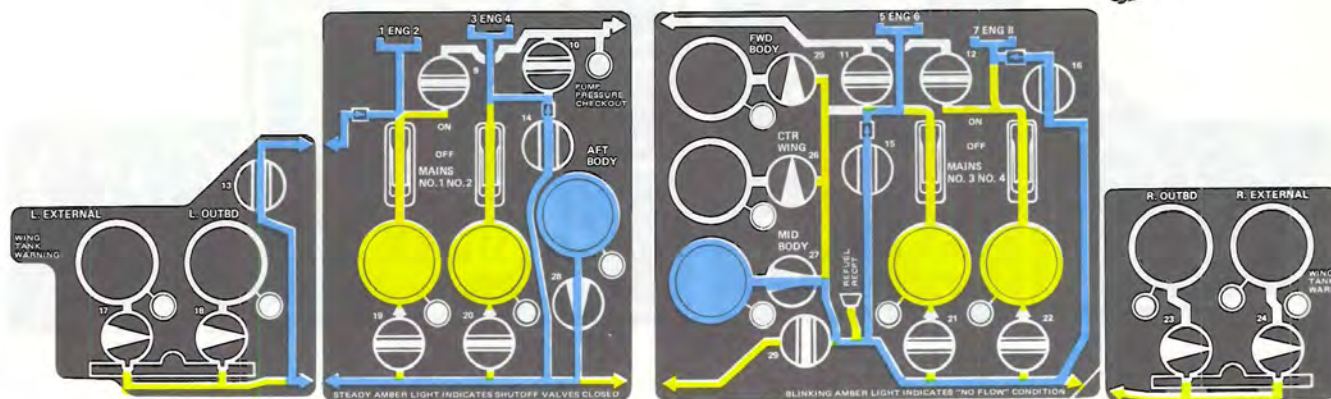
STEP 2: AFT BODY TO 1, 2, 3, AND 4; CENTER WING TO 5, 6, 7, AND 8 TO EMPTY



STEP 3: AFT BODY TO 1, 2, 3, AND 4; FWD BODY TO 5, 6, 7, AND 8 TO BALLAST



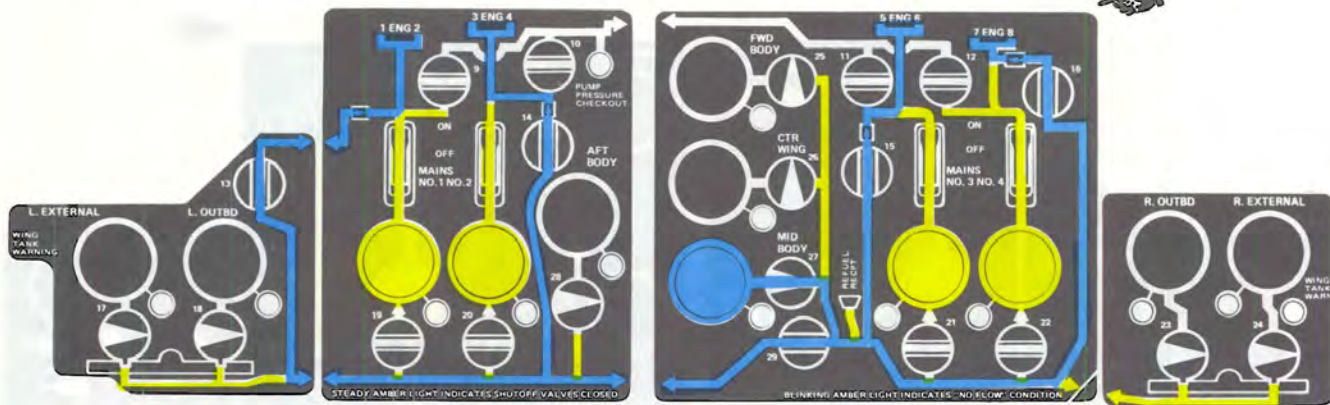
**STEP 4: AFT BODY TO 1, 2, 3, AND 4 – TO 5,700 POUNDS NOT REFUELED – TO 9,700 POUNDS AFTER AIR REFUELING
MID BODY TO 5, 6, 7, AND 8**



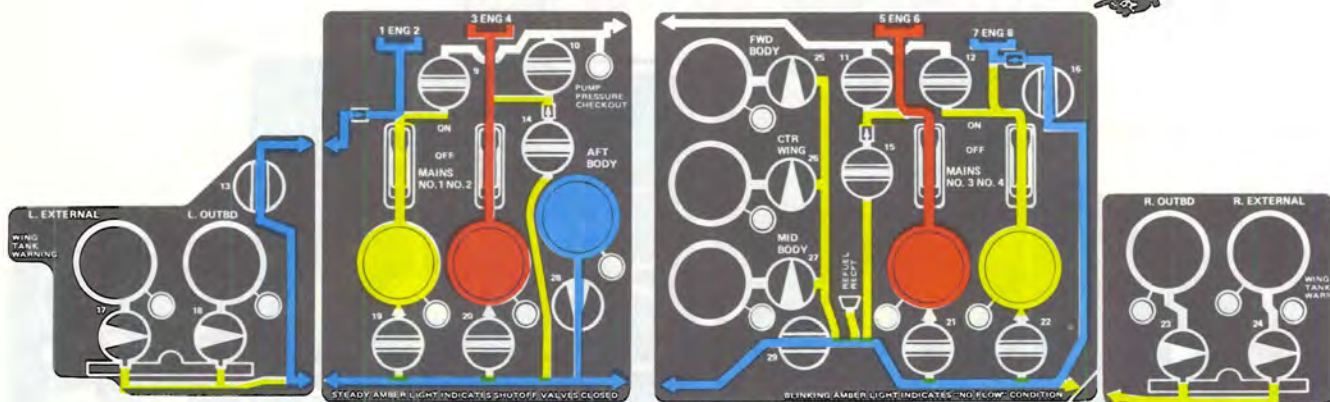
■■■■■■■■■■ Fuel System Operation (Typical)

Figure 7-3 (Sheet 2 of 6).

STEP 5: MID BODY TO ALL ENGINES TO EMPTY



STEP 6: AFT BODY TO 1, 2, 7, AND 8 TO EMPTY; NO. 2 MAIN TO 3 AND 4; NO. 3 MAIN TO 5 AND 6



STEP 7: MAINS TO ALL ENGINES TO GREEN BAND FOR 1 AND 4

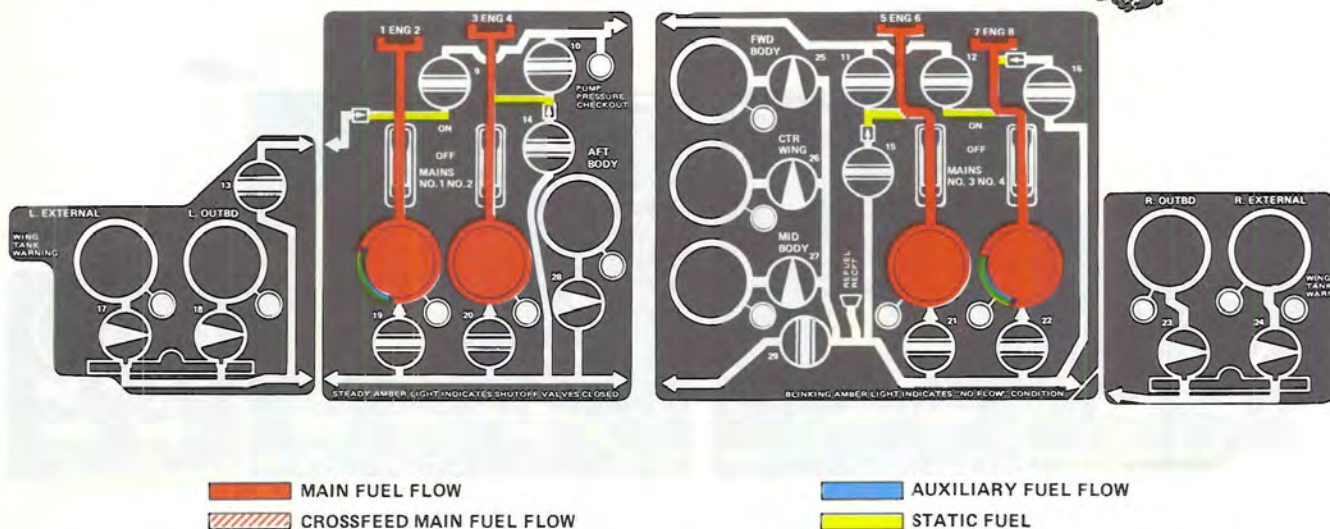
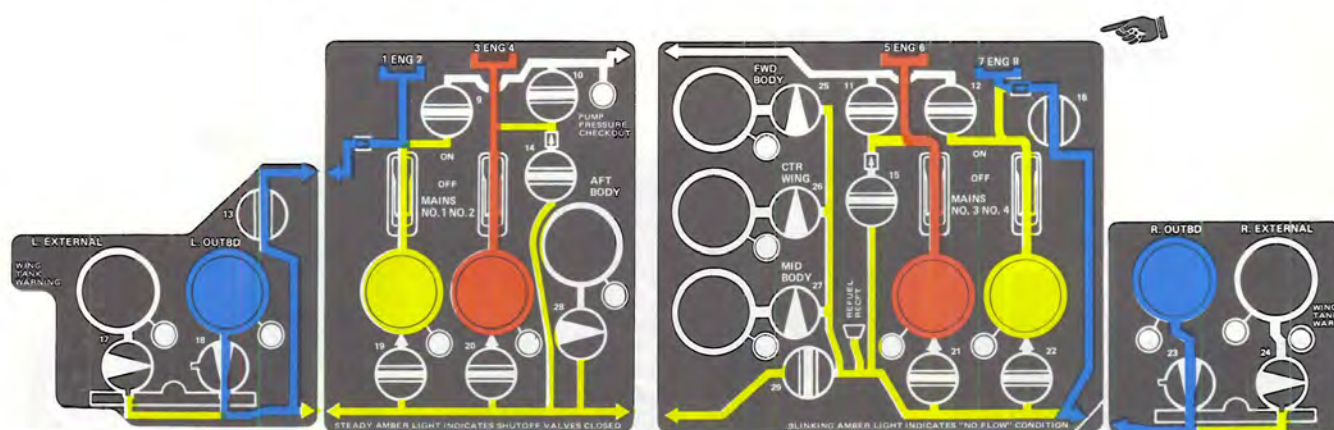
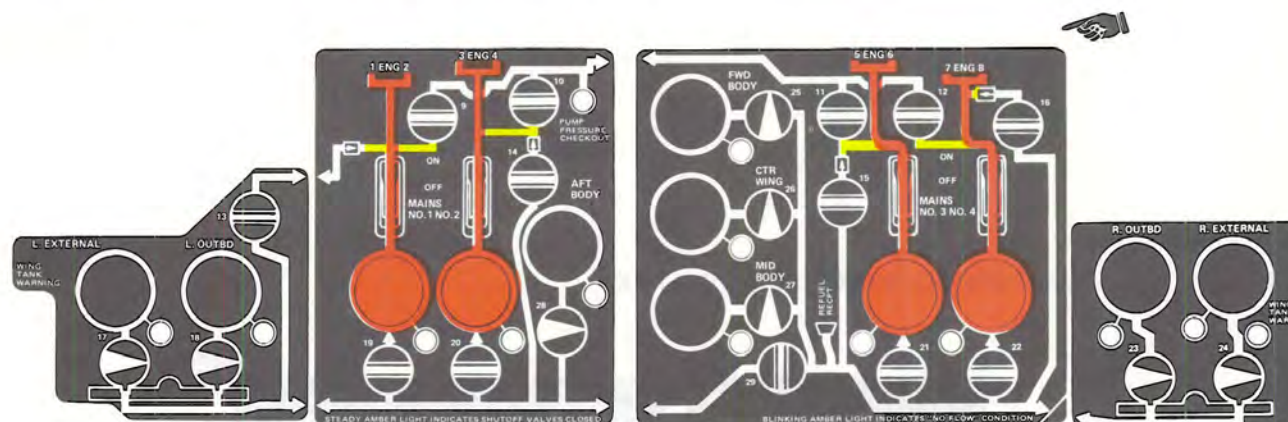


Figure 7-3 (Sheet 3 of 6).

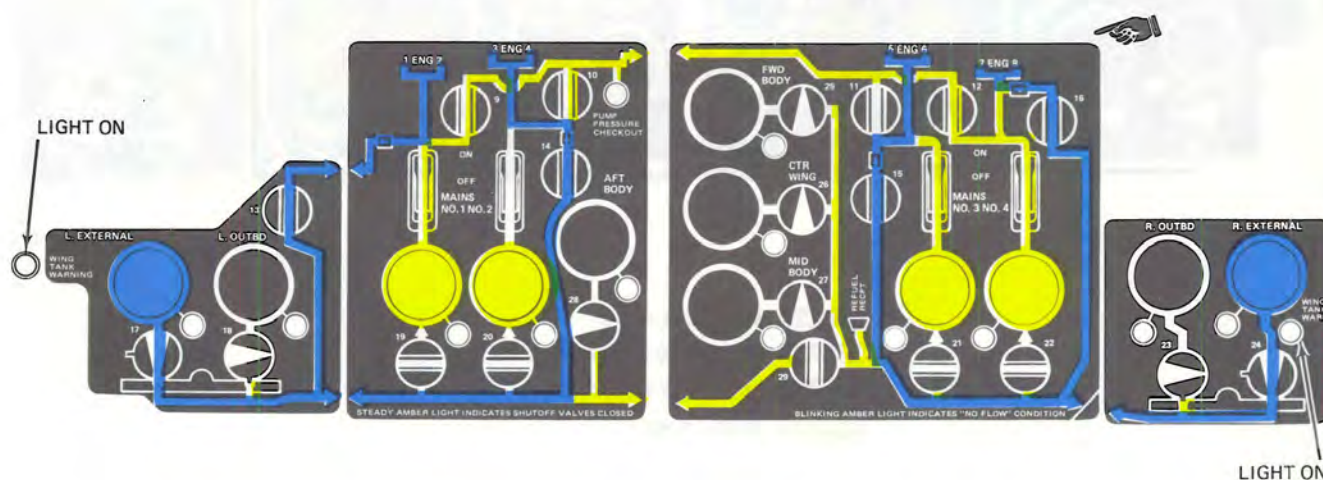
STEP 8: LEFT OUTBOARD TO 1 AND 2 TO EMPTY; NO. 2 MAIN TO 3 AND 4; NO. 3 MAIN TO 5 AND 6; RIGHT OUTBOARD TO 7 AND 8 TO EMPTY



STEP 9: MAINS TO ALL ENGINES TO 5,000 POUNDS EACH



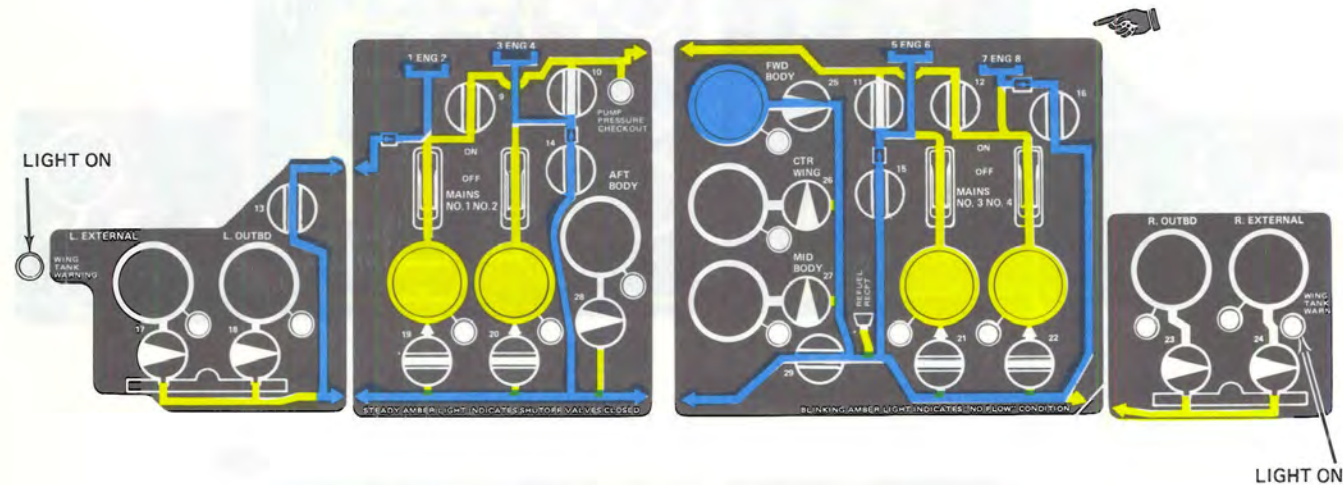
STEP 10: LEFT EXTERNAL TO 1, 2, 3, AND 4 TO EMPTY; RIGHT EXTERNAL TO 5, 6, 7, AND 8 TO EMPTY (CROSSFEED VALVES OPEN)



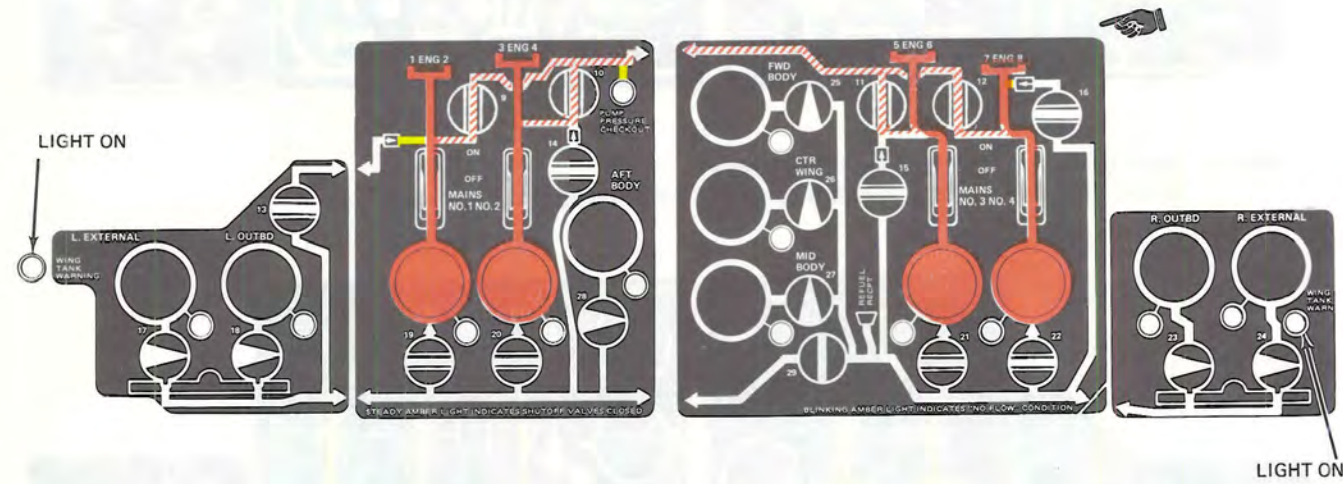
■■■■■■■■■■ Fuel System Operation (Typical)

Figure 7-3 (Sheet 4 of 6).

STEP 11: FWD BODY (BALLAST) TO ALL ENGINES TO EMPTY
(CROSSFEED VALVES OPEN)

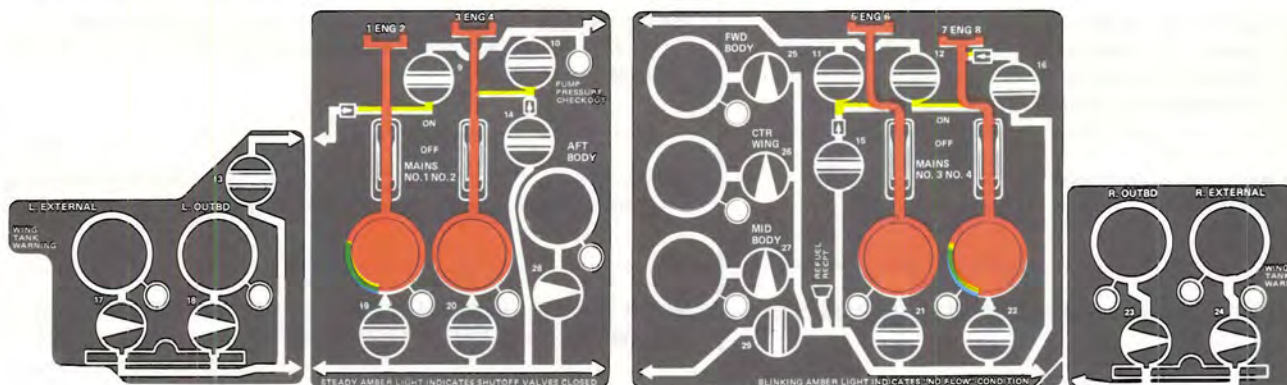


STEP 12: MAINS TO ALL ENGINES (CROSSFEED VALVES OPEN)



- MAIN FUEL FLOW
- CROSSFEED MAIN FUEL FLOW
- AUXILIARY FUEL FLOW
- STATIC FUEL

Figure 7-3 (Sheet 5 of 6).



OR _____

MAINS TO ALL ENGINES (CROSSFEED VALVES OPEN) – (MAIN 1 OR 4 IN GREEN BAND OR ANY MAIN BELOW 5,000 POUNDS)

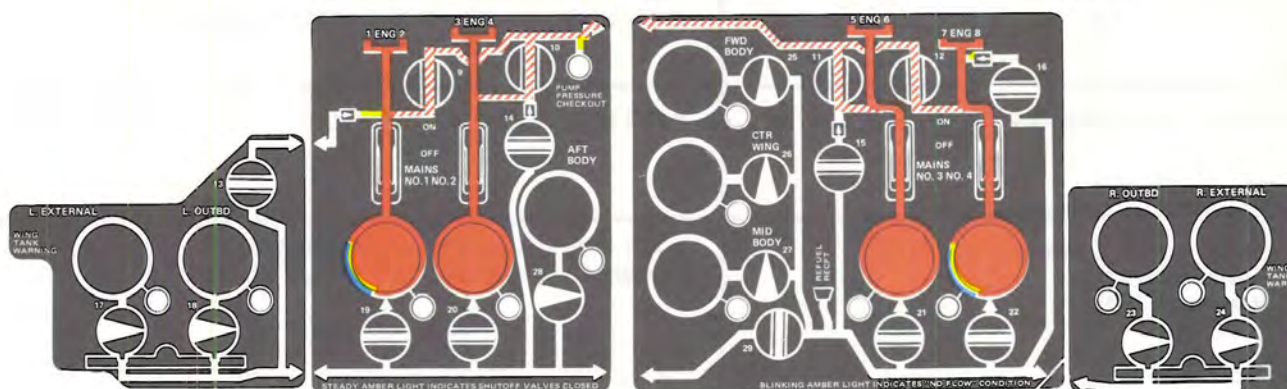


Figure 7-3 (Sheet 6 of 6).

Figure 7-3A (Deleted)

■■■■■■■■■■■■■■■■■■■■ FUEL SEQUENCE (NO EXTERNAL MISSILES) ■■■■■■■■■■■■■■■■■■■■

NOTE

OPERATING WEIGHT (BASIC WEIGHT PLUS CREW AND OIL) CG FROM 21% TO 28.5% MAC

STEP 1 TAKEOFF	
AFT BODY TO 1 AND 2 NO. 2 MAIN TO 3 AND 4 NO. 3 MAIN TO 5 AND 6 CENTER WING TO 7 AND 8 ----- OR -----	● FOR TAKEOFF WITH MAINS 1 AND 4 ABOVE GREEN BAND AND CENTER WING AND AFT BODY CONTAIN 2,000 POUNDS OR MORE EACH
MAINS TO ALL ENGINES ----- OR -----	● FOR TAKEOFF WITH MAINS 1 AND 4 ABOVE GREEN BAND AND EITHER CENTER WING OR AFT BODY LESS THAN 2,000 POUNDS
MAINS TO ALL ENGINES (CROSSFEED VALVES OPEN)	● FOR TAKEOFF WITH MAIN 1 OR 4 IN GREEN BAND. OPEN ALL CROSSFEED VALVES (9, 10, 11, AND 12)
STEP 2	
AFT BODY TO 1, 2, 3, AND 4 CENTER WING TO 5, 6, 7, AND 8	● CENTER WING TO EMPTY
STEP 3	
AFT BODY TO 1, 2, 3 AND 4 FWD BODY TO 5, 6, 7, AND 8	● FWD BODY TO BALLAST FUEL SHOWN IN FIGURE 7-4A
STEP 4	
AFT BODY TO 1, 2, 3, AND 4 MID BODY TO 5, 6, 7, AND 8	● AFT BODY TO 5,700 POUNDS (NOT REFUELED) ----- ● AFT BODY TO 9,700 POUNDS AFTER AIR REFUELING
STEP 5	
MID BODY TO ALL ENGINES	● MID BODY TO EMPTY
STEP 6	
AFT BODY TO 1, 2, 7, AND 8 NO. 2 MAIN TO 3 AND 4 NO. 3 MAIN TO 5 AND 6	● AFT BODY TO EMPTY. AFTER THIS STEP, MAINS 2 AND 3 WILL BE DOWN TO APPROXIMATELY 38,700 POUNDS EACH
STEP 7	
MAINS TO ALL ENGINES	● MAINS 1 AND 4 TO GREEN BAND. AFTER THIS STEP, MAINS 2 AND 3 WILL BE IN GREEN BAND AREA



Figure 7-4 (Sheet 1 of 2).

STEP 8 LEFT OUTBOARD TO 1 AND 2 NO. 2 MAIN TO 3 AND 4 NO. 3 MAIN TO 5 AND 6 RIGHT OUTBOARD TO 7 AND 8	● OUTBOARDS TO EMPTY. AFTER THIS STEP, ALL MAINS WILL BE DOWN TO APPROXIMATELY 9,000 POUNDS EACH. ● UTILIZE OUTBOARD FUEL AS NECESSARY TO OBTAIN THE DESIRED 9,000 POUNDS
STEP 9 MAINS TO ALL ENGINES	● ALL MAINS TO 5,000 POUNDS EACH
STEP 10 LEFT EXTERNAL TO 1, 2, 3, AND 4 RIGHT EXTERNAL TO 5, 6, 7 AND 8 (CROSSFEED VALVES OPEN)	● OPEN ALL CROSSFEED VALVES (9, 10, 11, AND 12) ● EXTERNALS TO EMPTY
STEP 11 FWD BODY (BALLAST) TO ALL ENGINES (CROSSFEED VALVES OPEN)	● OPEN ALL CROSSFEED VALVES (9, 10, 11, AND 12) ● FWD BODY TO EMPTY
STEP 12 MAINS TO ALL ENGINES (CROSSFEED VALVES OPEN)	● OPEN ALL CROSSFEED VALVES (9, 10, 11, AND 12)

ALL LANDING, TRANSITION, AND LOW APPROACHES

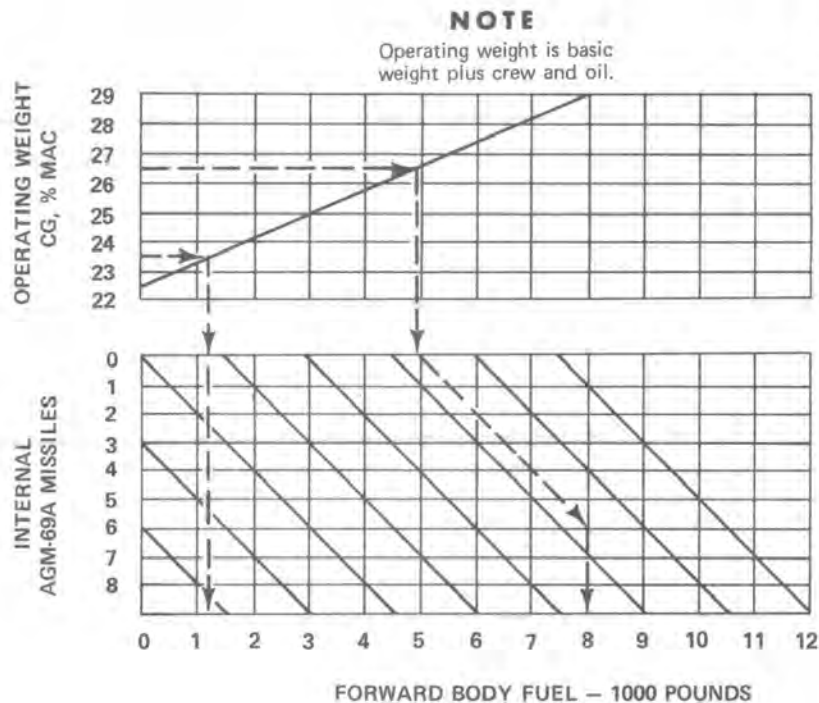
MAINS TO ALL ENGINES	● WITH MAINS 1 AND 4 ABOVE GREEN BAND AREA, CLOSE ALL CROSSFEED VALVES (9, 10, 11, AND 12)
OR	
MAINS TO ALL ENGINES (CROSSFEED VALVES OPEN)	● WITH MAIN 1 OR 4 IN THE GREEN BAND AREA, OPEN ALL CROSSFEED VALVES (9, 10, 11, AND 12) ● WITH ANY MAIN DOWN TO 5,000 POUNDS, OPEN ALL CROSSFEED VALVES (9, 10, 11, AND 12)

NOTE

IF AUXILIARY FUEL USAGE IS DESIRED, IT WILL BE TRANSFERRED DIRECTLY INTO MAIN TANKS THROUGH THE MAIN MANIFOLD. SEE "WING FLUTTER AIR-SPEED LIMITATIONS" SECTION V FOR SPEED RESTRICTIONS ASSOCIATED WITH USE OF AUXILIARY FUEL IN VARIOUS AIRCRAFT/MISSILE CONFIGURATIONS. AUXILIARY FUEL WILL BE USED IN ORDER OF OMITTED STEPS.

Fuel System Operation With No External Missiles

Figure 7-4 (Sheet 2 of 2).

**EXAMPLE 1:**

GIVEN:
Operating weight cg = 23.5%
No internal missiles

FIND:
Ballast requirements for landing

SOLUTION:
Ballast = 1250 pounds

EXAMPLE 2:

GIVEN:
Operating weight cg = 26.5%
6 internal missiles

FIND:
Ballast requirements for landing

SOLUTION:
Ballast = 8000 pounds

NOTE

- The ballast required is reduced by 500 pounds for each 2000 pounds carried in the forward bomb bay.
- Without chaff, ammo, and flares, the ballast required is reduced by the following amounts:

Chaff	200 pounds
Ammo	1900 pounds
Flares	700 pounds
All above	2800 pounds

Forward Body Ballast Fuel

For Landing, No External Missiles

Figure 7-4A.

AFTER TAKEOFF. After takeoff, the remainder of the fuel usage sequence, beginning with step 2, will be employed except for step omissions where tanks are empty or below specified quantities.

NOTE

- Immediately after initial climbout at high power settings, energizing fuel pumps for the center wing and body tanks may result in a delay in fuel flow from these tanks. This is a result of pump cavitation caused by fuel air dissolution and is affected by variables such as rate of climb, altitude, fuel head, and fuel temperature. Immediate flow may be obtained by reducing altitude. However, if an altitude change is undesirable, some reduction in the cavitation period may be obtained by energizing the pumps for approximately 3 minutes, deenergizing for approximately 2 minutes, energizing for approximately 3 minutes, and so on until flow is established.
- Fuel panel configurations for landing, transition, and low approaches are given following the normal fuel usage sequence steps. These configurations can be entered from any sequence step.

2. AFT BODY TO 1, 2, 3, AND 4

CENTER WING TO 5, 6, 7, AND 8 TO EMPTY
Fuel panel switches 1, 2, 3, and 4 to ON, 13, 14, 15, and 16 to OPEN, 26 and 28 to ENGINE FEED, all other switches to OFF or CLOSED. Depending on the takeoff sequence used, some of the above panel settings have been previously set. All engines are being fed from the main manifold by the pressure override condition.

3. AFT BODY TO 1, 2, 3, AND 4

FWD BODY TO 5, 6, 7, AND 8 TO BALLAST

NOTE

Retain forward body fuel as specified in figure 7-4A to preclude the possibility of exceeding the aft flight limit due to fuel shift as a result of acceleration for go-around or touch-and-go landing. Should the fuel loading be such that the aft body tank is empty and the forward body fuel exceeds the ballast required, feed all engines from the forward body down to the proper value.

Turn fuel panel switch 25 to ENGINE FEED and 26 to OFF. This panel configuration is set as soon as the center wing tank runs dry and is maintained until the forward body tank is down to the quantity specified in figure 7-4A. All engines are being fed from the main manifold by the pressure override condition.

4. AFT BODY TO 1, 2, 3, AND 4 - TO 5,700 POUNDS NOT REFUELED - TO 9,700 POUNDS AFTER AIR REFUELING
MID BODY TO 5, 6, 7, AND 8
Turn fuel panel switch 27 to ENGINE FEED and 25 to OFF. This panel configuration is set as soon as the forward body tank runs dry (or is down to the ballast fuel required as specified) and is maintained until the aft body tank is down to 5,700 pounds if aircraft has not air refueled. The configuration will be maintained until the aft body tank is down to 9,700 pounds after air refueling. All engines are being fed from the main manifold by the pressure override condition.

NOTE

Should the fuel loading be such that the mid body tank is empty or depleted prior to reaching the appropriate aft body quantity, feed aft body to all engines until the appropriate quantity is reached.

5. MID BODY TO ALL TO EMPTY

Turn fuel panel switch 29 to OPEN and 28 to OFF. This panel configuration is set as soon as the aft body tank is down to quantity specified in step 4 and is maintained until the mid body tank runs dry. All engines are being fed from the main manifold by the pressure override condition.

6. AFT BODY TO 1, 2, 7, AND 8 TO EMPTY

NO. 2 MAIN TO 3 AND 4

NO. 3 MAIN TO 5 AND 6

Turn fuel panel switches 14 and 15 to CLOSED, 27 to OFF, and 28 to ENGINE FEED. This panel configuration is set as soon as the midbody tank runs dry and is maintained until the aft body tank runs dry. After this step, mains 2 and 3 will be down to approximately 38,700 pounds each. Engines 3, 4, 5, and 6 are being fed directly from the main tanks. Engines 1, 2, 7, and 8 are being fed from the main manifold by the pressure override condition.

7. MAINS TO ALL ENGINES TO GREEN BAND IN MAINS 1 AND 4

Turn fuel panel switches 13, 16, and 29 to CLOSED and 28 to OFF. This panel configuration is set as soon as the aft body tank runs dry and is maintained until mains 1 and 4 fuel quantity gage pointers have reached the green band markings. At this point, mains 2 and 3 will be in green band area (approximately 16,400 pounds each). All engines are being fed directly from the main tanks.

NOTE

The following procedures will be used to maintain desired main tank lateral balance during cruise conditions.

1. Check auxiliary tank fuel flow control switches (13, 14, 15, and 16) closed.
2. Open crossfeed valve switches as required to feed the low tank engines from the high tank.
3. Shut off boost pump switches in the low tank. (Boost pumps should not be shut off in

more than one main tank at any time except when specified in a fuel sequence.)

4. When the desired main tank balance is attained, turn on all main tank boost pump switches prior to closing the crossfeed valves.

8. LEFT OUTBOARD TO 1 AND 2 TO EMPTY NO. 2 MAIN TO 3 AND 4

NO. 3 MAIN TO 5 AND 6

RIGHT OUTBOARD TO 7 AND 8 TO EMPTY

Turn fuel panel switches 13 and 16 to OPEN, 18 and 23 to ENGINE FEED. This panel configuration is set as soon as mains 1 and 4 fuel quantity gage pointers have reached the green band markings and is maintained until the outboard tanks run dry. After this step, all mains will be down to approximately 9,000 pounds each. Utilize outboard fuel as necessary to obtain desired 9,000 pounds fuel distribution in mains. Do not exceed upper limit of green band for mains during transfer. Engines 3, 4, 5, and 6 are being fed directly from the main tanks. Engines 1, 2, 7, and 8 are being fed from the main manifold by the pressure override condition. Glowing of a wing tank warning light after this panel configuration is set is an indication that one or both of the main tank fuel quantity gages for the respective wing main tanks have not reached the internal safe-level switches that correspond to the green band upper limit. In this case, step 7 should be reset on the fuel system panel and maintained until the warning light goes out. When the light goes out, step 8 should be reestablished.

9. MAINS TO ALL ENGINES TO 5,000 POUNDS EACH

Turn fuel system panel switches 13 and 16 to CLOSED and 18 and 23 to OFF. This panel configuration is set as soon as the outboard tanks run dry and is maintained until all main tanks are down to 5,000 pounds each. Open all crossfeed valves (9, 10, 11, and 12) when any main tank indicates 5,000 pounds or less. All engines are being fed directly from the main tanks.

10. LEFT EXTERNAL TO 1, 2, 3, AND 4 TO EMPTY

RIGHT EXTERNAL TO 5, 6, 7, AND 8 TO EMPTY (CROSSFEED VALVES OPEN)

Turn fuel system panel switches 13, 14, 15, and 16 to OPEN and 17 and 24 to ENGINE FEED. Open all crossfeed valves (9, 10, 11, and 12). This panel configuration is set as soon as all main tanks are down to 5,000 pounds each and is maintained until the external tanks run dry. All engines are being fed from the main manifold by the pressure override condition. When external tank switch 17 or 24 is placed in ENGINE FEED the respective wing tank warning light will come on.

11. FWD BODY (BALLAST) TO ALL ENGINES TO EMPTY (CROSSFEED VALVES OPEN)

If forward body fuel (ballast) was retained in step 3, it may be used during step 11. Turn fuel system panel switches 17 and 24 to OFF, 25 to ENGINE FEED, and 29 to OPEN. Open all crossfeed valves (9, 10, 11, and 12). This panel configuration is set as soon as the external tanks run dry and is maintained until the forward body tank runs dry. All engines are being fed from the main manifold by the pressure override condition.

12. MAINS TO ALL ENGINES (CROSSFEED VALVES OPEN).

Turn fuel panel switches 13, 14, 15, and 16 to CLOSED and 25 to OFF. Open all crossfeed valves (9, 10, 11, and 12). All engines are being fed directly from the main tanks.

ALL LANDING, TRANSITION, AND LOW APPROACHES. These panel configurations are used at any time when accomplishing landing, transition, and low approaches:

MAINS TO ALL ENGINES

Fuel system panel switches 1, 2, 3, and 4 to ON and 13, 14, 15, and 16 to CLOSED. With fuel level in mains 1 and 4 above green band area, close all crossfeed valves (9, 10, 11, and 12). With fuel level in main 1 or 4 in green band area, open all crossfeed valves (9, 10, 11, and 12). When any main is down to 5,000 pounds, open all crossfeed valves.

WARNING

Failure to accomplish prescribed fuel panel settings with fuel level in main tanks 1 or 4 in green band area or when any main tank is down to 5,000 pounds can provide a potential for engine flameout during a critical phase of flight.

NOTE

If auxiliary fuel usage is desired, it will be transferred directly into main tanks through the main manifold. See "Wing Flutter Airspeed Limitations," Section V, for speed restrictions associated with use of auxiliary fuel in various aircraft/missile configurations. Auxiliary fuel will be used in order of omitted steps.

Fuel System Operation with Internal AGM-69A Missiles

When carrying the AGM-69A missiles internally only, the normal fuel usage sequence (no external missiles) shown in figure 7-4 will be used. The sequence applies for operating weight cg from 21% to 28.5% MAC.

Fuel System Operation with External AGM-69A Missiles (Two Pylons—Symmetrical Loading—Two Thru 12 Missiles)

Proper management of the fuel supply system when carrying external AGM-69A missiles is accomplished by using the sequence shown in figure 7-5. This sequence is usable for operating weight cg from 20.9% to 26.7% MAC and will maintain the aircraft cg within the safe operating limits shown in figure 5-14. The forward body tank is not filled or used during this sequence. All center wing and mid body fuel is used during steps 2 and 3 respectively. Use aft body fuel to all engines during step 4, down to 5700 pounds if aircraft has not refueled. The configuration will be maintained until the aft body tank is down to 9700 pounds after air refueling. Mains to all engines is used in step 5 until mains 1 and 4 fuel quantity gage pointers reach the green band markings. After this step, mains 2 and 3 will be in green band area. The remainder of the aft body fuel is used in step 6 with mains 2 and 3. After this step, mains 2 and 3 will be down to approximately 16,400 pounds each. During step 7, use outboards to empty. After completing step 7, all main tanks contain approximately 9,000 pounds of fuel each. Utilize outboard fuel as necessary to obtain the desired 9,000 pounds fuel distribution in the mains. In step 8, main tanks to all engines is used until all tanks are down to 5,000 pounds each. Open all crossfeed valves when any main tank indicates 5,000 pounds or less. During step 9, the external tanks are used down to the fuel ballast required when landing with external AGM-69A missiles. The ballast requirements for external AGM-69A missiles are shown in figure 7-6. This fuel will not be usable. During steps 9 and 10, the aircraft is speed restricted. See "Wing Flutter Airspeed Limitations," Section V. The wing tank warning lights will come on to warn of this condition.

NOTE

In the event of asymmetrical release of AGM-69A missile(s), rapid lateral balance can be obtained by transfer of fuel between main tanks through the defuel valve. See "Emergency Emptying of a Main Tank," Section III.

Fuel System Operation with Asymmetrical External AGM-69A Missile(s) (One Thru Six Missiles on One Pylon)

When carrying asymmetrical external AGM-69A missile(s), lateral unbalance and trim requirements can be minimized by using a differential fuel load in the main wing tanks. The off-loaded tank(s) will be on the same side of the aircraft as the missile(s). Two fuel sequences are available depending on the asymmetrical missile(s) loading. The fuel sequence for carrying one, two, three, or four missiles on one pylon is shown in figure 7-7. For this fuel sequence, the differential fuel load to counterbalance the asymmetrical missile(s) loading is maintained between mains 2 and 3. During steps 11, 12, and 13, the aircraft is speed restricted. See "Wing Flutter Airspeed Limitations," Section V. The wing tank warning lights will come on to warn of this condition. The fuel sequence for carrying five or six missiles on one pylon is shown in figure 7-8. For this fuel sequence, the differential fuel load is maintained between mains 2 and 3 and mains 1 and 4. Both fuel sequences apply for operating weight CG from 21.7% to 27.6% MAC. During steps 10, 11, and 12, the aircraft is speed restricted. See "Wing Flutter Airspeed Limitations," Section V. The wing tank warning lights will come on to warn of this condition. In addition to the lateral balance fuel differential, forward body fuel (ballast) may be required to preclude the possibility of exceeding the aft flight limit due to fuel shift as a result of acceleration for go-around or touch-and-go landing. (See step 4.) When retaining five or six AGM-69A missiles, external fuel (ballast) may be required for landing. (See step 10.)

NOTE

In the event of asymmetrical release of AGM-69A missile(s), rapid lateral balance can be obtained by transfer of fuel between main tanks through the defuel valve. See "Emergency Emptying of a Main Tank," Section III.

FUEL SEQUENCE WHEN CARRYING EXTERNAL AGM-69A MISSILES
(TWO PYLONS — SYMMETRICAL LOADING — TWO THRU TWELVE MISSILES)

NOTE

OPERATING WEIGHT (BASIC WEIGHT PLUS CREW AND OIL) CG FROM 20.9% TO 26.7% MAC.

STEP 1 TAKEOFF

AFT BODY TO 1 AND 2
 NO. 2 MAIN TO 3 AND 4
 NO. 3 MAIN TO 5 AND 6
 CENTER WING TO 7 AND 8

OR

MAINS TO ALL ENGINES

OR

MAINS TO ALL ENGINES (CROSSFEED VALVES OPEN)

● FOR TAKEOFF WITH MAINS 1 AND 4 ABOVE GREEN BAND AND CENTER WING AND AFT BODY CONTAIN 2,000 POUNDS OR MORE EACH

● FOR TAKEOFF WITH MAINS 1 AND 4 ABOVE GREEN BAND AND EITHER CENTER WING OR AFT BODY LESS THAN 2,000 POUNDS

● FOR TAKEOFF WITH MAIN 1 OR 4 IN GREEN BAND. OPEN ALL CROSSFEED VALVES (9, 10, 11, AND 12)

STEP 2

AFT BODY TO 1, 2, 3, AND 4
 CENTER WING TO 5, 6, 7, AND 8

● CENTER WING TO EMPTY

STEP 3

MID BODY TO ALL ENGINES

● MID BODY TO EMPTY

STEP 4

AFT BODY TO ALL ENGINES

● AFT BODY TO 5,700 POUNDS (NOT REFUELED)

● AFT BODY TO 9,700 POUNDS AFTER AIR REFUELING

STEP 5

MAINS TO ALL ENGINES

● MAINS 1 AND 4 TO GREEN BAND. AFTER THIS STEP, MAINS 2 AND 3 WILL BE IN GREEN BAND AREA

STEP 6

AFT BODY TO 1, 2, 7, and 8
 NO. 2 MAIN TO 3 AND 4
 NO. 3 MAIN TO 5 AND 6

● AFT BODY TO EMPTY. AFTER THIS STEP, MAINS 2 AND 3 WILL BE DOWN TO APPROXIMATELY 16,400 POUNDS EACH

STEP 7

LEFT OUTBOARD TO 1 AND 2
 NO. 2 MAIN TO 3 AND 4
 NO. 3 MAIN TO 5 AND 6
 RIGHT OUTBOARD TO 7 AND 8

● OUTBOARDS TO EMPTY. AFTER THIS STEP, ALL MAINS WILL BE DOWN TO APPROXIMATELY 9,000 POUNDS EACH

● UTILIZE OUTBOARD FUEL AS NECESSARY TO OBTAIN THE DESIRED 9,000 POUNDS

Figure 7-5. (Sheet 1 of 2).

FUEL SEQUENCE WHEN CARRYING EXTERNAL AGM-69A MISSILES
(TWO PYLONS — SYMMETRICAL LOADING — TWO THRU TWELVE MISSILES) (CONT)

STEP 8 MAINS TO ALL ENGINES	● ALL MAINS TO 5,000 POUNDS EACH
STEP 9 LEFT EXTERNAL TO 1, 2, 3 AND 4 RIGHT EXTERNAL TO 5, 6, 7 AND 8 (CROSSFEED VALVES OPEN)	● SPEED RESTRICTED. SEE SECTION V FOR WING FLUTTER AIRSPEED LIMITS ● OPEN ALL CROSSFEED VALVES (9, 10, 11, AND 12) ● RETAIN BALLAST FUEL SHOWN IN FIGURE 7-6 IF MISSILES ARE RETAINED FOR LANDING
STEP 10 MAINS TO ALL ENGINES (CROSSFEED VALVES OPEN)	● SPEED RESTRICTED. SEE SECTION V FOR WING FLUTTER AIRSPEED LIMITS ● OPEN ALL CROSSFEED VALVES (9, 10, 11, AND 12)

ALL LANDING, TRANSITION, AND LOW APPROACHES

MAINS TO ALL ENGINES	● WITH MAINS 1 AND 4 ABOVE GREEN BAND AREA, CLOSE ALL CROSSFEED VALVES (9, 10, 11 AND 12)
— — — — — OR — — — — —	
MAINS TO ALL ENGINES (CROSSFEED VALVES OPEN)	● WITH MAIN 1 OR 4 IN THE GREEN BAND AREA, OPEN ALL CROSSFEED VALVES (9, 10, 11 AND 12) ● WITH ANY MAIN DOWN TO 5,000 POUNDS, OPEN ALL CROSSFEED VALVES (9, 10, 11, AND 12)

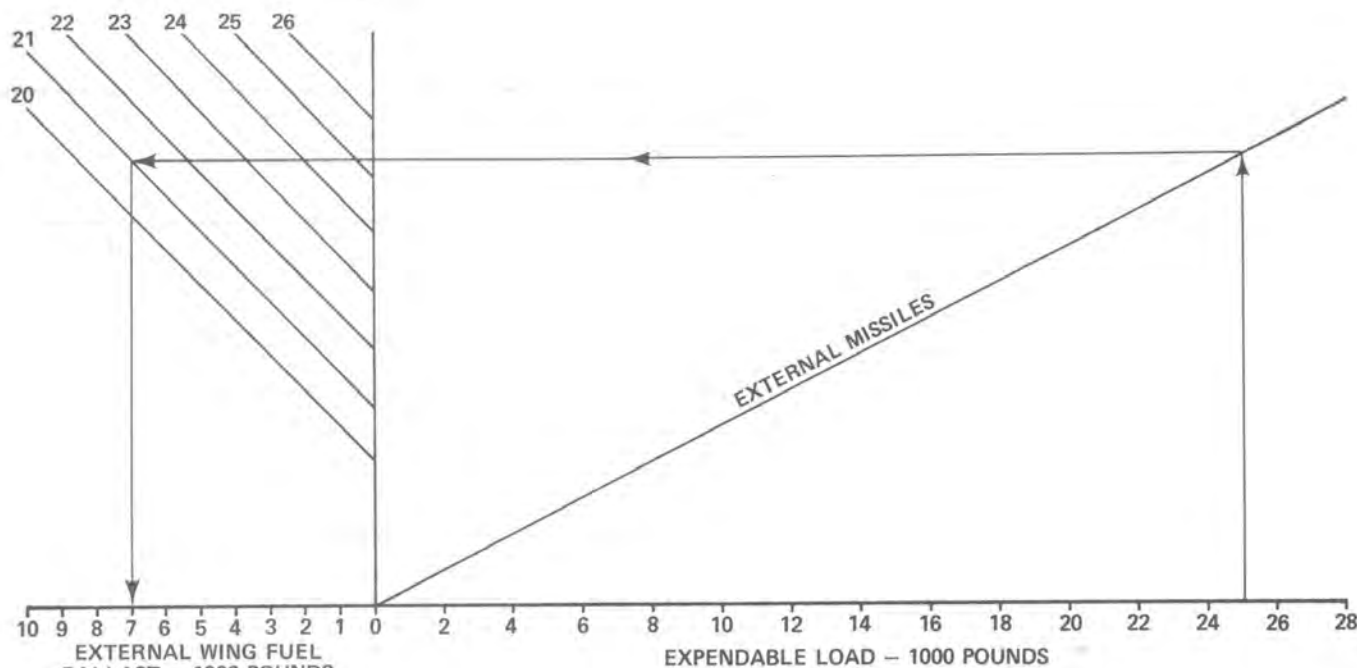
NOTE

IF AUXILIARY FUEL USAGE IS DESIRED, IT WILL BE TRANSFERRED DIRECTLY INTO MAIN TANKS THROUGH THE MAIN MANIFOLD. SEE "WING FLUTTER AIRSPEED LIMITATIONS" SECTION V FOR SPEED RESTRICTIONS ASSOCIATED WITH USE OF AUXILIARY FUEL IN VARIOUS AIRCRAFT/MISSILE CONFIGURATIONS. AUXILIARY FUEL WILL BE IN ORDER OF OMITTED STEPS.

Fuel System Operation With Symmetrical External AGM-69A Missiles

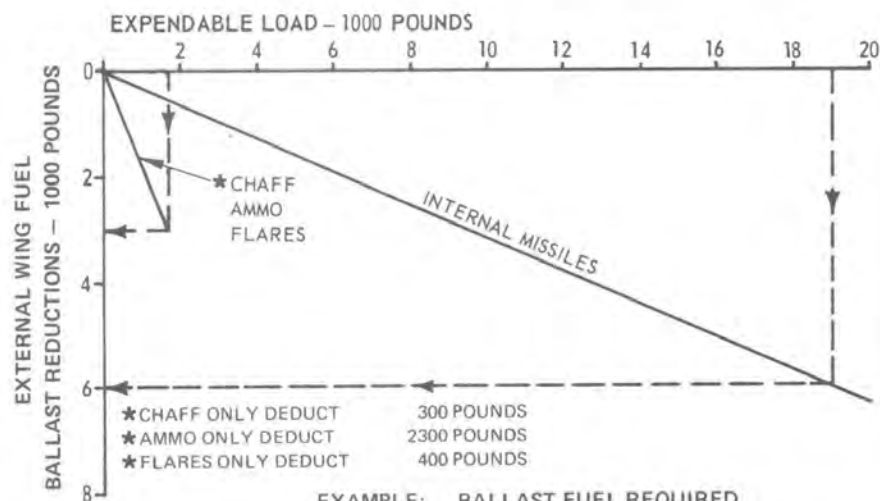
Figure 7-5. (Sheet 2 of 2).

OPERATING WEIGHT *CG, % MAC

**NOTE**

- Ballast additions only are included on this chart. See lower chart for any adjustments required for internal armament loads.
- Pylons, ECM equipment and CY-2617/ALA-17 rack and flare assembly are to be included in basic weight when installed.

*BASIC WEIGHT PLUS CREW AND OIL

**NOTE**

- Chart valid for operating weight cg 21% to 27% MAC
- For each 1000 pounds of bombs carried in the forward bomb bay, add 200 pounds of ballast fuel to the above ballast table.
- For ballast reduction for ADM-20 missiles, use internal missile scale and appropriate weight.

EXAMPLE: BALLAST FUEL REQUIRED
(For Operating Weight CG of 21% MAC)

External Missiles	25,000 Pounds = + 7,000 Pounds
Bombs - Forward	10,000 Pounds = + 2,000 Pounds
Internal Missiles	19,000 Pounds = - 6,000 Pounds
Chaff, Ammo, and Flares	1,608 Pounds = - 3,000 Pounds
TOTAL BALLAST REQUIRED	0 Pounds

External Wing Tank Ballast Fuel For Landing With External AGM-69A Missiles

Figure 7-6.

■ ■ ■ ■ ■ ■ ■ ■ ■ ■ **FUEL SEQUENCE WHEN CARRYING ONE, TWO, THREE, OR FOUR EXTERNAL AGM-69A MISSILES ON ONE PYLON** ■ ■ ■ ■ ■ ■ ■ ■ ■ ■

NOTE

- OPERATING WEIGHT (BASIC WEIGHT PLUS CREW AND OIL) CG FROM 21.7% TO 27.6% MAC.
- MAINTAIN THE FOLLOWING DIFFERENTIAL FUEL LOAD BETWEEN MAINS 2 AND 3 TO COUNTER BALANCE THE ASYMMETRICAL EXTERNAL AGM-69A MISSILES (ONE PYLON):

<u>NO. OF MISSILES</u>	<u>MAINS 2 AND 3 DIFFERENTIAL FUEL LOAD (OPPOSITE PYLON)</u>
1	+ 6,200 POUNDS
2	+ 8,900 POUNDS
3	+11,500 POUNDS
4	+14,100 POUNDS

STEP 1 TAKEOFF	
AFT BODY TO 1 AND 2 NO. 2 MAIN TO 3 AND 4 NO. 3 MAIN TO 5 AND 6 CENTER WING TO 7 AND 8 ----- OR -----	● FOR TAKEOFF WITH MAINS 1 AND 4 ABOVE GREEN BAND AND CENTER WING AND AFT BODY CONTAIN 2,000 POUNDS OR MORE EACH
MAINS TO ALL ENGINES ----- OR -----	● FOR TAKEOFF WITH MAINS 1 AND 4 ABOVE GREEN BAND AND EITHER CENTER WING OR AFT BODY LESS THAN 2,000 POUNDS
MAINS TO ALL ENGINES (CROSSFEED VALVES OPEN)	● FOR TAKEOFF WITH MAIN 1 OR 4 IN GREEN BAND. OPEN ALL CROSSFEED VALVES (9, 10, 11, AND 12)
STEP 2	
AFT BODY TO 1, 2, 3, AND 4 CENTER WING TO 5, 6, 7, AND 8	● CENTER WING TO EMPTY
STEP 3	
AFT BODY TO ALL ENGINES	● AFT BODY TO 13,100 POUNDS
STEP 4	
AFT BODY TO 1, 2, 3, AND 4 FWD BODY TO 5, 6, 7, and 8	● RETAIN 5,000 POUNDS FWD BODY FUEL (BALLAST) IF OPERATING WEIGHT CG IS 24.5% MAC OR AFT. OTHERWISE, FWD BODY TO EMPTY
STEP 5	
AFT BODY TO 1, 2, 3 AND 4 MID BODY TO 5, 6, 7, AND 8	● AFT BODY TO EMPTY

■ ■ ■ **Fuel System Operation With Asymmetrical External AGM-69A Missiles (One thru Four)**

Figure 7-7. (Sheet 1 of 3).

**FUEL SEQUENCE WHEN CARRYING ONE, TWO, THREE,
OR FOUR EXTERNAL AGM-69A MISSILES ON ONE PYLON (CONT)**

STEP 6 MID BODY TO ALL ENGINES	● MID BODY TO EMPTY
STEP 7 MAINS TO ALL ENGINES	● MAINS 1 AND 4 TO GREEN BAND. AFTER THIS STEP, MAINS 2 AND 3 WILL BE IN GREEN BAND AREA ● FOR DIFFERENTIAL FUEL LOAD REQUIREMENTS, SEE PRECEED-ING NOTE.
STEP 8 LEFT OUTBOARD TO 1, 2, 3 AND 4 RIGHT OUTBOARD TO 5, 6, 7, AND 8	● OUTBOARDS TO EMPTY
STEP 9 MAINS TO ALL ENGINES	● MAINS 1 AND 4 TO 5,000 POUNDS EACH ● FOR DIFFERENTIAL FUEL LOAD REQUIREMENTS, SEE PRECEED-ING NOTE ● WHEN ANY MAIN IS DOWN TO 5,000 POUNDS, OPEN ALL CROSS-FEED VALVES (9, 10, 11, AND 12)
STEP 10 NO. 2 MAIN TO 1, 2, 3, AND 4 NO. 3 MAIN TO 5, 6, 7, AND 8 (CROSSFEED VALVES OPEN) (MAIN BOOST PUMPS 1 AND 4 OFF) THIS STEP REQUIRED ONLY WHEN MAIN 2 OR 3 ADJACENT TO MISSILE CONTAINS OVER 5,000 POUNDS	
STEP 11 LEFT EXTERNAL TO 1, 2, 3, AND 4 RIGHT EXTERNAL TO 5, 6, 7, AND 8 (CROSSFEED VALVES OPEN)	● SPEED RESTRICTED. SEE SECTION V FOR WING FLUTTER AIR-SPEED LIMITS ● OPEN ALL CROSSFEED VALVES (9, 10, 11, AND 12) ● FUEL SYSTEM PANEL SWITCHES 1 AND 4 TO ON ● EXTERNALS TO EMPTY

Figure 7-7. (Sheet 2 of 3).

**FUEL SEQUENCE WHEN CARRYING ONE, TWO, THREE,
OR FOUR EXTERNAL AGM-69A MISSILES ON ONE PYLON (CONT)**

STEP 12

FWD BODY (BALLAST) TO ALL ENGINES
(CROSSFEED VALVES OPEN)

- SPEED RESTRICTED. SEE SECTION V FOR WING FLUTTER AIR-SPEED LIMITS
- OPEN ALL CROSSFEED VALVES (9, 10, 11, AND 12)
- FWD BODY TO EMPTY

STEP 13

MAINS TO ALL ENGINES (CROSSFEED VALVES
OPEN)

- SPEED RESTRICTED. SEE SECTION V FOR WING FLUTTER AIR-SPEED LIMITS
- OPEN ALL CROSSFEED VALVES (9, 10, 11, AND 12)
- FOR DIFFERENTIAL FUEL LOAD REQUIREMENTS, SEE PRECEDING NOTE

ALL LANDING, TRANSITION, AND LOW APPROACHES

MAINS TO ALL ENGINES

- WITH MAINS 1 AND 4 ABOVE GREEN BAND AREA, CLOSE ALL CROSSFEED VALVES (9, 10, 11 AND 12)

— OR —

MAINS TO ALL ENGINES (CROSSFEED VALVES
OPEN)

- WITH MAIN 1 OR 4 IN THE GREEN BAND AREA, OPEN ALL CROSSFEED VALVES (9, 10, 11, AND 12)
- WITH ANY MAIN DOWN TO 5,000 POUNDS, OPEN ALL CROSSFEED VALVES (9, 10, 11, AND 12)

NOTE

IF AUXILIARY FUEL USAGE IS DESIRED, IT WILL BE TRANSFERRED DIRECTLY INTO MAIN TANKS THROUGH THE MAIN MANIFOLD. SEE "WING FLUTTER AIR-SPEED LIMITATIONS" SECTION V FOR SPEED RESTRICTIONS ASSOCIATED WITH USE OF AUXILIARY FUEL IN VARIOUS AIRCRAFT/MISSILE CONFIGURATIONS. AUXILIARY FUEL WILL BE USED IN ORDER OF OMITTED STEPS.

Fuel System Operation With Asymmetrical External AGM-69A Missiles (One thru Four)

Figure 7-7. (Sheet 3 of 3).

**FUEL SEQUENCE WHEN CARRYING FIVE OR SIX
EXTERNAL AGM-69A MISSILES ON ONE PYLON**

NOTE

- OPERATING WEIGHT (BASIC WEIGHT PLUS CREW AND OIL) CG FROM 21.7% TO 27.6% MAC.
- MAINTAIN THE FOLLOWING DIFFERENTIAL FUEL LOAD BETWEEN MAINS 2 AND 3 AND MAINS 1 AND 4 TO COUNTER BALANCE THE ASYMMETRICAL EXTERNAL AGM-69A MISSILES (ONE PYLON):

NO. OF MISSILES	MAINS 2 AND 3 DIFFERENTIAL FUEL LOAD (OPPOSITE PYLON)	MAINS 1 AND 4 DIFFERENTIAL FUEL LOAD (OPPOSITE PYLON)
5	+14,100 POUNDS	+1,000 POUNDS
6	+14,100 POUNDS	+1,900 POUNDS

STEP 1 TAKEOFF

AFT BODY TO 1 AND 2
NO. 2 MAIN TO 3 AND 4
NO. 3 MAIN TO 5 AND 6
CENTER WING TO 7 AND 8

OR

- FOR TAKEOFF WITH MAINS 1 AND 4 ABOVE GREEN BAND AND CENTER WING AND AFT BODY CONTAIN 2,000 POUNDS OR MORE EACH

MAINS TO ALL ENGINES

OR

- FOR TAKEOFF WITH MAINS 1 AND 4 ABOVE GREEN BAND AND EITHER CENTER WING OR AFT BODY LESS THAN 2,000 POUNDS

MAINS TO ALL ENGINES (CROSSFEED VALVES OPEN)

- FOR TAKEOFF WITH MAIN 1 OR 4 IN GREEN BAND. OPEN ALL CROSSFEED VALVES (9, 10, 11, AND 12)

STEP 2

AFT BODY TO 1, 2, 3, AND 4
CENTER WING TO 5, 6, 7, AND 8

- CENTER WING TO EMPTY

STEP 3

AFT BODY TO ALL ENGINES

- AFT BODY TO 13,100 POUNDS

STEP 4

AFT BODY TO 1, 2, 3, AND 4
FWD BODY TO 5, 6, 7, AND 8

- RETAIN 5,000 POUNDS FWD BODY FUEL (BALLAST) IF OPERATING WEIGHT CG IS 24.5% MAC OR AFT. OTHERWISE, FWD BODY TO EMPTY

STEP 5

AFT BODY TO 1, 2, 3, AND 4
MID BODY TO 5, 6, 7, AND 8

- AFT BODY TO EMPTY

Figure 7-8. (Sheet 1 of 3).

**FUEL SEQUENCE WHEN CARRYING FIVE OR SIX
EXTERNAL AGM-69A MISSILES ON ONE PYLON (CONT)**

STEP 6	
MID BODY TO ALL ENGINES	● MID BODY TO EMPTY
STEP 7	
MAINS TO ALL ENGINES	● MAIN 1 OR 4 (OPPOSITE MISSILES) TO GREEN BAND; AFTER THIS STEP THE OTHER MAIN TANKS WILL BE IN GREEN BAND AREA ● FOR DIFFERENTIAL FUEL LOAD REQUIREMENTS, SEE PRECEDING NOTE
STEP 8	
LEFT OUTBOARD TO 1, 2, 3, AND 4 RIGHT OUTBOARD TO 5, 6, 7, AND 8	● OUTBOARDS TO EMPTY
STEP 9	
MAINS TO ALL ENGINES	● MAIN 1 OR 4 (OPPOSITE MISSILES) TO 5,000 POUNDS; AFTER THIS STEP MAIN 4 OR 1 (ADJACENT MISSILES) WILL BE BELOW 5,000 POUNDS ● FOR DIFFERENTIAL FUEL LOAD REQUIREMENTS, SEE PRECEDING NOTE ● WHEN ANY MAIN IS DOWN TO 5,000 POUNDS, OPEN ALL CROSSFEED VALVES (9, 10, 11, AND 12)
STEP 10	
LEFT EXTERNAL TO 1, 2, 3, AND 4 RIGHT EXTERNAL TO 5, 6, 7, AND 8 (CROSSFEED VALVES OPEN)	● SPEED RESTRICTED. SEE SECTION V FOR WING FLUTTER AIRSPEED LIMITS ● OPEN ALL CROSSFEED VALVES (9, 10, 11, AND 12) ● EXTERNALS TO EMPTY. EXCEPT RETAIN 1,000 POUNDS IN EACH TANK WHEN MISSILES ARE ATTACHED AND OPERATING WEIGHT CG IS 24.5% MAC OR FORWARD
STEP 11	
FWD BODY (BALLAST) TO ALL ENGINES (CROSSFEED VALVES OPEN)	● SPEED RESTRICTED. SEE SECTION V FOR WING FLUTTER AIRSPEED LIMITS ● OPEN ALL CROSSFEED VALVES (9, 10, 11, AND 12) ● FWD BODY TO EMPTY

**Fuel System Operation With Asymmetrical
External AGM-69A Missiles (Five or Six)**

Figure 7-8. (Sheet 2 of 3).

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FUEL SEQUENCE WHEN CARRYING FIVE OR SIX
EXTERNAL AGM-69A MISSILES ON ONE PYLON (CONT)

■■■■■■■■■■■■■■■■■■■■

STEP 12	
MAINS TO ALL ENGINES (CROSSFEED VALVES OPEN)	● SPEED RESTRICTED. SEE SECTION V FOR WING FLUTTER AIRSPEED LIMITS ● OPEN ALL CROSSFEED VALVES (9, 10, 11, AND 12) ● FOR DIFFERENTIAL FUEL LOAD REQUIREMENTS, SEE PRECEDING NOTE

ALL LANDING, TRANSITION, AND LOW APPROACHES

MAINS TO ALL ENGINES	● WITH MAINS 1 AND 4 ABOVE GREEN BAND AREA, CLOSE ALL CROSSFEED VALVES (9, 10, 11 AND 12)
----- OR -----	
MAINS TO ALL ENGINES (CROSSFEED VALVES OPEN)	● WITH MAIN 1 OR 4 IN THE GREEN BAND AREA, OPEN ALL CROSSFEED VALVES (9, 10, 11 AND 12) ● WITH ANY MAIN DOWN TO 5,000 POUNDS, OPEN ALL CROSSFEED VALVES (9, 10, 11 AND 12)

NOTE

IF AUXILIARY FUEL USAGE IS DESIRED IT WILL BE TRANSFERRED DIRECTLY INTO MAIN TANKS THROUGH THE MAIN MANIFOLD. SEE "WING FLUTTER AIRSPEED LIMITATIONS" SECTION V FOR SPEED RESTRICTIONS ASSOCIATED WITH USE OF AUXILIARY FUEL IN VARIOUS AIRCRAFT/MISSILE CONFIGURATIONS. AUXILIARY FUEL WILL BE USED IN ORDER OF OMITTED STEPS.

■■■■■■■

Fuel System Operation With Asymmetrical
External AGM-69A Missiles (Five or Six)

Figure 7-8. (Sheet 3 of 3).

ELECTRICAL SYSTEM OPERATION

CONTROL CIRCUITS

A complete understanding of the d-c relays which control the primary electrical system is a valuable aid in the efficient operation of the electrical systems. All controls that affect the starting and routing of electrical power use 24-volt d-c essential battery power. This use of essential battery power assures that with the battery switch in the ON position, there will always be power available to start, control, and route power throughout the aircraft. Control power for the external power relays is furnished by the external power carts.

INSTRUMENT INDICATIONS

Information which can be obtained from the electrical system instruments can be correctly interpreted only if the significance of the readings is understood. A brief explanation of the meaning of the instrument readings is given in the following paragraphs.

Voltage

Voltage is the electrical potential supplied by the batteries, TR units, or generators. It is the force which pushes current through the lines. The a-c

voltmeter measures the effective voltage rather than the instantaneous voltage at the peak of the cycle. The only indication of battery voltage is through the battery end of life lights which flash on and off when voltage decreases to 22.2 (± 0.1) volts or below. There are no means of measurement for TR voltage.

Frequency

The a-c frequency meter indicates the number of voltage (and current) cycles that occur in each second. One complete cycle is considered 360 electrical degrees and each phase reaches a voltage and a current peak in both directions once during each cycle. Since this is a balanced three-phase system, the voltage peaks of the three phases are separated by one-third of a cycle or 120° .

Load

Four a-c ammeters (figure 1-22) located on the a-c control panel are provided to measure a-c current and to enable the copilot to compare the four indicated load values. Current in amperes is the rate of flow of electricity.

D-C SYSTEM

Battery Charge Test

The battery charge test switch can be used to determine if the forward and aft batteries are 80% to 100% charged. When the test switch is placed in FWD AND AFT position, the forward and aft battery discharging lights will blink on and off at a slow rate if the batteries are 70% or more charged. However, excessive loads on the battery bus will prevent the battery charging TR unit from pulsing and the battery discharging lights will not blink on and off. If the battery discharging lights do not blink, retract airbrakes (if extended). If one or both of the discharging lights do not blink, it is an indication that the battery charging system is not operating properly.

EXTERNAL POWER

To connect external power, several preliminary steps must first be accomplished. The battery switch should be turned ON and a check made of the battery not charging lights. These lights should illuminate since TR power for battery charging is not available. The generator circuit breakers should be open since the control circuit for external power is routed through the open side of these circuit breakers. A check of the four circuit breaker position indicators would be sufficient to determine the correct position of the generator circuit breakers since these indicators use essential battery power. If the indicators show the circuit breakers are closed, actuate the generator switches to OFF position and circuit breakers will open. When external power is plugged into the external receptacle and the external power switch is placed in ON position, essential d-c power will close the external power circuit breaker sending power to the central bus tie. It is necessary that the bus tie circuit breakers be closed manually, if open, by placing generator switches to OFF in order to power all units on the aircraft. Placing any operating generator switch to ON, placing the external power switch to OFF, placing the power cart switch to OFF, or removing the external cord plug will remove external power from the aircraft system.

GENERATOR OPERATION

Starting

Each generator can be energized and placed on its main bus after its engine is started. Normally though, it is best to actuate the generator switch after all engines are started. The latter procedure allows external power to carry the entire electrical load until all engines are operating and the ground crew is ready to disconnect external power. In addition, less operator attention is required during engine starting.

It is not necessary to trip the generator switch to OFF prior to engine starting as the generator control relay is tripped automatically on engine shutdown. Holding of the generator switch to ON is required only during paralleling through the bus tie circuit breaker. Paralleling through the generator circuit breaker requires momentary actuation only of the generator switch to ON. The latter is by far the more common occurrence. Jogging of the engine speed is required if the generators do not parallel. After the generators are on their respective buses, loss of d-c control power will not affect a-c power generation. However, the operator will not be able to manually switch the generators nor will the automatic shutdown features function in the event of a-c system faults or abnormal operation.

Shutdown

The generator may be completely shut down by use of the constant speed drive (CSD) decoupler switch without shutting down the engine. Recoupling of the constant speed drive can only be accomplished on the ground with engines shut down. During normal shutdown, the under-over speed switch will trip the generator circuit breaker and deexcite the field.

ELECTRICAL LOADS

The generators are designed for a continuous rating of 70KVA at 0.75 power factor and an overload capability of 90KVA for 4 hours, 105KVA for 5 minutes, or 150KVA for 5 seconds. Under normal operating conditions, the load should never exceed the limitations on the ammeter of 240 amperes.

CAUTION

During ground operation, load per generator shall be limited to 125 amperes to avoid system damage due to lack of ram cooling air.

Load Fluctuation

It is possible when engines are operating at approximately 70% rpm the drive will be in transition between underdrive and overdrive condition causing frequency and load division control to be less precise. Results of load swap between paralleled units may be indicated on the ammeters. Normally this condition will not affect the aircraft or aircraft electrical system but will decrease the mechanical life of the drive. An extended operation under the above condition should be avoided but never to the extent of jeopardizing flight safety.

Parallel Operation

During parallel operation, all electrical loads are divided among the four generators. Should any generator or drive fail, the load would be automatically redistributed among the remaining three generators. Two or more generators operating in parallel will have the same frequency (speed) and voltage.

Isolated Operation

For information on generator isolation, see "Master Isolate Switch," Section I.

WHEEL BRAKE SYSTEM OPERATION

WHEEL BRAKE OPERATION

Brakes, themselves, merely stop the wheels from turning, but stopping the aircraft is dependent on the friction of the tires on the runway. This frictional force, in turn, is dependent on the load imposed on the wheel. Therefore, optimum braking action on landings cannot be expected until the tires are carrying heavy loads. Although the antiskid system allows for immediate braking after touchdown, lift should also be decreased as much as possible by extension of the airbrakes. The tendency for the tires to skid decreases considerably when the full weight of the aircraft is on the wheels. It has been found that optimum braking occurs with approximately a 15% to 20% rolling skid; that is, the wheel continues to rotate but has approximately 15% to 20% slippage on the surface so that the rotational speed is 80% to 85% of the speed which the wheel would have were it in a free roll. As the amount of skid increases beyond this amount, the coefficient of friction decreases rapidly so that with a 75% skid the friction is approximately 60% of the optimum and with a full skid becomes even lower. There are two reasons for this loss in braking effectiveness with skidding. First, the immediate action is to scuff the rubber, tearing off little pieces which act almost like rollers under the tire. Second, the heat generated starts to melt the rubber and the molten rubber acts as a lubricant between the tire and the ground surface.

BRAKE DESIGN

Aerodynamic braking should be utilized in an attempt to keep wheel brake usage to a minimum. To provide minimum brake weight, consistent with safe operation, the military specification to which the brakes are designed requires that they provide for only one maximum refused takeoff stop. Under such a condition, it is advisable to taxi clear of the runway using minimum braking before coming to a complete stop

and not to apply the parking brake. It is possible that the overheated brakes may seize, resulting in considerable delay on runway operations. For brake energy limits, see figure 5-12. Cold brakes on this aircraft may result from landing in a moderate headwind at light weight, on a long runway when little or no braking was done, or when there is a definite malfunction or failure of a brake. Usually some heat will be felt when approaching the wheel brake rotor or housing with the hand. The amount of heat radiating from the brake depends on these variables: the amount of braking needed to stop the aircraft, amount of hydraulic pressure delivered to the brakes, location of the wheel well doors affecting the airflow around the wheels, differential wheel loadings due to turns and crosswinds, and difference in rpm settings of the antiskid systems. Any heat at all radiating from a brake indicates that it has been operating satisfactorily, even though no two brakes will be at the same temperature.

WHEEL BRAKE LIMITATIONS

See "Wheel Brake Limitations" and "Tire Limitations," Section V.

ANTISKID OPERATION

The antiskid system is intended to prevent skids at high speed under light wheel loads and to provide optimum braking resulting in shorter stopping distances regardless of the surface conditions. Therefore, the antiskid switch should be ON during takeoff and landing. However, it should not be used to its maximum potential to purposely make all landing rolls as short as possible since this causes undue wear of the tires and brakes. While taxiing on a slippery surface with the antiskid switch ON, it is possible to lose up to 50% of the effective braking due to locked wheel conditions; the remaining braking action with antiskid protection is more effective than full braking without antiskid.

NOTE

Improper servicing of the shock struts or a malfunctioning landing gear safety switch may prevent transfer of the antiskid system from the "airborne" mode to the "ground" mode. If this occurs, the antiskid system automatically releases brakes on the affected gear (possibly all gear) when the aircraft is moving at a slow rate of speed, as during taxiing. When loss of braking due to this condition is experienced, turning the antiskid switch OFF restores braking action without antiskid protection. When the antiskid switch is OFF, braking action depends entirely on the pressure applied to the brake pedals.

HYDRAULIC SYSTEM OPERATION

SYSTEM OPERATION

Hydraulic pressure is provided by six separate hydraulic systems consisting of inboard and outboard right and left wing hydraulic systems and right and left body hydraulic systems. Six engine-driven pumps and four electric motor-driven standby pumps provide normal, standby, and emergency pressure for the six separate hydraulic systems. Except for the inboard wing hydraulic systems, which are provided with engine-driven pump pressure only, each system has both an engine-driven pump and an electric motor-driven standby pump to provide reliability of continued system operation. Standby pump pressure for the inboard wing hydraulic systems is not considered essential to continuous aircraft maneuverability since the aircraft can be flown without assistance of inboard spoilers. (For hydraulic pump installation locations, see "Hydraulic Power Supply Systems," Section I.) Each hydraulic system supplies hydraulic fluid under pressure to hydraulically operated components. With exception of the inboard spoilers and the aft bomb door actuator, each hydraulically operated component has either or both emergency or standby sources of pressure. The front bomb door actuator receives normal and emergency pressure but it cannot be actuated by standby pump pressure while in flight. Due to accumulative tolerance buildup in pressure transmitters and pressure gages, engine-driven and standby pump cutout pressures will indicate 3000 (± 250) psi on the hydraulic system pressure gages. Each pump has a rated flow of 12 gallons per minute at an output pressure of 2800 psi and provides variable flow and pressure in accordance with system demand. Hydraulic system pressure is independent of engine pump speed. However, the hydraulic oil flow rate is directly proportional to engine speed; at 10% (windmill) rpm, there will be 1 1/2 gallons of oil flow per minute available for system operation. Each electric motor-driven standby pump has a rated flow of 3 gallons per minute at 1300 psi output pressure. The variable delivery standby pumps are controlled by individual switches. Standby pump pressure is used in case of failure of either an engine or an engine-driven pump. Emergency or standby pressure is provided for certain hydraulically operated components by interconnecting pressure sources from both engine-driven and standby pumps of another system. However, with exception of emergency tip gear extension, hydraulic fluid does not pass from one system into another. The actuator components of the front landing gear, including brakes and steering on the left gear only, and the air refueling toggle actuator receive standby pump pressure from the left body system. Similarly the aft landing gear components, including brakes and steering on the right gear only, and the hydraulic jack-screw for the horizontal stabilizer receive an alternate source of pressure from the standby pump installed in the right body hydraulic system. Horizontal stabilizer control is accomplished through a hydraulic pressure driven jackscrew and nut assembly. Normal pressure for movement of the nut is furnished by the left body system. Standby pressure is not available to the nut; consequently, in case of normal

pressure failure, travel speed of the assembly is reduced one-half which affects control of the horizontal stabilizer by reducing movement to one-half speed. A motor-operated hydraulic shutoff valve is installed in the supply line of each system for control of fluid from the reservoir to the engine-driven pump. The shutoff valves, which have a rated flow of 25 gallons per minute with a working pressure of 100 psi, are open and provide continuous flow of hydraulic fluid when the fire shutoff switches on the pilots' instrument panel are pushed in to the normal position. As a safety feature in the event of a ruptured line, hydraulic fuses are installed to seal off the lines which provide normal and emergency slave pressure for actuation of the brakes, normal pressure for brake application, emergency pressure for tip gear extension, and both normal and emergency pressure for opening of the air refueling toggles and closing or opening of the air refueling doors. A pressure relief valve is incorporated in each system to limit maximum pressure at 3850 psi with a rated flow of 16 gallons per minute. A pressure transmitter in each system registers system pressure at the respective hydraulic system pressure gage. Each hydraulic system has an amber pump out warning light which indicates main pump pressure only. When pressure in any system falls below 350 (± 150) psi, a warning light illuminates. The light may go out at any pressure above this value and will positively go out when pressure reaches 700 psi maximum. The functional components of each system are designed to operate throughout an ambient temperature range from -65° to 160° F with variations of pressure altitude from sea level to 60,000 feet. Under cold temperature takeoff conditions down to -55° F, half-speed or better spoiler operation will provide adequate lateral control to allow takeoff without exercising the hydraulic system. A takeoff from cold soak conditions below the above temperature will require preliminary controls exercise to obtain at least half-speed operation. At -65° F, this will require from 3 to 4 minutes of continuous spoiler cycling.

Pressure Fluctuations

During normal operation of the stabilizer trim, right rear landing gear, brakes, or crosswind crab, a drop in pressure may be noted on the right body hydraulic system pressure gage. Sustained operation of any of these systems may cause the pressure to drop to 1000 psi. Also, normal operation of any of these systems simultaneously, or with any of the other systems connected to the right body hydraulic system, may cause the pressure to drop to 1000 psi. Due to the location of the pressure transmitter (figure 1-28), normal bomb door operation, right forward gear actuation, braking, or steering may not show a drop in pressure but will show a pressure surge above 3000 psi when the operation cycle has been completed. This surge will be noted whenever any of the systems are operated. Similarly, in the left body system, normal operation of the forward landing gear, brakes or steering, and air refueling doors will cause a drop in pressure indicated on the left body system pressure gage. Operation of the stabilizer, left rear gear, and brakes may not show a pressure drop on the left body system pressure gage

due to the location of the pressure transmitter. This pressure drop in either system with the resulting surge is normal provided engines 4 and 5 are operating at 82% rpm or above. In particular, if the left and right body systems are working properly, the stabilizer trim should move 6 units every 10 seconds and the bomb doors should close in 3 to 5 seconds. Normal pressure fluctuations of approximately 1500 psi will be experienced in the right body hydraulic system at initiation of AGM-69A rotary launcher drive in the secondary mode.

POWERED RUDDER/ELEVATOR SYSTEM OPERATION

In addition to the systems described above, two independent 3000 psi hydraulic pump and reservoir assemblies are installed to supply hydraulic power for the rudder and elevator actuators. Each electric motor-driven pump has nominal fluid flow of 4 gallons per minute at 2700 psi and is rated for continuous duty at 2 gallons per minute to an altitude of 55,000 feet. The two systems are redundant in the sense that either system has the capability of supplying sufficient hydraulic pressure to operate each elevator and rudder actuator for mission accomplishment following the failure of the other. The two reservoirs are crossvented through a relief/free flow valve and a balance line. This feature assures that unequal internal leakage at the rudder and elevator actuators, vents into the opposite reservoir rather than flowing overboard through the reservoir overboard relief valve. Backup or standby pressure is supplied to each system by the installation of two hydraulic transformers (hydraulic motor and pump) which derive power from the left and right hand body hydraulic systems. The transformers are designed to maintain fluid isolation between the body systems and rudder/elevator hydraulic systems. Fluid flow limitation is obtained by a flow regulator installed in the pressure port of the hydraulic motor (to limit flow to 3 (± 0.3) gallons per minute). The transformers have a zero flow delivery at pump differentials above 2800 psi and a flow delivery at differential pressures below 2470 psi. Each transformer has a normal output of 2 gallons per minute. Four lights located on the hydraulic control panel serve as a means for monitoring the main rudder/elevator pumps and the auxiliary (transformer) hydraulic pumps. These lights are controlled by a pressure switch connected to the sensing port of each hydraulic transformer pump and each power supply pump. Each pressure switch is so located and isolated with a check valve so that it will detect pressure only from the respective transformer output or the main pump output. The switch contacts are normally closed. Contact points open at 700 psi maximum during increasing pressure and close at 350 (± 50) psi on decreasing pressure, thus controlling the respective warning lights on the pilot's side panel. In addition to the four pressure switches used for pump failure monitor lights, two additional pressure switches are installed in the hydraulics. These two switches function in conjunction with the SAS electronics only.

AGM-69A LAUNCHER HYDRAULIC SYSTEM OPERATION

Two separate and independent hydraulic systems are permanently installed in the aircraft to power the AGM-69A rotary launcher. Each system contains a pressure, return, and case drain line connected to quick disconnect fittings on the left and right lower longerons for mating with the launcher hydraulic lines. The primary system consists of an electric motor-driven launcher power pump which takes hydraulic fluid from the left body hydraulic system return line and supplies pressure to the launcher manifold quick disconnect point. The pump is a variable delivery piston type. A relief valve is installed in a line connecting the pump output pressure and left body hydraulic return lines, and provides pressure relief at 3750 (± 25) psi if the launcher pump malfunctions. The pump is controlled by a three position switch on the pilot's hydraulic control panel. Selecting ON PRIMARY with the control switch supplies 28 volt d-c power from the left TR BUS to energize the hydraulic pump control relay. When energized, the relay supplies three phase AC power from the engine No. 1 generator power box to drive the launcher power pump. A pressure sensor is installed in the primary AGM-69A hydraulic system to provide a warning of inadequate pressure to operate the launcher by illuminating the launcher low pressure warning light. The light will come on when pressure decreases to 1300 (± 100) psi and will go out when pressure increases to 1500 (± 50) psi or when the launcher control switch is moved to the OFF or ON RH BODY position. The launcher power pump should not be operated unless an AGM-69A rotary launcher is installed in the aircraft as damage to the pump may occur. Failure of the launcher power pump to shut down when the control switch is placed in the OFF position will not damage the pump. In the event of left body hydraulic system fluid depletion, the launcher power pump should not be operated as overheating and pump failure will result. A hydraulic line failure downstream of the launcher power pump will result in depletion of the left body hydraulic system fluid if operation of the launcher power pump is continued. Failure of the left body engine driven pump will not affect operation of the launcher power pump as long as bleed air is available from either the number 3 or number 4 engine to pressurize the left body system hydraulic reservoir.

Secondary hydraulic pressure for emergency operation of the AGM-69A launcher is provided by the engine number 5 hydraulic pump through a solenoid operated, three-way hydraulic control valve in the right body hydraulic system, to the launcher manifold. The control valve is energized by 28 volt DC power from the left TR BUS when the AGM-69A launcher control switch is placed to the ON RH BODY position. When energized, the control valve routes pressure from the right body main pressure line to the launcher quick disconnect point. The engine number 5 (right body) hydraulic pressure gage will indicate the available supply when operating the secondary launcher hydraulic system. Operation of the launcher is interrupted during operation of either

the stabilizer trim system or the bomb door system. In the event of hydraulic line failure downstream of the solenoid operated control valve, the control switch must be returned to the OFF position to prevent depletion of the right body system hydraulic fluid. Loss of the right body engine driven pump or depletion of the right body system hydraulic will result in the secondary launcher hydraulic system being inoperative.

HYDRAULIC PUMP CAPACITIES

Hydraulic Pump (Engine Driven)

Rated capacity is affected by change of altitude and rpm as indicated for the following conditions and is:

- 13.2 gpm at sea level takeoff
- 8.7 gpm at sea level idle
- 11.6 gpm at high altitude cruise
- 10.1 gpm at high altitude idle.

Standby Pump (Electric-Driven)

Each standby pump produces 3 gpm flow within 0.05 second at 1300 psi and will reduce to 0 gpm flow at 3000 psi. The pumps are capable of continuous operation and are installed for ground check and emergency operation when for some reason the engine-driven pump is not functioning.

Ground Service (Test) Pumps

Two ground service (test) pumps, one in each in-board wing hydraulic system, provide a means of pressurizing the respective system during maintenance operations. Each pump is controlled by a toggle switch having ON--OFF (spring-loaded OFF) positions. These switches are located in the left lower longeron in the left forward wheel well. Each pump produces 0.45 gpm flow at 3000 psi.



To prevent pump overheating, the ground service (test) pumps are limited to 5 minutes continuous operations.

ESCAPE SYSTEMS OPERATION

The aircraft escape systems utilize ejection seats. Use of these systems will greatly increase the crew member's chances of safe escape from the aircraft in time of emergency. Detailed descriptions and the inspection and operating checklists for the escape systems are properly placed in other sections of this manual. However, this discussion is presented to enable the crew members to round out their knowledge and to consolidate references made to the systems in other parts of the manual. Every crew member who might possibly be in a position to use an automatic escape system should be familiar with the system and have confidence in it. Although operation is simple, if you do not know the system well enough to operate it quickly and correctly, or if distrust of the automatic features causes you to manually over-

ride them, you may lessen your chances in an already dangerous situation. For step-by-step procedures and minimum altitudes for operating the escape systems, see "Bailout," Section III. A detailed description of the automatic opening parachute, which should be considered a part of each escape system, can be found under "Integrated Harness" in Section I for upward ejection seats and in Section IV for downward ejection seats.

EJECTION SEAT SYSTEMS

Ejection seat systems, with their automatic features, increase the airspeed and the high and low extremes of altitude at which safe bailout can be accomplished. Automatic operation of a system includes stowing the control column, jettisoning the hatch, ejecting the seat, deployment of a drogue parachute, releasing the occupant from the seat, and activating the automatic parachute opening device. The downward ejection seat systems and the EW and gunner seats also provide automatic controlled man-seat separation. Release from the seat and opening the parachute can be accomplished manually by overriding the automatic system. However, fully automatic operation can greatly reduce the time required for seat separation and chute deployment at low altitudes and make safe descent from high altitudes possible even if loss of consciousness occurs.

Upward Ejection Seats

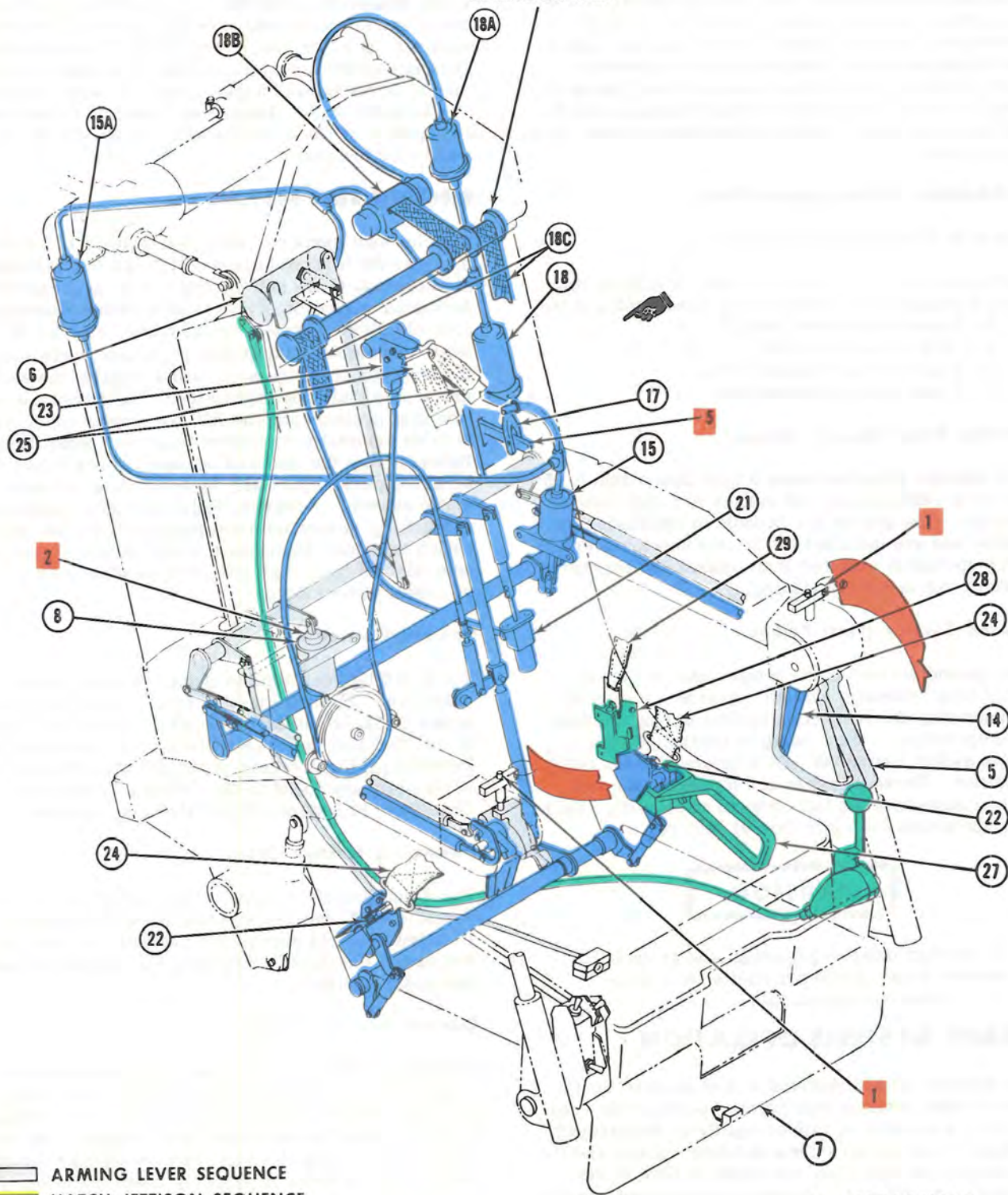
For a detailed description of the upward ejection seats, see "Upward Ejection Seats," Section I. Detailed preflight checks of the pilots' seats are found in the "Interior Inspection Checklists" in Section II. Detailed preflight checks of the EW officer's and gunner's seats are found in the "Interior Inspection Checklist" in Section VIII for that crew member.

Downward Ejection Seats

For a detailed description of the downward ejection seats, see "Downward Ejection Seats," Section IV. Detailed preflight checks are found in the "Interior Inspection Checklist" of Section VIII for the navigator and radar navigator.

Ejection Seat Illustrations

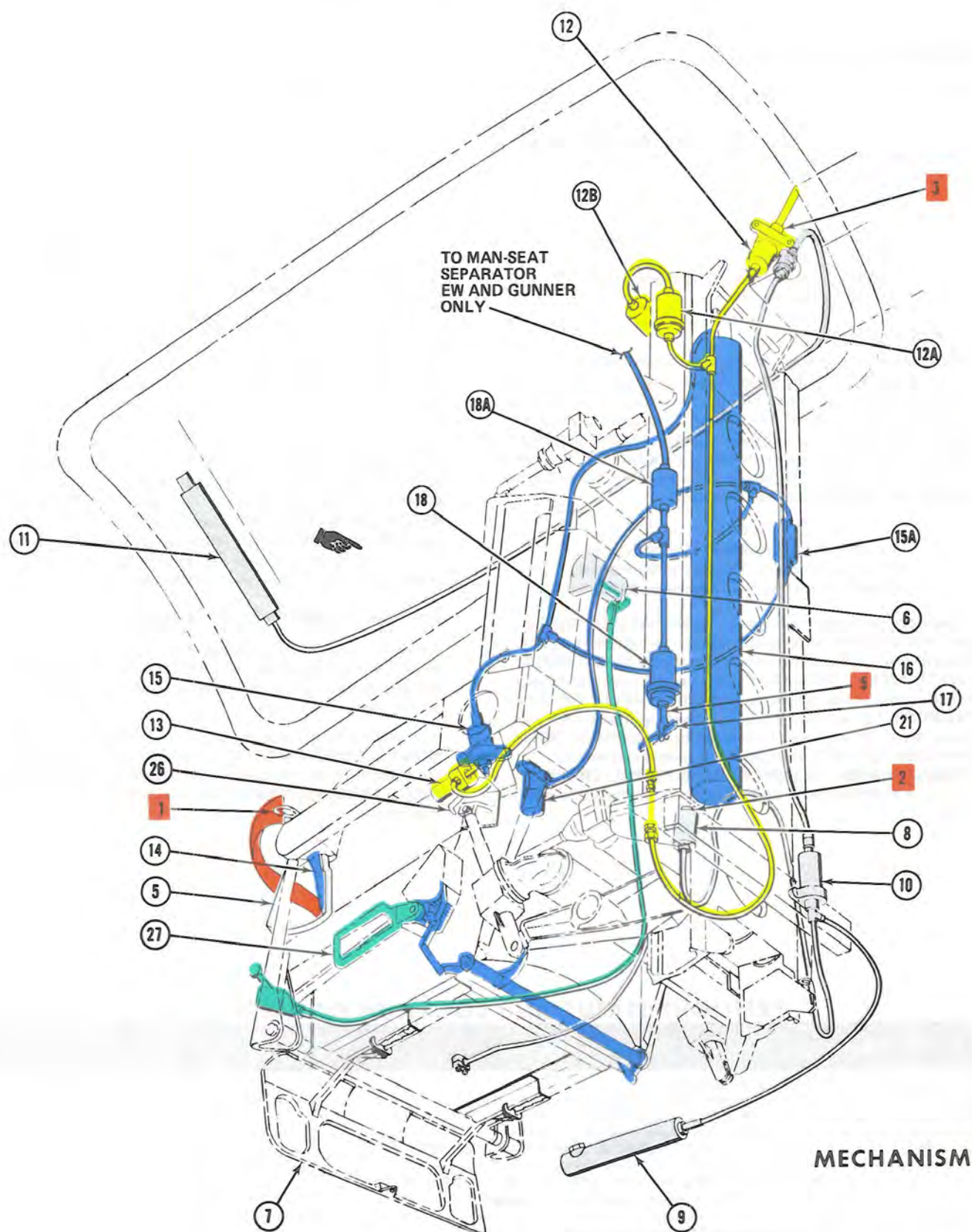
Illustrations of the upward and downward ejection seats accompany their respective descriptions in Sections I and IV and figures 7-10 and 7-11. These pictures show the configuration of the seats and the component parts with which the crew member should be familiar in order to properly check his seat. Figure 7-10 shows a schematic of the upward ejection seat system along with a sequence of events relative to the ejection operation. Color coding makes it possible to correlate the actuation of controls and mechanisms with the sequence of events. Figure 7-11 gives the same information for the downward seats. One sheet of each illustration contains a detailed sequence of events and is numbered; the numbers correspond to the callouts on other sheets of the illustration.

MAN-SEAT SEPARATOR
EW AND GUNNER

- ARMING LEVER SEQUENCE
- HATCH JETTISON SEQUENCE
- FIRING SEQUENCE
- MANUAL EMERGENCY OPERATION
- SAFETY PIN LOCATIONS

MECHANISM

Figure 7-10 (Sheet 1 of 4).



Upward Ejection System (Typical)

Figure 7-10 (Sheet 2 of 4)

NOTE

This is the key for sheets 1, 2, and 4.

EJECTION SEQUENCE

PRE-EJECTION PREPARATION

At least one of two **FLIGHT SAFETY PINS (1)** and three **MAINTENANCE SAFETY PINS (2, 3, and 5)** must be removed prior to accomplishing ejection sequence.

NOTE

The seat may be armed anytime the maintenance pins and either one of the No. 1 flight safety pins have been removed by rotation of same arming lever from which No. 1 pin has been removed.

ARMING SEQUENCE

Raise armrests to the up position. Squeeze arming lever release and rotate either, or both, **ARMING LEVERS (5)** forward and upward until locked. Rotation of arming lever locks **INERTIA REEL (6)**, thus locking shoulder straps (harness), unlocks **LEG SUPPORT/DROG PLATE (EW and GUNNER) (7)** which rotates and locks in armed position, and fires **ARMING INITIATOR (8)**. Gas expansion from arming initiator fires **CONTROL COLUMN STOWAGE THRUSTER (9)**, stowing the control column, and also fires the **HATCH JETTISONING INITIATOR (10)**.

NOTE

At the EW officer's and gunner's stations, there are no control column thrusters. The gunner's fire control unit stowage thruster is fired by the hatch jettisoning initiator.

Gas expansion from the jettisoning initiator fires the **HATCH JETTISONING THRUSTER (11)** which unlocks and opens the hatch thus jettisoning the hatch. A link attached to the hatch and connected to the **CATAPULT SAFETY PIN-PULL INITIATOR (12)** fires the initiator. Gas expansion from the pin-pull initiator operates the **CATAPULT SAFETY PIN-PULL CYLINDER (13)**, withdrawing the pin from the catapult initiator (15) thus arming the seat. On the pilot and copilots seats, gas also operates the **INITIATOR BOOSTER (12A)**, which provides gas pressure to operate the **DROGUE PARACHUTE SUPPORT ARMS PIN-PULLER (12B)**, unlatching the **SUPPORT ARM LATCH (12C)** allowing the support arms to extend.

FIRING SEQUENCE

Pull **FIRING TRIGGER (14)**. Action of the linkage fires the **CATAPULT INITIATOR (15)**. Gas expansion from the **CATAPULT INITIATOR (15)** fires the **INTEGRATED HARNESS RELEASE DELAY INITIATOR (0.3 SECOND DELAY) (15A)** and fires the **CATAPULT (16)**. Firing of the catapult causes the seat, ejectable rails, and intermediate rails to move up on the fixed rails. As the seat moves through the hatch opening, the drogue parachute support moves away from the seat pulling a lanyard, allowing drogue parachute deployment. On the EW and gunner seats, the drogue parachute which is attached to the bottom of the seat, is deployed by a lanyard attached to the intermediate rail. As the seat and ejectable rails move upward on the intermediate rails, the **INTEGRATED HARNESS RELEASE TRIP (17)** actuates the **ZERO DELAY INTEGRATED HARNESS RELEASE INITIATOR (18)**. Gas expansion in parallel from the **ZERO DELAY INTEGRATED HARNESS RELEASE INITIATOR (18)** and the **INTEGRATED HARNESS RELEASE DELAY INITIATOR (15A)** operates the **INTEGRATED HARNESS RELEASE PIN-PULL CYLINDER (21)**. Action of linkage unlocks the **SAFETY BELT RELEASE FITTINGS (22)** and the **SHOULDER STRAP RELEASE FITTING (23)**, releasing the **SAFETY BELT (24)** and **PARACHUTE HARNESS (25)** thus allowing the occupant to separate from the seat.

On the EW and gunner seats, gas expansion from the zero delay **INTEGRATED HARNESS RELEASE INITIATOR (18)** and the **INTEGRATED HARNESS RELEASE DELAY INITIATOR (15A)**, fires the **MAN-SEAT SEPARATION BOOSTER (18A)**. This action fires the **INTEGRATED ROTARY ACTUATOR (18B)**, which operates to pull the nylon **MAN-SEAT SEPARATION STRAPS (18C)** tight and forcibly separate the seat occupant from the seat immediately after release of **SAFETY BELT RELEASE FITTINGS (22)** and shoulder strap release fitting (23).

MANUAL EMERGENCY OPERATION

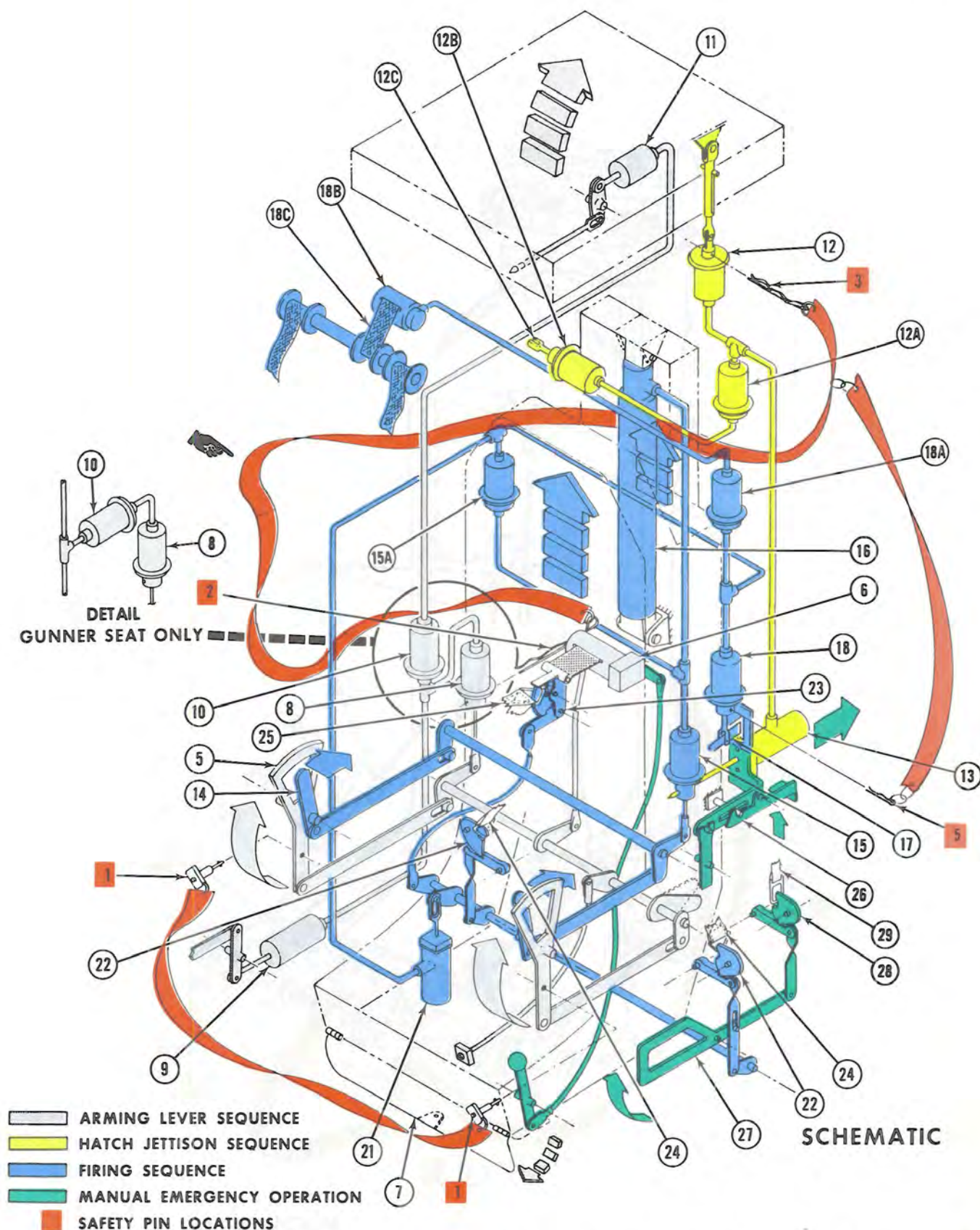
If the catapult initiator fails to fire when trigger is squeezed, squeeze the **CATAPULT SAFETY PIN-PULL CYLINDER MANUAL RELEASE (26)** and withdraw the pin-pull cylinder, withdrawing the safety pin from the catapult initiator. Again squeeze trigger.

If the integrated harness release fails to fire, pull the **INTEGRATED HARNESS RELEASE HANDLE (27)**. Action of linkage unlocks the safety belt release fittings (22), the shoulder strap release fitting (23), and the **PARACHUTE ARMING LANYARD (29)**, allowing the occupant to separate from the seat.

PREFLIGHT STATUS AND LOCATION OF SAFETY PINS

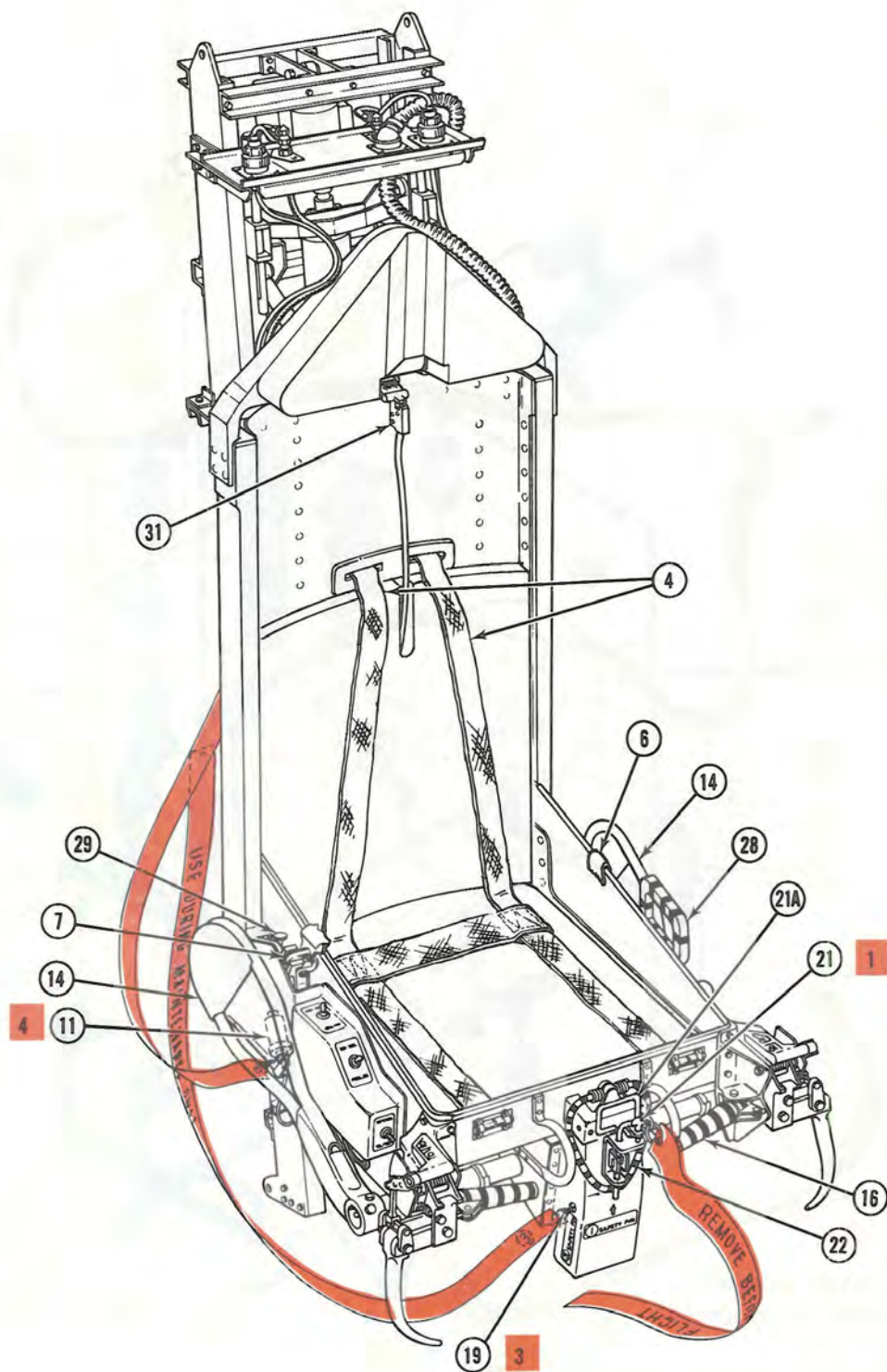
PIN NO.	LOCATION	REMOVED BY GROUND CREW	REMOVED BY FLIGHT CREW
No. 1	RH and LH Armrest (two)		✓
No. 2	RH Ejectable Rail (Arming Initiator)	✓	
No. 3	Pilots': On rail support bulkhead at top of rails (Catapult Safety Pin-Pull Initiator)	✓	
	Gunnery' and EW: Mounted on instrument panel upper mounting structure (Catapult Safety Pin-Pull Initiator)	✓	
No. 5	On LH Ejectable Rail (Integrated Harness Release Initiator)	✓	

Figure 7-10 (Sheet 3 of 4).



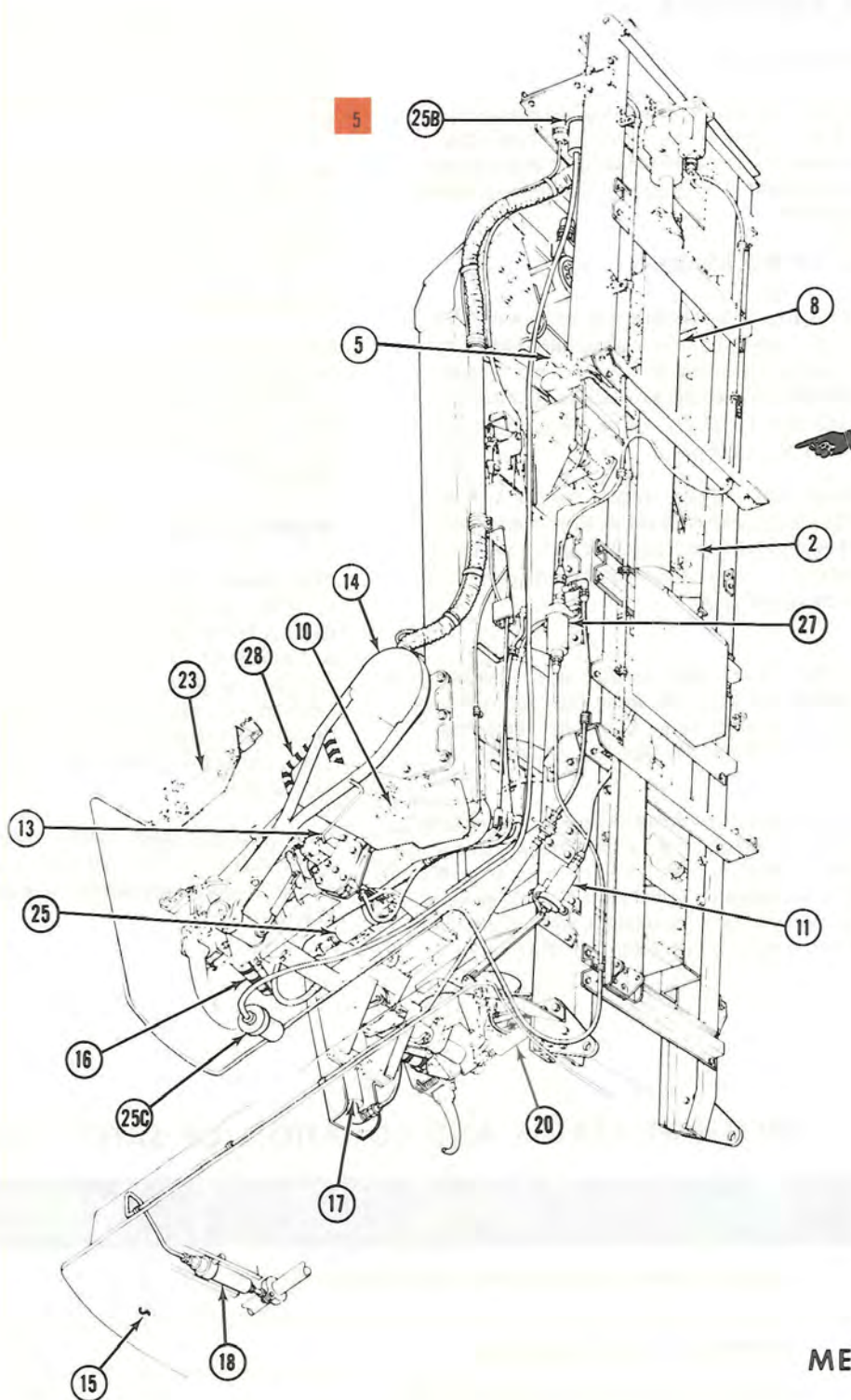
Upward Ejection System (Typical)

Figure 7-10 (Sheet 4 of 4).



MECHANISM

Figure 7-11 (Sheet 1 of 4).



MECHANISM

Downward Ejection System

Figure 7-11 (Sheet 2 of 4).

NOTE

This is the key for sheets 1, 2, and 4

EJECTION SEQUENCE

PRE-EJECTION SEQUENCE

One **FLIGHT SAFETY PIN NO. 1 (21)** and three **MAINTENANCE SAFETY PINS 3, 4 & 5** must be removed, and the **EJECTION CONTROL TRIGGER RING RELEASE MECHANISM PIN (21A)** must be actuated to release the ejection control trigger ring from the stowed position prior to accomplishing sequence.

ARMING AND FIRING SEQUENCE

Pull **EJECTION CONTROL TRIGGER RING (22)** upward. A cable attached through a shock absorber to the **ARMING INITIATOR (17)** fires the initiator. Gas expansion from the arming initiator fires the **LEG GUARD THRUSTER (20)**, **HATCH JETTISON THRUSTER (18)**, and **TABLE STOWAGE INITIATOR (27)**. As the leg guards (14) rotate, the **INERTIA REEL (5)** is locked.

Gas expansion from the table stowage initiator fires the **TABLE STOWAGE THRUSTER (23)**, thus moving **TABLE (24)** to stowed position. As the **ESCAPE HATCH (15)** is jettisoned, **CATAPULT SAFETY PIN-PULL INITIATOR (11)** is fired by means of catapult safety pin-pull link attached to the escape hatch.

Gas expansion from the catapult safety pin-pull initiator operates the **CATAPULT SAFETY PIN-PULL CYLINDER (26)** causing it to retract pin which acts as a safety on the **CATAPULT INITIATOR (25)**. Continued pull on the trigger ring (22) fires the catapult initiator (25).

Gas expansion from the **CATAPULT INITIATOR (25)** fires the **INTEGRATED HARNESS RELEASE DELAY INITIATOR (0.3 SECOND DELAY) (2)** and fires the **CATAPULT (8)**. Firing of the catapult causes the seat, ejectable rails, and intermediate rails to move downward on the fixed rails. As the seat moves through the hatch opening, the **DROGUE PARACHUTE SUPPORT ARM RELEASE INITIATOR (25B)** is fired by a **INITIATOR TRIP (25A)** mounted on

the fixed rails. Gas expansion from the **DROGUE PARACHUTE SUPPORT ARM RELEASE INITIATOR (25B)** causes the **DROGUE PARACHUTE SUPPORT ARM PIN-PULLER (25C)** to operate, allowing the drogue parachute support to rotate away from the seat pulling a lanyard, allowing drogue parachute deployment.

Gas expansion from the integrated harness release initiator operates the **INTEGRATED HARNESS RELEASE PIN-PULL CYLINDER (10)**. Action of the linkage unlocks the **SAFETY BELT RELEASE FITTINGS (7)** and **SHOULDER STRAP RELEASE FITTING (31)**, releasing the **SAFETY BELT (6)** and **PARACHUTE HARNESS (30)** thus allowing occupant to separate from seat.

Gas expansion from the integrated harness release initiator (2) also fires the **INTEGRATED ROTARY ACTUATOR (3)** which operates to pull the nylon **MAN-SEAT SEPARATION STRAPS (4)** tight and forcibly separate the seat occupant from the seat immediately after release of safety belt release fittings (7) and shoulder strap release fitting (31).

MANUAL EMERGENCY OPERATION

If the catapult initiator (25) fails to fire when the firing trigger ring is pulled, pull the **MANUAL CATAPULT PIN-PULL RELEASE HANDLE (13)** to withdraw the pin-pull cylinder and pin from the catapult initiator. If the integrated harness release initiator (2) fails to fire, pull the **INTEGRATED HARNESS RELEASE HANDLE (28)**. Action of the linkage unlocks the safety belt release fittings (7), shoulder strap release fitting (31), and **PARACHUTE ARMING LANYARD RELEASE FITTING (9)**, allowing the occupant to separate from the seat.

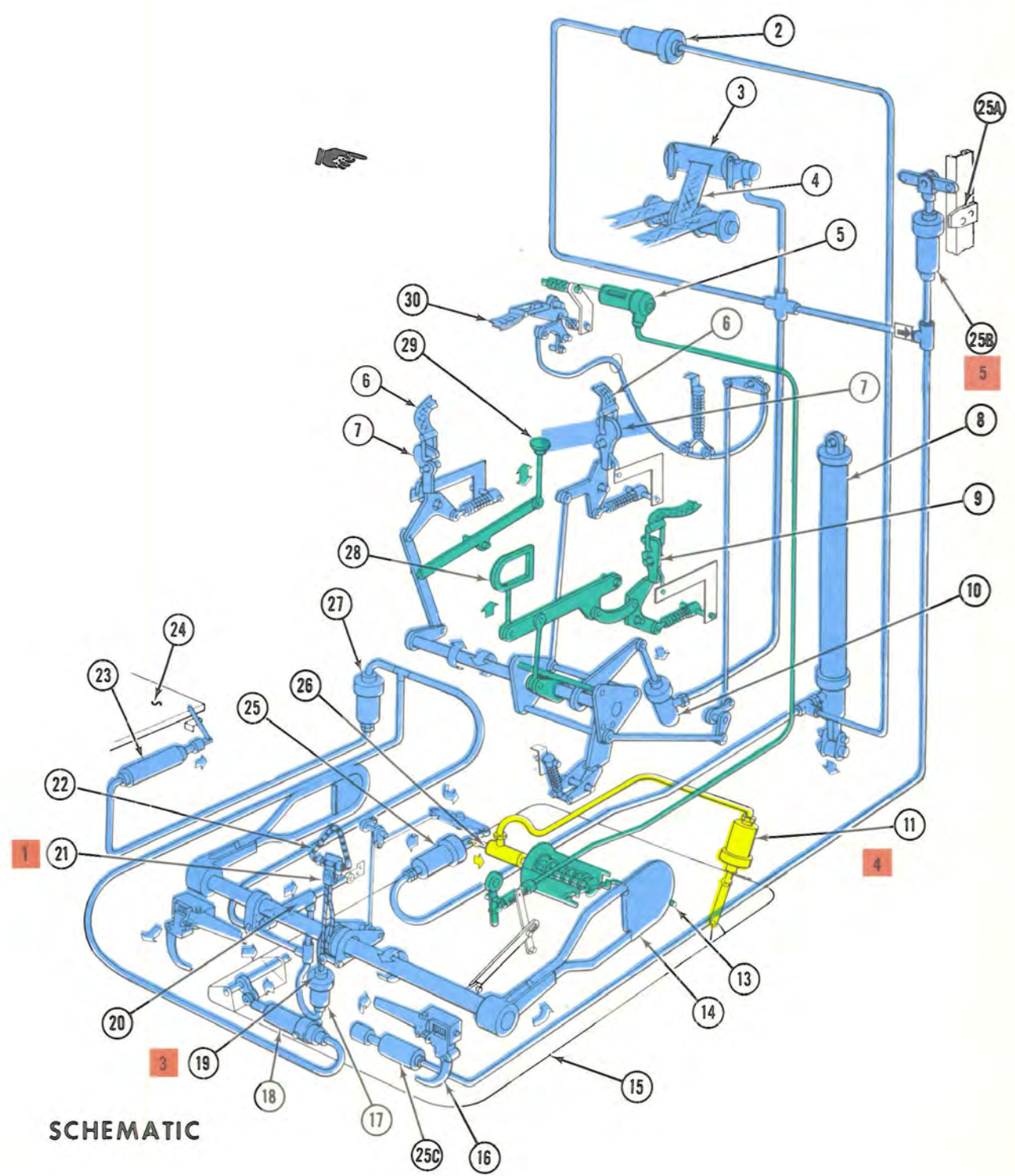
If the integrated harness release handle has been pulled for some reason other than bailout and it is desired to reset the mechanism, push down on the **INTEGRATED HARNESS RELEASE RESET BUTTON (29)**.

PREFLIGHT STATUS AND LOCATION OF SAFETY PINS

PIN NO	LOCATION	REMOVED BY GROUND CREW	REMOVED BY FLIGHT CREW
No. 1	Front center of seat bucket (Ejection Control Trigger Ring Release Mechanism Pin)		✓
No. 3	Front center of seat bucket (Arming Initiator)	✓	
No. 4	Body structure just aft hatch (Catapult Pin-Pull Initiator)	✓	
No. 5	On left ejectable rail (Drogue Parachute Support Arm Release Initiator)	✓	

downward ejection system

Figure 7-11 (Sheet 3 of 4).



SCHEMATIC

- HATCH JETTISON SEQUENCE
- ARMING AND FIRING SEQUENCE
- MANUAL EMERGENCY OPERATION
- SAFETY PIN LOCATION (PIN NO.)

.....**Downward Ejection System**

Figure 7-11 (Sheet 4 of 4).

Crew Duties

section VIII

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INTRODUCTION

The purpose of this section is to provide a compact collection of material wherein each crew member can readily determine his duties in relation to the accomplishment of the overall mission. Instructions relating to crew duties do not include information which is already covered in other sections.

CREW COORDINATION

Coordination of actions within a crew is of prime importance to insure the optimum degree of mission success and safety during all phases of operation. This coordination is not necessarily limited to actions alone. Complete familiarity with one's crew position, the responsibilities thereof, and a working knowledge of the other crewmembers' duties will contribute immeasurably toward crew coordination. Each crewmember will be constantly on the alert and should notify the responsible crewmember of any deviation or discrepancy which will affect successful accomplishment of the mission. Liaison between individuals concerned will be established prior to initiating any action or procedure which will alter aircraft configuration or require correlation of activities between crewmembers. Prior to flight, the pilot will insure that all crewmembers are thoroughly familiar with all aspects of the assigned mission as pertains to their crew specialty to include:

- Applicable instructions in the Flight Information Publications
- Departure routes, altitudes, obstructions, and traffic procedures
- Route of flight
- Navigation (to include low altitude)
- Air refueling information
- Bombing
- EW activities
- FCS operation activities
- Normal and emergency communications procedures
- Any special instructions or procedures pertaining to the mission.

NOTE

The pilot, copilot, radar navigator and navigator will be thoroughly familiar with the penetration, approach, missed approach, landing patterns, altitudes, and obstructions at both destination and alternate airfields. Available aids, such as current FLIP Terminal and approach charts, will be studied. A complete set of current approach charts will be available for inflight use of both the pilot and radar navigator. The radar navigator as well as the pilot not actually flying the aircraft, will closely monitor all penetrations and approaches. The pilot at the controls will be notified immediately of any deviation from published procedures.

It is imperative that positive measures be taken to insure that safety of personnel and aircraft are not jeopardized. Flight attitude of the aircraft will be carefully monitored by either pilot or copilot at all times. Prior to accomplishment of any of the following, verbal coordination between applicable crewmembers will be required when:

1. Control of the aircraft is transferred between pilot and copilot.
2. Control column of either the pilot or copilot is disconnected or reengaged.
3. Changing fuel control settings.
4. A crewmember returns to position, comes back on interphone, and removes his inflight safety pins, or unstows downward ejection control trigger ring.
5. A crewmember leaves position or goes off interphone.
6. A crewmember goes off oxygen and when he resumes oxygen use during flight when oxygen is required.
7. Autopilot control of aircraft is transferred between the radar navigator and pilot.
8. Any electrical power source is changed.
9. It is necessary for the pilot flying the aircraft to transfer control of the aircraft to the other pilot when he is required to do something which will divert his attention from flying, such as check oxygen, tune radios, change fuel control settings, etc.
10. The pilot intends to perform any critical maneuver, at which time all crew members will be secured in their respective positions.
11. Changing air outlet knob positions (notify copilot).
12. The inflight safety pins are installed or the downward ejection trigger ring is stowed. Conditions requiring pin installation or trigger ring stowage are:
 - a. All ground operations.

- b. Whenever the crew member leaves his seat in flight.
- c. When the parachute is not worn.
- d. When the seat belt and shoulder straps are not fastened.

All applicable crew members will acknowledge that the intended course of action is understood prior to actual accomplishment and will conduct themselves accordingly. All crew positions, when practical, should monitor communications outside the aircraft at all times.

WARNING

- Whenever a change of crew position is necessary, climb to a safe altitude and area before the change is made. The pilots will not exchange seats when only two pilots are aboard the aircraft.
- Any time during critical phases of flight and especially during night and/or instrument conditions, the pilot not flying the aircraft will closely monitor his flight instruments and cross-check them against the instruments of the other pilot. If an apparent error in aircraft attitude is detected, the pilot flying the aircraft will be advised immediately. The pilot not flying the aircraft will also monitor the engine instruments.
- Extreme care will be exercised by the pilots, when leaving seats, to avoid inadvertent operation of switches or controls on the aisle stand or overhead panel.
- Before leaving a pilots' ejection seat, stow the control column prior to releasing the safety belt. When returning to the seat, fasten the safety belt prior to engaging the control column. This should prevent inadvertent actuation of the control column by an unrestrained crewmember.
- When leaving the upward ejection seat, replace both arming lever safety pins, unbuckle the parachute harness and safety belt, leaving the parachute and survival kit in the seat. Upon returning to the seat, safety pins will be removed immediately after donning the parachute and fastening the safety belt.
- To prevent accidental firing of downward ejection seat, stow the ejection control trigger ring prior to leaving the seat during flight. Upon returning to the seat, fasten parachute and safety belt, then unstow the ejection control trigger ring from the stowed position.
- Prior to stowing/unstowing the ejection control ring, make a positive check that the trigger ring is properly seated in the detent and that the area is clear of straps and other equipment. If the trigger ring is found to be out detent, carefully secure all equipment and pull the

survival kit release handle, lock the inertia reel to assure release of the integrated harness, then pull the integrated harness release handle. Occupant can then leave the seat with the parachute and safety belt.

- If safety belt is removed in flight or on the ground, place the belt carefully so as not to inadvertently operate any switch.
- When moving around an ejection seat, care will be taken not to actuate the seat ejection mechanism.
- To prevent injury to personnel, the upper deck sliding hatch will be closed and locked when any crewmember is required to move about or conduct any activity in the area of the hatch.
- To insure an escape route for crewmembers normal or alternate bailout/crash landing exits and to provide access to the lower compartment for rescue personnel, the upper deck sliding hatch will be open and locked prior to takeoff, air refueling, low level activity, planned unusual maneuvers, penetration, and landing.
- Extreme caution will be exercised by all crewmembers when stowing and securing gear aboard the aircraft. Care will be taken to assure that gear is safely secured and is not stowed on or near heating ducts, outlets, electrical wiring, and electronic equipment. Periodically during flight each crewmember should check ducts, outlets, electrical wiring, and electronic equipment in his immediate area to see that they are free of combustible materials. For location of hot air ducts and outlets, see figure 4-2A.
- Extreme caution must be exercised when moving around and stowing equipment near upward ejection seats to avoid inadvertent actuation of the integrated harness release trip.

NOTE

When no nuclear bombs or missiles are loaded, safety wires and seals are not required on the associated monitor control and release system controls.

CHECKLISTS

The flight manual checklists have been designed so that they may be used for training missions with bombs or missiles, for alert posture, and for EWO missions.

Nuclear Bombs

Nuclear bomb strike mission amplified checklists appear in Section I of T.O. 1B-52D-25-2. The Pre-Takeoff and Inflight sections, only, have been integrated within the flight manual checklists. The integrated items appear without amplification in both

the amplified and abbreviated checklists. T.O. 1B-52D-25-2CL-1, "Nuclear Bomb Delivery Procedures," will be maintained as a separate checklist and will be available for use as required. The following additional checklists also appear in T.O.'s 1B-52D-25-2 and 1B-52D-25-2CL-1:

- Non-Strike Procedures
- EWO Restrike Procedures
- Emergency Procedures

Nonnuclear Weapons

Nonnuclear weapons procedures from T.O. 1B-52D-34-2-1 have been integrated with the affected flight crew checklists.

Missiles

The procedures that lend themselves to integration in existing checklists have been so integrated for applicable crew members. Otherwise, the procedures have been integrated as complete checklists. The integrated procedures appear as line items without amplification in both the amplified and abbreviated checklists. Amplification of the line items pertinent to missile normal procedures may be found in Section II of the appropriate publication as listed below. Numbering of checklist items in the abbreviated checklists will not coincide with the numbering in the amplified checklists as listed below unless the procedure has been integrated as a complete checklist.

AGM-69A CHECKLISTS. The AGM-69A normal procedures amplified checklists will appear in the B-52/AGM-69A Aircrew Weapon Delivery Technical Manual, T.O. 1B-52G-30-2. The abbreviated checklists for certain AGM-69A normal procedures are integrated in the "Normal" part of the pilots', navigator's, and radar navigator's abbreviated flight crew checklists. "AGM-69A Inflight Procedures" appear nonintegrated in the "Missile" part of the navigator's and radar navigator's abbreviated flight crew checklists. "Unscheduled Landing with AGM-69A Missiles" procedures are in the navigator's and radar navigator's abbreviated flight crew checklists only. The AGM-69A emergency procedures appear in the "Emergency" portion of the appropriate aircrew abbreviated checklists as nonintegrated items.

Bomb Run

The bomb run checklists in Section VIII have been designed so that they may be used for both training and EWO missions. They have been consolidated for use by both the navigator and radar navigator.

ELECTRONIC EQUIPMENT INTERFERENCE

Due to the electronic characteristics of certain aircraft equipment, intraplane interaction/interference may occur. An interference check will be accomplished in such detail as necessary so that each crew member responsible for operation of electronic equipment will be thoroughly familiar with the effect of interaction, magnitude of interference, presence of spurious responses, and be able to determine the useable portion of the frequency spectrum that will allow the most effective and coordinated operation of this equipment. Amplification of the interference check will appear in the EW Officer's checklist.

LOW ALTITUDE NAVIGATION

During low altitude flight, special emphasis by all crew members will be directed to maintaining route corridor and prescribed altitudes. Crew coordination is extremely essential for each change of heading and/or altitude. The navigator will notify the pilot when altitude deviates significantly from that planned. The navigator will announce each new magnetic heading, altitude, and ETA/ETE. This information will be cross-checked by the pilot/copilot. The pilot/copilot will monitor the aircraft position and take action as necessary to insure corridor limits are not exceeded.

ALTITUDE CALL PROCEDURES

The pilot, copilot, radar navigator, and navigator will be thoroughly familiar with all planned altitudes to be flown throughout the mission. In flight, the pilot, copilot, and radar navigator/navigator having primary altimeter responsibility will monitor all altitudes being flown to insure no deviations of flight altitude clearances. The following calls are mandatory and will be made over interphone when required altitude changes are being made.

1. The pilot flying the aircraft will announce, over interphone, when departing an assigned altitude with the altitude climbing or descending to. (eg, "Descending to 1,900.") No acknowledgement is required by other crewmembers unless an error is noted.

2. The responsible radar navigator/navigator will announce, over interphone, when 2000 and 1000 feet below or above any assigned altitude when climbing or descending (eg, "4,000 for 2,000"). Acknowledgement by the pilot flying the aircraft is required.

3. The responsible radar navigator/navigator will announce, over interphone, each 5,000 feet MSL during all descents commencing at 15,000 feet MSL.

This call will include the altitude the aircraft is descending to. (eg, "10,000 for 1,900.") Acknowledgement is required by the pilot flying the aircraft.

4. The responsible radar navigator/navigator will announce approaching DH/MDA during all instrument approaches. This call should be made approximately 100 feet above the DH/MDA and will include the appropriate DH/MDA altitude. (eg, "Approaching 363.") Acknowledgement by the pilot flying the aircraft is required.

5. The pilot not flying will announce DH, MDA, VDP, and, if required, MAP. Upon making a decision to land or execute a missed approach, the pilot flying will announce his intentions to the crew over interphone.

PILOT

The pilot is the aircraft commander and is responsible for the aircraft and crew. For simplification and to avoid any misunderstanding, the pilot and copilot will be referred to as such during interphone transmissions. The successful accomplishment of the mission is of prime importance; in no instance, however, will the safety of the aircraft or crew be compromised. The pilot is responsible for the issuance of instructions governing all phases of flight operation. In addition to his regular function, the pilot will perform the following:

Mission Preparation

1. Attend general briefing.
2. Coordinate with other crew members on route, charts, targets, items pertinent to individual crew procedures, and supervise the completion of required forms.
 - a. The pilot's low level chart will contain data as required to orient the pilot to actions necessary for the accomplishment of the low level portion of the mission.

NOTE

If the planned mission includes a low altitude portion, a forecast altimeter setting will be obtained for the low altitude entry point. This forecast setting will be compared with that received from the Air Traffic Control agency prior to starting the descent. When executing a descent prior to landing or for low altitude tactic, the pilot coordinates the altimeter setting with the navigator and both will compare actual and forecast altimeter settings at this time.

3. Complete and file DD Form 175.
4. Attend specialized briefings for air refueling, weather, and other pertinent information.
5. Compile latest information relative to flight to brief the crew.
6. Conduct specialized crew and emergency procedures briefing.
7. Check personal and professional equipment for completeness and working order.

8. Check publications and technical data for currency.

Bomb Run

1. Center FCI on radar navigator's request and transfer control of the aircraft to the radar navigator.

NOTE

One of the pilots should maintain the desired IAS and monitor engine instruments on the bomb run to enable the other pilot to handle any emergency in minimum time and to visually clear the aircraft.

2. The pilot will call time to go and heading error indicator position at appropriate intervals and request "Tone on" at 20 seconds time to go.

COPILOT

The copilot is the deputy aircraft commander and will assist the pilot in the proper flight of the aircraft. Inasmuch as the fuel panel and electrical system are controlled by the copilot, he will also act as the flight engineer.

NOTE

Increased attention must be devoted to monitoring all engine instruments and warning indicators any time the pilot's attention must be devoted solely outside the cockpit, i. e., during rendezvous, air refueling, formation flying, etc.

In addition to this regular function, the copilot will perform the following:

Mission Preparation

1. Attend general briefing.
2. Assist the pilot and navigator in mission planning and flight plan preparation. The copilot will prepare the fuel prediction curve and compute takeoff performance data.
3. Prepare aircraft loading and weight and balance forms for pilot's signature.
4. Attend specialized and emergency procedures briefings with pilot.
5. Check personal and professional equipment for completeness and working order.
6. Check publications and technical data for currency.

RADAR NAVIGATOR/NAVIGATOR

The navigator and radar navigator must work together continuously to insure successful completion of the mission. Each must have sufficient knowledge of the other's duties to enable him to perform them if the need arises.

Whenever a mission is flown with only a radar navigator or navigator, the RN/N flying will perform all applicable checklist items of his assigned position. In addition, he must accomplish all items in the RN/N not-flying checklist for the position not occupied by a qualified RN/N. These items are minimum steps to be accomplished. Additional items may be accomplished if needed or desired.

Mission Preparation

1. Attend general and specialized mission briefings as required. (RN-N)
2. Accomplish target study on assigned targets. (RN-N)
3. Accomplish study of AGM-69A mission program data. (RN-N)
 - a. Review target storage data. Review missile/target and CLASS settings.
 - b. Review programmed check point listing.
 - c. Determine gross safe in-range envelopes
4. Coordinate with maintenance personnel to determine status and history of bombing and navigation equipment and missiles as applicable. (RN-N)
5. Select maps and charts of suitable scale and projection as dictated by requirements of the mission. (RN-N)
6. Procure additional charts to provide coverage for emergency changes in flight. (N)
7. Procure all flight planning, inflight, and post-flight forms which are needed to plan, fly, and record the flight. (RN-N)
8. Procure Automated Offset Unit (AOU) punched card deck for the specified mission. (RN/N)
9. Procure letdown information for primary and alternate destinations. (Flight Information Publication Terminal is adequate.) (RN-N)
10. Procure or prepare bomb run inserts. (RN)
11. Check personal and professional equipment for completeness and working order. (RN-N)
12. Check publications and technical data for currency. (RN-N)

Preparation of Charts

1. The complete route will be correctly plotted. The routes will be planned from point to point. (N)
2. All pertinent special use airspace areas within 50 NM of planned route (20 NM for low level route portion) and within the planned altitude structure (high altitude vs low altitude) will be clearly marked with time and altitude limitations. (N)
3. Planned air refueling ARIP, ARCP, exit point, refueling altitude, and start descent point will be annotated on the chart. (N)

4. Coordinates of prominent radar returns along the route no more than 100 NM apart for high altitude will be annotated for updating position counters. For low altitude, coordinates of prominent radar returns along the route no more than 60 NM apart will be readily available for updating position counters. Coordinates of all turn points will be annotated. (RN)

5. All pertinent action points will be annotated on the chart. The crew will be notified by the navigator when each of these points is reached. (N/RN)

- a. PCTAP and HHCL.
- b. SCM, TAT, TTAT, and TCM points.
- c. Start and termination of gunnery activity.
- d. Grid entry and exit points. Convergence angles will be available.
- e. Pre-IP, IP, Timing Initiation Point, and Target.

6. Annotate AGM-69A action points and activity areas. (RN-N)

- a. Check Point Fix Location
- b. Prelaunch Check
- c. Launch/Simulated Launch Area
- d. LAC Areas (RN chart only)
- e. TAL Maneuver Area (if applicable)

7. The low altitude portion of the mission will be plotted on current edition of ONC/WAC charts. ONC charts are mandatory when available. Low altitude planning and annotations will be in accordance with applicable directives. (RN-N)

Preparation of Forms

1. Complete Flight Plan. (N)
2. Complete Bombing Computation Forms. Complete forms in accordance with applicable directives. Only the release data need be filled in for subsequent, identical bomb runs. (RN)
3. Complete AGM-69A Forms (N)
4. Complete Celestial Precomputation Forms as desired. (N)
5. Complete Radar Scope Photo Log as desired. (RN)

EW OFFICER

The primary responsibility of the EW officer is the utilization of the installed electronic countermeasures equipment to provide an active electronic defense against ground based or airborne electronic devices that pose a threat to the safety of the aircraft

and the completion of its mission. This is accomplished through the coordinated efforts and aid of all crew members. Secondary responsibility is obtaining celestial observations by use of the periscopic sextant when requested by the navigator. This activity is accomplished through coordination with the radar navigator and navigator. In addition, the EW Officer will monitor liaison radio communications as prescribed in governing directives. Monitoring responsibility may be assumed by another crewmember during those periods in which the EW Officer is accomplishing required checklists, ECM activity, or celestial observations.

Mission Preparation

1. Attend general briefing.
2. Accomplish study of all intelligence data necessary for the accomplishment of the EW portion of the mission.
3. The EW officer will accomplish flight planning, coordinating with other crew members on the necessary phases of EW activity, celestial navigation, interference checks, and DCE exercises.
4. Complete required logs/forms in accordance with applicable directives.
5. Attend specialized briefing when applicable.
6. Attend crew briefing.
7. Check personal and professional equipment for completeness and working order.
8. Check publications and technical data for currency.

GUNNER

The gunner is responsible for employment of the fire control system for active defense of the bomber against enemy fighters. He maintains constant radar search for enemy aircraft, reporting enemy aircraft activity to other members of the crew. Such coordination permits the crew to utilize defensive maneuvers, electronic countermeasures, chaff, and gun fire to the optimum extent in defending the aircraft. On aircraft **AU**, the gunner is responsible for operation of the AFSATCOM terminal.

Mission Preparation

1. Attend general briefing.
2. Accomplish mission planning, coordinating with other crew members concerning FCS activity. Insure that required FCS forms are obtained for use on the mission.
3. Attend specialized briefing as required. Receive and study available intelligence data regarding anticipated fighter attacks and, on aircraft **AU**, operational plan for use of the AFSATCOM terminal.
4. Review all data on the gunner's flimsy.
5. Check personal and professional equipment for completeness and working order.
6. Check publications and technical data for currency.

RADAR NAVIGATOR'S CHECKLIST (NUCLEAR)

BEFORE EXTERIOR INSPECTION (POWER OFF)

1. Readiness Switch Cover - Closed, sealed (RN)
2. AGM-69A Consent Panel: (RN)
 - a. Prearm-Safe Switch - Guard closed and sealed
 - b. Lock-Unlock Switch - Guard closed and sealed
3. Special Weapons Manual Lock Door - Sealed (RN)
4. AGM-69A Lock-Unlock Switch Cover - Sealed (RN)
5. Ejection Trigger Ring - Stowed, pin No. 1 installed (RN-N)

Check that ejection trigger ring is properly seated in detent.

WARNING

If the ejection trigger ring is not properly seated in the detent, call maintenance and ascertain status of arming initiator before continuing seat inspection.

RADAR NAVIGATOR'S CHECKLIST (NUCLEAR) (Cont)

6. Forward & Rear Special Weapon Manual Release Handles - Sealed (RN)
7. Release Circuits Disconnect - Disconnected, sealed (RN)
8. Circuit Breaker Panels: (RN-N)
 - a. Normal Release & Jettison Power Circuit Breakers - Out
 - b. ADM-20 Launch Control, Cart No. 1, Cart No. 2, and Actuator Circuit Breaker - OUT

CAUTION

Failure to open the launch control, Cart No. 1, Cart No. 2, and Actuator Circuit breaker places a potential electrical hazard in the ADM-20C relay box assembly.

- c. All Other Circuit Breakers & Fuses - In
9. CSS Indicator Window - Checked "A" (RN)

NOTE

Cease all activity and request CSS custodians (through the Command Post) if any CSSC indicator window is found set to other than "A."

10. DCU-9/A Control Levers - OS, sealed (RN)
11. DCU-9/A Selector Switches - OFF (RN)
12. SWK Monitor Select Switch - OFF (RN)
13. AGM-69A Weapon Status and Control Panel: (RN)
 - a. SAF Switch - Guard closed and sealed
 - b. CLASS III Switch - Neutral lock
14. FLIR Turret Air and STV Turret Air Switches - OFF (RN)

WARNING

Lethal voltages may exist on the FLIR turret window and the electrical cable routed to the STV turret if the switches are in the ON position when power is applied.

RADAR NAVIGATOR'S CHECKLIST (NUCLEAR) (Cont)**EXTERIOR INSPECTION (BOMB BAY INTERIOR)****WARNING**

The bomb door actuator struts must be disconnected before entering the bomb bay if power is applied to the aircraft.

1. General Condition of Bomb Bay - Checked (RN)

Check for fuel and hydraulic leaks and security of equipment (include check of walkways for loose objects).

2. Nuclear Bombs - Checked (RN)

When nuclear bombs are aboard, use the appropriate bomb preflight checklist from T.O. 1B-52D -25-2CL-1.

3. AGM-69A Launcher & Launcher Missiles: (RN-N)

- a. Launcher General Condition - Checked
- b. Ground Operation Safety Switch Pin - Check removed
- c. Missiles - Checked
 - (1) Payload Section Marking - Checked
 - (2) Motor Arm/Disarm Switch Safeing Pin & Streamer - Counted
 - (3) C/D Safeing Pin & Streamer (OTL Missiles) - Counted
- d. MAU-12 Ejector Rack Ground Safety Lock Pins - Counted
- e. All Safeing Pins - Stowed

Check all safeing, safety pins and streamers stowed aboard aircraft.

4. AGM-69A Power Distribution Panel and RAM Air Shutoff Valve - Checked (RN-N)

- a. Launcher Rotation Tool Circuit Breakers (3) and Inserter Circuit Breaker (1) - OUT
- b. All Other Circuit Breakers - IN
- c. RAM Air Shutoff Valve - OPEN INFLIGHT

INTERIOR INSPECTION

1. Equipment - Stowed

WARNING

Insure that no equipment is stowed on or near the lower deck heating ducts and outlets, electrical wiring, or electronic equipment.

RADAR NAVIGATOR'S CHECKLIST (NUCLEAR) (Cont)

2. Compass & True Heading Computer Cutoff Switch - ON
3. Doppler System Pressurization Shutoff Valve Handle - NORMAL
4. Ejection Seat & Escape Hatch:

WARNING

● Carefully check to insure that no streamer has been torn from a maintenance safety pin, thus inadvertently leaving the pin installed.

● If a maintenance safety pin is installed, the status of the seat will be ascertained prior to removal of the pin.

- a. Catapult Pin-Pull Initiator - Pin No. 4 removed, link to hatch secure
- b. Table Stowage Initiator - Checked
Inspect initiator for condition, installation, and tubing connected.
- c. Drogue Parachute Support Arm Release Initiator - Checked, pin No. 5 removed
Check maintenance safety pin No. 5 removed. Inspect initiator for condition, installation, and tubing connected.
- d. Manual Catapult Initiator Safety Pin-Pull Handle - Secure
Handle should be properly seated below left leg guard.
- e. Initiator Tube Runs - Checked connected
Check tube runs for proper and secure connections.
- f. Catapult Initiator Safety Pin-Pull Cylinder - Checked
Catapult initiator safety pin must extend all the way through the catapult initiator. If pin is pulled out, initiator may have been fired.
- g. Arming Initiator & Control Linkage - Checked, pin No. 3 removed
Check maintenance safety pin No. 3 removed. Inspect initiator for condition, installation, and tubing connected.
- h. Ankle Restraints - Checked
Inspect ankle restraints for proper operation and stow in downward position.
- i. Emergency Escape Hatch - Secure
Check that the paint stripe on lockpin is visible beyond the shield or that the lockpin overlaps the shoulder on the lockarm by 1/4 inch.
- j. Table Stowage Thruster & Tubing - Checked
- k. Inertia Reel - Checked
Check inertia reel lock for proper functioning.

RADAR NAVIGATOR'S CHECKLIST (NUCLEAR) (Cont)

5. Man-Seat Separator - Checked

Insure that the nylon man-seat separator straps are placed on the bare seat. Survival kit is then placed over man-seat separator straps.

6. Parachute Preflight:

a. Inspection Record:

- (1) Inspection & Repack Date - Checked
- (2) Automatic Release Time & Altitude Setting - Checked

b. Personal Locator Beacon Lanyard - Snapped/Unsnapped (as required)

For peacetime operations, the personal locator beacon lanyard must be configured for automatic operation. When mission requirements dictate the necessity to avoid detection and automatic actuation of the beacon is not desired, the lanyard must be configured for nonautomatic (manual) operation.

c. Bailout Bottle Pressure & Hose Connector - Checked

d. Parachute Arming Lanyard Anchor - Installed

WARNING

Be certain that the parachute arming lanyard anchor is securely fastened in the attachment fitting on the seat. Failure to attach the lanyard anchor to the seat will necessitate manual operation after ejection.

e. Parachute Straps - Adjusted (as required)

7. Global Survival Kit:

- a. Kit Installed & Plunger Depressed - Checked
- b. Kit Release Handle - Checked down
- c. Mode Selector Lever - AUTO
- d. Kit Straps to Parachute - Checked and attached

Check that attachment fittings are properly connected to the kit, the attachment straps threaded through the safety belt, and the quick-disconnect fittings are properly attached to the parachute (with release buttons on outside).

WARNING

Care must be taken to insure that the survival kit attachment straps are properly threaded through the safety belt.

RADAR NAVIGATOR'S CHECKLIST (NUCLEAR) (Cont)

8. Safety Belt Release Fittings - Connected
9. Shoulder Strap Attaching Fittings - Connected
10. Interphone - Connected
11. Oxygen System:
 - a. Regulator Diluter Lever - 100% OXYGEN
 - b. Shutoff Lever - OFF
 - c. Mask & Hose - Check disconnect, then reconnect

Check for 10- to 20-pound pull for disconnect, then reconnect mask and hose.

- d. Diluter Valve - Checked

Attempt to draw air through the oxygen mask. Ability to draw air indicates a defective diluter valve, oxygen hose and/or connections or mask. Then place the diluter valve to NORMAL position, draw air through the mask, if unable, this would indicate that only 100% oxygen will be available.

NOTE

- If the diluter valve is stuck in the 100% position, this will prohibit the detection of smoke or fumes when use of normal oxygen is required.
- If the CRU-73A regulator is installed, the crew member will not be able to draw air through the system with the shutoff lever OFF. The diluter lever may be moved to NORMAL with the shutoff lever OFF on some CRU-73A regulators. The diluter valve will be in the 100% oxygen position when the shutoff lever is OFF on all CRU-73A regulators.

- e. Shutoff Lever - ON
- f. Pressure - Checked

Pressure gage reads approximately 300 psi.

- g. Emergency Toggle Lever - TEST MASK

With mask disconnected at one side of helmet, the flow indicator should indicate continuous flow.

- h. Mask - Test

Attach mask to helmet and hold breath; indicator should indicate no flow.

NOTE

Flow condition may be indicated by a slight leak around the face form. If light hand pressure against the mask does not stop the flow, the mask is unacceptable.

RADAR NAVIGATOR'S CHECKLIST (NUCLEAR) (Cont)

- i. Emergency Toggle Lever - NORMAL
- j. Regulator Diluter Lever - NORMAL/100% (as required)
- 12. Pres Adj Panel:
 - a. Sweep Delay Switch - OFF
 - b. Sweep Delay Knob - CCW, in detent
 - c. IBDA Power Switch - OFF
 - d. IBDA Mode Switch - NORM
- 13. BNS External Power Switch - OFF
- 14. Ground Blowers Switch - OFF
- 15. Terrain Computer Power Switch - OFF
- 16. (Deleted)
- 17. BRIC - TRAIN and zero
- 18. BNS Power Panel:
 - a. Power Switch - OFF
 - b. Heaters Switch - ON
- 19. EVS Environmental Power Switches - OFF
- 20. Master Bomb Control Panel:
 - a. Master Bomb Control Switch - OFF
 - b. Bomb Indicator Lights Switch - ON
 - c. Bombing System Switch - MANUAL
 - d. Lights - Checked, tested
- 21. Nuclear Bombs/AGM Checklist:
 - a. Special Weapons Lock Indicators - Indicate locked
 - b. Bomb Indicator Lights - Off, tested (applicable lights for multiple carriage and/or AGM-69A)
 - b. Forward/Aft Weapon Released Lights - Off, tested (single carriage)
 - c. Special Weapons Select Switch- FWD/AFT (as briefed)
 - d. Bomb Release Mode Selector Switch **B-52 1** - NORMAL, safetied
 - e. Release Circuits Connected Light - Tested

RADAR NAVIGATOR'S CHECKLIST (NUCLEAR) (Cont)

22. IFC Power Select Switch - TR (guard closed)

22A. ALQ-117 to BNS Blanking Switch - ON

23. Coded Switch Set Controller (CSSC):

NOTE

Cease all activity and request CSS custodians (through the Command Post) if the enable light comes on at any time other than during the lamp test button check. For other abnormal indications refer to "CSS Malfunction Analysis" in T.O. 1B-52D-25-2 or T.O. 1B-52G-30-2.

a. Oper/Mon Switch - MON, DISEN light on

Hold the oper/mon switch in MON and check disen light on.

b. Lamp Test Button - Depressed

Disen, enable, and code lights should illuminate.

c. Sum Code _____ - Set

Set briefed sum code in CSSC by rotating thumbwheels.

d. Oper/Mon Switch - OPER

Code light should blink until end of cycle (approximately 2 minutes).

e. Code & Disen Lights - On

Illumination of the code and disen lights verifies operation of system, that proper enable codes have been entered in the code enable switch and that the system is disabled.

f. Oper/Mon Switch - MON (momentarily)

Code and disen lights should go off.

NOTE

System status (enable/disable) may be verified at any time by holding the oper/mon switch in MON and observing disen and enable light indication.

g. CSSC Indicator Windows - Set all "A's"

24. DCU-9/A and SWK Box (Multiple Carriage):

a. SWK Monitor Select Switch - First bomb to be released

b. DCU-9/A Selector Switch - SAFE

c. DCU-9/A Warning Light - Off, tested (each position of SWK box)

d. SWK Monitor Select Switch - OFF

e. DCU-9/A Warning Light - Off, tested

RADAR NAVIGATOR'S CHECKLIST (NUCLEAR) (Cont)

- f. DCU-9/A Selector Switch - OFF
- g. SWK Box Illumination Control - Full CCW
- 24. DCU-9/A (Single Carriage):
 - a. DCU-9/A Selector Switches - SAFE
 - b. DCU-9/A Warning Lights - Off, tested
 - c. DCU-9/A Selector Switches - OFF
- 25. AGM-69A Weapon Status & Control Panel:
 - a. Propulsion Disarm Switch - OFF, lock
 - b. Monitor & Jettison Select Switch - ALL
- 26. Air Outlet & Auxiliary Heat Knobs:
 - a. Upper - 1/2 out
 - b. Lower - As desired
 - c. Warmer - Full in

NOTE

These knob settings are approximate settings only. After the cabin temperature has stabilized, knob adjustment may then be slightly varied for crew comfort.

- 27. Radar Primary Panel:
 - a. Radar Power Switch - OFF
 - b. Antenna Speed Switch - FAST
- 28. D-2 Bomb Release Switch - Stowed
- 29. Terrain Radar Control Panel:
 - a. Radar Display Selector Switch - HI ALT GM
 - b. Rate Switch - OFF
- 30. Emergency Controls Panel:
 - a. TAS Switch - ON
 - b. Stab Bypass Switch - ON
 - c. All Other Switches - OFF
- 31. Radar Antenna Tilt Panel Receiver Tune Switch - AUTO
- 32. Range Sel Panel:
 - a. Range Selector Switch - 20
 - b. Sector Width Knob - CCW in detent
 - c. Markers Selector Switch - NAV
- 33. Trgt Scl Panel Radar Operation Selector Switch - RADAR

RADAR NAVIGATOR'S CHECKLIST (NUCLEAR) (Cont)

- 34. Pres Gain Panel:
 - a. Intensity Knob - CCW
 - b. Receiver Gain Knob - CCW
 - c. Video Knob - CCW
- 35. Bomb Control Panel Heading Switch - NAV
- 36. APN-150/AGM-69A Tie-In Control Switch - OFF
- 37. Topocomp:
 - a. Station Keeping Switch - OFF
 - b. Radar Map Switch - PPI NS
- 38. FLIR Control Panel:
 - a. Mode Select Switch - OFF
 - b. Bias & Contrast Knobs - CCW
- 39. EVS Video Select Switch - OFF
- 40. STV Control Panel:
 - a. MLC Gain Knob - OFF
 - b. Mode Switch - OFF
 - c. BIT Switch - NORM
- 41. BNS Data Preset Panel:
 - a. Gyro Erect Switch - HI
 - b. Gyro Latitude Indication Set Knob - Set local latitude
 - c. Present Position Switch - OFF
 - d. Doppler Wind Switch - OFF
- 41A. AOU Panel:
 - a. Function Switch - RESET
 - b. Offset Selector Switch - DIRECT
 - c. Multi Tgt-Norm Switch - NORM
 - d. Read-Open Lever - OPEN
 - e. Card Reader Cover - Closed

RADAR NAVIGATOR'S CHECKLIST (NUCLEAR) (Cont)

42. Radar Recording Camera:

- a. Camera Data Plate - Completed

EXAMPLE:

LAJUNTA
OB-21
EL PASO 218
30 June 74
B-52G 8196
SMITH, C. S.

- b. Clock - Set to GMT

43. Crew Report - Completed (at pilot's request)

- a. The sequence for crew reporting is as follows: N, G, EW, RN, CP, P, IN, DI, 10th, and IP.
- b. Switch to call and report, "Radar navigator's check complete."

Check consists of abandon signal and call operation.

44. Oxygen Regulator - OFF and 100% OXYGEN (if leaving the aircraft for an extended period of time)

AFTER ENGINE START**CAUTION**

After engine start, do not turn the BNS or EVS on until after being notified by the copilot that the generators are on the line and cooling air is available.

1. BNS Turn-On:

- a. Ground Blowers Switch - ON
- b. Terrain Computer Power Switch - ON
- c. Radar Power Switch - ON

CAUTION

The rate switch on the terrain radar control panel must be OFF prior to turning the radar power switch ON or damage to the BNS radar receiver-transmitter can occur.

- d. BNS Power Switch - ON

RADAR NAVIGATOR'S CHECKLIST (NUCLEAR) (Cont)

2. EVS Environmental Power Switches - ON



- The environmental control systems are to be operated at all times during flight to prevent condensation within the turrets, even though the sensor itself may not be turned on or a dummy sensor is installed.
- Step "3" will be accomplished within a 2-minute period to prevent overheating conditions in the PDU.

3. AGM-69A Check:

- a. AGM-69A Panel Lights - Full clockwise
- b. MA PWR Switch Master Power On Indicator Light - Depressed (momentarily), on
- c. Weapon Status & Control Panel Monitor Check:
 - (1) Lock Light - On
 - (2) Safe Light - On
- d. Manual Launch Switch - Checked
- e. MA PWR Switch/Master Power On Indicator Light - Depressed (momentarily), off

4. FLIR Mode Select Switch - OPR

FLIR turret rotates from stow position to view position. The OPR light will illuminate and when the detectors have reached operating temperatures (30 minutes maximum after turn-on), the READY light should illuminate, indicating FLIR is in normal operating mode.

5. Press-to-Test Lights:

- a. Tone On Indicator Light - Tested
- b. Overheat Power Supply, BNS Low Airflow (2), & Radar Pressure Low (2) Lights - Tested
- c. Bomb Door Control Valve Lights - Tested
- d. Low Altitude Calibration Panel Alt Cal Warning Light - Tested
- e. APN-150 No Go Light - Tested
- f. EVS Monitor Overheat Light - Tested

6. EVS Video Select Switch - STV

Azimuth and elevation scales are displayed provided the brightness and contrast knobs on the EVS monitor have not been rotated full CCW.

RADAR NAVIGATOR'S CHECKLIST (NUCLEAR) (Cont)**7. EVS Monitor - Adjusted**

With the contrast knob fully CCW, rotate the brightness knob CW until monitor illumination is visible and then rotate CCW until monitor illumination just disappears. Rotate contrast knob CW until optimum presentation of the azimuth and elevation scales is displayed.

8. STV Control Panel:**a. Mode Switch - STBY**

Standby light should come on.

b. HI SENS/HI RES Switch - HI RES**c. ALC FULL/ALC 1/4 Switch - ALC FULL****d. BIT Switch - LL****e. Mode Switch - OPR**

The operate light will come on after standby light has been on no longer than 30 seconds. View EVS monitor for normal display. Fiducial marks and preamplifier noise will be displayed.

CAUTION

If "target crossover" (an abnormal brightening or blooming) occurs on the EVS monitor, rotate mode switch to STBY, since further operation will damage the STV camera. After brightening or blooming disappears from monitor, rotate mode switch to OFF.

f. BIT Switch - NORM

STV turret rotates from stow position to view position and STV scene appears.

CAUTION

Point sources of high intensity illumination, relative to the overall scene illumination, which remain stationary within the field of view of the STV, may cause damage to the STV camera assembly. During operation on the ground, precautions should be taken to eliminate stationary sources of high intensity illumination (ramp lights, reflections from objects, vehicle head-lights, etc.) from within the field of view prior to continued operation of the STV in the operate mode. The camera assembly is protected from this type of damage in standby mode.

g. EVS Monitor - Adjusted

Adjust contrast for optimum display.

NOTE

Readjustment of the monitor will normally be required only when significant ambient light changes occur.

RADAR NAVIGATOR'S CHECKLIST (NUCLEAR) (Cont)

9. EVS Indicator Lights - Tested

Actuate the symbols switch on EVS video select panel to LAMP TEST and press lamp test switches on STV control panel, FLIR control panel, and EVS steering control panel to check all indicator lights.

10. Symbols Switch - SYMBOLS ON

Numerics and markers are displayed.

11. AOU Panel:

a. Reset Light - ON

b. EXEC Button - Depressed

While the EXEC button is depressed, check the RESET, UPDATE, and PGLD lights are on, and the LONG, LAT, and ELEV indicators for proper indication. The lights should go out and the indicators blank when the EXEC light is released.

c. Reset, Update, and PGLD Lights - OFF

NOTE

- If the PGLD light remains on, accomplish the "AOU Initial Program Load" Check-list.

- If mission data program has not previously been inserted, omit steps "d" thru "h."

d. Function Switch - SLEW

e. Target Number (As desired) - Dialed

f. EXEC Button - Depressed

g. Tgt Display Indicator - Checked

h. Function Switch - ACTIVE

12. Radar Tune-Up:

a. Test Meter Selector Switch - Checked -300, +120, +300

All readings should be 50 (± 2)

b. Centering Check - Completed

c. Circularity Check - Completed

d. Radar Recording Camera & Crosshair - Checked (RN-N)

Check operation of camera (O-32 mode sel switch in R) and movement of crosshair in search and track (full scan and off center scan).

e. Radar Recording Camera Power Switch - OFF (RN-N)

f. Plane Above Sea Level Indicator (H_A) - Set field elevation or lower limit using H_{CAL}.

Place selector switch to H_{CAL} and hold set control knob depressed until H_A stabilizes before setting.

RADAR NAVIGATOR'S CHECKLIST (NUCLEAR) (Cont)

- g. Radiate Button - Depressed (after standby light illuminates)

Check clear to radiate prior to depressing button. Check that radiate light illuminates.

WARNING

- Ground operation of radar transmitters is prohibited within 200 feet of (1) weapons which are not fully assembled, (2) weapons to which continuity testers are connected, or (3) weapons with open access doors.
- The BNS radar should not be in radiate when the aircraft is within 200 feet of any ground refueling operation or open fuel tank.
- The area in line with the radiation of a nonrotating BNS radar antenna is hazardous to personnel. For this reason, do not stop the antenna while the BNS radar is in radiate operation.

- h. Radar Indicator - Adjusted and checked

Adjust and check antenna tilt and scope presentation.

13. Gyro Leveling Check:

- a. Stab Bypass Switch - OFF
- b. Gyro Erect Switch - NORM
- c. Erect Cutoff Light - Off

If erection cutoff light illuminates, switch to high erect and perform gyro leveling check at a later time.

14. Preset Data:

The navigator may assist the radar navigator as desired.

- a. Present Position Indicators - Set
- b. Destination 1 & 2 Indicators - Set
- c. Wind Indicators - Set zero
- d. T_F & L - Set

Set approximate values for first bomb release.

RADAR NAVIGATOR'S CHECKLIST (NUCLEAR) (Cont)**AOU INITIAL PROGRAM LOAD****NOTE**

If the PGLD light remained on after step "11" of the AFTER ENGINE START checklist, accomplish the following:

1. PGLD Light - ON
2. Function Switch - PGLD
3. Card Reader Cover - OPEN
4. IPL Card Number 1 - Inserted
5. Read-Open Lever - READ
6. EXEC Button - Depressed
7. Read-Open Lever - OPEN
8. Target Number Indicator - Checked
9. IPL Card - Removed

NOTE

Accomplish steps "4," "5," "7," "8," and "9" for each subsequent IPL card. IPL cards 2 thru 8 must be loaded in numerical sequence. For cards 2 thru 64, the target number indicator will increase one number as each card is read.

RADAR NAVIGATOR'S CHECKLIST (NUCLEAR) (Cont)

10. End Card - Inserted
11. Read-Open Lever - READ
12. Data Display Indicators - Blank
13. Read-Open Lever - OPEN
14. End Card - Removed
15. Card Reader Cover - Closed
16. Function Switch - Active
17. PGLD Light - OFF

BEFORE TAKEOFF**CAUTION**

- BNS turn-on should be accomplished prior to taxi to prevent damage to gyros.
- Monitor the overheat and low airflow warning lights and the BNS temperature sensing indicator during all low engine power operation. If warning indications appear, refer to Section IX, T.O. 1B-52G-1-6-1 for corrective action.

NOTE

If BNS, EVS and AOU are on, omit steps "1" thru "4."

1. EVS - On (immediately after aircraft power on and stabilized)
 - a. Environmental Power Switches - ON
 - b. EVS Video Select Switch - STV
 - c. FLIR Mode Select Switch - OPR
 - d. STV Mode Switch - OPR
- 1A. AOU Function Switch - RESET

RADAR NAVIGATOR'S CHECKLIST (NUCLEAR) (Cont)**2. BNS Turn-On:**

- a. Ground Blowers Switch - ON
- b. Terrain Computer Power Switch - ON
- c. Radar Power Switch - ON

CAUTION

The rate switch on the terrain radar control panel must be OFF prior to turning the radar power switch ON or damage to the BNS radar receiver-transmitter can occur.

- d. BNS Power Switch - ON

2A. AOU Panel:

- a. Reset Light - ON
- b. EXEC Button - Depressed

While the EXEC button is depressed, Check the RESET, UPDATE, and PGLD lights are on, and the LONG, LAT, and ELEV indicators for proper indication. The lights should go out and the indicators blank when the EXEC light is released.

- c. Reset Light - OFF

NOTE

- If the PGLD light remains on, accomplish the "AOU Initial Program Load" Checklist.
- If mission data program has not previously been inserted, omit steps "d" thru "h."

- d. Function Switch - SLEW
 - e. Target Number (as desired) - Dialed
 - f. EXEC Button - Depressed
 - g. Tgt Display Indicator - Checked
 - h. Function Switch - ACTIVE
- 3. Radiate Button - Depressed (after standby light illuminates)**

Check clear to radiate prior to depressing button, check that radiate light illuminates.

WARNING

- Ground operation of radar transmitters is prohibited within 200 feet of (1) weapons which are not fully assembled, (2) weapons to which continuity testers are connected, or (3) weapons with open access doors.
- The BNS radar should not be in radiate when the aircraft is within 200 feet of any ground refueling operation or open fuel tank.
- The area in line with the radiation of a nonrotating BNS radar antenna is hazardous to personnel. For this reason, do not stop the antenna while the BNS radar is in radiate operation.

RADAR NAVIGATOR'S CHECKLIST (NUCLEAR) (Cont)

4. Radar Indicator - Adjusted and checked

Adjust and check antenna tilt and scope presentation.

5. EVS Video Select Switch - FLIR (if applicable) (RN/N)

When the READY light on the FLIR control panel is illuminated, adjust the FLIR bias and contrast knobs for optimum display.

- 5A. EVS Video Select Switch - STV/ FLIR (RN-N)

The radar navigator and navigator should monitor opposite sensors during takeoff and departure.

6. Special Weapons Lock Indicators - Indicate locked

7. Parachute & Safety Belt - Fastened

WARNING

- Tighten the parachute survival kit attachment straps as tightly as possible to prevent the safety belt from inflicting facial injuries during ejection bailout.
- Insure that the parachute arming lanyard is not entangled in the parachute harness. Lanyard entanglement could cause failure in seat separation and failure of the automatic features of the parachute.

NOTE

If it becomes necessary to leave the seat, the crew member should open the safety belt and unbuckle the parachute harness, leaving the parachute and survival kit in the seat. If the parachute is worn when leaving the seat, upon returning to the seat, it will be necessary to take it off in order to reinstall the parachute and safety belt in the seat.

8. Pin No. 1 - Removed

9. Ejection Control Trigger Ring - Unstowed

10. Oxygen Regulator - As required

11. Bailout Bottle - Connected

12. Takeoff Report - As required

Copilot announces over interphone "Crew, stand by for takeoff." Acknowledgement not required unless some discrepancy exists that may compromise successful completion of the mission.

13. Standby Button - Depressed (wet takeoff)

CAUTION

Place BNS radar to standby prior to activation of the water injection boost pumps to reduce the electrical load and the possibility of generator power surge.

RADAR NAVIGATOR'S CHECKLIST (NUCLEAR) (Cont)

TAKEOFF

1. Acceleration Timing - Checked (navigator backup)

As the pilot announces "Now" at 70 knots, start the stopwatch. If navigator is unable to check acceleration timing, announce over interphone "Coming up on _____ seconds" approximately 3 seconds prior to S_1 time. At S_1 time, announce "Now."

2. BNS Data Preset Panel:

- a. Doppler Wind Switch - ON
- b. Present Position Switch - ON
- c. Gyro Erect Switch - NORM

3. Emergency Controls Panel:

- a. TAS Switch - OFF
- b. Stab Bypass Switch - OFF

AFTER TAKEOFF

1. Radiate Button - Depressed, light on (wet takeoff)
2. Plane Above Sea Level Indicator (H_A) - Adjusted

Adjust the BNS altitude during climb as necessary.

3. Thermal Curtains - Closed (EWO only) (RN-P-CP)

Notify pilot and copilot to close thermal curtains after climb configuration is established.

WARNING

Failure to close thermal curtains as soon as practicable after takeoff may result in flash blindness from nuclear detonations.

4. 12,000 Foot Oxygen Check - Completed (G-RN-P/CP)

- a. During the climb, copilot requests an oxygen check at 12,000 feet. The sequence for oxygen report is gunner, radar navigator, pilot/copilot. The reporting crew member will visually check other crew member for alertness. He will report oxygen checks for both positions. Oxygen panel at each occupied crew position will be checked on all oxygen checks for:

- (1) Oxygen Supply Shutoff Lever - ON
- (2) Regulator Diluter Lever - As required
- (3) Pressure - 300 psi
- (4) Flow Indicator - Functions normally
- (5) Emergency Toggle Lever - NORMAL

RADAR NAVIGATOR'S CHECKLIST (NUCLEAR) (Cont)

- b. Gunner, radar navigator, and pilot/copilot report, "Oxygen panels checked." In addition, pilot/copilot reports "Cabin altitude _____ feet."
- c. Copilot requests oxygen check at level-off and during cruise at 1-hour intervals when cabin altitude is below 12,000 feet, at 30-minute intervals when cabin altitude is 12,000 to 25,000 feet, and at no longer than 10-minute intervals when cabin altitude is above 25,000 feet. If cabin altitude is below 12,000 feet, only the pilot/copilot will report. The remaining crewmembers will check their equipment and report if abnormal.

MISSION DATA PROGRAM LOAD

- 1. Reset Light - OFF
- 2. PGLD Light - OFF
- 3. Card Reader Cover - OPEN
- 4. Mission Data Card - Inserted
- 5. Read-Open Lever - READ
- 6. Data Display Indicators - Checked
- 7. Read-Open Lever - OPEN
- 8. Mission Data Card - Removed

NOTE

Accomplish steps "4" thru "8" for each mission data card.

- 9. Card Reader Cover - Closed
- 10. Function Switch - SLEW
- 11. Target Number (As desired) - Dialed
- 12. EXEC Button - Depressed
- 13. Tgt Display Indicator - Checked
- 14. Function Switch - ACTIVE

CSS ENABLING

CSS enabling will be accomplished as soon as possible after receipt of a valid "Execution."

NOTE

For any abnormal indications, refer to "CSS Malfunction Analysis" in T.O. 1B-52D-25-2 or T.O. 1B-52G-30-2.

- 1. Coded Switch Set Controller (CSSC):
 - a. Lamp Test Button - Depressed

Disen, enable, and code lights should illuminate.

RADAR NAVIGATOR'S CHECKLIST (NUCLEAR) (Cont)

- b. Enable Code _____- Set

Set enable code received in strike message in CSSC by rotating thumbwheels.

- c. Oper/Mon Switch - OPER

Code light should blink until end of cycle (approximately 2 minutes).

- d. Code & Enable Lights - On

Illumination of enable light indicates enabling of prearming circuits.

- e. Oper/Mon Switch - MON (momentarily)

Code and enable lights should go off.

NOTE

System status (enable/disable) may be verified at any time by holding the oper/mon switch in MON and observing disen and enable light indication.

AFTER LEVEL OFF

1. BNS - Set

Assure the proper setting of altitude, wind, present position, and destination indicators for accurate route navigation.

2. EVS Video Select Switch - FLIR (RN/N)

Adjust FLIR bias and contrast knobs for optimum display. The FLIR must be adjusted frequently throughout flight to provide an optimum display.

3. EVS - As required

Place FLIR mode select switch, STV mode switch, and video select switch to STBY whenever EVS is not in use. If the EVS system is not to be used for several hours, turn FLIR mode select switch and STV mode switch to OFF.

AOU PROCEDURES

TARGET/OFFSET VERIFICATION

1. Display Target & Offsets Stored Data (if required):

- a. Function Switch - DISP
- b. Target Number (As desired) - Dialed
- c. EXEC Button - Depressed (momentarily)
- d. Target Display Indicator - Checked
- e. Coordinate Display Indicators - Checked
- f. Offset Thumbwheel - As required
- g. Coordinate Display Indicators - Checked

NOTE

Accomplish steps "b" and "d" thru "g" for each target and offset to be verified. Targets and offsets need be verified only once during the mission for each synchronous target.

RADAR NAVIGATOR'S CHECKLIST (NUCLEAR) (Cont)

TARGET/OFFSET CHANGE/INSERTION

1. Display Target/Offset Stored Data:
 - a. Function Switch - DISP
 - b. Target and Offset Number - Dialed
 - c. EXEC Button - Depressed
2. Function Switch - UPDATE
3. UPDATE Light - ON
4. Offset Thumbwheel - As required
5. Target/Offset Latitude - Dialed (if required)
6. EXEC Button - Depressed
7. Target/Offset Longitude - Dialed (if required)
8. EXEC Button - Depressed
9. Offset Elevation - Dialed (if required)
10. EXEC Button - Depressed
11. Coordinate Display Indicators - Checked

NOTE

Accomplish steps "1" thru "11" for each target/offset to be changed or manually inserted.

12. Function Switch - ACTIVE

BEFORE DESCENT

1. (Deleted)
2. FLIR/STV Mode Switches - OPR

The FLIR will not be in a ready state for approximately 30 minutes.

3. EVS Video Select Switch - STV/FLIR. (RN-N)

The radar navigator and navigator should monitor opposite sensors during penetration and for all approach and landing patterns.

4. T_F & L - Zero and locked

Set T_F and L to zero using the set control knob on the emergency controls panel and leave the T_F and L switches ON.

RADAR NAVIGATOR'S CHECKLIST (NUCLEAR) (Cont)

5. AOU Panel:

- a. Target Display Indicator - Checked (if required)

If offsets are available for the approach end of the runway, insure that the desired target is displayed by use of either the SLEW function or the ADV/RET switch.

- b. Function Switch - ACTIVE

6. Target Above Sea Level Indicator - Set runway elevation

7. Burst Point Above Target Indicator - Zero

8. Nuclear Bomb Safety Checklist:

NOTE

Nuclear bombs aboard, complete the following safety check.

- a. Normal Release & Jettison Power Circuit Breakers - Out
- b. Release Circuits Disconnect - Disconnected
- c. Master Bomb Control Switch - OFF
- d. Bombing System Switch - MANUAL
- e. Readiness Switch Cover - Closed, latched (RN-P)
- f. Special Weapons Lock Indicators - Indicate locked
- g. Special Weapons Monitor Check (Multiple Carriage):
 - (1) DCU-9/A Selector Switch - SAFE

RADAR NAVIGATOR'S CHECKLIST (NUCLEAR) (Cont)

- (2) DCU-9/A Warning Light - Off, tested (each position of SWK box)
- (3) DCU-9/A Selector Switch - OFF
- (4) SWK Monitor Select Switch - OFF
- (5) SWK Box Illumination Control - Full CCW
- h. Special Weapons Monitor Check (Single Carriage):
 - (1) DCU-9/A Selector Switch(es) - SAFE
 - (2) DCU-9/A Warning Light(s) - Off
 - (3) DCU-9/A Selector Switch(es) - OFF
- 9. AGM-69A Missile Safety Checklist:

NOTE

AGM-69A missiles aboard, complete the following safety check.

- a. Release Circuits Disconnect - Disconnected
- b. AGM-69A Consent Panel: (RN-P)
 - (1) Prearm-Safe Switch - Neutral lock, cover down
 - (2) Lock-Unlock Switch - LOCK, cover down
- c. AGM-69A Lock-Unlock Switch Cover - LOCK, cover pinned (RN-EW)
- d. Weapons Status & Control Panel:
 - (1) SAF Switch - Neutral lock, cover down
 - (2) Monitor & Jettison Select Switch - ALL
 - (3) Safe Light - On
 - (4) Lock Light - On

DESCENT AND BEFORE LANDING

CAUTION

Monitor the overheat and low airflow warning lights or BNS temperature sensing indicator. If necessary, request that power be advanced on at least one engine (usually No. 4) to keep the cabin low airflow lights out.

- 1. Penetration & Approach - Reviewed (P-CP-RN-N)

Review the planned penetration and approach. This review will include navigation aid frequencies, minimum and emergency safe altitudes, descent rates, minimums for the approach to be flown,

RADAR NAVIGATOR'S CHECKLIST (NUCLEAR) (Cont)

missed approach procedures, and aerodrome sketch. As a minimum the pilot flying the approach will brief the crew on the descent rate, MDA/DH/VDP and missed approach procedures for the planned approach. Lost communications procedures will be coordinated if required. During the descent and approach other crewmembers will back up the pilot flying and report any deviation from prescribed procedures.

1A. BNS Radar Frequency - As required

Retune the BNS radar frequency to the high or low end of the frequency band to avoid PAR interference.

2. Initial Point - Made good

The radar navigator will coordinate with pilot in monitoring or directing aircraft path to the VOR station or any other reference point to be used for initiating the penetration, arriving over the point on the desired heading for initial descent.

3. Penetration - Initiated

Upon reaching point of initial penetration, the jet penetration as published in the Flight Information Publication will be initiated. Monitor or direct aircraft path over the ground and advise the pilot of any deviation from published penetration.

4. Penetration & Approach Altitudes - Monitored

5. Crosshair - Positioned

Place crosshair on offset aimpoint or the approach end of runway with the inner edge of the range marker on the edge of no return.

a. Track Button - Depressed

Monitor aircraft path over the ground and advise pilot of any departure from prescribed penetration.

b. Bomb Control Heading Switch - BOMB

6. Plane Above Sea Level Indicator (H_A) - Set

Upon reaching traffic pattern altitude, if terrain is level, true altitude can be determined by adding radar altimeter altitude to H_T . If true altitude cannot be determined, set altitude as indicated by the pressure altimeter.

7. Traffic Pattern - Monitored or directed

Monitor or direct the aircraft throughout the approach pattern being flown, advising the pilot of any deviation noted or discrepancies between the approach and airborne radar. Navigator will monitor altitude throughout the pattern.

8. FCI - Centered (on final approach)

Upon completing the turn onto the final approach, the radar navigator will reposition the crosshair on the approach end of the runway or offset aimpoint. If it is a directed approach, the FCI and time-to-go indicator will be used to make the final approach. If it is a monitored approach, the FCI and time-to-go indicator may be cross-checked by the pilot to determine progress on final approach.

RADAR NAVIGATOR'S CHECKLIST (NUCLEAR) (Cont)

9. Final Descent - Initiated

The descent phase normally will be commenced when ground range is 8 NM from approach end of runway. Altitude should be checked at 100 seconds (1000 feet altitude) and 60 seconds (600 feet altitude). The time-to-go indicator will read zero when the aircraft is approximately 1000 feet down the runway.

10. Emergency Controls Panel:

The following steps will be accomplished prior to touchdown or during the final phase of a low approach to prevent excessive chattering of the dials. These switches may be left ON for subsequent approaches.

- a. H_A Switch - ON
- b. TAS Switch - ON

AFTER LANDING

CAUTION

Monitor the overheat and low airflow warning lights or BNS temperature sensing indicator. If necessary, turn equipment off.

- 1. Intensity Knob - CCW
- 2. Receiver Gain Knob - CCW
- 3. Video Knob - CCW
- 4. Standby Button - Depressed
- 4A. STV Mode Switch - STBY (as required)

Place the mode switch to standby during periods of darkness to avoid damage to the camera assembly.

CAUTION

Point sources of high intensity illumination, relative to the overall scene illumination, which remains stationary within the field of view of the STV, may cause damage to the STV camera assembly. During operation on the ground, precautions should be taken to eliminate stationary sources of high intensity illumination (ramp lights, reflections from objects, vehicle head lights, etc.) from within the field of view prior to continued operation of the STV in the operate mode. The camera assembly is protected from this type of damage in standby mode.

5. AOU Panel:

- a. Multi Tgt-Norm Switch - NORM
- b. Offset Selector Switch - DIRECT
- c. Function Switch - RESET

6. Ejection Control Trigger Ring - Stowed

7. Pin No. 1 - Installed

MISSION DATA ERASE

- 1. Reset Light - OFF
- 2. PGLD Light - OFF

RADAR NAVIGATOR'S CHECKLIST (NUCLEAR) (Cont)

3. Function Switch - ERASE
4. Erase Code (-9999999) - Dialed
5. EXEC Button - Depressed (momentarily)
6. Coordinate Display Indicators - Blank
7. Function Switch - RESET

AFTER PARKING

1. Ejection Seat - Position forward and up
2. BNS Power Switch - OFF
3. BNS Heaters Switch - OFF
4. Terrain Computer Power Switch - OFF
5. Radar Power Switch - OFF
6. Ground Blowers Switch - OFF

CAUTION

Do not turn ground blowers switch off until doppler radar system power switch is turned off.

7. FLIR Control Panel:
 - a. Contrast and Bias Knobs - CCW
 - b. Mode Select Switch - OFF
8. STV Control Panel:
 - a. MLC Gain Control - OFF
 - b. Mode Switch - OFF
9. EVS Video Select Switch - OFF
10. EVS Environmental Power Switches - OFF
11. Inform Pilot - BNS and EVS off
12. Bomb Indicator Lights Switch - OFF
13. Interphone - Disconnected after engines off
14. Oxygen System:
 - a. Regulator - OFF and 100% OXYGEN
 - b. Supply Hose & Interphone Cord - Stowed
15. Compass & True Heading Computer Cutoff Switch - OFF
16. Nuclear Bombs Aboard - Accomplish "Ground Safeing" checklist (T.O. 1B-52D-25-2CL-1) (MMS not available)
17. AGM-69A Missiles Aboard & Qualified Personnel Not Available - Accomplish "AGM-69A Missile Ground Safeing" checklist (N/RN)

RADAR NAVIGATOR'S AND NAVIGATOR'S BOMBING PROCEDURES (NUCLEAR)

BOMBING - GENERAL

WARNING

To prevent possible collision between a released bomb and a simultaneously launched AGM-69A missile from the bomb bay or an inboard missile from the pylon, the manual/auto switch will be placed to MANUAL position before releasing a bomb.

On training missions after practice bombs have been released, a crewmember will make a visual check of the bomb bay prior to RBS runs, camera attacks, or landing. This is to insure that all bombs and munitions have been released and that there are no objects that could fall from the bomb bay when the bomb doors are opened.

Procedures for the use of the special weapon manual release handles are contained in the checklist "Emergency Manual Bomb Release." Proper usage of the special weapon manual release handles for each bomb and the type of release system are described in T.O. 1B-52D-25-1, Section II. If the planned method of release fails, an emergency release will be accomplished by use of the special weapon manual release handles.

The normal multiple carriage release sequence is LR, UR, LL, UL. This sequence is dependent upon closing the doors between releases. If the doors do not close after any release, the master bomb control switch can be turned OFF and then ON in order to maintain the normal sequence.

Prior to making any bomb runs, the BNS true heading will be checked using the automatic astrocompass on heading as close as possible to the planned bomb run headings, or using the AGM-69A heading readout. Prior to doing this, the AGM-69A will be confirmed as having a low divergence rate. This heading error will be recorded. If the automatic astrocompass is inoperative, check the heading with a low divergence, properly operating AGM-69A. As an additional backup procedure, a periscopic sextant check can be accomplished. Translate rotate procedures will be used, on all synchronous bomb runs, to confirm the accuracy of the headings used.

The radar navigator will advise the pilot to center the FCI during the bomb run. If desired, BNS steering may be requested.

The navigator will monitor all phases of the bomb run. He will indicate to the radar navigator any apparent errors in crosshair placement, proper use of offset, GPI coordinate settings, timing, and release headings. Switch positions, warning lights, the MD-1, and doppler will be continuously checked and the radar navigator advised as necessary. The navigator will record all pertinent bombing data, monitor the breakaway turn and provide the crew adequate warning concerning detonation times and, for programmed high altitude releases, shock arrival times.

MULTIPLE RELEASES

A double release bomb run is normally accomplished by bombing the first target using radar synchronous techniques and either timing the second target or, if the distance between targets permits, bombing both targets radar synchronous, using ACL or GPI techniques. In either case, the navigator determines a time and heading from the first release to the second release using the most reliable information avail-

RADAR NAVIGATOR'S AND NAVIGATOR'S BOMBING PROCEDURES (NUCLEAR) (Cont)

able. For all practical purposes, the time and heading between releases is the same as the time and heading between targets. The pilot must turn the aircraft to the desired heading immediately after release, and stopwatches will be started by applicable crewmembers. Use the "Bomb Run (Synchronous)" checklist through "bombs away" on the first target and either timing or synchronous procedures for the subsequent target. If the second release is by timing, the bomb doors must be opened manually and the D-2 bomb release switch activated at the expiration of the time between targets. Double release bomb runs may also be accomplished using timing procedures over, or abeam a known timing point using the "Bomb Run (Alternate)" checklist for both releases.

Other multiple releases may be accomplished bombing three or four targets from a single IP. This will require various combinations of synchronous and timing procedures, necessitating careful planning, precise crew coordination and optimum use of bomb run checklists. The navigator will determine a time from the first target to each of the succeeding targets and headings between each target. Additional timing computations will be necessary whenever timing is to be restarted from a synchronous second or third release of a series. Use the "Bomb Run (Synchronous)" checklist if the first target is radar synchronous. For succeeding targets, use timing or synchronous checklist block as required. Use the "Bomb Run (Alternate)" checklist if the release on the first target requires timing procedures, repeating for succeeding targets, as required.

AGM-69A missiles may be programmed for launch during multiple release bomb runs. When automatic launch is programmed, the navigator will refer to the bomb run missile launch checklist block. If manual launch is programmed or required, the navigator will refer to the appropriate missile launch procedures checklist.

BOMBING — ALTERNATE

When the status of the BNS is such that a radar synchronous bomb run cannot be accomplished, the crew must evaluate the system and complete the bomb run by the most accurate and reliable means remaining.

GPI Bombing

If the computer is operational, but the radar presentation is unusable, or offset distance is too great, a GPI bomb run may be accomplished using the "Bomb Run (Synchronous)" checklist.

Timing

All other alternate bomb runs are basically timing runs and the "Bomb Run (Alternate)" checklist will be used. Bombing by timing is primarily a method of bombing by establishing a track, and determining an ETA, to the bomb release point. Every bomb run should be planned as a timing bomb run so that if, at any time, a radar synchronous run is not possible, the bomb run can be completed using a timing backup.

Timing can be from a visual, celestial, or radar fix. A stopwatch can be started at a certain TG value while on a synchronous bomb run. Timing can be initiated when the target, or aiming point, is coincident with a fixed range mark. In this case, track is established by using multiple drift procedures, or by placing the etched cursor through the target, and turning the aircraft so that the heading marker is drift angle upwind. The ETA to the bomb release point can be computed by determining the ETA to the target and subtracting the actual range expressed in time. Actual range in seconds can be computed by using this formula:

$$\text{AR in seconds} = \frac{\text{AR (feet)}}{\text{GS (feet per second)}}$$

RADAR NAVIGATOR'S AND NAVIGATOR'S BOMBING CHECKLIST (NUCLEAR)**BOMBING SYSTEMS CHECK****NOTE**

- This check may be performed as soon as practicable and must be completed prior to Missile Preparation for Launch or Weapons Preparation for Release, whichever occurs first.

- It is imperative that the following steps be completed in sequence.

1. Safety Check: (RN) Monitor (N)

- a. Bombing System Switch - MANUAL
- b. Special Weapons Lock Indicators - Indicate locked
- c. Release Circuits Disconnect - Disconnected, sealed
- d. Master Bomb Control Switch - OFF
- e. Notify crew "Safety check complete."

2. MADREC - AUTO (N)**3. Bombing Equipment Check: (RN)**

- a. Normal Release Circuit Breaker (RBS Only) - In
- b. Circuit Breakers - Checked, set
- c. BRIC (RBS Only) - SEL, light dim
- d. BNS Hand Control Sensing Switch - LOS
- e. Crosshair - Positioned

Position crosshair along the heading of the aircraft a sufficient distance to permit completion of equipment check.

- f. Bomb Button - Depress
- g. Heading Error Indicator - Checked (RN-P)

Using crosshair control handle, deflect steering needle both sides of center and then to zero. Request pilot to simultaneously observe the flight command indicator for proper movement.

- h. BNS Steering - Requested (RN-P)
- i. BNS Steering Check - Completed

Using crosshair control handle, check for response of the aircraft to a turn. Release crosshair control handle; aircraft should return to straight and level flight and steering needle should center. Repeat for a turn in the opposite direction.

RADAR NAVIGATOR'S AND NAVIGATOR'S BOMBING CHECKLIST (NUCLEAR) (Cont)

j. Offset Checks - Completed

Check offsets and observe that crosshair is correctly displaced. The offset check is not required if previously accomplished.

k. Multi Tgt-Norm Switch - MULTI TGT

Ensure that the subsequent target is within AOU range limitations of the active target.

l. Master Bomb Control Switch (RBS Only) - ON

m. UHF Radios (RBS Only) - Set (RN-CP)

Notify copilot to switch radio to briefed frequency.

n. Time-to-Go Indicator - Checked for drive (RN-P)

Request pilot call TG at 25-second intervals, at 20 seconds for RBS, and at TG zero.

o. Bomb Tone Scoring Switch (RBS Only) - INITIATE

Check tone break with D-2 bomb release switch, reinitiate tone at 20 seconds TG for automatic tone break.

p. Bomb Release Check:

(1) Tone Break (RBS Only) - Checked

(2) Time-to-Go Indicator - Indicates zero

When the time-to-go indicator equals zero, the BDI TG = 0 light may not illuminate for this check.

(3) Search/Track Button - Depress

(4) Tgt Number Indicator - Checked

(5) Multi Tgt-Norm Switch - NORM

(6) Master Bomb Control Switch - OFF

q. BNS Hand Control Sensing Switch - As desired

4. Crew notified "Bombing system check completed."

5. MADREC - STDBY (N)

WEAPONS PREPARATION FOR RELEASE/MISSILE PREPARATION FOR LAUNCH (STRIKE MISSIONS ONLY)

NOTE

- Perform this checklist within 15 minutes prior to HHCL, within 15 minutes prior to descent for a low altitude mission, or within 15 minutes prior to launch, whichever is reached first, and only after the receipt of a valid "Execution."
- Navigator will monitor the WPR and insure completion of all items. Radar Navigator will monitor the MPL and insure completion of all items.
- It is imperative that the following steps be completed in sequence. Missile preparation for launch may occur before WPR and therefore alter the sequence of WPR steps.

RADAR NAVIGATOR'S AND NAVIGATOR'S BOMBING CHECKLIST (NUCLEAR) (Cont)

1. Thermal Curtains - Checked closed and fastened (RN-P-CP)
2. Cabin Pressurization - Combat (if applicable) (RN-CP)
3. Personal Locator Beacon Lanyards - Notify crew to set as required (RN/N)

Mission requirements will dictate the configuration of the personal locator beacon lanyard.

4. Walkway Lights Circuit Breakers - Out (RN)
- 4A. Exterior Lights - OFF (RN-P)
5. Normal Release & Jettison Power Circuit Breakers - In (RN)
6. Release Circuits Disconnect Door - Seal broken, opened (RN)

NOTE

Accomplish these steps if internal bombs are to be released.

7. Special Weapons Manual Lock Handle - Pulled, stowed (RN-EW)
8. Forward & Rear Special Weapon Manual Release Handles - Seals broken (RN/N)
9. Bomb Readiness Switches - READY (RN-P)
10. DCU-9/A Selector Switches - SAFE (RN)
11. Special Weapons Pre-Arming (Multiple Carriage): (RN)
 - a. DCU-9/A Warning Light - Off, tested (each position of SWK box)
 - b. DCU-9/A Selector Switch - GND or AIR (as briefed)
 - c. DCU-9/A Warning Light - Off, tested (each position of SWK box)
 - d. SWK Monitor Select Switch - First bomb to be released
11. Special Weapons Pre-Arming (Single Carriage): (RN)
 - a. DCU-9/A Warning Lights - Off, tested
 - b. DCU-9/A Selector Switches - GND or AIR (as briefed)
 - c. DCU-9/A Warning Lights - Off, tested
12. Special Weapons Lock Indicators - Indicate unlocked (RN)
13. Bomb Indicator Lights - Off, tested (multiple carriage) (RN)
13. Fwd/Aft Weapon Released Lights - Off, tested (single carriage) (RN)
14. Special Weapons Select Switch - FWD/AFT (as required) (RN)
15. Bomb Release Mode Selector Switch **B-52 1** - NORMAL, safetied (RN)

RADAR NAVIGATOR'S AND NAVIGATOR'S BOMBING CHECKLIST (NUCLEAR) (CONT)

NOTE

Accomplish these steps if AGM-69A missiles are to be launched.

16. AGM-69A:

- a. Missile Power - Checked, on (N)
- b. Target Data Verification - Completed (N)
- c. AGM-69A Launcher Hydraulic Control Switch - Checked, ON PRIMARY (if required) (N-P)
- d. Weapon Status & Control Panel: (RN)
 - (1) Monitor and Jettison Select Switch - ALL
 - (2) Master Unsafe Warning Light -Off

RADAR NAVIGATOR'S AND NAVIGATOR'S BOMBING CHECKLIST (NUCLEAR) (Cont)

- e. AGM-69A Lock-Unlock Switch - Seal broken, cover up, UNLOCK (RN-EW)
- f. AGM-69A Consent Panel: (RN-P)
 - (1) Lock-Unlock Switch - Seal broken, UNLOCK
 - (2) Prearm-Safe Switch - Seal broken, PREARM
- g. Weapon Status & Control Panel: (RN)
 - (1) Unlock Light - Off
 - (2) Lock Light - On
 - (3) SAF Switch - Seal broken, PREARM (1 sec), neutral lock
 - (4) Safe Light - Off
 - (5) Prearm Light - On
 - (6) WSCP CLASS III OVERRIDE Switch - As required
 - (7) WSCP CLASS III Indicator Change (if applicable) - Checked
- h. Bomb Indicator Lights - Off, tested (RN)
- i. GAM-72 Gear Jettison & AGM-69A Circuit Breaker - Check in (RN-P)

WEAPONS PREPARATION FOR SIMULATED RELEASE/MISSILE PREPARATION FOR SIMULATED LAUNCH (TRAINING MISSIONS ONLY)

NOTE

- Perform this checklist within 15 minutes prior to HHCL, within 15 minutes prior to descent for a low altitude mission, or within 15 minutes prior to simulated launch, whichever is reached first.
- Navigator will monitor the WPSR and insure completion of all items. Radar Navigator will monitor the MPSL and insure completion of all items.
- It is imperative that the following steps be completed in sequence. Missile preparation for simulated launch may occur before WPSR and therefore alter the sequence of WPSR steps.

1. Thermal Curtains - Checked closed and fastened (as required) (RN-P-CP)
2. Cabin Pressurization - Combat (if applicable) (RN-CP)
3. Personal Locator Beacon Lanyards - Notify crew to set as required (RN/N)

Mission requirements will dictate the configuration of the personal locator beacon lanyard.

RADAR NAVIGATOR'S AND NAVIGATOR'S BOMBING CHECKLIST (NUCLEAR) (Cont)

4. Walkway Lights Circuit Breakers - Out (RN)
5. Normal Release & Jettison Power Circuit Breakers - In (RN)
6. Release Circuits Disconnect Door - Seal broken, opened (RN)

NOTE

- Do not break seal on training missions when AGM-69A missiles are carried.
- Accomplish these steps if internal bombs are to be simulated released.

7. Special Weapons Manual Lock Handle - Pulled, stowed (RN-EW)

NOTE

For training, when releases are to be made on a designated bombing range, the special weapons racks will not be unlocked until the aircraft is actually over the bombing range.

8. Forward & Rear Special Weapon Manual Release Handles - Seals broken (RN/N)
9. Bomb Readiness Switches - READY (RN-P)
10. DCU-9/A Selector Switches - SAFE (RN)
11. Special Weapons Pre-Arming (Multiple Carriage): (RN)
 - a. DCU-9/A Warning Light - Off, tested (each position of SWK box)
 - b. DCU-9/A Selector Switch - GND or AIR (as briefed)
 - c. DCU-9/A Warning Light - Off, tested (each position of SWK box)
 - d. SWK Monitor Select Switch - First bomb to be released
11. Special Weapons Pre-Arming (Single Carriage): (RN)
 - a. DCU-9/A Warning Lights - Off, tested
 - b. DCU-9/A Selector Switches - GND or AIR (as briefed)
 - c. DCU-9/A Warning Lights - Off, tested
12. Special Weapons Lock Indicators - Indicate unlocked (RN)
13. Bomb Indicator Lights - Off, tested (multiple carriage) (RN)
13. Fwd/Aft Weapon Released Lights - Off, tested (single carriage) (RN)
14. Special Weapons Select Switch - FWD/AFT (as required) (RN)
15. Bomb Release Mode Selector Switch **B.52 1** - NORMAL, safetied (RN)

RADAR NAVIGATOR'S AND NAVIGATOR'S BOMBING CHECKLIST (NUCLEAR) (Cont)

NOTE

Accomplish these steps if AGM-69A missiles are to be simulated launched.

16. AGM-69A:

- a. Missile Power - Checked, on (N)
- b. Target Data Verification - Completed (N)
- c. AGM-69A Launcher Hydraulic Control Switch - Checked, ON PRIMARY (if required) (N-P)
- d. Weapon Status & Control Panel: (RN)
 - (1) Monitor and Jettison Select Switch - ALL
 - (2) Master Unsafe Warning Light - Off
- e. AGM-69A Lock-Unlock Switch Cover - Sealed (RN-EW)
- f. AGM-69A Consent Panel: (RN-P)
 - (1) Lock - Unlock Switch - Guard closed, sealed
 - (2) Prearm-Safe Switch - Guard closed, sealed
- g. Weapon Status & Control Panel: (RN)
 - (1) Unlock Light - OFF
 - (2) Lock Light - ON
 - (3) SAF Switch - Guard closed, sealed
 - (4) Safe Light - On
 - (5) Prearm Light - Off
 - (6) WSCP Class III Override Switch (if required) - As briefed
 - (7) WSCP Class III Indicator Change (if applicable) - Checked
- h. Bomb Indicator Lights - Off, tested (RN)
- i. GAM-72 Gear Jettison & AGM-69A Circuit Breaker - Check in (RN-P)

RADAR NAVIGATOR'S AND NAVIGATOR'S BOMBING CHECKLIST (NUCLEAR) (Cont)

HIGH ALTITUDE (NUCLEAR)

BEFORE PRE-IP

The following checks are to be completed within 1 hour of the Pre-IP:

1. Altitude Measurement - Completed (RN)
2. Bombing Data Form - Completed; cross-checked (RN-N)
3. Bombing Data: (RN-N)
 - a. Ballistics Derivative Indicators - Set (N)
 - b. Preset Knots Indicator - Set (RN)
 - c. Preset Height of Fall Indicator - Set (RN)
 - d. Burst Point Above Target Indicator - Set (RN)
 - e. T_F Indicator - Set (RN/N)
 - f. L Indicator - Set (RN/N)
 - g. Targets/Offsets - Verified/Inserted (RN)

Not required if previously accomplished
 - h. H_A - Adjusted (RN)
4. Gyro Latitude Indicator Set Knob - Set (latitude of target) (RN)
5. Heading Select Switch - Best heading available (N)

BEFORE IP

1. AGM-69A Prelaunch/Presimulated Launch Check - Initiated (RN-N)

Insure that the checklist has been started in sufficient time to assure completion prior to launch if missiles are programmed for launch during multiple release.
2. DCU-9/A Selector Switch(es) - GND or AIR (as briefed) (RN)
3. DCU-9/A Warning Light(s) - Off, tested (each position of SWK box - multiple carriage) (RN)
4. SWK Monitor Select Switch - Bomb to be released (multiple carriage) (RN)
5. Circuit Breakers - Checked (RN)

RADAR NAVIGATOR'S AND NAVIGATOR'S BOMBING CHECKLIST (NUCLEAR) (Cont)

6. BRIC - SEL, light dim (RN)

CAUTION

A steady bright light will indicate internal shorting of the B-3C BRIC. If this malfunction occurs, do not attempt release using the BNS or D-2. Release will be accomplished using the "Emergency Manual Bomb Release" procedures.

7. MADREC - AUTO (N)
8. IBDA Power Switch - OFF (RN)
9. Special Weapons Select Switch - FWD/AFT (as required) (RN)
10. Bombing Data Check:

RN CALLS

NAV RESPONSE

- | | |
|-------------------------------|-------------------------|
| a. "Ballistics Derivatives" | "Reads _____" |
| b. "Preset Knots" | "Reads _____" |
| c. "Burst Point Above Target" | "Reads _____" |
| d. "Preset Height of Fall" | "Reads _____" |
| e. "T _F and L" | "Reads _____ and _____" |

11. Target Above Sea Level Indicator - Set (RN)
12. Over IP - Notify pilot and give initial headings for all releases (N)
13. Radar Recording Camera Switches - 1:4 (RN/N)

RADAR NAVIGATOR'S AND NAVIGATOR'S BOMBING CHECKLIST (NUCLEAR) (Cont)

LOW ALTITUDE (NUCLEAR)

BEFORE DESCENT

NOTE

The circled numbers indicate items that must be rechecked or reaccomplished prior to additional low level bomb runs.

1. EVS STV/FLIR Mode Switches - OPR (approximately 30 minutes prior to descent) (RN)
2. (Deleted)
3. In-Flight TA Functional Check - Accomplished (RN-N)

Use the "In-Flight TA Functional Check" checklist

4. Circuit Breakers - Checked (RN)
5. BRIC - SEL, light dim (RN)

CAUTION

A steady bright light will indicate internal shorting of the B-3C BRIC. If this malfunction occurs, do not attempt release using the BNS or D-2. Release will be accomplished using the "Emergency Manual Bomb Release" procedures.

6. Special Weapons Select Switch - FWD/AFT (as required) (RN)
7. Radar Recording Camera Switches - ON, 1:12 (RN/N)
8. IBDA Power Switch - OFF (RN)
9. FRL Angle-of-Attack Indicator - Set (N); cross-checked (RN)

Set FRL angle-of-attack indicator for the predicted conditions at the TA calibration point, reference figure 8-2. The FRL angle-of-attack will have to be reset periodically during terrain avoidance system flight due to changes in aircraft gross weight and/or airspeed.

NOTE

- The FRL angle-of-attack should be up-dated to maintain the set-in value accurate within 0.2°.
- The FRL angle-of-attack values should be computed for zero airbrakes, or as required.

RADAR NAVIGATOR'S AND NAVIGATOR'S BOMBING CHECKLIST (NUCLEAR) (Cont)

10. Bombing Data Form - Completed, cross-checked (RN-N)

11. TA Calibration Altitude - Computed and cross-checked (RN-N)

Forecast altimeter setting and "D" values from PMSV will be used.

12. Bombing Data: (RN-N)

- a. Ballistics Derivative Indicators - Set (N)
- b. Preset Knots Indicator - Set (RN)
- c. Preset Height of Fall Indicator - Set (RN)
- d. Burst Point Above Target Indicator - Set (RN)
- e. T_F Indicator - Set and locked (RN/N)

Set T_F using the set control knob on the emergency controls panel and leave the T_F switch ON.

- f. L Indicator - Set (RN/N)
- g. Targets/Offsets - Verified/Inserted (RN)

Not required if previously accomplished.

13. Bombing Data Check:

RN CALLS

- a. "Ballistics Derivatives"
- b. "Preset Knots"
- c. "Burst Point Above Target"
- d. "Preset Ht of Fall"
- e. "T_F and L"

NAV RESPONSE

"Reads _____"

"Reads _____"

"Reads _____"

"Reads _____"

"Reads _____ and _____"

RADAR NAVIGATOR'S AND NAVIGATOR'S BOMBING CHECKLIST (NUCLEAR) (Cont)

DESCENT AND AFTER DESCENT

1. Altimeter - Set _____ (P-CP-N)

Compute a level-off altimeter setting using metro or in-flight D values, PMSV or ARTC altimeter settings will be used if available. Reset altimeter to station pressure immediately prior to initiating penetration or upon passing through transition altitude.

2. EVS Video Select Switch - STV/FLIR (RN-N)

The radar navigator and navigator should monitor opposite sensors during the low level navigation leg. The FLIR bias and contrast knobs must be adjusted frequently to ensure an optimum FLIR display during low level flight.

3. Descent Point - Pilot notified (N)
4. Altitude Calls - Accomplished (N)
5. Altitude Measured (if applicable) - Accomplished (RN)

Level-off momentarily and measure altitude at as low an altitude as practical if over reasonably level terrain of known elevation. Measure altitude with the low altitude calibrator unit (below 5000 feet absolute altitude).

6. Doppler RF Power Switch - LOW (N)

The doppler RF power switch will be positioned to LOW prior to descending through 2000 feet above the terrain and will remain in LOW until the aircraft climbs above 2000 feet.

7. Level Off at IFR Altitude/Emergency Minimum Safe Altitude - Accomplished (P-CP-RN-N)

NOTE

For descent into Low Altitude High Speed Routes (VFR), initial level-off should be made at the planned emergency minimum safe altitude for that segment.

8. Radar Altimeter Indicators, Pressure Altimeters & HA Indicator - Cross-checked (P-CP-RN-N)

The navigator will state terrain elevation. The pilot will then read the indications of his radar altimeter and pressure altimeter. The copilot, radar navigator, and navigator will cross-check their instruments for proper indications and respond "cross-checked." If the IFR altitude/emergency minimum safe altitude exceeds 5000 feet absolute altitude (radar altimeter capability), the cross-check must be made as soon as a lower absolute altitude permits.

RADAR NAVIGATOR'S AND NAVIGATOR'S BOMBING CHECKLIST (NUCLEAR) (Cont)

9. Altimeters - Reset (P-CP-N)

Forecast altimeter setting obtained from PMSV will be used for TA calibration.

10. Level Off at TA Calibration Altitude - Accomplished (P-CP-RN-N)

For flat terrain checks, level-off will be accomplished at 800 feet on the radar altimeter. For peak checks (and flat terrain checks with an inoperative radar altimeter), level off at the computed pressure altitude which is based upon 800 feet above the calibration terrain feature or point.

11. Radar Altimeter Indicators & Pressure Altimeters - Cross-checked (P-CP-RN-N)

The navigator will state terrain elevation. The pilot will then read the indications of his radar altimeter and pressure altimeter. The copilot, radar navigator, and navigator will cross-check their instruments for proper indications and respond "cross-checked." If the IFR altitude/emergency minimum safe altitude exceeds 5000 feet absolute altitude (radar altimeter capability), the cross-check must be made as soon as a lower absolute altitude permits.

12. TA Calibration - Accomplished (P-CP-RN-N)

NOTE

- Terrain trace breakup with fly-up command may occur when the AN/ALQ-117 is transmitting and the TA is operated in any mode other than PRO-3.
- The radar navigator will be responsible for monitoring altitude and position during the TA calibration checks.
- The radar navigator is responsible for monitoring terrain beyond the range selected on the pilots' EVS monitors. The radar navigator will alert the pilot when approaching the preselected calibration area and will make a 10-mile range call. On peak calibration checks, the radar navigator will make calls at 6, 5, 4, 3, and 2 miles. Refer to Sections II and IV for calibration procedures.
- The navigator will record all readings made by the pilot during this check on the calibration worksheet and announce the corrections to be applied.

13. Altimeters - Reset (P-CP-N)

Current altimeter setting obtained by radio from nearby FSS radios will be used. If unable to obtain FSS altimeter setting while at low level, use PMSV forecast altimeter setting. During strike missions, set and maintain true altitude in the altimeters. True altitude will be determined from an altitude measurement if possible; otherwise use the predicted "D" value converted to an altimeter setting.

NOTE

If over reasonably level terrain of known elevation and absolute altitude is less than 5000 feet, true altitude may be determined by adding the radar altimeter reading to terrain elevation.

14. TA System Error Compensation - Accomplish if applicable (N/RN)

If a system error exists, the TA system error compensation procedures in Section IV should be accomplished, time and/or conditions permitting. Normally a minimum of 60 miles will be required prior to commencing the bomb run to facilitate accomplishment of calibration and error

RADAR NAVIGATOR'S AND NAVIGATOR'S BOMBING CHECKLIST (NUCLEAR) (Cont)

compensations, if required. If time and/or conditions do not allow the necessary compensation procedures to be accomplished, the published IFR altitude will be maintained. In any event in-flight calibration data and TA system error computations will be recorded on the calibration worksheet.

15. FRL & FVR Stabilization Modes - Compared (P/CP-RN)

After tilt compensation is applied (if required), radar navigator select LO ALT TA mode and pilot/copilot select FRL stabilization. Radar navigator fades a return at 6 miles and notes clearance plane setting, then pilot/copilot selects FVR stabilization and radar navigator fades the same terrain feature and notes clearance plane setting. This comparison should be made at approximately 800 feet absolute altitude above the terrain faded. Compare the clearance plane settings and if they do not differ more than 400 feet, then select FVR stabilization for TA low level flight. If the clearance plane settings differ by more than 400 feet, then FRL stabilization must be used for TA low level flight.

16. Plane Above Sea Level Indicator (H_A) - Low altitude calibrate (RN)

Low altitude calibrate using low altitude calibrate unit.

17. APN-150/AGM-69A Tie-In Control Switch - Checked (RN)

RADAR NAVIGATOR'S AND NAVIGATOR'S BOMBING CHECKLIST (NUCLEAR) (CONT)

18. Final Descent to TA altitude - Monitored (RN-N)

NOTE

- Radar navigator and navigator will monitor radar scope presentations. The navigator will monitor all other instruments available.
- The radar navigator provides terrain assessments beyond the pilot's range. When hazardous terrain is observed, the radar navigator will continue to advise pilot until pilot is tracking obstacle on his indicator.

BEFORE IP

1. AGM-69A Prelaunch/Presimulated Launch Check - Initiated (RN-N)

Insure that the checklist has been started in sufficient time to assure completion prior to launch if missiles are programmed for launch during multiple release.

NOTE

These steps must be rechecked or reaccomplished prior to additional low level bomb runs.

1A. DCU-9/A Warning Light(s) - Off, tested (each position of SWK box-multiple carriage) (RN)

2. SWK Monitor Select Switch - Bomb to be released (multiple carriage) (RN)

3. Plane Above Sea Level Indicator (H_A) - Low altitude calibrate (RN)

Adjust the true altitude (H_A) in the BNS for the bomb run. If the aircraft is over suitable terrain and less than 5000 feet AGL, perform a low altitude calibration. If an altitude calibration can not be made and the H_A is inaccurate, set and lock the computed H_A value from the bomb form; if the H_A is accurate and operating properly, the H_A need not be adjusted.

4. Target Above Sea Level Indicator - Set (RN)

5. Target Area Altimeter Setting - Set (P-CP-N)

Pressure altimeters may be calibrated using radar altimeter if time and conditions permit.

6. Gyro Latitude Indicator Set Knob - Set (latitude of target) (RN)

7. Radar Recording Camera - 1:4 (RN/N)

8. FRL Angle-of-Attack Indicator - Updated (N); cross-checked (RN)

9. Over IP - Notify pilot and give initial headings for all bomb runs (N)

10. Radios - Set (N-CP) (training missions only)

Copilot will insure radios are set in accordance with command directives.

RADAR NAVIGATOR'S AND NAVIGATOR'S BOMBING CHECKLIST (NUCLEAR) (CONT)

BOMB RUN (NUCLEAR)

SYNCHRONOUS

1. AOU Panel: (RN)

a. Tgt Display Indicator - Checked

Ensure that the desired target is displayed by use of either the SLEW function or the ADV/RET switch

b. Function Switch - ACTIVE

1A. Target or Offset - Acquired (RN)

2. Target No. 2, 3, or 4 Coordinates (As Required) - Set (RN-N)

3. Bomb Button - Depressed (RN)

NOTE

To withhold release, depress track button and proceed to applicable checklist for next release or to "Post Bomb Release/Abort Checklist " if no further releases are to be made.

4. Pilot's Bombs-Released Light - Off, tested (RN-P)

If the pilot's bombs-released light is illuminated, attempt to reset BRIC by moving BRIC switch to TRAIN with counter knob at zero, then back to SEL.

WARNING

With the pilot's bombs-released light illuminated, opening the bomb doors after completion of the release configuration check could result in an immediate release.

NOTE

If pilot's bombs-released light remains illuminated, release must be accomplished using the "Emergency Manual Bomb Release" procedures.

4A. Multi Tgt-Norm Switch - As required

5. Release Configuration Check:

NAV CALLS

RN RESPONSE

a. "Special Weapons Lock Indicators"

"Indicate unlocked"

b. "RCD"

"Connected, light on"

WARNING

When live/inert weapons are carried and the bomb doors are opened manually or external weapons are loaded, the RCD will be connected no earlier than 10 seconds TTG on the first release and disconnected after last release/launch on that bomb run.

c. "BRIC"

"SEL, light dim"

d. "Master Bomb Control Switch"

"ON, light on"

RADAR NAVIGATOR'S AND NAVIGATOR'S BOMBING CHECKLIST (NUCLEAR) (Cont)

- e. "Bombing System Switch" "AUTO"
- f. "Bomb Door Control Valve Lights Off"
- 5A. SRAM Checkpoint Fix - Entered (if required) (RN/N)
- 6. Bomb Tone (RBS only) - On (20 seconds prior to bomb release) (RN)
- 7. AGM-69A Manual/Auto Mode Switch - MANUAL (20 seconds prior to bomb release) (N)

WARNING

To prevent possible collision between a released bomb and a simultaneously launched AGM-69A missile from the bomb bay or an inboard missile from the pylon, the manual/auto switch will be placed to MANUAL position before releasing a bomb.

NOTE

When AGM-69A missiles are programmed for automatic launch during a multiple release, the navigator will refer to the missile launch checklist block.

- 8. Bomb Door Opening Monitored - Bomb doors open (RN/P)

NOTE

If doors fail to open automatically, place the bombing system switch in MANUAL and attempt opening with bomb door open switch. If doors cannot be opened by any means, release must be accomplished using "Emergency Manual Bomb Release" procedures.

- 9. Bomb Release Monitored - "Bomb Away" (RN/P)

Bomb release will be indicated by the applicable weapon released or bomb indicator light illuminating.

NOTE

- If the BNS fails to effect a release, release must be accomplished using "Emergency Manual Bomb Release" procedures.
- The D-2 switch will never be used as an alternate method of triggering the BRIC during an apparent failure of the BNS to effect a release. A premature actuation of the D-2 switch could result in a multiple release.

- 10. Bomb Doors - Closed (multiple carriage) (RN)

NOTE

- If BNS fails to close bomb doors automatically, place bombing system switch in MANUAL and attempt closure using bomb door switch. If doors still fail to close, recycle master bomb control switch to OFF then ON to maintain normal release sequence.
- Turning the master bomb control switch OFF then ON to maintain the normal release sequence must be accomplished prior to 16 seconds TG or no release pulse will be generated for a synchronous bomb run.

- 11. Track Button - Depressed (RN)
- 12. Special Weapons Select Switch - FWD/AFT (as required) (single carriage) (RN)

For single carriage, alternate bay must be selected for release of second bomb.

RADAR NAVIGATOR'S AND NAVIGATOR'S BOMBING CHECKLIST (NUCLEAR) (Cont)

AGM-69A Auto Launch

NOTE

If AGM-69A auto launch is programmed, accomplish the following.

- 12A. Safe In-Range Light - On (N/RN)
- 12B. Bomb Tone (RBS only) - On (20 seconds prior to launch) (RN)
- 12C. Manual/Auto Mode Switch - AUTO (5 seconds prior to launch) (N/RN)
- 12D. Missile Away - Pilot notified (RN)
- 12E. Manual/Auto Mode Switch - MANUAL (20 seconds prior to bomb release) (N/RN)

WARNING

To prevent possible collision between a released bomb and a simultaneously launched AGM-69A missile from the bomb bay or an inboard missile from the pylon, the manual/auto switch will be placed to MANUAL position before releasing a bomb.

RADAR NAVIGATOR'S AND NAVIGATOR'S BOMBING CHECKLIST (NUCLEAR) (Cont)

Multiple Releases

NOTE

If any subsequent release is to be synchronous, accomplish the following.

- 13. Destination Selector Switch - Target No. 2, 3, or 4 (as required) (RN)
- 14. ACL Button - Depressed (if applicable) (RN)
- 14A. Tgt Display Indicator - Checked (RN)

Ensure that the desired target is displayed and the Function switch is the ACTIVE position.

- 15. Offset Selector Switch - As required (RN)

Timing

NOTE

Accomplish applicable steps for any timing run during multiple releases.

- 16. Bomb Door Control Valve Lights - Off (RN)
- 17. Bombing System Switch - MANUAL (RN)
- 18. Bomb Doors - Opened (RN)

NOTE

If bomb doors fail to open with bomb door open switch, release must be accomplished using "Emergency Manual Bomb Release" procedures.

- 19. Bomb Tone (RBS only) - On (20 seconds prior to bomb release) (RN)
- 20. D-2 Bomb Release Switch - Actuated (RN)

NOTE

If the D-2 switch fails to effect a release, release must be accomplished using "Emergency Manual Bomb Release" procedures.

- 21. Bomb Release Monitored - "Bomb Away" (RN/P)

NOTE

If required by command tactical doctrine bomb doors will be closed between releases.

Synchronous

NOTE

Accomplish applicable steps for any subsequent synchronous run during multiple releases.

- 16. Target or Offset - Acquired (RN)

RADAR NAVIGATOR'S AND NAVIGATOR'S BOMBING CHECKLIST (NUCLEAR) (Cont)

17. Bomb Button - Depressed (RN)

NOTE

To withhold release, depress track button and proceed to applicable checklist for next release or to "Post Bomb Release/Abort Checklist," if no further releases are to be made.

18. Bombing System Switch - AUTO (RN)
19. Bomb Door Control Valve Lights - Off (RN)
20. Bomb Tone (RBS only) - On (20 seconds prior to bomb release) (RN)
21. Bomb Door Opening Monitored - Bomb doors open (RN/P)

NOTE

If doors fail to open automatically, place the bombing system switch in MANUAL and attempt opening with bomb door open switch. If doors cannot be opened by any means, release must be accomplished using "Emergency Manual Bomb Release" procedures.

22. Bomb Release Monitored - "Bomb Away" (RN/P)

NOTE

- If the BNS fails to effect a release, release must be accomplished using "Emergency Manual Bomb Release" procedures.
- The D-2 switch will never be used as an alternate method of triggering the BRIC during an apparent failure of the BNS to effect a release. A premature actuation of the D-2 switch could result in a multiple release.

23. Track Button - Depressed (RN)

NOTE

If more than two synchronous runs are programmed during a multiple release, accomplish steps "13" thru "23" as applicable after entering new target coordinates.

ALTERNATE

1. Pilot's Bombs-Released Light - Off, tested (RN-P)

If the pilot's bombs-released light is illuminated, attempt to reset BRIC by moving BRIC switch to TRAIN with counter knob at zero, then back to SEL.

WARNING

With the pilot's bombs-released light illuminated, opening the bomb doors after completion of the release configuration check could result in an immediate release.

NOTE

If pilot's bombs-released light remains illuminated, release must be accomplished using "Emergency Manual Bomb Release" procedures.

RADAR NAVIGATOR'S AND NAVIGATOR'S BOMBING CHECKLIST (NUCLEAR) (Cont)

2. Multiple Drift Corrections/Timing - Accomplish (as required) (RN-N)

3. Release Configuration Check:

NAV CALLS	RN RESPONSE
a. "Special Weapons Lock Indicators"	"Indicate unlocked"
b. "RCD"	"Connected, light on"

WARNING

When live/inert weapons are carried and the bomb doors are opened manually or external weapons are loaded, the RCD will be connected no earlier than 10 seconds TTG on the first release and disconnected after last release/launch on that bomb run.

c. "BRIC"	"SEL, light dim"
d. "Master Bomb Control Switch"	"ON, light on"
e. "Bomb Door Control Valve Lights Off"	
f. "Bombing System Switch"	"MANUAL"
g. "Bomb Doors"	"Opened (approximately 120 seconds prior to release)"

Bomb doors will be opened manually using bomb door switch approximately 120 seconds prior to release.

NOTE

If bomb doors fail to open with bomb door open switch, release must be accomplished using "Emergency Manual Bomb Release" procedures.

4. Bomb Tone (RBS only) - On (20 seconds prior to bomb release) (RN)

5. AGM-69A Manual/Auto Mode Switch - MANUAL (20 seconds prior to bomb release) (N)

WARNING

To prevent possible collision between a released bomb and a simultaneously launched AGM-69A missile from the bomb bay or an inboard missile from the pylon, the manual/auto switch will be placed to MANUAL position before releasing a bomb.

NOTE

When AGM-69A missiles are programmed for automatic launch during a multiple release, the navigator will refer to the missile launch checklist block.

RADAR NAVIGATOR'S AND NAVIGATOR'S BOMBING CHECKLIST (NUCLEAR) (Cont)

6. D-2 Bomb Release Switch - Actuated (RN)

At expiration of time to release/ETA to bomb release line, accomplish release using D-2 bomb release switch.

NOTE

If the D-2 switch fails to effect a release, release must be accomplished using "Emergency Manual Bomb Release" procedures.

7. Bomb Release Monitored - "Bomb Away" (RN/P)

Bomb release will be indicated by the applicable weapon released or bomb indicator light illuminating.

NOTE

- Perform following steps for multiple release.
- If required by command tactical doctrine, bomb doors will be closed between releases.

7A. SRAM Checkpoint Fix - Entered (if required) (RN/N)

Accomplish a visual overfly position fix when over the target.

8. Multiple Drift Corrections Timing - Accomplish (as required) (RN-N)

If target separation allows, radar navigator will reinitiate multiple drift corrections/timing procedures. Radar navigator will be prepared to release second bomb at expiration of a predetermined time interval between releases.

9. Special Weapons Select Switch - FWD/AFT (as required) (single carriage) (RN)

10. Master Bomb Control Switch - OFF, then ON (multiple carriage) (RN)

This step is applicable only when bomb bay doors are not closed between the first and second release.

11. Bomb Doors - Opened (RN/P)

12. Bomb Tone (RBS only) - On (20 seconds prior to bomb release) (RN)

13. D-2 Bomb Release Switch - Actuated (RN)

NOTE

If the D-2 switch fails to effect a release, release must be accomplished using "Emergency Manual Bomb Release" procedures.

14. Bomb Release Monitored - "Bomb Away" (RN/P)

NOTE

Repeat steps "8" thru "14" for releases on subsequent targets of a multiple release.

RADAR NAVIGATOR'S AND NAVIGATOR'S BOMBING CHECKLIST (NUCLEAR) (Cont)

POST BOMB RELEASE/ABORT (NUCLEAR) (RN-N)

Accomplish immediately after any single release or last release of a multiple release, or an abort if WPR/MPL check has been performed (RN).

Perform required steps and assure accomplishment of checks (N).

1. Release Circuits Disconnect - Disconnected (Launch/mission abort only) (RN/N)
2. Track Button - Depressed (RN)
3. Bombing System Switch - Manual (RN)
4. Bomb Doors - Closed (RN)
5. Master Bomb Control Switch - OFF (RN)
6. AOU Panel: (RN)
 - a. Multi-Tgt-Norm Switch - As required
 - b. Offset Selector Switch - As required
7. H_A Switch - OFF (RN)
8. Radar Recording Camera Switches - As required (N)
9. AGM-69A MANUAL/AUTO Mode Switch - As required (N)

For launch/mission abort, place switch to MANUAL position.
10. Manual Launch Switch - Depressed/off (if required) (N)

NOTE

Accomplish steps "11" and/or "12" for mission abort when no further releases/launches are to be attempted.

11. Internal Bombs:
 - a. DCU-9/A Selector Switches - SAFE (RN)
 - b. DCU-9/A Control Levers - OS (RN)
 - c. DCU-9/A Warning Lights - Off, tested (each position of SWK box) (RN)
 - d. DCU-9/A Selector Switches - OFF (RN)
 - e. Readiness Switch Cover - Closed, latched (RN-P)
 - f. Special Weapons Manual Lock Handle - Locked (RN-EW)
 - g. Special Weapons Lock Indicators - Indicate locked (RN)
 - h. Normal Release & Jettison Power Circuit Breakers - Out (RN)
 - i. BRIC - TRAIN, zero, light off (RN)

RADAR NAVIGATOR'S AND NAVIGATOR'S BOMBING CHECKLIST (NUCLEAR) (Cont)

12. AGM-69A:

- a. Missile Select Switch - ALL (N)
- b. Missile Power Switch - OFF (momentarily), neutral lock (N)
- c. MSL Power Lights - Off (N)
- d. Monitor and Jettison Select Switch - ALL (RN)
- e. AGM-69A Lock-Unlock Switch - LOCK (RN-EW)
- f. Lock Light - On (RN)
- g. AGM-69A Consent Panel: (RN-P)
 - (1) Prearm-Safe Switch - SAFE (1 second), neutral lock
 - (2) Lock-Unlock Switch - LOCK
- h. Safe Light - On (RN)
- i. Prearm Light - Off (RN)
- j. SAF Switch - SAFE (1 second) (RN)
- k. AGM-69A Launcher Hydraulic Control Switch - OFF (if required) (N-P)

NOTE

After all bombs and missiles have been released/launched, perform steps "13" through "15."

- 13. Release Circuits Disconnect - Disconnected (RN/N)
- 14. BRIC - TRAIN, zero, light off (RN)
- 15. DCU-9/A Selector Switches - OFF (RN)

NOTE

Accomplish steps "16" through "18" during climb after low level.

- 16. Doppler RF Power Switch - NORM (N)

The doppler RF power switch will be positioned to NORM after the aircraft climbs above 2000 feet above the terrain.

- 17. 12,000 Foot Oxygen Check - Completed (G-RN-P/CP)
- 18. Altimeter - Set 29.92 (P-CP-N)

NOTE

Accomplish steps "19," "20," and "21" when departing enemy territory.

- 19. Walkway Lights Circuit Breakers - In (RN)
- 20. Exterior Lights - As required (RN-P)
- 21. Personal Locator Beacon Lanyard - Notify crew to set as required (N)

NAVIGATOR'S CHECKLIST (NUCLEAR)

BEFORE EXTERIOR INSPECTION (POWER OFF)

1. Readiness Switch Cover - Closed, sealed (RN)
2. AGM-69A Consent Panel: (RN)
 - a. Prearm-Safe Switch - Guard closed and sealed
 - b. Lock-Unlock Switch - Guard closed and sealed
3. Special Weapons Manual Lock Door - Sealed (RN)
4. AGM-69A Lock-Unlock Switch Cover - Sealed (RN)
5. Ejection Trigger Ring - Stowed, pin No. 1 installed (RN-N)

Check that ejection trigger ring is properly seated in detent.

WARNING

If the ejection trigger ring is not properly seated in the detent, call maintenance and ascertain status of arming initiator before continuing seat inspection.

6. Forward & Rear Special Weapon Manual Release Handles - Sealed (RN)
7. Release Circuits Disconnect - Disconnected, sealed (RN)
8. Circuit Breaker Panels: (RN/N)
 - a. Normal Release & Jettison Power Circuit Breakers - Out
 - b. ADM-20 Launch Control, Cart No. 1, Cart No. 2, and Actuator Circuit Breaker - OUT

CAUTION

Failure to open the launch control, Cart No. 1, Cart No. 2, and Actuator Circuit breaker places a potential electrical hazard in the ADM-20C relay box assembly.

- c. All Other Circuit Breakers & Fuses - In

NAVIGATOR'S CHECKLIST (NUCLEAR) (Cont)

9. CSS Indicator Windows - Checked "A" (RN)

NOTE

Cease all activity and request CSS custodians (through the Command Post) if any CSSC indicator window is found set to other than "A."

10. DCU-9/A Control Levers - OS, sealed (RN)
11. DCU-9/A Selector Switches - OFF (RN)
12. SWK Monitor Select Switch - OFF (RN)
13. AGM-69A Weapon Status and Control Panel: (RN)
- a. SAF Switch - Guard closed and sealed
 - b. Class III Switch - Neutral lock
14. FLIR Turret Air and STV Turret Air Switches - OFF (RN)

WARNING

Lethal voltages may exist on the FLIR turret window and the electrical cable routed to the STV turret if the switches are in the ON position when power is applied.

EXTERIOR INSPECTION (BOMB BAY INTERIOR)

WARNING

The bomb door actuator struts must be disconnected before entering the bomb bay if power is applied to the aircraft.

1. General Condition of Bomb Bay - Checked (RN)
- Check for fuel and hydraulic leaks and security of equipment (include check of walkways for loose objects).
2. Nuclear Bombs - Checked (RN)
- When nuclear bombs are aboard, use the appropriate bomb preflight checklist from T.O. 1B-52D-25-2CL-1.
3. AGM-69A Launcher & Launcher Missile: (RN-N)
- a. Launcher General Condition - Checked
 - b. Ground Operation Safety Switch Pin - Checked removed
 - c. Missiles - Checked
 - (1) Payload Section Marking - Checked
 - (2) Motor Arm/Disarm Switch Safeing Pin & Streamer - Counted

NAVIGATOR'S CHECKLIST (NUCLEAR) (Cont)

(3) C/D Safeing Pin & Streamer (OTL Missiles) - Counted

- d. MAU-12 Ejector Rack Ground Safety Lock Pins - Counted
- e. All Safeing Pins - Stowed

Check all safeing, safety pins and streamers stowed aboard aircraft.

- 4. AGM-69A Power Distribution Panel and RAM Air Shutoff Valve - Checked (RN-N)
 - a. Launcher Rotation Tool Circuit Breakers (3) and Inserter Circuit Breaker (1) - OUT
 - b. All Other Circuit Breakers - IN
 - c. RAM Air Shutoff Valve - OPEN INFLIGHT

INTERIOR INSPECTION

- 1. Equipment - Stowed

WARNING

Insure that no equipment is stowed on or near the lower deck heating ducts and outlets, electrical wiring, or electronic equipment.

- 2. Lower Deck Spare Parachute Preflight:

- a. Inspection Record:
 - (1) Inspection & Repack Date - Checked
 - (2) Automatic Release Time & Altitude Setting - Checked
- b. Bailout Bottle Pressure & Hose Connector - Checked
- c. Personal Locator Beacon Lanyard - Snapped/Unsnapped (as required)

For peacetime operations, the personal locator beacon lanyard must be configured for automatic operation. When mission requirements dictate the necessity to avoid detection and automatic actuation of the beacon is not desired, the lanyard must be configured for nonautomatic (manual) operation.

- d. Parachute - Unbuckled and stowed

Spare parachute will be unbuckled and stowed in an easily accessible location.

- 2A. IN Oxygen Regulator - OFF and 100% Oxygen (IN not flying)

- 3. Lower Deck Fire Extinguisher - Checked

Insure that appropriate safety device (safety wire/seal or locking pin/lever, as applicable) is installed. Check for fully serviced pressure.

NAVIGATOR'S CHECKLIST (NUCLEAR) (Cont)

4. MADREC Recorder Clock - Wound, set to GMT
5. Sight Reduction Tables - Checked (if applicable)

When tables are stored aboard aircraft, check that all three volumes are current.

6. Interphone - Connected

7. Oxygen System:

- a. Regulator Diluter Lever - 100% OXYGEN
- b. Shutoff Lever - OFF
- c. Mask & Hose - Check disconnect, then reconnect

Check for 10- to 20-pound pull for disconnect, then reconnect mask and hose.

- d. Diluter Valve - Checked

Attempt to draw air through the oxygen mask. Ability to draw air indicates a defective diluter valve, oxygen hose and/or connections or mask. Then place the diluter valve to NORMAL position, draw air through the mask, if unable, this would indicate that only 100% oxygen will be available.

NOTE

- If the diluter valve is stuck in the 100% position, this will prohibit the detection of smoke or fumes when use of normal oxygen is required.
- If the CRU-73A regulator is installed, the crew member will not be able to draw air through the system with the shutoff lever OFF. The diluter lever may be moved to NORMAL with the shutoff lever OFF on some CRU-73A regulators. The diluter valve will be in the 100% oxygen position when the shutoff lever is OFF on all CRU-73A regulators.

- e. Shutoff Lever - ON
- f. Pressure - Checked

Pressure gage reads approximately 300 psi.

- g. Emergency Toggle Lever - TEST MASK

With mask disconnected at one side of helmet, the flow indicator should indicate continuous flow.

- h. Mask - Test

Attach mask to helmet and hold breath; indicator should indicate no flow.

NOTE

Flow condition may be indicated by a slight leak around the face form. If light hand pressure against the mask does not stop the flow, the mask is unacceptable.

- i. Emergency Toggle Lever - NORMAL
- j. Regulator Diluter Lever - NORMAL/100% (as required)

NAVIGATOR'S CHECKLIST (NUCLEAR) (Cont)

8. N-1 Compass Master Indicator:

- a. Latitude Correction Pointer - OFF
- b. Synchronizer Knob - Synchronize N-1

9. True Heading System Panel:

- a. Mag-Syn-Gyro Switch - MAG
- b. Bias or Syn Knob - Zero bias indicator

NOTE

Magnetic variation indicator may drift due to lack of excitation from the BNS.

10. Automatic Astrocompass Power Filter Switch - Checked OFF

11. Heading Select Switch - TRUE HEAD COMPUTER

12. Doppler Vertical Reference Switch - NORMAL

13. Doppler Drift Switch - ON

14. Doppler RF Power Switch - NORM

15. 5-Inch Indicator:

- a. Video Knob - CCW
- b. Intensity Knob - CCW
- c. Marker Knob - CCW

16. EVS Video Select Switch - OFF

17. Ejection Seat & Escape Hatch:

WARNING

- Carefully check to insure that no streamer has been torn from a maintenance safety pin, thus inadvertently leaving the pin installed.
- If a maintenance safety pin is installed, the status of the seat will be ascertained prior to removal of the pin.

- a. Catapult Pin-Pull Initiator - Pin No. 4 removed, link to hatch secure
- b. Table Stowage Initiator - Checked

Inspect initiator for condition, installation, and tubing connected.

NAVIGATOR'S CHECKLIST (NUCLEAR) (Cont)

- c. Manual Catapult Initiator Safety Pin-Pull Handle - Secure
Handle should be properly seated below left leg guard.
 - d. Initiator Tube Runs - Checked connected
Check tube runs for proper and secure connections.
 - e. Catapult Initiator Safety Pin-Pull Cylinder - Checked
Catapult initiator safety pin must extend all the way through the catapult initiator. If pin is pulled out, initiator may have been fired.
 - f. Arming Initiator & Control Linkage - Checked, pin No. 3 removed
Check maintenance safety pin No. 3 removed. Inspect initiator for condition, installation, and tubing connected.
 - g. Ankle Restraints - Checked
Inspect ankle restraints for proper operation and stow in downward position.
 - h. Emergency Escape Hatch - Secure
Check that the paint stripe on lockpin is visible beyond the shield or that the lockpin overlaps the shoulder on the lockarm by 1/4 inch.
 - i. Table Stowage Thruster & Tubing - Checked
 - j. Drogue Parachute Support Arm Release Initiator - Checked, pin No. 5 removed
Check maintenance safety pin No. 5 removed. Inspect initiator for condition, installation, and tubing connected.
 - k. Inertia Reel - Checked
Check inertia reel lock for proper functioning.
18. Man-Seat Separator - Checked
Insure that the nylon man-seat separator straps are placed on the bare seat. Survival kit is then placed over man-seat separator straps.
19. Parachute Preflight:
- a. Inspection Record:
 - (1) Inspection & Repack Date - Checked
 - (2) Automatic Release Time & Altitude Setting - Checked
 - b. Personal Locator Beacon Lanyard - Snapped/Unsnapped (as required)
For peacetime operations, the personal locator beacon lanyard must be configured for automatic operation. When mission requirements dictate the necessity to avoid detection and automatic actuation of the beacon is not desired, the lanyard must be configured for nonautomatic (manual) operation.

NAVIGATOR'S CHECKLIST (NUCLEAR) (Cont)

- c. Bailout Bottle Pressure & Hose Connector - Checked
- d. Parachute Arming Lanyard Anchor - Installed

WARNING

Be certain that the parachute arming lanyard anchor is securely fastened in the attachment fitting on the seat. Failure to attach the lanyard anchor to the seat will necessitate manual operation after ejection.

- e. Parachute Straps - Adjusted (as required)

20. Global Survival Kit:

- a. Kit Installed & Plunger Depressed - Checked
- b. Kit Release Handle - Checked down
- c. Mode Selector Lever - AUTO
- d. Kit Straps to Parachute - Checked and attached

Check that attachment fittings are properly connected to the kit, the attachment straps threaded through the safety belt, and the quick-disconnect fittings are properly attached to the parachute (with release buttons on outside).

WARNING

Care must be taken to insure that the survival kit attachment straps are properly threaded through the safety belt.

- 21. Safety Belt Release Fittings - Connected
- 22. Shoulder Strap Attaching Fittings - Connected
- 23. AGM-69A Check:

- a. Status and Control Panel:
 - (1) Missile Select Switch - ALL
 - (2) Training/Operation Mode Switch - As required, lock
 - (3) Homer/Inertial Mode Switch - INERTIAL, lock
 - (4) Manual/Auto Mode Switch - MANUAL, lock
 - (5) Launch Control Switch - NAV, lock

NAVIGATOR'S CHECKLIST (NUCLEAR) (Cont)

- 24. Doppler Radar Silence Switch - SILENT
- 25. Doppler Radar System Power Switch - OFF
- 26. Radar Pressure Pump Control Switches - NORMAL ON
- 27. Bomb Bay Door Timer - Set 10 seconds
- 28. APN-69 Pressurization Switch - COMPRESSOR ON
- 29. APN-69 Low Pressure Warning Light - Off, tested
- 30. APN-69 Power Switch - OFF (code set)
- 31. MADREC - OFF
- 32. Ground Locks & Bypass Keys - Counted, stowed

Six locks and two keys.

- 33. Pressure Bulkhead Door - Closed, latched, locked (alert only)

A positive locked indication will be obtained by attempting to open the door with the door handle.

NAVIGATOR'S CHECKLIST (NUCLEAR) (Cont)

34. Altimeter - Set

Set in accordance with AFM 51-40.

WARNING

When setting altimeter, special attention should be given to the altimeter to insure the 10,000-foot pointer is reading correctly.

35. Crew Report - Completed (at pilot's request)

- a. The sequence for crew reporting is as follows: N, G, EW, RN, CP, P, IN, DI, 10th, and IP.
- b. Switch to call and report, "Navigator's check complete." Check consists of abandon signal and call operation.

36. Oxygen Regulator - OFF and 100% OXYGEN (if leaving the aircraft for extended period of time)

BEFORE TAKEOFF

1. Entrance Door - Checked locked, folding hatch closed

A positive lock indication will be obtained by attempting to unlatch the door with the latch unlatch handle.

2. Pressure Bulkhead Door - Closed, latched, unlocked

3. Pressure Dump Handle - CLOSED, safetied

4. Oxygen Regulator - As required

NOTE

Accomplish following steps after BNS power switch ON.

5. Automatic Astrocompass:

CAUTION

The declination and SHA for Polaris are to be inserted into the No. 1 star data panel for astrocompass operation (including standby) between the latitudes of 0° and 75° N to reduce the potential of limits or "lock-up" damage to the altitude-azimuth computer.

- a. Star Selector Switch - OFF
- b. Rate Switch - SOL or SID

NAVIGATOR'S CHECKLIST (NUCLEAR) (Cont)

- c. Power Filter Switch - SUN or STAR

NOTE

There is a 2-minute delay before information may be preset and an additional 5-minute delay before the system can track. If the celestial coordinates for Polaris are not displayed in star data panel No. 1, they are to be inserted as soon as the 2-minute delay has elapsed.

- d. Lat-Long Switch - AUTO

6. (Deleted)

7. Doppler Radar System Power Switch - ON

CAUTION

Do not turn doppler radar system power switch to ON position until cooling air is available and the ground blowers switch is ON.

8. MADREC:

- a. System Select Switch - STDBY

The recorder failure light will remain on for approximately 20 seconds.

- b. Press-to-Test Button - Depressed

The ready and failure indicators should illuminate.

9. EVS Symbols Switch - LAMP TEST, then SYMBOLS ON

Check BNS HDG light.

10. 5-Inch Indicator - Adjusted, checked

Accomplish as soon as the radar navigator has put the BNS radar in radiate operation.

11. Memory Point, Offset In and Bomb Function Lights - Tested

12. BDI TG = 0 & BNS Steering Lights - Tested

13. EVS Monitor Overheat Light - Tested

14. EVS Video Select Switch - STV

Azimuth and elevation scales, numerics, and markers are displayed provided the brightness and contrast knobs on the EVS monitor have not been rotated full CCW.

15. EVS Monitor - Adjusted

With the contrast knob fully CCW, rotate brightness knob CW so presentation is just visible and then rotate CCW until presentation just disappears. Rotate contrast knob CW until optimum presentation is displayed.

NOTE

Readjustment of the monitor will normally be required only when significant ambient light changes occur.

NAVIGATOR'S CHECKLIST (NUCLEAR) (Cont)

16. Automatic Astrocompass:

- a. Heading Correction - Set zero
- b. Clock - Set GMT

When set time comes up, switch to GHA and check for clock drive.

- c. GHA - Set

When set time comes up, switch to SHA and check GHA for drive.

- d. SHA & Dec - Set (Polaris coordinates in No. 1 star data panel)

- e. Star Selector Switch - As desired

17. APN-69 Power Switch - STDBY

18. MADREC - AUTO (if ready indicator is illuminated)

19. Vertical Camera Master Switch - OFF and door closed

20. EVS Video Select Switch- FLIR (if applicable) (RN/N)

When the READY light on the FLIR control panel is illuminated, adjust the FLIR bias and contrast knobs for optimum display.

20A. EVS Video Select Switch - STV/FLIR (RN-N)

The radar navigator and navigator should monitor opposite sensors during takeoff and departure.

21. Flight Instruments - Rechecked and set (P-CP-N)

- a. Pilot, copilot, and navigator recheck their altimeters with a known elevation.
- b. Pilot, copilot, and navigator cross-check heading indicators and magnetic standby compass.

22. Parachute & Safety Belt - Fastened

WARNING

- Tighten the parachute survival kit attachment straps as tightly as possible to prevent the safety belt from inflicting facial injuries during ejection bailout.
- Insure that the parachute arming lanyard is not entangled in the parachute harness. Lanyard entanglement could cause failure in seat separation and failure of the automatic features of the parachute.

NOTE

If it becomes necessary to leave the seat, the crew member should open the safety belt and unbuckle the parachute harness leaving the parachute and survival kit in the seat. If the parachute is worn when leaving the seat, upon returning to the seat, it will be necessary to take it off in order to reinstall the parachute and safety belt in the seat.

23. Pin No. 1 - Removed

24. Ejection Control Trigger Ring - Unstowed

25. Bailout Bottle - Connected

26. Takeoff Data - Reviewed (P-CP-N)

NAVIGATOR'S CHECKLIST (NUCLEAR) (Cont)

TAKEOFF

1. Acceleration Timing - Checked

As the pilot announces "Now" at 70 knots, start the stopwatch. Announce over the interphone "Coming up on _____ seconds" approximately 3 seconds prior to S_1 time. At S_1 time, announce "Now."

AFTER TAKEOFF

1. Doppler Radar Silence Switch - TRANSMIT

Place the doppler radar silence switch to TRANSMIT when attaining an altitude of approximately 200 feet above the ground.

2. APN-69 Power Switch - OPERATE (if required)

APN-69 should be placed in operation at takeoff whenever buddy refueling or cell tactics are to be employed.

3. Departure Plan - Monitored

Monitor aircraft position to assure adherence to planned departure.

4. Altitude & Airspeed - Monitored

Monitor altitude and airspeed for safe margin until aircraft has attained an altitude of 5000 feet above the terrain. Advise pilot if altitude falls below a safe margin or airspeed fails to show a positive increase. Upon reaching level-off altitude minus 2000 feet, report altitude to pilot every 1000 feet and at level-off altitude. Altitude calls will be made by stating the passing altitude and the intended level-off altitude.

5. Climb EPR Value - Computed (if requested)

6. AGM-69A System Power Application - As desired

7. 12,000 Foot Oxygen Check - Completed (G-RN-P/CP)

- a. During the climb, copilot requests an oxygen check at 12,000 feet. The sequence for oxygen report is gunner, radar navigator, and pilot/copilot. The reporting crew member will visually check other crew member for alertness. He will report oxygen checks for both positions. Oxygen panel at each occupied crew position will be checked on all oxygen checks for:

- (1) Oxygen Supply Shutoff Lever - ON
- (2) Regulator Diluter Lever - As required
- (3) Pressure - 300 psi
- (4) Flow Indicator - Functions normally
- (5) Emergency Toggle Lever - NORMAL

- b. Gunner, radar navigator, and pilot/copilot report "Oxygen panels checked." In addition, pilot/copilot reports "Cabin altitude _____ feet."

- c. Copilot requests oxygen check at level-off and during cruise at 1-hour intervals when cabin altitude is below 12,000 feet, at 30-minute intervals when cabin altitude is 12,000 to 25,000 feet, and at no longer than 10-minute intervals when cabin altitude is above 25,000 feet. If cabin altitude is below 12,000 feet, only the pilot/copilot will report. The remaining crewmembers will check their equipment and report if abnormal.

8. Altimeter - Set 29.92 (P-CP-N)

NAVIGATOR'S CHECKLIST (NUCLEAR) (Cont)

AFTER LEVEL OFF

1. Heading Select Switch - Best heading available
2. EVS Video Select Switch - FLIR (if applicable) (RN/N)

Adjust FLIR bias and contrast knobs for optimum display. The FLIR must be adjusted frequently throughout flight to provide an optimum display.

3. EVS Video Select Switch - STBY, as desired

Place video select switch to STBY whenever EVS is not being used.

4. True Airspeed Indicators - Cross-checked

If more than a 10 knot difference exists, compute TAS. If the BNS true airspeed is in error by 10 knots or more, set BNS true airspeed with emergency controls panel.

BEFORE DESCENT

1. Heading Select Switch - TRUE HEAD COMPUTER
2. AGM-69A Launcher Position - Checked, indexed (if required)
3. AGM-69A Launcher Hydraulic Control Switch - OFF (N-P)
4. EVS Video Select Switch - STV/FLIR (RN-N)

The radar navigator and navigator should monitor opposite sensors during penetration and for all approach and landing patterns.

DESCENT AND BEFORE LANDING

1. Penetration & Approach - Reviewed (P-CP-RN-N)

Review the planned penetration and approach. This review will include navigation aid frequencies, minimum and emergency safe altitudes, descent rates, minimums for the approach to be flown, missed approach procedures, and aerodrome sketch. As a minimum the pilot flying the approach will brief the crew on the descent rate, MDA/DH/VDP and missed approach procedures for the planned approach. Lost communications procedures will be coordinated if required. During the descent and approach other crewmembers will back up the pilot flying and report any deviation from prescribed procedures.

- 1A. Best Flare Speed - Computed and crosschecked with copilot

This item will be reaccomplished during the approach and landing phase and for all subsequent approaches and landings.

2. Altimeter - Set _____ (P-CP-N)

Reset altimeter to station pressure immediately prior to initiating penetration or upon passing through transition altitude. When mission requirements dictate and current altimeter setting is not available, compute an altimeter setting using metro or in-flight "D" values.

3. Descent Altitude Calls - Accomplish

- a. Coordinate with the pilot as to level-off altitude(s) to be used for descent and entry to landing pattern.

NAVIGATOR'S CHECKLIST (NUCLEAR) (Cont)

- b. Call off altitude to pilot every 5,000 feet commencing at 15,000 feet. Upon reaching level-off altitude plus 2,000 feet, report altitude to pilot every 1,000 feet and at level-off altitude. Altitude calls will be made by stating the passing altitude and the intended level-off altitude.
- c. Announce approaching DH/MDA during all instrument approaches. This call should be made approximately 100 feet above the DH/MDA and will include the appropriate DH/MDA altitude (e.g., "Approaching 363").

4. AGM-69A Shutdown:

NOTE

Perform steps "a" thru "c" if powered missiles are aboard.

- a. Missile Select Switch - ALL
- b. Missile Power Switch - OFF (momentarily), neutral lock
- c. Missile Power Light - Off

CAUTION

Turn off master power within 2 minutes after system power shutdown to prevent overheat condition in the PDU.

- d. System Power Switch - OFF (momentarily), neutral lock
- e. System Power On Indicator Light - Off
- f. MA PWR Switch/Master Power On Indicator Light - Depressed (momentarily), off

5. Automatic Astrocompass:

- a. Star Data Panel No. 1 - Polaris coordinates set
- b. Set Selector Switch - GHA
- c. Power Filter Switch - SUN
- d. Star Selector Switch - OFF
- e. Lat-Long Switch - MANUAL

6. Doppler Radar Silence Switch - SILENT

Place the doppler radar silence switch to SILENT when approximately 200 feet above the ground for low approaches and landings. For subsequent activity, the doppler may be left in SILENT.

AFTER LANDING

1. 5-Inch Indicator:

- a. Video Knob - CCW
- b. Intensity Knob - CCW
- c. Marker Knob - CCW

NAVIGATOR'S CHECKLIST (NUCLEAR) (Cont)

2. Radar Recording Camera:
 - a. Expose 20 Frames
 - b. Power Switch OFF
3. APN-69 Power Switch - OFF
4. APN-69 Pressurization Switch - OFF
5. Ejection Control Trigger Ring - Stowed
6. Pin No. 1 - Installed

AFTER PARKING

1. Ejection Seat - Position forward and up
2. Doppler Radar System Power Switch - OFF
3. EVS Video Select Switch - OFF
4. Astro Power Filter Switch - POWER OFF
5. Oxygen System:
 - a. Regulator - OFF and 100% OXYGEN
 - b. Supply Hose & Interphone Cord - Stowed
6. MADREC - OFF
7. Radar Pressure Pump Control Switches - OFF
8. Nuclear Bombs Aboard - Accomplish "Ground Safeing Checklist" (T.O. 1B-52D-25-2CL-1) (MMS not available)
9. AGM-69A Missiles Aboard & Qualified Personnel Not Available - Accomplish "AGM-69A Missile Ground Safeing" checklist (N/RN)

RADAR NAVIGATOR'S CHECKLIST (NONNUCLEAR WEAPONS)**BEFORE EXTERIOR INSPECTION (POWER OFF)**

1. Readiness Switch Cover - Closed, latched (clip-in) (RN)
2. Special Weapons Manual Lock Handle/Door - Stowed/closed (clip-in) (RN)
3. Ejection Trigger Ring - Stowed, pin No. 1 installed (RN-N)

Check that ejection trigger ring is properly seated in detent.

WARNING

If the ejection trigger ring is not properly seated in the detent, call maintenance and ascertain status of arming initiator before continuing seat inspection.

4. Forward & Rear Special Weapon Manual Release Handles - Stowed (clip-in) (RN)
5. Release Circuits Disconnect - Disconnected (RN)
6. Circuit Breaker Panels: (RN/N)
 - a. Normal Release & Jettison Power Circuit Breakers - Out
 - b. ADM-20 Launch Control, Cart No. 1, Cart No. 2, and Actuator Circuit Breakers - OUT

CAUTION

Failure to open the launch control, Cart No. 1, Cart No. 2, and Actuator Circuit breaker places a potential electrical hazard in the ADM-20C relay box assembly.

- c. All Other Circuit Breakers & Fuses - In
7. DCU-9/A Selector Switches - OFF (clip-in) (RN)
8. FLIR Turret Air and STV Turret Air Switches - OFF (RN)

WARNING

Lethal voltages may exist on the FLIR turret window and the electrical cable routed to the STV turret if the switches are in the ON position when power is applied.

RADAR NAVIGATOR'S CHECKLIST (NONNUCLEAR WEAPONS) (Cont)**EXTERIOR INSPECTION (POWER OFF) (RN/N)****WARNING**

- The bomb door actuator struts must be disconnected before entering the bomb bay if power is applied to the aircraft.
- To prevent personnel injury in the event of inadvertent actuation of the release system, the following checks will be accomplished prior to any power (aircraft or external) being applied to the aircraft.

NOTE

If any discrepancies are found, notify MMS personnel.

1. General Condition of Bomb Bay - Checked

Check for fuel and hydraulic leaks and security of equipment (include check of walkways for loose objects).

RADAR NAVIGATOR'S CHECKLIST (NONNUCLEAR WEAPONS) (Cont)

Clip-In

2. MB-3A Bomb Rack Lockpins (Lower Only) - Inserted
3. General Condition of Bombs/Mines - Checked
4. Arming Wires & Fuzes - Checked

Visually check that arming wires are properly inserted in fuze/arming assemblies and that retaining clips (Fahnestock/beryllium) are installed when applicable.

Cluster

2. General Condition of Bombs/Mines - Checked
3. Arming Wires & Fuzes - Checked

Visually check that arming wires are properly inserted in fuze/arming assemblies and that retaining clips (Fahnestock/beryllium) are installed when applicable.

4. Shackle Locking Pin(s) - Removed, counted, and stowed

There should be a locking pin for each shackle.

WARNING

- Prior to removing any shackle locking pin, ensure that the A-5/A-6 release is cocked and the B-11 shackle release lever is mated with the release arm of the A-5/A-6 release.
- Removal of the shackle-locking pin from a loaded shackle with the A-5/A-6 release uncocked and/or the B-11 shackle release lever in the release position, will result in an immediate release of the weapon.
- If undue resistance is encountered when removing any shackle locking pin, the aircrew will cease further action and call MMS personnel.

INTERIOR INSPECTION

1. Equipment - Stowed

WARNING

Insure that no equipment is stowed on or near the lower deck heating ducts and outlets, electrical wiring, or electronic equipment.

2. Compass & True Heading Computer Cutoff Switch - ON
3. Doppler System Pressurization Shutoff Valve Handle - NORMAL

RADAR NAVIGATOR'S CHECKLIST (NONNUCLEAR WEAPONS) (Cont)

4. Ejection Seat & Escape Hatch:

WARNING

- Carefully check to insure that no streamer has been torn from a maintenance safety pin, thus inadvertently leaving the pin installed.
- If a maintenance safety pin is installed, the status of the seat will be ascertained prior to removal of the pin.

a. Catapult Pin-Pull Initiator - Pin No. 4 removed, link to hatch secure

b. Table Stowage Initiator - Checked

Inspect initiator for condition, installation, and tubing connected.

c. Drogue Parachute Support Arm Release Initiator - Checked, pin No. 5 removed

Check maintenance safety pin No. 5 removed. Inspect initiator for condition, installation, and tubing connected.

d. Manual Catapult Initiator Safety Pin-Pull Handle - Secure

Handle should be properly seated below left leg guard.

e. Initiator Tube Runs - Checked connected

Check tube runs for proper and secure connections.

f. Catapult Initiator Safety Pin-Pull Cylinder - Checked

Catapult initiator safety pin must extend all the way through the catapult initiator. If pin is pulled out, initiator may have been fired.

g. Arming Initiator & Control Linkage - Checked, pin No. 3 removed

Check maintenance safety pin No. 3 removed. Inspect initiator for condition, installation, and tubing connected.

h. Ankle Restraints - Checked

Inspect ankle restraints for proper operation and stow in downward position.

i. Emergency Escape Hatch - Secure

Check that the paint stripe on lockpin is visible beyond the shield or that the lockpin overlaps the shoulder on the lockarm by 1/4 inch.

j. Table Stowage Thruster & Tubing - Checked

k. Inertia Reel - Checked

Check inertia reel lock for proper functioning.

5. Man-Seat Separator - Checked

Insure that the nylon man-seat separator straps are placed on the bare seat. Survival kit is then placed over man-seat separator straps.

RADAR NAVIGATOR'S CHECKLIST (NONNUCLEAR WEAPONS) (Cont)

6. Parachute Preflight:

a. Inspection Record:

- (1) Inspection & Repack Date - Checked
- (2) Automatic Release Time & Altitude Setting - Checked

b. Personal Locator Beacon Lanyard - Snapped/Unsnapped (as required)

For peacetime operations, the personal locator beacon lanyard must be configured for automatic operation. When mission requirements dictate the necessity to avoid detection and automatic actuation of the beacon is not desired, the lanyard must be configured for nonautomatic (manual) operation.

c. Bailout Bottle Pressure & Hose Connector - Checked

d. Parachute Arming Lanyard Anchor - Installed

WARNING

Be certain that the parachute arming lanyard anchor is securely fastened in the attachment fitting on the seat. Failure to attach the lanyard anchor to the seat will necessitate manual operation after ejection.

e. Parachute Straps - Adjusted (as required)

7. Global Survival Kit:

- a. Kit Installed & Plunger Depressed - Checked
- b. Kit Release Handle - Checked down
- c. Mode Selector Lever - AUTO
- d. Kit Straps to Parachute - Checked and attached

Check that attachment fittings are properly connected to the kit, the attachment straps threaded through the safety belt, and the quick-disconnect fittings are properly attached to the parachute (with release buttons on outside).

WARNING

Care must be taken to insure that the survival kit attachment straps are properly threaded through the safety belt.

8. Safety Belt Release Fittings - Connected

9. Shoulder Strap Attaching Fittings - Connected

10. Interphone - Connected

RADAR NAVIGATOR'S CHECKLIST (NONNUCLEAR WEAPONS) (Cont)**11. Oxygen System:**

- a. Regulator Diluter Lever - 100% OXYGEN
- b. Shutoff Lever - OFF
- c. Mask & Hose - Check disconnect, then reconnect

Check for 10- to 20-pound pull for disconnect, then reconnect mask and hose.

- d. Diluter Valve - Checked

Attempt to draw air through the oxygen mask. Ability to draw air indicates a defective diluter valve, oxygen hose and/or connections or mask. Then place the diluter valve to NORMAL position, draw air through the mask, if unable, this would indicate that only 100% oxygen will be available.

NOTE

- If the diluter valve is stuck in the 100% position, this will prohibit the detection of smoke or fumes when use of normal oxygen is required.
- If the CRU-73A regulator is installed, the crew member will not be able to draw air through the system with the shutoff lever OFF. The diluter lever may be moved to NORMAL with the shutoff lever OFF on some CRU-73A regulators. The diluter valve will be in the 100% oxygen position when the shutoff lever is OFF on all CRU-73A regulators.

- e. Shutoff Lever - ON

- f. Pressure - Checked

Pressure gage reads approximately 300 psi.

- g. Emergency Toggle Lever - TEST MASK

With mask disconnected at one side of helmet, the flow indicator should indicate continuous flow.

- h. Mask - Test

Attach mask to helmet and hold breath: indicator should indicate no flow.

NOTE

Flow condition may be indicated by a slight leak around the face form. If light hand pressure against the mask does not stop the flow, the mask is unacceptable.

- i. Emergency Toggle Lever - NORMAL
- j. Regulator Diluter Lever - NORMAL/100% (as required)

12. Pres Adj Panel:

- a. Sweep Delay Switch - OFF
- b. Sweep Delay Knob - CCW, in detent
- c. IBDA Power Switch - OFF
- d. IBDA Mode Switch - NORM

RADAR NAVIGATOR'S CHECKLIST (NONNUCLEAR WEAPONS) (Cont)

13. BNS External Power Switch - OFF
14. Ground Blowers Switch - OFF
15. Terrain Computer Power Switch - OFF
16. BRIC - Train and zero
17. BNS Power Panel:
 - a. Power Switch - OFF
 - b. Heaters Switch - ON
18. EVS Environmental Power Switches - OFF
19. Master Bomb Control Panel:
 - a. Master Bomb Control Switch - OFF
 - b. Bomb Indicator Lights Switch - ON
 - c. Bombing System Switch - MANUAL
 - d. Lights - Checked, tested
20. Special Weapons Lock Indicators - Indicate locked (clip-in)
21. Bomb Indicator Lights - On (for applicable weapons); off, tested (clip-in)
22. Special Weapons Select Switch - FWD
23. IFC Power Select Switch - TR (guard closed)
24. ALQ-117 to BNS Blanking Switch - ON
25. DCU-9/A Selector Switches - OFF (clip-in)
26. Release Circuits Connected Light - Tested
27. Air Outlet & Auxiliary Heat Knobs:
 - a. Upper - 1/2 out
 - b. Lower - As desired
 - c. Warmer - Full in

NOTE

These knob settings are approximate settings only. After the cabin temperature has stabilized, knob adjustment may then be slightly varied for crew comfort.

28. Radar Primary Panel:
 - a. Radar Power Switch - OFF
 - b. Antenna Speed Switch - FAST

RADAR NAVIGATOR'S CHECKLIST (NONNUCLEAR WEAPONS) (Cont)

29. D-2 Bomb Release Switch - Stowed
30. Terrain Radar Control Panel:
 - a. Radar Display Selector Switch - HI ALT GM
 - b. Rate Switch - OFF
31. Emergency Controls Panel:
 - a. TAS Switch - ON
 - b. Stab Bypass Switch - ON
 - c. All Other Switches - OFF
32. Radar Antenna Tilt Panel Receiver Tune Switch - AUTO
33. Range Sel Panel:
 - a. Range Selector Switch - 20
 - b. Sector Width Knob - CCW in detent
 - c. Markers Selector Switch - NAV
34. Trgt Scl Panel Radar Operation Selector Switch - RADAR
35. Pres Gain Panel:
 - a. Intensity Knob - CCW
 - b. Receiver Gain Knob - CCW
 - c. Video Knob - CCW
36. Bomb Control Panel Heading Switch - NAV
37. APN-150/AGM-69A Tie-In Control Switch - OFF
38. Topocomp:
 - a. Station Keeping Switch - OFF
 - b. Radar Man Switch - PPI NS
39. FLIR Control Panel:
 - a. Mode Select Switch - OFF
 - b. Bias & Contrast Knobs - CCW
40. EVS Video Select Switch - OFF
41. STV Control Panel:
 - a. MLC Gain Knob - OFF
 - b. Mode Switch - OFF
 - c. BIT Switch - NORM

RADAR NAVIGATOR'S CHECKLIST (NONNUCLEAR WEAPONS) (Cont)**42. BNS Data Preset Panel:**

- a. Gyro Erect Switch - HI
- b. Gyro Latitude Indicator Set Knob - Set local latitude
- c. Present Position Switch - OFF
- d. Doppler Wind Switch - OFF

43. AOU Panel:

- a. Function Switch - RESET
- b. Offset Selector Switch - DIRECT
- c. Multi Tgt-Norm Switch - NORM
- d. Read-Open Lever - OPEN
- e. Card Reader Cover - Closed

44. Radar Recording Camera:

- a. Camera Date Plate - Completed

EXAMPLE:

HOLBROOK
IR-144
30 Jun 71
8196
SMITH, C.S.

high release

low release

- b. Clock - Set to GMT

45. Crew Report - Completed (at pilot's request)

- a. The sequence for crew reporting is as follows: N, G, EW, RN, CP, P, IN, DI, 10th, and IP.
- b. Switch to call and report, "Radar navigator's check complete." Check consists of abandon signal and call operation.

46. Oxygen Regulator - OFF and 100% OXYGEN (if leaving the aircraft for an extended period of time)**AFTER ENGINE START****CAUTION**

After engine start, do not turn the BNS or EVS on until after being notified by the copilot that the generators are on the line and cooling air is available.

1. BNS Turn-On:

- a. Ground Blowers Switch - ON

RADAR NAVIGATOR'S CHECKLIST (NONNUCLEAR WEAPONS) (Cont)

- b. Terrain Computer Power Switch - ON
- c. Radar Power Switch - ON

CAUTION

The rate switch on the terrain radar control panel must be OFF prior to turning the radar power switch ON or damage to the BNS radar receiver-transmitter can occur.

- d. BNS Power Switch - ON
2. EVS Environmental Power Switches - ON

CAUTION

The environmental control systems are to be operated at all times during flight to prevent condensation within the turrets, even though the sensor itself may not be turned on or a dummy sensor is installed.

3. FLIR Mode Select Switch - OPR

FLIR turret rotates from stow position to view position. The OPR light will illuminate and when the detectors have reached operating temperatures (30 minutes maximum after turn-on), the READY light should illuminate, indicating FLIR is in normal operating mode.

4. Press-to-Test Lights:

- a. Tone On Indicator Light - Tested
- b. Overheat Power Supply, BNS Low Airflow (2), & Radar Pressure Low (2) Lights - Tested
- c. Bomb Door Control Valve Lights - Tested
- d. Low Altitude Calibration Panel Alt Cal Warning Light - Tested
- e. APN-150 No Go Light - Tested
- f. EVS Monitor Overheat Light - Tested

5. EVS Video Select Switch - STV

Azimuth and elevation scale are displayed provided the brightness and contrast knobs on the EVS monitor have not been rotated full CCW.

6. EVS Monitor - Adjusted

With the contrast knob fully CCW, rotate the brightness knob CW until monitor illumination is visible and then rotate CCW until monitor illumination just disappears. Rotate contrast knob CW until optimum presentation of the azimuth and elevation scales is displayed.

7. STV Control Panel:

- a. Mode Switch - STBY
Standby light should come on
- b. HI SENS/HI RES Switch - HI RES
- c. ALC FULL/ALC 1/4 Switch - ALC FULL

RADAR NAVIGATOR'S CHECKLIST (NONNUCLEAR WEAPONS) (Cont)

d. BIT Switch - LL

e. Mode Switch - OPR

The operate light will come on after standby light has been on no longer than 30 seconds. View EVS monitor for normal display. Fiducial marks and preamplifier noise will be displayed.

CAUTION

If "target crossover" (an abnormal brightening or blooming) occurs on the EVS monitor, rotate mode switch to STBY, since further operation will damage the STV camera. After brightening or blooming disappears from monitor, rotate mode switch to OFF.

f. BIT Switch - NORM

STV turret rotates from stow position to view position and STV scene appears.

CAUTION

Point sources of high intensity illumination, relative to the overall scene illumination, which remain stationary within the field of view of the STV, may cause damage to the STV camera assembly. During operation on the ground, precautions should be taken to eliminate stationary sources of high intensity illumination (ramp lights, reflections from objects, vehicle headlights, etc.) from within the field of view prior to continued operation of the STV in the operate mode. The camera assembly is protected from this type of damage in standby mode.

g. EVS Monitor - Adjusted

Adjust contrast for optimum display.

NOTE

Readjustment of the monitor will normally be required only when significant ambient light changes occur.

8. EVS Indicator Lights - Tested

Actuate the symbols switch on EVS video select panel to LAMP TEST and press lamp test switch on STV control panel, FLIR control panel, and EVS steering control panel to check all indicator lights.

9. Symbols Switch - SYMBOLS ON

Numerics and markers are displayed.

10. AOU Panel:

a. Reset Light - ON

b. EXEC Button - Depressed

While the EXEC button is depressed, check the RESET, UPDATE, and PGLD lights are on, and the LONG, LAT, and ELEV indicators for proper indication. The lights should go out and the indicators blank when the EXEC light is released.

RADAR NAVIGATOR'S CHECKLIST (NONNUCLEAR WEAPONS) (Cont)

- c. Reset, Update, and PGLD Lights - OFF

NOTE

- If the PGLD light remains on, accomplish the "AOU Initial Program Load" Checklist.
- If mission data program has not previously been inserted, omit steps "d" thru "h."

- d. Function Switch - SLEW
- e. Target Number (As desired) - Dialed
- f. EXEC Button - Depressed
- g. Tgt Display Indicator - Checked
- h. Function Switch - ACTIVE
11. Radar Tune-Up:
- a. Test Meter Selector Switch - Checked -300, +120, +300
All readings should be 50 (± 2).
- b. Centering Check - Completed
- c. Circularity Check - Completed
- d. Radar Recording Camera & Crosshair - Checked (RN-N)
Check operation of camera (O-32 mode sel switch in R) and movement of crosshair in search and track (full scan and off-center scan).
- e. Radar Recording Camera Power Switch - OFF (RN-N)
- f. Plane Above Sea Level Indicator (H_A) - Set field elevation or lower limit using H_{CAL}
Place selector switch to H_{CAL} and hold set control knob depressed until H_A stabilizes before setting.
- g. Radiate Button - Depressed (after standby light illuminates)
Check clear to radiate prior to depressing button. Check that radiate light illuminates.

WARNING

- Ground operation of radar transmitters is prohibited within 200 feet of (1) weapons which are not fully assembled, (2) weapons to which continuity testers are connected, or (3) weapons with open access doors.
- The BNS radar should not be in radiate when the aircraft is within 200 feet of any ground refueling operation or open fuel tank.
- The area in line with the radiation of a nonrotating BNS radar antenna is hazardous to personnel. For this reason, do not stop the antenna while the BNS radar is in radiate operation.

RADAR NAVIGATOR'S CHECKLIST (NONNUCLEAR WEAPONS) (Cont)

- h. Radar Indicator - Adjusted and checked

Adjust and check antenna tilt and scope presentation.

12. Gyro Leveling Check:

- a. Stab Bypass Switch - OFF
- b. Gyro Erect Switch - NORM
- c. Erect Cutoff Light - Off

If erection cutoff light illuminates, switch to high erect and perform gyro leveling check at a later time.

13. Preset Data:

The navigator may assist the radar navigator as desired.

- a. Present Position Indicators - Set
- b. Destination 1 & 2 Indicators - Set
- c. Wind Indicators - Set zero
- d. T_F & L - Set

Set approximate values for first bomb release.

AOU INITIAL PROGRAM LOAD

NOTE

If the PGLD light remained on after step "10" of the AFTER ENGINE START checklist, accomplish the following:

- 1. PGLD Light - ON
- 2. Function Switch - PGLD
- 3. Card Reader Cover - OPEN
- 4. IPL Card Number 1 - Inserted
- 5. Read-Open Lever - READ
- 6. EXEC Button - Depressed
- 7. Read-Open Lever - OPEN
- 8. Target Number Indicator - Checked
- 9. IPL Card - Removed

NOTE

Accomplish steps "4," "5," "7," "8," and "9" for each subsequent IPL card. IPL cards 2 thru 8 must be loaded in numerical sequence. For cards 2 thru 63, the target number indicator will increase one number as each card is read.

RADAR NAVIGATOR'S CHECKLIST (NONNUCLEAR WEAPONS) (Cont)

10. End Card - Inserted
11. Read-Open Lever - READ
12. Data Display Indicators - Blank
13. Read-Open Lever - OPEN
14. End Card - Removed
15. Card Reader Cover - Closed
16. Function Switch - ACTIVE
17. PGLD Light - OFF

BEFORE TAKEOFF**CAUTION**

- BNS turn-on should be accomplished prior to taxi to prevent damage to gyros.
- Monitor the overheat and low airflow warning lights and the BNS temperature sensing indicator during all low engine power operation. If warning indications appear, refer to Section IX, T.O. 1B-52G-1-6-1 for corrective action.

NOTE

If BNS, EVS, and AOU are on, omit steps "1" thru "6."

1. EVS - ON (immediately after aircraft power on and stabilized)
 - a. Environmental Power Switches - ON
 - b. EVS Video Select Switch - STV
 - c. FLIR Mode Select Switch - OPR
 - d. STV Mode Switch - OPR
2. AOU Function Switch - RESET
3. BNS Turn-On:
 - a. Ground Blowers Switch - ON
 - b. Terrain Computer Power Switch - ON
 - c. Radar Power Switch - ON

CAUTION

The RATE switch on the Terrain Radar Control Panel must be OFF prior to turning the radar power switch ON or damage to the BNS radar receiver-transmitter can occur.

- d. BNS Power Switch - ON

RADAR NAVIGATOR'S CHECKLIST (NONNUCLEAR WEAPONS) (Cont)

4. AOU Panel:

- a. Reset Light - ON
- b. EXEC Button - Depressed

While the EXEC button is depressed, check the RESET, UPDATE, and PGLD lights are on, and the LONG, LAT, and ELEV indicators for proper indication. The lights should go out and the indicators blank when the EXEC light is released.

- c. Reset, Update, and PGLD Lights - OFF

NOTE

- If the PGLD light remains on, accomplish the "AOU Initial Program Load" checklist.
- If mission data program has not previously been inserted, omit steps "d" thru "h."

- d. Function Switch - SLEW
- e. Target Number (As desired) - Dialed
- f. EXEC Button - Depressed
- g. Tgt Display Indicator - Checked
- h. Function Switch - ACTIVE

5. Radiate Button - Depressed (after standby light illuminates)

Check clear to radiate prior to depressing button, Check that radiate light illuminates.

WARNING

- Ground operation of radar transmitters is prohibited within 200 feet of (1) weapons which are not fully assembled, (2) weapons to which continuity testers are connected, or (3) weapons with open access doors.
- The BNS radar should not be in radiate when the aircraft is within 200 feet of any ground refueling operation or open fuel tank.
- The area in line with the radiation of a nonrotating BNS radar antenna is hazardous to personnel. For this reason, do not stop the antenna while the BNS radar is in radiate operation.

6. Radar Indicator - Adjusted and checked

Adjust and check antenna tilt and scope presentation.

7. EVS Video Select Switch - FLIR (if applicable) (RN/N)

When the READY light on the FLIR control panel is illuminated, adjust the FLIR bias and contrast knobs for optimum display.

8. EVS Video Select Switch - STV/FLIR (RN-N)

The radar navigator and navigator should monitor opposite sensors during takeoff and departure.

RADAR NAVIGATOR'S CHECKLIST (NONNUCLEAR WEAPONS) (Cont)

9. Parachute & Safety Belt - Fastened

WARNING

- Tighten the parachute survival kit attachment straps as tightly as possible to prevent the safety belt from inflicting facial injuries during ejection bailout.
- Insure that the parachute arming lanyard is not entangled in the parachute harness. Lanyard entanglement could cause failure in seat separation and failure of the automatic features of the parachute.

NOTE

If it becomes necessary to leave the seat, the crew member should open the safety belt and unbuckle the parachute harness, leaving the parachute and survival kit in the seat. If the parachute is worn when leaving the seat, upon returning to the seat, it will be necessary to take it off in order to reinstall the parachute and safety belt in the seat.

10. Pin No. 1 - Removed
11. Ejection Control Trigger Ring - Unstowed
12. Oxygen Regulator - As required
13. Bailout Bottle - Connected
14. Takeoff Report - As required

Copilot announces over interphone, "Crew, stand by for takeoff." Acknowledgement not required unless some discrepancy exists that may compromise successful completion of the mission.

15. Standby Button - Depressed (wet takeoff)

CAUTION

Place BNS radar to standby prior to activation of the water injection boost pumps to reduce the electrical load and the possibility of generator power surge.

TAKEOFF

1. Acceleration Timing - Checked (navigator backup)

As the pilot announces, "Now," at 70 knots, start the stopwatch. If navigator is unable to check acceleration timing, announce over interphone, "Coming up on _____ seconds," approximately 3 seconds prior to S₁ time. At S₁ time, announce, "Now."

I RADAR NAVIGATOR'S CHECKLIST (NONNUCLEAR WEAPONS) (Cont)

2. BNS Data Preset Panel:

- a. Doppler Wind Switch - ON
- b. Present Position Switch - ON
- c. Gyro Erect Switch - NORM

3. Emergency Controls Panel:

- a. TAS Switch - OFF
- b. Stab Bypass Switch - OFF

AFTER TAKEOFF

1. Radiate Button - Depressed, light on (wet takeoff)

2. Plane Above Sea Level Indicator (H_A) - Adjusted

Adjust the BNS altitude during climb as necessary.

3. 12,000-Foot Oxygen Check - Completed (G-RN-P/CP)

- a. During the climb, copilot requests an oxygen check at 12,000 feet. The sequence for oxygen report is gunner, radar navigator, pilot/copilot. The reporting crew member will visually check other crew member for alertness. He will report oxygen check for both positions. Oxygen panel at each occupied crew position will be checked on all oxygen checks for:

- (1) Oxygen Supply Shutoff Lever - ON
- (2) Regulator Diluter Lever - As required
- (3) Pressure - 300 psi
- (4) Flow Indicator - Functions normally
- (5) Emergency Toggle Lever - NORMAL

- b. Gunner, radar navigator, and pilot/copilot report, "Oxygen panels checked." In addition, pilot/copilot reports, "Cabin altitude _____ feet."

- c. Copilot requests oxygen check at level-off and during cruise at 1-hour intervals when cabin altitude is below 12,000 feet, at 30-minute intervals when cabin altitude is 12,000 to 25,000 feet, and at no longer than 10-minute intervals when cabin altitude is above 25,000 feet. If cabin altitude is below 12,000 feet, only the pilot/copilot will report. The remaining crewmembers will check their equipment and report if abnormal

MISSION DATA PROGRAM LOAD

- 1. Reset Light - OFF
- 2. PGLD Light - OFF
- 3. Card Reader Cover - OPEN

RADAR NAVIGATOR'S CHECKLIST (NONNUCLEAR WEAPONS) (Cont)

4. Mission Data Card - Inserted
5. Read-Open Lever - READ
6. Data Display Indicators - Checked
7. Read-Open Lever - OPEN
8. Mission Data Card - Removed

NOTE

Accomplish steps "4" thru "8" for each mission data card.

9. Card Reader Cover - Closed
10. Function Switch - SLEW
11. Target Number (As desired) - Dialed
12. EXEC Button - Depressed
13. Tgt Display Indicator - Checked
14. Function Switch - ACTIVE

AFTER LEVEL-OFF

1. BNS - Set

Assure the proper setting of altitude, wind, present position, and destination indicators for accurate route navigation.

2. EVS Video Select Switch - FLIR (RN/N)

Adjust FLIR bias and contrast knobs for optimum display. The FLIR must be adjusted frequently throughout flight to provide an optimum display.

3. EVS - As required

Place FLIR mode select switch, STV mode switch, and video select switch to STBY whenever EVS is not in use. If the EVS system is not to be used for several hours, turn FLIR mode select switch and STV mode switch to OFF.

AOU PROCEDURES

TARGET/OFFSET VERIFICATION

1. Display Target & Offsets Stored Data (if required):
 - a. Function Switch - DISP
 - b. Target Number (As desired) - Dialed
 - c. EXEC Button - Depressed
 - d. Target Display Indicator - Checked

RADAR NAVIGATOR'S CHECKLIST (NONNUCLEAR WEAPONS) (Cont)

- e. Coordinate Display Indicators - Checked
- f. Offset Thumbwheel - As required
- g. Coordinate Display Indicators - Checked

NOTE

Accomplish steps "b" and "d" thru "g" for each target and offset to be verified. Targets and offsets need be verified only once during the mission for each synchronous target.

TARGET/OFFSET CHANGE/INSERTION

1. Display Target/Offset Stored Data:
 - a. Function Switch - DISP
 - b. Target and Offset Number - Dialed
 - c. EXEC Button - Depressed
2. Function Switch - UPDATE
3. UPDATE Light - ON
4. Offset Thumbwheel - As required
5. Target/Offset Latitude - Dialed (if required)
6. EXEC Button - Depressed
7. Target/Offset Longitude - Dialed (if required)
8. EXEC Button - Depressed
9. Offset Elevation - Dialed (if required)
10. EXEC Button - Depressed
11. Coordinate Display Indicators - Checked

NOTE

Accomplish steps "1" thru "11" for each target/offset to be changed or manually inserted.

12. Function Switch - ACTIVE

RADAR NAVIGATOR'S CHECKLIST (NONNUCLEAR WEAPONS) (Cont)

BEFORE DESCENT

1. FLIR/STV Mode Switches - OPR

The FLIR will not be in a ready state for approximately 30 minutes.

2. EVS Video Select Switch - STV/FLIR (RN-N)

The radar navigator and navigator should monitor opposite sensors during penetration and for all approach and landing patterns.

3. T_F & L - Zero and locked

Set T_F and L to zero using the set control knob on the emergency controls panel and leave the T_F and L switches ON.

4. AOU Panel:

- a. Target Display Indicator - Checked (if required)

If offsets are available for the approach end of the runway, insure that the desired target is displayed by use of either the SLEW function or the ADV/RET switch.

- b. Function Switch - ACTIVE

5. Target Above Sea Level Indicator - Set runway elevation

6. Burst Point Above Target Indicator - Zero

7. Nonnuclear Weapons Safety Checklist:

NOTE

If nonnuclear weapons are aboard or have been released; a safety check must be accomplished.

- a. Normal Release & Jettison Power Circuit Breakers - Out
 - b. Release Circuits Disconnect - Disconnected
 - c. Master Bomb Control Switch - OFF
 - d. Bombing System Switch - MANUAL
 - e. Readiness Switch Cover - Closed, latched (clip-in) (RN-P)
 - f. Special Weapons Lock Indicators - Indicate locked (clip-in)
 - g. DCU-9/A Selector Switches - OFF (clip-in)

RADAR NAVIGATOR'S CHECKLIST (NONNUCLEAR WEAPONS) (Cont)

DESCENT AND BEFORE LANDING

CAUTION

Monitor the overheat and low airflow warning lights or BNS temperature sensing indicator. If necessary, request that power be advanced on at least one engine (usually No. 4) to keep the cabin low airflow lights out.

1. Penetration & Approach - Reviewed (P-CP-RN-N)

Review the planned penetration and approach. This review will include navigation aid frequencies, minimum and emergency safe altitudes, descent rates, minimums for the approach to be flown, missed approach procedures, and aerodrome sketch. As a minimum the pilot flying the approach will brief the crew on the descent rate, MDA/DH/VDP and missed approach procedures for the planned approach. Lost communications procedures will be coordinated if required. During the descent and approach other crewmembers will back up the pilot flying and report any deviation from prescribed procedures.

2. BNS Radar Frequency - As required

Retune the BNS radar frequency to the high or low end of the frequency band to avoid PAR interference.

3. Initial Point - Made good

The radar navigator will coordinate with pilot in monitoring or directing aircraft path to the VOR station or any other reference point to be used for initiating the penetration, arriving over the point on the desired heading for initial descent.

4. Penetration - Initiated

Upon reaching point of initial penetration, the jet penetration as published in the Flight Information Publication will be initiated. Monitor or direct aircraft path over the ground and advise the pilot of any deviation from published penetration.

5. Penetration & Approach Altitudes - Monitored

6. Crosshair - Positioned

Place crosshair on offset aimpoint or the approach end of runway with the inner edge of the range marker on the edge of no return.

a. Track Button - Depressed

Monitor aircraft path over the ground and advise pilot of any departure from prescribed penetration.

b. Bomb Control Heading Switch - BOMB

RADAR NAVIGATOR'S CHECKLIST (NONNUCLEAR WEAPONS) (Cont)

7. Plane Above Sea Level Indicator (H_A) - Set

Upon reaching traffic pattern altitude, if terrain is level, true altitude can be determined by adding radar altimeter altitude to H_T . If true altitude cannot be determined, set altitude as indicated by the pressure altimeter.

8. Traffic Pattern - Monitored or directed

Monitor or direct the aircraft throughout the approach pattern being flown, advising the pilot of any deviation noted or discrepancies between the approach and airborne radar. Navigator will monitor altitude throughout the pattern.

9. FCI - Centered (on final approach)

Upon completing the turn onto the final approach, the radar navigator will reposition the crosshair on the approach end of the runway or offset aim point. If it is a directed approach, the FCI and time to go indicator will be used to make the final approach. If it is a monitored approach, the FCI and time to go indicator may be cross-checked by the pilot to determine progress on final approach.

10. Final Descent - Initiated

The descent phase normally will be commenced when ground range is 8 NM from approach end of runway. Altitude should be checked at 100 seconds (1000 feet altitude) and 60 seconds (600 feet altitude). The time to go indicator will read zero when the aircraft is approximately 1000 feet down the runway.

11. Emergency Controls Panel:

The following steps will be accomplished prior to touchdown or during the final phase of a low approach to prevent excessive chattering of the dials. These switches may be left ON for subsequent approaches.

- a. H_A Switch - ON
- b. TAS Switch - ON

AFTER LANDING

CAUTION

Monitor the overheat and low airflow warning lights or BNS temperature sensing indicator. If necessary, turn equipment off.

1. Intensity Knob - CCW
2. Receiver Gain Knob - CCW
3. Video Knob - CCW

RADAR NAVIGATOR'S CHECKLIST (NONNUCLEAR WEAPONS) (Cont)

4. Standby Button - Depressed
5. STV Mode Switch - STBY (as required)

Place the mode switch to standby during periods of darkness to avoid damage to the camera assembly.

CAUTION

Point sources of high intensity illumination, relative to the overall scene illumination which remains stationary within the field of view of the STV, may cause damage to the STV camera assembly. During operation on the ground, precautions should be taken to eliminate stationary sources of high intensity illumination (ramp lights, reflections from objects, vehicle head lights, etc.) from within the field of view prior to continued operation of the STV in the operate mode. The camera assembly is protected from this type of damage in standby mode.

6. AOU Panel:
 - a. Multi Tgt-Norm Switch - NORM
 - b. Offset Selector Switch - DIRECT
 - c. Function Switch - RESET
7. Ejection Control Trigger Ring - Stowed
8. Pin No. 1 - Installed

MISSION DATA ERASE

1. Reset Light - OFF
2. PGLD Light - OFF
3. Function Switch - ERASE
4. Erase Code (-9999999) - Dialed
5. EXEC Button - Depressed
6. Coordinate Display Indicators - Blank
7. Function Switch - RESET

AFTER PARKING

1. Ejection Seat - Position forward and up
2. BNS Power Switch - OFF
3. BNS Heaters Switch - OFF
4. Terrain Computer Power Switch - OFF
5. Radar Power Switch - OFF

RADAR NAVIGATOR'S CHECKLIST (NONNUCLEAR WEAPONS) (Cont)

6. Ground Blowers Switch - OFF

CAUTION

Do not turn ground blowers switch off until doppler radar system power switch is turned off.

7. FLIR Control Panel:

- a. Contrast and Bias Knobs - CCW
- b. Mode Select Switch - OFF

8. STV Control Panel:

- a. MLC Gain Control - OFF
- b. Mode Switch - OFF

9. EVS Video Select Switch - OFF

10. EVS Environmental Power Switches - OFF

11. Inform Pilot - BNS and EVS off

12. Bomb Indicator Lights Switch - OFF

13. Interphone - Disconnected after engines off

14. Oxygen System:

- a. Regulator - OFF and 100% OXYGEN
- b. Supply Hose & Interphone Cord - Stowed

15. Compass & True Heading Computer Cutoff Switch - OFF

16. Nonnuclear Weapons Aboard - Install shackle locking pins for each weapon (RN/N)

RN/N perform if qualified personnel are not available.

WARNING

External power will not be applied until step "16" has been completed.

RADAR NAVIGATOR'S AND NAVIGATOR'S BOMBING PROCEDURES (NONNUCLEAR WEAPONS)

BOMBING — GENERAL

On training missions after practice weapons have been released, a crewmember will make a visual check of the bomb bay prior to STR runs, camera attacks, or landing. This is to insure that all weapons have been released and that there are no objects that could fall from the bomb bay when the bomb doors are opened. On strike missions, a visual check of the bomb bay will be accomplished prior to landing if the tactical/fuel/recovery situation permits.

Proper usage of the nonnuclear weapons release system is described in T.O. 1B-52D-34-2-1, Section I. If a release over any authorized area cannot be accomplished, release system power will be isolated and the aircraft will proceed by a safe route to the briefed base.

Prior to making any bomb runs, the BNS true heading will be checked using the automatic astrocompass/AGM-69A CAE on headings as close as possible to the planned bomb run headings. This heading error will be recorded. If the automatic astrocompass/AGM-69A CAE are inoperative, these heading checks will be made with the periscopic sextant. If, for any reason, it is impossible to obtain a heading check on or near the bomb run heading, the best available true heading correction will be applied to the BNS true heading for the bomb run.

The radar navigator will advise the pilot to center the FCI during the bomb run. If desired, BNS steering may be requested.

The navigator will monitor all phases of the bomb run. He will indicate to the radar navigator any apparent errors in crosshair placement, proper use of offset, GPI coordinate settings, timing, and release headings. Switch positions, warning lights, the MD-1, AGM-69A CAE, and doppler will be continuously checked and the radar navigator advised as necessary. The navigator will record all pertinent bombing data.

When the status of the BNS is such that a radar synchronous bomb run cannot be accomplished, the crew will refer to Volume IX, SACM 55-21 for emergency bombing procedures.

RADAR NAVIGATOR'S AND NAVIGATOR'S BOMBING CHECKLIST (NONNUCLEAR WEAPONS)

BOMBING SYSTEMS CHECK

NOTE

- This check will normally be performed after level-off but may be performed prior to level-off to meet operational requirements but must always be completed prior to "Nonnuclear Weapons Preparation for Release."

- It is imperative that the following steps be completed in sequence.

1. Safety Check: (RN) Monitor (N)

- a. Bombing System Switch - MANUAL
- b. Special Weapons Lock Indicators - Indicate locked (clip-in)
- c. Release Circuits Disconnect - Disconnected
- d. Master Bomb Control Switch - OFF
- e. Notify crew "Safety check complete."

2. Bombing Equipment Check: (RN)

- a. Normal Release Circuit Breaker - Out
- b. Circuit Breakers - Checked, set
- c. BRIC - TRAIN, zero, light off
- d. BNS Hand Control Sensing Switch - LOS
- e. Crosshair - Positioned

Position crosshair along the heading of the aircraft a sufficient distance to permit completion of equipment check.

- f. Bomb Button - Depress
- g. Heading Error Indicator - Checked (RN-P)

Using crosshair control handle, deflect steering needle both sides of center and then to zero. Request pilot to simultaneously observe the flight command indicator for proper movement.

- h. BNS Steering - Requested (RN-P)
- i. BNS Steering Check - Completed

Using crosshair control handle, check for response of the aircraft to a turn. Release crosshair control handle; aircraft should return to straight and level flight and steering needle should center. Repeat for a turn in the opposite direction.

RADAR NAVIGATOR'S AND NAVIGATOR'S BOMBING CHECKLIST (NONNUCLEAR WEAPONS) (Cont)

j. Offset Checks - Completed

Check offsets and observe that crosshair is correctly displaced.

k. Time-to-Go Indicator - Checked for drive (RN-P)

Request pilot call TG at 25 second intervals and at TG Zero.

l. Bomb Release Check:

(1) Time-to-Go Indicator - Indicates zero

When the time-to-go indicator equals zero, the BDI TG = 0 light may not illuminate for this check.

(2) Search/Track Button - Depress

m. BNS Hand Control Sensing Switch - As desired

3. Crew notified "Bombing system check completed."

NONNUCLEAR WEAPONS PREPARATION FOR RELEASE (RN-N)

NOTE

- Perform this checklist not later than 15 minutes prior to the Pre-IP (high deliveries), or not later than 15 minutes prior to descent (low deliveries).
- It is imperative that the following steps be completed in sequence.

1. Before Ground Directed Bombing Tactics:

NOTE

This check must be accomplished only for Ground Directed Bombing Tactics.

- a. Beacon Transponder Power Switch - ON (N)
- b. Beacon Transponder Mode Switch - As briefed (N)
- c. Beacon Transponder Function Switch - STBY (N)
- d. APN-69 Power Switch - STBY (N)
- e. BNS Frequency Control Switch - Decrease (set lower limit) (RN)
2. Walkway Lights Circuit Breakers - Out (RN)
3. Exterior Lights - As required (RN-P)
4. Normal Release & Jettison Power Circuit Breakers - In (RN)
5. Special Weapons Manual Lock Handle - Pulled and stowed (clip-in) (RN-EW)
6. Readiness Switches - READY (clip-in) (RN-P)
7. DCU-9/A Selector Switches - GND (clip-in) (RN)

RADAR NAVIGATOR'S AND NAVIGATOR'S BOMBING CHECKLIST (NONNUCLEAR WEAPONS) (Cont)

8. Special Weapons Lock Indicators - Indicate unlocked (clip-in) (RN)
9. Bomb Indicator Lights - On: Off, tested (clip-in) (RN)
10. Special Weapons Select Switch - FWD (RN)
11. Bomb Release Mode Selector Switch **B-52 1** - As briefed (RN)

WARNING

If high drag weapons/mines are carried, the bomb mode selector switch must be in NORMAL position to prevent weapon drafting and collisions.

12. BRIC: (RN)
 - a. BRIC Switch - As briefed
 - b. BRIC Counter - As briefed
 - c. BRIC Light - Dim

CAUTION

A steady bright light will indicate internal shorting of the B-3C BRIC. If this malfunction occurs, do not attempt release using the BNS or D-2. An armed release can be accomplished using the "Emergency Release Checklist."

- d. BRIC Interval - As briefed

WARNING

If high drag weapons/mines are carried, observe BRIC minimum interval restrictions in T.O. 1B-52D-34-2-1, figure 4-2.

HIGH ALTITUDE

BEFORE PRE-IP

The following checklist will be accomplished within 1 hour of the Pre-IP.

1. Altitude Measurement - Completed (RN)
2. Bombing Data Form - Completed and cross-checked (RN-N)
3. Bombing Data
 - a. Ballistics Derivatives Indicators - Set (N)
 - b. Preset Knots - Set (RN)

RADAR NAVIGATOR'S AND NAVIGATOR'S BOMBING CHECKLIST (NONNUCLEAR WEAPONS) (Cont)

- c. Preset Height of Fall - Set (RN)
 - d. Burst Point Above Target - Set (RN)
 - e. T_F - Set (RN)
 - f. L - Set (RN)
 - g. Targets/Offsets - Verified/Inserted (RN/N)
Not required if previously accomplished.
 - h. HA - Adjusted (RN)
4. Gyro Latitude Indicator Set Knob - Set (RN)
 5. Optional Bombing Procedures - Accomplished (wet snow only) (RN)
 6. Bomb Run Review:

NOTE

- Accomplish within 1 hour prior to pre-IP or after receipt of bombing information.
- If aircraft position is changed after the accomplishment of bomb run review, reaccomplish steps a, b, c, and d.

NAV CALLS	RESPONSE
a. "Bombing Procedures"	"_____ " (RN)
b. "Radio Monitor Plan"	"_____ " (CP)
c. "Emergency Bombing Procedures"	"_____ " (RN)
d. "Cell Color and Position"	"_____ " (N)
e. "Stop Release Time"	"_____ " (N)
f. "Post Release Turn"	"Hold heading _____ seconds, Turn L/R to _____ MH. Use a _____ °Bank Angle" (N)
g. "Review Code Words"	

BEFORE IP

1. Circuit Breakers - Checked (RN)
2. IBDA Power Switch - OFF (RN)
3. Bomb Indicator Lights Switch - ON (RN)
4. Special Weapons Select Switch - FWD (RN)
5. Bomb Release Mode Selector Switch **B-52 1** - As briefed (RN)

RADAR NAVIGATOR'S AND NAVIGATOR'S BOMBING CHECKLIST (NONNUCLEAR WEAPONS) (Cont)

6. Bomb Data Check:

RN CALLS	NAV RESPONSE
a. "Ballistics Derivatives"	"Reads _____"
b. "Preset Knots"	"Reads _____"
c. "Burst Point Above Target"	"Reads _____"
d. "Preset Height of Fall"	"Reads _____"
e. "T _F and L"	"Reads _____ and _____"

7. BRIC:

NAV CALLS	RN RESPONSE
a. "BRIC Switch"	As briefed
b. "BRIC Counter"	As briefed
c. "BRIC Light"	"Dim"

CAUTION

A steady bright light will indicate internal shorting of the B-3C BRIC. If this malfunction occurs, do not attempt release using the BNS or D-2. An armed release can be accomplished using the "Emergency Release Checklist."

- | | |
|--------------------|------------|
| d. "BRIC Interval" | As briefed |
|--------------------|------------|

WARNING

If high drag weapons/mines are carried, observe BRIC minimum interval restrictions in T.O. 1B-52D-34-2-1, figure 4-2.

8. Radar Recording Camera: (N)

- a. Power Switch - ON
- b. Selector Switch - 1:4

9. Release Circuits Disconnect Door - Open (RN)

10. Beacon Transponder Function Switch - As required (N)

11. Vertical Camera Intervalometer Power Switch - As required (N)

12. Target Above Sea Level Indicator - Set target altitude (RN)

RADAR NAVIGATOR'S AND NAVIGATOR'S BOMBING CHECKLIST (NONNUCLEAR WEAPONS) (Cont)

LOW ALTITUDE

BEFORE DESCENT

1. EVS STV/FLIR Mode Switches - OPR (approximately 30 minutes prior to descent) (RN)
2. Inflight TA Functional Check - Accomplished (RN-N)
3. Circuit Breakers - Checked (RN)
4. IBDA Power Switch - OFF (RN)
5. Bomb Indicator Lights Switch - ON (RN)
6. Special Weapons Select Switch - FWD (RN)
7. Bomb Release Mode Selector Switch **B-52 1** - As briefed (RN)
8. BRIC:

NAV CALLS	RN RESPONSE
a. "BRIC Switch"	As briefed
b. "BRIC Counter"	As briefed
c. "BRIC Light"	"Dim"

CAUTION

A steady bright light will indicate internal shorting of the B-3C BRIC. If this malfunction occurs, do not attempt release using the BNS or D-2. An armed release can be accomplished using the Emergency Release Checklist.

- | | |
|--------------------|------------|
| d. "BRIC Interval" | As briefed |
|--------------------|------------|

WARNING

If high drag weapons/mines are carried, observe BRIC minimum interval restrictions in T.O. 1B-52D-34-2-1, figure 4-2.

RADAR NAVIGATOR'S AND NAVIGATOR'S BOMBING CHECKLIST (NONNUCLEAR WEAPONS) (Cont)

9. Radar Recording Camera: (N)

- a. Power Switch - ON
- b. Selector Switch - 1:12

10. FRL Angle-of-Attack Indicator - Set (N); Cross-checked (RN)

Set the FRL angle of attack indicator for the predicted conditions at the TA calibration point, reference figure 8-2. The FRL angle of attack will have to be reset periodically during TA flight due to changes in aircraft gross weight and/or airspeed.

NOTE

- The FRL angle of attack should be updated to maintain the set-in value accurate within 0.2° .
- The FRL angle of attack values should be computed for zero airbrakes, or as required.

11. Bombing Data Form - Completed and cross-checked (RN-N)

12. TA Calibration Altitude - Computed and cross-checked (RN-N)

Forecast altimeter setting and "D" values from PMSV will be used.

13. Bombing Data:

- a. Preset Height of Fall - Set (RN)
- b. T_F - Set and locked (RN)
- c. L - Set and locked (RN)
- d. Targets/Offsets - Verified/inserted (RN/N)

Not required if previously accomplished.

14. Bombing Data Check:

RN CALLS

- a. " T_F "
- b. "L"

NAV RESPONSE

"Reads _____"

"Reads _____"

15. Initial Level-Off Indicated Altitude - Determined (RN-N)

RADAR NAVIGATOR'S AND NAVIGATOR'S BOMBING CHECKLIST (NONNUCLEAR WEAPONS) (Cont)

16. Bomb Run Review:

NOTE

- Accomplish within 1 hour prior to descent or after receipt of bombing information.
- If aircraft position is changed after the accomplishment of bomb run review, reaccomplish steps a, b, c, and d.

NAV CALLS	RESPONSE
a. "Bombing Procedures"	"_____ " (RN)
b. "Radio Monitor Plan"	"_____ " (CP)
c. "Emergency Bombing Procedures"	"_____ " (RN)
d. "Cell Color and Position"	"_____ " (N)
e. "Stop Release Time"	"_____ " (N)
f. "Post Release Turn"	"Hold heading _____ min/sec. Turn L/R to _____ MH to S/C Pt _____:" (N)
g. "Review Code Words"	

DESCENT AND AFTER DESCENT

1. Altimeter - Set _____ (P-CP-N)

Compute a level-off altimeter setting using metro or inflight "D" values. PMSV or ARTC altimeter settings will be used if available. Reset altimeter to station pressure immediately prior to initiating penetration or upon passing through transition altitude.

2. EVS Video Select Switch - STV/FLIR (RN-N)

The radar navigator and navigator should monitor opposite sensors during the low level navigation leg. The FLIR bias and contrast knobs must be adjusted frequently to ensure an optimum FLIR display during low level flight.

3. Descent Point - Pilot notified (N)

4. Altitude Calls - Accomplished (N)

Coordinate with the pilot as to level-off altitude(s) to be used for descent and entry to the low altitude navigation leg. Navigator calls off altitude to the pilot every 5000 feet commencing at 15,000 feet MSL. Upon reaching level-off altitude plus 2000 feet, report altitude to the pilot every 1000 feet and at level-off altitude. Altitude calls will be made by stating the passing altitude and the intended level-off altitude. Coordinate with the pilot as to proper heading and altitude to be used during the low altitude navigation leg at each change of heading and/or altitude.

5. Altitude Measured (if applicable) - Accomplished (RN)

Level off momentarily and measure altitude at as low an altitude as practical if over reasonably level terrain of known elevation. Measure altitude with the low altitude calibrator unit (below 5000 feet absolute altitude).

RADAR NAVIGATOR'S AND NAVIGATOR'S BOMBING CHECKLIST (NONNUCLEAR WEAPONS) (Cont)

6. Doppler RF Power Switch - LOW (N)

The doppler RF power switch will be positioned to LOW prior to descending through 2000 feet above the terrain and will remain in LOW until the aircraft climbs above 2000 feet.

7. Level Off at IFR Altitude/Emergency Minimum Safe Altitude - Accomplished (P-CP-RN-N)

NOTE

For descent into Low Altitude High Speed Routes (VFR), initial level off should be made at the planned emergency minimum safe altitude for that segment.

8. Radar Altimeter Indicators, Pressure Altimeters & H_A Indicator - Cross-checked (P-CP-RN-N)

The navigator will state terrain elevation. The pilot will then read the indications of his radar altimeter and pressure altimeter. The copilot, radar navigator, and navigator will cross-check their instruments for proper indications and respond "cross-checked". If the IFR altitude/emergency minimum safe altitude exceeds 5000 feet absolute altitude (radar altimeter capability), the cross-check must be made as soon as a lower absolute altitude permits.

9. Altimeters - Reset (P-CP-N)

Forecast altimeter setting obtained from PMSV will be used for TA calibration.

10. Level Off at TA Calibration Altitude - Accomplished (P-CP-RN-N)

For flat terrain checks level-off will be accomplished at 800 feet on the radar altimeter. For peak checks (and flat terrain checks with an inoperative radar altimeter) level off at the computed pressure altitude which is based upon 800 feet above the calibration terrain feature or point.

11. Radar Altimeter Indicators & Pressure Altimeters - Cross-checked (P-CP-RN-N)

The navigator will state terrain elevation. The pilot will then read the indications of his radar altimeter and pressure altimeter. The copilot, radar navigator, and navigator will cross-check their instruments for proper indications and respond "cross-checked." If the IFR altitude/emergency minimum safe altitude exceeds 5000 feet absolute altitude (radar altimeter capability), the cross-check must be made as soon as a lower absolute altitude permits.

12. TA Calibration - Accomplished (P-CP-RN-N)

NOTE

- Terrain trace breakup with fly-up command may occur when the AN/ALQ-117 is transmitting and the TA is operated in any mode other than PRO-3.
- The radar navigator will be responsible for monitoring altitude and position during the TA calibration checks.
- The radar navigator is responsible for monitoring terrain beyond the range selected on the pilots' EVS monitors. The radar navigator will alert the pilot when approaching the preselected calibration area and will make a 10-mile range call. On peak calibration checks, the radar navigator will make range calls at 6, 5, 4, 3, and 2 miles. Refer to Sections II and IV for calibration procedures.
- The navigator will record all readings made by the pilot during this check on the calibration work sheet and announce the corrections to be applied.

RADAR NAVIGATOR'S AND NAVIGATOR'S BOMBING CHECKLIST (NONNUCLEAR WEAPONS) (Cont)

13. Altimeters - Reset (P-CP-N)

Current altimeter setting obtained by radio from nearby FSS radios will be used. If unable to obtain FSS altimeter setting while at low level, use PMSV forecast altimeter setting. During strike missions, set and maintain true altitude in the altimeters. True altitude will be determined from an altitude measurement if possible; otherwise use the predicted "D" value converted to an altimeter setting.

NOTE

If over reasonably level terrain of known elevation, and if absolute altitude is less than 5000 feet, true altitude may be determined by adding the radar altimeter reading to terrain elevation.

14. TA System Error Compensation - Accomplish if applicable (N/RN)

If a system error exists, the TA system error compensation procedures in Section IV should be accomplished, time and/or conditions permitting. Normally a minimum of 60 miles will be required prior to commencing the bomb run to facilitate accomplishment of calibration and error compensations, if required. If time and/or conditions do not allow the necessary compensation procedures to be accomplished, the published IFR altitude will be maintained. In any event, in-flight calibration data and TA system error computations will be recorded on the calibration work sheet.

15. FRL & FVR Stabilization Modes - Compared (P/CP-RN)

After tilt compensation is applied (if required), radar navigator select LO ALT TA mode and pilot/copilot select FRL stabilization. Radar navigator fades a return at 6 miles and notes clearance plane setting, then pilot/copilot selects FVR stabilization and radar navigator fades the same terrain feature and notes clearance plane setting. This comparison should be made at approximately 800 feet absolute altitude above the terrain faded. Compare the clearance plane settings and if they do not differ more than 400 feet, then select FVR stabilization for TA low level flight. If the clearance plane settings differ by more than 400 feet, then FRL stabilization must be used for TA low level flight.

16. Plane Above Sea Level Indicator (H_A) - Low altitude calibrate (RN)

Low altitude calibrate using low altitude calibrate unit.

17. Final Descent to TA Altitude - Monitored (RN-N)

NOTE

- Radar navigator and navigator will monitor radar scope presentations. The navigator will monitor all other instruments available.
- The radar navigator provides terrain assessments beyond the pilot's range. When hazardous terrain is observed, the radar navigator will continue to advise pilot until pilot is tracking obstacle on his indicator.

RADAR NAVIGATOR'S AND NAVIGATOR'S BOMBING CHECKLIST (NONNUCLEAR WEAPONS) (Cont)

BEFORE IP (LOW)

1. Plane Above Sea Level Indicator (HA) - Set level-off true altitude (RN)
2. Target Above Sea Level Indicator - Set (RN)
3. Target Area Altimeter Setting - Set (P-CP-N)

Pressure altimeters may be calibrated using radar altimeters if time and conditions permit.

4. Gyro Latitude Indicator Set Knob - Set latitude of target (RN)
5. Radar Recording Camera Selector Switch - 1:4 (N)
6. Heading Systems - Cross checked (RN/N)
7. Release Circuits Disconnect Door - Opened (RN)
8. FRL Angle of Attack Indicator - Updated (N); crosschecked (RN)

BOMB RUN (SYNCHRONOUS)

1. AOU Panel: (RN)
 - a. Target Display Indicator - Checked

Insure that the desired target is displayed by use of either the SLEW function or the ADV/RET switch.

- b. Function Switch - ACTIVE
2. Target or Offset - Acquired (RN)
3. Bomb Button - Depressed (RN)
4. FCI - Centered (ADF as required) (RN-P)
5. Pilot's Bombs-Released Light - OFF, tested (RN-P)

If the pilot's bombs-released light is illuminated, attempt to reset the BRIC by moving the BRIC switch to SEL, then to TRAIN and ZERO, then back to briefed setting. Presence of a release pulse will be confirmed if the B-3C BRIC light is on bright.

WARNING

Completion of the bomb run check through RCD closure with the pilot's bombs-released light illuminated could result in immediate release of weapons.

NOTE

If the pilot's bombs-released light is illuminated and the BRIC cannot be reset, training missions do not attempt release. Combat missions complete step "6" and release using the "Emergency Release Checklist."

RADAR NAVIGATOR'S AND NAVIGATOR'S BOMBING CHECKLIST (NONNUCLEAR WEAPONS) (Cont)

6. Release Configuration Check:

NOTE

When releases are to be made on a designated bombing range, do not perform this check until the aircraft is on the range.

NAV CALLS	RN RESPONSE
a. "Special Weapons Lock Indicators" (clip-in only)	"Indicate unlocked"
b. "Master Bomb Control Switch"	"ON, light on"
c. "Bombing System Switch"	"AUTO/MANUAL" (as required by special instructions)
d. "Bomb Door Control Valve Lights"	"OFF"

7. Ready to Release Check:

NAV CALLS	RN RESPONSE
a. "Stop watch started"	As required
b. "RCD"	"Connected, light on"

WARNING

When live/inert weapons are carried and the bomb doors are opened manually or external weapons are loaded, the RCD will be connected no earlier than 10 seconds TTG on the first release and disconnected after last release/launch on that bomb run.

NOTE

To withhold release or interrupt an initiated release, immediately disconnect the RCD and proceed to "Post Release Checklist."

- | | |
|--------------------------------|------------------------|
| c. Bomb Door Opening Monitored | Bomb Doors Open (RN/P) |
|--------------------------------|------------------------|

NOTE

If doors fail to open automatically, place the bombing system switch in MANUAL and attempt opening with bomb door open switch.

WARNING

- If the Bomb Door Not Latched Light is illuminated or there is an indicated bomb release, do not open bomb doors. Refer to the "Emergency Release Checklist."
- If the pilot's bombs released light is illuminated or the B-3C BRIC light is on bright, do not open bomb doors. Refer to the "Emergency Release Checklist."

RADAR NAVIGATOR'S AND NAVIGATOR'S BOMBING CHECKLIST (NONNUCLEAR WEAPONS) (Cont)

8. Bomb Release Monitored - "Bombs away" (RN-P)

NOTE

- Combat mission only -- If a bomb release indication is not received immediately after illumination of the bomb release light, actuate the D-2 release switch.
- If applicable, the navigator will continue countup from release to "Stop Release Time." At action words "Stop Release," the RN will disconnect the RCD.

BOMB RUN (ALTERNATE)

1. Pilot's Bombs-Released Light - Off, tested (RN-P)

If the pilot's bombs-released light is illuminated, attempt to reset the BRIC by moving the BRIC switch to SEL, then to TRAIN and ZERO, then back to briefed setting. Presence of a release pulse will be confirmed if the BRIC light is on bright.

WARNING

Completion of the bomb run check through RCD closure with the pilot's bombs-released light illuminated could result in immediate release of weapons.

NOTE

If the pilot's bombs-released light is illuminated and the BRIC cannot be reset, training missions do not attempt release. Combat missions complete step 3 and release using the "Emergency Release Checklist."

2. Heading Corrections/Timing - Accomplished (as required) (RN-N)

3. Release Configuration Check:

NOTE

When releases are to be made on designated bombing ranges, do not perform this check until the aircraft is on the range.

NAV CALLS

RN RESPONSE

- | | |
|--|---------------------|
| a. "Special Weapons Lock Indicators"
(clip-in only) | "Indicate unlocked" |
| b. "Master Bomb Control Switch" | "ON, light on" |
| c. "Bombing System Switch" | "MANUAL" |
| d. "Bomb Door Control Valve Lights" | "OFF" |

4. Ready to Release Check:

NAV CALLS

RN RESPONSE

- | | |
|--------------------------------|-------------|
| a. "Standing by 60 Seconds TG" | "60 TG" |
| b. "Stopwatch Started" | As required |

RADAR NAVIGATOR'S AND NAVIGATOR'S BOMBING CHECKLIST (NONNUCLEAR WEAPONS) (Cont)

c. "RCD"

"Connected, light on"

WARNING

When live/inert weapons are carried and the bomb doors are opened manually or external weapons are loaded, the RCD will be connected no earlier than 10 seconds TTG on the first release and disconnected after last release/launch on that bomb run.

NOTE

To withhold release or interrupt an initiated release, immediately disconnect the RCD and proceed to the "Post Release Checklist."

d. "Bomb Doors"

"Opened" (As briefed)

WARNING

- If the bomb door not latched light is illuminated or there is an indicated bomb release, do not open the bomb doors. Refer to the "Emergency Release Checklist."
- If the pilot's bombs-released light is illuminated or the B-3C BRIC light is on bright, do not open the bomb doors. Refer to the "Emergency Release Checklist."

5. Bomb Release Time/Signal:

"HACK"

WARNING

Crew will ensure that release of weapons is not initiated prematurely when hearing the word "HACK" pertaining to other aircraft.

- a. D-2 Bomb Release Switch - Actuated (RN)
- b. Bomb Release Monitored - "Bombs Away" (RN-P)

NOTE

The navigator will continue countup from release to "Stop Release Time." At action words "Stop Release," the RN will disconnect the RCD.

POST RELEASE/ABORT (NONNUCLEAR)

Accomplish immediately after weapon release or abort/withhold (RN); assure accomplishment of checks (N)

WARNING

Following any attempted release or jettison, any weapon that does not separate from the aircraft should be considered armed and susceptible to inadvertent release during landing impact. See "Internal Hung Bomb Procedures Checklist," Section III of T.O. 1B-52D-34-2-1.

1. Release Circuits Disconnect - Disconnected (RN)

RADAR NAVIGATOR'S AND NAVIGATOR'S BOMBING CHECKLIST (NONNUCLEAR WEAPONS) (Cont)

2. Bomb Doors - Closed (RN)



Do not cycle bomb doors until a bomb bay check has been performed.
If hung bombs are discovered, comply with "Internal Hung Bomb Procedures Checklist," Section III of T. O. 1B-52D-34-2-1.

3. Beacon Transponder Power Switch - OFF (N)
4. Track Button - Depressed (RN)
5. Master Bomb Control Switch - OFF (RN)
6. Applicable Bomb Indicator Lights - OFF: ON (clip-in) (RN)
7. AOU Panel: (RN)
- a. Multi Tgt-Norm Switch - As required
 - b. Offset Selector Switch - As required

8. Radar Recording Camera Switches - As required (N)
9. Vertical Camera Doors - Closed (N)
10. Doppler RF Power Switch - As required (N)

Doppler RF power switch will be positioned to NORM after the aircraft climbs above 2000 feet above the terrain.

NOTE

- If further release attempts are to be made, proceed to the Before Pre-IP, Before IP, and the appropriate bomb run checklists.
- Accomplish the remaining items only when no further releases are to be made.

11. Normal Release and Jettison Power Circuit Breakers - Out (RN)
12. BRIC - TRAIN, zero, light off (RN)
13. DCU -9/A Selector Switches - OFF (clip-in) (RN)
14. Readiness Switch Cover - Closed, latched (clip-in) (RN-P)
15. Special Weapons Manual Lock Handle - Locked (clip-in) (RN-EW)
16. Special Weapons Lock Indicators - Indicate locked (clip-in) (RN)
17. Walkway Lights Circuit Breakers - IN (RN)
18. Exterior Lights - As required (RN-P)
19. Vertical Camera Intervalometer Power Switch - OFF (N)
20. APN-69 Power Switch - As required (N)

NAVIGATOR'S CHECKLIST (NONNUCLEAR WEAPONS)

BEFORE EXTERIOR INSPECTION (POWER OFF)

1. Readiness Switch Cover - Closed, latched (clip-in) (RN)
2. Special Weapons Manual Lock Handle/Door - Stowed/Closed (clip-in) (RN)
3. Ejection Trigger Ring - Stowed, pin No. 1 installed (RN-N)

Check that ejection trigger ring is properly seated in detent.

WARNING

If the ejection trigger ring is not properly seated in the detent, call maintenance and ascertain status of arming initiator before continuing seat inspection.

4. Forward & Rear Special Weapon Manual Release Handles - Stowed (clip-in) (RN)
5. Release Circuits Disconnect - Disconnected (RN)
6. Circuit Breaker Panels: (RN/N)
 - a. Normal Release & Jettison Power Circuit Breakers - Out
 - b. ADM-20 Launch Control, Cart No. 1, Cart No. 2, and Actuator Circuit Breaker - OUT

CAUTION

Failure to open the launch control, Cart No. 1, Cart No. 2, and Actuator Circuit breaker places a potential electrical hazard in the ADM-20C relay box assembly.

- c. All Other Circuit Breakers & Fuses - In
7. DCU-9/A Selector Switches - OFF (clip-in) (RN)
8. FLIR Turret Air and STV Turret Air Switches - OFF (RN)

WARNING

Lethal voltages may exist on the FLIR turret window and the electrical cable routed to the STV turret if the switches are in the ON position when power is applied.

EXTERIOR INSPECTION (POWER OFF) (RN/N)

WARNING

- The bomb door actuator struts must be disconnected before entering the bomb bay if power is applied to the aircraft.
- To prevent personnel injury in the event of inadvertent actuation of the release system, the following checks will be accomplished prior to any power (aircraft or external) being applied to the aircraft.

NOTE

If any discrepancies are found, notify MMS personnel.

NAVIGATOR'S CHECKLIST (NONNUCLEAR WEAPONS) (Cont)

1. General Condition of Bomb Bay - Checked

Check for fuel and hydraulic leaks and security of equipment (include check of walkways for loose objects).

Clip-In

2. MB-3A Bomb Rack Lockpins (Lower Only) - Inserted
3. General Condition of Bombs/Mines - Checked
4. Arming Wires & Fuzes - Checked

Visually check that arming wires are properly inserted in fuze/arming assemblies and that retaining clips (Fahnestock/beryllium) are installed when applicable.

Cluster

2. General Condition of Bombs/Mines - Checked
3. Arming Wires & Fuzes - Checked

Visually check that arming wires are properly inserted in nose fuze/arming assemblies and that retaining clips (Fahnestock/beryllium) are installed when applicable.

4. Shackle Locking Pin(s) - Removed, counted, and stowed

There should be a locking pin for each shackle.

WARNING

- Prior to removing any shackle locking pin, insure that the A-5/A-6 release is cocked and the B-11 shackle release lever is mated with the release arm of the A-5/A-6 release.
- Removal of the shackle-locking pin from a loaded shackle with the A-5/A-6 release uncocked and/or the B-11 shackle release lever in the release position, will result in an immediate release of the weapon.
- If undue resistance is encountered when removing any shackle locking pin, the aircrew will cease further action and call MMS personnel.

INTERIOR INSPECTION

1. Equipment - Stowed

WARNING

Insure that no equipment is stowed on or near the lower deck heating ducts and outlets, electrical wiring, or electronic equipment.

NAVIGATOR'S CHECKLIST (NONNUCLEAR WEAPONS) (Cont)

2. Lower Deck Spare Parachute Preflight:

a. Inspection Record:

- (1) Inspection & Repack Date - Checked
- (2) Automatic Release Time & Altitude Setting - Checked

b. Bailout Bottle Pressure & Hose Connector - Checked

c. Personal Locator Beacon Lanyard - Snapped/Unsnapped (as required)

For peacetime operations, the personal locator beacon lanyard must be configured for automatic operation. When mission requirements dictate the necessity to avoid detection and automatic actuation of the beacon is not desired, the lanyard must be configured for nonautomatic (manual) operation.

d. Parachute - Unbuckled and stowed

Spare parachute will be unbuckled and stowed in an easily accessible location.

3. IN Oxygen Regulator - OFF and 100% Oxygen (IN not flying)

4. Lower Deck Fire Extinguisher - Checked

Insure that appropriate safety device (safety wire/seal or locking pin/lever, as applicable) is installed. Check for fully serviced pressure.

5. Sight Reduction Tables - Checked (if applicable)

When tables are stowed aboard aircraft, check that all three volumes are current.

6. Interphone - Connected

7. Oxygen System:

- a. Regulator Diluter Lever - 100% OXYGEN
- b. Shutoff Lever - OFF
- c. Mask & Hose - Check disconnect, then reconnect

Check for 10- to 20-pound pull for disconnect, then reconnect mask and hose.

NAVIGATOR'S CHECKLIST (NONNUCLEAR WEAPONS) (Cont)

d. Diluter Valve - Checked

Attempt to draw air through the oxygen mask. Ability to draw air indicates a defective diluter valve, oxygen hose and/or connections or mask. Then place the diluter valve to NORMAL position, draw air through the mask, if unable, this would indicate that only 100% oxygen will be available.

NOTE

- If the diluter valve is stuck in the 100% position, this will prohibit the detection of smoke or fumes when use of normal oxygen is required.
- If the CRU-73A regulator is installed, the crew member will not be able to draw air through the system with the shutoff lever OFF. The diluter lever may be moved to NORMAL with the shutoff lever OFF on some CRU-73A regulators. The diluter valve will be in the 100% oxygen position when the shutoff lever is OFF on all CRU-73A regulators.

e. Shutoff Lever - ON

f. Pressure - Checked

Pressure gage reads approximately 300 psi.

g. Emergency Toggle Lever - TEST MASK

With mask disconnected at one side of helmet, the flow indicator should indicate continuous flow.

h. Mask - Test

Attach mask to helmet and hold breath; indicator should indicate no flow.

NOTE

Flow condition may be indicated by a slight leak around the face form. If light hand pressure against the mask does not stop the flow, the mask is unacceptable.

i. Emergency Toggle Lever - NORMAL

j. Regulator Diluter Lever - NORMAL/100% (as required)

8. N-1 Compass Master Indicator:

a. Latitude Correction Pointer - OFF

b. Synchronizer Knob - Synchronize N-1

9. True Heading System Panel:

a. Mag-Syn-Gyro Switch - MAG

NAVIGATOR'S CHECKLIST (NONNUCLEAR WEAPONS) (Cont)

- b. Bias or Syn Knob - Zero bias indicator

NOTE

Magnetic variation indicator may drift due to lack of excitation from the BNS.

10. Automatic Astrocompass Power Filter Switch - Checked OFF
11. Heading Select Switch - TRUE HEAD COMPUTER
12. Doppler Vertical Reference Switch - NORMAL
13. Doppler Drift Switch - ON
14. Doppler RF Power Switch - NORM
15. 5-Inch Indicator:
 - a. Video Knob - CCW
 - b. Intensity Knob - CCW
 - c. Marker Knob - CCW
16. EVS Video Select Switch - OFF
17. Ejection Seat & Escape Hatch:

WARNING

- Carefully check to insure that no streamer has been torn from a maintenance safety pin, thus inadvertently leaving the pin installed.
 - If a maintenance safety pin is installed, the status of the seat will be ascertained prior to removal of the pin.
- a. Catapult Pin-Pull Initiator - Pin No. 4 removed, link to hatch secure
 - b. Table Stowage Initiator - Checked
Inspect initiator for condition, installation, and tubing connected.
 - c. Manual Catapult Initiator Safety Pin-Pull Handle - Secure
Handle should be properly seated below left leg guard.
 - d. Initiator Tube Runs - Checked connected
Check tube runs for proper and secure connections.

NAVIGATOR'S CHECKLIST (NONNUCLEAR WEAPONS) (Cont)

- e. Catapult Initiator Safety Pin-Pull Cylinder - Checked

Catapult initiator safety pin must extend all the way through the catapult initiator. If pin is pulled out, initiator may have been fired.

- f. Arming Initiator & Control Linkage - Checked, pin No. 3 removed

Check maintenance safety pin No. 3 removed. Inspect initiator for condition, installation, and tubing connected.

- g. Ankle Restraints - Checked

Inspect ankle restraints for proper operation and stow in downward position.

- h. Emergency Escape Hatch - Secure

Check that the paint stripe on lockpin is visible beyond the shield or that the lockpin overlaps the shoulder on the lockarm by 1/4 inch.

- i. Table Stowage Thruster & Tubing - Checked

- j. Drogue Parachute Support Arm Release Initiator - Checked, pin No. 5 removed

Check maintenance safety pin No. 5 removed. Inspect initiator for condition, installation, and tubing connected.

- k. Inertia Reel - Checked

Check inertia reel lock for proper functioning.

18. Man-Seat Separator - Checked

Insure that the nylon man-seat separator straps are placed on the bare seat. Survival kit is then placed over man-seat separator straps.

19. Parachute Preflight:

- a. Inspection Record:

(1) Inspection & Repack Date - Checked

(2) Automatic Release Time & Altitude Setting - Checked

- b. Personal Locator Beacon Lanyard - Snapped/Unsnapped (as required)

For peacetime operations, the personal locator beacon lanyard must be configured for automatic operation. When mission requirements dictate the necessity to avoid detection and automatic actuation of the beacon is not desired, the lanyard must be configured for nonautomatic (manual) operation.

NAVIGATOR'S CHECKLIST (NONNUCLEAR WEAPONS) (Cont)

- c. Bailout Bottle Pressure & Hose Connector - Checked
- d. Parachute Arming Lanyard Anchor - Installed

WARNING

Be certain that the parachute arming lanyard anchor is securely fastened in the attachment fitting on the seat. Failure to attach the lanyard anchor to the seat will necessitate manual operation after ejection.

- e. Parachute Straps - Adjusted (as required)
20. Global Survival Kit:
- a. Kit Installed & Plunger Depressed - Checked
 - b. Kit Release Handle - Checked down
 - c. Mode Selector Lever - AUTO
 - d. Kit Straps to Parachute - Checked and attached

Check that attachment fittings are properly connected to the kit, the attachment straps threaded through the safety belt, and the quick-disconnect fittings are properly attached to the parachute (with release buttons on outside).

WARNING

Care must be taken to insure that the survival kit attachment straps are properly threaded through the safety belt.

- 21. Safety Belt Release Fittings - Connected
- 22. Shoulder Strap Attaching Fittings - Connected
- 23. Doppler Radar Silence Switch - SILENT

NAVIGATOR'S CHECKLIST (NONNUCLEAR WEAPONS) (Cont)

- 24. Doppler Radar System Power Switch - OFF
- 25. Radar Pressure Pump Control Switches - NORMAL ON
- 26. APN-69 Pressurization Switch - COMPRESSOR ON
- 27. APN-69 Low Pressure Warning Light - Off, tested
- 28. Vertical Camera Master Switch - ON (if required)
- 29. Vertical Camera Intervalometer:
 - a. Intervalometer Power Switch - OFF
 - b. Exposure Delay Control - Set (as briefed)
 - c. Exposure Interval Control - Set (as briefed)
 - d. Exposure Limiter Control - Set (as briefed)
- 30. APN-69 Power Switch - OFF (code set)
- 31. Ground Locks & Bypass Keys - Counted, stowed
Six locks and two keys.
- 32. Altimeter - Set
Set in accordance with AFM 51-40.

WARNING

When setting altimeter, special attention should be given to the altimeter to insure the 10,000-foot pointer is reading correctly.

- 33. Crew Report - Completed (at pilot's request)
 - a. The sequence for crew reporting is as follows: N, G, EW, RN, CP, P, IN, DI, 10th, and IP.
 - b. Switch to call and report, "Navigator's check complete." Check consists of abandon signal and call operation.
- 34. Oxygen Regulator - OFF and 100% OXYGEN (if leaving the aircraft for extended period of time)

BEFORE TAKEOFF

- 1. Entrance Door - Checked locked, folding hatch closed

A positive lock indication will be obtained by attempting to unlatch the door with the latch unlatch handle.

RADAR NAVIGATOR'S CHECKLIST (NONNUCLEAR WEAPONS) (Cont)

2. Pressure Bulkhead Door - Closed, latched, unlocked
3. Pressure Dump Handle - CLOSED, safetied
4. Oxygen Regulator - As required

NOTE

Accomplish following steps after BNS power switch ON.

5. Automatic Astrocompass:

CAUTION

The declination and SHA for Polaris are to be inserted into the No. 1 star data panel for astrocompass operation (including standby) between the latitudes of 0° and 75° N to reduce the potential of limits or "lock-up" damage to the altitude-azimuth computer.

- a. Star Selector Switch - OFF
- b. Rate Switch - SOL or SID
- c. Power Filter Switch - SUN or STAR

NOTE

There is a 2-minute delay before information may be preset and an additional 5-minute delay before the system can track. If the celestial coordinates for Polaris are not displayed in star data panel No. 1, they are to be inserted as soon as the 2-minute delay has elapsed.

- d. Lat-Long Switch - AUTO
6. Doppler Radar System Power Switch - ON

CAUTION

Do not turn doppler radar system power switch to ON position until cooling air is available and the ground blowers switch is ON.

7. EVS Symbols Switch - LAMP TEST, then SYMBOLS ON

Check BNS HDG light.

NAVIGATOR'S CHECKLIST (NONNUCLEAR WEAPONS) (Cont)

8. 5-Inch Indicator - Adjusted, checked

Accomplish as soon as the radar navigator has put the BNS radar in radiate operation.

9. Memory Point, Offset In and Bomb Function Lights - Tested
10. BDI TG = 0 & BNS Steering Lights - Tested
11. EVS Monitor Overheat Light - Tested
12. EVS Video Select Switch - STV

Azimuth and elevation scales, numerics, and markers are displayed provided the brightness and contrast knobs on the EVS monitor have not been rotated full CCW.

13. EVS Monitor - Adjusted

With contrast knob fully CCW, rotate the brightness knob CW until monitor illumination is visible and then rotate CCW until monitor illumination just disappears. Rotate contrast control CW until optimum presentation is displayed.

NOTE

Readjustment of the monitor will normally be required only when significant ambient light changes occur.

14. Automatic Astrocompass:

- a. Heading Correction - Set zero
- b. Clock - Set GMT

When set time comes up, switch to GHA and check for clock drive.

- c. GHA - Set

When set time comes up, switch to SHA and check GHA for drive.

- d. SHA & Dec - Set (Polaris coordinates in No. 1 star data panel)
- e. Star Selector Switch - As desired

15. APN-69 Power Switch - STDBY

16. Vertical Camera Doors - Closed, light out (after bomb bay doors are closed)

17. Vertical Camera Master Switch - OFF AND DOOR CLOSED (loaded magazine not installed)

18. EVS Video Select Switch - FLIR (if applicable) (RN/N)

When the READY light on the FLIR control panel is illuminated, adjust the FLIR bias and contrast knobs for optimum display.

19. EVS Video Select Switch - STV/FLIR (RN-N)

The radar navigator and navigator should monitor opposite sensors during takeoff and departure.

20. Flight Instruments - Rechecked and set (P-CP-N)

- a. Pilot, copilot, and navigator recheck their altimeters with a known elevation.
- b. Pilot, copilot, and navigator cross-check heading indicators and magnetic standby compass.

NAVIGATOR'S CHECKLIST (NONNUCLEAR WEAPONS) (Cont)

21. Parachute & Safety Belt - Fastened

WARNING

- Tighten the parachute survival kit attachment straps as tightly as possible to prevent the safety belt from inflicting facial injuries during ejection bailout.
- Insure that the parachute arming lanyard is not entangled in the parachute harness. Lanyard entanglement could cause failure in seat separation and failure of the automatic features of the parachute.

NOTE

If it becomes necessary to leave the seat, the crew member should open the safety belt and unbuckle the parachute harness leaving the parachute and survival kit in the seat. If the parachute is worn when leaving the seat, upon returning to the seat, it will be necessary to take it off in order to reinstall the parachute and safety belt in the seat.

22. Pin No. 1 - Removed

23. Ejection Control Trigger Ring - Unstowed

24. Bailout Bottle - Connected

25. Takeoff Data - Reviewed (P-CP-N)

TAKEOFF

1. Acceleration Timing - Checked

As the pilot announces, "Now," at 70 knots, start the stopwatch. Announce over the interphone, "Coming up on _____ seconds," approximately 3 seconds prior to S_1 time. At S_1 time, announce, "Now."

AFTER TAKEOFF

1. Doppler Radar Silence Switch - TRANSMIT

Place the doppler radar silence switch to TRANSMIT when attaining an altitude of approximately 200 feet above the ground.

2. APN-69 Power Switch - OPERATE (if required)

APN-69 should be placed in operation at takeoff whenever buddy refueling or cell tactics are to be employed.

3. Departure Plan - Monitored

Monitor aircraft position to assure adherence to planned departure.

4. Altitude & Airspeed - Monitored

Monitor altitude and airspeed for safe margin until aircraft has attained an altitude of 5000 feet above the terrain. Advise pilot if altitude falls below a safe margin or airspeed fails to show a positive increase. Upon reaching level-off altitude minus 2000 feet, report altitude to pilot every 1000 feet and at level-off altitude. Altitude calls will be made by stating the passing altitude and the intended level-off altitude.

NAVIGATOR'S CHECKLIST (NONNUCLEAR WEAPONS) (Cont)

5. Climb EPR Value - Computed (if requested)
6. AGM-69A System Power Application - As desired
7. 12,000-Foot Oxygen Check - Completed (G-RN-P/CP)
 - a. During the climb, copilot requests an oxygen check at 12,000 feet. The sequence for oxygen report is gunner, radar navigator, and pilot/copilot. The reporting crew member will visually check other crew member for alertness. He will report oxygen check for both positions. Oxygen panel at each occupied crew position will be checked on all oxygen checks for:
 - (1) Oxygen Supply Shutoff Lever - ON
 - (2) Regulator Diluter Lever - As required
 - (3) Pressure - 300 psi
 - (4) Flow Indicator - Functions normally
 - (5) Emergency Toggle Lever - NORMAL
 - b. Gunner, radar navigator, and pilot/copilot report, "Oxygen panels checked." In addition, pilot/copilot reports, "Cabin altitude _____ feet.
 - c. Copilot requests oxygen check at level-off and during cruise at 1-hour intervals when cabin altitude is below 12,000 feet, at 30-minute intervals when cabin altitude is 12,000 to 25,000 feet, and at no longer than 10-minute intervals when cabin altitude is above 25,000 feet. If cabin altitude is below 12,000 feet, only the pilot/copilot will report. The remaining crewmembers will check their equipment and report if abnormal.
8. Altimeter - Set 29.92 (P-CP-N)

AFTER LEVEL-OFF

1. Heading Select Switch - Best heading available
2. EVS Video Select Switch - FLIR (RN/N)

Adjust FLIR bias and contrast knobs for optimum display. The FLIR must be adjusted frequently throughout flight to provide an optimum display.
3. EVS Video Select Switch - STBY (as desired)

Place video select switch to STBY whenever EVS is not being used.
4. True Airspeed Indicators - Cross-checked

If more than a 10-knot difference exists, compute TAS. If the BNS true airspeed is in error by 10 knots or more, set BNS true airspeed with emergency controls panel.

BEFORE DESCENT

1. Heading Select Switch - TRUE HEAD COMPUTER
2. EVS Video Select Switch - STV/FLIR (RN-N)

The radar navigator and navigator should monitor opposite sensors during penetration and for all approach and landing patterns.

NAVIGATOR'S CHECKLIST (NONNUCLEAR WEAPONS) (Cont)

DESCENT AND BEFORE LANDING

1. Penetration & Approach - Reviewed (P-CP-RN-N)

Review the planned penetration and approach. This review will include navigation aid frequencies, minimum and emergency safe altitudes, descent rates, minimums for the approach to be flown, missed approach procedures, and aerodrome sketch. As a minimum the pilot flying the approach will brief the crew on the descent rate, MDA/DH/VDP and missed approach procedures for the planned approach. Lost communications procedures will be coordinated if required. During the descent and approach other crewmembers will back up the pilot flying and report any deviation from prescribed procedures.

2. Best Flare Speed - Computed and cross-checked with copilot

This item will be reaccomplished during the approach and landing phase and for all subsequent approaches and landings.

3. Altimeter - Set _____ (P-CP-N)

Reset altimeter to station pressure immediately prior to initiating penetration or upon passing through transition altitude. When mission requirements dictate and current altimeter setting is not available, compute an altimeter setting using metro or in-flight "D" values.

4. Descent Altitude Calls - Accomplish

- a. Coordinate with the pilot as to level-off altitude(s) to be used for descent and entry to landing pattern.
- b. Call off altitude to pilot every 5000 feet commencing at 15,000 feet. Upon reaching level-off altitude plus 2000 feet, report altitude to pilot every 1000 feet and at level-off altitude. Altitude calls will be made by stating the passing altitude and the intended level-off altitude.
- c. Announce approaching DH/MDA during all instrument approaches. This call should be made approximately 100 feet above the DH/MDA and will include the appropriate DH/MDA altitude (eg, "Approaching 363").

5. AGM-69A Shutdown:

CAUTION

Turn off master power within 2 minutes after system power shutdown to prevent overheat condition in the PDU.

- a. System Power Switch - OFF (momentarily), neutral lock
- b. System Power On Indicator - OFF
- c. MA PWR Switch/Master Power On Indicator Light - Depressed (momentarily), off

6. Automatic Astrocompass:

- a. Star Data Panel No. 1 - Polaris coordinates set
- b. Set Selector Switch - GHA
- c. Power Filter Switch - SUN
- d. Star Selector Switch - OFF
- e. Lat-Long Switch - MANUAL

NAVIGATOR'S CHECKLIST (NONNUCLEAR WEAPONS) (Cont)

7. Doppler Radar Silence Switch - SILENT

Place the doppler radar silence switch to SILENT when approximately 200 feet above the ground for low approaches and landings. For subsequent activity, the doppler may be left in SILENT.

AFTER LANDING

1. Vertical Camera Master Switch - OFF AND DOOR CLOSED

2. 5-Inch Indicator:

- a. Video Knob - CCW
- b. Intensity Knob - CCW
- c. Marker Knob - CCW

3. Radar Recording Camera:

- a. Expose 20 frames
- b. Power Switch OFF

4. APN-69 Power Switch - OFF

5. APN-69 Pressurization Switch - OFF

6. Ejection Control Trigger Ring - Stowed

7. Pin No. 1 - Installed

AFTER PARKING

1. Ejection Seat - Position forward and up

2. Doppler Radar System Power Switch - OFF

3. EVS Video Select Switch - OFF

4. Astro Power Filter Switch- POWER OFF

5. Oxygen System:

- a. Regulator - OFF and 100% OXYGEN
- b. Supply Hose & Interphone Cord - Stowed

6. Radar Pressure Pump Control Switches - OFF

7. Nonnuclear Weapons Aboard - Install shackle locking pins for each weapon

RN/N perform if qualified personnel are not available.

WARNING

External power will not be applied until step "7" has been completed.

GROSS WEIGHT	FLAPS DOWN 100%	
	BEST FLARE SPEED (AIR-BRAKES NO. 4)	MINIMUM TOUCH-DOWN
175,000	109	97
180,000	110	98
185,000	112	100
190,000	113	101
195,000	115	102
200,000	116	104
205,000	118	105
210,000	119	106
215,000	121	107
220,000	122	109
225,000	123	110
230,000	125	111
235,000	126	112
240,000	128	114
245,000	129	115
250,000	130	116
255,000	131	117
260,000	133	118
265,000	134	119
270,000	135	120
275,000	136	121
280,000	138	122
285,000	139	124
290,000	140	125
295,000	141	126
300,000	142	127
305,000	144	128
310,000	145	129
315,000	146	131
320,000	147	132
325,000	148	133
	BEST FLARE AIRBRAKES NO. 1	
330,000	137	134
335,000	138	135
340,000	140	136
345,000	141	137
350,000	142	138
355,000	143	139
360,000	144	141
365,000	145	142
370,000	146	143
375,000	147	144
400,000	152	146
425,000	156	151
450,000	161	155

DATA CONTAINED IN T.O. 1B-52G-1CL-2 AND T.O. 1B-52G-1CL-3.

Best Flare Speed (Knots IAS)

Computation Table

Figure 8-1.

MISSION DATA RECORDING PROCEDURES

1. High level.

- a. Flight data will be recorded on the chart or on a separate form. The information recorded must permit complete and accurate reconstruction of the mission. Minimum information will consist of time, true heading, true airspeed, and wind for each position or fix. These items may reflect average data since the last position or fix or may show the information used in computing a new true heading and ETA. A stamp with a format similar to that shown below may be used as an aid.

Time	
TC _____	TH _____ / _____
GS _____	TAS _____
W/V _____	ETA _____

- b. Positions and fixes will be indicated on the chart by appropriate symbols and time GMT. A fix or position is required at least every 30 minutes and at each turning point. This requirement is waived during departure, penetration, transition, holding patterns, fighter/bomber intercept areas, gunnery ranges, and instrument practice.
 - c. Altitude normally will be flown as planned. If a change is necessary, the new altitude will be recorded.
 - d. Pertinent observations will be noted with the time they take place.
- ### 2. Low level.
- a. The navigator must devote his major attention to maintaining course through scope interpretation and monitoring of equipment to maintain desired track during low level operations. Turbulence, frequent turn points, and added checklist activity may make recording difficult. In lieu of recording a fix symbol and required fix information, fix information will be recorded on the SAC Form 200/200A during low level operations. Record ATA's for each entry on the flight plan that has an ETA. During authorized deviations from route corridor, information will be recorded on the flight plan or chart so that airplane flight path and profile can be reconstructed.
 - b. Low level data recording procedures begin at the high altitude entry fix and terminate at the high altitude exit fix for the route being flown.
 - c. Compliance with these instructions provides adequate information for replot purposes.

INFLIGHT TA FUNCTIONAL CHECK (RN-N)

NOTE

- This check will be accomplished prior to descent to low level.
- This check must be accomplished prior to the pilots performing their 'In-flight TA Functional Check.'
- Photograph any unusual or abnormal radar displays with radar recording camera operating at every other scan for all phases of TA system operation.
- Notify pilot prior to performing this check.

1. Deleted

2. BNS Radar Meter Readings - Checked (RN)

Check BNS radar meter readings -300, +120, +300, MIX XTL #1 and #2, and AFC #1 and #2.

3. Radar Display Selector Switch - LO ALT TA (RN)

4. Terrain Test Panel: (RN)

The BNS radar must be in radiate mode while performing this check.

a. Terrain Test Selector Switch - Checked

Check meter readings +150, +150, -150, +300, +12, +50, and -12. All readings should read midscale plus or minus tolerance on meter.

b. Terrain Test Selector Switch - Checked XL1, XL2 then OFF

All readings should be three divisions or higher.

c. Radar Failure Warning Light - Checked

Place the BNS radar to standby and check that the radar failure warning light illuminates. Return BNS radar to radiate mode and check that radar failure warning light extinguishes.

INFLIGHT TA FUNCTIONAL CHECK (RN-N) (Cont)

5. Radar and Heading Drift Switch - OFF (N)

Place the radar and heading drift switch to OFF and check for a $170^{\circ} (\pm 5^{\circ})$ sector about heading marker on 10-inch radar indicator.

6. Radar and Heading Drift Switch - ON (N)

Note where edges of sector appear on 10-inch radar indicator scale, place radar and heading drift switch to ON. Note that the sector will shift by the amount of drift on doppler drift angle indicator.

7. Radar Display Selector Switch - HI ALT AJ1 (RN)

NOTE

- Pilots terrain display mode selector switch must be OFF during the AJ1 check.
- Ranges in excess of 75 miles should not be selected while in AJ1 mode because the video from the terrain computer is limited to 75 miles.

Adjust STC gain control and note that a satisfactory presentation is available.

8. Radar Display Selector Switch - As required (RN)

NOTE

SEA LEVEL TO 10,000 FEET
NO AIRBRAKES — FLAPS UP

INDICATED AIRSPEED — KNOTS

GROSS WEIGHT — 1000 LB	INDICATED AIRSPEED — KNOTS											
	220	250	280	290	300	315	325	340	350	370		
420	+2.3	+0.7	-0.4	-0.7	-1.0	-1.3	-1.5	-1.8	-2.0	-2.3		
410	+2.2	+0.6	-0.5	-0.8	-1.1	-1.4	-1.6	-1.9	-2.1	-2.4		
400	+2.0	+0.4	-0.6	-0.9	-1.2	-1.5	-1.7	-2.0	-2.1	-2.4		
390	+1.9	+0.3	-0.7	-1.0	-1.3	-1.6	-1.8	-2.0	-2.2	-2.5		
380	+1.7	+0.2	-0.8	-1.1	-1.4	-1.7	-1.9	-2.1	-2.3	-2.6		
370	+1.5	0.0	-1.0	-1.2	-1.4	-1.8	-1.9	-2.2	-2.4	-2.6		
360	+1.3	-0.1	-1.1	-1.3	-1.5	-1.8	-2.0	-2.3	-2.4	-2.7		
350	+1.2	-0.2	-1.2	-1.4	-1.6	-1.9	-2.1	-2.4	-2.5	-2.7		
340	+1.0	-0.3	-1.3	-1.5	-1.7	-2.0	-2.2	-2.4	-2.6	-2.8		
330	+0.8	-0.5	-1.4	-1.6	-1.8	-2.1	-2.3	-2.5	-2.6	-2.9		
320	+0.6	-0.6	-1.5	-1.7	-1.9	-2.2	-2.4	-2.6	-2.7	-2.9		
310	+0.4	-0.7	-1.6	-1.8	-2.0	-2.3	-2.4	-2.7	-2.8	-3.0		
300	+0.3	-0.9	-1.7	-1.9	-2.1	-2.4	-2.5	-2.7	-2.8	-3.0		
290	+0.1	-1.0	-1.8	-2.0	-2.2	-2.4	-2.6	-2.8	-2.9	-3.1		
280	0.0	-1.2	-1.9	-2.1	-2.3	-2.5	-2.7	-2.9	-3.0	-3.2		
270	-0.2	-1.3	-2.0	-2.2	-2.4	-2.6	-2.8	-2.9	-3.0	-3.2		
260	-0.4	-1.4	-2.1	-2.3	-2.5	-2.7	-2.8	-3.0	-3.1	-3.3		
250	-0.6	-1.5	-2.2	-2.4	-2.6	-2.8	-2.9	-3.1	-3.2	-3.4		
240	-0.8	-1.7	-2.3	-2.5	-2.7	-2.9	-3.0	-3.2	-3.3	-3.4		
230	-1.0	-1.8	-2.4	-2.6	-2.8	-2.9	-3.1	-3.2	-3.3	-3.5		
220	-1.1	-2.0	-2.6	-2.7	-2.8	-3.0	-3.2	-3.3	-3.4	-3.5		

- For gross weight and indicated airspeed values falling between the tabulated values. Use the nearest value listed.
- Use airbrake corrections in airbrake position 2 column when the inboard airbrake circuit breaker is pulled out and airbrake position 4 is selected per low altitude tactic in Section II.
- When flying with constant airspeed and a gross weight less than that used to compute the FRL settings, the use of airbrakes will tend to improve the accuracy of the TA system display by providing a more noseup angle of attack. At heavier gross weights, the use of airbrakes will tend to degrade the accuracy of the TA system display.
- There is no angle of attack correction required when AGM-69A wing pylons installed without missiles.
- Less than 7 external AGM-69A missiles or 7 or more external AGM-69A missiles installed on the aircraft wing pylons changes the angle of attack 0.1° and 0.2° respectively in the positive direction due to aircraft loss of lift when missiles are installed.

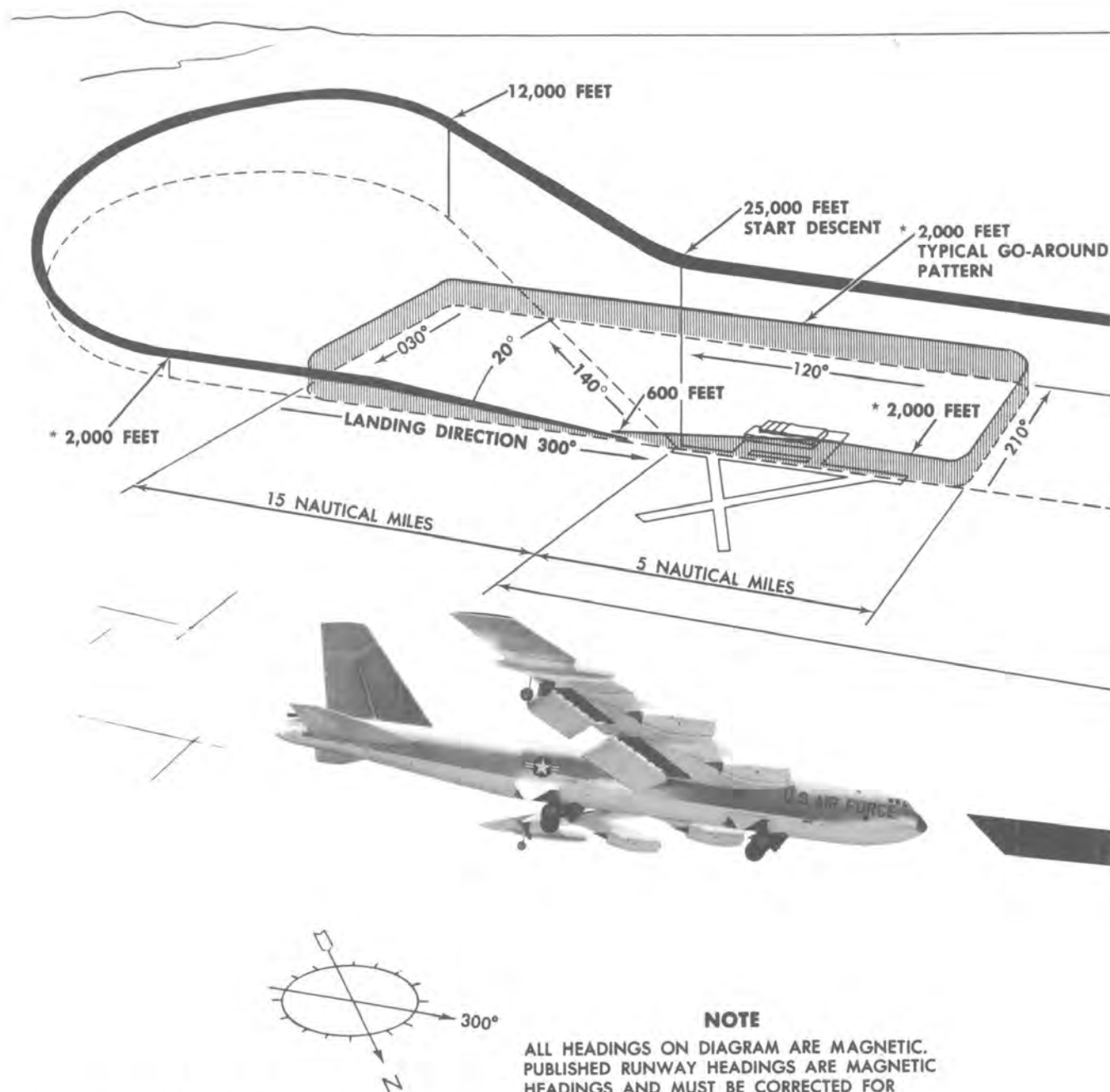
EXAMPLE:

If the aircraft gross weight (including 12 AGM-69A missiles) is 300,000 pounds, the angle of attack value at 260 knots indicated airspeed from the chart is -1.2° then add $+0.2^\circ$ correction for the missiles which results in an angle of attack setting of -1.0° .

INDICATED AIRSPEED KNOTS	AIRBRAKE CORRECTION	
	ADD THIS CORRECTION TO THE ANGLE OF ATTACK FROM THE TABLE	
	AIRBRAKE POSITION 2	AIRBRAKE POSITION 4
220	$+0.3^\circ$	$+0.7^\circ$
260 — 300	$+0.3^\circ$	$+0.6^\circ$
325 — 340	$+0.3^\circ$	$+0.5^\circ$
370	$+0.3^\circ$	$+0.4^\circ$

FRL Angle of Attack (Level Flight) Settings - Degrees

Figure 8-2.

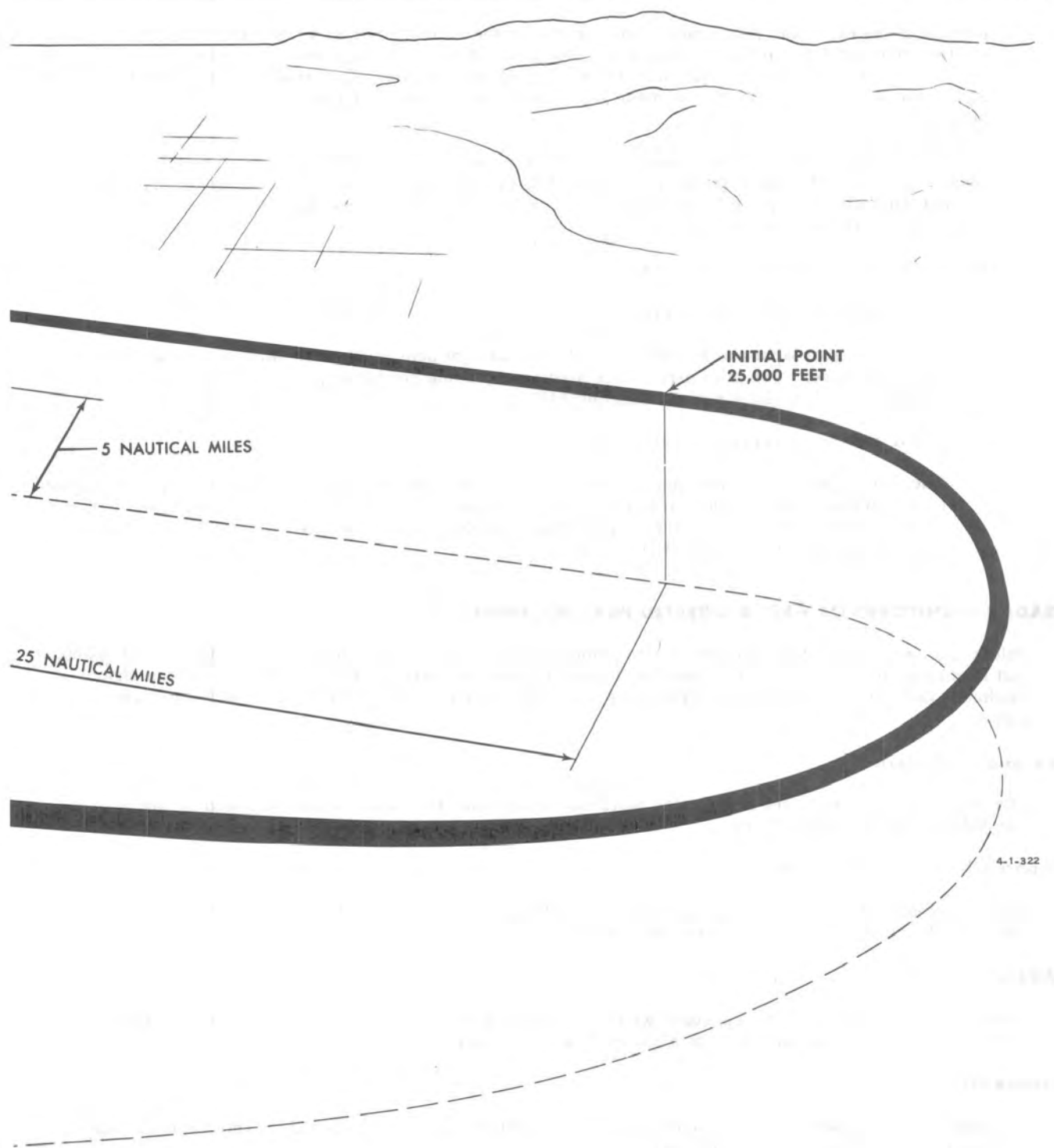


* 2,000 FEET ABOVE RUNWAY
OR 1,000 FEET ABOVE HIGH-
EST TERRAIN WITHIN FIVE
MILES.

NOTE

ALL HEADINGS ON DIAGRAM ARE MAGNETIC.
PUBLISHED RUNWAY HEADINGS ARE MAGNETIC
HEADINGS AND MUST BE CORRECTED FOR
VARIATION.

Figure 8-3 (Sheet 1 of 2).



Typical Radar Directed Emergency Approach

Figure 8-3 (Sheet 2 of 2).

AIRBORNE RADAR APPROACHES

1. In view of the fact that radar equipment installed in the airplane permits the radar navigator to monitor the position of the airplane constantly regardless of weather conditions or outside approach facilities, it is essential that the equipment be utilized during instrument approaches. In an emergency the equipment within the airplane will make it possible for the radar navigator to direct the pilot to a safe approach.
2. Radar navigators will properly monitor all letdowns and approaches regardless of type (i. e., VFR, GCA, ILS, etc) until the airplane is in the landing pattern and the pilot is definitely assured that visual contact with the runway can be maintained during the remainder of the approach, including an emergency go-around if necessary.
3. Radar approaches are divided into two classes:

- a. Radar monitored or directed approaches:

These are approaches to fields for which standard jet penetrations or enroute penetrations have been published. The pilot directs the airplane by using normal approach facilities or the radar navigator directs the airplane using the BNS.

- b. Radar directed emergency approaches:

These are approaches to fields for which no published letdown procedures have been established or approaches wherein the normal ground or airplane approach facilities are inoperative (e. g., GCA or omni equipment failure). The radar navigator directs the airplane by using the procedure outlined in this manual (figure 8-3).

RADAR MONITORED OR RADAR DIRECTED PRACTICE APPROACH

Pilots and radar navigators should become completely familiar with the penetration patterns and approach and landing patterns to be used at both the destination and alternates. Applicable publications should be studied. Annotated scope photos of previous approaches, if available, will be a great aid to radar navigators.

Penetration Pattern

The published or interim jet penetration patterns for the specific station will be utilized by the pilot for the initial portion of the pattern.

Approach and Landing Patterns

The published approach pattern ground track and altitude restrictions will be followed from the final approach fix to the published missed approach point.

Altitudes

Altitudes for any phase of the approach will be those published in the current FLIP terminal approach plate for the penetration and approach phase of the maneuver.

Airspeeds

Airspeed for the penetration and approach will be directed in Sections II and III of this flight manual for the aircraft configuration being used.

AIRBORNE RADAR APPROACHES (Cont)

RADAR DIRECTED EMERGENCY APPROACH

The radar navigator may accomplish a radar directed approach when:

1. An instrument approach is necessary at a field without a published penetration.
2. A normal instrument or visual approach cannot be made because of failure of ground or airplane equipment.
3. It is not prohibited by directives or known traffic at base of intended landing.

Required Information

Prior to attempting a radar directed emergency approach, the following information should be known:

1. Field elevation
2. Active runway
3. All terrain and prominent radar returns within a 25-mile radius of the airbase
4. Obstructions located on the final approach
5. Offset aiming point
6. Initial point will be a point approximately 25 miles beyond the approach end of the runway in the direction of intended landing.
7. Terminal weather

Approach Procedure

NOTE

All radar approaches will be made with the bomb control panel heading switch in BOMB and track button depressed.

1. Accomplish the "Before Descent Checklist."
2. Airplane will descend to 25,000 feet.
3. Accomplish the "Descent and Before Landing Checklist" as applicable.
4. The radar navigator will direct the airplane to the initial point and then start a simulated bombing run on the approach end of the runway. (Initial phase of run may be made with crosshairs on the airbase built-up area and crosshairs may be placed on runway or OAP when identification becomes possible.)
5. Pilot should be instructed to follow the FCI over the runway.

AIRBORNE RADAR APPROACHES (Cont)

6. When the time-to-go indicator reads zero, the pilot will execute a standard rate turn to the right to the reciprocal of the runway heading plus 20° (drift must be considered if crosswind exists) and an immediate penetration will be initiated from 25,000 feet. Maintain crosshairs on the approach end of the runway or OAP during the entire approach.
7. Upon reaching 12,000 feet, a 200° standard rate turn to the left will be initiated, rolling out on the runway heading (to which drift correction angle has been applied), continuing the descent to 2000 feet above runway or 1000 feet above highest terrain within 5 miles of either side of approach heading, whichever is higher. After rolling out and leveling off, an IAS of best flare speed plus 20 knots will be established.

NOTE

Right and left turns indicated above may be reversed if local terrain makes this advisable.

8. Pilot will continue to track the FCI using standard ADF instrument technique. Example: If aircraft is on runway heading and FCI is 10° to the left, pilot should turn 20° to the left and hold the new heading until the FCI moves 20° to the right. At this point, the pilot should turn back 20° to the right. This will center the FCI and put the aircraft on the runway heading. Corrections should be continued as required to maintain FCI centering with aircraft on runway heading. The radar navigator should occasionally view a full scan presentation to check the position of the aircraft with respect to the on course track to the runway. If necessary, appropriate heading changes will be made to reposition the aircraft to the runway track after which the aircraft will be returned to the runway heading.
9. When 8 NM from runway, a 600 feet per minute descent will be initiated at an IAS of best flare speed plus 10 knots. This descent will be continued until the time-to-go reading is discernible. At this time, the rate of descent will be adjusted. If airplane was leveled off above 2000 feet, the descent will be at a range equal to altitude above the runway, divided by 1000, times 3.5 NM, and reference to time-to-go indicator as outlined above.

NOTE

If BFS plus 10 has not been established, the time-to-go indicator reading of 200 seconds will indicate an erroneous descent point.

10. During descent, the pilot will cross-check altimeter readings against time-to-go readings at 150, 100, and 60 seconds and will adjust rate of descent accordingly. At 60 seconds, the aircraft should be at 600 feet and under visual conditions. Except under extreme emergency conditions, descents will not be made below 600 feet unless the pilot has visual contact with the runway. If the approach is continued, the aircraft will be approximately 1000 feet down the runway when time to go is zero.

NOTE

The 1000-foot distance is based on a combination of pulse length and spot size error and the average width of the range crosshair. It is predicated on the procedure of placing the inner edge of the range marker on the apparent end of the area of no return representing the runway. While the exact distance will vary somewhat with control settings, this procedure will establish a glide path comparable to that of GCA and should insure the aircraft will not land short of the runway.

AIRBORNE RADAR APPROACHES (Cont)

MISSED APPROACH PROCEDURE

1. Go-arounds or GCA patterns—If a go-around becomes necessary or the pilot desires to complete the pattern utilized under normal GCA procedures, a pull-up will be made to 2000 feet at best flare speed plus 30 knots. Radar navigator will position the radar map switch to PPI-NS. This will allow him to utilize full scan and range marks during GCA pattern while crosshairs remain on runway.
2. Heading and altitude will be maintained until the airplane has reached a point approximately 5 miles beyond the approach end of runway. This may be determined by timing (90 seconds) or by reference to the ground range indicator. At this point the pilot will be directed to execute a 90° turn to the left. This heading will be the crosswind leg and will be maintained for 90 seconds or until the runway is approximately 5 miles behind. At this point the radar navigator will direct the pilot to turn 90° left to the downwind heading. Downwind heading should be maintained until the airplane is approximately 15 miles beyond the approach end of the runway. When the airplane is 15 miles beyond the approach end of the runway, another 90° turn to the left will be executed to the base leg and the IAS will be reduced to best flare speed plus 20 knots. After completion of the turn onto the base leg, the radar navigator will position the marker selector switch to BOMB. When FCI reads 80° left, pilot will execute the turn to runway heading and steps "8" thru "10" of "Approach Procedure Radar Directed Emergency Approach" will be repeated.
3. In the event of failure of the FCI or time-to-go indicator, the same approach may be made utilizing range marks and azimuth marker. Under these conditions the radar navigator will direct the airplane. The 600 feet per minute descent will be started at 8 miles. The standard GCA glide path closely approximates 250 feet per mile and this may be cross-checked by checking ranges against the altimeter.
4. To prevent conflict with other traffic during simulated radar directed emergency approaches, the pilot will remain in contact with approach control or the tower and will keep them informed on airplane location.
5. The pilot will evaluate the approach at the point go-around is initiated. The approach will be considered successful if, in his opinion, a safe landing would be accomplished from that point. He will further note the position of the airplane when the time-to-go indicator reads zero to evaluate the glide path.

WARNING

All altitudes referred to above, except penetration altitudes, are absolute altitudes above terrain.

GRID NAVIGATION

USAF grid system will be used at all times when flying in areas where magnetic compass indications become unreliable, where course angles change rapidly because of meridian convergence, and where large and rapidly changing magnetic variations exist. The unslaved N-1 compass is used as the primary steering instrument; however, grid legs may be flown with BNS steering engaged. Grid heading will be checked at appropriate intervals by celestial means. The MD-1 astrocompass may be used to accomplish these checks. Grid headings, gyro readings of the N-1 compass, and the heading indicator (gyro) will be recorded. The precession rate for either gyro need not be determined unless it is used as the primary steering instrument, and then only if the difference between the steering gyro and celestial grid heading exceeds 4. Full use will be made of the information displayed by the present position indicators unless restricted by training directives.

GRID NAVIGATION PROCEDURES (RN-N)

NOTE

During the grid navigation leg, step "15" of the grid entry checklist will be accomplished at appropriate intervals.

Entry

1. Radar Recording Camera - As desired

2. Grid Heading - Determined

Apply convergence angle or longitude, as applicable, to desired aircraft true heading.

3. Alter Heading - Completed (if applicable)

When over the start navigation point, turn aircraft to desired magnetic heading. Omit this step if grid entry is desired prior to the start navigation point.

4. BNS Steering - Disengaged

5. True Heading - Recorded

6. MD-1 Star Selector Switch - OFF

7. Emergency Controls Panel HDG Switch - ON

8. BNS Data Preset Panel Doppler Wind Switch - OFF

9. N-1 Compass Master Indicator:

a. Latitude Correction Pointer - AUTO

b. Synchronizer Knob - Set grid heading

10. True Heading System Panel:

a. Mag-Syn-Gyro Switch - SYN

b. Bias or Syn Knob - Center synchronize indicator

c. Mag-Syn-Gyro Switch - GYRO

d. Bias or Syn Knob & Fast Slew Button - Set true heading recorded in step "5"

GRID NAVIGATION (Cont)

11. MD-1 Heading Correction - Set zero
12. MD-1 Star Selector Switch - 1, 2, or 3
13. Emergency Controls Panel HDG Switch - OFF
14. BNS Data Preset Panel Doppler Wind Switch - ON
15. Heading Check:
 - a. Heading - Checked by celestial/inertial means
 - b. N-1 Compass - Reset to grid heading
 - c. Heading Indicator (gyro) - Set to grid heading (P/CP)
 - d. True Heading Indicator - Reset to true heading
16. Aircraft Heading - Corrected

Exit

1. BNS Steering - Disengaged
2. Emergency Controls Panel HDG Switch - ON
3. BNS Data Preset Panel Doppler Wind Switch - OFF
4. True Heading - Recorded
5. MD-1 Star Selector Switch - OFF
6. N-1 Compass Master Indicator:
 - a. Latitude Correction Pointer - OFF
 - b. Synchronizer Knob - Center annunciator
7. True Heading System Panel:
 - a. Mag-Syn-Gyro Switch - MAG
 - b. Bias or Syn Knob & Fast Slew Button - Zero bias indicator
8. MD-1 Star Selector Switch - 1, 2, or 3
9. True Heading Indicator - Checked by celestial/inertial means
10. Emergency Controls Panel HDG Switch - OFF
11. BNS Data Preset Panel Doppler Wind Switch - ON
12. Heading Indicator (gyro) - Reset (P/CP)

GRID NAVIGATION (Cont)

Subpolar and Polar Reorientation

Since the convergence factor of the polar series JN charts is different from the subpolar series, their respective grid north orientations are not compatible. It is therefore necessary to reorient the compasses when changing from one chart to the other. If no change of course is intended, the reorientation is made as follows:

1. Reorientation Point - Determined

Select a point that is common to the chart that is being departed and the new chart. This point should be a prominent radar return if possible.

2. Conversion Correction - Determined

3. Grid Reference (N-1):

a. Emergency Controls HDG Switch - ON

b. Doppler Wind Switch - OFF

c. True Heading - Recorded

d. MD-1 Star Selector Switch - OFF

e. N-1 Compass Pointer - Set

Set the N-1 compass pointer to the new grid reference heading.

f. True Heading Indicator - Set

With bias or syn knob, set true heading as recorded in step "c."

g. MD-1 Star Selector Switch - 1, 2, or 3

h. Emergency Controls HDG Switch - OFF

i. Doppler Wind Switch - ON

4. Heading Indicator (gyro) - Reset (P/CP)

Reset the heading indicator (gyro) to the same value as the N-1 compass.

5. Grid Heading - Checked

Check grid heading by celestial/inertial means, using true heading plus or minus longitude when going to polar areas (true heading plus or minus convergence angle when going to subpolar areas).

If a change of course is intended at the reorientation point, after completing the grid heading check, steer aircraft to the intended new grid heading.

PHOTOGRAPHY

RADAR RECORDING CAMERA (O-32 or KS-32A)

Camera Data Plates

The following data will be entered on the camera data plate during preflight.

TARGET COMPLEXES. The complexes or ranges to be bombed during the mission will be entered in chronological order. A maximum of three complexes will be listed; if a greater number of targets are to be attacked, the data plate must be changed in flight after the first three targets are bombed. At the discretion of the radar navigator, the data plate may be corrected prior to bombing each complex to facilitate identification of film during critique. However, the complex bombed must appear on the data plate regardless of the method used.

DATE. The date entered on the data plate during preflight will be the Greenwich date of the ETA to the first complex.

AIRCRAFT TYPE AND NUMBER. The airplane type will be completely identified: B-52G, etc. The last four digits of the tail number of the airplane will also be entered.

LAST NAME OF RADAR NAVIGATOR. The last name (and initials in those cases requiring further identification) of the radar navigator will be entered.

EXAMPLE:

LAJUNTA
OB-21
EL PASO 218
30 June 74
B-52G 8196
SMITH, C.S.

VERTICAL (STRIKE) CAMERA

Inflight Operation Using the Vertical Camera Intervalometer

1. Camera Control Panel:
 - a. Camera Master Switch - ON
 - b. Camera Intervalometer Switch - AUTO
2. Delay, Interval & Exposure Limiter Control Knobs - Set as desired
 - a. The camera exposure delay control setting is the time between initiation of the intervalometer (whether normal or remote) and the time the camera actually starts taking pictures. In normal operation, this will be the ATF minus the time before impact it is desired to start taking pictures.

PHOTOGRAPHY (Cont)

- b. The camera exposure interval control setting is the desired setting between pictures when the camera intervalometer power switch is on BOMB SPOTTING. It is the total length of time the camera will take pictures when the camera intervalometer power switch is on RUNAWAY.
 - c. The camera exposure limiter control is set for the desired number of pictures when the camera intervalometer power switch is on BOMB SPOTTING. This control has no effect when the camera intervalometer power switch is on RUNAWAY.
3. Camera Intervalometer Power Switch - BOMB SPOTTING

The camera intervalometer may be initiated manually by depressing the camera intervalometer manual initiation switch or remotely by a bomb release pulse.

Miscellaneous Data

With the camera master switch in ON position, the camera door opens automatically with the bomb bay doors, but does not close automatically. The camera doors may be closed by placing the camera door switch to CLOSE or by placing the camera master switch to OFF AND DOOR CLOSED position. If photos are desired at other than bomb release, the camera door must be opened manually.

CAMERA OPERATION AT MAXIMUM RATE. To operate the camera at maximum rate, proceed as follows:

- 1. Camera Control Panel:
 - a. Camera Master Switch - ON
 - b. Camera Intervalometer Switch - AUTO
- 2. Delay & Interval Control Knobs - Set as desired
 - a. The camera exposure delay control setting is the time between initiation of the intervalometer (whether normal or remote) and the time the camera actually starts taking pictures. In normal operation, this will be the ATF minus the time before impact it is desired to start taking pictures.
 - b. The camera exposure interval control setting will determine total time in seconds the camera will operate at maximum rate. Example: Interval control 100 seconds = 100 seconds of camera operation at maximum rate.
- 3. Camera Intervalometer Power Switch - RUNAWAY

The camera intervalometer may be initiated manually by depressing the camera intervalometer manual switch or remotely by a bomb release pulse.

RADAR NAVIGATOR NOT FLYING CHECKLIST (NAVIGATOR ACCOMPLISHES)

NOTE

- This checklist will be used by the navigator with the radar navigator not flying. The navigator will accomplish both his normal checklist and the items contained in this checklist. The navigator's normal checklist will be used for amplification of required checks for the radar navigator's ejection seat and escape hatch, parachute, survival kit, and oxygen system.
- This checklist does not appear as an abbreviated checklist.

INTERIOR INSPECTION

1. Ejection Seat & Escape Hatch - Checked
2. Parachute Preflight - Accomplished
3. Man-Seat Separator - Checked
4. Global Survival Kit - Checked
5. Safety Belt Release Fittings - Connected
6. Shoulder Strap Attaching Fittings - Connected
7. Compass & True Heading Computer Cutoff Switch - ON
8. Doppler System Pressurization Shutoff Valve Handle - NORMAL
9. Circuit Breaker Panels:
 - a. Normal Release & Jettison Power Circuit Breakers - Out
 - b. ADM-20 Launch Control, Cart No. 1, Cart No. 2, and Actuator Circuit Breaker - OUT

CAUTION

Failure to open the launch control, Cart No. 1, Cart No. 2, and Actuator Circuit breaker places a potential electrical hazard in the ADM-20C relay box assembly.

- c. All Other Circuit Breakers & Fuses - In
10. Oxygen System - Checked
11. BNS External Power Switch - OFF
12. Ground Blowers Switch - OFF
13. BNS Power Panel:
 - a. Power Switch - OFF
 - b. Heaters Switch - ON
14. EVS Environmental Power Switches - OFF
15. Terrain Computer Power Switch - OFF

**RADAR NAVIGATOR NOT FLYING CHECKLIST
(NAVIGATOR ACCOMPLISHES) (Cont)****16. Master Bomb Control Panel:**

- a. Master Bomb Control Switch - OFF
- b. Bomb Indicator Lights Switch - ON
- c. Bombing System Switch - MANUAL
- d. Lights - Checked, tested

17. Air Outlet & Auxiliary Heat Knobs:

- a. Upper - 1/2 out
- b. Lower - As desired
- c. Warmer - Full in

NOTE

These knob settings are approximate settings only. After the cabin temperature has stabilized, knob adjustment may then be varied slightly for crew comfort.

18. Radar Primary Panel:

- a. Radar Power Switch - OFF
- b. Antenna Speed Switch - FAST

19. Pres Gain Panel:

- a. Intensity Knob - CCW
- b. Receiver Gain Knob - CCW
- c. Video Knob - CCW

20. FLIR Control Panel:

- a. Mode Select Switch - OFF
- b. Bias & Contrast Knobs - CCW

21. EVS Video Select Switch - OFF**22. STV Control Panel:**

- a. MLC Gain Knob - OFF
- b. Mode Switch - OFF
- c. BIT Switch - NORM

RADAR NAVIGATOR NOT FLYING CHECKLIST (NAVIGATOR ACCOMPLISHES) (Cont)

23. BNS Data Preset Panel:

- a. Gyro Erect Switch - HI
- b. Gyro Latitude Indicator Set Knob - Set local latitude
- c. Present Position Switch - OFF
- d. Doppler Wind Switch - OFF

24. Emergency Controls Panel:

- a. TAS Switch - ON
- b. Stab Bypass Switch - ON
- c. All Other Switches - OFF

AFTER ENGINE START

CAUTION

After engine start, do not turn the BNS and EVS on until after being notified by the copilot that the generators are on the line and cooling air is available.

1. BNS Turn-On:

- a. Ground Blowers Switch - ON
- b. BNS Power Switch - ON

2. EVS - On

- a. Environmental Power Switches - ON

CAUTION

The environmental control systems are to be operated at all times during flight to prevent condensation within the turrets, even though the sensor itself may not be turned on or a dummy sensor is installed.

- b. EVS Video Select Switch - STV
- c. FLIR Mode Select Switch - OPR

RADAR NAVIGATOR NOT FLYING CHECKLIST (NAVIGATOR ACCOMPLISHES) (Cont)

- d. STV Mode Switch - OPR



Point sources of high intensity illumination, relative to the overall scene illumination, which remain stationary within the field of view of the STV, may cause damage to the STV camera assembly. During operation on the ground, precautions should be taken to eliminate stationary sources of high intensity illumination (ramp lights, reflections from objects, vehicle headlight, etc.) from within the field of view prior to continued operation of the STV in the operate mode. The camera assembly is protected from this type of damage in standby mode.

- e. HI SENS/HI RES Switch - HI RES
f. ALC FULL/ALC 1/4 Switch - ALC FULL
g. EVS Video Select Switch - FLIR (if applicable)

When the READY light on the FLIR control panel is illuminated, adjust the FLIR bias and contrast knobs for optimum display.

3. Gyro Leveling Check:

- a. Stab Bypass Switch - OFF
b. Gyro Erect Switch - NORM
c. Erect Cutoff Light - Off

If erection cutoff light illuminates, switch to high erect and perform gyro leveling check at a later time.

TAKEOFF

1. Emergency Controls Panel:

- a. TAS Switch - OFF
b. Stab Bypass Switch - OFF

2. EVS - As required

Place FLIR mode select switch, STV mode switch, and video select switch to STBY whenever EVS is not in use. If the EVS system is not to be used for several hours, turn FLIR mode select switch and STV mode switch to OFF.

DESCENT AND BEFORE LANDING

1. FLIR/STV Mode Switches - OPR

The FLIR will not be in a ready state for approximately 30 minutes.

RADAR NAVIGATOR NOT FLYING CHECKLIST (NAVIGATOR ACCOMPLISHES) (Cont)

2. EVS Video Select Switch - STV/FLIR, as desired
3. Penetration & Approach Altitudes - Monitored

AFTER PARKING

1. BNS Power Switch - OFF
2. BNS Heaters Switch - OFF
3. Ground Blowers Switch - OFF

CAUTION

Do not turn ground blowers switch off until doppler radar system power switch is turned off.

4. EVS - OFF
 - a. FLIR Control Panel:
 - (1) Contrast and Bias Knobs - CCW
 - (2) Mode Select Switch - OFF
 - b. STV Control Panel:
 - (1) MLC Gain Control - OFF
 - (2) Mode Switch - OFF
 - c. EVS Video Select Switch - OFF
 - d. EVS Environmental Power Switches - OFF
5. Inform Pilot - BNS and EVS off
6. Bomb Indicator Lights Switch - OFF
7. Compass & True Heading Computer Cutoff Switch - OFF

NAVIGATOR NOT FLYING CHECKLIST (RADAR NAVIGATOR ACCOMPLISHES)

NOTE

- This checklist will be used by the radar navigator with the navigator not flying. The radar navigator will accomplish both his normal checklist and items contained in this checklist. The radar navigator's normal checklist will be used for amplification of required checks for the navigator's ejection seat and escape hatch, parachute, survival kit, and oxygen system.
- This checklist does not appear as an abbreviated checklist.

INTERIOR INSPECTION

1. Lower Deck Spare Parachute Preflight:

a. Inspection Record:

- (1) Inspection & Repack Date - Checked
- (2) Automatic Release Time & Altitude Setting - Checked

b. Bailout Bottle Pressure & Hose Connector - Checked

c. Personal Locator Beacon Lanyard - Snapped/Unsnapped (as required)

For peacetime operations, the personal locator beacon lanyard must be configured for automatic operation. When mission requirements dictate the necessity to avoid detection and automatic actuation of the beacon is not desired, the lanyard must be configured for nonautomatic (manual) operation.

d. Parachute - Unbuckled and stowed

Spare parachute will be unbuckled and stowed in an easily accessible location.

1A. IN Oxygen Regulator - OFF and 100% Oxygen (IN not flying)

2. Lower Deck Fire Extinguisher - Checked

Assure that appropriate safety device (safety wire/seal or locking pin/lever, as applicable) is installed. Check for fully serviced pressure.

3. Oxygen System - Checked

4. N-1 Compass Master Indicator:

- a. Latitude Correction Pointer - OFF
- b. Synchronizer Knob - Synchronize N-1

5. True Heading System Panel:

- a. Mag-Syn-Gyro Switch - MAG
- b. Bias or Syn Knob - Zero bias indicator

NOTE

Magnetic variation indicator may drift due to lack of excitation from the BNS.

NAVIGATOR NOT FLYING CHECKLIST (RADAR NAVIGATOR ACCOMPLISHES) (Cont)

6. Doppler Vertical Reference Switch - NORMAL
7. Doppler Drift Switch - ON
8. Doppler RF Power Switch - NORM
9. 5-Inch Indicator:
 - a. Video Knob - CCW
 - b. Intensity Knob - CCW
 - c. Marker Knob - CCW
10. Ejection Seat & Escape Hatch - Checked
11. EVS Video Select Switch - OFF
12. Parachute Preflight - Accomplished
13. Man-Seat Separator - Checked
14. Global Survival Kit - Checked
15. Safety Belt Release Fittings - Connected
16. Shoulder Strap Attaching Fittings - Connected
17. Doppler Radar Silence Switch - SILENT
18. Doppler Radar System Power Switch - OFF
19. Radar Pressure Pump Control Switches - NORMAL ON
20. APN-69 Pressurization Switch - COMPRESSOR ON
21. APN-69 Low Pressure Warning Light - Off, tested
22. Ground Locks & Bypass Keys - Counted and stowed
Six locks and two keys.

BEFORE TAKEOFF

1. Entrance Door - Checked locked, folding hatch closed
2. Pressure Bulkhead Door - Closed, latched, and unlocked
3. Pressure Dump Handle - CLOSED and safetied
4. Automatic Astrocompass:

CAUTION

The declination and SHA for Polaris are to be inserted into the No. 1 star data panel for astrocompass operation (including standby) between the latitudes of 0° and 75°N to reduce the potential of limits of "lock-up" damage to the altitude-azimuth computer.

NAVIGATOR NOT FLYING CHECKLIST (RADAR NAVIGATOR ACCOMPLISHES) (Cont)

- a. Star Selector Switch - OFF
- b. Rate Switch - SOL or SID (as required)
- c. Lat-Long Switch - AUTO
- d. Heading Select Switch - TRUE HEAD COMPUTER
- e. Power Filter Switch - SUN or STAR

NOTE

There is a 2-minute delay before information may be preset and an additional 5-minute delay before the system can track. If the celestial coordinates for Polaris are not displayed in star data panel No. 1, they are to be inserted as soon as the 2-minute delay has elapsed.

- 5. Doppler Radar System Power Switch - ON

CAUTION

Do not turn doppler radar system power switch ON until cooling air is available and the ground blowers switch is ON.

- 6. Altimeter - Set

Set in accordance with AFM 51-40.

WARNING

When setting altimeter, special attention should be given to the altimeter to insure the 10,000-foot pointer is reading correctly.

- 7. Heading Indicators - Cross-checked (P-CP-RN)

Cross-check heading indicators and magnetic standby compass.

- 8. Takeoff Data - Reviewed (P-CP-RN)

AFTER TAKEOFF

- 1. Doppler Radar Silence Switch - TRANSMIT (if desired)

Place the doppler radar silence switch to TRANSMIT when attaining an altitude of approximately 200 feet above the ground.

- 2. Departure Plan - Monitored

Monitor aircraft position to assure adherence to planned departure.

- 3. Altitude & Airspeed - Monitored

Monitor altitude and airspeed for safe margin until aircraft has attained an altitude of 5000 feet above the terrain. Advise pilot if altitude falls below a safe margin or airspeed fails to show a positive increase. Upon reaching level-off altitude minus 2000 feet, report altitude to pilot every 1000 feet and at level-off altitude. Altitude calls will be made by stating the passing altitude and the intended level-off altitude.

NAVIGATOR NOT FLYING CHECKLIST (RADAR NAVIGATOR ACCOMPLISHES) (Cont)

4. Climb EPR Value - Computed (if requested)

5. Altimeter - Set

AFTER LEVEL-OFF

1. True Airspeed Indicators - Cross-checked

If more than a 10-knot difference exists, compute TAS. If the BNS true airspeed is in error by 10 knots or more, set BNS true airspeed with emergency controls panel.

BEFORE DESCENT

1. Best Flare Speed - Computed and cross-checked with copilot

DESCENT AND BEFORE LANDING

1. Altimeter Setting - Determined and set (N-RN-P-CP)

Compute a level-off altimeter setting using metro or inflight "D" values. Enroute metro or ARTC altimeter settings will be used if available.

2. Descent Altitude Calls - Accomplish

- a. Coordinate with the pilot as to level-off altitude(s) to be used for descent and entry to landing pattern.
- b. Call off altitude to pilot every 5000 feet commencing at 15,000 feet MSL. Upon reaching level-off altitude plus 2000 feet, report altitude to pilot every 1000 feet and at level-off altitude. Altitude calls will be made by stating the passing altitude and the intended level-off altitude.
- c. Announce approaching DH/MDA during all instrument approaches. This call should be made approximately 100 feet above the DH/MDA and will include the appropriate DH/MDA altitude (eg, "Approaching 363").

3. Doppler Radar Silence Switch - SILENT (if required)

Place the doppler radar silence switch to SILENT when approximately 200 feet above the ground for low approaches and landings. Return the switch to TRANSMIT when above 200 feet during missed approach or after subsequent takeoffs.

4. Emergency Controls Panel:

The following steps will be accomplished prior to touchdown or during the final phase of a low approach to prevent excessive chattering of the dials. Return these switches to OFF after takeoff for subsequent approaches.

- a. H_A Switch - ON
- b. TAS Switch - ON

AFTER LANDING

1. APN-69 Pressurization Switch - OFF

AFTER PARKING

1. Doppler Radar System Power Switch - OFF
2. Astro Power Filter Switch - POWER OFF
3. Radar Pressure Pump Control Switches - OFF

EW OFFICER'S CHECKLIST**BEFORE EXTERIOR INSPECTION — SAFETY CHECK**

1. Form 781 - Checked

Check Form 781 for pertinent equipment writeups and chaff and flare loadings not specifically covered in the pilot's review of the form. Confirm with ground crew that any missing transmitter component receiving ram air cooling has been replaced by a dummy box to block ram air outlet. If any ECM equipment that receives air from a common cooling duct is removed and not replaced with a dummy box, none of the other equipment that receives cooling from that cooling duct can be operated since cooling air will be lost through the open hole and adequate cooling will not be available for the remaining equipment. If this is applicable, see "Airspeed Limitations," Section V.

2. Arming Levers - Stowed, No. 1 safety pins installed and locked

WARNING

If the arming lever(s) has been rotated on a stowed armrest, raising the armrest will fire the arming initiator. If the arming lever(s) has been rotated or the arming lever(s) safety pin is not installed, call maintenance immediately and stay clear of the seat.

3. ECM Equipment/Expendables Safety Check - Completed

a. ECM Equipment, Chaff & Flare Power Switches - OFF

NOTE

ALQ-117 and ALQ-122 system status cannot be determined until power is available to the system. An internal self-protection circuit will ensure the system remains off until the POWER switch is activated after power is applied. The ALQ-122 must be checked after external power is applied to ensure the system is off.

b. Chaff, Flare & Rocket Circuit Breakers - Out

WARNING

During this inspection, the EW officer will ensure that all systems are completely deactivated to prevent inadvertent jamming or dispensing of expendables with the application of ground power.

4. Warning Revr Circuit Breaker - Out

5. ALQ-117 Sys 15 and Sys 16 Ind Cont Circuit Breaker - Out

The "Sys 15 and 16 Ind Cont" circuit breaker will be pulled to assure deactivation of the ALQ-117 system.

6. CM SET Circuit Breaker **BG** - Out

The "CM SET" circuit breaker on the right load central circuit breaker panel will be pulled to assure deactivation of the ALQ-153(V) system.

EW OFFICER'S CHECKLIST (Cont)

EXTERIOR INSPECTION

1. Forward/Center Exterior Antennas - Checked

Check protruding ECM antennas and antenna covers mounted on the fuselage for condition, security, and cleanliness.

2. ALE-20 Ground Test Switch - OFF

Check that the ALE-20 ground test switch (in forward wheel well) has not been inadvertently left propped in the ON position. (Switch is spring-loaded to OFF position.)

3. Left ALE-24 Wing Chaff Dispenser Ports - Checked

Visually check that exposed chaff packages conform with mission requirements.

4. Left Aft Exterior Antennas - Checked

Check protruding antennas and antenna covers mounted on fuselage for condition, security, and cleanliness.

5. Left ALE-20 Flare Ejectors - Checked

Visually check that ejector covers are secure (if flares are not loaded) or that openings are unobstructed (if flares are loaded).

6. Tail-Mounted Antennas - Checked

Check protruding ECM antennas and antenna covers mounted on the fuselage for condition, security, and cleanliness.

7. Right ALE-20 Flare Ejectors - Checked

Visually check that ejector covers are secure (if flares are not loaded) or that openings are unobstructed (if flares are loaded).

EW OFFICER'S CHECKLIST (Cont)

8. ALE-20 Safety Interlock Switch Door - Check open, remove streamer, and close

Check that the ALE-20 flare ejector safety interlock switch door is open, then remove streamer and close the door. If the door is found closed, check with maintenance personnel on the status of the ALE-20 equipment. When the aircraft is on ground alert in a cocked configuration, the streamer will be removed and the door closed.

9. Right Aft Exterior Antennas - Checked

Check protruding antennas and antenna covers mounted on fuselage for condition, security, and cleanliness.

10. Right ALE-24 Wing Chaff Dispenser Ports - Checked

Visually check that exposed chaff packages conform with mission requirements.

INTERIOR INSPECTION

1. Equipment - Stowed

WARNING

Ensure that no equipment is stowed on or near the heating duct, electrical wiring, or electronic equipment.

2. IFF Mode 4 Computer - Encoded

3. Ejection Seat:

- a. Hatch Link - Checked

Check link connecting escape hatch to catapult safety pin-pull initiator.

- b. Maintenance Safety Pins No. 2, 3, and 5 - Checked removed

WARNING

Ensure that no streamer has been torn from a maintenance safety pin, thus inadvertently leaving the pin installed. If a maintenance safety pin is installed the status of the seat will be ascertained prior to removal of the pin.

EW OFFICER'S CHECKLIST (Cont)

- c. Catapult Initiator Safety Pin-Pull Cylinder - Pin in place

Catapult initiator safety pin should extend through the catapult initiator. If pin is pulled out, initiator may have been fired; call maintenance immediately.

- d. Manual Catapult Pin-Pull Lever - Checked

Lever latched, pin-pull cylinder secured.

- e. Initiator Tube Runs - Checked connected

Check tubes for proper and secure connections.

- f. Inertia Reel - Checked

Check inertia reel lock for proper functioning.

- g. Shoulder Strap Attaching Fittings - Connected

3A. Man-Seat Separator - Checked

Insure that the nylon man-seat separator straps are placed on the bare seat. Survival kit is then placed over man-seat separator straps.

4. Parachute Preflight:

- a. Inspection Record:

(1) Inspection & Repack Date - Checked

(2) Automatic Release Time & Altitude Setting - Checked

- b. Personal Locator Beacon Lanyard - Snapped/Unsnapped (as required)

For peacetime operations, the personal locator beacon lanyard must be configured for automatic operation. When mission requirements dictate the necessity to avoid detection and automatic actuation of the beacon is not desired, the lanyard must be configured for nonautomatic (manual) operation.

- c. Bailout Bottle Pressure & Hose Connector - Checked

- d. Parachute Arming Lanyard Anchor - Installed

WARNING

Be certain that the parachute arming lanyard anchor is securely fastened in the attachment fitting on the seat. Failure to attach the lanyard anchor to the seat will necessitate manual operation after ejection.

- e. Parachute Straps - Adjusted (as required)

5. Global Survival Kit:

- a. Kit Installed & Plunger Depressed - Checked

- b. Kit Release Handle - Checked down

EW OFFICER'S CHECKLIST (Cont)

- c. Mode Selector Lever - AUTO
- d. Kit Straps to Parachute - Checked and attached

Check that attachment fittings are properly connected to the kit, the attachment straps threaded through the safety belt, and the quick-disconnect fittings are properly attached to the parachute (with release buttons on outside).

WARNING

Care must be taken to insure that the survival kit attachment straps are properly threaded through the safety belt.

- 6. Safety Belt Release Fittings - Connected
- 7. Circuit Breakers - Set

Check all circuit breakers set to "in" position on the ECM circuit breaker panel except those for the chaff dispenser, flare ejector, rocket pods, APR-25/Warning receiver and the ALQ-117 sys 15 and 16 Ind Cont (1). Chaff dispenser and flare ejector circuit breakers will be left "out" until ready to dispense chaff or flares and "out" after activity is completed. APR-25/warning receiver circuit breaker and ALQ-117 Sys 15 and 16 Ind Cont circuit breaker will be left "out" until required "in" by the "After Takeoff - Climb" checklist.

- 8. Air Outlet Knobs:
 - a. Upper - 1/2 to full out
 - b. Warmer - Full in
 - c. Lower - Full out

NOTE

These knob settings are approximate settings only. After the cabin temperature has stabilized, knob adjustment may then be varied slightly for crew comfort.

- 9. Interphone - Monitor

The EW officer will monitor the interphone at the station he is occupying.

- 10. Oxygen System:
 - a. Regulator Diluter Lever - 100% OXYGEN
 - b. Shutoff Lever - OFF
 - c. Mask & Hose - Check disconnect, then reconnect

Check for 10- to 20-pound pull for disconnect, then reconnect mask and hose.

WARNING

Insure that oxygen supply hose is under seat armrest before hookup with the oxygen mask hose.

EW OFFICER'S CHECKLIST (Cont)

d. Diluter Valve - Checked

Attempt to draw air through the oxygen mask. Ability to draw air indicates a defective diluter valve, oxygen hose and/or connections or mask. Then place the diluter valve to **NORMAL** position, draw air through the mask, if unable, this would indicate that only 100% oxygen will be available.

NOTE

- If the diluter valve is stuck in the 100% position, this will prohibit the detection of smoke or fumes when use of normal oxygen is required.
- If the CRU-73A regulator is installed, the crew member will not be able to draw air through the system with the shutoff lever OFF. The diluter lever may be moved to **NORMAL** with the shutoff lever OFF on some CRU-73A regulators. The diluter valve will be in the 100% oxygen position when the shutoff lever is OFF on all CRU-73A regulators.

e. Shutoff Lever - ON

f. Pressure - Checked

Pressure gage reads approximately 300 psi.

g. Emergency Toggle Lever - TEST MASK

With mask disconnected at one side of helmet, the flow indicator should indicate continuous flow.

h. Mask - Test

Attach mask to helmet and hold breath; indicator should indicate no flow.

NOTE

Flow condition may be indicated by a slight leak around the face form. If light hand pressure against the mask does not stop the flow, the mask is unacceptable.

i. Emergency Toggle Lever - NORMAL

j. Regulator Diluter Lever - NORMAL/100% (as required)

11. Lights - Checked and set

Check light switches and controls for proper operation and set as desired.

12. ECM Equipment Controls Preset:

a. ALT-6B/ALT-22 Operate-Standby Switches - STBY

b. ALQ-117 Heater Switch - ON

c. ALQ-117 Blanking Switch - HIGH

d. ALR-46 Intensity & Audio Controls - Minimum

e. Flare & Chaff Counters - Checked

Check all counters for correct loading (should agree with Form 781 entry).

f. ALQ-122 Power Switch **AL** - OFFg. ALQ-153(V) Control-Indicator Panel **BG** - Checked

Check all panel lights off.

EW OFFICER'S CHECKLIST (Cont)**13. AGM-69A Lock-Unlock Switch Cover - Sealed**

Check that the AGM-69A lock-unlock switch cover is closed with the pin inserted and sealed.

14. Refuel Valve Emergency Control Lever - CENTER**NOTE**

Preflight of the defense instructor's station checklist items including the sextant and mount may be performed before or after the EW station checklist items according to the dictates of the situation.

15. Defense Instructor's Station Oxygen System:

When the station is not occupied

- a. Regulator Diluter Lever - 100% OXYGEN
- b. Shutoff Lever - OFF
- c. Mask & Hose - Check disconnect, then reconnect

Check for 10 to 20 pound pull for disconnect, then reconnect mask and hose.

- d. Diluter Valve - Checked

Attempt to draw air through the oxygen mask. Ability to draw air indicates a defective diluter valve, oxygen hose and/or connections or mask. Then place the diluter valve to NORMAL position, draw air through the mask, if unable, this would indicate that only 100% oxygen will be available.

NOTE

- If the diluter valve is stuck in the 100% position, this will prohibit the detection of smoke or fumes when use of normal oxygen is required.
- If the CRU-73A regulator is installed, the crew member will not be able to draw air through the system with the shutoff lever OFF. The diluter lever may be moved to NORMAL with the shutoff lever OFF on some CRU-73A regulators. The diluter valve will be in the 100% oxygen position when the shutoff lever is OFF on all CRU-73A regulators.

- e. Shutoff Lever - ON

- f. Pressure - Checked

Pressure gage reads approximately 300 psi.

- g. Emergency Toggle Lever - TEST MASK

With mask disconnected at one side of helmet, the flow indicator should indicate continuous flow.

EW OFFICER'S CHECKLIST (Cont)

- h. Emergency Toggle Lever - NORMAL
- i. Oxygen Regulator - 100% and OFF

When the oxygen system at the celestial station is not in use, place the regulator diluter lever to 100% OXYGEN and the shutoff lever to OFF.

16. Periscopic Sextant & Mount:

WARNING

The upper deck sliding hatch will be closed and locked during periscopic sextant and mount check to prevent injury to personnel.

NOTE

If sextant is not stored in the aircraft, steps "a," "b," and "f" may be performed at any time prior to arrival at aircraft. Circled items will be performed on second sextant.

- (a.) Sextant Desiccant - Checked
- (b.) Halftime Dial Accuracy Check - Completed
 - (1) Depress averager winding lever; averager indicator should align. Allow averager to operate for 4 seconds. Averager should stop automatically and time dial should indicate zero.
 - (2) Rotate altitude knob. Rotation of the altitude knob should not cause the average indices to move more than twice the width of the index line.
 - (3) Depress actuating lever (or button) and read watch.
 - (4) Check halftime dial, averager indicators, and watch. Read when shutter clicks and compare with watch. Dial should read 59 since shutter closes 2 seconds before averager stops. The period of operation of the averager should be 120 (± 2) seconds. If any of the tolerances are exceeded, the navigator should be notified.

NOTE

Step "b" may be performed while accomplishing steps "c" and "d."

- (c.) Sextant - Inserted and lights checked

Connect power cable and check sextant and mount for proper lighting.
- (d.) Alignment - Checked

Rotate azimuth knob until 0° is on the index and compare with azimuth counters. Variations over $1/2^\circ$ should be entered into AFTO Form 781. Reset azimuth counters to 0° . Collimate on the center line of the vertical stabilizer: 180° should be read under the vertical stabilizer. Small errors may be removed by rotation of the projection lens.

EW OFFICER'S CHECKLIST (Cont)

- e. Sextant - Removed and stowed

Rotate bubble adjust knob to full increase and depress and release averager actuating lever (button).

CAUTION

When the sextant is not being used for an observation, the averager actuating lever (button) should always be depressed to allow the averager to run down and prevent damage to the spring.

- f. Spare Bulbs in Sextant Case - Checked

- g. Sextant Mount - Drained (may be open on alert)

17. CM SET Circuit Breaker **BG** - In

18. ALQ-153(V) Control-Indicator Panel **BG** - All lights checked off

19. Crew Report - Completed

- a. Pilot actuates the emergency alarm switch to ABANDON, switches intercom to CALL position, and announces, "Crew report."
- b. EW officer reports on interphone following gunner. Switch to CALL position and report "EW check complete." Check consists of abandon signal and call operation.
- c. If the celestial preflight is interrupted by "Crew Report," the EW officer may report from the DI position. On return to his seat, the interphone CALL position will be checked with the gunner.

20. Oxygen Regulator - OFF and 100% oxygen (if leaving the aircraft for an extended period of time)

STARTING ENGINES

WARNING

Whenever contamination is suspected, 100% OXYGEN will be used during ground operation and takeoff.

1. Interphone & UHF Radios - Monitored
2. Stand by to Taxi - Report if not ready to taxi

EW OFFICER'S CHECKLIST (Cont)

3. Parachute & Safety Belt - Fastened

WARNING

- Tighten the parachute-survival kit attachment straps as tightly as possible to prevent the safety belt from inflicting facial injuries during ejection bailout.
- Insure that the parachute arming lanyard is not entangled in the parachute harness. Lanyard entanglement could cause failure in seat separation and failure of the automatic features of the parachute.

NOTE

- Steps "3" thru "5" may be accomplished during taxi.
- If it becomes necessary to leave the seat, the crew member should open the safety belt and unbuckle the parachute harness leaving the parachute and survival kit in the seat. If the parachute is worn when leaving the seat, upon returning to the seat, it will be necessary to take it off in order to reinstall the parachute and safety belt in the seat.

4. Oxygen Hose & Bailout Bottle - Connected to mask

WARNING

Insure that oxygen supply hose is under the seat armrest before hookup with oxygen mask hose.

5. Oxygen Regulator - As required

TAXIING CHECKLIST (Copilot /EW reads)

Checklist appears in EW officer's abbreviated checklists and will be read on request of the pilot.

BEFORE LINEUP CHECKLIST (Copilot /EW reads)

Checklist appears in EW officer's abbreviated checklists and will be read on request of the pilot.

AFTER TAKEOFF — CLIMB

1. ECM Equipment:

- a. Warning Rcvr Circuit Breaker - In
- b. ALQ-117 Sys 15 and 16 Ind Cont Circuit Breaker - In

The "Sys 15 and 16 Ind Cont" circuit breaker will be pushed in to assure activation of the ALQ-117 system.

EW OFFICER'S CHECKLIST (Cont)

- c. All ECM equipment power switches (except ALQ-122, chaff, and flare) will be turned on during climbout after flaps up. Care should be exercised that ECM transmitters are in standby except when they are to be used.

WARNING

To prevent accidental actuation of the transmitter switches, extreme care must be exercised when leaving or returning to the seat.

NOTE

- Single control ALT-28 transmitters Less **AW** will be momentarily placed to RESET then back to STBY. Dual control ALT-28, Less **AX**, ALQ-155 **AX** transmitters will be set to STBY 2. Less **AL**
- The ALT-6B C band transmitter will remain off until completion of the ALT-16 portion of the "Calibration/Interference" checklist. Erroneous ALT-16 power readings may occur with the ALT-6B in any configuration but off.
- All ALR-46(V)-4 indicator control panel lights should illuminate momentarily and one burst of Launch Audio may be heard when system is turned on. Any panel light that does not illuminate should be pressed to verify it comes on. (System audio and visual presentations at turn-on are dependent on system control and interphone panel settings).
- The AN/ALQ-117 is capable of interfering with precision approach radars. On training sorties, the STANDBY/OPERATE pushbuttons will be placed in the operate position only when conducting activity authorized by Air Force and SAC directives.
- The AN/ALQ-153(V) STBY/OPER pushbutton will be placed in the operate position only when conducting activities authorized by Air Force and SAC directives. **BG**
- When AN/ALQ-153(V) POWER pushbutton is depressed, the POWER and TEST/MALF lights come on for duration of warmup period (minimum of 41 to a maximum of 130 seconds). Following warmup, the POWER and TEST/MALF lights go off and the STBY/OPER light comes on (amber). **BG**

- d. ALT-6B/ALT-22 Slow Width Controls Less **AX** - Approximately 1/4 turn CCW

NOTE

During all periods when the ALT-6B and ALT-22 have power on but are not in transmit mode, the slow width and sweep width controls will be opened to approximately 1/4 turn CCW.

2. (Deleted)

3. Oxygen Check - Completed

- a. During the climb, copilot requests an oxygen check at 12,000 feet. The sequence for oxygen report is gunner, radar navigator, and pilot/copilot. The reporting crew member will visually check other crew members for alertness. He will report oxygen check for both positions. Oxygen panel at each occupied crew position will be checked on all oxygen checks for:
- (1) Oxygen Supply Shutoff Lever - ON
 - (2) Regulator Diluter Lever - As required
 - (3) Pressure - 300 psi

EW OFFICER'S CHECKLIST (Cont)

- (4) Flow Indicator - Functions normally
 - (5) Emergency Toggle Lever - NORMAL
 - b. Gunner, radar navigator, and pilot/copilot report "Oxygen panels checked." In addition, pilot/copilot reports "Cabin altitude _____ feet.
 - c. Copilot requests oxygen check at level-off and during cruise at 1-hour intervals when cabin altitude is below 12,000 feet, at 30-minute intervals when cabin altitude is 12,000 to 25,000 feet, and at no longer than 10-minute intervals when cabin altitude is above 25,000 feet. If cabin altitude is below 12,000 feet, only the pilot/copilot will report. The remaining crewmembers will check their equipment and report if abnormal.
4. Periscopic Sextant - Inserted as required

WARNING

- The upper deck sliding hatch must be closed and locked while taking celestial observations and when checking the periscopic sextant and mount.
 - When the EW position is unoccupied during the time that he is performing celestial duties, the parachute will remain in the seat which will be configured for immediate reoccupancy and ejection, except that the No. 1 safety pins will be installed. If conditions permit and the EW elects to use a headset while performing celestial duties, his helmet and mask may be left connected to the EW oxygen supply and the helmet stored on the headrest of the EW ejection seat. The interphone from the EW position will be used by the additional crewmember occupying the defense instructor's seat. This crewmember will be able to monitor interphone but will be unable to transmit because of the location of the EW interphone foot switch. A position change between the DI and EW positions may be accomplished while celestial duties are being performed. Each crewmember will use the interphone, oxygen supply, and parachute at his new position.
5. Level Off - Air outlet knobs adjusted; copilot notified
- a. Upper - Full in
 - b. Warmer - 1/2 to full out
 - c. Lower - Full out

NOTE

Adjustments should occur at planned level-off altitude and after cabin temperature has stabilized. Settings may be other than stated above provided the copilot is notified for each change of setting.

AIR REFUELING

Checklist appears in T.O. 1-1C-1-15.

EW CALIBRATION INTERFERENCE

The calibration of ECM equipment and interference to and from other aircraft systems will be determined as soon as practical after takeoff. The purpose of this check is to determine whether the equipment meets the minimum requirements for dependable operation. If this abbreviated check reveals a malfunction or failure and conditions permit, refer to the applicable portion of the MALFUNCTION AND ANALYSIS CHECKLIST in T.O. 1B-52-G-1CL-4 and the T.O. 1B-52D-1-2 Malfunction, Analysis, and Emergency Operation Section. Each transmitter will be checked for normal efficiency by comparing the output with like systems, taking the antenna position into consideration. Transmitters will be momentarily activated in a clear band, consistent with clearance and operating restrictions. On training missions only, when the mission profile precludes accomplishing the entire check prior to the HHCL, only systems and

EW OFFICER'S CHECKLIST (Cont)

frequency bands programmed for use will be checked. Deviations from checklist sequence to comply with local area clearances are authorized. The entire crew must be alerted for coordination during this check. UHF guard frequency must be monitored throughout the check.

NOTE

- Receivers and appropriate transmitters may be checked during climb commensurate with clearance and crew coordination.
- ALT-28 transmitters will be placed in STBY 2/STBY Less **AX**, ALQ-155 transmitters in STBY 2 **AX** mode no more than 30 minutes prior to ECM activity and placed in STBY 1/warmup mode after completion of ECM activity unless scheduled for activity within 30 minutes.
- Items that are circled will be repeated for each receiver band/trace and like transmitter.

1. AIC-10 Mixer Switches - As required

2. ALR-20A:

- a. Sweep Width Controls (7) - Full CW
- b. RF Level Controls (7) - Checked, adjust for optimum signal presentation

Check for a change in signal amplitude by varying each RF level control, then set to optimum level.

CAUTION

Do not "pull out" on any RF level control knob in an attempt to interrupt BNS blanking to the receiver. Complete receiver loss may occur due to circuit overloads created within system.

NOTE

Use RF test if no signals are available.

- c. Scale Illumination - Optimum
- d. Scope Presentation - Checked

Check for presence of known signals and interference.

- e. RF Test Button - Depressed, signals checked
- f. Expansion Trace Selectors A & B - Checked

Set expansion A selector on the desired trace. Monitor expansion trace A for display of this trace. RF test may be used. Repeat procedures for expansion trace B.

- g. Right & Left Mark Controls - Checked

Vary the mark control. Mark should move across both expansion traces. Repeat procedure for left mark control.

- h. Sweep Width Control - Checked, then full CCW

Rotate the sweep width control CCW from the full CW position to select a segment approximately 1/4 of the trace. Vary the manual frequency control and the segment should move across the trace. Continue rotation of the sweep width control to the full CCW position (in detent).

EW OFFICER'S CHECKLIST (Cont)

- i. Manual Frequency Control - Adjust to signal frequency

NOTE

Use RF test if no signals are present.

- j. Volume Control - Adjusted
- k. Sweep Width Control - Full CW

3. ALR-46:

- a. Warning Receiver Mixer Switch - Up (EW-G)
- b. Audio & Intensity Controls - Optimum

Adjust intensity control clockwise until an optimum display of symbols is obtained on the ALR-46. It may be necessary to activate the test function for symbol presentation.

- c. Self Test - Accomplished (notify gunner)
- d. CRT Indicator - Check for interference

NOTE

If interference is received, have FCS radar go OFF or BNS to STANDBY, as necessary, to isolate interference source.

3A. ALQ-153(V) **BG**

- a. ALQ-153 Mixer Switch - Up (EW-G)
- b. LAMPS PUSH TO TEST Control - Depressed, brightness adjusted.

All control indicator lights should come on and may be adjusted to desired brightness by rotating the control knob. Range indicator reads 8.8.

- c. TONE PUSH TO TEST Control - Depressed, volume adjusted

Missile warning tone should be audible (EW and G) for approximately 3 seconds. Adjust volume as desired by rotating the control knob.

- d. TTI ENAB/INHBT Pushbutton - INHBT
- e. MIN RNG ENAB/INHBT - ENAB, set to fourth setting
- f. TEST/MALF Pushbutton - Depressed

- (1) TEST, MIN, RNG ENAB, and 0-3 lights - ON

Lights remain on for duration of the test (approximately 15 seconds). Initial reading in the range indicator should be approximately equal to the groundspeed readout (within 5%) of the doppler.

- (2) JAM Light - On

It should remain on for approximately 4 seconds.

(3) LMSL and RMSL Lights - On

After approximately 8 1/2 seconds these lights come on, the range indicator reads 1.0 and a 3 second tone burst sounds.

(4) Range Indicator - Decreases in steps to 0.5

The CM TRIG light should come on at the time specified and remains on until 0.5.

(5) 0-3, LMSL, RMSL, and TEST lights - Off system to STBY

After 15 seconds, these lights should go out and the range indicator is blank. STBY light is on and system is ready for normal operation.

g. STBY/OPER Pushbutton - OPER (if applicable)

Check receivers for presentation and interference. The MALF light will illuminate momentarily while transitioning from standby to operate or operate to standby. Leave the system in operate for approximately 15 seconds to make sure that any system malfunctions are discovered.

h. STBY/OPER Pushbutton - STBY

4. ALQ-117:

a. Lamp Test Pushbuttons - Depressed, indicators checked

b. Self-Test Selector - Depressed, self-test accomplished

Check for receiver interference during self-test cycle.

NOTE

The ALQ-117 Blanking Switch must be in the HIGH position to assure a valid self-test.

5. ALT-16 Less **AL** /ALT-16A **AL** :

(a.) Channel Selector Button(s) - Depressed as desired

(b.) Power Selector - TRANSMIT

(c.) Power Monitor Meter - Checked

Meter should read 50 or greater.

(d.) VSWR Button - Depressed, meter checked

Meter should read 40% or less of reading in step "c".

CAUTION

Do not operate transmitter if meter reading in step "d" is more than 40% of step "c" as damage to the transmitter may result.

EW OFFICER'S CHECKLIST (Cont)

- (e.) Signal Presentation, Calibration & Interference - Checked
- (f.) Power Selector - STANDBY
- g. ALT-6B "C" Band Power Switch Less **AX** - ON

5A. ALQ-122 Power Switch **AL** - ON

NOTE

ALT-16A transmitters will not operate in the normal barrage mode **AL** with the ALQ-122 system power turned on.

6. ALT-32:

- (a.) Spot A & B Bandwidth Controls - CCW to minimum
- (b.) Spot A & B Frequency Controls - Set to clear frequencies

CAUTION

Rapid movement of the transmit channel selector through the mode positions may blow fuses in the power supply or transmitter and render the transmitter inoperative.

- (c.) Transmit Channel Selector - A
 - (d.) Signal Presentation, Calibration & Interference - Checked
 - (e.) Spot A Bandwidth Control - Checked and CCW
 - (f.) Transmit Channel Selector - B
 - (g.) Signal Presentation, Calibration & Interference - Checked
 - (h.) Spot B Bandwidth Control - Checked and CCW
 - (i.) Transmit Channel Selector - A & B
- Check that both A & B signals are present.
- (j.) Transmit Channel Selector - BARRAGE 1, 2, 3, and 4
 - (k.) Signal Presentation, Calibration & Interference - Checked
 - (l.) Transmit Channel Selector - STBY

7. ALT-6B/ALT-22/C-7211 Less **AX** :

NOTE

- The C-7211 programmer must be installed in the aircraft before the ALT-22 can be operated.
- The ALT-22 transmitters can be operated without external (C-7211) modulation. However, to do this, the C-7211 power switch must be in the ON position and the applicable mode selectors in N position.

EW OFFICER'S CHECKLIST (Cont)

- a. C-7211 Mode Selector - N (normal)
- b. Width Controls - CW to zero
- c. Tuning Control - Set to clear frequency

CAUTION

Observe restriction on 58D2098-13A, 58D2098-30, and 58D2098-37 antennas listed in T.O. 1B-52D-1-2.

- d. Operate-Standby Switch - OPR, check meter
 ALT-6B MOD CUR 4.0 to 5.5, MOD VOLTS 3.0 to 6.4
 ALT-22 MOD CUR 4.5 to 6.0, MOD VOLTS 3.5 to 8.5
- e. Signal Presentation, Calibration & Interference - Checked
- f. Sweep Widths & Rates - Checked, then CW to zero
- g. C-7211 Modulation - Checked
 Check for audible changes in all modes.
- h. C-7211 Mode Selector - N (normal)
- i. Operate-Standby Switch - STBY
- j. Slow Width Controls - 1/4 CCW

8. ALQ-122 **AL** :

- a. Lamp Test - Accomplished
- b. Mode Switch - XMIT
- c. ALT-16A Power Selectors - TRANSMIT
- d. Test-in-Progress Switch - Depressed, self-test accomplished
- e. ALT-16A Power Selectors - STANDBY
- f. Mode Switch - STBY

9. ALT-28, D/E Band Less **AX** :

- a. Program Selector - BARR
- b. RF Bandwidth Control - FM OFF
- c. Center Frequency Control - Set to clear frequency
- d. Function Selector Less **AW** - BARRAGE

EW OFFICER'S CHECKLIST (Cont)

- (d.) Mode Selector **AW** - MAN
- (e.) Signal Presentation, Calibration & Interference - Checked
- (f.) RF Bandwidth Control - Checked and FM OFF
- (g.) Function/Mode Selector - Warmup mode

10. ALT-28 E/F Band Less **AX:**

- (a.) Program Selector - BARR
- b. Manual Rate Control - Full CW
- (c.) RF Bandwidth Control - FM OFF
- (d.) Center Frequency Control - Set to clear frequency
- (e.) Function Selector Less **AW** - BARRAGE
- (e.) Mode Selector **AW** - MAN
- (f.) Signal Presentation, Calibration & Interference - Checked
- (g.) RF Bandwidth Control - Checked and FM OFF
- (h.) Function Selector Less **AW** - A, set signal to coincidence check frequency
- (h.) Center Frequency Control **AW** - Set signal to coincidence check frequency
- i. ALR-20A Expansion Trace Selector - Set to required trace
- (j.) ALR-20A Sweep Width Control - Set

Select approximately 1/4 of main trace. Position selected segment around transmitter signal.

- (k.) Program Selector - MAN, check for coincidence and modulation

Adjustments of manual rate control and RF level may be necessary to properly display coincidence of back and peak power levels. Check visually for modulation.

NOTE**Less **AW****

Perform programmer check on first transmitter only for each program selector. Perform this check for additional E/F transmitters connected to a different selector.

1. ALT-28 Programmer Less **AW - Checked**

- (1) ALR-20A Sweep Width Control - Full CCW

Tune to transmitter signal.

- (2) Manual Rate Control - Checked and full CW

Check for audible increase/decrease of pulse rate.

EW OFFICER'S CHECKLIST (Cont)

- (3) Program Selector - CS2

Check for audible change in pulse rate while in that mode.

- (4) Program Selector - CS1

Check for audible change in pulse rate while in that mode.

- (5) Program Selector - TS

Check for audible change in pulse rate while in that mode.

1. ALT-28 Control-Indicator Programmer **AW** - Checked

- (1) ALR-20A Sweep Width Control - Full CCW

Tune to transmitter signal.

- (2) Manual Rate Control - Checked and full CW

Check for audible increase/decrease of pulse rate.

- (3) Program Selector - 2

Check for audible change in pulse rate while in that mode.

- (4) Program Selector - A2

Check for audible change in pulse rate while in that mode.

- (5) Program Selector - A1

Check for audible change in pulse rate while in that mode.

- m. Program Selector - BARR

- n. ALR-20A Sweep Width Control - Full CW

- o. Preset Center Frequency Control **Less AW** - Checked, set to required frequency

Check limits in authorized band, then set to required frequency.

- p. Function/Mode Selector - Warmup mode

11. ALT-28 G Band Single Control **Less AW** :

- a. Program Selector - BARR

- b. Manual Rate Control - Full CW

- c. RF Bandwidth Control - FM OFF

- d. Barrage Center Frequency Control - Set to clear frequency

- e. Function Selector - BARRAGE

- f. Signal Presentation, Calibration & Interference - Checked

- g. RF Bandwidth Control - Checked and FM OFF

EW OFFICER'S CHECKLIST (Cont)

- h. Function Selector - A (High Power Transmitter) or B (Low Power Transmitter), set signal to coincidence check frequency

- i. ALR-20A Expansion Trace Selector - Set to required trace

- j. ALR-20A Sweep Width Control - Set

Select approximately 1/4 of main trace. Position selected segment around the transmitter signal.

CAUTION

Do not adjust manual rate control below dial setting of 80 while accomplishing step "k."

- k. Program Selector - MAN, check for coincidence and modulation

Adjustments of manual rate control and RF level may be necessary to properly display coincidence of back and peak power levels. Check visually for modulation.

- l. Program Selector - TS (first transmitter only)

Check visually for modulation.

- m. Program Selector - BARR

- n. ALR-20A Sweep Width Control - Full CW

- o. Preset Center Frequency Control - Checked, set to required frequency

Check limit in authorized band, then set to required frequency.

- p. Function Selector - Warmup mode

12. ALT-28 Dual Control G/H Band Less AX :

- a. Antenna Selector - FWD (Systems 1 and 2)

- b. Program Selector - BARR

- c. Manual Rate Control - Full CW

- d. RF Bandwidth Control - FM OFF

- e. Center Frequency Control - Set to clear frequency

- f. Mode Selector Less AW - BARRAGE

- f. Mode Selector AW - MAN

- g. Signal Presentation, Calibration & Interference - Checked

NOTE

When the ALT-28 system 1 transmitter is transmitting with the forward looking antenna selected and the AN/ALQ-117 is transmitting in the PD FWD mode, system 1 will be blanked in a frequency range 800 to 1,400 MHz below its maximum frequency.

EW OFFICER'S CHECKLIST (Cont)

- h. RF Bandwidth Control - Checked and FM OFF
- i. Mode Selector Less **AW** - A, set signal to coincidence check frequency
- i. Center Frequency Control **AW** - Set signal to coincidence check frequency
- j. ALR-20A Expansion Trace Selector - Set to required trace
- k. ALR-20A Sweep Width Control - Set

Select approximately 1/4 of main trace. Position selected segment around the transmitter signal.

CAUTION

Do not adjust manual rate control below dial setting of 50 while accomplishing step "1."

- l. Program Selector - MAN, check for coincidence and modulation
Adjustments of manual rate control and RF level may be necessary to properly display coincidence of back and peak power levels. Check visually for modulation.
- m. Program Selector Less **AW** - TS1
Check visually for modulation.
- m. Program Selector **AW** - 2
Check visually for modulation.
- n. Program Selector Less **AW** - Slave (G Band only)
- o. C-7240 Program Selector Less **AW** - TS (G-Band only)
Check visually for modulation.
- p. Program Selector(s) - BARR
- q. ALR-20A Sweep Width Control - Full CW
- r. Antenna Selector - OMNI (Systems 1 and 2)
- s. Signal Presentation & Interference - Checked (Systems 1 and 2)
- t. Omni Antenna Monitor Switch - Depressed, signal presentation checked
- u. Preset Center Frequency Control Less **AW** - Checked, set to required frequency
Check limits in authorized band, then set to required frequency.
- v. Mode Selector - Warmup mode

EW OFFICER'S CHECKLIST (Cont)**13. ALQ-155 D/E Band AX :**

- a. Program Selector - BARR
- b. RF Bandwidth Control - FM OFF
- c. Center Frequency Control - Set to clear frequency
- d. Mode Selector - MAN
- e. Signal Presentation, Calibration, & Interference - Checked
- f. RF Bandwidth Control - Checked and FM OFF
- g. DES Switch - Depressed, signal checked

Check for clear band around system search width. The LOK light should not illuminate and the center frequency control should operate normally.

NOTE

Steps "i" and "j" must be accomplished within 30 seconds after initiating step "h."

- h. Mode Selector - BIT, check for signal presence

Switch is spring-loaded to the AUTO position. If test is successful, all lights except FAU will come on. If self-test is not successful, the ERR light will come on and the THREAT ENGAGED indicator will display a character relating to the specific malfunction.

- i. DES Switch - Depressed, signal checked

Signal frequency and bandwidth should increase.

- j. JOG/RES Switch - Depressed, signal checked

Signal should disappear.

- k. Mode Selector - Warmup mode

14. ALQ-155 E/F Band AX :

- a. Program Selector - BARR
- b. Manual Rate Control - Full CW
- c. RF Bandwidth Control - FM OFF
- d. Center Frequency Control - Set to clear frequency
- e. Mode Selector - MAN
- f. Signal Presentation, Calibration, & Interference - Checked
- g. RF Bandwidth Control - Checked and FM OFF
- h. DES Switch - Depressed, set signal to coincidence check frequency

Check for clear band around system search width. The LOK light should not illuminate and the center frequency control should operate normally. Reset system to manual mode and set to an expected threat frequency for the coincidence check.

- i. ALR-20A Expansion Trace Selector - Set to required trace

EW OFFICER'S CHECKLIST (cont)

- j. ALR-20A Sweep Width Control - Set

Select approximately 1/4 of main trace. Position selected segment around transmitter signal.
 - k. Program Selector - MAN, check for coincidence and modulation

Adjustments of manual rate control and RF level may be necessary to properly display coincidence of back and peak power levels. Check visually for modulation.
 - l. Programmer - Checked

 - (1) ALR-20A Sweep Width Control - Full CCW

Tune to transmitter signal.

 - (2) Manual Rate Control - Checked and full CW

Check for audible increase/decrease of pulse rate.

 - (3) Program Selector - 2

Check for audible change in pulse rate.

 - (4) Program Selector - A2

Check for audible change in pulse rate.

 - (5) Program Selector - A1

Check for audible change in pulse rate.
 - m. Slave Function (Systems 5 & 8) - Checked

 - (1) Program Selector - Slave
 - (2) Master Program Selector - 2

Check visually for modulation.
 - n. Program Selector(s) - BARR
 - o. ALR-20A Sweep Width Control - Full CW
- NOTE**
- Steps "q" and "r" must be accomplished within 30 seconds after initiating step "p."
- p. Mode Selector - BIT, check for signal presence

Switch is spring loaded to the AUTO position. If test is successful, all lights except FAU will come on. If self-test is not successful, the ERR light will come on and the THREAT ENGAGED indicator will display a character relating to the specific malfunction.
 - q. DES Switch - Depressed, signal checked

Signal frequency and bandwidth should increase.
 - r. JOG/RES Switch - Depressed, signal checked

Signal should disappear
 - s. Mode Selector - Warmup mode

EW OFFICER'S CHECKLIST (cont)15. ALQ-155 G/H/I Band **AX** :

- (a.) Antenna Selector - FWD (Systems 1 & 2)
- (b.) Program Selector - BARR
- (c.) Manual Rate Control - Full CW
- (d.) RF Bandwidth Control - FM OFF
- (e.) Center Frequency Control - Set to clear frequency
- (f.) Mode Selector - MAN
- (g.) Signal Presentation, Calibration, & Interference - Checked

NOTE

When the ALQ-155 systems 1 & 2 transmitters are transmitting with the forward looking antenna selected and the AN/ALQ-117 is transmitting in the PD FWD mode, systems 1 & 2 will be blanked in a frequency range of 800 to 1,400 MHz below its maximum frequency.

- (h.) RF Bandwidth Control - Checked and FM OFF
- (i.) DES Switch - Depressed, set signal to coincidence check frequency

Check for clear band around system search width. The LOK light should not illuminate and the center frequency control should operate normally. Reset system to manual mode and set to an expected threat frequency for the coincidence check.

- j. ALR-20A Expansion Trace Selector - Set to required trace
- (k.) ALR-20A Sweep Width Control - Set

Select approximately 1/4 of main trace. Position selected segment around transmitter signal.

CAUTION

Do not adjust the manual rate control below dial setting of 50 while accomplishing step "1."

- (l.) Program Selector - MAN, check for coincidence and modulation

Adjustments of manual rate control and RF level may be necessary to properly display coincidence of back and peak power levels. Check visually for modulation.

- (m.) Programmer - Checked (G band)

- (1) Program Selector - 2

Check visually for modulation.

- (2) Program Selector (Systems 4 & 6) - Slave

- (3) Master Program Selector (Systems 4 & 6) - 2

Check visually for modulation.

EW OFFICER'S CHECKLIST (cont)

- (m.) Programmer - Checked (H/I band)
 - (1) Program Selector - 6
 - Check visually for modulation
- (n.) Program Selector(s) - BARR
- (o.) ALR-20A Sweep Width Control - Full CW
- (p.) Antenna Selector - Checked (Systems 1 & 2)
 - (1) OMNI - Depressed
 - (2) Signal Presentation and Interference - Checked
- (q.) Omni Antenna Monitor Switch - Depressed, signal presentation checked

NOTE

Steps "s" and "t" must be accomplished within 30 seconds after initiating step "r."

- (r.) Mode Selector - BIT, check for signal presence

Switch is spring loaded to the AUTO position. If test is successful, all lights except FAU will come on. If self-test is not successful, the ERR light will come on and the THREAT ENGAGED indicator will display a character relating to the specific malfunction.
- (s.) DES Switch - Depressed, signal checked

Signal frequency and bandwidth should increase.
- (t.) JOG/RES Switch - Depressed, signal checked

Signal should disappear.
- (u.) Mode Selector - Warmup mode

EW OFFICER'S CHECKLIST (Cont)**EW EQUIPMENT SET**

Operational ECM equipment will be preset for use as soon as practical after completing the Calibration and Interference Check. Additionally, applicable portions of this checklist may be used throughout penetration and withdrawal to verify equipment readiness and settings. On training missions, applicable portions of this checklist will be used prior to and after all ECM activity. (Successive runs against a single STR site do not require reaccomplishment of this checklist.) Transmitters will not be reactivated. Antenna locations, intelligence data, and the results of the calibration and interference check will be considered when presetting equipment.

NOTE

- ALT-28 transmitters will be placed in STBY 2/STBY Less **AX**, ALQ-155 transmitters in STBY 2 **AX** mode no more than 30 minutes prior to ECM activity and placed in STBY 1/warmup mode after completion of ECM activity unless scheduled for activity within 30 minutes.
- Items that are circled will be repeated for each receiver band/trace and like transmitter.
- To extend the service life of the ALR-20A it should be in Standby when its use is not required. On training missions the ALR-20A should be placed in Standby at the completion of the Equipment Calibration and Interference Check, and remain in Standby until its use is required for area/threat penetrations. The ALR-20A will be returned to Standby when its use is no longer required or at the termination countermeasures point.
- The ALR-46(V)-4 EID file selection, altitude function, search function, and unknown function must be updated as required throughout the mission profile.
- The ALQ-153(V) altitude and HOMING DEFEAT functions must be updated as required throughout the mission profile. **BG**

1. AIC-10 Mixer Switches - As required

2. ALR-20A:

- a. Controls - Optimum
- b. Expansion Traces - Set

Adjust the expansion traces to monitor a threat frequency band.

EW OFFICER'S CHECKLIST (Cont)**3. ALR-46:**

- a. Audio Control - Optimum
- b. Dimming Control - Optimum
- c. Button 1 - As required

3A. ALQ-122 **AL :**

- a. Program Switch - As required
- b. Cover Switch - As required
- c. Mode Switch - As required
- d. ALT-16A Power Selectors - As required

NOTE

For proper operation of the ALQ-122, both ALT-16A transmitters must be in radiate and should be placed in standby when operation is no longer required to conserve TWT life.

4. ALT-16 Less **AL / ALT-16A **AL** :**

- (a.) Channel Buttons - Depressed as required

5. ALT-32:

- (a.) Frequency and Bandwidth Controls - As required

6. ALT-6B/ALT-22/C-7211 Less **AX :**

- (a.) Center Frequency Control - As required
- (b.) Rate & Width Controls - As required
- (c.) C-7211 Mode Selectors - As required
- d. C-7211 CS Frequency Selector - As required

7. ALT-28 Less **AX , ALQ-155 **AX** :**

- (a.) Transmitter Mode - As required
- (b.) Ctr Freq & RF Bandwidth Controls - As required
- (c.) Program Selector - As required

To be accomplished when presetting the first transmitter of each program selector.

- (d.) Manual Rate Control - As required
- (e.) G/H Antenna Selector - As required

EW OFFICER'S CHECKLIST (Cont)

NOTE

- All chaff and flare circuit breakers available to the EW officer will be pulled at all times except when accomplishing this checklist in preparation for actual dispensing of chaff and/or flares. The proper positioning of circuit breakers will then be governed by existing directives.
- The pilot's ALE-20 flare set power switch will be in the OFF position at all times except when accomplishing this checklist in preparation for actual dispensing of flares. (This check is only necessary for initial accomplishment of this checklist unless flares are actually programmed to be dispensed.) The proper positioning of appropriate ALE-20 switches during preparation for actual dispensing will then be governed by existing directives.

8. ALE-24:

- a. Power Switch - OFF
- b. Programmer Selector Switches - As required
- c. Dispense Switches - OFF
- d. Circuit Breaker - In or as directed
- e. Power Switch - ON or as directed
- f. Press-to-Test Lights - Tested
- g. Auto Mode Switch - As required

EW OFFICER'S CHECKLIST (Cont)**9. ALE-20:**

- a. Power Switch - OFF
- b. Flare Program - As required
- c. Transfer Switch - Checked OFF
- d. Pilot's Flare Set Power Switch - ON or as directed
- e. Circuit Breakers - In or as directed
- f. Power Switch - ON or as directed

CAUTION

Removing power from the system while a program is in progress can result in the clutch coil cam being stuck in the detent position, making program mode inoperative.

- g. Press-to-Test Lights - Tested
- h. Auto Mode Switch - As required
- i. Crew Notified - Accomplished

NOTE

Prior to any normal dispensing or emergency jettisoning of flares, the EW officer will notify all crewmembers of this intended action.

10. ALQ-117:

- a. Mode Selector - As required
- b. Standby/Operation Function Selector - As required

NOTE

The ALQ-117 blanking switch will be in HIGH position at all times except when excessive BNS interference is experienced.

10A. ALQ-153(V) BG :

- a. TTI Control - As required
- b. MIN RNG Control - As required
- c. TTI and MIN RNG ENAB/INHBT Pushbutton - As required
- d. STBY/OPER Pushbutton - As required

11. Master Expendables Control Panel:

- a. Flare Burst Interval Selector - Set
- b. Flare Interval Selector - As required

EW OFFICER'S CHECKLIST (Cont)

PRELANDING OPERATIONAL CHECK

1. Periscopic Sextant - Stowed, port closed
- 1A. Special Weapons Manual Lock Handle - Stowed, door closed
2. Prelanding Operational Check - Completed

All ECM equipment not used for ECM runs during the sortie or checked during the "EW Calibration and Interference" check will be checked for operation prior to landing in accordance with procedures for the abbreviated check as outlined in the "EW Calibration and Interference Checklist" consistent with clearance requirements and operating restrictions. Discrepancies will be entered in the appropriate forms.

3. ECM Equipment:



If one or more generators are inoperative, all ECM equipment will be turned off prior to descent.

- a. ECM Equipment - STBY
- b. Chaff & Flare Power Switches - OFF
- c. Chaff, Flare, & Rocket Circuit Breakers - OUT
- d. ALR-46 Intensity Control - Minimum (EW-G)
- e. ALR-46 Power Button - Depressed, power light off
- f. ALQ-153 Power Pushbutton **BG** - Depressed, all panel lights off
- g. Warning Rcvr Circuit Breaker - Out
- h. ALR-20A Power Switch - OFF
4. Safety Belt & Parachute Harness - Fastened
5. Dome & Flood Lights - Adjusted

White lights will be adjusted to preclude interference with night vision of pilot and copilot.

DESCENT AND LANDING CHECKLIST (Copilot/EW reads)

Checklist appears in EW officer's abbreviated checklists and will be read on request of the pilot.

TRAFFIC PATTERN CHECKLIST (Copilot/EW reads)

Checklist appears in EW officer's abbreviated checklists and will be read on request of the pilot.

EW OFFICER'S CHECKLIST (Cont)

AFTER LANDING

NOTE

The "After Landing Checklist" will be performed in the event the mission is ground aborted after preflight has been initiated and after all alert exercises.

1. Arming Lever Safety Pins (No. 1) - Installed
2. Armrests - Stowed
3. ECM Power Switches - OFF



Aircraft electrical power must be maintained for 5 minutes after turning off ECM equipment to allow cooling system to cycle-out, thus preventing damage to the system.

NOTE

- If channel buttons on ALT-16A control-indicators **AL** are depressed and power selector switch is in TRANSMIT, power can be radiated if ALQ-122 system is turned off before ALT-16A system is turned off.
 - Check all ECM power switches, including ALQ-117 heater switch (except alert aircraft), OFF and recheck all chaff and flare power switches prior to leaving position to prevent inadvertent jamming or jettisoning of ECM expendables with the application of ground power.
 - If taxi-back landings are accomplished, the ECM equipment will be turned OFF on the first landing
4. ALQ-117 Sys 15 and Sys 16 Ind Cont Circuit Breaker - Out
 The "Sys 15 and 16 Ind Cont" circuit breaker will be pulled to assure deactivation of the ALQ-117 system.
 5. Ejection Seat - Down and forward
 6. Oxygen System:
 - a. Regulator - OFF and 100% OXYGEN
 - b. Supply Hose & Interphone Cord - Stowed
 7. DI Station:
 - a. Regulator - OFF and 100% OXYGEN
 - b. Supply Hose & Interphone Cord - Stowed

EW OFFICER'S CHECKLIST (Cont)

8. CM SET Circuit Breaker - **BG** - Out

The "CM SET" circuit breaker on the right load central circuit breaker panel will be pulled to assure deactivation of the ALQ-153(V) system.

POSTFLIGHT

1. ALE-20 Safety Interlock Switch Door - Open, streamer installed

On all training flights, the EW officer will insure that the ALE-20 flare ejector safety interlock switch door is open and that streamer is installed.

NOTE

Aircraft accepted for alert status will have the streamers removed and the ALE-20 safety interlock switch doors closed.

2. Required Forms - Completed
3. Crew Debriefing - Completed

Forms, logs, and classified material turned in as briefed.

SYSTEM RESTRICTIONS

Restrictions to operation of any system will be governed by existing regulations and/or directives.

RADIATION RESTRICTIONS

WARNING

- When ECM transmitters are operating, radiation hazardous to human life exists within a 10-foot radius of ALT-28 Less **AX**, ALQ-155 **AX**, ALQ-153 **BG** antennas, and ALQ-117 antennas; and a 6-foot radius of remaining antennas. During periods of ground radiation, ground crew will be notified of the above restrictions.
- Ground operation of ECM transmitters is prohibited within 200 feet of (1) weapons which are not fully assembled, (2) weapons to which continuity testers are connected, or (3) weapons with open access doors.

CAUTION

Do not operate the AN/ALT-28/ALQ-155 system using forward directional antennas for more than 5 minutes on the ground since damage to radome can result. A cooling period of 30 minutes must be observed before this operation may be resumed.

EQUIPMENT COOLING

Critical cooling requirements of ECM equipment demand precautions during ground and inflight operations. Ground cooling must be supplied to the applicable ram air inlet or aircraft compartment when extended ground operation of ECM equipment is required. During inflight operations or ground operations with ground cooling connected, any removed ECM equipment that was located within a cooling shroud must be replaced with a dummy box or equivalent. Failure to do so will result in the loss of cooling air; therefore, operation of any equipment within that shroud is prohibited. Ground operation of ECM systems without cooling air is authorized provided the time and temperature limitations listed in the following table are observed.

CAUTION

- Due to probable equipment damage, operation of ECM equipment without complying with proper cooling, time and/or temperature limitations is prohibited.
- The ALQ-153(V) system will not be operated on the ground unless ground cooling equipment is used. Time, temperature, and cooling requirements of T.O. 1B-52G-2-20 must be complied with.

MAXIMUM GROUND TIME AND TEMPERATURE LIMITATIONS WITHOUT GROUND COOLING			
GROUP	SYSTEMS	TIME	OAT TEMP
A	1, 3, 5, 7 & 20	10 min ↓	60°F 
B	2, 4, 6, 8 (& 21 AL)		
C	9, 11 & 13		
D	10, 12 & 14		
E	15		
F	16		
	ALR-20A	NO TIME LIMIT	↓

Provided no more than one system per group is operating, a system may be operated in transmit for the time and outside air temperature (OAT) depicted. During operation, access doors and shroud covers may be closed except when specified open on the chart. After operation, ECM equipment must cool for at least 30 minutes before operation can be resumed.

 ECM systems may be operated at OAT's above 60°F provided the detailed requirements of T.O. 1B-52G-2-20 are met.

ECM Equipment Operation Requirements

Figure 8-4.

GUNNER'S CHECKLIST

MISSION PLANNING

MISSION PREPARATION

1. Mission Planning:

a. Scheduled FCS Activity - Reviewed

Review mission planning form and weekly aircrew flying schedule for scheduled FCS activity.

b. Flight/FCS Activity Planning - Accomplished

The gunner will accomplish flight planning, coordinating with other crew members on the necessary phases of FCS equipment checks, interference checks, DCE, fighter intercepts, live firing, FEO, and Bonus Deal activity.

c. Gunnery Mission Planning/Activity Report - Completed

The gunner will complete the applicable portion of the gunnery mission planning/activity report in accordance with applicable directives and mission requirements.

d. Publications & Technical Data - Checked

Directives, manuals, and checklists will be checked for currency.

2. Crew Briefing - Attended and completed

Gunner will attend crew briefing and will brief the other crew members and staff (as applicable) on the FCS activity to be accomplished during the mission.

3. Personal Equipment - Checked

Prior to reporting to the aircraft, the gunner will determine that he has the required personal equipment and that it is in proper working order.

PREFLIGHT PROCEDURES

BEFORE EXTERIOR INSPECTION

1. Aircraft Form 781:

Pilot reads Form 781, gunner checks/notes the following:

a. Gun Status - Checked

b. Ammunition Quantity & Type - Checked

c. FEO Loading - Checked

d. FCS Discrepancies & Status - Noted

GUNNER'S CHECKLIST (Cont)

EXTERIOR INSPECTION

1. Walkaround Inspection - Completed

NOTE

The gunner will perform a walkaround inspection and visually check FCS access doors, panels, antenna radomes, cowling, and turret.

INTERIOR INSPECTION

1. Ejection Seat Arming Levers - Stowed, No. 1 safety pins installed and locked

WARNING

If the arming lever(s) has been rotated on a stowed armrest, raising the armrest will fire the arming initiator. If the arming lever(s) has been rotated or the arming lever(s) safety pin is not installed, call maintenance immediately and stay clear of the seat.

- 1A. Equipment - Stowed

Stow personal equipment at crew position.

WARNING

Insure that no equipment is stowed on or near the heating duct, electrical wiring, or electronic equipment.

NOTE

To provide accurate cabin temperature control, do not obstruct the louvered airflow openings in the cabin temperature sensor case on the sidewall adjacent to the gunner's ejection seat.

2. Upper Deck Spare Parachute Preflight:

- a. Inspection Record:

- (1) Inspection & Repack Date - Checked
- (2) Automatic Release Time & Altitude Setting - Checked

- b. Personal Locator Beacon Lanyard - Snapped/Unsnapped (as required)

For peacetime operations, the personal locator beacon lanyard must be configured for automatic operation. When mission requirements dictate the necessity to avoid detection and automatic actuation of the beacon is not desired, the lanyard must be configured for nonautomatic (manual) operation.

- c. Bailout Bottle Pressure & Hose Connector - Checked
- d. Parachute - Unbuckled and stowed

Spare parachute will be unbuckled and stowed in an easily accessible location.

GUNNER'S CHECKLIST (Cont)**3. Ejection Seat:****a. Hatch Link - Checked**

Check link connecting escape hatch to catapult safety pin-pull initiator.

b. Maintenance Safety Pins No. 2, 3, and 5 - Checked removed**WARNING**

Ensure that no streamer has been torn from a maintenance safety pin, thus inadvertently leaving the pin installed. If a maintenance safety pin is installed the status of the seat will be ascertained prior to removal of the pin.

c. Catapult Initiator Safety Pin-Pull Cylinder - Pin in place

Catapult initiator safety pin should extend through the catapult initiator. If pin is pulled out, initiator may have been fired. Call maintenance immediately.

d. Manual Catapult Pin-Pull Lever - Checked

Lever latched, pin-pull cylinder secured.

e. Initiator Tube Runs - Checked connected

Check tubes for proper and secure connections.

f. Shoulder Strap Attaching Fittings - Connected**g. Inertia Reel - Checked**

Check inertia reel lock for proper functioning.

3A. Man-Seat Separator - Checked

Ensure that the nylon man-seat separator straps are placed on the bare seat. Survival kit is then placed over man-seat separator straps.

4. Parachute Preflight:**a. Inspection Record:**

(1) Inspection & Repack Date - Checked

(2) Automatic Release Time & Altitude Setting - Checked

b. Personal Locator Beacon Lanyard - Snapped/Unsnapped (as required)

For peacetime operations, the personal locator beacon lanyard must be configured for automatic operation. When mission requirements dictate the necessity to avoid detection and automatic actuation of the beacon is not desired, the lanyard must be configured for nonautomatic (manual) operation.

GUNNER'S CHECKLIST (Cont)

- c. Bailout Bottle Pressure & Hose Connector - Checked
- d. Parachute Arming Lanyard Anchor - Installed

WARNING

Be certain that the parachute arming lanyard anchor is securely fastened in the attachment fitting on the seat. Failure to attach the lanyard anchor to the seat will necessitate manual operation after ejection.

- e. Parachute Straps - Adjusted (as required)
5. Global Survival Kit:
- a. Kit Plunger Depressed - Checked
 - b. Kit Release Handle Locked - Checked
 - c. Mode Selector Lever - AUTO
 - d. Kit Straps to Parachute/Safety Belt Release Fittings - Checked and attached

Check that attachment fittings are properly connected to the kit, the attachment straps threaded through the safety belt, and the quick-disconnect fittings are properly attached to the parachute (with release buttons on outside), and safety belt release fittings are connected to the seat.

WARNING

Care must be taken to insure that the survival kit attachment straps are properly threaded through the safety belt.

6. Interphone - Connected/Panel set

Transmit function can be checked by momentarily depressing the foot mike switch.

7. Oxygen System:

- a. Regulator Diluter Lever - 100% OXYGEN
- b. Shutoff Lever - OFF

GUNNER'S CHECKLIST (Cont)

- c. Mask & Hose - Check disconnect, then reconnect

Check for 10- to 20-pound pull for disconnect, then reconnect mask and hose.

WARNING

Insure that oxygen supply hose is under seat armrest before hookup with the oxygen mask hose.

- d. Diluter Valve - Checked

Attempt to draw air through the oxygen mask. Ability to draw air indicates a defective diluter valve, oxygen hose and/or connections or mask. Then place the diluter valve to NORMAL position, draw air through the mask, if unable, this would indicate that only 100% oxygen will be available.

NOTE

- If the diluter valve is stuck in the 100% position, this will prohibit the detection of smoke or fumes when use of normal oxygen is required.
- If the CRU-73A regulator is installed, the crew member will not be able to draw air through the system with the shutoff lever OFF. The diluter lever may be moved to NORMAL with the shutoff lever OFF on some CRU-73A regulators. The diluter valve will be in the 100% oxygen position when the shutoff lever is OFF on all CRU-73A regulators.

- e. Shutoff Lever - ON

- f. Pressure - Checked

Pressure gage reads approximately 300 psi.

- g. Emergency Toggle Lever - TEST MASK

With mask disconnected at one side of helmet, the flow indicator should indicate continuous flow.

- h. Mask Test - Accomplished

Attach mask to helmet and hold breath; indicator should indicate no flow.

NOTE

Flow condition may be indicated by a slight leak around the face form. If light hand pressure against the mask does not stop the flow, the mask is unacceptable.

- i. Emergency Toggle Lever - NORMAL

- j. Regulator Diluter Lever - NORMAL/100% (as required)

8. FCS Control Panel:

- a. FCS Switches - OFF/Safe and pinned

- b. Spare Fuses - Checked

GUNNER'S CHECKLIST (Cont)

9. Radar Control Panel:
 - a. Search & Track Emergency Switches - NORMAL
 - b. All Other Switches - OFF
10. ALR-46 Intensity Control - CCW
11. B & C Scope, Cursor Intensity & ANL Controls - CCW
12. Gunner's Stowable Control Unit:
 - a. Control Unit - Extended and locked
 - b. Track & Range Select Switches - RADAR
 - c. Course Switch - PURSUIT
 - d. Control Unit - Stowed and locked
13. FEO Selector Switch - OFF
14. FCS Circuit Breakers - Set
15. Gunner's Light Control Panel - Checked and set (as desired)
16. Warning and Indicator Lights:
 - a. Standby Switch - ON
 - b. Search & Track Low Pressure Lens Control - Open
 - c. Press-to-Test Lights - Checked

Check search and track low pressure warning, FEO, limit indicator, target warning, gyro ready, radar search operate, and gun charger low pressure lights. On aircraft **AU**, the AFSATCOM panels indicator lights will be checked during checkout procedures.
 - d. Standby Switch - OFF
17. Ammunition Counters - Set (as required)

If ammunition is loaded, rounds counters will be set to ammunition load as indicated in AFTO Form 781.
18. Spare Lamps - Checked
19. Hot Cup - OFF
20. Upper Deck Fire Extinguisher - Checked

Assure that appropriate safety device (safety wire/seal or locking pin/lever, as applicable) is installed. Check for fully serviced pressure.

GUNNER'S CHECKLIST (Cont)21. AFSATCOM Terminal **AU** :

The printer must be turned on prior to the SATCOM control panel turn-on to avoid the possibility of the receiver-transmitter locking in the transmit mode.

NOTE

Time permitting, this check will be accomplished prior to engine start; otherwise, it will be accomplished after engine start or takeoff.

a. Printer:

- (1) Power Switch - ON, PWR light on
- (2) Illumination Switch - As desired
- (3) Paper Supply - Serviced (as required)
- (4) Paper Feed - Checked

b. Keyboard:

- (1) Memory Indicator - Displays small zero
- (2) RESET Key - Pressed, indicators checked

All lights on keyboard will come on, word panel flashes, MEM indicator displays alternating ☐ and - and TEST indicator displays alternating * and ☐.

c. SATCOM Control:

- (1) Lamp Test Button - Pressed, indicators checked

All segments of digital display and all annunciators are illuminated.

- (2) Dim-Bright Control - As desired
- (3) LOS Radio Preempt Check:

- (a) Mode Selector - KEY
- (b) LOS Function Selector - BOTH - (G-CP)

Request copilot to position LOS function selector switch to BOTH.

- (c) LOS PMT Light - Checked on
- (d) LOS Function Selector - SATL - (G-CP)

Request copilot to position LOS function selector switch to SATL.

- (e) LOS PMT Light - OFF

- (4) Mode Selector - BIT

- (a) Annunciators and Digit Display - Checked

All annunciators and digit display will light for 5 seconds.

GUNNER'S CHECKLIST (Cont)

(b) Fault Test - Completed

If no faults are present, the built-in-test will take approximately 35 seconds.

(c) Channel Select Data - Checked

Cycle each channel select switch through its range and note that the digit display increases by one each time the associated thumbwheel increases by one. The left most alphabetic position will be displayed in numeric equivalent, i.e., (A-1, B-2, etc).

(5) MNL Check

The following check may be accomplished only while channel select data is being displayed:

(a) MNL XMT Key - Pressed

(b) Type Several Characters - Typed

Each input character should be printed out once by the printer. Note that RCVR BUSY indicator comes on. If no key is pressed for approximately 10 seconds, four ETXs will be printed.

NOTE

Approximately 20 seconds after the last character is entered the complete BIT cycle will repeat.

(c) LOS Function Selector - As desired (G-CP)

Advise copilot to position LOS function selector switch as desired.

(d) Mode Selector - LOAD

GUNNER'S CHECKLIST (Cont)

d. Keyboard:

NOTE

During the keyboard check, the message will be printed out on the printer, the AUTO XMT indicator will go off and the I/O FLT annunciator on the control panel will come on.

(1) Buffer # 1-set (20 characters)

(2) Message-typed

Message should contain all keyboard characters. ETX should be the last character entered. When 20 characters are entered, the MEM indicator will alternate 1 and F. When 20 characters are exceeded, the MEM indicator will alternate 1 and E.

(3) Buffer # 1-set (60 characters)

(4) Message - Transmitted

Utilize AUTO XMT and select Buffer # 1

e. SATCOM Control Mode Selector - Off (N/A after generators are on the line)

f. Printer Power Switch - Off (N/A after generators are on the line)

g. Address Enable/Disable Switch - Positioned (as directed)

h. Prepositioned Channelization and Address Settings - Set (as directed)

Manually set all information not requiring power on.

22. Crew Report - Completed (at pilot's request)

The sequence for crew reporting is: N, G, EW, RN, CP, P, IN, DI, 10th, and IP. Switch interphone to CALL and report, "Gunner's check complete." Check consists of abandon signal and call operation.

GUNNER'S CHECKLIST (Cont)

PRE-TAKEOFF PROCEDURES

BEFORE ENGINE START

1. Oxygen Regulator - ON, NORMAL/100% (as required)
2. Upper Deck Sliding Hatch - Open and locked

WARNING

The upper deck sliding hatch will be opened and locked prior to takeoff, air refueling, low level activity, planned unusual maneuvers, penetration, and landings.

AFTER ENGINE START/BEFORE TAKEOFF

WARNING

Whenever contamination is suspected, 100% oxygen will be used for ground operation and takeoff.

CAUTION

To ensure that damage to the FCS does not occur when operating on the ground, operate in WARMUP or ON no longer than 20 minutes prior to takeoff when OAT is 85° or higher.

NOTE

Time permitting, the following items "1" thru "16" will be accomplished prior to takeoff.

1. FCS Power Switch - WARMUP (after generators are on the line)
2. Target Warning Light - Checked

Check that the target warning light comes on, remains on for a short period of time, and then goes out. This indicates power is applied to the search radar.

3. Search Antenna Switch - ON

GUNNER'S CHECKLIST (Cont)**4. Radar Indicator Check:****a. Overlay Intensity - Set****b. B Scope Intensity & Rasters (3 range sweeps) - Checked and adjusted**

Increase B intensity until rasters are visible. Focus rasters. Check that there are no broken or missing rasters. Check that rasters extend to both azimuth limits of the scope. Check that rasters extend from the bottom to the top of the scope in all three range sweeps. Reduce B intensity to just under raster visibility.

c. C Gate Length Control - Checked

Check that STC marker is visible. Check that marker can be positioned farther than 20,000 yards and closer than 500 yards.

d. C Scope Intensity & Rasters - Checked and adjusted

Increase C intensity until rasters are visible. Focus rasters. Check that rasters are not jagged or broken. Check that rasters cross at zero elevation and extend to scope limits in both azimuth and elevation. Reduce C intensity until sweeping rasters are just visible.

e. Circle Cursor - Checked and adjusted

Hold action switch closed. Turn up cursor intensity until circle cursor appears on C scope. Focus cursor with C focus control if necessary. Check that cursor is circular with a diameter of about 1/8 to 1/4 inch. Adjust cursor intensity for optimum presentation.

f. Dot Cursor - Checked

With action switch closed, press second target button. Check that dot cursor appears within 5° of center of C scope.

5. FCS Power Switch - ON

The track button will not be depressed until the gyros have timed out.

6. Range Dial 1700 (± 75) Yards - Checked**7. Circle Cursor - Checked**

Close action switch with control handles centered. Check that circle appears at center of C scope and can be moved in azimuth and elevation.

GUNNER'S CHECKLIST (Cont)

8. Turret Stowed - Checked

Close action switch and press second target button. Check that dot cursor appears at center of C scope. Notify pilot if dot cursor position indicates turret not stowed.

9. Radar Search Switch - ON

10. Search Antenna Switch - OFF

11. Search Radar Check:

a. Search Operate Light On - Checked

Check that the search operate light comes on after the search radar has had at least a 3- to 4-minute timeout since placing the FCS power switch to WARMUP. Check that the light is not blinking.

b. Video - Checked

Check that video on both scopes is strong and not breaking up. Check that some distant ground returns are present in range sweep 20.

c. ANL - Checked

Rotate ANL control just out of detent. Check that noise and all but extremely strong ground returns disappear from both scopes. Rotate ANL control clockwise and check that noise increases to maximum at full clockwise position. Set ANL for optimum video presentation in detent.

12. Emergency Search Switch - ON

13. Range Marker Switch - ON

14. Track Radar Check:

a. Video - Checked

Check that video appears on the programming on both scopes and that it is strong and not breaking up. Check that distant ground returns are presented in range sweep 20.

b. Range Lock-On and AGC:

(1) Stow Button - Depressed and held

(2) Range Gate Locked on 500, 2000, 2500, and 7000 Yard Markers - Accomplished, range dial checked

Use thumbwheels as necessary to lock range gate on the markers, simultaneously check range dial reading corresponds within 75 yards up to dial limit.

GUNNER'S CHECKLIST (Cont)

- (3) Video Dimming - Checked

Check that video on both scopes dims as the range gate locks on.

- (4) Stow Button - Released

- c. Emergency Search Switch - OFF

15. Range Sweep Calibration Check:



Do not press track button at any time during this check.

- a. Range Sweep Switch - 10
- b. STC Marker - 4000 yards
- c. Track Switch (on radar control panel) - ON
- d. Action Switch - Closed

Close action switch to display a single range gate on the B cursor.

- e. Lock On 2000-Yard Marker - Accomplished

Use thumbwheels as necessary to lock range gate on 2000-yard range marker.

- f. Range Gate Appears at 2000-Yard Grid Line - Checked
- g. Range Sweep Switch - 5
- h. Range Gate & STC Marker - Checked

Check that the range gate has moved to 4000 yards and the STC marker has moved to 8000 yards on the grid overlay.

- i. Range Sweep Switch - 20
- j. Range Gate & STC Marker - Checked

Check that the range gate is halfway between 0 and 2000 yards and STC marker has moved to 2000 yards on the grid overlay.

- k. Track Switch - OFF

GUNNER'S CHECKLIST (Cont)

- l. Range Marker Switch - OFF
- m. Range Sweep Switch - As desired

16. AFSATCOM Terminal **AU** :

CAUTION

The printer must be turned on prior to the SATCOM control panel turn-on to avoid the possibility of the receiver-transmitter locking in the transmit mode.

NOTE

Do not enter data into memory until aircraft power is available. A possibility exists that a momentary interruption of power could occur when switching from ground to aircraft power which would erase the memory in the character memory unit.

- a. Printer Power Switch - ON
- b. SATCOM Control:
 - (1) Mode Selector - Set (as required)

The mode selector must be in KEY when loading the AFSAT sync code and alternate frequency, and in LOAD when loading the LES sync code and real time.

- (2) Real Time - Set (as required)
- (3) Sync Code - Loaded
- (4) Alt Freq - Loaded
- (5) Time Slot - Set

Position mode selector to OPR-1 prior to loading the time slot (IBX).

- (6) Mode Selector - Set (as directed)

GUNNER'S CHECKLIST (Cont)**17. Crew Equipment:**

- a. Parachute - On, fastened and adjusted
- b. Oxygen Hose & Bailout Bottle - Connected
- c. Safety Belt - Fastened
- d. Survival Kit Straps - Adjusted

WARNING

- Tighten the parachute survival kit attachment straps as tightly as possible to prevent the safety belt from inflicting facial injuries during bailout.
- Insure that the parachute arming lanyard is not entangled in the parachute harness. Lanyard entanglement could cause failure in seat separation and failure of the automatic features of the parachute.

18. Arming Lever Safety Pins - Removed (P-CP-EW-G)**19. Takeoff Report - As required**

Copilot announces over interphone, "Crew, stand by for takeoff." Acknowledgment by crewmembers not required unless some discrepancy exists that may compromise successful completion of the mission.

GUNNER'S CHECKLIST (Cont)**INFLIGHT PROCEDURES****TAKEOFF**

1. Radar Scope - Monitored and report (as required)

Report approximate clock angle and range of overtaking/cell aircraft on the FCS indicator.

2. Ammunition Chambered - Accomplished:

WARNING

ACTUAL AMMUNITION chambering item "d" will be accomplished on EWO airborne alert, contingency launches, or when specifically directed by Major Command Headquarters. Chambering will be accomplished over uninhabited areas as soon as possible after takeoff. Under NO circumstances will item "d" be accomplished on routine training missions.

- a. Guns Ready-Safe Switch - SAFE and pinned
- b. Range Sweep Switch - 20
- c. Area Clear & Not Over Populated Area - Checked

Gunner will request Radar Navigator to clear forward area; the gunner will clear the aft area.

- d. Battery Holdback Switch - HOLDBACK (one operation only) (simulated on training missions)

WARNING

- In the event of a runaway gun, the gunner will actuate the Emergency Mode switch to ON to gain positional control of turret and point guns into an uninhabited area.
- On missions taking off in cell with ammunition loaded, the gunner will actuate the emergency mode switch to ON to gain positional control of the turret and point the guns away from the following aircraft in cell prior to actuating the battery holdback switch.

GUNNER'S CHECKLIST (Cont)

CLIMB

NOTE

The circled numbers indicate those items which will be accomplished during climbout from low level.

① 12,000-Foot Oxygen Check - Completed (G-RN-P/CP)

- a. During the climb, copilot requests an oxygen check at 12,000 feet. The sequence for oxygen report is gunner, radar navigator, pilot/copilot. The reporting crew member will visually check other crew members for alertness. He will report oxygen check for both positions. Oxygen panel at each occupied crew position(s) will be checked on all oxygen checks for:

- (1) Oxygen Supply Shutoff Lever - ON
- (2) Regulator Diluter Lever - As required
- (3) Pressure - 300 psi
- (4) Flow Indicator - Functions normally
- (5) Emergency Toggle Lever - NORMAL

- b. Gunner reports, "Oxygen panels checked,"

② Level-Off Oxygen Check - Completed

The copilot requests an oxygen check at level-off. Gunner checks equipment and reports if abnormal.

FCS OPERATION/PROCEDURES

1. Equipment Interference Check:

- a. ALR-46:

- (1) ALR-46 Mixer Switch - UP
- (2) Intensity & Audio Controls - Optimum

Adjust ALR-46 intensity control clockwise until an optimum display of symbols is obtained (may be accomplished during self-test).

- (3) Self-Test Video & Audio Indications - Checked and reported

Report video and audio following each test cycle.

- b. ALQ-153 **BG**

- (1) ALQ-153 Mixer Switch - UP
- (2) Self-Test Audio Indication - Checked and reported

Report audio following a tone of approximately 3 seconds.

GUNNER'S CHECKLIST (Cont)**2. FCS Operational Check - Accomplished**

- a. Crew Notified Prior to Operating Turret - Accomplished
- b. Accomplish the FCS Equipment Check procedures as outlined in this section.

3. Defensive Coordination Exercise - Accomplished

Accomplish DCE in accordance with applicable directives.

4. Cell Join Up Procedures - Monitored and reported**5. FCS/BNS Range & Azimuth Check - Accomplished and reported (contingency only)**

- a. Accomplish FCS/BNS check in accordance with applicable directives.
- b. Report bonus deal capability to pilot.

NOTE

Bonus deal capability will only be reported on contingency missions/ contingency training missions where actual range checks are accomplished.

6. After Level Off/On Watch Procedures:

These procedures will be accomplished in accordance with applicable directives upon completion of the equipment interference and FCS operational checks.

- a. FCS Switches Optimum Mode - Checked

NOTE

Based on the results of the FCS equipment checks, the gunner will configure the FCS for the optimum mode available. This configuration may change if FCS malfunctions occur after completion of the FCS operational check.

- (1) Range Sweep Switch - 20
- (2) Guns Ready-Safe Switch - READY (simulated on training missions)

WARNING

On missions flying in cell formation with ammunition loaded, the gunner will actuate the emergency mode switch to ON to gain positional control of the turret. Grasp the control handles being sure not to close an action switch or trigger and position the guns away from following aircraft. With guns pointing in a safe area, place the ready-safe switch to READY and close both action switches.

GUNNER'S CHECKLIST (Cont)

- (3) STC Marker - Set (as required)
- b. FCS Indicator & ALR-46 - Monitored
- 7. On Watch and FCS Status:
 - a. Gunner Reports - On Watch and Status of FCS

NOTE

Throughout the mission, the gunner will inform the pilot of any change of system capabilities for target detection and radar tracking.

- 8. HHCL Procedures:
 - a. FCS Switches - As required

FCS will be configured and operated in accordance with applicable directives.

CRUISE

CAUTION

If it becomes necessary to leave the seat, the gunner will place the radar search/emergency search switch OFF.

- 1. Radar Scope - Monitored and report (as required)

Report approximate clock angle and range of overtaking aircraft detected on the FCS indicator.
- 2. Oxygen Checks - Completed

Check equipment in accordance with procedure outlined under CLIMB.

NOTE

During cruise the copilot requests oxygen checks at 1-hour intervals when cabin altitude is below 12,000 feet, at 30-minute intervals when cabin altitude is 12,000 to 25,000 feet, and at no longer than 10-minute intervals when cabin altitude is above 25,000 feet. If cabin altitude is below 12,000 feet, only the pilot/copilot will report. The remaining crewmembers will check their equipment and report if abnormal. Oxygen checks are not required below 10,000 feet MSL.

AIR REFUELING

- 1. Interphone Panel - Set

GUNNER'S CHECKLIST (Cont)

2. Upper Deck Sliding Hatch - Open and locked
3. Tanker Position - Monitored and reported (if applicable)
4. FCS Switches:
 - a. FCS Power Switch - WARMUP
 - b. Radar Search Switch - OFF
 - c. FCS Switches Positioned - Report (at pilot's/copilot's request)
5. FCS Switches - Positioned

Switches will be placed ON (commensurate with system capability) immediately after final disconnect or emergency separation (either actual or practice) to notify crew of tanker position.

DESCENT/LANDING**NOTE**

The circled numbers indicate those line items which will be accomplished prior to low level.

1. ALR-46 Audio & Intensity Controls - Minimum (at EW's request)
2. Interphone Panel - Set
- ③. Upper Deck Sliding Hatch - Opened and locked
4. Guns Ready-Safe Switch - SAFE and pinned
5. FCS Power Switch - ON
6. Turret Stowed - Checked (report as required)

GUNNER'S CHECKLIST (Cont)

POSTFLIGHT PROCEDURES

AFTER LANDING

1. Arming Lever Safety Pins (2) - Installed

NOTE

If ammunition has been loaded, the following circled items will be accomplished in addition to the remaining required items of the "After Landing" checklist.

- ② Emergency Mode Switch - ON
- ③ Control Handle Upper Elevation Limit & Held - Accomplished
- ④ Turret Position - Checked and maintained

Continue to hold control handles against the upper elevation limit for approximately 30 seconds after turning the FCS power switch OFF to insure that the turret remains elevated.

5. B & C Scope Intensities - CCW
6. Cursor Intensity - CCW
7. Radar Search Switch - OFF
8. FCS Power Switch - OFF
9. FCS Control Panel Switches - OFF, SAFE, and pinned

NOTE

- Do not pull FCS circuit breakers or remove FCS control panel fuses when recovering from practice alert exercises.
- The following circled items will be accomplished when uncocking alert aircraft.

GUNNER'S CHECKLIST (Cont)

10. FCS Circuit Breaker Panel:

- a. FCS Forward Ground Power Control Circuit Breaker - Pulled
- b. FCS Power Circuit Breaker - Pulled
- c. FCS Aft Ground Power Control Circuit Breaker - Pulled

11. FCS Control Panel Fuses (4) - Removed and stowed

Stow fuses in the No. 1 flight safety pin pouch located on the EW officer's seat.

11A. AFSATCOM Terminal **AU** :

- a. SATCOM Control Mode Selector - OFF
- b. Address - Set 000
- c. Printer Power Switch - OFF

12. Ejection Seat - Down and forward, armrest stowed.

13. Oxygen System - OFF/100%

14. "Hot Guns" Sign - Installed

Install "Hot Guns" sign on FCS control panel.

15. Lighting Panel Controls - As required

16. Interphone & Oxygen Hose - Disconnected and stowed

17. Exterior Inspection - Completed

NOTE

The gunner performs a walkaround and inspection of the turret, visually checking for hydraulic leaks, FCS access doors/panels, antenna radomes, cowling, and azimuth and elevation stow position of the turret.

18. Crew Debriefing:

- a. FCS Operator Log/Forms - Completed
- b. Form 781 Entries - Completed

FIRE CONTROL SYSTEM CHECKOUT PROCEDURES

NOTE

- Proceed with the following equipment check if all required FCS checks under the After Engine Start/Before Takeoff checklist have been previously completed.
- The procedures outlined in this checklist are designed as a guide for the gunner in determining the optimum operational capability of the system. If the gunner detects a malfunction of an operational mode, he may elect to use various operational configurations to cross-check and isolate the malfunctions. If FCS malfunction(s) precludes accomplishment of a complete checkout, the applicable portions will be accomplished. Refer to T.O. 1B-52G-1-5, Section IV, for malfunction analysis and emergency operation.
- Notify crew prior to operating turret (movement of the turret will cause vibration of the aircraft).

WARNING

When performing operational checks on training missions with ammo loaded, the guns ready-safe switch must be in SAFE and pinned, chargers released (battery-holdback switch in BATTERY), and trigger(s) not pressed except over designated firing areas.

CAUTION

- If the search low pressure warning light comes on, position the radar search switch to OFF and operate in emergency search. If the track low pressure warning light comes on, position the track and range select switches to MANUAL and operate in manual track-manual range.
- When stow pin is installed in turret, system operation is limited to operation from radar control panel ONLY. Serious damage to turret drive system will result if power is applied from the FCS control panel.
- The radars may be operated below 6000 feet pressure altitude if either or both low pressure warning lights are on.
- Do not operate system above 50,000 feet as arcing of components can occur at high altitude.
- It will be necessary to reposition the FCS power switch to WARMUP to determine if the gyros have timed out.
- If the GYROS READY light does not come on, indicating that the gyros have timed out, do not attempt to enter radar track/manual track until gyro operation is checked. Gyro operation can be checked in emergency manual track-manual range by using the lead correction check.
- Any time the radar system is not being monitored by the gunner, the radar search/emergency search switches will be positioned to OFF.

FIRE CONTROL SYSTEM CHECKOUT PROCEDURES (Cont)

SEARCH MODE

1. Gyros Ready Light - Checked

Check GYROS READY light is on by placing FCS power switch to WARMUP, and then return to ON.

2. Action Switch - Closed

3. Circle Cursor Appears - Checked

4. L/S Servos Rate Control Check (Azimuth and Elevation):

- a. Circle Cursor Drives Smoothly to Full Limits When Control Handles Are Displaced - Checked
- b. Circle Cursor May Be Stopped at Any Desired Position by Centering Control Handles - Checked

5. Boost Control of L/S Servos - Checked

Move control handles rapidly and check that circle cursor appears to jump while handles are being moved. Check boost in both azimuth and elevation.

6. Action Switch - Released

7. Circle Cursor Disappears - Checked

8. STC Marker - Checked

Check STC marker controls the range of the C-scope.

9. ANL - Adjusted for optimum

NOTE

Normally, optimum presentation will occur when the ANL control is set at full counterclockwise (detent) position; however, if video is weak at this setting, a higher noise level should be selected. Proper noise level is indicated when the scopes display a slight "salt and pepper" appearance when no video is being presented.

FIRE CONTROL SYSTEM CHECKOUT PROCEDURES (Cont)**ACQUISITION MODE**

1. Action Switch - Closed
2. Range Gate Sweep Check:
 - a. Track Button - LIGHT PRESS; range gate sweeps to 7000 yards
 - b. Track Button - HARD PRESS; range gate sweeps to 2500 yards
3. Nominal Prediction Check:

NOTE

- If range gate is locking on noise or ground returns, place the range select switch to MANUAL for this check. When the check is completed, stow the system immediately by placing the range select switch back to RADAR.
 - Perform items "c" and "d" in all four directions.
- a. Second Target Button - Depressed and held
 - b. Dot Cursor Appears at Center of Circle Cursor With L/S at Center - Checked

FIRE CONTROL SYSTEM CHECKOUT PROCEDURES (Cont)

- c. Dot & Circle Cursors Maintain Nominal Prediction Separation as L/S Angle is Increased; Limit Indicator Light Comes on as Dot Cursor Stops at Turret Limit, Circle Cursor Moves to Edge of Scope - Checked
 - d. With Control Handles Displaced Slightly in Opposite Direction, Observe that the Turret moves off the Limit When the Nominal Prediction Angle is Reestablished - Checked
- 4. Control Handles - Released
 - 5. System Stows - Checked

RADAR TRACK/SECOND TARGET MODES

- 1. Range Marker Switch - ON
- 2. Action Switch - Closed
- 3. Circle Cursor Centered on C Scope - Accomplished
- 4. Track Button - Depressed and held
- 5. Range Gate Locked on Marker - Noted
- 6. System Controlled by Track Radar - Checked

With the action switch and track button still depressed, move the control handles and check that the handles have lost control of the circle cursor.

- 7. Track Button - Released

NOTE

Second target mode can be entered only from radar track mode.

- 8. Second Target Button - Depressed and held
- 9. Dot Cursor Appears at Turret Position - Checked
- 10. Circle Cursor Positioned on Opposite Side of Scope from Turret but Within Turret Limits - Accomplished
- 11. Track Button - Depressed and held
- 12. Dot Cursor Drives to 4/5 L/S Angle - Checked

Since the range gate is locked on an internal marker, which has no azimuth or elevation position, the range gate will not unlock as the turret slews to a new position. The system will, therefore, remain in acquisition mode until the track button is released or until a new lock-on is obtained.

- 13. Control Handles - Released

FIRE CONTROL SYSTEM CHECKOUT PROCEDURES (Cont)

14. Circle Cursor Drives Toward Center of Scope - Checked

The track radar does not develop tracking correction signals while locked on a range marker. The system tracks toward center at a nominal tracking rate that was determined by the angle-off of the L/S.

15. Stow Button - Depressed and released

16. Range Marker Switch - OFF

MANUAL TRACK — MANUAL RANGE MODE

NOTE

If engaged in FEO activity, position track range marker switch OFF.

1. Track & Range Select Switches - MANUAL

2. System Drift Check:

NOTE

Do not move control handles during this check.

a. Action Switch & Track Button - Depressed and released

b. Circle Cursor Remains at Center of Scope or Drifts Slowly to a Limit - Checked

NOTE

- If the circle cursor drives rapidly away from center in manual track, it is likely that the turret drive loop is malfunctioning. System drift is within tolerance when the turret (as indicated by the circle cursor) does not drift to a limit in less than 15 seconds.
- Any allowable drift that is present during step "2" will affect system performance during the following steps "3," "4," and "5." So long as this drift can be cancelled out with slight corrections from the control handles during these checks, no malfunction is indicated.

3. Azimuth Aided Rate and Gyro Servos Check:

NOTE

Perform this check on both sides in azimuth.

a. Action Switch & Track Button - Depressed and held

b. Circle Cursor 60° Azimuth, 0° Elevation - Positioned

c. Control Handles - Released

d. Circle Cursor Drives Smoothly Through Center at a Constant Rate; When Turret Reaches Opposite Limit, Circle Cursor Continues on to Edge of Scope - Checked

FIRE CONTROL SYSTEM CHECKOUT PROCEDURES (Cont)

4. Elevation Aided Rate and Gyro Servos Check:

NOTE

- Perform this check on both sides in elevation.
- Nominal tracking rates in elevation are inherently slow. It may be necessary to give the aided rate servo a slight additional signal with the control handles to start the system tracking in the proper direction.

- a. Action Switch & Track Button - Depressed and held
- b. Circle Cursor 45° Elevation, 0° Azimuth - Positioned
- c. Control Handles - Released
- d. Circle Cursor Drives Smoothly Through Center at a Constant Rate; When Turret Reaches Opposite Limit, Circle Cursor Continues on to Edge of Scope - Checked

5. Cross-Roll Gyro Check:

NOTE

Perform this check in all four quadrants.

- a. Action Switch & Track Button - Depressed and held
- b. Circle Cursor 60° Azimuth, 45° Elevation - Positioned
- c. Control Handles - Released
- d. Circle Cursor Drives Smoothly Toward Center & Into the Opposite Quadrant - Checked

6. Acceleration Control Check:

NOTE

Perform this check in both azimuth and elevation.

- a. Control Handles - Centered
- b. Action Switch & Track Button - Depressed and released
- c. Control Handles Displaced & Held; Circle Cursor Accelerates - Checked
- d. Control Handles Displaced & Held in Opposite Direction of Cursor Movement; Circle Cursor Decelerates - Checked

7. Stow Button - Depressed and released

FIRE CONTROL SYSTEM CHECKOUT PROCEDURES (Cont)

EMERGENCY SEARCH — ON MODE

1. Range Sweep Switch - 20M
2. Track & Range Select Switches - RADAR
3. Emergency Search Switch - ON
4. Search Operate Light Out - Checked
5. B & C Intensities Adjusted - As required
6. Programming Pattern - Checked

Pattern appears at center of scope, extends to approximately 45° in azimuth and 10° in elevation and moves in a clockwise direction.

EMERGENCY SEARCH — SYNCHRONIZATION/ACQUISITION MODES

1. Action Switch - Closed
2. Track Button - LIGHT PRESS
3. Rate Control of Programming Pattern - Checked
4. Track Antenna Movement Check:
 - a. Programming Pattern Full Down in Elevation - Positioned
 - b. Ground Returns on B Scope Appear at Longer Range on Left to Right Sweep Than on Right to Left Sweep - Checked
5. Track Button - HARD PRESS
6. Presentation Collapses at Center of Pattern; Range Gate Sweeps to 7000 Yards - Checked
7. Track Antenna Movement In-Limits - Checked

Keeping turret in limit, move C Dot up & down; leading edge of ground return on B-line moves out and in as dot moves up and down.
8. Control Handles - Released
9. Programming Pattern Reappears at Scope Center - Checked
10. Emergency Search Switch - OFF
11. B & C Intensities Readjusted for Search Presentation - As required

EMERGENCY ON MODE

1. Emergency Mode Switch - ON
2. Circle Cursor Appears at Scope Center - Checked
3. Second Target Button - Depressed and held
4. Positional Control Check:
 - a. Circle & Dot Cursors Follow Control Handle Movement & Stop When Handles Are Stopped - Checked
 - b. Circle Cursor Does Not Move Beyond Turret Limits - Checked

FIRE CONTROL SYSTEM CHECKOUT PROCEDURES (Cont)

EMERGENCY MANUAL TRACK — MANUAL RANGE MODE

NOTE

If engaged in FEO activity, position the emergency mode switch to ON.

1. Track & Range Select Switches - MANUAL
2. Windage Correction Check:

NOTE

Perform this check in all four limits.

- a. Action Switch & Track Button - Depressed and held
 - b. Range Wheels - Maximum range out and held
 - c. Circle Cursor Against a Limit - Positioned
 - d. Track Button Released; Circle Cursor Moves in Slightly Toward Center - Checked
 - e. Track Button Depressed & Held; Circle Cursor Jumps Back to Limit - Checked
3. Lead Correction Check:

NOTE

Perform this check in all four directions away from center.

- a. Action Switch & Track Button - Depressed and released
 - b. Range Wheels - Maximum range out and held
 - c. Move Control Handles Rapidly Away from Center & Past Turret Limits; Circle Cursor Initially Moves Rapidly, Then Slows Down or Stops, Then Drifts Slowly Toward Turret Limit - Checked
4. Range Servo Check:
 - a. Estimated Target Speed:
 - (1) Scribe Mark on Right Range Wheel - Centered
 - (2) Action Switch & Track Button Depressed & Held; Range Dial Stowed - Checked
 - (3) Track Button Released; Range Dial Drives to Minimum Range at Nominal Range Rate - Checked
 - b. Range Dial Controlled by Range Wheels - Checked
 5. Stow Button - Depressed and released
 6. Track & Range Select Switches - RADAR
 7. Emergency Mode Switch - OFF

NOTE

If the system does not meet the requirements of this equipment check, the discrepancies will be entered in AFTO Form 781 and in Gunnery Mission Planning/Activity Report.

DEFENSIVE COORDINATION EXERCISE

NOTE

If FCS malfunctions preclude accomplishment of the complete check as outlined below, the applicable portions will be accomplished.

1. FCS Configured For Radar Track/Radar Range - SET

If system will not track in RT/RR, complete the applicable portions of line items 2, 3, and 4 using MT/RR or EMERG MT/RR to determine system capability.

2. STC Marker - SET

3. Range Sweep Switch - 20M

4. Chaff Drop - Requested

a. Minimum Target Presentation Range - Noted

b. Lock-On - Accomplished

c. Acquisition Range - Noted

Depress second target button to determine radar tracking and turret stability.

d. Maximum Tracking Range - Noted

e. Maximum Target Presentation Range - Noted

5. Angular Track Check - Accomplished

If the system is not capable of full automatic track (RT/RR) the angular track check is not required.

a. Chaff Drop - Requested

b. Lock-On - Accomplished

Insure that system is in automatic track (approximately 500 yards) before proceeding with the angular track check. Depress second target button to determine turret stability.

c. Request Pilot Initiate Maneuver - Accomplished

Request pilot to initiate a 30° turn from track using a 30° bank angle. Upon completing the 30° heading change return to the original heading. Initiate second maneuver and reaccomplish steps 5a through 5c, making the initial heading change in opposite direction from that previously conducted.

6. Emergency Search Switch - ON

If search radar malfunctions preclude target presentation, applicable portions of the DCE will be accomplished in Emergency search.

7. Chaff Drop - Requested

a. Minimum Target Presentation Range - Noted

b. Maximum Target Presentation Range - Noted

8. Emergency Search Switch - OFF

FIGHTER INTERCEPT EXERCISE

1. Upper Deck Sliding Hatch - Open and locked

NOTE

Whenever scheduled fighter intercepts are to be conducted, the gunner will accomplish the armament safety procedures prior to the first attack by the interceptor.

2. Armament Safety Check:
 - a. Guns Ready-Safe Switch - SAFE and pinned
 - b. Battery Holdback Switch - BATTERY
 - c. Battery Holdback Switch Fuse (4 Amp) - Removed
 - d. Safety Check - Accomplished and report
 - e. Notify Navigator/Note Time - Accomplished
3. Fighter Intercept Procedures:

NOTE

Do not press triggers during this activity.

- a. FCS Switches Optimum Mode - Set
- b. Radar Search Switch - ON
- c. Range Sweep Switch - 20
- d. STC Marker - Set
- e. Interphone Panel - Set
- f. ALR-46:
 - (1) Mixer Switch - Up
 - (2) Audio Control - Set (optimum)
 - (3) Intensity Control - Set (optimum)
 - (4) Audio & Indicator - Monitored
- g. Intercept Activity Conducted in Accordance with Governing Directives - Accomplished
- h. Log/Form Entries - Completed
- i. Battery Holdback Switch Fuse (4 amp) - Installed

FIREOUT PROCEDURE

1. FCS Switches Optimum Mode - Set
2. Interphone Panel - Set
3. Radar Search Switch - ON

NOTE

If the search radar is inoperative, the track radar will be used for radar surveillance to clear the aft area.

4. Radar Clearance Check - Accomplished

Gunner will monitor his scope to insure no targets are visible within his area of radar coverage.

5. Firing:

- a. Request Clearance to Fire from Pilot - Accomplished

NOTE

Following items will be accomplished after pilot authorizes firing.

- b. Ammo Chambering - Accomplished

Place battery holdback switch to HOLDBACK and then to BATTERY to chamber ammunition.

- c. Guns Ready-Safe Switch - READY

- d. Action & Trigger Switches - Depressed

Use a 3-second burst (maximum) and a 45-second cooling period (minimum) between bursts.

6. Armament Safety Check:

NOTE

The following items will be accomplished prior to departing the firing area.

- a. Guns Ready-Safe Switch - SAFE and pinned

- b. Action & Trigger Switches - Depressed

The guns should not fire.

- c. Safety Check Completed - Notify pilot

7. Log/Form Entries - Completed

FEO OPERATING PROCEDURE

NOTE

- Allow a minimum FEO warmup of 5 minutes prior to FEO operation.
- Guns ready-safe switch is not required for an FEO operation and should be SAFE and pinned at all times.
- Should the gunner be required to perform other duties while operating in PHANTOM TARGET mode, the program may be interrupted by placing the selector switch back to WARMUP. The program will resume when the selector switch is again positioned to PHANTOM TARGET.

1. FEO Real Target FCS Equipment Checks:

NOTE

- FCS switches will be positioned to accomplish the required modes checks as outlined under the applicable FCS equipment checks, this section.
- Any time an action switch is closed or the system is in a track mode, the FEO recorder will be operating.

- a. FEO Selector Switch - WARMUP
- b. FCS Switches - Positioned
- c. FEO Selector Switch - REAL TARGET
- d. FEO/FCS Equipment Checks: - Accomplished

NOTE

FEO/FCS equipment checks consist of: Acquisition Mode, Radar Track Mode (items 1 thru 7), Manual Track Mode, and Emergency Manual Track Mode.

FEO OPERATING PROCEDURE (Cont)

2. FEO Phantom Target Combat Exercise:

NOTE

The circle cursor may have to be offset from the target to effect a lock-on. This is due to peculiarities in some FEO units and may not be a FCS malfunction.

- a. FCS Switches Positioned for Optimum Mode - Set
- b. Selector Switch - PHANTOM TARGET
- c. Phantom Target Activity - Accomplished

Phantom target activity will be conducted in accordance with governing directives.

3. FEO Selector Switch - OFF
4. Log/Form Entries - Completed

CONTINGENCY PROCEDURES

1. Interphone Panel - Set
2. Interphone Selector Switch - UHF
3. Assistance Request - Acknowledged
4. FCS Power Switch - ON
5. Radar Search Switch - ON
6. Contingency Procedures - Accomplished

Contingency activity will be conducted in accordance with governing directives.

7. Logs/Forms - Completed

GUNNER'S STRANGE FIELD DISARMING PROCEDURE

When an aircraft lands with hot guns (rounds in the chambers), the guns will be disarmed as soon as practical, all other operational safety factors considered; e.g., weather, proper equipment, ample light, qualified personnel, etc. Until such time as guns are disarmed, turret will be stowed with guns up, FCS electrical circuits disabled, and the aircraft positioned so that guns point toward an uninhabited area.

WARNING

During the entire disarming procedure, use extreme caution to insure ammunition is handled in a safe manner and the guns are pointed in an area that assures maximum safety to personnel and property.

NOTE

Gunner will supervise the following disarming procedure performed by the disarming team. In the event no team is present, he will accomplish disarming with the aid of another crew member.

1. FCS Control Panel Fuses (4) - Installed

Remove fuses from the No. 1 flight safety pin pouch located on the EW officer's seat and reinstall.

2. FCS Power Circuit Breaker - Reset

Reset 15 Amp DC Control Power circuit breaker (marked "FCS PWR") located on gunner's FCS circuit breaker panel.

3. FCS Power Switch - WARMUP

Turret should stow through magnetic amplifiers, enabling gunner to remove turret side panels.

4. FCS Power Switch - OFF

5. FCS Control Panel Fuses (4) - Removed

Stow fuses in the No. 1 flight safety pin pouch located on the EW officer's seat.

6. FCS Power Circuit Breaker - Pulled

7. FCS Switches - OFF/SAFE and pinned

8. Turret Cowling - Removed

NOTE

There is one turret interlock (three-position) and one gun heater (three-position) switch located on each sidearm. The top switches control a-c power to the hydraulic system and the bottom switches control d-c power to the four gun heaters. When turret side panels are installed, all four switches are positioned in, allowing power to be supplied to the gun heaters and hydraulic system. By removing the turret side panels, switches will spring to the intermediate position, preventing power from being supplied to gun heaters and hydraulic system. When interlock and gun heater switches are pulled to the out position, power is supplied to gun heaters and hydraulic systems.

GUNNER'S STRANGE FIELD DISARMING PROCEDURE (Cont)

- a. Remove left side panel and check turret interlock and gun heater switches are in the intermediate position. Unfasten upper and lower cowling fasteners.
 - b. Remove right side panel and check turret interlock and gun heater switches are in the intermediate position. Unfasten remaining fasteners on upper and lower cowling and remove.
9. Ammunition Chutes - Disconnected
- a. Disconnect ammunition chutes from ammunition boosters and break belts at boosters.
 - b. Position double link of each belt out through the side of the flexible chute and attach the single round.
10. Bolts Position - Checked

WARNING

If any gun is not in battery position, do not proceed with "Strange Field Disarming Procedures." Reconnect ammo chutes and replace turret cowling. Install FCS control panel fuses, reset FCS circuit breakers, turn FCS power switch ON, search radar ON, and reaccomplish the required steps of the "After Landing" checklist.

- a. Visually check that upper gun bolts are in battery position by looking through the side of the receiver.
- b. Visually check that lower gun bolts are in battery position by looking up through the bottom of the receiver.

NOTE

The gunner may elect to clear one gun at a time. In this case he will complete steps "11" thru "15" for each weapon.

- 11. Gun Cover(s) - Raised
- 12. Link Chute(s) (upper) - Removed
- 13. Ammunition Booster(s) (lower) - Removed
- 14. Feedway(s) - Cleared
 - a. Remove ammunition by pulling belt toward direction of feed (upper).
 - b. Remove ammunition by pulling opposite direction of feed (lower).
- 15. Gun Cover(s) - Closed
- 16. Gun Chambers Cleared - Accomplished
 - a. External Gun Charger Switch or Valve - Actuated

Actuate the gun charger switch or valve to clear the guns.

NOTE

If guns cannot be charged by the external gun charger switch do not proceed with "Strange Field Disarming Procedures." Reconnect ammo chutes and replace turret cowling. Install FCS control panel fuses, reset FCS circuit breakers, turn FCS power switch ON, and reaccomplish the required steps of the "After Landing" checklist.

GUNNER'S STRANGE FIELD DISARMING PROCEDURE (Cont)

17. Bolts Position - Checked

WARNING

If any gun is not in battery position, do not proceed with "Strange Field Disarming Procedures." Reconnect ammo chutes and replace turret cowling. Install FCS control panel fuses, reset FCS circuit breakers, turn FCS power switch ON, search radar ON, and reaccomplish the required steps of the "After Landing" checklist.

NOTE

The gunner may elect to complete one gun at a time. In this case he will complete steps "18" thru "21" for each weapon.

18. Gun Cover(s) - Raised

- a. Visually check upper gun bolt(s) T-slot(s) are clear.
- b. Visually check lower gun bolt(s) T-slot(s) are clear by looking up through the bottom of the receiver.

NOTE

If gun chambers have not been cleared upon completion of step "18b," return to step "15" and repeat chamber clearing procedure through step "18b."

19. Link Chute(s) - Replaced

20. Ammunition Booster(s) - Replaced (if applicable)

21. Gun Cover(s) - Closed

22. Ammunition Chute(s) - Reconnected

23. Ammunition - Secured

- a. Position double link of each belt out through the side of the flexible chute and attach the remaining rounds (this precludes the possibility of ammunition feeding into the boosters).
- b. Safety wire loose end of ammunition belt to ammunition chutes.

24. Turret Cowling - Replaced

25. Crew Debriefing - Accomplished

- a. FCS Log - Completed
- b. AFTO Form 781 - Completed.

In the form 781A enter the ammunition status and quantity remaining. Enter the page and item number of this entry in block 11 of the 781H and circle, in red, the gun status.

GROUND CREW CHECKLIST

NOTE

The abbreviated ground crew checklist is contained in T.O. 1B-52G-1CL-6.
The gunner's abbreviated scramble portion of ground crew checklist is contained in T.O. 1B-52G-1CL-5.

1. When the aircraft is moved into the alert line, the ground crew accomplishes the "Alert Line Preparation" checklist.
2. After the aircraft is "cocked," install "cocked" sign.

WARNING

Entrance to the designated "No Lone Zone" of a "cocked" configured aircraft will be in accordance with command directives.

3. When the execution order to scramble is received, one ground crew member and the flight crew gunner will remove all plugs and covers and accomplish the applicable ground crew scramble checklist without delay.
4. When practice alerts are terminated, the "Alert Line Preparation" checklist will be completed in conjunction with the flight crew recocking the aircraft.

ALERT LINE PREPARATION

1. Position aircraft in designated parking position.
2. Position Wheel Chocks.
 - a. Standard Chocks: Position one chock in front of each forward gear and one chock behind each aft gear.
 - b. Alert Rollover Chocks: Position one chock firmly in front of each aft gear. Position one standard chock behind each aft gear.
3. Install static ground/Pass wire (forward).
4. Position AGE.
 - a. Position MD-3 on either side of the aircraft in a location that will permit the aircraft to taxi safely. Use 30-, 60-, or 120-foot cables. When 60-foot cable is used, position MD-3 between the inboard and outboard engine pods. When 120-foot cable is used, position MD-3's outboard of the wing tip.
5. Check AGE fuel and oil service.
6. Position fire extinguishers. (One 50-pound CO₂ or one 10-gallon (CB) unit at each wing tip.)
7. Connect interphone cord and headset. Headset and interphone cord will be stored in a suitable location out of the weather and near the ground cord receptacle.
8. Cold Weather Operation. Position ground heaters as required to preheat the MD-3 and crew compartment.
9. Position stands as required.
10. Install nose and tail covers (climatic or as desired).

GROUND CREW CHECKLIST (Cont)

11. Install chaff dispenser plugs or covers (as required).
12. Install pitot covers (climatic).
13. Install ram air inlet plugs (climatic or as required).
14. Install engine inlet and tailcone plugs (climatic).
15. Remove and secure all unnecessary stands and equipment.
16. After aircraft is cocked, place "cocked" sign on entrance hatch. (If hatch is to remain closed, place "cocked" sign in cockpit facing pilots' window.)

GROUND CREW SCRAMBLE

This checklist will be accomplished by one ground crewmember and the flight crew gunner when the order to scramble is given.

WARNING

- During aircraft engine cartridge starts, the cartridge starter produces extremely hot exhaust gases. Therefore, remain clear of a 4 foot radius area around the cartridge starter exhaust directly below nacelles of any engine being cartridge started.
- Simultaneous cartridge starts of "quick start" configured aircraft can produce toxic gases in sufficient concentration to be hazardous to individuals who remain in the immediate vicinity of the aircraft. The potential hazard is dependent on aircraft parking configuration, wind velocity and direction, and other ambient conditions. Ground crewmembers and security police who are required to remain in a toxic cloud must wear proper eye and respiratory protection.

Man No. 1 — Crew Chief

1. REMOVE AIRCRAFT PITOT COVERS AND AGM-69 RAM AIRSCOOP PLUGS.
2. REMOVE FRONT AND REAR ENGINE PLUGS FROM ENGINES 5, 6, 7 AND 8, IN THAT ORDER AND PLACE CLEAR OF AIRCRAFT (AS REQUIRED).
3. INSURE ENGINE PLUGS ARE REMOVED FROM LEFT WING ENGINES (AS REQUIRED).
4. PUT ON HEADSET AND REPORT TO PILOT, "CLEAR TO START ENGINES."
5. CUT OFF HEATER AND REMOVE, ALONG WITH DUCTING, CLEAR OF RIGHT WING TIP (AS REQUIRED).
6. MONITOR STARTING OF ALL AIRCRAFT ENGINES.

GROUND CREW CHECKLIST (Cont)**7. CLOSE ENTRANCE HATCH.**

8. ADVISE PILOT THAT PITOT COVERS ARE REMOVED, AND GROUND EQUIPMENT IS CLEAR. ACKNOWLEDGE PILOT WHEN INSTRUCTED TO DISCONNECT INTERPHONE CORD AND REMOVE CHOCKS PRIOR TO DEPARTING THE AIRCRAFT.

9. THE CREW CHIEF WILL THEN DISCONNECT THE INTERPHONE CORD, REMOVE CHOCKS IF APPLICABLE, AND MOVE TO THE PROPER POSITION (AS LOCAL CONDITIONS REQUIRE) TO DIRECT THE PILOT WHILE TAXIING OUT OF THE PARKED POSITION.

10. Accomplish the "Alert Line Preparation" checklist when practice alert is terminated (if applicable).

Man No. 2 — Gunner

- 1. REMOVE FRONT AND REAR ENGINE PLUGS FROM ENGINES 4, 3, 2 AND 1, IN THAT ORDER AND PLACE CLEAR OF AIRCRAFT (AS REQUIRED).**
- 2. CUTOFF FORWARD BAY HEATER AND REMOVE HEATER AND DUCTING CLEAR OF LEFT WING TIP (AS REQUIRED).**
- 3. REMOVE FORWARD GROUND/PASS WIRE.**
- 4. SIGNAL MAN NO. 1 WHEN ALL EQUIPMENT IS CLEAR AND BOARD THE AIRCRAFT.**

EMERGENCY TAXI CHECKLIST**WARNING**

DO NOT USE FOR FLIGHT

NOTE

- Minimum cockpit crew may be one pilot and one ground crew member who serves as copilot. Both must meet the requirements of AFR 60-11 concerning movement of aircraft.
- Pilot and copilot will perform their respective "Before Starting Engines" checklists simultaneously.
- This checklist is designed for emergency use. Two copies of the abbreviated checklist are to be placed in the cockpit of each aircraft. It is not to be carried in the crew member's individual checklist folder.

BEFORE STARTING ENGINES (PILOT)

1. Status of Aircraft - Checked

Pilot will check with ground crew for status of aircraft for taxiing and for desired starting mode (cartridge/pneumatic). He will issue instructions to clear aircraft of all obstructions and to stand by on interphone.

2. Circuit Breakers - Set

Pilot sets left load central and pilot's circuit breakers. (Leave GAM-72 gear jettison circuit breakers pulled.)

3. Interphone Power Switch - ON

4. Ground, Start External Power & Air - Roger (GC)

5. Body System Standby Pump Switches - STBY

6. Engine Fire Shutoff Switches - IN

7. Antiskid Switch - ON, guard closed

8. Steering Ratio Selector Lever - TAXI

9. Parking Brakes - Set

10. Ground, Remove Bypass Keys - Roger (GC)

11. Radio Call - Completed

Contact Command Post or tower. Advise ready to start engines and request instructions.

EMERGENCY TAXI CHECKLIST (Cont)

BEFORE STARTING ENGINES (COPILOT)

1. Circuit Breakers - Set

Copilot sets right load central and copilot's circuit breakers.

2. Battery Switch - ON

3. Navigation Lights - BRIGHT and FLASH

4. UHF Radios - ON

5. Manifold Valve - OPEN

6. Engine Starter Switches - OFF and PNEUMATIC (for pneumatic start); engines 3, 4, 5, and 6 START, others OFF and FLIGHT (for cartridge start)

7. Generator Selector Switch - CENTRAL BUS TIE

8. Generator Switches - OFF

Momentarily position generator switches to OFF.

9. External Power Switch - ON

External power circuit breaker position indicator will not close if phase sequence is not correct or if generator circuit breaker is closed.

10. Fuel Panel Switches No. 2 & 3 - ON

11. Wing Flaps - Up, lever OFF (GC)

Ground crew will advise flap position and movement.

STARTING ENGINES AND TAXIING (Pilot/Copilot Reads)

1. Stand by to Start Engines - Fire guard posted and clear (GC)

2. Start Engines 4, 3, 5, & 6 (Pneumatic Start); 3, 4, 5, & 6 Simultaneously (Cartridge Start) - Started (CP)

Copilot starts No. 4 engine, then No. 3 engine. When No. 3 engine reaches IDLE rpm, copilot places No. 3 generator - ON. Copilot then starts No. 5 and 6 engines. When starting with cartridges installed, copilot starts engines 3, 4, 5, and 6 simultaneously. See Section II. "Starting Engines and Before Taxiing Checklist," line item "Start Engines - Started (CP)" for detailed starting procedures.

3. Starter Warning Light - Out (CP)

As soon as engines are started, check light out.

EMERGENCY TAXI CHECKLIST (Cont)

4. Manifold Valve Switch - CLOSE (CP)



Place air bleed manifold valve switch in CLOSE position after engines are started to prevent excessive manifold temperature which will be attained if the switch is left OPEN.

5. Generator 5 - ON (CP)
 - a. Momentarily hold generator switch ON to energize the generator field and close the generator circuit breakers.
 - b. Check that generator and bus tie breaker position indicators show closed.
6. Body System Standby Pump Switches - OFF (P)
7. Hydraulic System Pressures - Checked (P)
8. Ground, Clear Aircraft for Taxi, Remove Chocks & Disconnect Interphone - Roger (GC)
9. Anticollision and Navigation Lights - ON and STEADY (CP)
10. Taxi on Crew Chief's Signal (P-CP)
11. Brakes - Checked (P)

ENGINE SHUTDOWN (Copilot Reads)

1. Parking Brake Lever - ON (P)
2. Generators 3 & 5 - OFF (CP)
3. External Power - ON (if available) (CP)
4. Throttles - 75% rpm, then CLOSED (P)

Advance throttles to 75% for 15 to 30 seconds, then retard to CLOSED.

5. UHF Radios - OFF (CP)
6. Fuel Panel Switches - OFF or CLOSED (CP)
7. Wheel Chocks - In place (GC)
8. Parking Brake Lever - OFF (P)
9. Light Switches - OFF or as required (P-CP)
10. Battery Switch - OFF (CP)
11. Seat Positioning Switch - DOWN and AFT (external power available) (P-CP)
12. Interphone Power Switch - OFF (P)

CUT ON DASHED LINE

(EXTRACTED FROM T.O. 1B-52G-1)

EMERGENCY TAXI CHECKLIST**WARNING**

DO NOT USE FOR FLIGHT.

NOTE

- Minimum cockpit crew may be one pilot and one ground crew member, who serves as copilot. Both must meet the requirements of AFR 60-11 concerning movement of aircraft.
- Pilot and copilot will perform their respective "Before Starting Engines" checklists simultaneously.
- This checklist is designed for emergency use. Two copies of the abbreviated checklist are to be placed in the cockpit of each aircraft. It is not to be carried in the crew member's individual checklist folder.

BEFORE STARTING ENGINES (PILOT)

1. Status of Aircraft – Checked
2. Circuit Breakers – Set
3. Interphone Switch – ON
4. Ground, Start External Power & Air – Roger (GC)

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CUT ON DASHED LINE

(EXTRACTED FROM T.O. 1B-52G-1)

EMERGENCY TAXI CHECKLIST (Cont)

5. Body Standby Pumps – STBY
6. Firewall Switches – IN
7. Antiskid – ON, guard closed
8. Steering Ratio – TAXI
9. Parking Brakes – Set
10. Ground, Remove Bypass Keys – Roger (GC)
11. Radio Call – Completed

BEFORE STARTING ENGINES (COPILOT)

1. Circuit Breakers – Set
2. Battery Switch – ON
3. Navigation Lights – BRIGHT and FLASH
4. UHF Radios – ON
5. Manifold Valve – OPEN
6. Engine Starter Switches – OFF and PNEUMATIC (for pneumatic start); engines 3, 4, 5, and 6 START, others OFF and FLIGHT (for cartridge start)
7. Generator Selector Switch – CENTRAL BUS TIE
8. Generator Switches – OFF
9. External Power – ON
10. Fuel Switches 2 & 3 – ON
11. Wing Flaps – Up, lever OFF (GC)

(EXTRACTED FROM T.O. 1B-52G-1)

EMERGENCY TAXI CHECKLIST (Cont)**STARTING ENGINES AND TAXIING****(Pilot/Copilot Reads)**

1. Stand By to Start Engines – Fire guard posted and clear (GC)
2. Start Engines 4, 3, 5 & 6 (pneumatic start); 3, 4, 5, and 6 Simultaneously (cartridge start) – Started (CP)
3. Starter Warning Light – Out (CP)
4. Manifold Valve – CLOSE (CP)
5. Generator 5 – ON (CP)
6. Body Standby Pumps – OFF (P)
7. Hydraulic Pressures – Checked (P)
8. Ground, Clear Aircraft for Taxi, Remove Chocks & Disconnect Interphone – Roger (GC)
9. Anticollision & Nav Lights – ON and STEADY (CP)
10. Taxi on Crew Chief's Signal (P-CP)
11. Brakes – Checked (P)

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CUT ON DASHED LINE

CUT ON DASH LINE

(EXTRACTED FROM T.O. 1B-52G-1)

ENGINE SHUTDOWN (Copilot Reads)

1. Parking Brakes – ON (P)
2. Generators 3 & 5 – OFF (CP)
3. External Power – ON (if available) (CP)
4. Throttles – 75% rpm, then CLOSED (P)
5. UHF Radios – OFF (CP)
6. Fuel Switches – OFF or CLOSED (CP)
7. Wheel Chocks – In place (GC)
8. Brakes – OFF (P)
9. Lights – OFF or as required (P-CP)
10. Battery Switch – OFF (CP)
11. Seats – DOWN and AFT (external power available) (P-CP)
12. Interphone – OFF (P)

ACCEPTANCE AND/OR FUNCTIONAL CHECK FLIGHT CHECKS

Procedures and criteria for functional check flights will be accomplished in accordance with T.O. 1B-52G-6CF-1 and T.O. 1B-52G-6CF-1-1, Acceptance and/or Functional Check Flight Procedures manuals. Each manual contains amplified checklists identified as "Before Inflight Checklists," "Inflight System Operational Checks," and "After Inflight Checklists."

Flight crew abbreviated checklists are contained in T.O. 1B-52G-6CL-1 thru -6. The "Emergency Procedures" contained in T.O. 1B-52G-1 will be used. Aircraft requiring functional check flights are redelivered aircraft, modification maintenance aircraft, and aircraft wherein maintenance performed requires a functional check flight as specified in T.O. 1-1-300.

All Weather Operation

section IX

INTRODUCTION: Except for some repetition necessary for emphasis, clarity, or continuity of thought, this section contains only those procedures that differ or are in addition to the normal operating instructions covered in Section II. Any discussions relative to systems operation are covered in Section IV and VII.

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Instrument Flight Procedures

The procedures and techniques outlined in current instrument flying directives should be followed. Flight characteristics during instrument conditions do not differ from those encountered during visual flight conditions. Limit angle of bank to 30° for all normal instrument maneuvers.

INSTRUMENT TAKEOFF AND INITIAL CLIMB

An instrument takeoff is essentially the same as a normal VFR takeoff. The same procedures are used as given in Section II. Ensure the attitude indicator is set for takeoff by aligning the horizon bar with the miniature aircraft.

1. Align the aircraft visually with the runway. The copilot will visually monitor the takeoff and initial climb. A takeoff with reference to instruments exclusively may be required because of low visibility conditions.

NOTE

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The bank steering bar will be used during the takeoff and climb as an aid in heading control. Cross-checking of the bank steering bar, turn needle, and heading indicator will provide indication of attitude indicator failure in the roll axis. If the roll axis of the ADI is inoperative on takeoff, the bank steering bar will aid in maintaining a wings-level attitude until a new heading is selected. This type of failure has occurred several times without a warning flag in view. If a new heading is selected, then the roll axis failure should become apparent as the turn is initiated. A rapidly precessing heading indicator will also give the same indications.

2. As the aircraft breaks ground, maintain the unstick attitude as indicated by the attitude indicator until a cross-check of vertical velocity indicator and altimeter indicate a definite rate of climb with increasing airspeed.

WARNING

- If a pitchup occurs as the aircraft becomes airborne, failure to initiate positive action with the elevator control and trim to stop the aircraft nose up rotation could result in a stall.
- The OFF flag will not appear during every attitude indicator failure. Therefore, it is possible that a malfunction of the attitude indicator might be determined only by cross-checking it with the turn and slip indicator and the other flight instruments.

NOTE

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- The ATT warning flag indicates the attitude information displayed on the pilot's and/or copilot's attitude director indicator may be erroneous and the standby attitude indicator should be checked to determine proper attitude references.
- An error in the pitch indication of the attitude indicators is generated during accelerations or decelerations. The error is indicated in a nose high direction during and after a forward acceleration and a nose down direction during and after deceleration. The longer the duration of acceleration (or deceleration), the greater will be the indicated error and the longer it will persist when acceleration (or deceleration) ceases. The erection system will reduce the error at about the same rate as it was generated. Pitch error may reach one bar width during a high gross weight takeoff.
- 3. Retract the gear as recommended in Section II for a VFR takeoff; however, be certain that a safe stabilized climb has been established. Adjust pitch as necessary to maintain a climb at 180 knots IAS.
- 4. Retract flaps as recommended in Section II for a VFR takeoff.

INSTRUMENT CLIMB

Maintain recommended best climb schedule as given in Part 4 of the Appendix.

INSTRUMENT CRUISE

The aircraft has satisfactory handling characteristics throughout the design airspeed and altitude range. Use the recommended procedures given in Part 5 of the Appendix for cruise operation.

NOTE

The rotating anticollision lights should be turned off during actual instrument flight conditions whenever the pilot can notice the rotating light reflections in the cockpit. A pilot may experience vertigo from these reflections. In addition, the lights will be ineffective during such instrument flight conditions.

HOLDING

Enter the holding pattern in accordance with procedures as outlined in current directives. Establish a holding airspeed of 230 knots IAS for all altitudes from 15,000 feet to 35,000 feet and for all gross weights up to 325,000 pounds. For all gross weights greater than 325,000 pounds, refer to the appropriate fuel mileage chart in Part 5 of the Appendix with the existing gross weight and altitude for a best endurance indicated airspeed. Maintain the airspeed 10 knots above that given or Mach .77, whichever is less, for endurance at the given weight to allow for holding turns.

NOTE

If it is necessary to endure and fuel quantity is low, establish the holding airspeed recommended in Part 6 of the Appendix for the existing gross weight and altitude. Increase the airspeed 10 knots or maintain Mach .77, whichever is less. Maximum endurance altitude is recommended.

TYPICAL DESCENTS AND PENETRATIONS

NOTE

Enroute descents are compatible with the typical penetration procedures except for aircraft configuration, airspeed, rate of descent and routing to the final approach.

1. A typical penetration is shown in figure 9-1. Prior to starting a penetration, initiate the "Descent and Landing Checklist."
2. A normal penetration is accomplished with the gear down, throttles idle, airbrakes position 4 or as required at 240 knots IAS or .75 Mach, whichever is slower.

WARNING

Care should be taken to retrim between each two-unit increment of airbrake operation.

NOTE

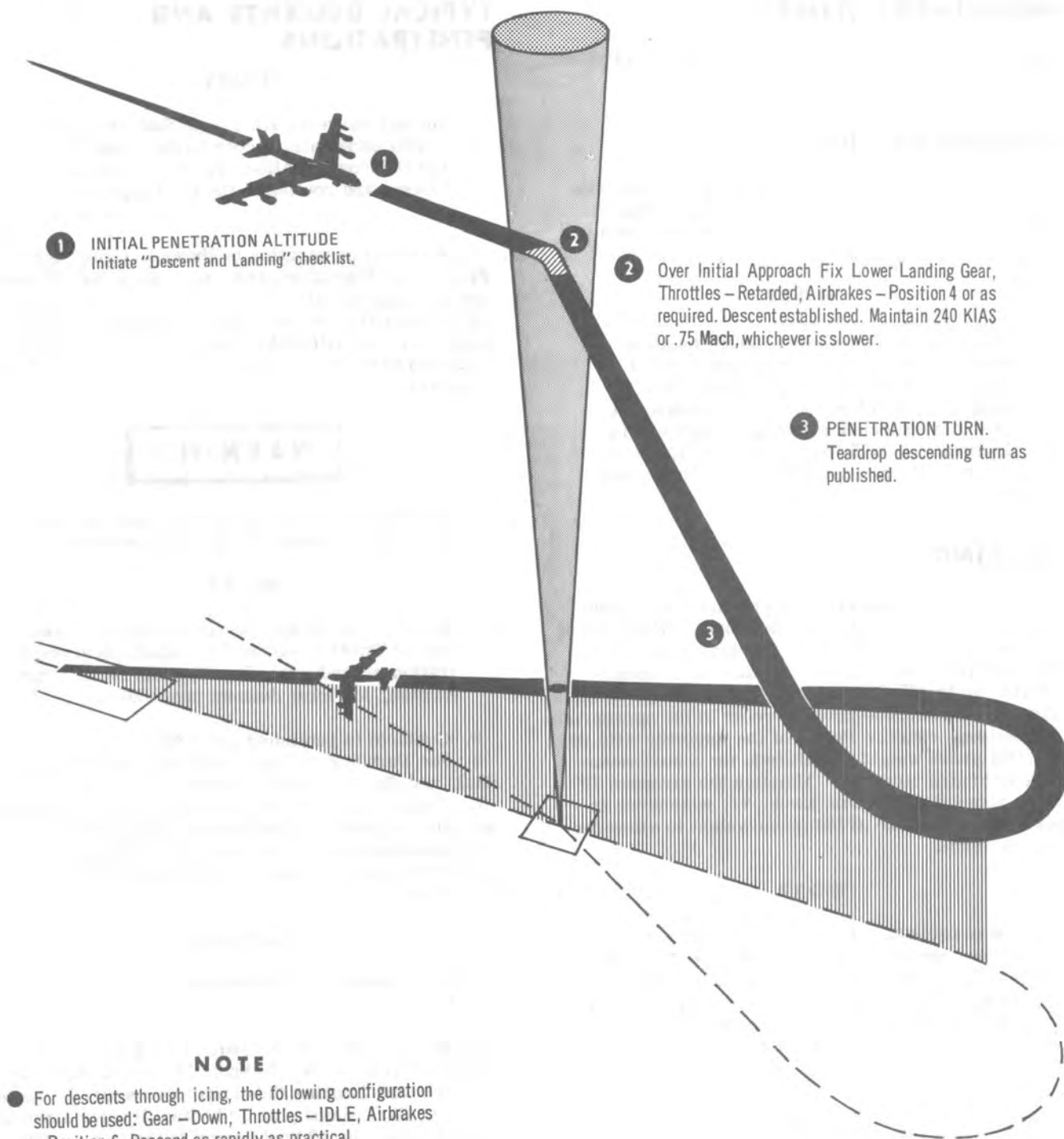
Rate of descent may be varied (by airbrakes and/or throttle position) to satisfy local penetration procedures. See "Ice and Rain," this section, for icing descent procedures.

3. Conform to published procedures.
4. See Part 8 of the applicable Appendix for time, fuel, and distance requirements.
5. Copilot obtains altimeter setting prior to descent and pilot, copilot, and navigator set altimeters at the prescribed time during descent. The pilot and copilot will cross-check each altitude called by the navigator.

NOTE

See "Altitude Call Procedures" in Section VIII.

6. Retract airbrakes as required. Allow the aircraft to decelerate to 220 knots IAS. Complete the "Descent and Landing Checklist" as required. Establish best flare speed plus 30 knots. Reduce airspeed to best flare plus 10 knots prior to the final approach fix or glide slope interception. (About 25,000 pounds per hour total fuel flow will be required during descent on final approach.) Maintain best flare plus 10 knots until the flare for landing is started. If visual references at the missed approached points are insufficient to land, execute the missed approach procedure.



Typical Penetration

Figure 9-1.

INSTRUMENT APPROACHES

This aircraft, and all modified versions thereof, is in approach category "E."

RADAR APPROACH

Entry into the radar approach pattern (figure 9-2) is normally made with gear down at 220 knots IAS. Complete "Descent and Landing Checklist" as outlined in Section II. Adjust power to maintain best flare speed plus 30 knots IAS after the flaps are down. Reduce airspeed to best flare plus 20 knots on base leg. After the turn to final approach and prior to reaching the glide slope, reduce airspeed to best flare plus 10 knots IAS. (About 25,000 pounds per hour total fuel flow will be required during descent on final approach.) Maintain best flare plus 10 knots until the flare for landing is started. When the minimum altitude is reached as indicated by the altimeter or when advised by the controller, whichever occurs first, perform the missed approach procedure if visual references are inadequate for landing.

INSTRUMENT LANDING SYSTEM

The aircraft is equipped with an approach coupler which permits automatic ILS approaches. Except for the use of the autopilot and approach coupler, the following procedures also apply to manual approaches. For automatic approach procedures, see figure 9-3.

WARNING

When making an automatic coupled ILS approach or a manual ILS approach under other than VFR conditions, do not transmit on the AN/ARC-58 liaison radio. Such transmission has been found to cause erroneous deflections of the course deviation indicator and erratic autopilot inputs producing aircraft wallow whenever the ILS frequency is a direct multiple of the ARC-58 frequency being used.

Transition to Final

Accomplish a normal transition as specified in the FLIP terminal charts. Set the nav mode select switch to ILS, tune the ILS frequency, set in the inbound localizer course in the course selector window, and set the heading selector switch to NOR. Complete the "Descent and Landing Checklist," as outlined in Section II. Establish best flare plus 30 knots IAS. Engage the autopilot and turn altitude control switch ON when at glide slope interception altitude. When the aircraft is within 90° of the inbound course, decelerate to best flare plus 20 knots IAS and center the bank steering bar. This will initially establish up to a 45° intercept to the localizer. As the aircraft approaches the localizer, the bank steering bar will direct a turn-on course. When the aircraft is on the localizer course inbound (CDI centered), engage the autopilot localizer and place the nav mode select switch to ILS APP. Stabilize the aircraft at best flare plus 10 knots IAS prior to the glide slope interception point. Eliminate localizer standoff by use of the roll trim knob.

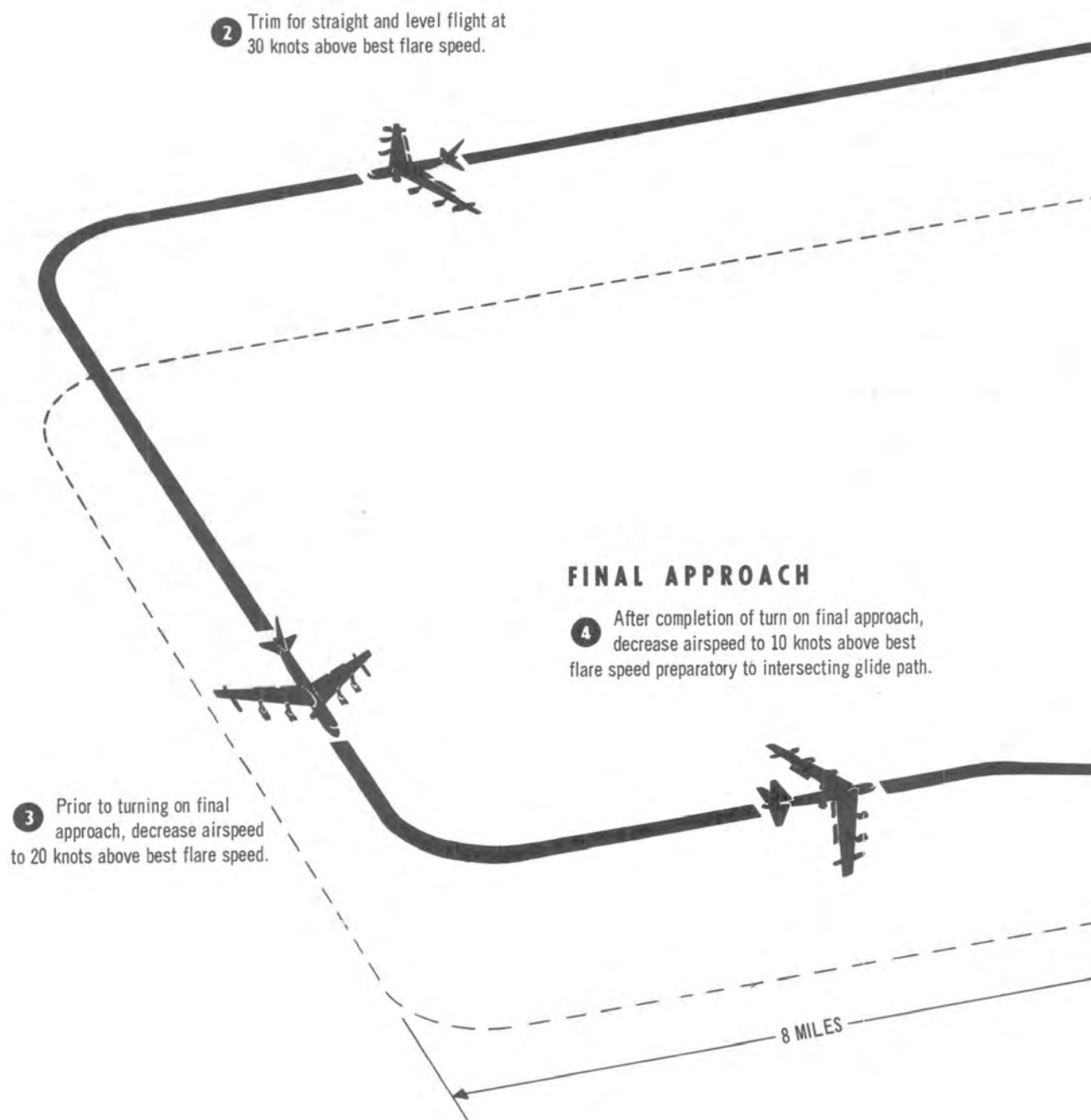
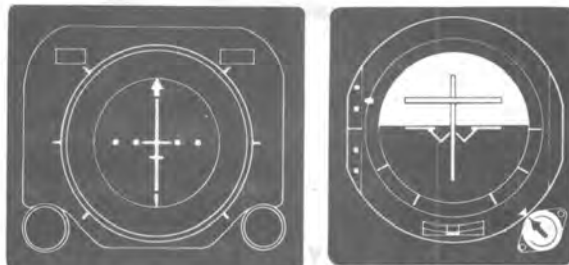
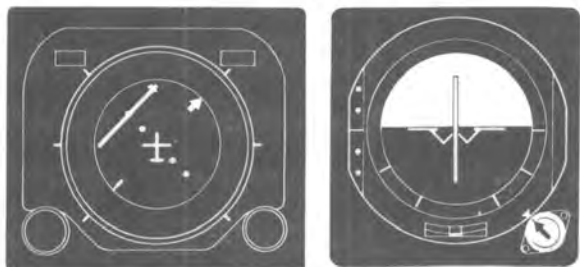


Figure 9-2. (Sheet 1 of 2).

- 1** **TRANSITION TO FINAL** — Set the nav mode select switch to ILS, tune the ILS frequency, set the inbound course, and set the heading selector switch to NOR. Complete the "Descent and Landing" or "Traffic Pattern Checklist" as outlined in Section II. Establish best flare plus 30 knots IAS. Engage autopilot and "altitude hold."

- 3** When established on localizer course (CDI centered), engage the autopilot localizer and place the nav mode select switch to ILS APP. Stabilize aircraft at best flare plus 10 knots IAS. Eliminate localizer standoff by use of the roll trim knob.

**NOTE**

The attitude views displayed are shown for the ARU-2B/A ADI on aircraft **Less BB**, but they are also the same attitude views for the ARU-49/A ADI on aircraft **BB**.

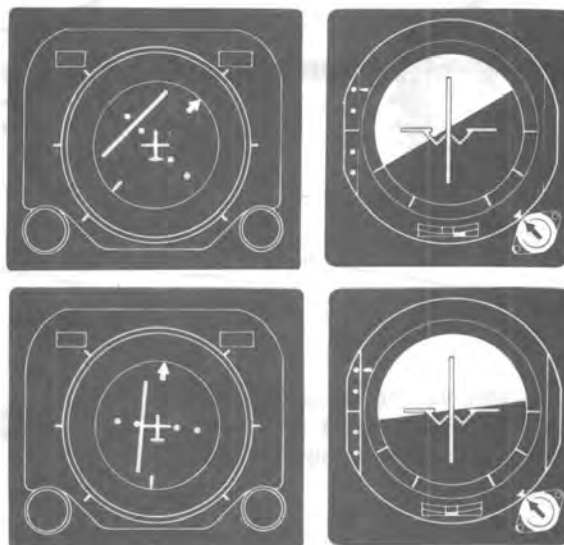
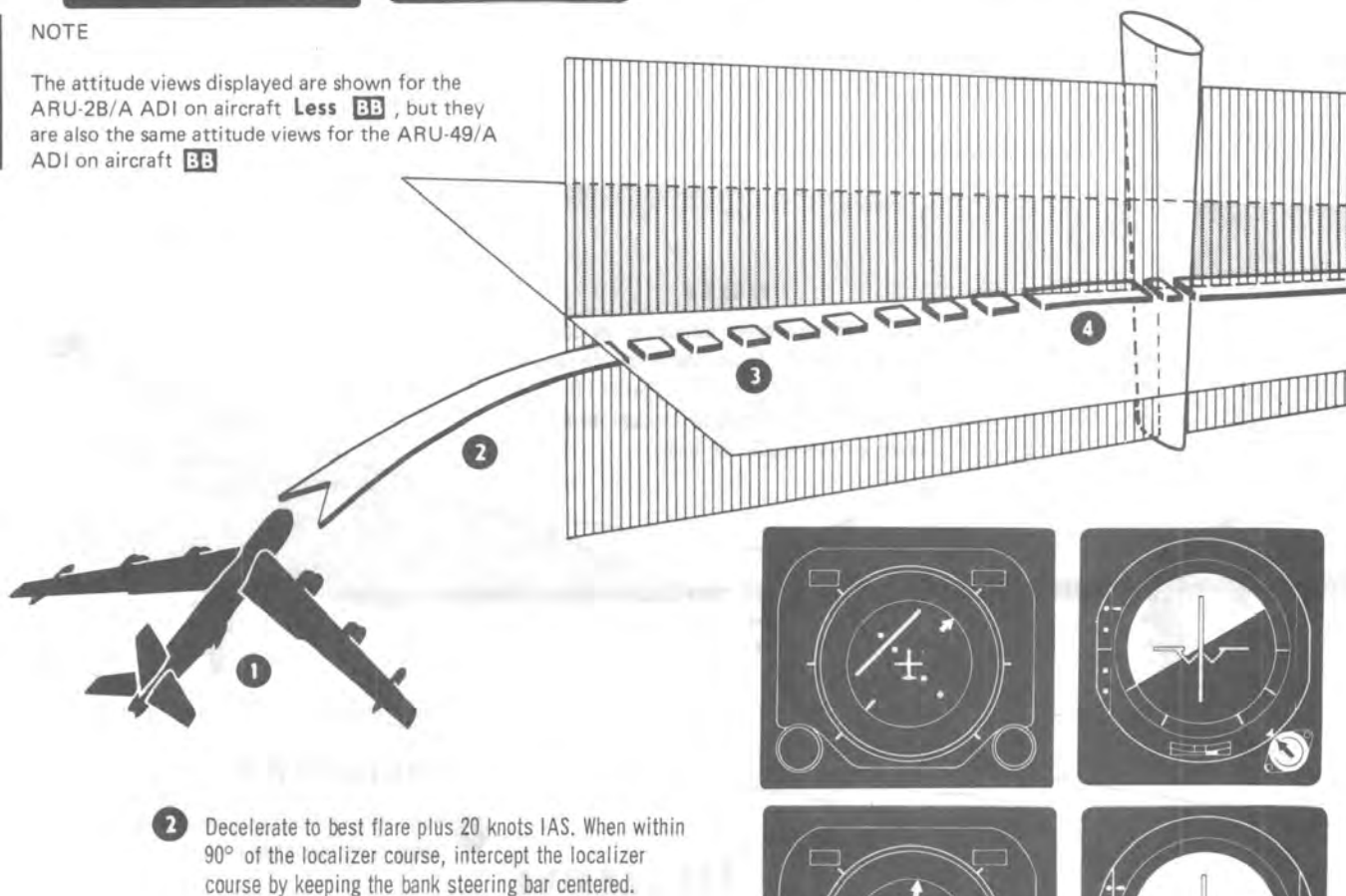
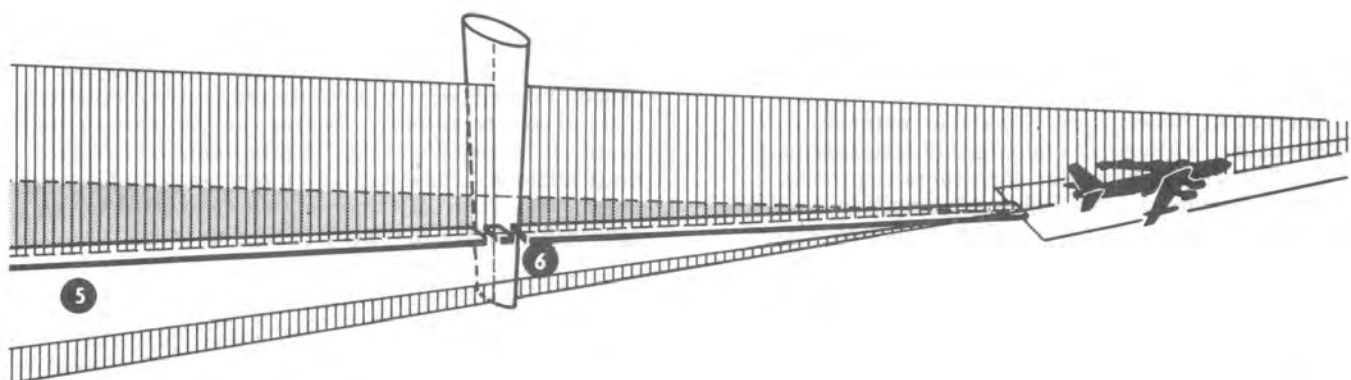
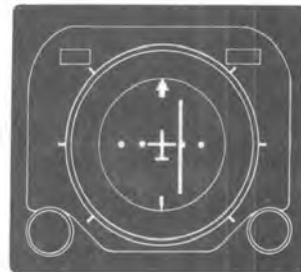
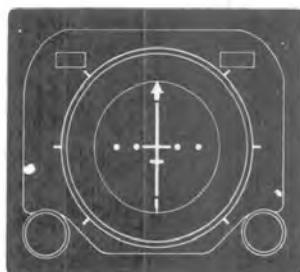


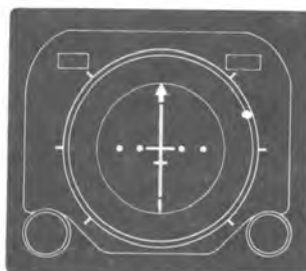
Figure 9-3. (Sheet 1 of 2).

- 4 When the glide slope reaches center, engage glide slope switch. Adjust power to maintain best flare plus 10 knots IAS.

- 5 Maintain crosscheck of ADI and HSI. Maintain airspeed at best flare plus 10 knots.



- 6 Check trim indicators before disengaging autopilot. Disengage autopilot and accomplish landing or perform missed approach.



■ ■ ■ Flight Director System Automatic Approach

Figure 9-3. (Sheet 2 of 2).

Final Approach

When the glide slope indicator reaches center, engage the glide slope switch and adjust power to maintain best flare plus 10 knots IAS. For a manual approach, keeping the bank steering bar centered will automatically correct for wind and keeping the pitch steering bar centered will establish the pitch attitude necessary to correct to or maintain the glide slope. Continue the approach until visual references are sufficient to land or to published minimums, whichever is higher. At this point, disengage the autopilot to land or to follow the missed approach procedures. Check trim indicators prior to disengaging autopilot.

WARNING

During an ILS final approach using the Flight Director System (ILS APP mode selected) the loss, or reduction in strength, of the glide slope signal will normally cause the glide slope warning flag to appear. Simultaneously with the warning flag appearance, the glide slope indicator and pitch steering bar may remain at or slowly move toward a centered position. Failure to immediately observe the (red) warning flag under conditions requiring high instrument (red) lighting intensities, coupled with the false "on glide slope" indication, could result in misinterpretation by the pilot. During the ILS final approach phase a frequent cross-check should be made for the glide slope warning flag and/or unduly stabilized glide slope indicator/pitch steering bar combination. A continuous cross-check of altitude and rate of descent should be made as well as monitoring marker beacons, aural signals and radar altimeters, whenever possible.

CIRCLING APPROACH

Generalized procedures for circling approaches are contained in current instrument flight directives. Follow enroute descent or jet penetration procedures; however, reduce airspeed to best flare plus twenty knots prior to the final approach fix. Maintain twenty knots above best flare speed during the circling maneuver until beginning roll out to align with the landing runway. At that time, reduce to best flare speed plus ten knots until the landing flare point is reached. Bank angle should be limited to thirty degrees throughout the maneuver.

MISSED APPROACH

Missed approaches are accomplished using the same procedures as given in Section II for VFR go-arounds. Advance throttles as required, retract airbrakes, establish a positive climb, (approximately 1000 feet per minute is appropriate for most missed approaches), trim as required, and check for a positive increase in airspeed. Aircraft acceleration upon executing the missed approach procedure is such that at light weights under instrument conditions, flap placard speeds may be rather quickly exceeded.

WARNING

Care should be exercised in applying power at light gross weights due to pitchup developing during acceleration. See "Go-Around," Section VI, for a detailed discussion of this characteristic.

Retract gear as soon as it is certain that the aircraft will not touch the ground and retract flaps as specified in Section II if the published missed approach procedure is to be followed or if proceeding to an alternate airport. During the flap retraction cycle, it is required that the pilot monitor the aircraft attitude indications as closely as possible, keeping the aircraft trimmed to a zero stick force, especially during the last 20% of flap retraction.

NOTE

If a closed radar approach pattern is to be made, the pilot may, at his discretion, leave the gear and flaps down and maintain airspeeds as specified for a normal radar approach pattern.

AIRBORNE RADAR APPROACH

See "Airborne Radar Approaches," Section VIII, for proper procedures and techniques.

PARTIAL PANEL OPERATION

In case of flight instrument failure, especially the attitude indicators and heading indicator, do not use airbrakes during descent and use minimum angles of bank in all turns (1 1/2° per second maximum rate). Make descent under radar control if possible and maintain .75 Mach or 240 knots IAS, whichever is slower, but not less than 220 knots IAS. Plan a long straight-in approach, keeping turns to a minimum.

Ice and Rain

ICING

This aircraft is equipped to prevent ice formation on critical areas of each engine and nacelle, air conditioning pack, Q-spring ram air scoops, pitot heads, TA angle of attack vanes, and pilot's windshield and windows. If rain repellent has been applied to the windshield, do not use windshield wipers unless necessary.

WARNING

- Ice formation in the Q-spring system is possible during some flight conditions even with the anti-icing system on. This may constitute a hazardous flight condition due to the loss of Q-spring pressure. Springs in the artificial feel system will provide partial artificial feel to both the elevator and rudder in the event Q-spring pressure is lost. For additional information, see "Q-spring" under "Flight Control System Components," Section VI.
- Caution must be observed to avoid areas of known or suspected icing conditions when flying with complete a-c power failure since no pitot anti-icing is available.

TAXIING

On ice-covered taxiways and runways and on painted areas that are moisture covered, taxi with extreme caution. High crosswinds or excessive speed during turns may start a skid. Also, be alert for extreme slipperiness at the approach end of snow-covered runways. The intense heat produced by jet engine blasts may form ice due to melting and refreezing.

FLIGHT OPERATION

CAUTION

- There is a possibility of engine damage occurring when the engine is operated during freezing rain. No part of the system has sufficient capacity to anti-ice during extended operation in a freezing rain.
- No EPR drop noted on one or more engines upon actuating the engine and nacelle anti-icing control switch would indicate possible malfunction of the anti-icing system and known or suspected icing conditions should be avoided.

NOTE

- The engine and nacelle anti-icing system should be turned ON before suspected icing conditions are encountered. All engines should show a noticeable EPR drop at time of switch actuation to indicate a properly operating system.
- If anti-icing is required, refer to the Appendix for range degradation.

Takeoff

Water and slush standing on the runway will decrease the acceleration rate and extend the ground run. For effect of water or slush on takeoff performance, refer to Part 2 of the Appendix. When icy or snow covered runways exist, the decision distance will be adjusted as necessary to allow for reduced RCR and the balance of the takeoff data computed using the shorter decision distance. Refer to Part 2 of the Appendix for additional information. Under slush and wet runway conditions in winter weather, leave landing gear down approximately 30 seconds after takeoff to allow moisture to be blown from landing gear prior to braking wheels and retraction.

WARNING

Takeoffs should not be attempted when runway is covered by water and/or slush in excess of 0.3 inch depth. If an abort is attempted under such conditions, hydroplaning, which will cause severe control and braking losses, may occur at higher ground roll speeds even though a low RCR reading has not been reported. If aborted takeoff considerations are to be disregarded, takeoff should not be attempted if the depth of the water or slush on the runway exceeds 0.4 inch because of extreme performance loss.

NOTE

Due to engine performance loss, the use of engine, nacelle, and scoops anti-icing during takeoff will reduce EPR settings, increase S_2 distance by 5%, and reduce the initial climb rate. See Parts 2 and 3 of the Appendix for specific effects on performance.

If icing conditions are anticipated during or immediately after takeoff, place starter switches to START and anti-icing switches to ON before advancing throttles to takeoff thrust. This is to prevent engine surge and flameout. If anti-icing is turned on at high power settings (above NRT), do not turn starter switches OFF until rpm and EPR have stabilized.

Climb

If icing conditions are known to exist within the climb flight path, the anti-icing switches should be turned ON prior to the time the icing conditions are encountered, since less heat is required to keep the ice from forming than for removal once ice has been formed. If sudden icing conditions or freezing rains are encountered, anti-icing switches should be turned ON at the first sign of icing. Ice collected during climb will reduce the rate of climb and range. If excessive ice formations remain on the aircraft after climbing through an icing layer, flexing of the wings at normal climb speed may be beneficial in removing the larger formations.

Cruise

Icing conditions at cruise altitude will be rare, with the area and vertical extent of these conditions being generally small. Normally these areas may be avoided by slight changes in course or altitude.

Descent

For descent through or into known or suspected icing conditions, turn the engine, nacelle, and scoops anti-icing switch ON and make the descent as rapidly as practical using gear down and airbrakes position 6. No minimum EPR is held during the descent so that anti-icing is not insured during this time. This is the most practical procedure since a rapid descent to pattern altitude will minimize exposure to icing conditions. Once the pattern altitude is reached and flaps extended, the minimum EPR to insure anti-ice can readily be held. See "Approach and Landing," this section.

CAUTION

- Ignition should be turned ON during descent. Leave ignition ON until sufficient power for anti-ice heat has been reestablished and stable engine operation obtained.

- With the gear extended during descent, it is possible for ice to build up on the landing gear and landing gear doors. This could result in damage to the doors if the gear was retracted.

NOTE

The landing lights generate sufficient heat to remove, within a few minutes, any ice which may accumulate on them while the wheels are down during descent.

If ice is accumulating in the compressor inlet, surge may occur when the throttle is advanced, indicating that a slower airspeed is necessary until the icing region has been penetrated. At the relatively high thrust settings used during climb or cruise, ample heat is provided to assure protection of the compressor inlet during severe icing conditions.

Approach and Landing

WARNING

Care should be exercised when landing on a runway covered by water and/or slush. Under such conditions, hydroplaning, which will cause severe control and braking losses, may occur even though a low RCR reading has not been reported.

Ice formations on the aircraft will increase the stalling speed and consequently the final approach speed should be increased above normal. The amount of increase required depends upon the thickness and shape of the ice formations on the wings and empennage.

nage of the aircraft. For ice formations less than 1 inch in thickness, increase final approach speed 5 knots IAS. Increase speed 10 knots IAS for 1 to 2 inches and 15 knots IAS for more than 2 inches. Except for increased speed on final approach, use normal approach and landing procedures. When making an approach under known or suspected icing conditions, the minimum EPR given in the following table must be maintained to insure adequate anti-icing for the engines and nacelles. Under most conditions, normal approach configuration (flaps and gear down, airbrakes position 4) will be sufficient to maintain these EPR's. However, if necessary, the airbrakes may be further extended.

Altitude	Minimum EPR
Sea Level	1.61
5,000 ft	1.75
10,000 ft	1.83

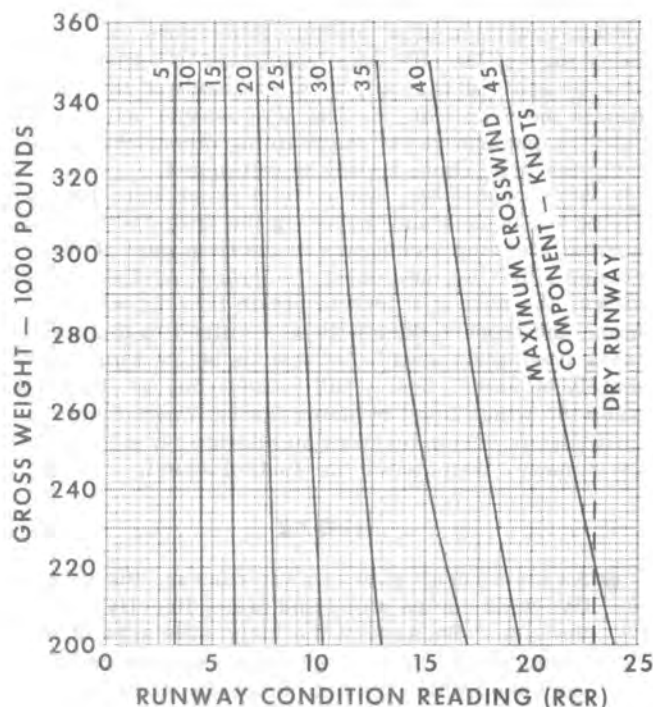
When landing under possible inlet icing conditions, ignition should be ON prior to final power reduction. Turn ignition OFF as soon as possible after landing to keep operating time to a minimum.

Anti-icing System Inoperative

In cases of engine and nacelle anti-icing system malfunction wherein ice formations are observed on the engine cowl lips, engine struts, and oil coolers, insure that ignition is ON and idle the respective engines if operating conditions permit before the ice is ingested. There is considerably less possibility of damage at low engine rpm. After the ice has been ingested, check idle engine operation and, if normal, increase power.

Landing with Crosswind on Slippery Runways

When landing with a strong crosswind and a low RCR, directional control may be lost which could allow the aircraft to skid sideways off the downwind side of the runway. This loss of directional control will occur at low speeds where the aerodynamic controls will have lost their effectiveness and the steering forces are small because of the slippery runway. Figure 9-5 shows the maximum crosswind component which will allow a safe landing under a given weight and RCR conditions. In order to accomplish a safe landing when the crosswind component is near the maximum, it is imperative that the crosswind gear be left at the landing setting during rollout and not centered until ready to turn off the runway. If these conditions exist, the following is recommended:



CONDITIONS:

- FLAPS DOWN
- AIRBRAKE POSITION 6 IMMEDIATELY AFTER TOUCHDOWN
- WITH OR WITHOUT DRAG CHUTE

REMARKS:

USE AVERAGE HEADING OF A VARIABLE WIND AND ONE-THIRD GUST VALUE TO COMPUTE CROSSWIND COMPONENT. THE CROSSWIND LANDING GEAR POSITION CHART MAY BE USED FOR THE COMPUTATION

Maximum Allowable Crosswind Component

Figure 9-4.

1. Landing should not be attempted if the stopping distance is critical since the drag chute may have to be jettisoned and braking stopped during the ground run to maintain directional control. Compute and set in the crosswind crab in the normal manner noting the crosswind component for use in determining if safe conditions exist from figure 9-4.

2. Anticipate that the aircraft will have a tendency to skid downwind at slow speeds. Therefore, in the early part of the roll, take advantage of any desirable runway position that might be attainable at that time. Retain the drag chute as long as possible but, if difficulty is encountered in maintaining directional control, the drag chute should be jettisoned.

3. After touchdown, use normal procedures for applying the brakes and deploying the drag chute. Use normal steering techniques in the first part of the ground roll. Do not center the gear. As the aircraft slows, the nose will tend to rotate into the wind and more and more rudder will be required to maintain track down the runway. At speeds below approximately 60 knots, nearly full rudder may be required. Keep the wings level by using lateral control until difficulty is encountered in maintaining track down the runway, then center the control wheel.

NOTE

- As the aircraft slows on the runway, the relative wind comes more and more directly from the side. Because of the large side area of the fuselage and fin, a large force is generated at low speed which tends to force the aircraft sideways off the downwind side of the runway. Normally, this side force is opposed by the friction of the tires on the runway and the aerodynamic controls. However, when the runway is slick, the tire force is not sufficient to maintain steering control. Therefore, use of the crosswind crab system will relieve some of this side force by turning the nose of the aircraft into the wind which will give less exposed side area.
- Most aircraft which slip off the runway under crosswind conditions do so between speeds of approximately 10 to 30 knots. Therefore, do not relax steering or center the crosswind crab until after the aircraft is ready to turn off the runway.

HYDROPLANING

When a tire hydroplanes during the aircraft ground roll it is either partially or totally supported by a thin layer of water and/or slush covering the runway. If hydroplaning occurs, the pilot may either have difficulty stopping the aircraft or controlling it directionally unless adequate precautions are taken against: 1) dynamic hydroplaning, 2) viscous hydroplaning and 3) reverted rubber skidding.

DYNAMIC HYDROPLANING

Dynamic hydroplaning can occur during takeoff or stopping whenever water or slush stands on the runway. It is caused by the buildup of hydrodynamic pressure between the tire and the runway. When this water pressure builds up to the tire inflation pressure the tire is deflected, forming a wedge of

water which initiates the partial hydroplaning condition. For a takeoff roll condition the tire "footprint" dry area decreases at a faster rate during partial hydroplaning than would normally occur during a dry runway takeoff. When total hydroplaning speed is reached the tire to runway dry footprint area reduces to zero. The tire is then supported above the runway and rolls (with perhaps some spin-down) on a thin film of water or slush until the aircraft reaches its takeoff (S_2) speed. With the exception of a hysteresis effect (delay) on total hydroplaning speed, these same hydroplaning conditions occur in reverse order for landing or aborted takeoff. The reduction in normal dry footprint area can present problems in braking and directional control of the aircraft. These takeoff and landing problems can be compounded if there is a significant crosswind or tailwind. There are many factors which influence or contribute to the hydroplaning condition of an aircraft tire, and it is difficult to determine which factors and the extent of each that exist for a given time and location.

1. **Velocity of Aircraft.** Since the rate of build-up of hydrodynamic pressure ahead of the tire is proportional to the square of the aircraft ground speed, onset of partial hydroplaning for some conditions can occur at a relatively low indicated airspeed during the ground roll.

2. **Tire Inflation Pressure.** Partial and total dynamic hydroplaning speeds are proportional to the square root of tire inflation pressure which is a linear function of takeoff gross weight. Therefore the tires should be properly inflated in order to keep the hydroplaning speeds as high as possible.

3. **Depth of Water or Slush.** Depths of about 0.1 inch or greater on non-grooved runways will cause dynamic hydroplaning at predicted indicated airspeeds if the depth is equal to or greater than the average tire tread groove depth. Although 0.1 inch depth is approximately the minimum for dynamic hydroplaning, other types of hydroplaning exist at shallower depths or on a damp runway surface.

4. **Slush.** Hydroplaning speeds in slush are approximately 8% higher than on water.

5. **Tire Tread Groove Depth.** Tests show that for tire tread groove depths which are less than the water/slush depth covering the runway, the tread pattern and wear have no effect on total dynamic hydroplaning speed, but if 50% or more of the tread depth remains, the braking coefficient of friction is increased in the partial hydroplaning region. If the average groove depth is greater than the water/slush depth, hydroplaning will be delayed to higher speeds since the water or slush will be allowed to escape from the tire footprint, relieving hydrodynamic pressure.

6. **Runway Surface Texture.** Open textured or coarse runway surfaces tend to relieve hydrodynamic pressures and delay slightly the onset of hydroplaning. Recent tests show that groove runways (perpendicular to the runway centerline) have a very pronounced effect on hydroplaning, and may prevent it in some cases.

7. Tire Geometry and Design. Rib tread tires with circumferential grooves of optimum width are best for the relief of hydrodynamic pressure during the ground roll. Also for a given tire diameter, wider tires hydroplane earlier than the narrow ones.

8. Aft Gear Tracking. When there is no crosswind during the takeoff or landing roll, the aft gear will track the forward gear and will usually be exposed to a much shallower depth of water or slush. Depending on the average depth of the tread, the aft gear tires may not hydroplane at all.

VISCOUS HYDROPLANING

Viscous hydroplaning (or thin film lubrication) is potentially as much of a problem as dynamic hydroplaning. It can occur at lower indicated airspeeds than dynamic hydroplaning on damp runway surfaces that are wet but without standing water. It is caused by the formation of a viscous film between the tire and the runway surface which prevents traction, especially when both surfaces are smooth. The more significant factors which influence this type of hydroplaning are as follows, although the magnitude of their effects are difficult to estimate:

1. Viscosity of Water Contaminants. The more contaminated the water film with viscous foreign materials such as oil, dust, etc., the higher the viscosity of the mixture and the greater the chances for hydroplaning. Conditions such as this results from a light rain shower following an extended dry period. The lubricating properties of these viscous contaminants adversely affect the braking friction coefficient.

2. Runway Surface Texture. Coarseness of the runway surface is a very important factor in the prevention of viscous hydroplaning since the depth of the film of fluid coating the runway is quite small and therefore only requires small openings in the surface to break up this film.

3. Tire Tread Design and Wear. Viscous hydroplaning can be prevented on a coarse runway surface by proper tire tread grooving. Wet braking friction coefficients are higher on a grooved tire than on a smooth, badly worn tire.

REVERTED RUBBER SKIDDING

In addition to the problem of hydroplaning when decelerating on wet runway surfaces, there also exists the possibility of reverted rubber skidding. If the wheel brake anti-skid system is turned off, or if it malfunctions and the brakes lock, elevated tire footprint temperatures soon cause the rubber tread to revert to its uncured state. This may also happen momentarily at landing touchdown, prior to wheel spin-up. If the temperatures are high enough, superheated steam may be generated and trapped in the forward part of the footprint, raising that portion

off the runway similar to dynamic hydroplaning. Since the outer portion of the tread near the carcass sidewall is much softer than normal, due to its reverted rubber condition, it may prevent runway surface roughness from penetrating the film of water, thereby causing viscous hydroplaning. If this occurs, a seal is created which traps the water/steam mixture. This type of hydroplaning results in near zero braking friction coefficients and has been known to continue almost to the point of zero ground speed. The characteristic white skid marks associated with reverted rubber skidding are the result of a "steam cleaning" effect caused by the high temperature and velocity of the trapped water/steam mixture. Runway surface texture has little effect on the alleviation of reverted rubber skidding, although tests indicate that transverse grooving will raise the braking coefficient considerably.

SUMMARY OF HYDROPLANING FACTORS

As discussed under "Hydroplaning," hydroplaning is a phenomenon with many variables. However, certain factors should be considered in order to properly plan for takeoff or landing under hydroplaning conditions.

1. An approximate speed at which dynamic hydroplaning occurs can be determined by reference to figure 9-5. Smooth tires or tires with very little tread remaining will result in hydroplaning with less water depth on the runway.

2. Anti-skid operation will provide the maximum effective braking during an aborted takeoff or landing roll. Therefore, anti-skid should remain on unless a known loss of brakes or failure of the anti-skid system has occurred.

3. Areas of rubber deposits on the runway will have a detrimental effect on braking action. Therefore, reduce speed as much as possible prior to entering these areas.

4. Minimum landing run technique should be used to reduce the flare distance and allow more runway remaining after touchdown (See Section II for discussion).

5. Tires should be properly inflated for the operating gross weight at takeoff. If the tire pressures are low, hydroplaning will occur at a lower speed.

6. In total dynamic hydroplaning conditions, landing gear steering and wheel braking are ineffective. Therefore, it is important that the ground track at touchdown be properly aligned with the runway. As speed is reduced, viscous hydroplaning may occur. Under this condition, simultaneous steering and braking may result in neither being effective. It may be more advantageous to avoid simultaneous steering and braking.

7. The advantages of delayed landing or proceeding to an alternate should be considered when dynamic hydroplaning conditions exist.

EXAMPLE 1:

GIVEN:

Gross weight = 450,000 lb
Runway wind component = 10 knot headwind
Runway pressure altitude = 2000 ft
Runway temperature = 60°F

FIND:

Total and partial hydroplaning speeds for takeoff.

SOLUTION:

Total hydroplaning speed is 127 knots IAS, and the partial hydroplaning speed is 96 knots IAS.

EXAMPLE 2:

GIVEN:

Gross weight = 450,000 lb
Runway wind component = 10 knot headwind
Runway pressure altitude = 2000 ft
Runway temperature = 60°F

FIND:

Total and partial hydroplaning speeds for an aborted takeoff.

SOLUTION:

Total hydroplaning speed is 115 knots IAS, and the partial hydroplaning speed is 96 knots IAS.

EXAMPLE 3:

GIVEN:

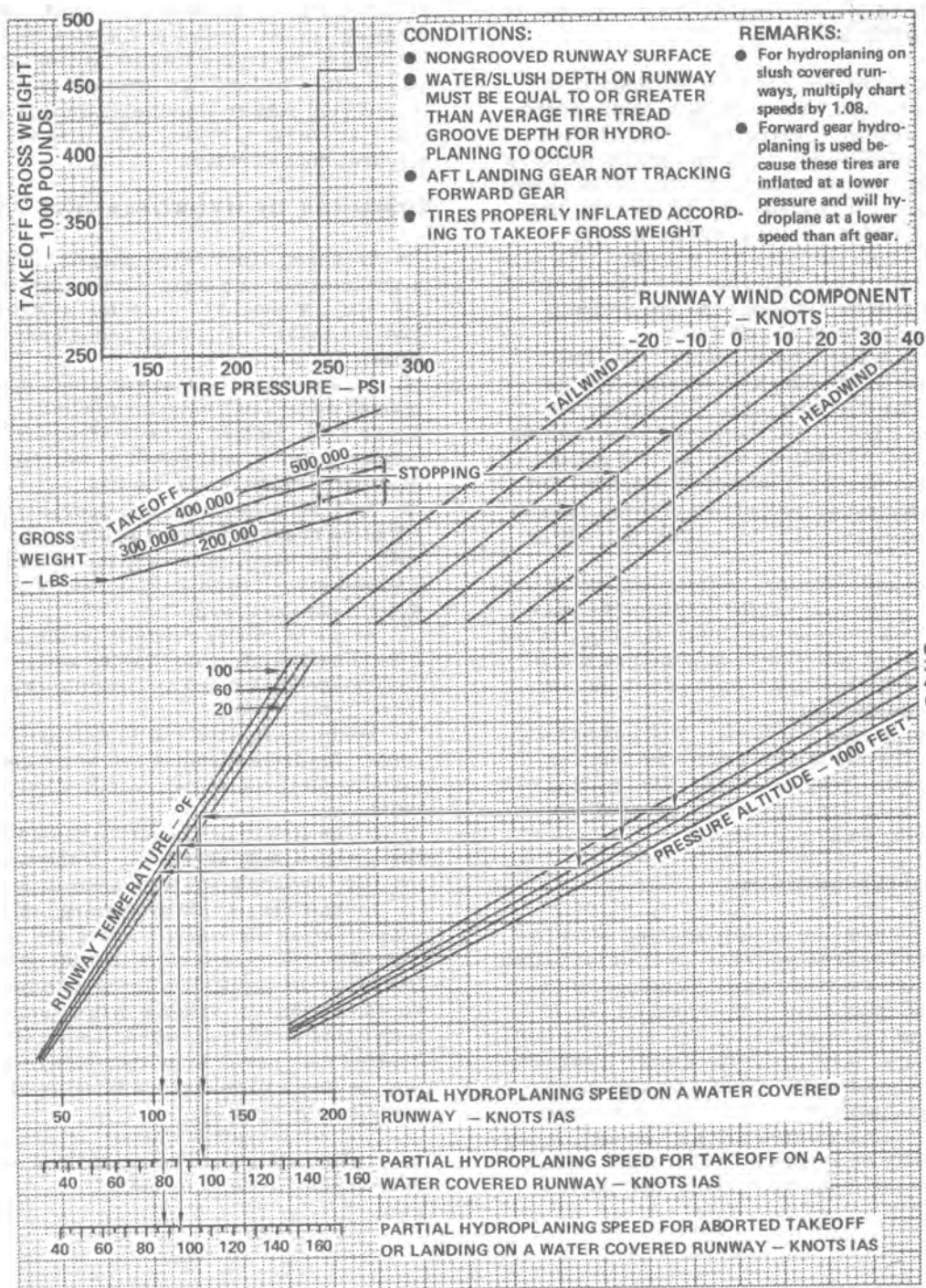
Takeoff gross weight = 450,000 (gross weight entry is based on takeoff tire pressure)
Landing gross weight = 270,000 lb
Runway wind component = 10 knot headwind
Runway pressure altitude = 2000 ft
Runway temperature = 60°F

FIND:

Total and partial hydroplaning speeds for landing.

SOLUTION:

Total hydroplaning speed is 105 knots IAS, and partial hydroplaning speed is 88 knots IAS.



Dynamic Hydroplaning Speeds

Figure 9-5.

the following procedures are recommended prior to entering the storm.

a. Use a penetration altitude of at least 5000 feet below maximum range cruise altitude for better control of the aircraft and establish turbulent air penetration speed.

b. Turn on the engine and nacelle anti-icing system.

c. Energize engine ignition systems by placing starter switches to the START position for the operative engines.

d. Thunderstorm lights may be used to lessen the blinding effect of lightning flashes.

3. Corrective action to be taken if turbulence greater than forecast is encountered will be preplanned with the assistance of the weather forecaster during the weather briefing for all flights. For further information on corrective action, see step "6."

CAUTION

- The turbulent air penetration speed is 270 KIAS or .77 Mach, whichever is less.
- When in turbulence at any altitude, extreme care should be exercised to assure that all control and thrust inputs are applied in a smooth positive manner, avoiding abrupt application of thrust and flight controls whenever possible. Uncoordinated control inputs and applied corrections out of phase with the inherent aircraft stability reactions will aggravate and increase yaw deviations and dutch roll. Such out-of-phase inputs can induce large structural loads on the aircraft empennage and must be avoided.
- If the aircraft has been trimmed for the turbulent air penetration speed, disregard momentary airspeed changes and do not change the stabilizer trim setting.

NOTE

- The autopilot in nonsteering modes will repeatedly disengage in turbulence and should not be used in turbulence at low altitudes. The autopilot will not disengage in turbulent conditions when operated in low level mode and will assist in relieving the effect of gust loads on the aircraft.
 - Pitch and yaw SAS will assist in relieving the effect of gust loads on the aircraft and should be left on at all times.
 - Bank angles in excess of 15° should be avoided.
 - Allow the aircraft to ride out gust strikes.
4. At altitudes other than low level, if turbulence is encountered, observe the MA-1 accelerometer read-

ings immediately. If the readings exceed 1.4 or 0.6 "g" (1.0 (±0.4) "g"), disengage autopilot to prevent an inadvertent disconnect in an unusual attitude and to allow the pilot to assess the degree of turbulence. If the readings reach 1.6 or 0.4 "g" (1.0 (±0.6) "g") more than twice per minute, adjust speed immediately to the appropriate turbulent air penetration speed and place airbrakes in position 2 (see "Dutch Roll Damping," this section).

WARNING

Never climb above maximum range cruise altitude to clear the turbulence.

5. During TA contour operations, flights are prohibited in mountainous areas if peaks extend more than 1000 feet above the terrain within 5 miles either side of the low level corridor when reported or observed flight level winds are 40 knots or greater. All low level operations, either TA or highest terrain clearance, are prohibited when moderate or severe turbulence in mountain wave activity is reported or forecast.

NOTE

- Prior to descending for any low level operation, the latest forecast or inflight reports regarding winds or mounting wave activity along the intended low level route will be obtained from the Air Traffic Control facility or the nearest Pilot to Forecaster service.
- See Section VI for "Low Altitude Flight Characteristics."

Doppler radar will be used to measure flight level winds. If doppler is inoperable, alternate wind finding methods will be used. If turbulence is encountered, observe the MA-1 accelerometer readings immediately. If the magnitude and frequency of the readings reach 1.6 or 0.4 "g" (1.0 (±0.6) "g") more than twice per minute, adjust speed immediately to the appropriate turbulent air penetration speed. If autopilot low level mode is not available, place airbrakes in position 2.

6. When operating at turbulent air penetration speed and the MA-1 accelerometer readings reach 1.6 or 0.4 "g" (1.0 (±0.6) "g") more than twice per minute, preplanned corrective action must be initiated. Corrective action will be as follows:

a. During low level training (highest terrain clearance or contour operations), start a gradual climb not to exceed 1000 feet per minute at turbulent air penetration speed. Continue the climb until the turbulence decreases to an allowable level or the altitude becomes too high to be of value for low level training, then resort to alternate training, mission abort, etc, as planned or directed.

b. During operations other than low level, corrective action may include turns, descent, or climb at penetration airspeed to avoid the areas of turbulence. When the turbulence decreases to an allowable level, continue the mission or resort to alternate training as planned or directed.

NOTE

- The incremental acceleration criteria based on MA-1 accelerometer readings are intended for use as a guide to assist in identifying the level of turbulence in which the aircraft should not be operated without severely compromising flight safety. Turbulence having intensity levels below that associated with these criteria may cause incremental accelerations in excess of the values previously noted at frequencies less than twice per minute. These criteria alone will not provide adequate warning in cases where the turbulence intensity increases abruptly from light or moderate to extremely severe.

- At any time in the pilot's judgment, if turbulence is approaching a critical level (horizontal or vertical) regardless of whether limiting accelerometer readings are observed or not, penetration airspeed should be established and preplanned corrective action taken.

7. If turbulence is encountered such that the MA-1 accelerometer readings exceed 1) those charted on figure 5-10, or 2) if, in the pilot's opinion, the aircraft has encountered heavy loads due to turbulence, the pilot will make entry on Form 781 after landing to the effect that turbulence was encountered and will enter the highest and lowest accelerometer readings so that the appropriate structural inspection will be made prior to the next flight.

DUTCH ROLL DAMPING

"Dutch roll" is the name given to a combined rolling, yawing motion, often described as "wallowing." The motion is named for its resemblance to the characteristic rhythm of an ice skater, where the yawing is out of phase with the rolling; e. g., the nose will be yawing to the left while the right wing is still going down. This motion is more pronounced with swept wing aircraft than with straight wing aircraft or similar size because of the larger rolling moments produced by side slip or yaw. Dutch roll is usually generated by disturbances such as gust encounters together with lateral/directional overcontrolling. The frequency of the dutch roll oscillation in the B-52 will be one complete cycle in 6 to 8 seconds. The amplitude however depends on the magnitude of the disturbances, the fuel loading, and the flight condition (angle of attack). Because the cyclic yawing mo-

tion of the dutch roll will add to the loading already imposed on the vertical tail by random turbulence, it is important to minimize the dutch roll, particularly when flying in turbulence.

The directional damping stability of the aircraft has been increased by means of the yaw SAS. This device will operate satisfactorily in turbulence unless the magnitude of the turbulence becomes so great that the yaw damper no longer has sufficient authority to overcome the resulting dutch roll. In this event, the pilot will have to use manual inputs to assist in damping the dutch roll. If these manual inputs are not correctly applied, the dutch roll will be aggravated and the loads on the vertical tail increased. Dutch roll exists because of a combination of rolling and yawing motions which, being out of phase, tend to complement or "feed" each other. Dutch roll cannot exist in the absence of either of these motions. In order then, to stop dutch roll, at least one of these motions must be controlled. Rudder control can be used to damp dutch roll, but this action requires close observance of the turn rate needle since it can and does become erratic in turbulence. Because the yawing motion is out of phase with, and of considerably lower amplitude than the rolling motion; it is considered most effective to apply corrective action with lateral control.

In the application of lateral control corrections, the pilot's natural inclination will be to correct for displacement rather than rate; i. e., he will apply control inputs to raise the low wing rather than to stop the rolling motion. Continued lateral control inputs in this manner can cause the dutch roll to diverge (increase in amplitude). The pilot will actually be "feeding" the dutch roll rather than damping it. The lateral control inputs must therefore be applied in opposition to the rolling motion. In the turbulence induced dutch roll situation, the yaw SAS is still attempting to stabilize the aircraft about the yaw axis but is prevented from being fully effective by the magnitude of the turbulence upsets. The pilot, by applying lateral control deflections in opposition to the direction of the rolling motion, reduces the magnitude of the dutch roll sufficiently to allow the yaw damper to regain control of the yawing motion. Thereafter, continued lateral control inputs as necessary to oppose any tendency to roll away from a wings-level attitude should prevent regeneration of the dutch roll. Extending the airbrakes will increase the dutch roll stability and therefore decrease the vertical tail loads. For low altitude airbrake usage, see "Turbulent Air Penetration," this section. The maximum recommended position is airbrake position 2. Although some spoiler buffet will be experienced in airbrake position 2, this is not considered detrimental. Airbrake positions greater than 2 are not recommended because of the associated pitch trim change and the possibility of an

unfavorable gust encounter while the aircraft is in a mistrimmed condition. Extension of airbrakes to position 2 should be accomplished cautiously in turbulence making every effort to maintain zero mistrim throughout the procedure to minimize loading. The transient mistrim incurred during airbrake extension is justified by the considerably more stable configuration which results. Based on the foregoing discussion, the following technique for manually damping dutch roll is recommended:

1. Apply lateral control as necessary in opposition to the direction of the rolling motion.
2. Continue lateral control inputs in small pulses to maintain wings-level attitude.
3. When moderate or greater turbulence is encountered, raise airbrakes to position 2 except when in autopilot low level mode.

Cold Weather Procedures

NOTE

Only those cold weather operating procedures not common to all large jet aircraft are included here. Icing conditions during flight are covered under "Ice and Rain," this section.

Many cold weather operating difficulties can be eliminated by proper caution during ground operation. Extreme diligence on the part of both flight and ground crews is essential to successful cold weather operation. If preheating is required, arrange preheating periods so that all aircraft equipment will be inspected, warmed, ready, and operating at the time of starting the engines. While preheating is being accomplished, inspections and operational checks can be made. This work must be thorough since low temperatures may cause hidden difficulties. Avoid touching cold metal with bare skin; it may freeze to the metal.

GROUND

BEFORE ENTERING THE AIRCRAFT

Snow removal should be completed prior to beginning the preheating operation since running water from melted snow will seek hidden places and refreeze. Any personnel on the wings and fuselage should be protected by safety lines to prevent their falling to the ground. All surfaces should be swept with brooms and not beaten or chopped since skin damage may result. Isopropyl alcohol applied with sprayers is effective in removing ice and snow and is particularly valuable in removing ice from between the stabilizer and fuselage. Snow or ice accumulations can increase takeoff distance and adversely affect climb-out performance, stalling speed, and handling characteristics. Inflight structural damage can result from vibrations induced by unremoved accumulations. Preheat the BNS high speed radar antenna drive system for 15 minutes if ambient temperatures have been consistently below -20°F (-29°C).

NOTE

Extend airbrakes cautiously and maintain as near to zero mistrim as possible during extension.

ENGINE COMPRESSOR STALL

Compressor stall may occur when flying in or around thunderheads due to ice crystal ingestion. At high altitudes, the weight of airflow into the engine is low so the water/air ratio for water injection may be exceeded as the ice crystals melt, causing compressor stall in extreme cases. Normal compressor stall procedures as described in Section VII under "Engine Operation" should be employed to counter this condition.

CAUTION

At temperatures below -50°F (-46°C), the high speed radar antenna will not rotate unless preheated. An attempt to operate without preheating may result in failure of the drive motor.

NOTE

- The same special tool is used to attach a hot air line to the radome ram air inlet for this purpose as is used for a ground cooling air line when cooling is required.
- Leakage can be expected of the antenna high pressure air when operation is begun at extremely low ambient temperatures. The pressurization system pump will recycle frequently in attempting to maintain pressure during the 20 to 30 minutes which may be required for operation to warm the equipment sufficiently for the seals to hold pressure.

The nickel-cadmium batteries have heaters and are capable of satisfactory operation at -40°C (-40°F). The batteries may be heated by the use of external electrical power. At a temperature of -54°C (-65°F) 1 hour of heating will condition the batteries for normal operation.

Although not required, it is desirable to preheat the crew compartment during cold weather operations.

CAUTION

Failure to remove snow from the fuselage before applying interior heat will result in ice refreezing on the sides of the fuselage, causing drag and possible erratic airspeed indications if it forms around the pitot heads or static ports.

Ice formed from runoff water has been found in a thin clear sheet over static ports. The air refueling slipway doors are vulnerable to runoff icing as are the static ports for the air conditioning system. Melting snow from above the aft compartment may freeze on the junction of fuselage and horizontal stabilizer, thus preventing movement of the stabilizer. When operating out of a nose dock and snowfall is occurring, open nose dock doors in time to cool the skin of the aircraft before removing it from the dock as snow will cling to a warm surface and freeze. Flight tests have revealed that takeoff can be made with frost formations up to 1/8 inch thick on the lifting surfaces without appreciably affecting performance.

CAUTION

- If heat is used to remove ice or snow, check movable control surfaces for freedom of movement prior to entry into the aircraft.
- Before removing snow and ice from the empennage of the aircraft, the stabilizer leading edge should be placed in the up position. Start engines 4 and 5 and set the stabilizer trim to 8 units aircraft nose down position. The stabilizer should be retained in this position during deicing and for a period of 10 to 15 minutes after deicing so that runoff from the deicing operation does not seep into the balance bay areas and refreeze. Any ice or slush in the balance bay could possibly limit control surface movement and reduce aircraft control. If the aircraft is to be left unattended or is to be put on alert for extended periods under snow and icing conditions, the stabilizer may be left in this position and will be reset to takeoff trim setting prior to takeoff during the "Before Lineup" checklist.

STARTING ENGINES

Whenever an aircraft is removed from a heated hangar or dock, a ground heater should be available to supply heat to the engine fuel control units, starter valves, and starter turbine if this becomes necessary. If an air supply is available inside the dock or hangar, the engines should be motored for a short period before removing the aircraft. This procedure should remove any moisture from the ducts and starter system.

NOTE

The indicated oil pressure may be slow to rise to the normal operating range after starting a cold-soaked engine during very cold weather. Provided some indication of oil pressure is observed when the engine is first started, up to 3 1/2 minutes may be allowed for the indicated oil pressure to reach the minimum limit.

If a starter valve fails to open during engine start, use of the starter switch and hot pressurized air is recommended for thawing of the starter valve. Often the starter valve will open after the starter switch has been energized for 3 minutes and hot pressurized air is being supplied from an adjacent engine or ground cart. The heat created by the energized starter solenoid will penetrate the regulator housing and the hot pneumatic air, through gradual flow, will help heat the valve area thus allowing the valve to open and operate properly.

AFTER STARTING ENGINES

If the ambient temperature is -30°C (-22°F) or below, idle the engines for a 2-minute warmup period.

TAXIING

On ice- and snow-covered areas, taxi speed should be reduced and the normal taxi interval between planes should be increased. Taxiing in deep snow should be avoided as taxiing and steering are extremely difficult and frozen brakes and gear may result. During low temperatures, a slight delay in brake response can be expected. Care should be taken when maneuvering near other parked aircraft as the jet blast will blow melted snow onto other aircraft where cold metal will freeze it. The wide spread of the wing tip protection gear requires close observation during taxiing to prevent damage from snow banks.

WARNING

In cold weather, make sure all instruments have warmed up sufficiently to insure normal operation. Check for sluggish instruments during taxiing.

NOTE

- On very slick surfaces, come to a complete stop prior to attempting to turn the aircraft.
- Under certain atmospheric conditions at temperatures of -30°C (-22°F) and lower, a large amount of ice fog may be caused by the engines. Taxiing on the runway should be kept to a minimum to keep from lowering the visibility.

At temperatures below -40°F , the spoilers should be cycled continuously for three complete cycles to assure adequate lateral control for takeoff and the stabilizer trim should be cycled three times to assure satisfactory operation of the system during takeoff and climb.

FLIGHT

TAKEOFF

Gear retraction time will be slightly longer than the normal retraction time of 10 to 15 seconds. At a temperature of -28.9°C (-20°F), retraction time will be 2 seconds longer and at a temperature of -40°C (-40°F), retraction time will be 30 to 35 seconds. This delay is due to the cold temperature of the hydraulic oil.

DURING FLIGHT

Range and endurance are both affected favorably by low temperatures. See Parts 5 and 6 of the Appendix for appropriate correction factors. Information regarding inflight icing may be found under "Ice and Rain," this section.

CROSSWIND OPERATION

On takeoffs and landings, set in any crosswind crab component required. See the crosswind landing gear position charts in Parts 2 and 3 of the Appendix.

NOTE

When landing on a slippery runway, do not center the crosswind crab until ready to turn off of the runway.

LANDING APPROACH

Long flat unbroken stretches of snow make depth perception difficult. The tendency is to overestimate the aircraft altitude. During snow periods, if approaching at night, visibility will be reduced by using both landing lights.

LANDING

WARNING

Care should be exercised when landing on a runway covered by water and/or slush in excess of 0.3-inch depth. Under such conditions, hydroplaning, which will cause severe control and braking losses, may occur even though a low RCR reading has not been reported.

A slippery runway combined with a crosswind may result in a condition such that a landing is not recommended. For further information, see "Landing With Crosswind on Slippery Runways" under "Ice and Rain" in this section. Braking action approaches normal on a slippery runway if all-weather tires are installed. When landing on snow or ice, use normal braking action except when large amounts of crosswind crab are used. See Part 9 of the Appendix for increase in ground run using the proper RCR number.

AFTER LANDING

Stopping Engines

At temperatures of -30°C (-22°F) or below, the engines should be permitted to idle for at least 2 minutes before normal shutdown procedures are accomplished. This will prevent damage resulting from rapid temperature changes.

Hot Weather Procedures

Hot weather operation, both arid and tropical, requires additional attention and preparation other than the normal operating instructions given in Section II. Only specific information for care of the aircraft during ground and flight operation will be covered in this section.

GROUND

BEFORE ENTERING THE AIRCRAFT

1. Wear gloves and use care when working around metal surfaces of the aircraft that are exposed to the sun.
2. Delicate electrical equipment such as communications and instruments must be completely dry. In locations where high humidity is encountered, equipment will be subject to malfunctions due to corrosion, fungus, and moisture absorption by nonmetallic materials. Such equipment should be kept warmer than the ambient temperature if possible to prevent condensation of moisture inside the units.
3. Units incorporating plastic or rubber should be protected from excessive temperatures and direct sun rays by the use of suitable covers.
4. Crew compartments will be cooled with a portable air conditioner prior to entering the aircraft.

ON ENTERING THE AIRCRAFT

If high humidity has caused instruments and cabin controls to become covered with moisture, dry thoroughly with flow of warm air from portable ground heater.

STARTING ENGINES

Use normal engine starting procedures, keeping ground tests to the minimum required time.

NOTE

Engines will accelerate to idle rpm on a hot day much more slowly than on a normal or cold day.

TAXIING

Use brakes as little as possible as cooling will be retarded by high temperatures.

FLIGHT

TAKEOFF AND CLIMB

1. Required takeoff distance increases during hot weather operation. See Parts 2 and 3 of the Appendix for takeoff distances.
2. Follow normal climb pattern for conditions prevailing.

NOTE

The rate of climb should be held as low as practicable to reduce fuel vaporization losses.

LANDING

Use normal landing technique but expect a longer ground roll in hot weather. As soon as the parking position has been reached, have wheel chocks securely placed and release parking brakes at once to forestall possible damage to brake discs because of excess heat generated during taxiing.

POSTFLIGHT

1. Have closures and covers installed for protection from sun.
2. Leave windows and doors open for ventilation.

NOTE

If fuel tanks are topped off, overflow from expansion may present a fire hazard.

Desert Procedures

Very high and low temperatures and low humidity, together with the abrasive effect of blowing sand and dust, make desert operations considerably more difficult than normal conditions which are covered by operating instructions in Section II. Considerable damage to both aircraft and engines can occur if the extra precautions covered here are not observed.

GROUND

BEFORE ENTERING THE AIRCRAFT

On exterior inspection, if sand is evident on shock strut pistons or other hydraulic pistons where piston touches cylinder seal, have it removed with a dry soft cloth.

CAUTION

Position the aircraft so that consideration can be given to other aircraft, personnel, and ground installations when engines are started. Sand blown by operating engines of one aircraft can add hours to the maintenance problems of other aircraft or do bodily harm to personnel.

ON ENTERING THE AIRCRAFT

Excessive dust accumulations on instrument dials and blown sand on and around movable flight controls, dials, and switches must be cleaned away.

STARTING ENGINES

Use normal starting procedures.

CAUTION

Get the aircraft into the air as soon as possible after engines have been started so that dust and blowing sand will not be drawn through the engines with resultant damage to internal parts.

TAXIING

When taxiing, keep adequate distance between aircraft to prevent sand and dust kicked up by engine

blast from being blown on and into the aircraft and engines.

BEFORE TAKEOFF

Do not take off during sand or dust storms unless absolutely necessary; instead, head aircraft into wind, stop engines, and have all protective covers and closures installed.

FLIGHT

TAKEOFF

Be prepared for sudden gusts of wind during takeoff run. In arid localities, extreme temperature variations may occur within a relatively short time. Therefore, takeoff data should be reviewed immediately prior to takeoff.

DURING FLIGHT

CAUTION

Avoid flying through dust storms if possible; excessive dust and grit in the air will cause considerable damage to internal parts of the engine.

STOPPING ENGINES

Have dust covers and closures installed immediately to prevent blowing sand and dust from entering engines.

POSTFLIGHT

See that all ducts and openings are covered. Have both forward and aft main landing gear wheel wells, fuselage, nose, pitot tube, and windshield covers installed, if such covers are available.

NOTE

In extremely dusty locations where it is necessary to leave hatches or doors open for ventilation, all equipment in the cabin should be covered with dust-proof covers where possible to keep out dust and blowing sand.

NOTE

For Performance Data, refer to T.O. 1B-52G-1-1.

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