USAF SERIES

F-86A AIRCRAFT

FLIGHT HANDBOOK

Commanders are responsible for bringing this handbook to the attention of all personnel cleared for operation of affected aircraft.

Published under authority of the Secretary of the Air Force.

This reissue replaces T.O. 1F-86A-1, dated 12 October 1955, and Safety of Flight Supplements -1V through -1Z, and -1CC through -1CR. See Basic Index, T.O. 0-1-1, and Weekly Index, T.O. 0-1-1A, for current status of Safety of Flight Supplements.

F-86A-1-0-16

A.F. SMAMA 11/21/57—2,500

30 AUGUST 1957

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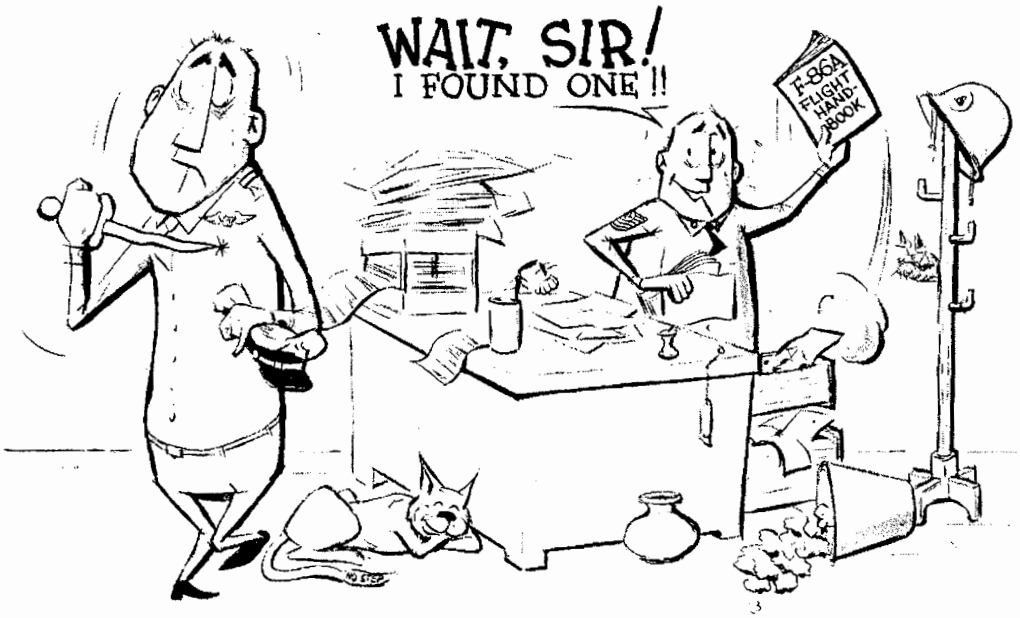


F-86A-1-0-17

The intent of Air Force Regulation 5-13, dated 11 August 1953, is to entitle each pilot to his own personal copy of the Flight Handbook.

Scope. This handbook contains all the information necessary for safe and efficient operation of the F-86A Airplane. These instructions do not teach basic flight principles, but are designed to provide you with a general knowledge of the airplane, its flight characteristics, and specific normal and emergency operating procedures. Your flying experience is recognized, and elementary instructions have been avoided.

Sound Judgment. The instructions in this handbook are designed to provide for the needs of a pilot inexperienced in the operation of this airplane. This book 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 contained herein.

Permissible Operations. The Flight Handbook takes a "positive approach," and normally tells you only what you can do. Any unusual operation or configuration (such as asymmetrical loading) is prohibited unless specifically covered in the Flight Handbook. Clearance must be obtained from ARDC before any questionable operation is attempted which is not specifically covered in the Flight Handbook.

Standardization. Once you have learned to use one Flight Handbook, you will know how to use them all—closely guarded standardization ensures that the scope and arrangement of all Flight Handbooks are identical.

Arrangement. The handbook has been divided into 10 sections, each with its own table of contents. The objective of this subdivision is to make it easy to read the book straight through when it is first received and to use it as a reference manual. The independence of these sections also makes it possible to rearrange the book to satisfy the user's personal requirements. The first three sections cover the minimum information required to safely get the airplane into the air and back down again. Before flying any new airplane, these three sections must be thoroughly read and fully understood. Section IV covers all equipment not essential to flight but which permits the airplane to perform special functions. The contents of Sections V and VI are obvious from their titles. Section VII covers lengthy discussions on any technique or theory of operation which may be applicable to the particular airplane in question. The experienced pilot probably will be aware of most of the information in this section, but he should check it for any possible new information. The contents of the remaining sections are obvious from their titles.

Your Responsibility. These Flight Handbooks are constantly maintained current through an extremely active revision program. Frequent conferences with operating personnel and constant review of UR's, accident reports, flight test reports, etc, ensure inclusion of the latest data in these handbooks. In this regard, it is essential that you do your part! If you find anything you don't like about this book, let us know right away. We cannot correct errors whose existence is unknown to us.

Tabs and Binders. Flexible, loose-leaf tabs and binders have been provided to hold your personal copy of the Flight Handbook. These good-looking, simulated-leather binders will make it much easier for you to revise your handbook as well as to keep it in good shape. These tabs and binders are secured through your local Materiel Staff and Contracting Officer.

How to Get Copies. If you want to be sure of getting your handbooks on time, order them before you need them. Early ordering will ensure that enough copies are printed to cover your requirements. Technical Order 0-5-2 explains how to order Flight Handbooks so that you will automatically get all revisions, reissues, and Safety of Flight Supplements. Basically, all you have to do is order the required quantities in the Publication Requirements Table (T.O. 0-3-1). Talk to your Senior Materiel Staff Officer—it is his job to fulfill your Technical Order requests. Establish some system that will rapidly get the books and Safety of Flight Supplements to the pilots once they are received on the base.

Safety of Flight Supplements. Safety of Flight Supplements are used to get information to you in a hurry. Safety of Flight Supplements use the same number as your Flight Handbook, except for the addition of a suffix letter. Supplements covering loss of life will get to you in 48 hours; those concerning serious damage to equipment will make it in 10 days. You can determine the status of Safety of Flight Supplements by referring to the Index of Technical Publications (T.O. 0-1-1) and the Weekly Supplemental Index (T.O. 0-1-1A). This is the only way you can determine whether a supplement has been rescinded. The title page of the Flight Handbook and title block of each Safety of Flight Supplement should also be checked to determine the effect that these publications may have on existing Safety of Flight Supplements. It is critically important that you remain constantly aware of the status of all supplements —you must comply with all existing supplements but there is no point in restricting the operation of your aircraft by complying with a supplement that has been replaced or rescinded. If you have ordered your Flight Handbook on the Publications Requirements Table, you automatically will receive all supplements pertaining to your airplane. Technical Order 0-5-1 covers some additional information regarding these supplements.

Warnings, Cautions, and Notes. For your information, the following definitions apply to the "Warnings," "Cautions," and "Notes" found throughout the handbook:

WARNING

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

CAUTION

Operating procedures, practices, etc, which if not strictly observed will result in damage to equipment.

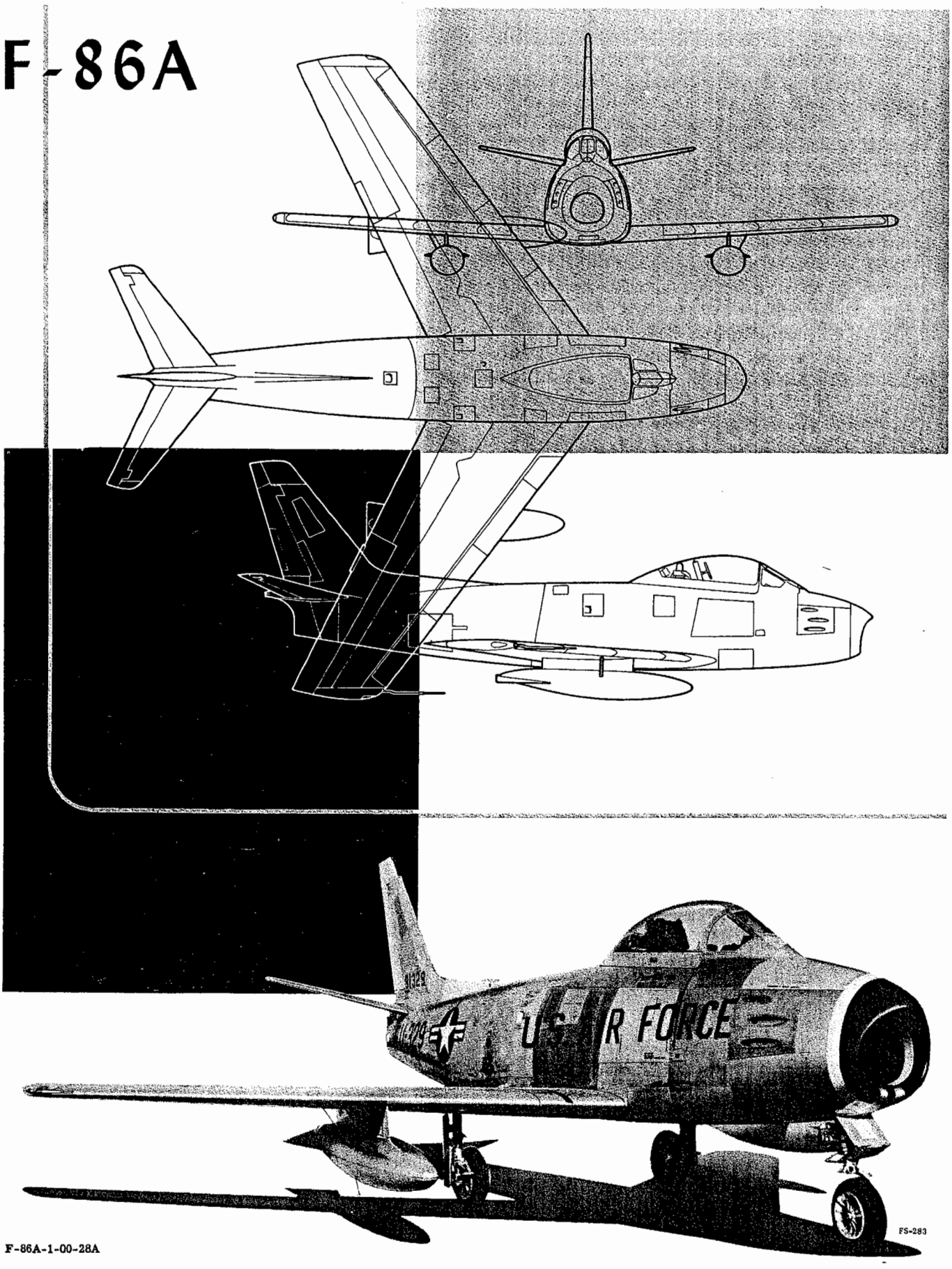
Note

An operating procedure, condition, etc, which it is essential to emphasize.

Maintenance Handbook. If you desire more detailed information on the various airplane systems and components than is provided within the scope of the Flight Handbook, refer to the Maintenance Handbook for your airplane (T.O. 1F-86A-2).

Comments and Questions. Comments and questions regarding any phase of the Flight Handbook program are invited and should be forwarded through your Command Headquarters to Commander, Detachment No. 1, HQ Air Research and Development Command, Wright-Patterson AF Base, Ohio, Attention: RDZSPH.

F-86A



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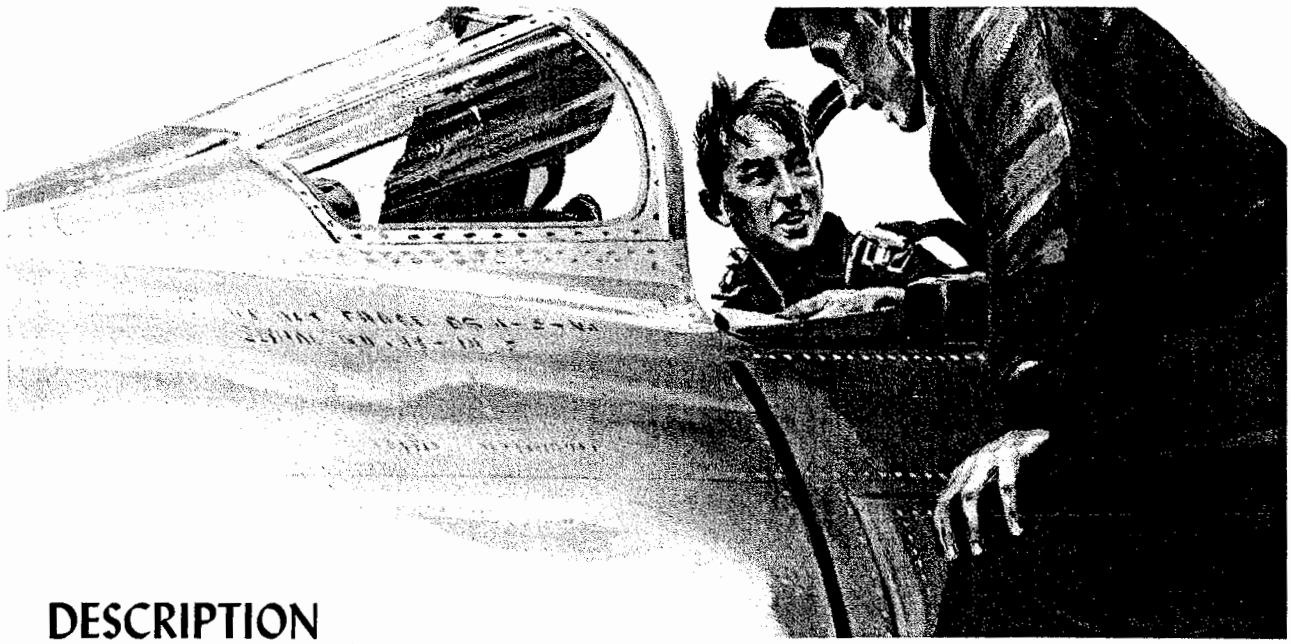

SECTION I

DESCRIPTION

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AIRPLANE.

The North American F-86A Sabre is a single-place, high-altitude fighter, powered by an axial-flow turbojet engine. It is characterized by swept-back wings and empennage. Noteworthy features include an adjustable horizontal stabilizer, leading edge wing slats, and fuselage speed brakes. Designed primarily for flight in the sonic and subsonic speed ranges at high altitudes, the airplane may also be used to attack ground or naval objectives with gunfire, bombs, rockets, or chemicals.

AIRPLANE DIMENSIONS.

Over-all dimensions of the airplane are as follows:

Wing span	37.1 feet
Length	37.5 feet
Height (to top of vertical stabilizer)	14.7 feet
Tread	8.3 feet

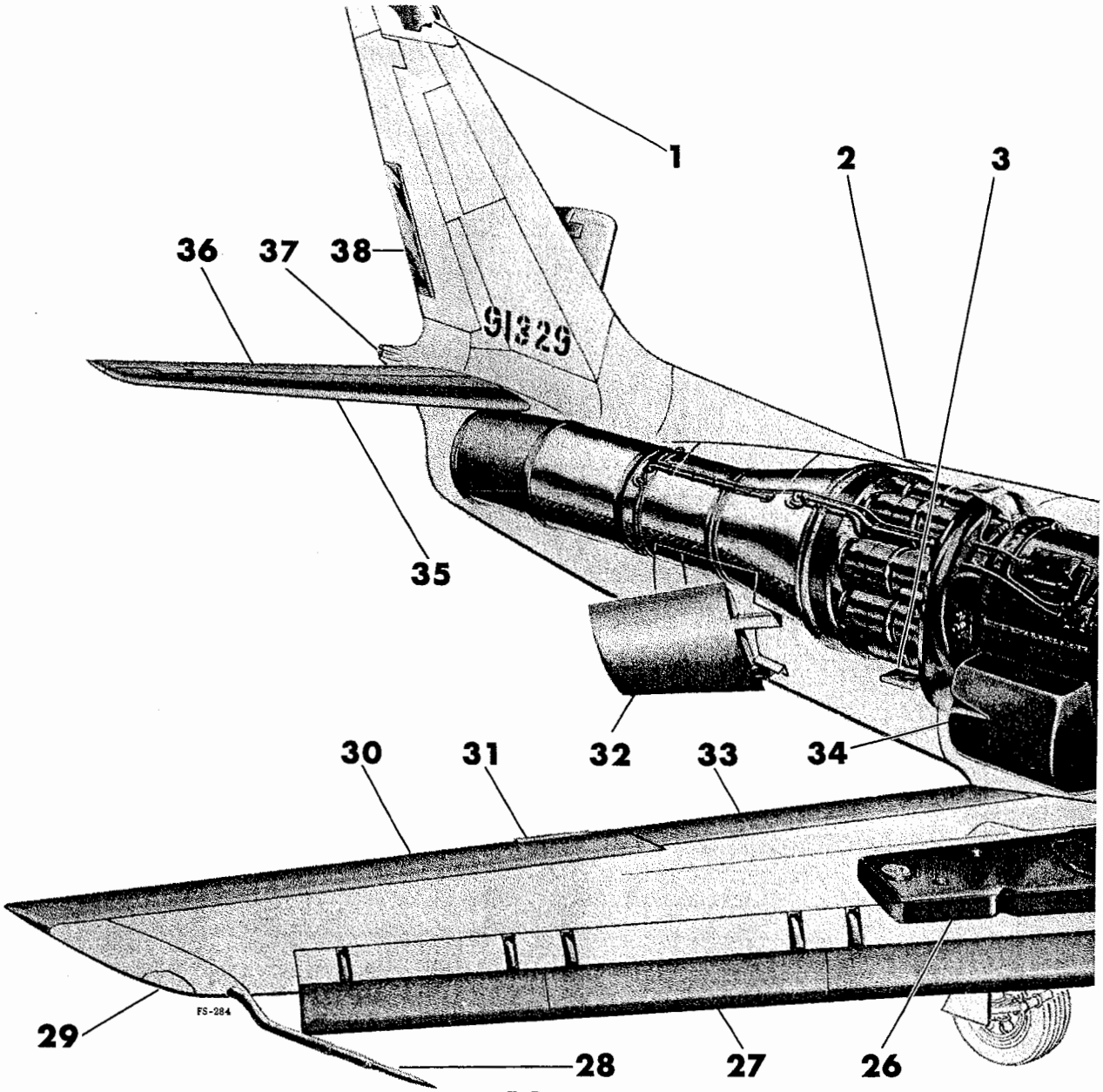
AIRPLANE GROSS WEIGHT.

The approximate take-off gross weight of the airplane [including full fuel (JP-3 or JP-4) and ammunition, but not including the pilot] is as follows:

No external load	14,250 pounds
With two 206½ US gallon drop tanks (heaviest external load)	17,250 pounds
With two 120 US gallon drop tanks	16,000 pounds

ARMAMENT.

The airplane is armed with six .50-caliber machine guns, three mounted on each side of the engine air intake duct, and is capable of carrying bombs, rockets, or chemical tanks as external load. (Refer to "Armament Equipment" in Section IV for detailed information.)



1 COMMAND RADIO ANTENNA

2 J47-GE-7 OR -13 ENGINE

3 DATA CASE

4 AILERON TRIM TAB

5 RADIO COMPASS SENSE ANTENNA

6 RADIO COMPASS LOOP ANTENNA

7 DIRECTIONAL INDICATOR TRANSMITTER

8 EJECTION SEAT

9 REAR-VISION MIRROR

10 TYPE A-1CM SIGHT (F-86A-5 AIRPLANES AF49-1316 THROUGH -1339 AND F-86A-6 AND F-86A-7 AIRPLANES)

11 RADAR RANGING EQUIPMENT

12 BATTERY

13 RADAR ANTENNA (F-86A-7 AIRPLANES)

14 GUN CAMERA

15 RETRACTABLE LANDING AND TAXI LIGHT

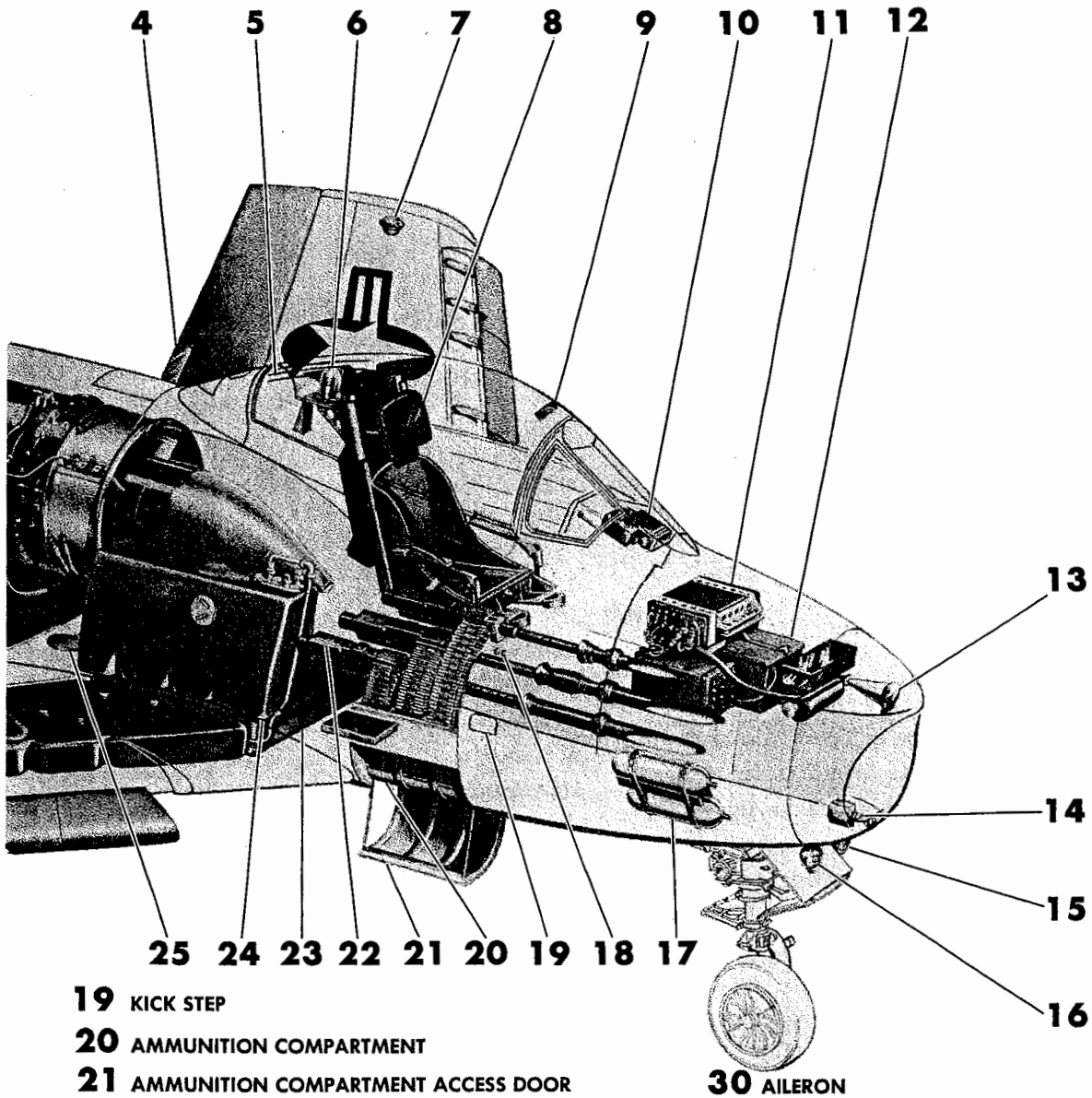
16 RETRACTABLE LANDING LIGHT

17 OXYGEN CYLINDERS

18 CANOPY EXTERNAL CONTROL BUTTONS

F-86A-1-00-1B

Figure 1-1



19 KICK STEP
20 AMMUNITION COMPARTMENT
21 AMMUNITION COMPARTMENT ACCESS DOOR
22 GUN COMPARTMENT
23 FORWARD FUSELAGE FUEL TANK—LOWER CELL
24 FORWARD FUSELAGE FUEL TANK—UPPER CELL
25 IFF RADAR ANTENNA
26 OUTER WING FUEL TANK
27 WING SLATS
28 PITOT-STATIC HEAD
29 POSITION LIGHT (LEFT AND RIGHT WINGS)
30 AILERON
31 GROUND ADJUSTABLE AILERON TRIM TAB
32 SPEED BRAKE
33 WING FLAP
34 AFT FUSELAGE FUEL TANK
35 ADJUSTABLE HORIZONTAL STABILIZER
36 ELEVATOR
37 POSITION LIGHTS
38 RUDDER TRIM TAB

F-86A-1-00-2A

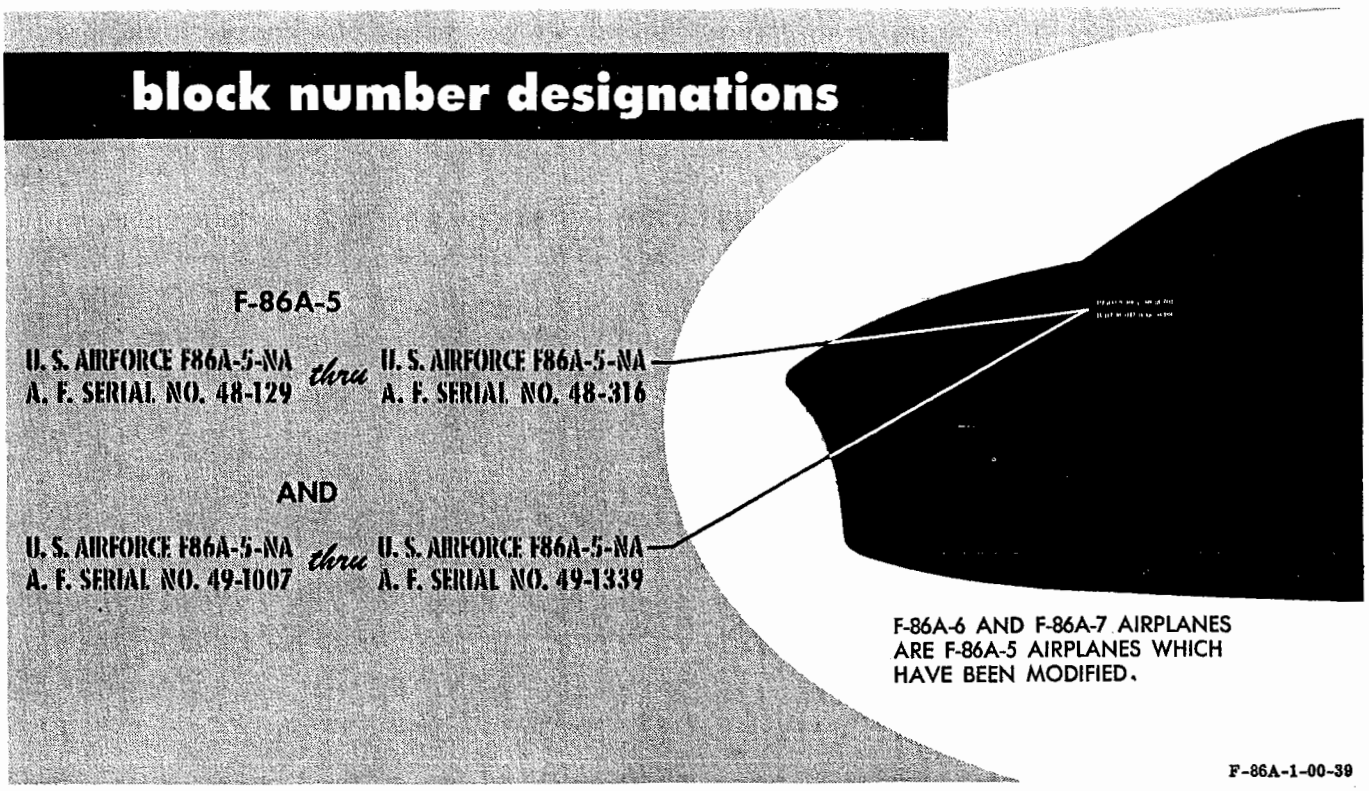


Figure 1-2

MAIN DIFFERENCES TABLE.

The block number designations of F-86A Airplanes are shown in figure 1-2, and the main differences between the F-86 Series Airplanes are shown in figure 1-3. F-86A-5 Airplanes which have been changed at the Contractor's plant retain originally assigned Air Force serial numbers but were redesignated either F-86A-6 or F-86A-7 Airplanes. Airplanes modified to include the Type A-1CM sight and AN/APG-5C radar are F-86A-6 Airplanes; those modified to incorporate the A-1CM sight and AN/APG-30 radar are F-86A-7 Airplanes. The instructions and descriptions in this handbook that are coded for F-86A-5 Airplanes are also applicable for F-86A-6 and F-86A-7 Airplanes unless specifically noted. Information that applies only to F-86A-6 and F-86A-7 Airplanes is coded accordingly. Because of the nature of the modification program, consecutive serial numbers cannot be provided for F-86A-6 and F-86A-7 Airplanes. However, these airplanes can be identified by equipment changes and external model identification markings. Upon modification of the airplane, all applicable forms, historical records, and reports were changed. There are no F-86A-1 Airplanes on flight status.

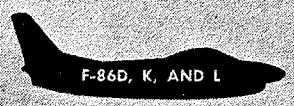
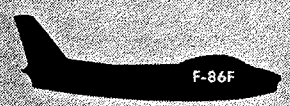
ENGINE.

The engine (figure 1-4) is an axial-flow, jet-propulsion unit, Model J47-GE-7 or -13, having a rated thrust of approximately 5200 pounds. In engine operation, air enters the intake duct in the nose of the airplane and passes through an axial-flow compressor where the air is compressed progressively in 12 stages. The compressed air then flows to the combustion chambers where atomized fuel is injected and combustion occurs. From the combustion chambers, the hot exhaust gases pass through a turbine and on out the tail pipe in gradually expanding form to provide the high-velocity jet and reaction thrust. The turbine, which is rotated by the exhaust gases passing through it, is directly connected to, and drives, the compressor.

ENGINE FUEL CONTROL SYSTEMS.

Fuel flow to the engine is regulated by a fuel system consisting of a main system and an emergency system. The major units of the main system are duplicated in the emergency system, which is used to maintain fuel flow to the engine if the main system fails.

main differences table

F-86 SERIES	F-86A	 F-86D, K, AND L	F-86E	 F-86F	F-86H
ITEM	**A**	**D, K, and L**	**E**	**F**	**H**
Engine	J47-GE-7 or -13	J47-GE-17, -17B, or -33 with afterburner	J47-GE-13	J47-GE-27	J73-GE-3 Series
Engine Control	Mechanical	Electronic	Mechanical	Mechanical	Hydromechanical
Automatic Pilot	No	Yes	No	No	No
Horizontal Tail	Conventional	Single, controllable surface	Controllable stabilizer and elevator	Controllable stabilizer and elevator	Controllable stabilizer and elevator
Aileron & Horizontal Tail Control	Conventional and hydraulic boost	Full-power hydraulic irreversible control	Full-power hydraulic irreversible control	Full-power hydraulic irreversible control	Full-power hydraulic irreversible control
Aileron & Horizontal Tail Artificial Feel System	No	Yes	Yes	Yes	Yes
Armament	Machine guns, bombs, rockets, or chemical tanks	F-86D AND F-86L: Rockets in fuselage package F-86K: 20mm guns	Machine guns, bombs, rockets, or chemical tanks	Machine guns, bombs, rockets, or special store	Machine guns, bombs, rockets, or special store
Windshield	"V"	Flat	"V" or flat	Flat	Flat
Canopy Ejection Control	Right handgrip on seat Either handgrip (some airplanes)	Right handgrip on seat Either handgrip (some airplanes)	Right handgrip on seat Either handgrip (some airplanes)	Right handgrip on seat Either handgrip (some airplanes)	Either handgrip on seat
Canopy	Sliding	Clamshell	Sliding	Sliding	Clamshell
Oxygen Regulator	A-14 or D-2	D-1, D-2, D-2A, or MD-1	A-14 or D-2	D-1, D-2, or D-2A	D-2

F-86A-1-00-25A

Figure 1-3

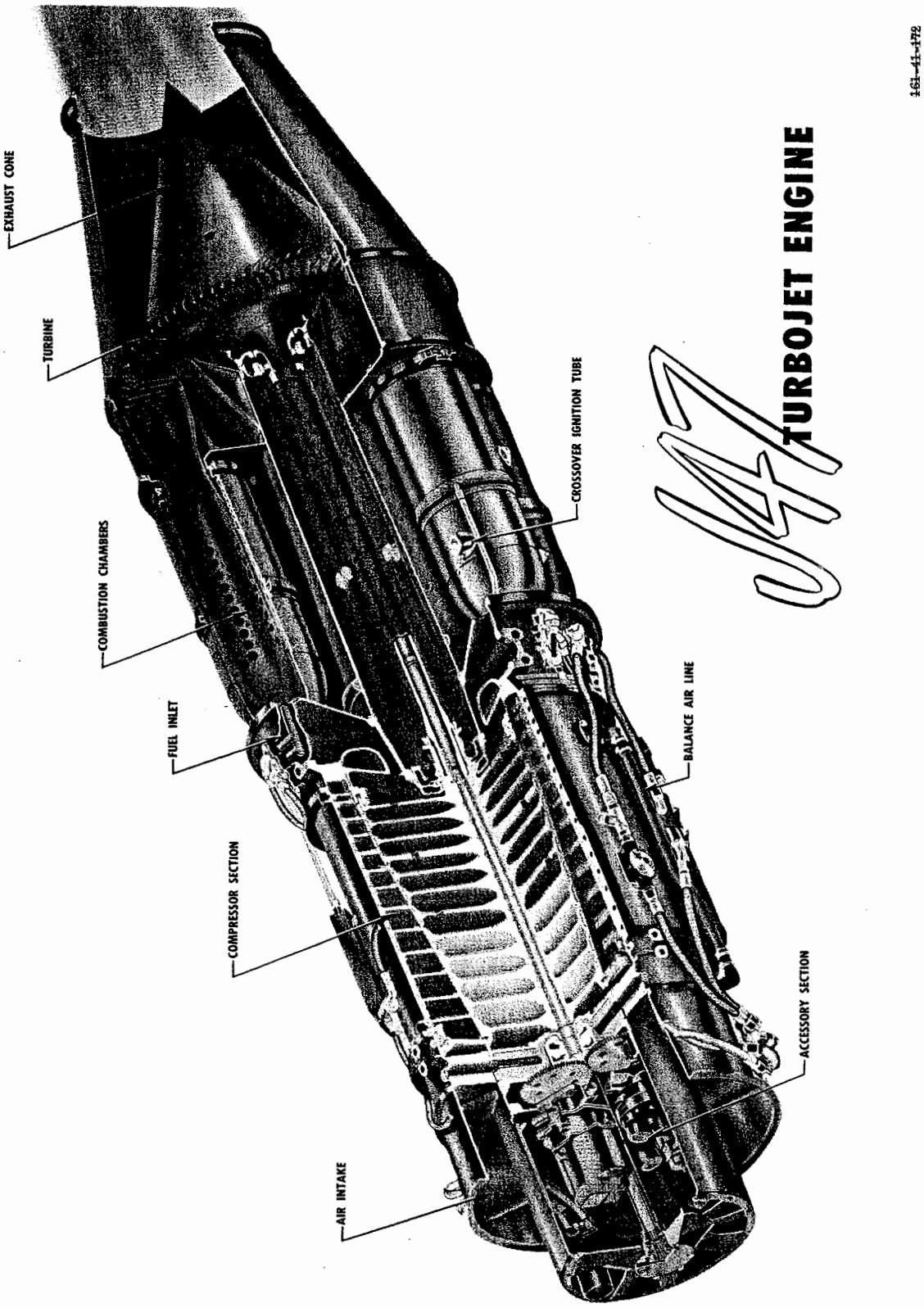
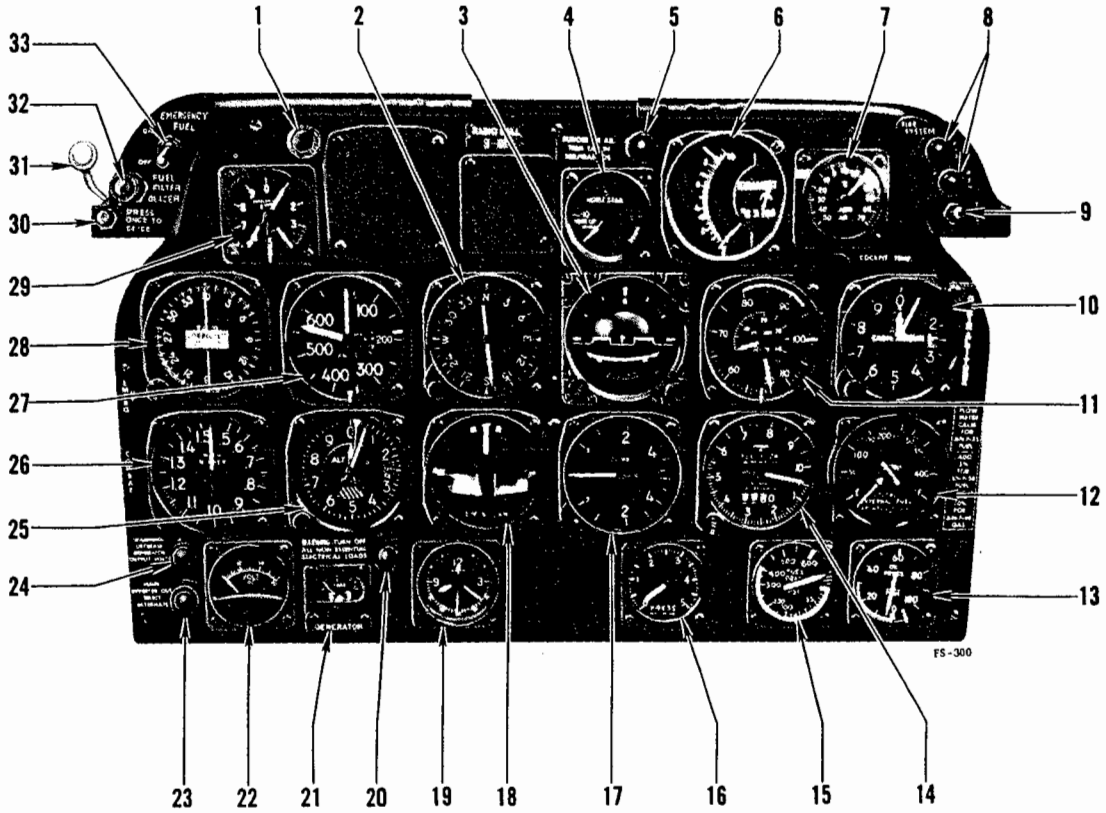

J47 TURBOJET ENGINE
161-41-172
EXHAUST CONE
TURBINE
COMBUSTION CHAMBERS
FUEL INLET
COMPRESSOR SECTION
AIR INTAKE
CROSSOVER IGNITION TUBE
BALANCE AIR LINE
ACCESSORY SECTION

Figure 1-4

instrument panel



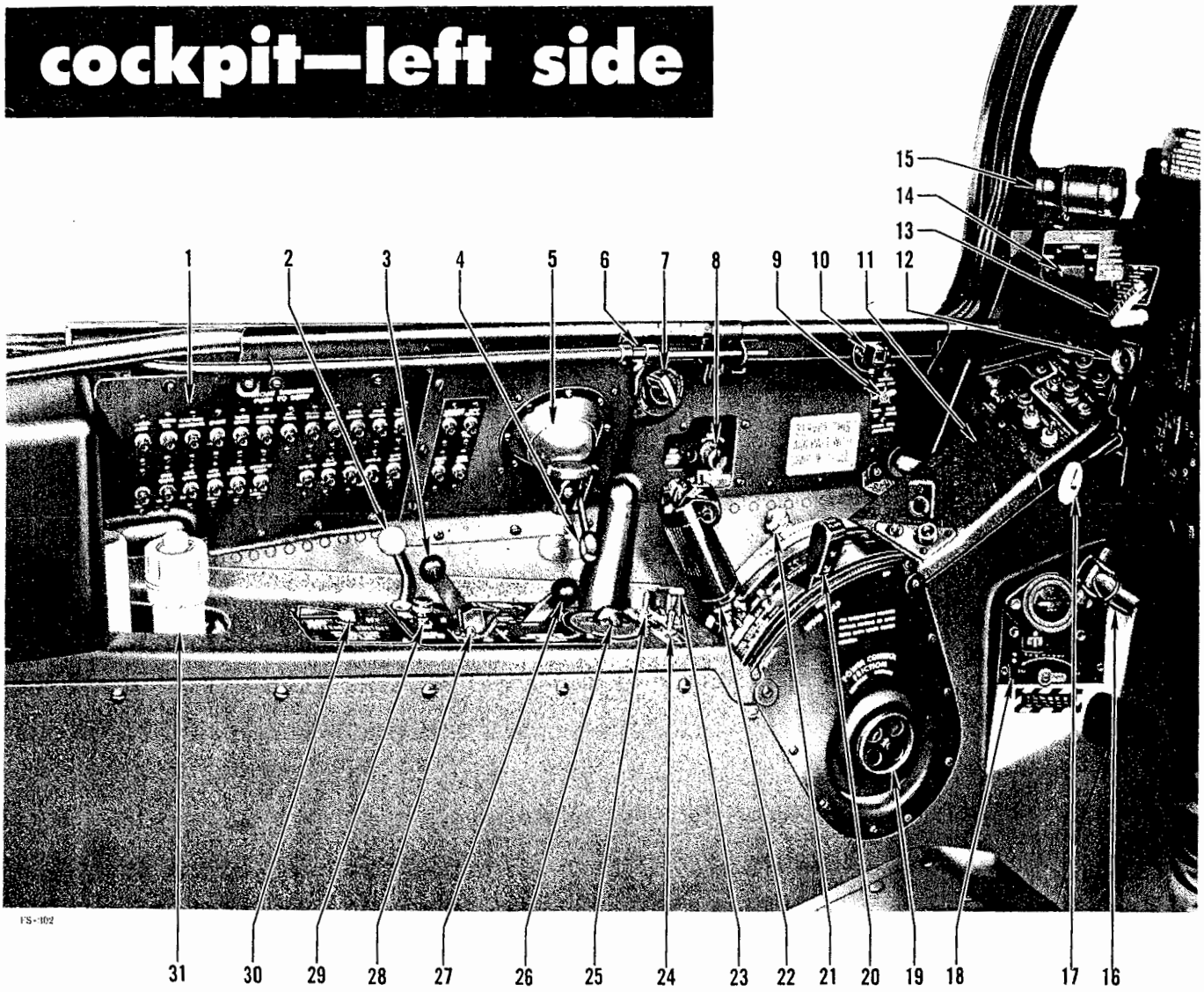
1. LANDING GEAR HANDLE-UP INDICATOR LIGHT *
2. DIRECTIONAL INDICATOR (SLAVED)
3. ATTITUDE INDICATOR
4. HORIZONTAL STABILIZER POSITION INDICATOR
5. RUDDER (AND AILERON *) TRIM TAB NEUTRAL INDICATOR LIGHT
6. EXHAUST TEMPERATURE GAGE
7. COCKPIT AIR TEMPERATURE GAGE
8. FIRE-WARNING LIGHTS
9. FIRE-WARNING SYSTEM TEST BUTTON
10. CABIN PRESSURE ALTIMETER
11. TACHOMETER
12. FUEL QUANTITY GAGE
13. OIL PRESSURE GAGE
14. FUEL FLOWMETER AND TOTALIZER *
15. FUEL PRESSURE GAGE
16. UTILITY HYDRAULIC PRESSURE GAGE
17. VERTICAL VELOCITY INDICATOR
18. TURN-AND-SLIP INDICATOR
19. CLOCK
20. GENERATOR WARNING LIGHT
21. LOADMETER
22. VOLTMETER
23. INVERTER WARNING LIGHT
24. GENERATOR OVERVOLTAGE WARNING LIGHT
25. ALTIMETER
26. MACHMETER
27. AIRSPEED INDICATOR
28. RADIO COMPASS INDICATOR
29. ACCELEROMETER
30. FUEL FILTER DEICER BUTTON *
31. SLAT LOCK LEVER *
32. FUEL FILTER ICE WARNING LIGHT *
33. EMERGENCY FUEL SWITCH

* Some airplanes. (Refer to applicable text.)

F-86A-1-00-3B

Figure 1-5

cockpit—left side



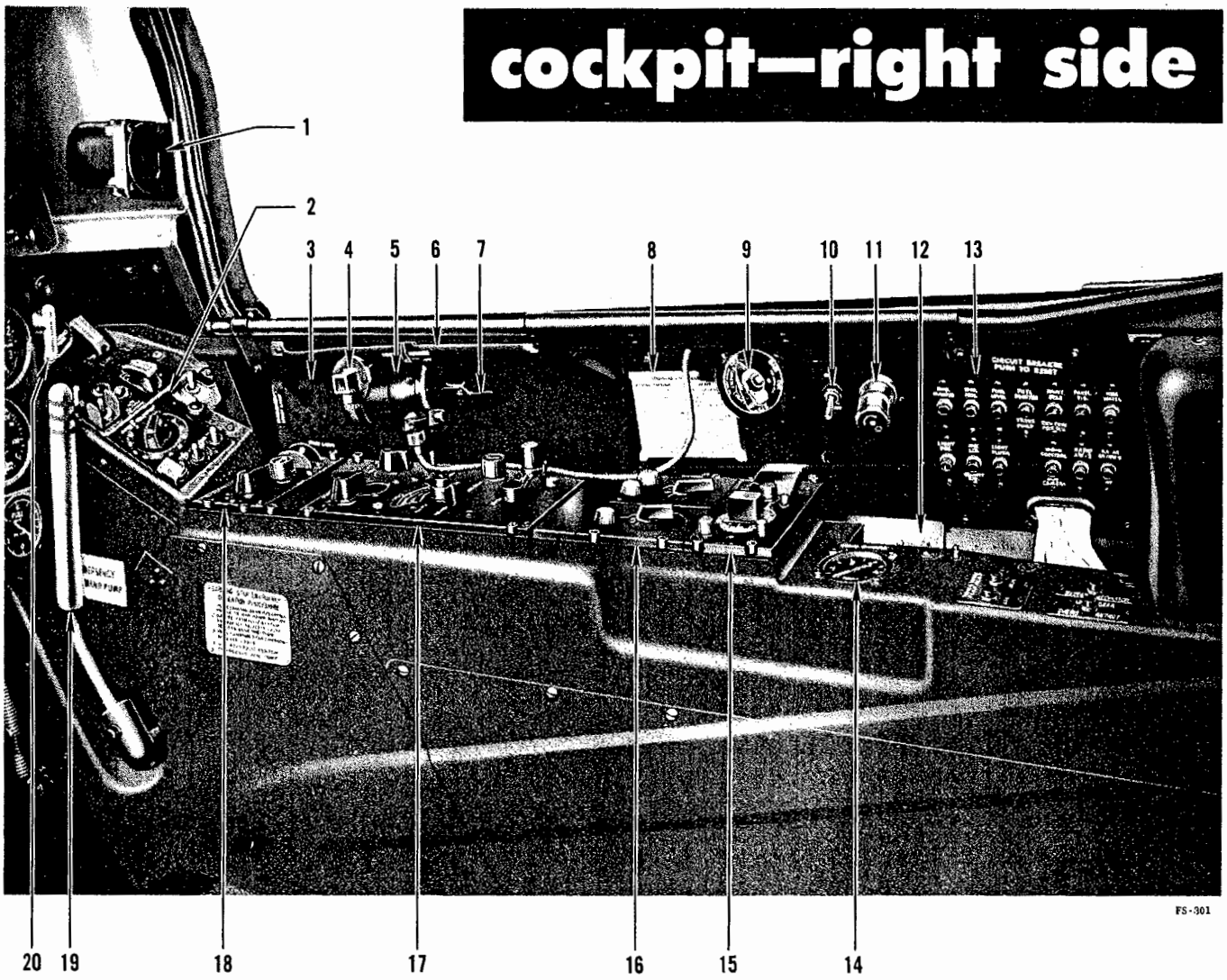
1. CIRCUIT-BREAKER PANEL
2. AMMUNITION COMPARTMENT HEAT EMERGENCY SHUTOFF HANDLE
3. CABIN PRESSURE CONTROL LEVER
4. WINDSHIELD DEICING LEVER
5. SIDE AIR OUTLET
6. CANOPY AUXILIARY DEFROST LEVER
7. FLUORESCENT LIGHT RHEOSTAT
8. ROCKET INTERVALOMETER
9. HORIZONTAL STABILIZER ALTERNATE TRIM SWITCH
10. FLUORESCENT LIGHT ALTERNATE MOUNTING
11. FORWARD CONSOLE
12. LANDING GEAR EMERGENCY-UP BUTTON
13. PARKING BRAKE HANDLE
14. CANOPY SWITCH
15. FLUORESCENT LIGHT
16. EMERGENCY JETTISON HANDLE
17. LANDING GEAR HANDLE
18. TYPE D2 OXYGEN REGULATOR PANEL*
19. THROTTLE FRICTION WHEEL
20. WING FLAP LEVER
21. SPEED BRAKE EMERGENCY LEVER
22. THROTTLE
23. AILERON BOOST SWITCH
24. RUDDER TRIM SWITCH
25. AILERON ALTERNATE TRIM SWITCH
26. COCKPIT TEMPERATURE CONTROL RHEOSTAT
27. AIR OUTLET SELECTOR LEVER
28. COCKPIT AIR TEMPERATURE CONTROL RHEOSTAT
29. AMMUNITION COMPARTMENT OVERHEAT WARNING LIGHT
30. DROP TANK PRESSURE SHUTOFF VALVE
31. ANTI-G SUIT PRESSURE-REGULATING VALVE

*Some airplanes. (Refer to applicable text.)

F-86A-1-00-27A

Figure 1-6

cockpit—right side



1. STAND-BY COMPASS
2. FORWARD CONSOLE
3. SPARE BULB STORAGE
4. FLUORESCENT LIGHT ALTERNATE MOUNTING
5. FLUORESCENT LIGHT
6. SIDE AIR OUTLET
7. SIDE AIR OUTLET SHUTOFF HANDLE
8. VHF RADIO FREQUENCY CARD
9. FLUORESCENT LIGHT RHEOSTAT
10. EXTENSION LIGHT SWITCH
11. EXTENSION LIGHT
12. MAP CASE
13. CIRCUIT-BREAKER PANEL
14. HYDRAULIC BOOST SYSTEM PRESSURE GAGE
15. IFF CONTROL PANEL
16. UHF COMMAND RADIO CONTROL PANEL *
17. RADIO COMPASS CONTROL PANEL
18. VHF COMMAND RADIO CONTROL PANEL *
19. EMERGENCY HYDRAULIC HAND-PUMP
20. CANOPY ALTERNATE EMERGENCY JETTISON HANDLE *

* Some airplanes. (Refer to applicable text.)

F-86A-1-00-34A

Figure 1-7

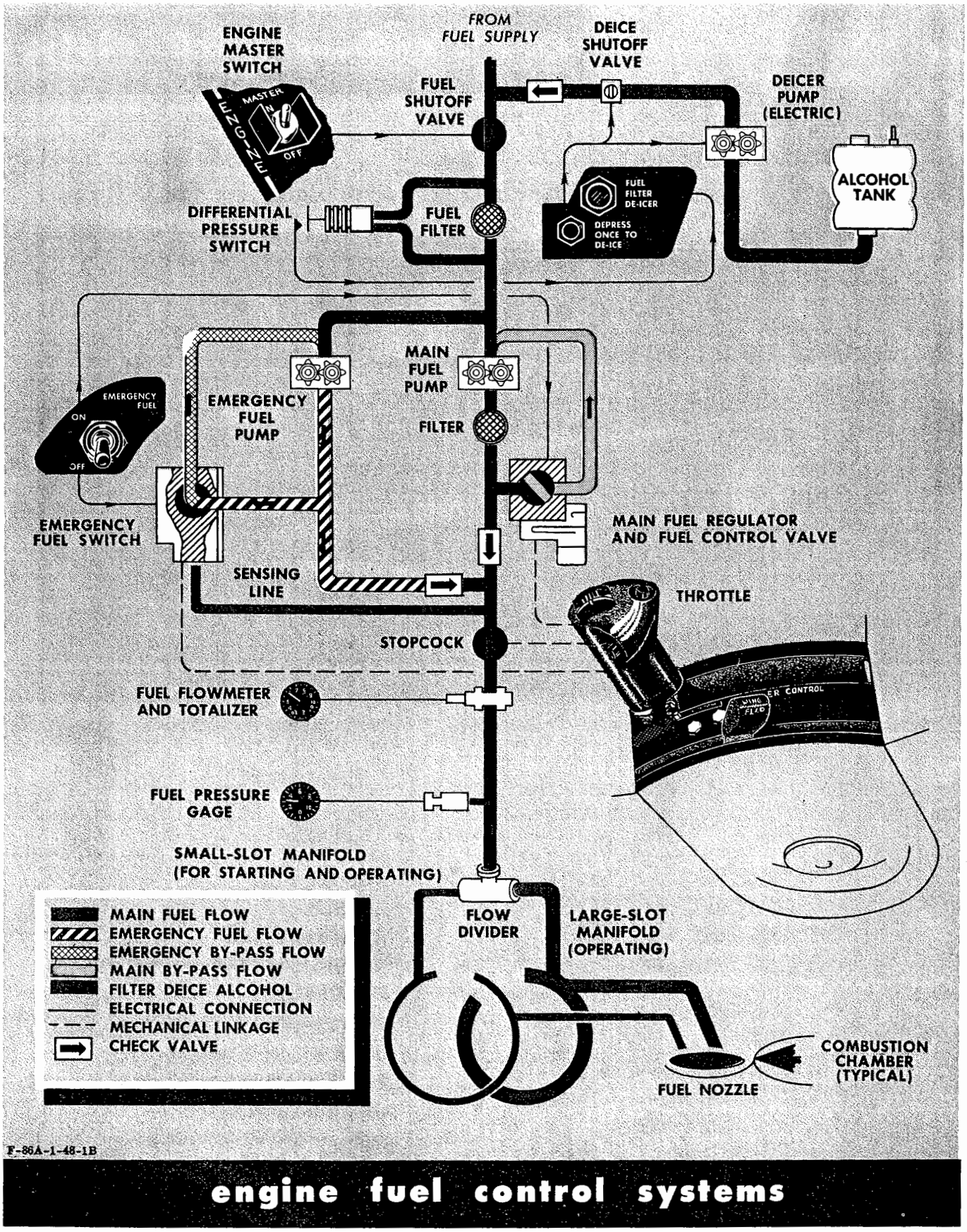

ENGINE MASTER SWITCH
MASTER
ENGINE
ON
OFF
FROM FUEL SUPPLY
FUEL SHUTOFF VALVE
DEICE SHUTOFF VALVE
DEICER PUMP (ELECTRIC)
ALCOHOL TANK
FUEL FILTER DE-ICER
DEPRESS ONCE TO DE-ICE
DIFFERENTIAL PRESSURE SWITCH
FUEL FILTER
MAIN FUEL PUMP
FILTER
EMERGENCY FUEL
ON
OFF
EMERGENCY FUEL PUMP
EMERGENCY FUEL SWITCH
MAIN FUEL REGULATOR AND FUEL CONTROL VALVE
SENSING LINE
THROTTLE
STOPCOCK
FUEL FLOWMETER AND TOTALIZER
FUEL PRESSURE GAGE
SMALL-SLOT MANIFOLD (FOR STARTING AND OPERATING)
FLOW DIVIDER
LARGE-SLOT MANIFOLD (OPERATING)
COMBUSTION CHAMBER (TYPICAL)
FUEL NOZZLE
MAIN FUEL FLOW
EMERGENCY FUEL FLOW
EMERGENCY BY-PASS FLOW
MAIN BY-PASS FLOW
FILTER DEICE ALCOHOL
ELECTRICAL CONNECTION
MECHANICAL LINKAGE
CHECK VALVE
F-86A-1-48-1B
engine fuel control systems

Figure 1-8

Main Fuel Control System.

The main fuel control system (figure 1-8) is controlled by the throttle, and includes an engine-driven, constant-output fuel pump, a main fuel regulator, and a fuel control valve. Since pump output is constant for any given rpm, it is the function of the main fuel regulator to determine the amount of fuel the engine receives for varied operating conditions and to maintain the selected rpm regardless of altitude or airspeed changes. The regulator, operated by mechanical linkage from the throttle, regulates fuel flow to the engine according to throttle setting, engine rpm, and altitude by adjusting the fuel control valve by-pass position. (No fuel passes through the regulator.) The fuel control valve is basically a variable by-pass valve. It responds to regulator control by varying the amount of fuel directed to the engine and by-passing the fuel not needed for the particular operating condition back to the main fuel pump. A constant-speed governor, effective in the range from approximately 30% to 100% engine rpm at sea level, is incorporated in the regulator. The governor serves to maintain constant engine speed for the selected throttle setting and prevents overspeed during rapid altitude and attitude changes.

WARNING

When outside air temperature is less than 50°F, rapid throttle movement during operation on the main fuel system below 10,000 feet, when engine speed is below 70% rpm, may produce compressor stall or total loss of power.

For information on main fuel regulator characteristics, compressor stall, and acceleration flame-outs, refer to Section VII.

Emergency Fuel Control System.

The emergency fuel control system (figure 1-8), consisting of the emergency element of the engine-driven dual fuel pump and an emergency fuel regulator, may be used to maintain engine operation if failure of the main fuel control system occurs. During normal operation, the emergency system is not engaged, since electrical (dc) power holds the emergency regulator inoperative so that it continuously by-passes the total output of the emergency segment of the fuel pump. When the emergency fuel system is engaged, it assumes control of fuel flow to the engine and the main fuel system regulator is electrically (dc) disabled, so that the total output of the main system element of the fuel pump is continuously by-passed. The emergency regulator, which is mechanically actuated by the throttle, compensates for altitude changes to maintain approximately the rpm selected by the throttle setting. However, this regulator is not provided with a governor as is the main fuel regulator, and consequently, provides neither precise speed regulation nor overspeed protection.

Note

The emergency fuel regulator is set to give 99% rpm on a 100°F day, and therefore will provide somewhat less than 99% at lower ambient temperatures. (See figure 2-4.)

Fuel System Flow Divider.

The engine fuel system flow divider (figure 1-8), located downstream of the main and emergency fuel control systems, directs fuel to one or both engine fuel manifolds. (The small-slot manifold is used during starting and is also used with the large-slot manifold for normal operation.) To facilitate starting, the flow divider directs fuel to the small-slot manifold only when fuel pressure is below approximately 50 psi. At pressures above approximately 50 psi, the flow divider routes fuel to the large-slot manifold, as well as to the small-slot manifold, for normal operation. The flow divider is controlled by fuel pressure, and its operation is completely automatic.

Engine Fuel Stopcock.

The engine fuel stopcock (figure 1-8) is a manually operated fuel shutoff valve, controlled by mechanical linkage from the throttle. Movement of the throttle from OFF to IDLE partially opens the stopcock. Any additional throttle movement past the IDLE position fully opens the stopcock.

ENGINE CONTROLS.

Throttle (Power Control).

Engine power is controlled by the throttle (22, figure 1-6), which is located in a quadrant on the left side of the cockpit. The throttle is spring-loaded inboard and mechanically actuates the main and emergency fuel regulators and the fuel stopcock. When the engine master switch is ON, initial outboard movement of the throttle from OFF starts the fuel booster pumps and will turn on the ignition circuit when the starter is energized; subsequent movement of the throttle to IDLE opens the fuel stopcock. (Ignition is automatically cut off when engine speed reaches approximately 23% rpm.) When the engine is running, additional throttle advancement produces increasing engine rpm. To prevent inadvertent shutting off of the fuel supply when the throttle is retarded, a stop is provided on the throttle quadrant between the IDLE and OFF positions. Outboard

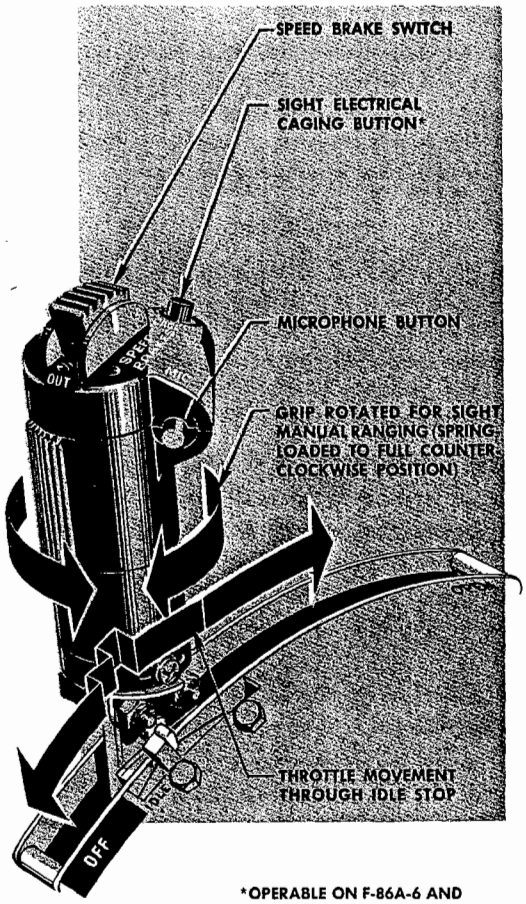


Figure 1-9

movement of the throttle allows the stop to be by-passed when the engine is being started or stopped. Clockwise rotation of the throttle grip provides manual ranging for the A-1CM sight; the grip is spring-loaded to the full counterclockwise (maximum range) position. The throttle grip (figure 1-9) contains a sight electrical caging button, a microphone button, and the speed brake switch. Rotation of the wheel (19, figure 1-6) on the inboard face of the throttle quadrant adjusts the throttle friction.

Engine Master Switch.

The guarded engine master switch (figure 1-13) is located on the right forward console and is powered by the primary bus. Moving the switch to ON opens the main fuel shutoff valve and completes the electrical circuits to the throttle-actuated microswitch to start the fuel booster pumps and to provide ignition during starting. Ignition is supplied when the engine master switch is ON, the battery-starter switch is held momentarily at STARTER, and the throttle is moved from OFF.

Emergency Fuel Switch.

The emergency fuel switch (33, figure 1-5) is on the upper left corner of the instrument panel. With the emergency fuel switch OFF, primary bus power is directed to a solenoid which mechanically holds the emergency fuel regulator in the full by-pass position. This makes the emergency system inoperative, because the total output of the emergency element of the fuel pump is by-passed. Thus, the emergency system is prevented from overriding the main system during normal operation.

WARNING

If, during engine operation, primary bus power failure occurs or the battery-starter switch is moved to OFF when generator output is not available, the emergency fuel system operates automatically, regardless of emergency fuel switch position. Subsequent rapid throttle advancement can cause the emergency system to override the main system, resulting in complete power failure as a result of engine overspeeding or compressor stall.

The emergency fuel switch should be maintained at OFF for all flight conditions except in case of actual main fuel control system failure. When the emergency fuel switch is at ON, the holding circuit to the emergency regulator is broken and the main fuel system regulator is electrically (dc) disabled allowing the emergency system to assume control of fuel flow to the engine.

WARNING

- The emergency fuel switch should be at OFF for all flight conditions except when actual failure of the main fuel system occurs. With the emergency fuel switch ON, rapid throttle advancement can cause compressor stall or flame-out.
- If rpm is below 80% when main fuel system fails, do not turn on emergency fuel switch without first retarding throttle to IDLE. To do so may cause dangerous engine overheating or compressor stall.

ENGINE INDICATORS.

Exhaust Temperature Gage.

The exhaust temperature gage (6, figure 1-5), on the instrument panel, indicates exhaust temperature in degrees centigrade. The gage is a self-generated electrical unit, not requiring power from the airplane electrical system. Gage indications are received from bayonet-type thermocouples mounted in the forward section of the tail pipe.

Tachometer.

The Tachometer (11, figure 1-5), on the instrument panel, registers engine speed in percentage of maximum rated rpm (7950). This indication, when used in conjunction with that of the exhaust temperature gage, permits engine power to be accurately set without exceeding engine limitations. The tachometer receives its power from the tachometer generator which is geared to the engine rotor shaft, and therefore, does not depend on the airplane electrical system.

Oil Pressure Gage.

The oil pressure gage (13, figure 1-5), on the instrument panel, registers engine oil pressure in pounds per square inch. Electrically operated, the gage receives power from the three-phase ac bus.

Fuel Pressure Gage.

The fuel pressure gage (15, figure 1-5), on the instrument panel, electrically records fuel pressure. The gage is powered by the three-phase ac bus. Fuel pressure is recorded in pounds per square inch. Some airplanes have a fuel gage with an expanded scale which facilitates reading of slight fuel pressure fluctuations at the lower end of the scale. This will assist in making successful air starts.

Fuel Flowmeter and Totalizer.

The fuel flowmeter and totalizer (14, figure 1-5), on the instrument panel, is electrically operated by the single-phase inverter. Some airplanes* do not include a totalizer. The fuel flowmeter on these airplanes senses the fuel flow in pounds per hour but indicates in gallons per hour, and is calibrated for JP-1 fuel (Specification MIL-F-5616); therefore, conversions must be made if other fuels are used. Five percent must be added to the flowmeter reading if JP-4 or JP-3 fuel (Specification MIL-F-5624) is used, and 10 percent must be added if gasoline (Specification MIL-F-5572) is used. On airplanes† with the totalizer, conversion is not necessary, since the flowmeter senses and indicates fuel flow in the same units of measure. The totalizer, which indicates gallons of fuel consumed, is combined in the same case with the fuel flowmeter. A knob on the instrument is used to preset the fuel-consumed totalizer to zero when the airplane is refueled. The totalizer dial indicates pounds of fuel remaining when set to the total pounds of fuel in the tanks prior to take-off.

Note

The totalizer dial of the fuel flowmeter should not be relied upon for accurate fuel-remaining indications. Large errors are inherent in the instrument because of uncompensated fuel density, unmetered fuel passing around the instrument, and instrument inaccuracy; therefore, it should be used for rough estimates only. Accurate fuel-remaining data can be obtained only from the fuel quantity gage.

ENGINE IGNITION SYSTEM.

The ignition system, providing ignition through two spark plugs, functions only during starting. With the engine master switch at ON and the battery-starter switch momentarily held at STARTER, ignition will occur automatically when the throttle is moved from OFF. For ignition, dc power is routed through the ignition vibrators, which supply high-tension voltage to the spark plugs located in combustion chambers 2 and 7. The ignition circuit is opened automatically when the starter disengages as engine speed reaches approximately 23% rpm.

Engine Master Switch.

Refer to "Engine Controls" in this section.

Emergency Ignition Switch.

The guarded emergency ignition switch (figure 1-13), on the right forward console, permits manual operation of the ignition system for engine restart in flight. When the switch is ON, advancing the throttle from OFF permits primary bus power to energize the emergency ignition circuit. The emergency ignition will remain on until the emergency ignition switch is turned OFF.

CAUTION

- Continuous operation of the emergency ignition circuit is limited to a maximum of 3 minutes.

***F-86A-5 Airplanes AF48-129 through -316, AF49-1007 through -1119, and -1121 through -1146**
†F-86A-5 Airplanes AF49-1120, and -1147 and all later airplanes

Longer periods of use, or too frequent use, will damage the ignition vibrator units.

- Emergency ignition should be used for air starts only, to prevent unnecessary depletion of battery power. An external supply provides power to energize the ignition circuit for ground starts.

STARTER-GENERATOR.

The combination starter-generator, mounted on the front of the engine, functions as a starter until engine speed reaches approximately 23% rpm. Above this speed, the unit serves as a generator. However, normal generator output of 28.5 volts is not obtained until engine rpm is approximately 45%. Should the engine fail to start, the starter can be de-energized by a manually operated switch to permit another starting attempt. The starter can be energized only when an external power source is connected to the airplane electrical system.

CAUTION

A 28.5-volt dc power source capable of supplying 1200 amperes surge and a continuous operating current of 500 amperes must be connected to both external power receptacles to provide adequate electrical power for starting.

Battery-Starter Switch.

The three-position battery-starter switch (figure 1-13) is located on the right forward console. The switch is spring-loaded to the OFF position from the STARTER position. The OFF and BATTERY positions are maintained. When the switch is held momentarily at STARTER with either the throttle retarded to OFF or the engine master switch ON and with external power connected, the starter is actuated and continues to be energized through an electrical relay until the engine rpm reaches approximately 23%. The starter is then automatically disconnected. The switch will return to OFF from the STARTER position when released and should be set at BATTERY for all normal operation. With the switch at BATTERY, the primary bus is powered by the battery, provided no other power source is supplying the electrical system. When the battery-starter switch is OFF, battery power will be supplied only to those units connected to the battery bus.

Stop-Starter Button.

The stop-starter button (figure 1-13), located outboard of the battery-starter switch on the right forward console, is used to de-energize the starter if the engine fails to start or malfunction occurs. Depressing the button cuts off primary bus power to the starter and to the ignition system. The button should not be used to disengage the starter after normal starts, as the starter cuts out automatically at 23% rpm.

fuel quantity data

US GALLONS

	NO.	USABLE FUEL IN LEVEL FLIGHT (EACH)	FULLY SERVICED (EACH)
FORWARD FUSELAGE TANK	1	196	201
AFT FUSELAGE TANK	1	105	106
OUTER WING TANK	2	67	68
DROP TANKS	2	120	120
DROP TANKS	2	206-1/2	209

- Total usable internal fuel, 435 gallons.
- Total usable fuel with 120-gallon drop tanks, 675 gallons.
- Total usable fuel with 206-1/2-gallon drop tanks, 848 gallons.

F-86A-1-93-2A

Figure 1-10

CAUTION

Use of the stop-starter button after normal starts will cause rapid deterioration of the starter control relay and may also cut out the starter too soon, slowing the rate of engine acceleration.

OIL SYSTEM.

The oil system is completely automatic and requires no manual control. The engine is lubricated by a gear-type pressure oil pump that incorporates lubricating and scavenging elements. Oil is supplied by gravity feed from a 5.7 US gallon tank to the pump, which supplies oil pressure to all engine parts requiring it. The scavenging unit on the oil pump returns oil from the gear case sump to the oil tank. A mid-frame (aft) oil scavenging pump, driven by the compressor shaft, returns oil from the mid-, aft-, and damper-bearing

sumps, through an oil cooler to the tank. To ensure internal cooling and control oil for the main fuel regulator, a portion of the oil discharged by the pump is directed to the main fuel regulator. See figure 1-30 for oil specifications.

AIRPLANE FUEL SYSTEM.

The airplane fuel system (figure 1-11) includes four self-sealing tanks, two in the fuselage and one in each outer wing panel. The forward fuselage tank consists of two cells. The lower one, located in the wing center section, receives fuel from the upper cell and from all the internal tanks by gravity feed. Fuel is supplied to the engine from the forward fuselage tank under pressure by means of two electric booster pumps. The fuel filler access doors at the tank filler points cannot be closed unless the tank caps are secured in the locked position. During normal refueling operations, the forward fuselage tank must be filled first to utilize full tank capacity; if the aft fuselage tank or the wing tanks are filled first, fuel from these tanks will slowly drain into the forward fuselage tank lower cell while the forward fuselage tank is being serviced. Fuel tank capacities are shown in figure 1-10; for fuel specifications, see figure 1-30.

Drop Tanks.

The main fuel supply can be supplemented by the installation of a 120 or 206½ US gallon drop tank under each wing. Four types of drop tanks may be carried externally on this airplane. Type I and Type II tanks are of knock-down construction and are designed so that final assembly can be accomplished by maintenance personnel in the field. Type III and Type IV tanks are completely assembled for installation and provisions for disassembly are not required. Types II and IV are limited service tanks and always have lower operating limitations than Type I and Type III tanks of corresponding size. Types I and III are general service tanks. Type II and Type IV tanks generally have a "TYPE II" or "TYPE IV" stencil on the tank (as applicable) located so that it can be seen from the cockpit. Type I and Type III tanks generally have no identifying stencil. (See figures 5-1 and 5-2 for flight restrictions for all types of tanks.) The 206½-gallon drop tanks are standard 245-gallon drop tanks to which has been added an additional (lower) filler opening to prevent filling above the 206½-gallon capacity. Drop tank fuel is selected by a pressure shutoff valve in the cockpit; however, the fuel in the drop tanks should be used before that in the internal tanks. When the drop tank system is selected, compressed air from the engine compressor section forces fuel from the drop tanks through a fuel level control valve into the upper cell of the forward fuselage tank. The fuel level control valve automatically controls fuel flow from the drop tanks to the upper cell of the forward fuselage tank.

Fuel Booster Pumps.

Two electric booster pumps (figure 1-11) in the lower cell of the forward fuselage tank are energized when the engine master switch is ON and the throttle is moved outboard from the OFF position past the IDLE stop.

Note

The booster pumps and aft fuselage tank transfer pump may be tested on the ground by means of two switches in the left wheel well.

Fuel Shutoff Valve.

The fuel shutoff valve (figure 1-11), located upstream of the low-pressure filter, is electrically controlled by the engine master switch. When the switch is ON, the valve is opened, allowing fuel to feed to the engine fuel control system.

Fuel Filter Deicing System.

Refer to "Defrosting and Anti-icing Systems" in Section IV.

AIRPLANE FUEL SYSTEM CONTROLS AND INDICATOR.

Drop Tank Release.

The drop tanks may be released by means of the normal bomb release system, or both tanks can be jettisoned simultaneously by means of the bomb-rocket-tank salvo button (figure 1-13) on the left forward console. Drop tanks can also be mechanically released simultaneously by pulling the emergency jettison handle (16, figure 1-6) which is recessed in the inboard face of the left forward console.

WARNING

- Drop tanks should be released manually for test or maintenance purposes. Jettisoning the tanks electrically presents a potential explosive hazard which could seriously injure ground personnel.
- To prevent accidental explosion of drop tanks, they must not be installed, removed, or given an operational drop test (either manually or electrically) unless the airplane and drop tanks are electrostatically grounded.

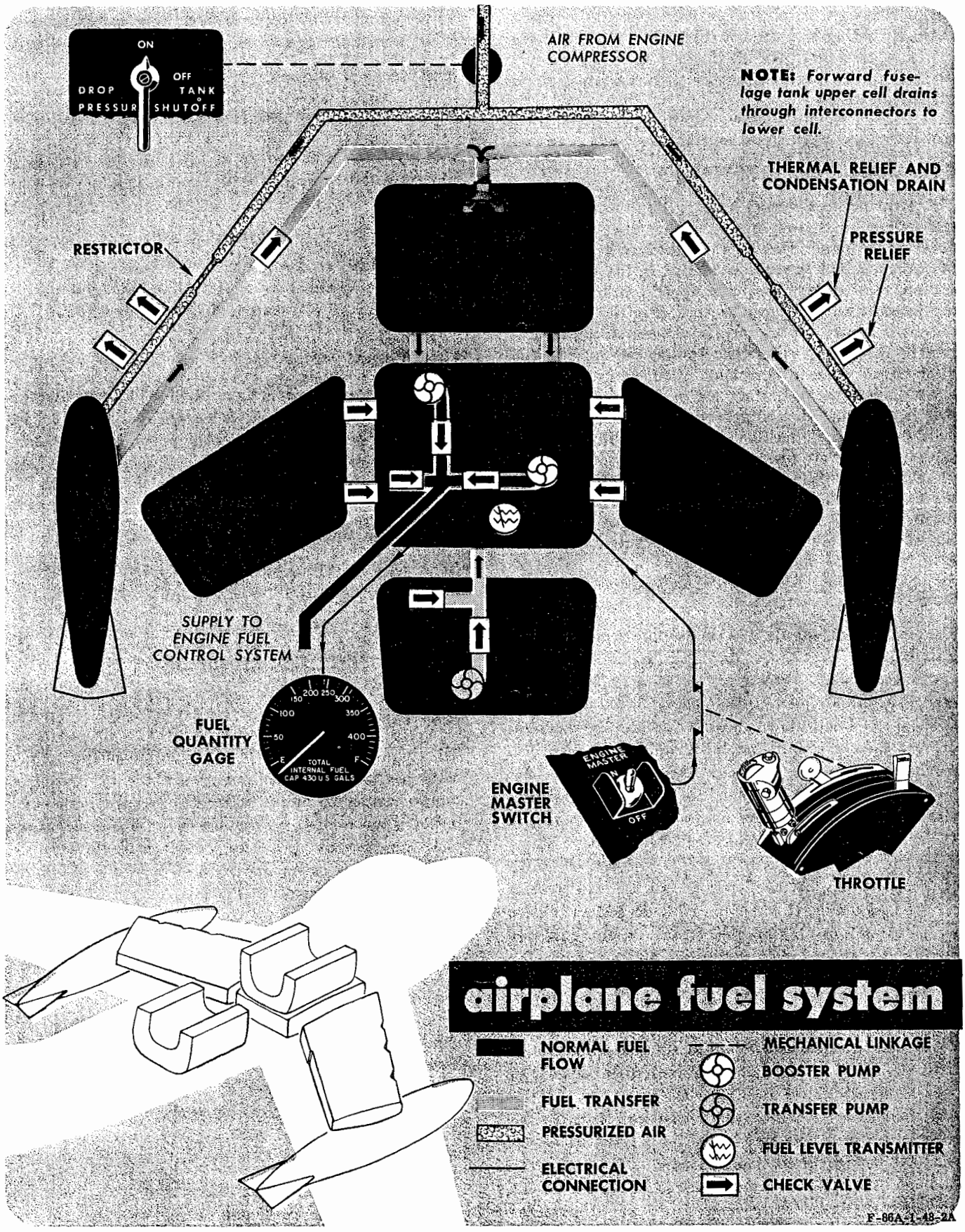
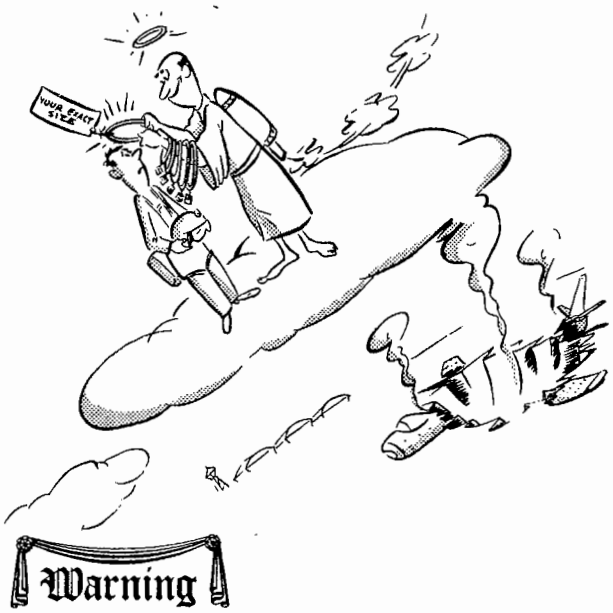

ON
OFF
DROP TANK PRESSUR SHUTOFF
AIR FROM ENGINE COMPRESSOR
NOTE: Forward fuselage tank upper cell drains through interconnectors to lower cell.
THERMAL RELIEF AND CONDENSATION DRAIN
PRESSURE RELIEF
RESTRICTOR
SUPPLY TO ENGINE FUEL CONTROL SYSTEM
FUEL QUANTITY GAGE
TOTAL INTERNAL FUEL CAP 430 U S GALS
ENGINE MASTER SWITCH
ENGINE MASTER
ON
OFF
THROTTLE
airplane fuel system
NORMAL FUEL FLOW
FUEL TRANSFER
PRESSURIZED AIR
ELECTRICAL CONNECTION
MECHANICAL LINKAGE
BOOSTER PUMP
TRANSFER PUMP
FUEL LEVEL TRANSMITTER
CHECK VALVE
F-86A-1-48-2A

Figure 1-11

Drop Tank Pressure Shutoff Valve.

The two-position drop tank pressure shutoff valve (30, figure 1-6) is on the left aft console. When the valve is ON, both drop tanks are pressurized by air from the engine compressor section, so that fuel from the drop tanks is forced into the forward fuselage tank. As there is no fuel quantity gage to indicate when the drop tanks are empty, the pressure shutoff valve should be ON at all times in flight when drop tanks are installed, to ensure that all drop tank fuel is consumed and to prevent tank collapse during rapid descent.



Fuel Quantity Gage.

The fuel quantity gage (12, figure 1-5) on the instrument panel, is powered by the primary bus and indicates total internal fuel in US gallons. The drop tank fuel quantity is not recorded.

Note

The fuel quantity gage will not indicate a decrease in fuel supply until the drop tank fuel has been consumed and the engine begins to use internal fuel.

ELECTRICAL POWER SUPPLY SYSTEM.

The airplane is equipped with ac and dc power systems. The 28-volt direct-current system is powered by a 400-ampere, engine-driven starter-generator with a 24-volt, 34-ampere-hour storage battery as a stand-by. Direct current can also be supplied from an external power source. Power for the alternating-current system is supplied by one three-phase inverter and one single-phase inverter; most airplanes* have a three-phase electronic sight inverter for A-1CM sight operation.

DC Electrical Power Distribution.

Direct-current power distribution is made through three electrical busses: battery, primary, and secondary. (See figure 1-12.) The battery bus is "hot" at all times when the battery is installed, so that essential equipment, powered by the battery, is operable regardless of the position of the battery-starter switch. The primary bus is energized by the battery through the battery bus when the battery-starter switch is at BATTERY, and is energized directly when the generator is operating or when an external power source is used. The secondary bus receives its power through the primary bus and is energized only when generator output is available or when external power is connected to the No. 1 receptacle.

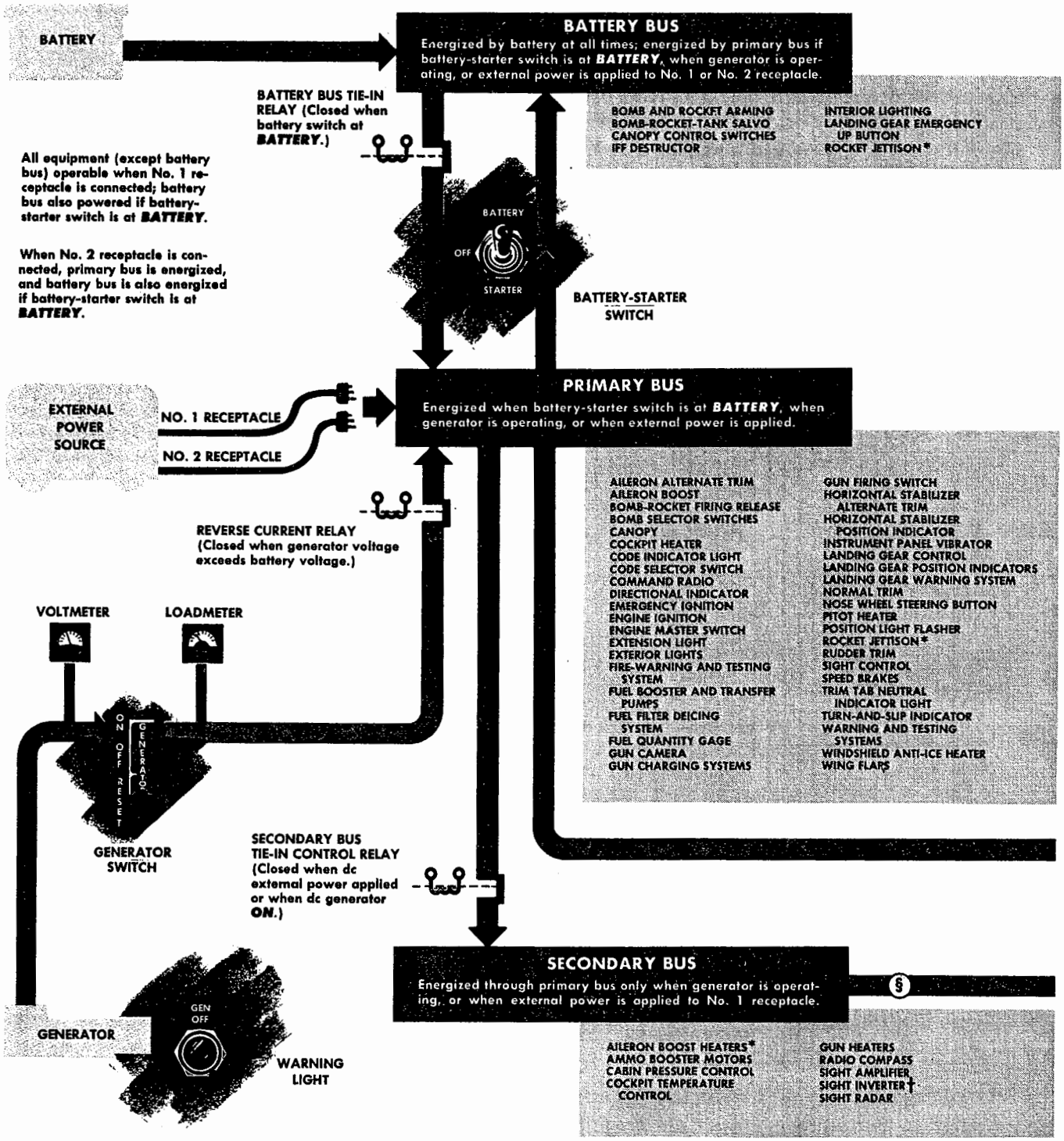
AC Electrical Power Distribution.

Alternating-current power distribution is made by a three-phase inverter, a single-phase inverter that utilizes a phase adapter to convert single-phase output to three-phase, and a three-phase electronic sight inverter. The single-phase inverter primarily supplies power to the radar units and to the phase adapter, which supplies three-phase power to the attitude indicator, directional indicator, and an autotransformer for stepping down the voltage for the autosyn instruments. On some airplanes,† the three-phase inverter normally supplies power to the A-1CM sight and acts as an alternate for the single-phase inverter and phase adapter. On most airplanes,* the three-phase inverter acts as a stand-by for the single-phase inverter and operates only when the single-phase inverter fails. If the generator fails, causing loss of the single-phase inverter, transfer to the three-phase inverter is automatic. If the single-phase inverter alone fails, transfer to the three-phase inverter must be made by selection of the ALT position with the instrument power switch. All units powered by the single-phase inverter, except the radar, A-1CM sight, and fuel flow transmitter and indicator, which are disconnected to prevent possible overloading of the three-phase inverter, will be transferred to the three-phase inverter.

*F-86A-5 Airplane AF48-145 and all later airplanes
†F-86A-5 Airplanes AF48-129 through -144

electrical power distribution

FUNCTIONAL FLOW DIAGRAM



*Some airplanes. (Refer to applicable text.)

†F-86A-5 Airplane AF48-145 and all later airplanes.

‡F-86A-5 Airplanes AF49-1135 through -1339.

§F-86A-5 Airplanes AF48-129 through -316 and AF49-1007 through -1134.

¶F-86A-5 Airplanes AF48-129 through -144.

F-86A-1-54-1B

Figure 1-12

Electrically Operated Equipment.

See figure 1-12.

External Power Receptacles.

Two external power receptacles (figure 1-30) are located within an access panel on the left side of the fuselage, above and aft of the wing trailing edge. The external power source must be connected to the No. 1 receptacle to supply power to both the primary and secondary busses. Suitable power units are A3, A4, C-22, C-26, NA5A, and V-1. If No. 2 receptacle is connected, power is supplied only to the primary bus. To provide adequate electrical power for starting the engine, external power must be connected to both receptacles.

ELECTRICAL POWER SUPPLY SYSTEM CONTROLS.

Battery-Starter Switch.

Refer to "Starter-Generator" in this section.

Generator Switch.

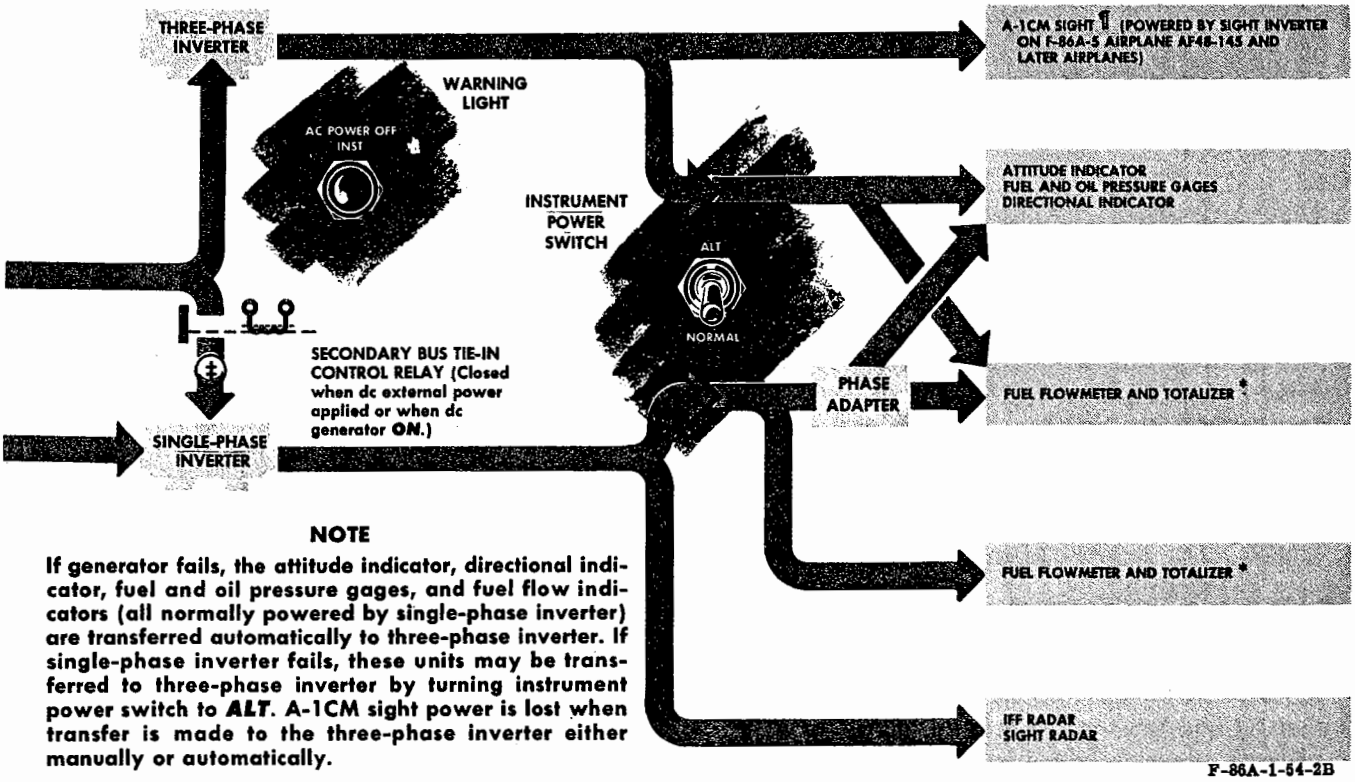
The three-position generator switch (figure 1-13), on the right forward console, uses primary bus power to control generator operation. Guarded in the ON position, the switch is spring-loaded from RESET to OFF. If an overvoltage condition cuts out the generator, as indicated by illumination of the generator warning light, the switch can be momentarily held at RESET and then returned to ON to restore generator operation to normal.

Generator Voltage Regulator Rheostat.

The voltage regulator is preset on the ground, but in an emergency, may be adjusted in flight by means of a guarded rheostat (figure 1-13) mounted on the right forward console. Turning the rheostat counterclockwise decreases the voltage, and turning the rheostat clockwise increases the voltage. With engine rpm above 45%, voltmeter readings should be approximately 28 volts.

Instrument Power Switch.

The instrument power switch (figure 4-12), on the center pedestal, is positioned to select, by means of power from the primary bus, the source of ac power. If the single-phase inverter fails, as indicated by illumination of the inverter warning light, the units it powers can be manually transferred to the three-phase inverter by selection of the ALT position on the instrument power switch (the inverter warning light will remain on, even



NOTE

If generator fails, the attitude indicator, directional indicator, fuel and oil pressure gages, and fuel flow indicators (all normally powered by single-phase inverter) are transferred automatically to three-phase inverter. If single-phase inverter fails, these units may be transferred to three-phase inverter by turning instrument power switch to *ALT*. A-1CM sight power is lost when transfer is made to the three-phase inverter either manually or automatically.

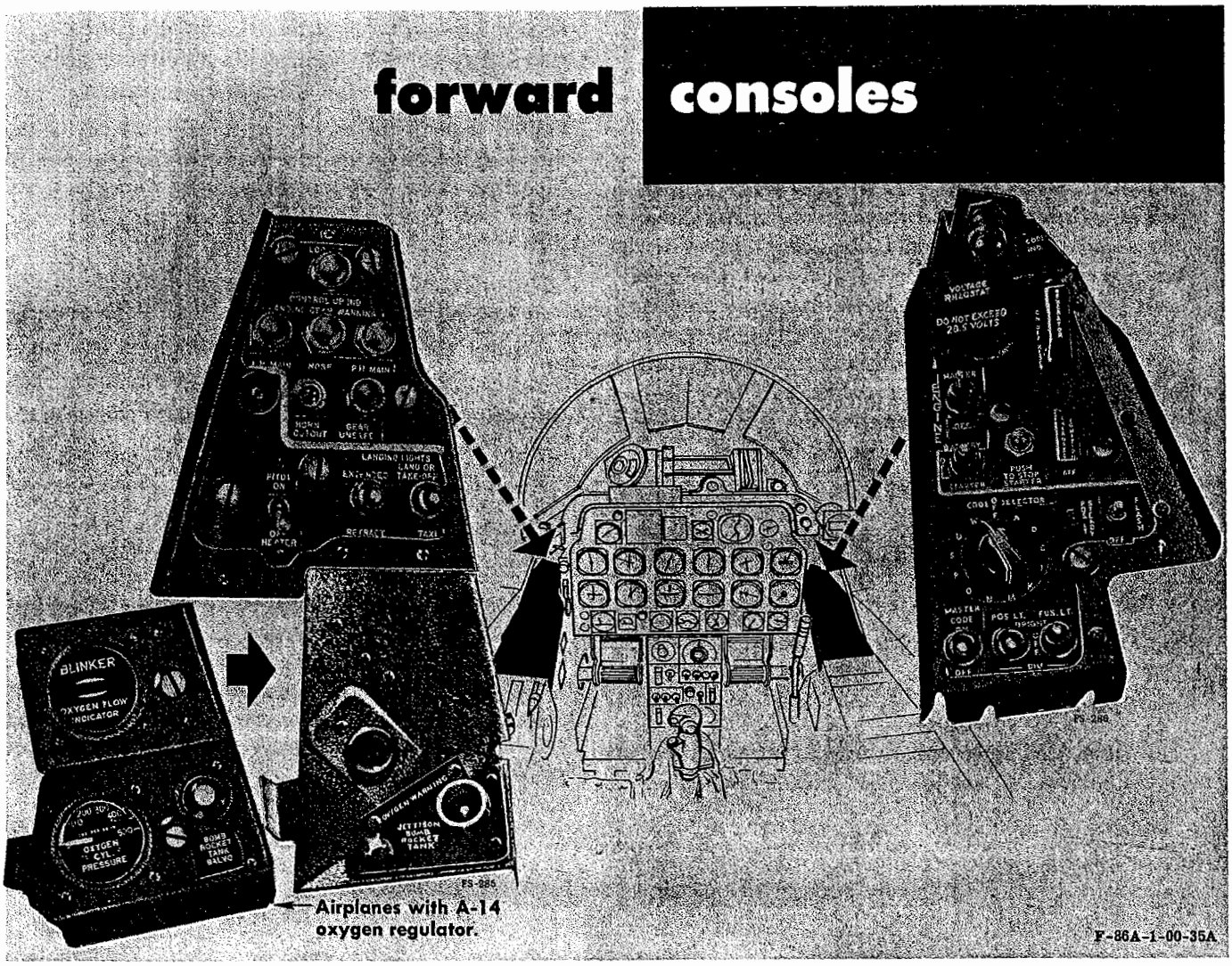


Figure 1-13

though the instrument power switch is in the ALT position). When generator failure occurs (indicated by illumination of the generator warning light), causing loss of the single-phase inverter (the inverter warning light will not come on), transfer to the three-phase inverter is automatic. On early airplanes,* all units are transferred to the three-phase inverter except the IFF and sight radar units and A-1CM sight. On late airplanes,† all units are transferred except the IFF and sight radar units, A-1CM sight, and the fuel flow and fuel totalizer systems.

Circuit Breakers.

Most of the dc electrical circuits are protected by push-pull circuit breakers or circuit-breaker switches. Circuit-breaker panels (1, figure 1-6; 13, figure 1-7), accessible to the pilot, are located on each side of the cockpit. Most of the ac circuits are protected by fuses which cannot be replaced in flight.

CAUTION

Circuit breakers should not be pulled or reset without a thorough understanding of all the effects and results. Use of the circuit breakers can eliminate from the system some related warning system, interlocking circuit, or cancelling signal, which could result in an undesirable reaction.

*F-86A-5 Airplanes AF48-129 through -316 and AF49-1007 through -1146
†F-86A-5 Airplane AF49-1147 and all later airplanes

ELECTRICAL SYSTEM INDICATORS.

Voltmeter.

The voltmeter (22, figure 1-5), on the instrument panel, provides direct indication of the generator voltage output.

Loadmeter.

The loadmeter (21, figure 1-5), on the instrument panel, indicates the percentage of total system amperage being used.

Generator Warning Light.

The generator warning light (20, figure 1-5), on the instrument panel, is illuminated by primary bus power when the generator fails, generator voltage drops below that required to close the reverse-current relay, or when the generator switch is OFF. Illumination of the warning light indicates that all equipment powered by the secondary bus is inoperative; therefore, all other nonessential electrical equipment should be turned off to conserve battery power.

Generator Overvoltage Warning Light.

If generator voltage output becomes excessive (over 31 volts), the generator is automatically cut out of the circuit, and the overvoltage warning light (24, figure 1-5), powered by the primary bus, comes on. The light is on the instrument panel. Holding the generator switch momentarily at the RESET position and then returning the switch to ON will bring the generator back into the circuit. If the warning light again comes on, the generator is still inoperative, and the generator switch should be turned OFF.

Inverter Warning Light.

The inverter warning light (23, figure 1-5), will come on any time the single-phase inverter fails, and on late airplanes,* when the three-phase inverter fails. The warning light is on the instrument panel and is powered by the primary bus.

HYDRAULIC POWER SUPPLY SYSTEMS.

The main hydraulic system combines a utility (constant-pressure type) system and a hydraulic boost (open-center type) system. Output of a single engine-driven hydraulic pump is divided equally between the two systems by a flow divider. A manually operated emergency hydraulic system is provided. See figure 1-30 for hydraulic fluid specification.

UTILITY HYDRAULIC SYSTEM.

The utility hydraulic system (figure 1-14) is under constant pressure and has an accumulator for pressure storage. System pressure is controlled by a pressure regulating valve. This system supplies hydraulic pressure for operation of landing gear, speed brakes, slat locks on early airplanes† not changed by T.O., nose wheel steering, and wheel brake control boost.‡ Operating speed brakes and landing gear on a pressure-type system makes it unnecessary to return controls to neutral after each operation; however, the neutral position provided for each control should be used to relieve pressure from the individual systems and prevent loss of fluid in case of a damaged line.

HYDRAULIC BOOST SYSTEM.

The hydraulic boost system (figure 1-15) is a nonpressurized system, having no means of pressure storage. When the engine-driven hydraulic pump is operating, fluid circulates through the system and does not build up pressure until a control valve is moved from neutral to an operating position. Then fluid circulation is restricted at the affected control valve to build up pressure required to perform the desired operation. This system supplies pressure for flight control boost (aileron and elevator), and on some airplanes,§ wheel brake control boost. Maximum boost pressures for the units operating off the hydraulic boost system will vary, depending on the unit. Normal line friction pressure will be about 250 to 300 psi with no operating load on the system; for the various units, approximate pressures obtained during ground test with full control deflection, are as follows:

Full-down elevator	1950 psi
Full-up elevator	2100 psi
Wheel brake pressure	800 psi
Aileron (pressure range)	1400 to 1900 psi

As these pressures are maximums and seldom obtained during flight, operating pressures with normal stick deflection will be somewhat lower.

EMERGENCY HYDRAULIC SYSTEM.

Early airplanes† not changed by T.O., are equipped with an emergency hydraulic system (figure 1-14), consisting of a separate emergency fluid reservoir, an emergency hydraulic selector, and an emergency hand-pump.

***F-86A-5 Airplane AF49-1247 and all later airplanes**
†F-86A-5 Airplanes AF48-129 through -254
‡F-86A-5 Airplane AF49-1007 and all later airplanes
§F-86A-5 Airplanes AF48-129 through -316

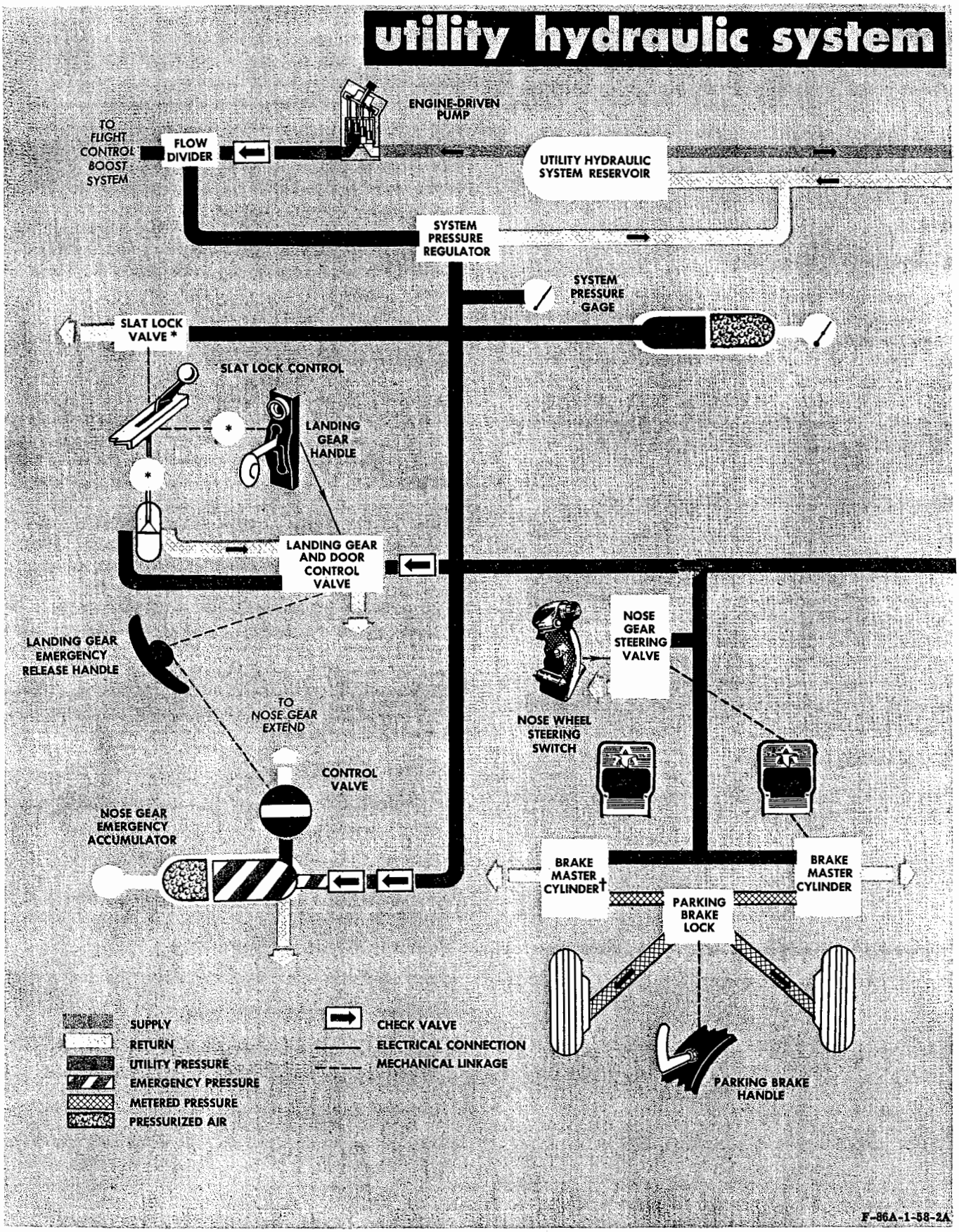
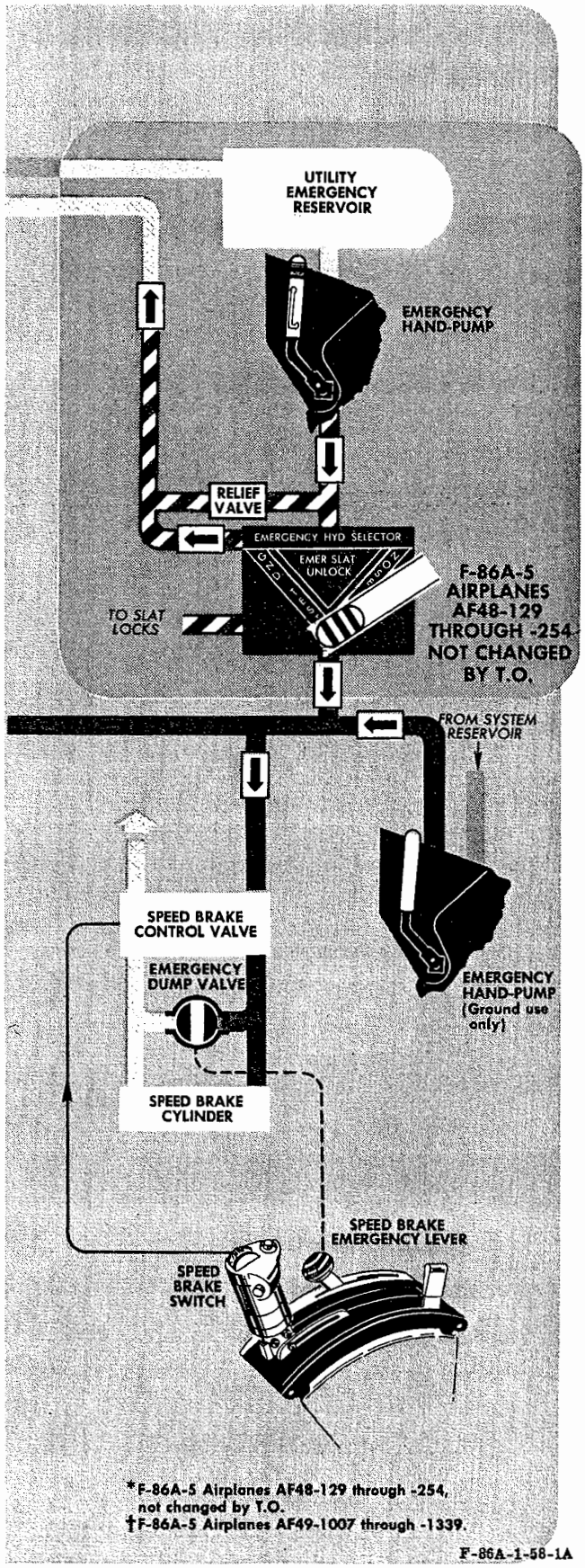

utility hydraulic system
ENGINE-DRIVEN PUMP
TO FLIGHT CONTROL BOOST SYSTEM
FLOW DIVIDER
UTILITY HYDRAULIC SYSTEM RESERVOIR
SYSTEM PRESSURE REGULATOR
SYSTEM PRESSURE GAGE
SLAT LOCK VALVE *
SLAT LOCK CONTROL
LANDING GEAR HANDLE
LANDING GEAR AND DOOR CONTROL VALVE
LANDING GEAR EMERGENCY RELEASE HANDLE
TO NOSE GEAR EXTEND
CONTROL VALVE
NOSE GEAR EMERGENCY ACCUMULATOR
NOSE GEAR STEERING VALVE
NOSE WHEEL STEERING SWITCH
BRAKE MASTER CYLINDER†
BRAKE MASTER CYLINDER
PARKING BRAKE LOCK
PARKING BRAKE HANDLE
SUPPLY
RETURN
UTILITY PRESSURE
EMERGENCY PRESSURE
METERED PRESSURE
PRESSURIZED AIR
CHECK VALVE
ELECTRICAL CONNECTION
MECHANICAL LINKAGE
F-86A-1-58-2A

Figure 1-14



HYDRAULIC SYSTEM CONTROLS AND INDICATORS.

Emergency Hydraulic Selector

The emergency hydraulic selector (figure 1-19) is on the lower center pedestal. The selector has four positions: OFF, NOSE GR INOP, EMER SLAT UNLOCK, and GND TEST. The NOSE GR INOP position is inoperative. The EMER SLAT UNLOCK position is selected to unlock the slats; and the GND TEST position is selected for ground-checking any utility hydraulic unit. The emergency hydraulic selector is included only on airplanes which have the emergency hydraulic system.

CAUTION

- The GND TEST position is provided only for ground check of hydraulic system operation and should not be used for emergency purposes in flight, as its use could cause all hydraulic fluid to be pumped overboard through a damaged unit or line.
- The emergency selector must always be maintained in the OFF position when the emergency system is not in use, so that all emergency lines will be open to return.

Emergency Hydraulic Hand-pump.

The emergency hand-pump (19, figure 1-7) is on the right forward side of the cockpit. The hand-pump supplies hydraulic pressure to the utility system for ground testing, and on early airplanes* not changed by T.O., for unlocking the wing slats during flight in an emergency.

Hydraulic System Pressure Gages.

The utility hydraulic system pressure gage (16, figure 1-5), on the lower edge of the instrument panel, measures hydraulic pressure in the utility system. The hydraulic boost system pressure gage (14, figure 1-7), on the aft right console, measures hydraulic boost system pressure. Both gages are the direct-reading type, and indicate pressure in pounds per square inch.

FLIGHT CONTROL SYSTEM.

The primary flight controls are conventionally operated by a cable and linkage system from the rudder pedals and control stick. To reduce the amount of stick force required by the pilot to actuate the elevators and ailerons, hydraulic boost is incorporated in the system.

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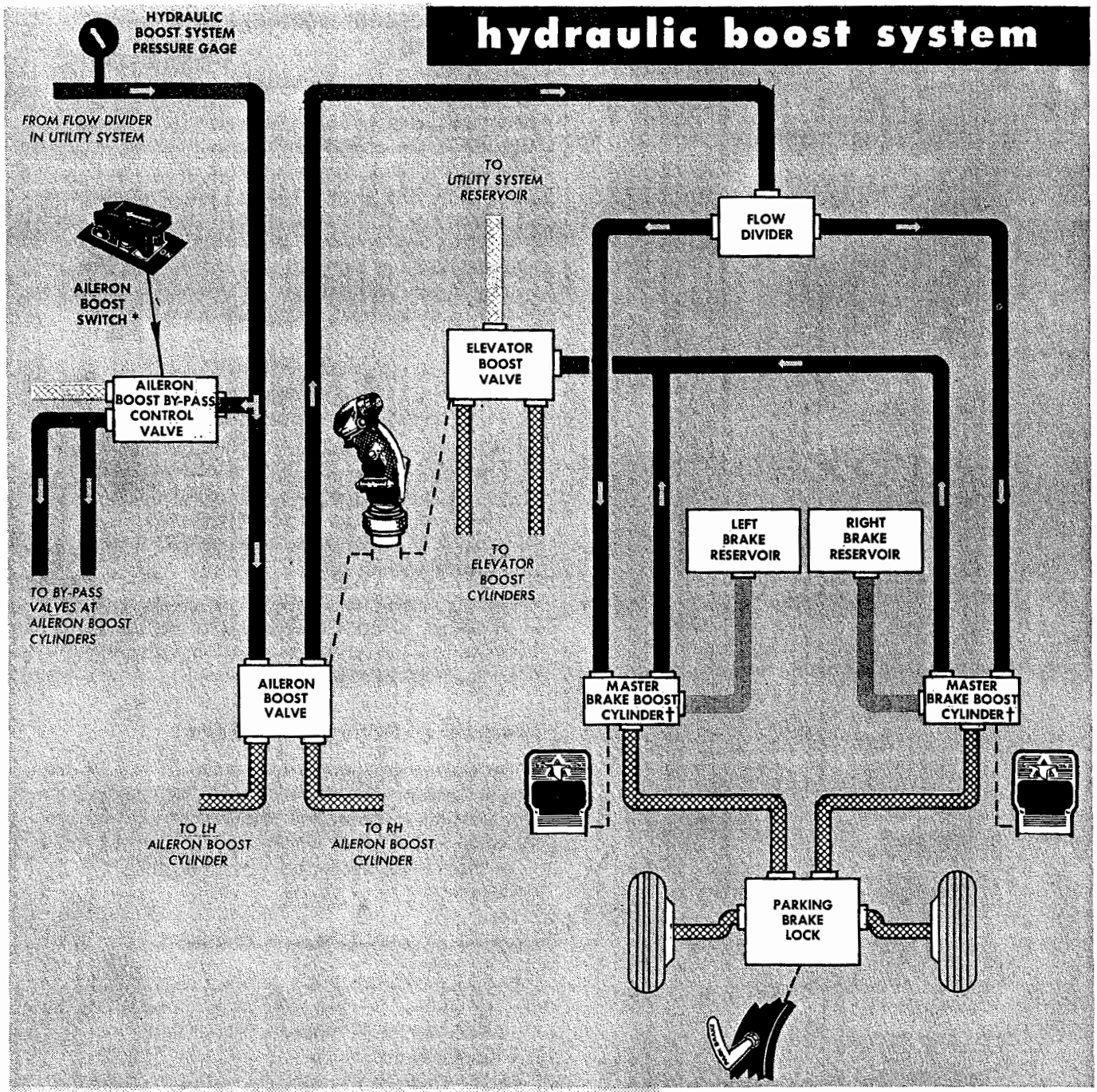
*F-86A-5 Airplanes AF48-129 through -254



*Moving aileron boost switch to BYPASS stops hydraulic boost flow at the aileron boost by-pass control valve and opens the valve to return, thereby relieving pressure from the by-pass valves. The by-pass valves are then open, permitting free flow of fluid between the two sides of the boost cylinders.

†Brake boost pressure is supplied to master boost cylinders from hydraulic boost system on F-86A-5 Airplanes AF48-129 through -316.

Figure 1-15

The rudder is actuated by direct mechanical linkage. A statically and aerodynamically balanced rudder provides directional control. The rudder is the all-metal type, having a laminated plastic tip, and an all-metal, electrically actuated trim tab. The elevators are all-metal and are balanced statically and aerodynamically. Longitudinal trim is provided by the adjustable horizontal stabilizer. Lateral control is provided by all-metal, statically and aerodynamically balanced ailerons, and lateral trim is provided by a tab, located on the left aileron. To improve boost-out control characteristics on late airplanes,* an aileron with a shorter chord has been installed. However, the rate of roll with the short-chord aileron is slightly slower than with the long-chord aileron because of the decreased working surface. Stick forces with the hydraulic boost system inoperative will be somewhat higher with the long-chord aileron than with the short-chord aileron. An increase in the available G-load at the same stick force is made possible by removal of the bob-weight and bungee assembly from the elevator torque tube.

FLIGHT CONTROL HYDRAULIC BOOST SYSTEM.

To reduce stick forces in flight, the hydraulic boost system (figure 1-15) supplies boost pressure for movement of ailerons and elevators. Hydraulic pressure is supplied by the engine-driven hydraulic pump, and normally, the system is operative whenever the engine is running.

Note

Maximum elevator boost output is sometimes reached in high-speed pull-ups at low altitude, and boost pressure will not increase with any further pull force on the stick.

If the flight control boost system fails, stick forces will increase considerably, but the airplane will still be controllable if the ailerons have been previously trimmed "hands-off." In such an emergency, the aileron boost system is by-passed automatically or by use of the aileron boost switch. By-pass of elevator boost is unnecessary, because the boost ratio of the elevator system is low, and increased elevator stick force resulting from a boost failure can readily be overcome by horizontal stabilizer adjustment.

AILERON TRIM TABS.

A conventional, electrically operated trim tab is mounted on the inboard trailing edge of the left aileron. The trim tab is actuated by either the normal trim switch on the stick grip, or by the aileron alternate trim switch on the left console. The horizontal stabilizer alternate trim switch must be in the NORMAL STICK GRIP position before the normal aileron trim switch is operable. A ground-adjustment trim tab, mounted on the right aileron, is used for rigging purposes.

ADJUSTABLE HORIZONTAL STABILIZER.

The adjustable horizontal stabilizer is conventionally operated by means of either the normal trim switch on the stick grip, or the horizontal stabilizer alternate trim switch on the left console. The alternate trim switch must be at the NORMAL STICK GRIP position before the normal trim switch is operable. The stabilizer has a trim range from +1 degree to −10 degrees.

RUDDER TRIM TAB.

A conventional, electrically operated trim tab is mounted on the trailing edge of the rudder. The trim tab is actuated by a rudder trim switch on the left console.

FLIGHT CONTROLS.

Control Stick.

The control stick is of conventional design on which is mounted a pistol-type grip. The grip (figure 1-16) includes the following switches; radar target selector button, horizontal stabilizer and aileron trim switch, bomb-rocket-tank release button, gun trigger switch, and nose wheel steering button.

Rudder Pedals.

Conventional rudder pedals are adjustable fore and aft. Exact alignment of the pedals is facilitated by position indicators on the outboard side of each pedal. Each indicator consists of a numbered dial; when the visible dial numbers correspond, the pedals are adjusted evenly.

Aileron Boost Switch.

The primary-bus-powered aileron boost switch (23, figure 1-6), is located on the left console. On early airplanes,† it electrically controls a solenoid-operated by-pass control valve. The normal position for the guarded switch is ON, so that the control valve directs fluid to the pressure-operated by-pass valves, located on the aileron actuating cylinders. If the guard is raised and the switch is moved to BYPASS, the by-pass valves

*F-86A-5 Airplane AF49-1067 and all later airplanes
†F-86A-5 Airplanes AF48-129 through -316 and AF49-1007 through -1066

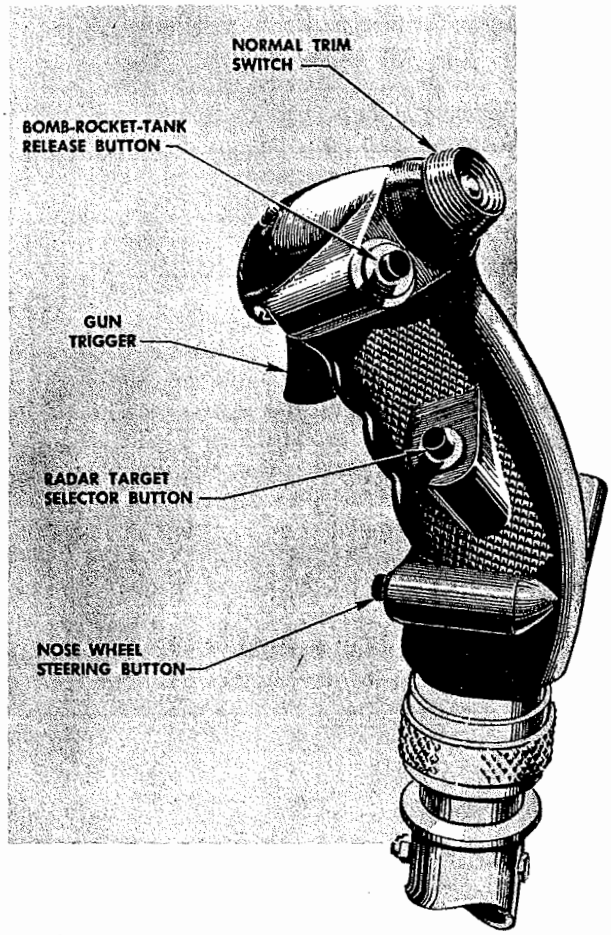


Figure 1-16

will open automatically, because fluid is by-passed to return from the control valve. This allows for manual control of the ailerons. If the hydraulic boost system fails, the pressure-operated by-pass valves open automatically to allow manual aileron control. On late airplanes,* the aileron boost switch electrically controls solenoid-operated aileron boost by-pass valves, located on the aileron actuating cylinders. For normal operation, the switch is positioned at ON. Raising the guard and placing the switch at BYPASS actuates the solenoid-operated by-pass valves, permitting fluid to free-flow between the two sides of the actuating cylinders, allowing manual control of the ailerons. If the hydraulic boost system fails, a flow-operated switch will electrically energize the solenoid-operated by-pass valves, permitting fluid to free-flow to allow manual aileron control.

Normal Trim Switch.

Normal trim of the ailerons or the adjustable horizontal stabilizer is accomplished through primary bus power, by means of a five-position, thumb-actuated switch (figure 1-16), on top of the stick grip. Provided the horizontal stabilizer alternate switch is at NORMAL STICK GRIP, desired aileron trim is accomplished when the normal trim switch is held to either the right or left, causing the trim tab on the left aileron to move either up or down. Horizontal stabilizer trim is changed when the normal trim switch is moved either up or down, causing either nose-up or nose-down trim. The normal trim switch is spring-loaded to the OFF (center) position; when released, it automatically returns to this position and trim action stops.

CAUTION

The normal trim switch is subject to sticking in any or all of the actuated positions, resulting in application of extreme trim. If the switch sticks in any actuated position during ground check, enter this fact with a red cross on DD Form 781, and *do not fly the airplane.*

WARNING

The airplane must be carefully trimmed for "hands-off" flight from time to time to ensure against an out-of-trim condition in case of aileron boost failure. An uncontrollable roll could result from this condition.

Horizontal Stabilizer Alternate Trim Switch.

The four-position horizontal stabilizer alternate trim switch (9, figure 1-6) is on the left side of the cockpit, above the forward console. This switch uses primary bus power to control a separate circuit for adjusting horizontal stabilizer position and may be used for longitudinal trim. The switch operates the stabilizer trim tab at half the speed of the normal trim switch when the switch is held at either of the spring-loaded positions, NOSE UP or NOSE DOWN. When the NORMAL STICK GRIP position is selected, the trim is controlled by the stick grip trim switch only. With the horizontal stabilizer alternate trim switch in the OFF position, the normal stick grip trim switch will not be operative.

*F-86A-5 Airplane AF49-1067 and all later airplanes

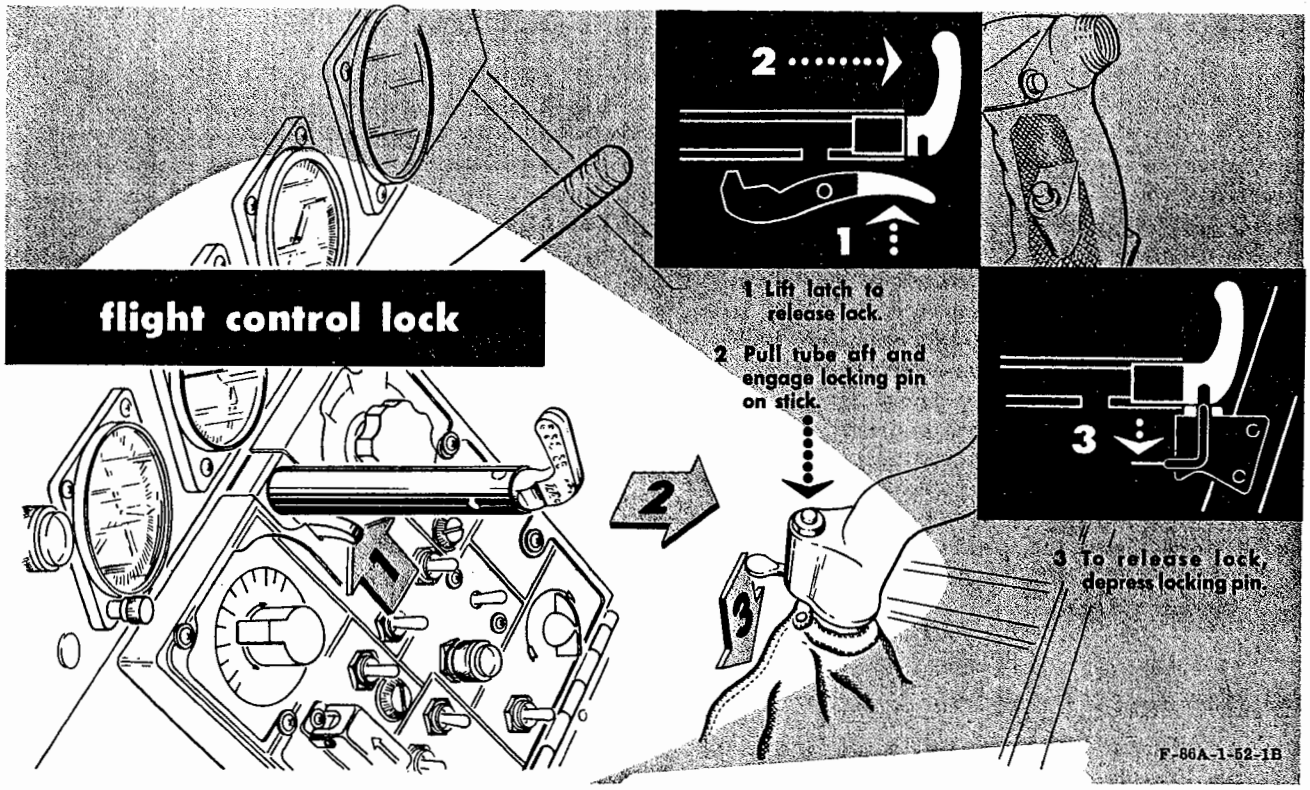


Figure 1-17

Aileron Alternate Trim Switch.

A primary-bus-powered three-position switch (25, figure 1-6), on the left aft console, controls an alternate circuit for trimming the ailerons. Normal position for the switch is the OFF (center) position. Holding the switch either to the LEFT or RIGHT position trims the left aileron, either up or down respectively, but at a slower rate than when trimmed with the normal trim switch. The RIGHT and LEFT positions are spring-loaded, and the switch will return to the OFF (center) position when released.

Rudder Trim Switch.

An electrically actuated rudder trim tab is controlled by a three-position switch (24, figure 1-6), on the left aft console. The switch, powered by the primary bus, is held at either LEFT or RIGHT for corresponding rudder trim and is spring-loaded to the OFF (center) position.

Flight Control Lock.

The flight control lock (figure 1-17) is an extendible tube, beneath the center of the instrument panel; when the tube is pulled out, it engages with a locking pin on the control stick. The rudder is also locked when the tube is pulled aft and the pedals are in neutral.

FLIGHT CONTROL SYSTEM INDICATORS.

Trim Tab Neutral Indicator Light.

Powered by the primary bus, an amber light (5, figure 1-5) on the instrument panel, is used to indicate the neutral position of the rudder trim tab on early airplanes* and the neutral position of the rudder and aileron trim tabs on late airplanes†. On early airplanes, the light comes on when the rudder trim tab reaches neutral. The light goes out when the rudder trim switch is released. On late airplanes the light comes on when either the rudder trim or the aileron alternate trim switch is actuated, and goes out when either switch is released or when the tabs are neutral. The light functions in the same manner when aileron trim is accomplished through the normal trim switch.

Horizontal Stabilizer Position Indicator.

The horizontal stabilizer position indicator (4, figure 1-5), on the instrument panel, is powered by the primary bus and shows the position of the adjustable horizontal stabilizer. Stabilizer indications are from +1 degree to −10 degrees, with a take-off setting of −5 degrees to −7 degrees.

***F-86A-5 Airplanes AF48-129 through -316 and AF49-1007 through -1066**
†F-86A-5 Airplane AF49-1067 and all later airplanes

WING FLAP SYSTEM.

The airplane is equipped with slotted-type wing flaps extending spanwise from the fuselage to the aileron on the trailing edge of each wing panel. Each wing flap is actuated through an individual electric motor and an individual electric circuit powered by the primary bus. The wing flaps are mechanically interconnected, so that if one actuating motor or one electrical circuit fails, the corresponding flap will still be actuated through mechanical linkage with the opposite flap. (Under such a condition, the flaps operate at a reduced speed.) This mechanical interlinking also prevents individual or uneven flap operation. (Flap-up travel is limited by mechanical stops; flap down-travel is limited by electrical limit switches.) A clutch, or brake arrangement, on each actuating motor prevents air load from moving the flaps. No emergency system is provided, as there is adequate protection present in the normal system through mechanical linkage, the individual electric motors, and electric circuits.

WING FLAP LEVER.

The wing flap lever (20, figure 1-6) is on the inboard face of the throttle quadrant. There are three detent lever positions on the quadrant: UP, HOLD, and DOWN. To move lever from one position to another, first move lever outboard (inboard on some airplanes) to clear detent. To operate the wing flaps to the full-up or full-down position, the flap lever is moved to UP or DOWN, and returned to HOLD after desired position is reached. For intermediate flap positions in flight, the lever is held at UP or DOWN and then returned to HOLD when the desired flap effect is obtained. There is no flap position indicator.

WING SLATS.

Wing slats extend from fuselage to wing tips along the leading edge of each wing panel. Aerodynamic forces acting upon the slats cause them to open and close automatically, depending upon the airspeed and attitude of the airplane. When they open, the slats move forward along a curved track, forming a slot in the wing leading edge. This automatic extension of the slats changes the airflow over the wing upper surface and increases lift, resulting in lower stalling speeds. At higher speeds, in unaccelerated flight, the slats automatically close to provide minimum drag for maximum performance in flight. On early airplanes,* not changed by T.O., hydraulically actuated locks are provided to hold the slats in their closed position, flush with the wing contour, when desired. No slat locks are provided on later airplanes, since a different wing slat installation on these airplanes causes the slats to open and close at airspeeds below those used for climb and cruise.

SLAT LOCK LEVER.

On early airplanes* not changed by T.O., a two-position slat lock lever (31, figure 1-5), is on the frame below the left side of the windshield. Moving the lever to LOCK will lock the slats if they are closed, or, if the slats are open when the lever is moved, the locks are spring-loaded to engage as soon as the slats retract. Moving the lever to UNLOCK releases the locks, freeing the slats to open and close automatically. To ensure that the slats are unlocked for take-off and landing, the landing gear system and the slat lock lever are interconnected. Mechanical linkage between the landing gear handle and the slat lock lever moves the slat lock to UNLOCK when the landing gear handle is moved to the DOWN position. On early airplanes* not changed by T.O., if the utility hydraulic system fails, the wing slats can be unlocked by means of the emergency hydraulic system. When the emergency hydraulic selector is placed at EMER SLAT UNLOCK and the slat lock lever at UNLOCK, operation of the emergency hand-pump will supply pressure to unlock the slats.

SPEED BRAKE SYSTEM.

A hydraulically operated speed brake (32, figure 1-1) is located on each side of the fuselage, below the dorsal fin. Each speed brake consists of a panel hinged at the forward edge which, when open, extends down and forward into the air stream. Pressure for normal operation of the speed brakes is supplied by the utility hydraulic system. The speed brakes are designed to open fully, under any flight condition, in approximately 3 seconds. Quantity measuring fuses are installed to prevent excessive loss of fluid in case of broken or damaged lines.

SPEED BRAKE SWITCH.

A serrated switch (figure 1-9), on top of the throttle, controls speed brake operation, using primary bus power. The switch has three fixed positions: IN, OUT, and a HOLD (neutral) position which is indicated by a white alignment mark on the switch guide. The brakes can be stopped in any position by movement of the switch to neutral. After the speed brakes have been opened or closed, the switch should be returned to the neutral position.

CAUTION

Since the speed brake hydraulic lines are routed near the engine, it is recommended that the speed brake switch be kept in the neutral posi-

*F-86A-5 Airplanes AF48-129 through -254

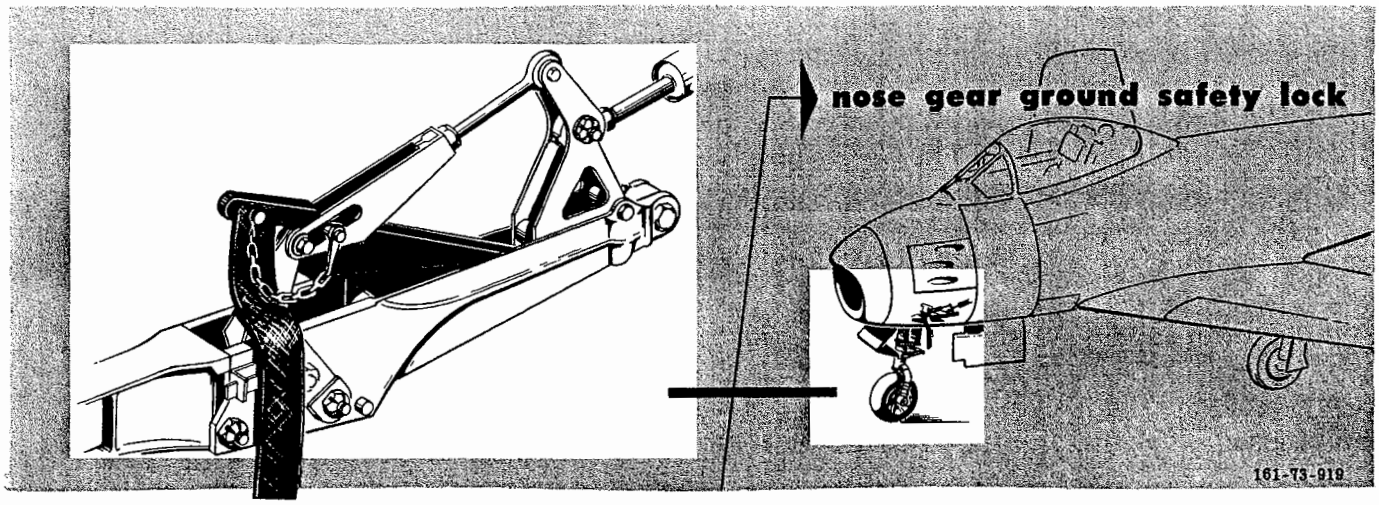


Figure 1-18

tion to cut off hydraulic pressure and minimize any possible fire hazard in case of a damaged line.

SPEED BRAKE EMERGENCY LEVER.

To provide a means of closing the speed brakes when normal operation fails, a speed brake emergency lever (21, figure 1-6) is installed outboard of the throttle, on the left console. Normally, the lever is safety-wired at its aft, NORMAL, position. When pushed forward to EMERG CLOSED, the control lever mechanically opens a dump valve, relieving hydraulic pressure from the speed brake actuating cylinders. Air loads then close the brakes. No emergency means of opening the brakes is provided.

LANDING GEAR SYSTEM.

The fully retractable tricycle landing gear, as well as the gear and wheel fairing doors, is hydraulically actuated and electrically controlled and sequenced. The main gear retracts inboard into the lower surface of the wing and fuselage; the nose gear retracts aft into the fuselage, pivoting 90 degrees so that the nose wheel is horizontal when retracted. After the gear is down and locked, the wheel fairing doors are retracted to the closed position to prevent mud, dirt, etc, from entering the wheel wells during landing, taxiing, and take-off. Incorporated in the nose gear assembly is a hydraulic steering unit which acts as a conventional shimmy damper when the steering mechanism is not engaged.

NOSE GEAR GROUND SAFETY LOCK.

A ground safety lock (figure 1-18) may be inserted in the nose gear assembly to prevent collapsing of the nose gear on the ground. The lock has a conventional warning streamer and must be removed before flight. No ground safety locks are provided for the main gear, as weight of the airplane on the main gear prevents accidental release while the airplane is motionless.

LANDING GEAR CONTROLS.

Landing Gear Handle.

The landing gear handle (17, figure 1-6) powered by the primary bus, controls the landing gear and gear door hydraulic selector valve. The control handle has three positions: UP, COMBAT (neutral), and DOWN. Moving the handle UP or DOWN causes utility hydraulic system pressure to position the gear accordingly. When the handle is placed at COMBAT, the gear and door control valves shift to a neutral position, thus relieving hydraulic pressure in the system. When the gear is down and locked and the weight of the airplane is on the gear, a ground safety switch prevents gear retraction if the gear handle is inadvertently moved to UP. The fairing doors are not controlled by this switch and will follow their normal sequence, opening when the control handle is moved to UP, thereby warning the ground crew that the gear handle is in the wrong position for ground operation. The ground safety switch can be intentionally overridden by use of the landing gear emergency-up button when the gear handle is in the UP position and the weight of the airplane on the gear. On early airplanes,* not changed by T.O., the gear handle is connected mechanically to the wing slat lock lever, so that when the gear handle is moved to the DOWN position, the slat lock lever is simultaneously moved to UNLOCK, thus ensuring that the slats will be unlocked for take-off and landing.

***F-86A-5 Airplanes AF48-129 through -254**

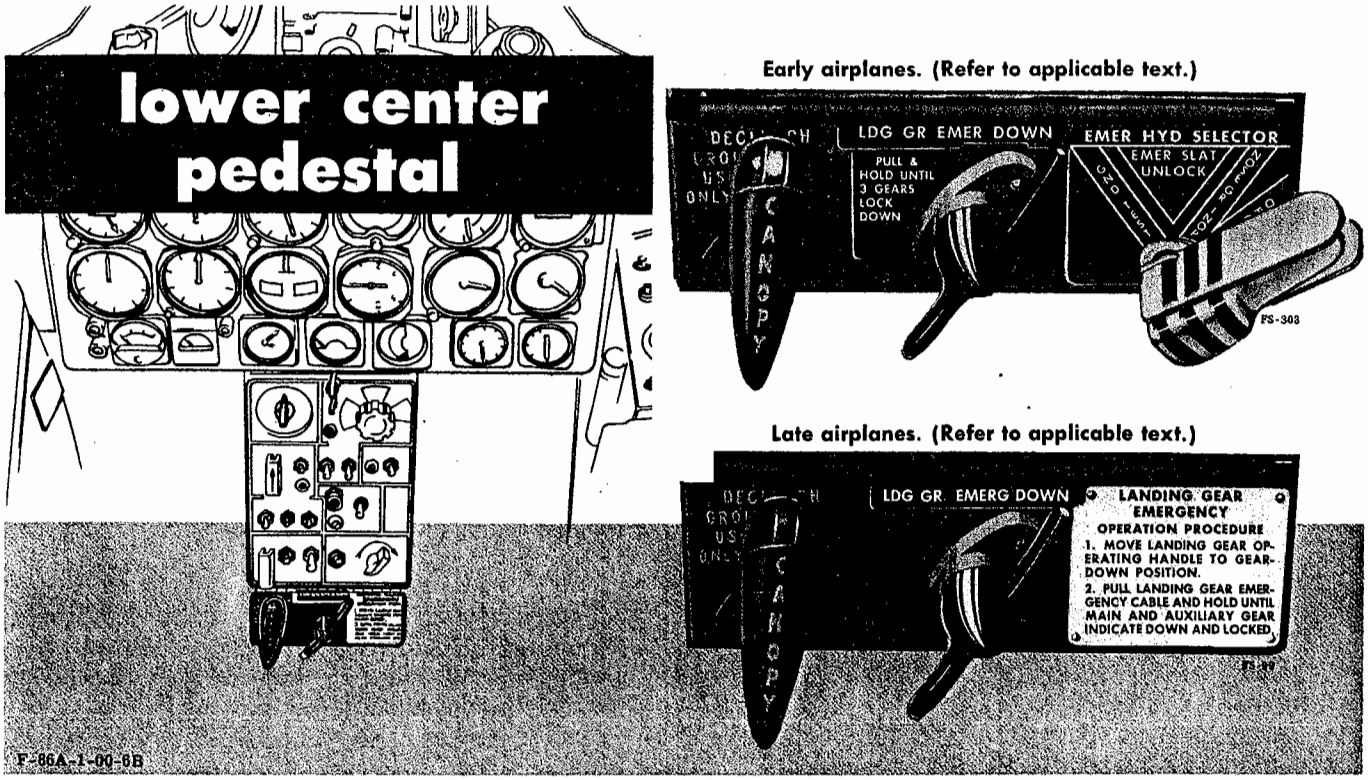


Figure 1-19

Landing Gear Emergency Release Handle.

If failure of the utility hydraulic system or electrical system occurs, the gear may be lowered by pulling the landing gear emergency release handle (figure 1-19) on the lower center pedestal.

CAUTION

The emergency release handle must be pulled to full extension (approximately 20 inches) with a force of about 60 pounds to release all gear uplocks and to properly position the hydraulic selector valves.

When this handle is pulled fully out, the nose gear automatically extends and locks, and the main gear free-falls and locks. The release handle should be held extended until gear is down and locked (approximately 11 seconds).

CAUTION

If the gear must be lowered in this manner, the landing gear handle must first be placed in the DOWN position; otherwise the main gear may retract when the emergency release handle is released.

Emergency lowering is accomplished through a hydraulically operated emergency nose gear extension system, which has its own accumulator. When the handle is pulled, a control valve is opened which allows hydraulic pressure from the accumulator to extend the nose gear. This pressure is sufficient for one extension only and the control valve must be reset on the ground. To reset the emergency nose gear extension control valve, located in an access on the right fuselage outboard of the nose gear well, pull the valve reset button to full extension (approximately 1½ inches) and then release.

Note

- Make sure the reset button returns full back to the reset position when released. It may have to be pushed back.
- The nose gear cannot be retracted in flight after being lowered by means of the landing gear release handle. Therefore, to restore normal operation, the extension control valve must be reset before the next flight if the gear has been lowered by use of the emergency release handle.

Landing Gear Emergency-up Button.

CAUTION

Do not use the landing gear emergency-up button in flight to raise the gear, because damage to gear doors and the gear lowering mechanism may result.

If it is necessary to collapse the gear on the ground (because of insufficient runway in which to stop the airplane), the landing gear ground safety switch can be overridden by use of a guarded emergency-up button (12, figure 1-6), above the landing gear handle. When the gear handle is at UP and the emergency-up button is depressed, the ground safety switch is by-passed and the gear is retracted hydraulically in the normal manner, except that the gear fairing doors may not have sufficient time to fully open. This system is operable only if hydraulic pressure and battery bus power are available, and the button must be held depressed until the gear retracts.

LANDING GEAR INDICATORS.

Landing Gear Handle Up Indicator Light.

The gear handle up indicator light (1, figure 1-5) is on the instrument panel of a few early airplanes,* and on the left forward console of the remaining airplanes. The light is illuminated by power from the primary bus whenever the gear handle is in the UP position, reminding the pilot to return the handle to COMBAT after the gear unsafe warning light goes out. On late airplanes,† the light can be turned to vary the brightness. If the handle is left at UP in flight, negative loads may actuate the gear sequencing switch and cause the doors to cycle, which could cause severe damage if it happened at high speeds. On the ground, the ground safety switch will prevent gear retraction if the gear handle is moved to UP; however, if the airplane is taxied on rough ground, the gear struts may extend enough to allow the gear ground safety switch to open and permit the gear to fold.

CAUTION

Moving the landing gear handle when airspeed is above 185 knots IAS may cause the wheel doors to cycle, and, at high speeds, the doors could be torn off.

Landing Gear Position Indicators.

The position of the landing gear is indicated by three green lights and one red light (figure 1-13), all powered by the primary bus. The lights are on the left forward console. The three green lights, one for each gear, indicate when each respective gear is down and locked. The red light comes on if the gear is in any position other than down and locked or up and locked, if the gear is up and locked and the throttle is retarded below minimum cruising rpm, or if the gear is up and locked and any gear door is not completely closed.

Landing Gear Warning Horn.

A primary bus powered warning horn in the cockpit sounds if the gear is in any position other than down and locked when the throttle is retarded below minimum cruising power. A horn cut-out button (figure 1-13), below the landing gear position indicator lights, is provided to silence the horn. Advancing the throttle past minimum cruise rpm will automatically reset the horn circuit.

NOSE WHEEL STEERING SYSTEM.

Nose wheel steering is electrically engaged, hydraulically powered, and controlled by rudder pedal action. Steering is accomplished when a button on the control stick grip is depressed and the rudder pedals are operated to control a hydraulically operated nose wheel steering unit. This unit allows the wheel to be turned approximately 21 degrees each side of center by pressure on the respective rudder pedal. When not engaged for steering, the unit serves as a conventional hydraulic shimmy damper. A safety switch, mounted on the nose wheel strut scissors, prevents engagement of the steering unit whenever the weight of the airplane is off the nose gear.

NOSE WHEEL TOWING RELEASE PIN.

The nose wheel towing release pin is on the left side of the nose gear strut, just above the wheel fork. For towing the airplane, the pin must be disengaged, allowing the nose gear fork to swivel. A wedge lock (which is fastened to one of the nose gear towing lugs when not in use) should be inserted through the release pin to prevent the pin from slipping back into its engaged position during towing operations.

CAUTION

Before flight, make sure wedge is stowed on towing lug, and that release pin is engaged with safety cap on pin so that nose gear will not free-swivel.

***F-86A-5 Airplanes AF48-129 through -164**
†F-86A-5 Airplane AF49-1067 and all later airplanes

NOSE WHEEL STEERING BUTTON.

The push-button type nose wheel steering switch (figure 1-16), on the control stick grip permits primary bus power to actuate a shutoff valve to supply hydraulic pressure to the nose gear steering unit. In order to engage the steering unit, the button must be depressed and the rudder pedals aligned in the direction the nose wheel is turned. When the nose wheel and rudder pedals are coordinated in this manner, the nose wheel steering unit is automatically engaged.

Note

The nose wheel unit will not engage if the nose wheel is more than 21 degrees either side of center. If the nose wheel is turned more than this, it must be brought within the steering range by use of the wheel brakes.

WHEEL BRAKE SYSTEM.

The power-boost wheel brakes are operated by toe action on the rudder pedals. On early airplanes,* the brake system is separate from the utility hydraulic system, and has its own fluid supply. Boost pressure for brake control is provided by the hydraulic boost system. When the brakes are applied, hydraulic fluid flow is restricted, causing a back pressure at the boost cylinder piston to build up and aid in brake application. On late airplanes,† fluid and pressure for brake control are supplied by the utility hydraulic system. Brake boost pressure is metered to the brakes when toe pressure is applied to the rudder pedals. The harder the pedals are depressed, the more the brake pressure is built-up. If no pressure is available from the hydraulic system, the brakes will function through conventional action of the brake master cylinders when toe pressure is applied to the rudder pedals.

PARKING BRAKE HANDLE.

The parking brake handle (13, figure 1-6) is on the left side of the cockpit, above the landing gear handle. To set the parking brakes on early airplanes,* it is necessary to pull the handle part way out, press hard on the toe pedals, and then pull the handle full out before releasing the toe brake pressure. To release brakes when boost is not available (engine off) after they have been set with power boost (engine running), it is necessary to push in the parking brake handle rather than depress the toe pedals. To set the parking brakes on late airplanes,† it is necessary to depress the toe pedals, pull the handle full out, and release the toe pedals. When the toe pedals are depressed, the brakes are released. If the brakes do not release easily, the toe pedals should be pressed hard and the handle pushed all the way in.

INSTRUMENTS.

Most of the instruments are mounted on the instrument panel (figure 1-5) and are powered by the ac and/or dc electrical system. An electric automatic vibrator powered by the primary bus, is mounted on the forward side of the instrument panel to prevent instrument lag or sticky pointer indications.

Note

For information regarding instruments that are an integral part of a particular system, refer to applicable paragraphs in this section and in Section IV.

AIRSPEED INDICATOR.

The airspeed indicator (27, figure 1-5) is conventional, with the addition of a red, limiting hand. This hand has two adjustments. The first permits setting the hand to indicate the airspeed corresponding to a limit Mach number. This adjustment is indicated by the position of a Mach scale on a windowed disk on the instrument face. The second adjustment prevents clockwise movement of the limiting hand beyond a limit airspeed. The limiting hand will indicate the airspeed corresponding to a limit Mach number or limit airspeed, whichever is less, for a given external loading configuration. (Refer to "Airspeed Limitations" in Section V.) If there is no airspeed or Mach number limit for the airplane, the hand will be set to show at any altitude the airspeed corresponding to Mach 1.0, the design limit of the instrument. The pitot-static head is installed on a boom on the right wing tip. Airspeed indications do not have to be corrected for installation error.

MACHMETER.

A Machmeter (26, figure 1-5) is provided as a primary flight instrument for indicating speed. (Refer to "Mach Number" in Section VI.) The Machmeter is extremely valuable, particularly at high altitudes, because its reading is more closely related to true airspeed than is indicated airspeed. For example, at 45,000 feet, an indicated airspeed of 240 knots is actually a true airspeed of 510 knots. This true airspeed is indicated on the Machmeter as Mach .89 at 45,000 feet or Mach .77 at sea level. Thus there is a difference of only about one-tenth Mach number between 45,000 feet and sea level, while indicated airspeed varies 270 knots.

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*F-86A-5 Airplanes AF48-129 through -316
†F-86A-5 Airplane AF49-1007 and all later airplanes

ACCELEROMETER.

The accelerometer (29, figure 1-5), on the instrument panel, registers the positive G applied to the airplane. Some early airplanes are equipped with accelerometers that will register positive and negative G.

ALTIMETER.

The altimeter (figure 1-20) has three pointers, 100-foot, 1000-foot, and 10,000-foot. The 10,000-foot pointer incorporates an extension, which cannot be obscured by the other pointers, and a notched disk. At altitudes below 16,000 feet, the notched disk will move to expose a set of warning stripes. Thus, the altimeter offers improved readability and visually warns the pilot when altitudes under 16,000 feet are entered.

ATTITUDE INDICATOR.

A visual indication of the flight attitude of the airplane in pitch and roll is provided by the gyro-controlled J-8 attitude indicator (3, figure 1-5; figure 1-21) on the instrument panel. The unit is electrically operated from the ac electrical system and has an "OFF" indicator flag, which appears in the upper right arc of the dial whenever power is not being supplied or if the indicator is not up to speed. Within a range of 27 degrees in a climb or dive, the pitch attitude of the airplane is indicated by displacement of the horizon bar in relation to the miniature indicator airplane. When the pitch attitude of the airplane exceeds 27 degrees, the horizon bar remains in the extreme position, and the sphere then serves as the reference. If the climb or dive angle is further increased with the airplane approaching a vertical position, the attitude is indicated by graduations on the sphere. After certain maneuvers, the attitude indicator will "lag" approximately 5 degrees upon return to straight and level flight. The unit begins to correct these errors immediately. The gyro may be manually caged by use of the caging knob on the lower right side of the bezel. Smoothly pulling out the knob and releasing it quickly as soon as it reaches the limit of travel cages the gyro. The manual caging feature permits fast gyro erection for scramble take-offs or for erecting the gyro to correct in-flight errors caused by turns or aerobatics. For scramble take-offs, 30 seconds should be allowed after the power is applied to bring the gyro up to speed; it should then be caged immediately. The gyro should be caged to correct in-flight errors only when the airplane is in straight and level flight as determined by visual reference to a true horizon, since the indicator cages to the attitude of the airplane. A knob on the lower left side of the bezel permits the miniature indicator airplane to be adjusted to compensate for longitudinal trim changes.

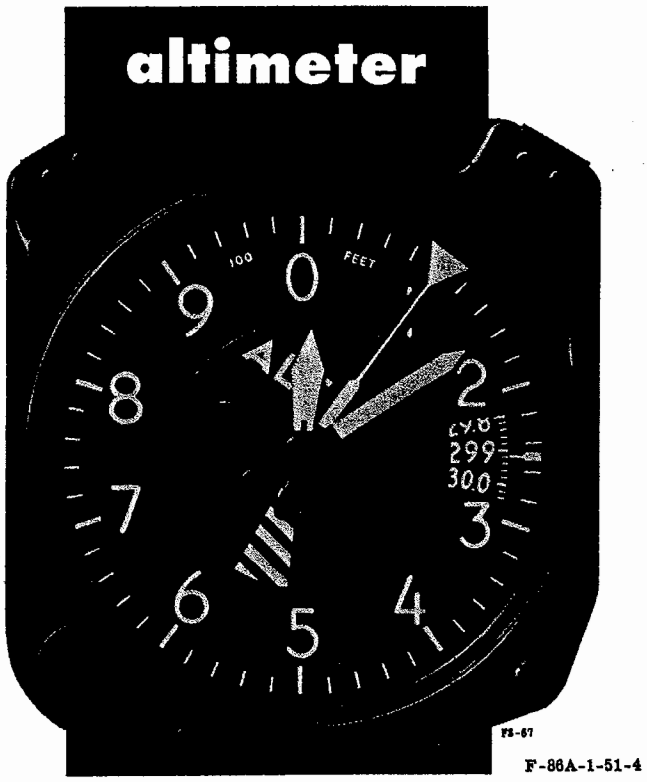


Figure 1-20

WARNING

A slight amount of pitch error in the indication of the Type J-8 attitude indicator will result from accelerations or decelerations. It will appear as a slight climb indication after a forward acceleration and as a slight dive indication after deceleration when the airplane is flying straight and level. This error will be most noticeable at the time the airplane breaks ground during the take-off run. At this time, a climb indication error of about 1½ bar widths will normally be noticed; however, the exact amount of error will depend upon the acceleration and elapsed time of each individual take-off. The erection system will automatically remove the error after the acceleration ceases.

STAND-BY COMPASS.

A conventional magnetic compass (1, figure 1-7) on the windshield bow to the right of the instrument panel, is furnished for navigation in the event of instrument or electrical system failure.

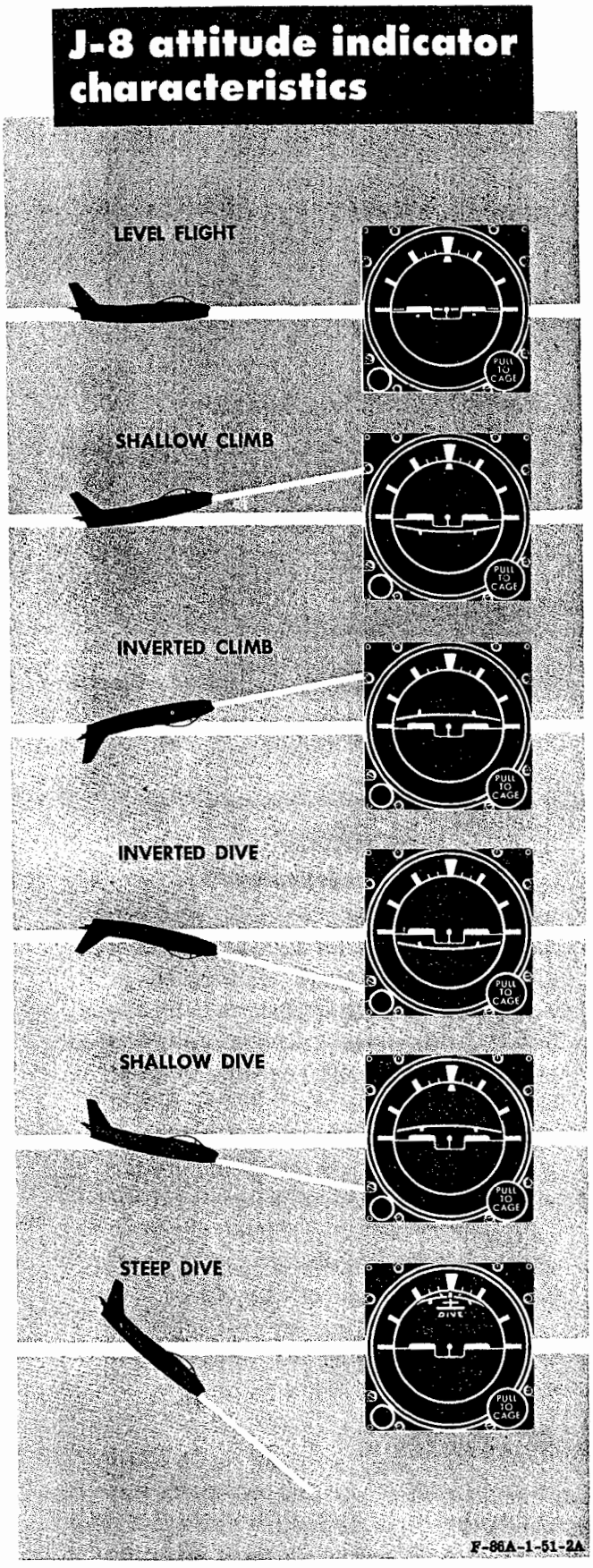


Figure 1-21

DIRECTIONAL INDICATOR (SLAVED).

Refer to "Navigation Equipment" in Section IV.

TURN-AND-SLIP INDICATOR.

A turn-and-slip indicator (18, figure 1-5) on the instrument panel, is electrically driven by power from the primary bus.

EMERGENCY EQUIPMENT.

ENGINE FIRE DETECTOR SYSTEM.

Two fire detector systems are provided to detect and indicate overheat or fire in the forward or aft engine compartments. The forward engine compartment (which includes the compressor and accessory section) and the aft compartment (which includes the combustion chambers and the tail pipe) are divided by a fire wall at the engine mid-frame. The systems consist of fire detector units, mounted throughout the engine and engine compartments, and warning lights in the cockpit. No fire-extinguishing system is installed.

Fire-warning Lights.

An abnormal rise of temperature within either engine compartment is indicated by red warning lights (8, figure 1-5), mounted on the shroud, above the right side of the instrument panel. The two lights, one for the forward and one for the aft compartment, are illuminated by primary bus power to show an excessive temperature condition or fire in the respective engine section. Operation of the system and the lights can be checked by means of a test button (9, figure 1-5) below the lights. The lights are push-to-test type, permitting a check of bulb illumination independent of the system operation check.

CANOPY.

The sliding canopy can be controlled from either the cockpit or outside the airplane. As the canopy actuator is powered by the battery bus or an external power source, the battery-starter switch need not be at BATTERY for canopy operation. Provisions are made also for manual operation of the canopy. Air loads prevent the canopy from being opened normally at speeds above 215 knots IAS. Emergency release of the canopy in flight is accomplished by a remover (figure 1-22), which fires the canopy directly aft from the airplane. When the canopy is jettisoned (on airplanes not changed by T.O. 1F-86-161), it pulls a safety pin from the seat catapult firing mechanism so that the seat can be ejected only after the canopy leaves the airplane. On airplanes changed by T.O. 1F-86-161, the seat may be ejected through the canopy if canopy fails to jettison; or the

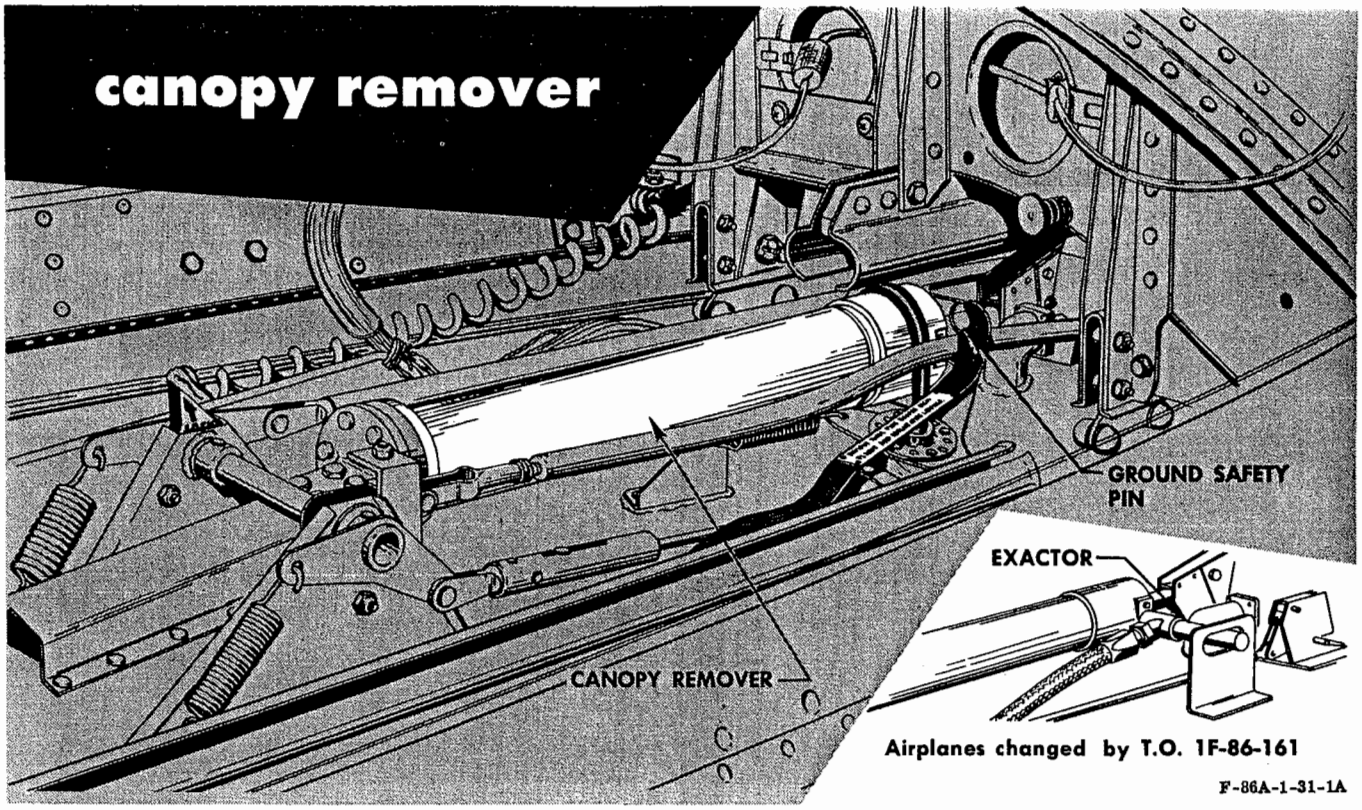
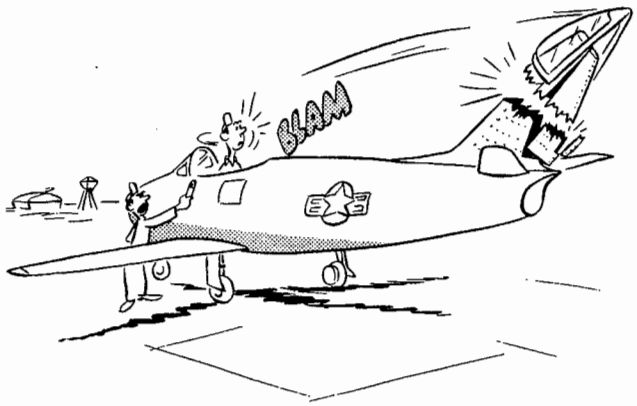


Figure 1-22

seat may be ejected normally if the canopy fails to pull the safety pin as it jettisons. Some airplanes are modified to include an alternate means of jettisoning the canopy.



Warning

A SAFETY PIN IN THE CANOPY REMOVER, ON UNMODIFIED AIRPLANES, OR A SAFETY PIN IN THE CANOPY INITIATOR, ON MODIFIED AIRPLANES, PREVENTS THE REMOVER FROM BEING FIRED ACCIDENTALLY WHILE THE AIRPLANE IS ON THE GROUND. THE SAFETY PIN MUST BE REMOVED BEFORE FLIGHT AND MUST BE REINSTALLED AFTER FLIGHT.

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Canopy Seal.

An inflatable canopy seal seals the canopy in the closed position. Pressure for inflation of the seal is provided by engine compressor air and is automatically controlled by a pressure regulator. The seal becomes inflated when the canopy is fully closed and the engine is operating. When the canopy switch is actuated, the seal is automatically deflated to allow the canopy to move. The seal is also automatically deflated before canopy jettison.

Note

If the canopy switch is moved to CLOSE during flight, the canopy seal will be deflated, and, at altitude, deflation will result in loss of cockpit pressurization. However, when the switch is released, the seal will be deflated, and the cockpit will become pressurized again.

CANOPY CONTROLS.

Canopy External Control Buttons.

The canopy is operated externally by two spring-loaded push buttons (18, figure 1-1), located on each side of the fuselage, approximately 2 feet below and in line with the windshield bow. One button is marked "OPEN"

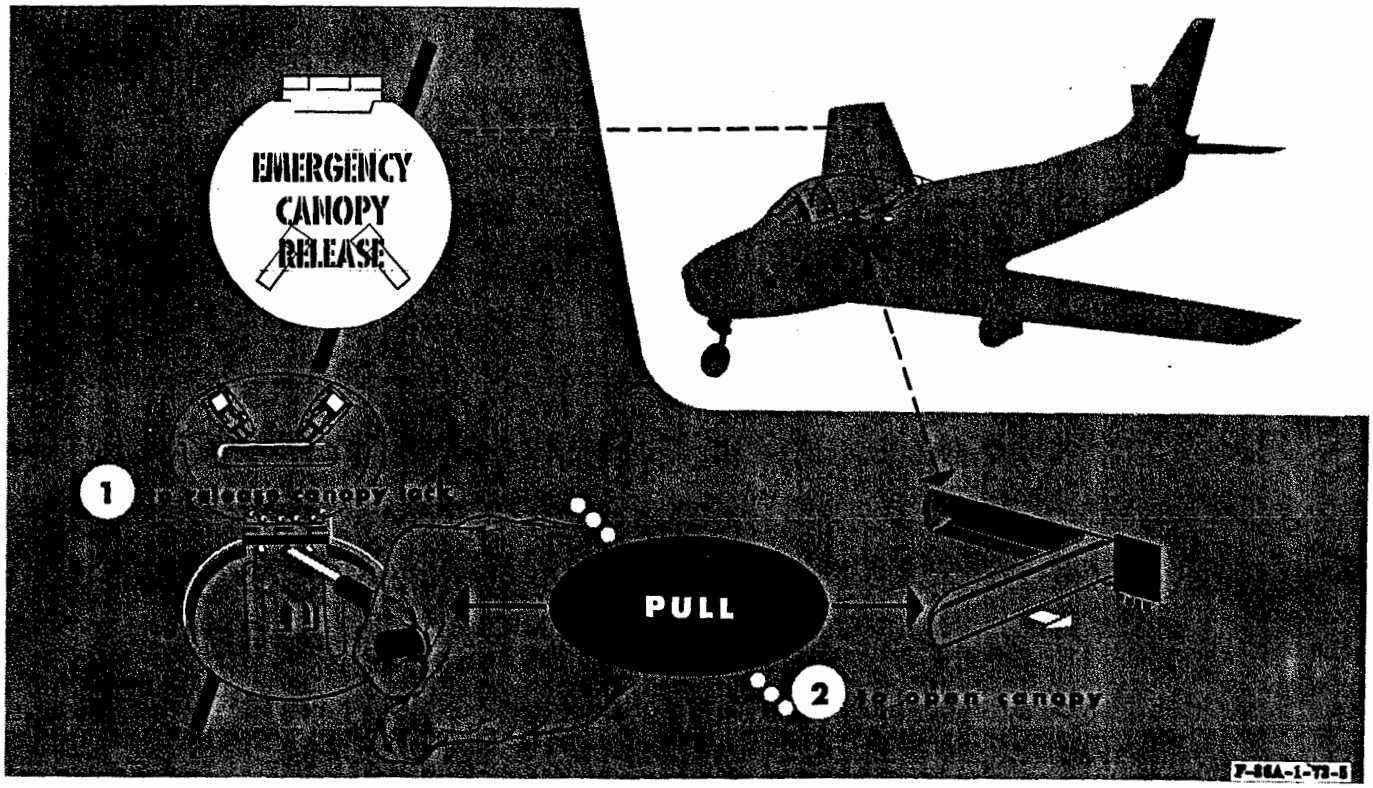

Figure 1-23

and the other "CLOSED," and depressing either button operates the canopy.

Note

Operation of any external button overrides the setting of the canopy switch in the cockpit. However, if the cockpit switch is left at OPEN and the external button is used for closing, the canopy will open as soon as the external button is released.

Canopy Switch.

The canopy is controlled from within the cockpit by a three-position guarded toggle switch (14, figure 1-6), above the left forward console. To close the canopy, the switch must be held at the spring-loaded CLOSE position. Moving the switch to OPEN will open the canopy; when the canopy reaches the fully open position, power to the canopy actuator will be automatically cut off. When the switch is at its OFF (center) position, the canopy is locked, whether open, partly open, or closed.

Canopy Declutch Handle.

A canopy declutch handle (figure 1-19), on the lower center pedestal, is intended for emergency use on the ground, and, when pulled, disengages the canopy from the drive shaft so it can be moved manually.

Canopy Manual Operating Handle.

A handle in the cockpit, on the right side of the canopy bow is used for pulling the canopy open on the ground if it cannot be opened electrically. The handle should also be used in flight only if the canopy must be declutched for removal. The canopy declutch handle must be held out while the canopy is pulled open manually.

Canopy Emergency Jettison Release.

When the right handgrip on airplanes not changed by T.O. 1F-86-227 or either handgrip on airplanes changed by T.O. 1F-86-227 is pulled full up in preparation for seat ejection, the canopy remover is fired, jettisoning the canopy rearward to permit emergency ejection. The canopy can be jettisoned at any airspeed or airplane attitude. On airplanes not changed by T.O. 1F-86-161, mechanical linkage from the right handgrip releases the sear pin in the canopy remover, thus firing the cartridge. On airplanes changed by T.O. 1F-86-161, the mechanical linkage assembly for firing the canopy has been replaced by an initiator-exactor system. Raising the right handgrip fires a cartridge within the initiator. On airplanes changed by T.O. 1F-86-227, raising either handgrip fires the cartridge. The gases produced move a piston in the exactor. Movement of the piston pulls the sear pin from the canopy remover, causing the remover to fire.

WARNING

A ground safety pin in the canopy remover, on airplanes not changed by T.O. 1F-86-161 or a maintenance safety pin in the canopy initiator on airplanes changed by T.O. 1F-86-161, prevents the remover from being fired accidentally while the airplane is on the ground. This safety pin must be removed before flight and stowed in the map case. It must be reinstalled after flight.

Canopy Alternate Emergency Jettison Handle.

On airplanes changed by T.O., a canopy alternate emergency jettison handle (20, figure 1-7) is installed so that the canopy may be jettisoned without arming the seat catapult. The handle, labeled "ALT CANOPY JET," is mounted just to the right of the instrument panel. When this handle is pulled to its full extended position (approximately 2 inches), a mechanical linkage withdraws the canopy initiator sear pin, firing a cartridge within the initiator. This actuates the exactor and fires the canopy remover.

Note

This handle is provided as an alternate means of removing the canopy and is designed to be used when it is desired to jettison the canopy without arming the seat catapult. It should not be used in place of the seat handgrip sequence when ejection from the airplane is intended.

Canopy External Emergency Release Handle.

The canopy external emergency release handle (figure 1-23) can be reached through an access door on the left side of the fuselage, below the canopy frame. Pulling this handle disengages the canopy and allows it to be moved manually full aft on canopy tracks, then off of the fuselage. The canopy external emergency release handle does not fire the canopy remover.

EJECTION SEAT.

The ejection seat (figures 1-24, 1-25, and 1-26) permits emergency ejection at any speed or flight attitude. An explosive cartridge-type catapult is mounted vertically aft of the seat and when fired, supplies the necessary force to eject the seat and pilot from the airplane. The seat has either a manual-opening or automatic-opening safety belt. The seat may be adjusted vertically and is provided with an adjustable headrest. If additional seat height is needed when raft or survival kit is carried, use a solid filler block, provided the combined thickness does not exceed 5 inches.

CAUTION

Do not use the A-5 seat cushion, or any similar sponge rubber cushion, when equipped with a one-man life raft or survival kit. If ejection is necessary, serious spinal injuries can result when the ejection force compresses the cushion and enables the seat to gain considerable momentum before exerting a direct force on the pilot. The chance of injury during a forced landing is also increased.

Armrests and footrests on the seat are fixed; however handgrips at the forward end of each armrest are hinged to actuate the ejection sequence. Airplanes not changed by T.O. 1F-86-227 have a mechanical linkage assembly which operates the firing lever in the seat catapult. Airplanes changed by T.O. 1F-86-227, have mechanical linkage assemblies which fire the seat initiators. On airplanes not changed by T.O. 1F-86-161, the ground safety pins inserted through both seat handgrips and the maintenance safety pin in the seat catapult, to prevent inadvertent firing on the ground, must be removed before flight. On airplanes changed by T.O. 1F-86-161, a ground safety pin inserted through the right handgrip and a maintenance safety pin in the seat catapult must be removed before flight. On airplanes changed by T.O. 1F-86-227, ground safety pins inserted in both seat handgrips must be removed before flight. The radio lead and the anti-G suit and oxygen hoses are fitted into a single disconnect assembly on the forward edge of the seat between the footrests. On airplanes changed by T.O. 1F-86-530, the radio headset plug-in is just above the left seat armrest. When the seat is ejected, these connections are severed automatically at the disconnect assembly.

EJECTION SEAT CONTROLS.

Right Handgrip.

Pulling the right handgrip to the full-up position fires the canopy from the airplane and raises the seat catapult trigger out of its guard. On airplanes changed by T.O. 1F-86-227, raising the handgrip also locks the shoulder harness.

Left Handgrip.

Raising the hinged left handgrip to the full-up position automatically locks the shoulder harness for ejection. In addition to locking the shoulder harness, actuation of the left handgrip, on airplanes changed by T.O. 1F-86-161, pulls the safety pin from the seat catapult. Thus, if the pin is not removed because the canopy fail to jettison, or in jettisoning fails to pull the safety pi

ejection seat

AIRPLANES NOT CHANGED BY T.O. 1F-86-161 AND T.O. 1F-86-227

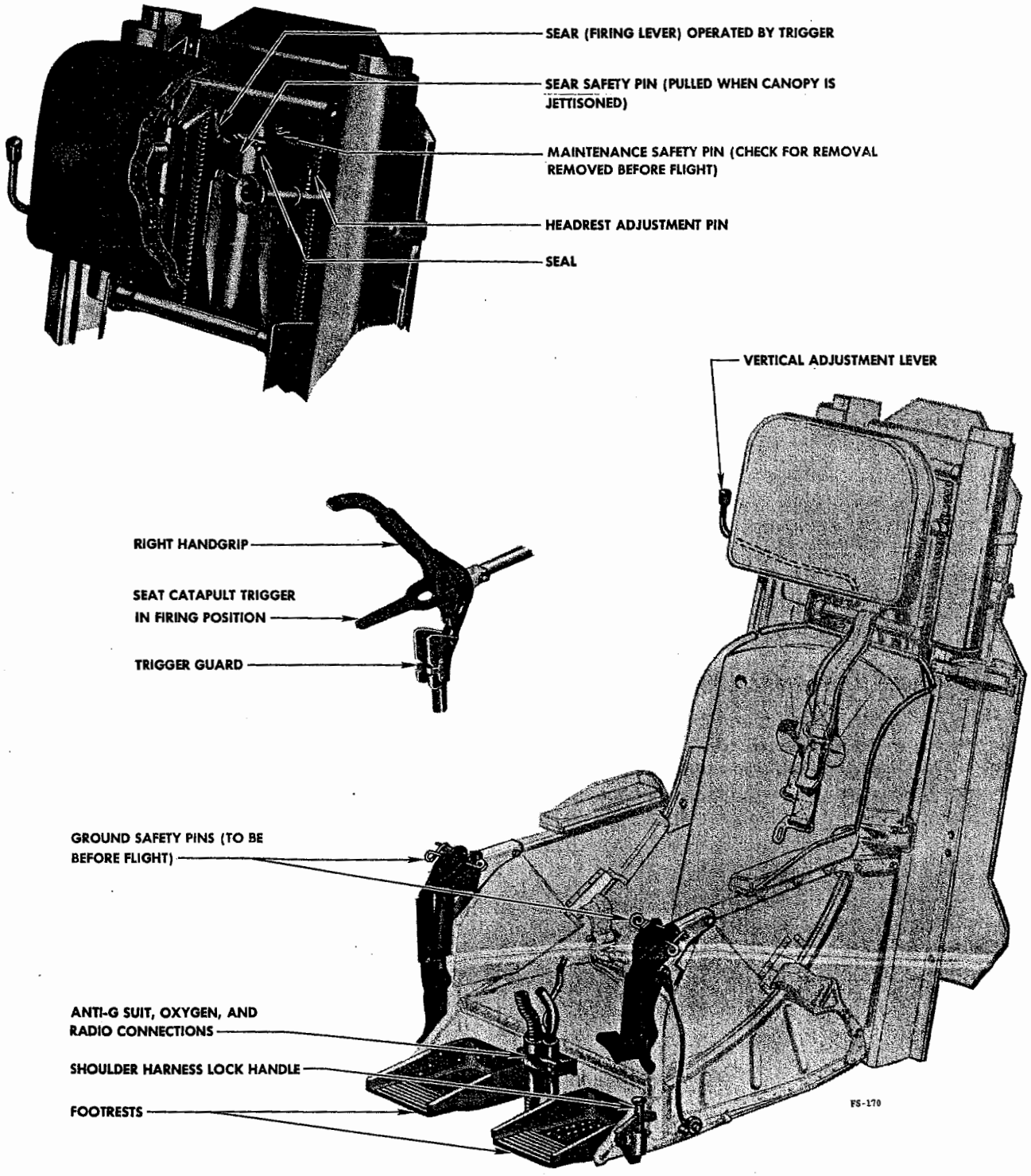

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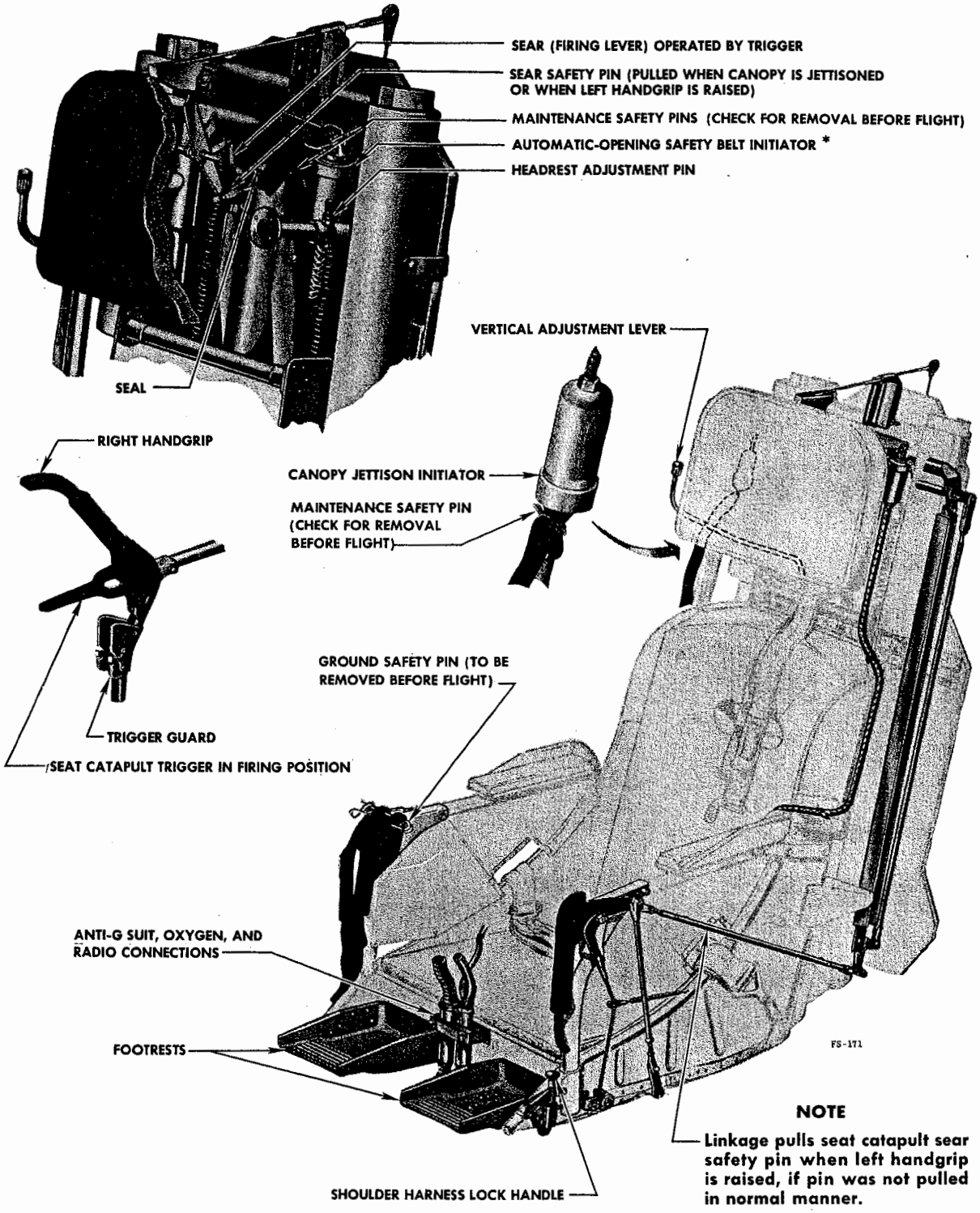
Figure 1-24

ejection seat

AIRPLANES NOT CHANGED BY T.O. 1F-86-227



* Some airplanes. (Refer to applicable text.)

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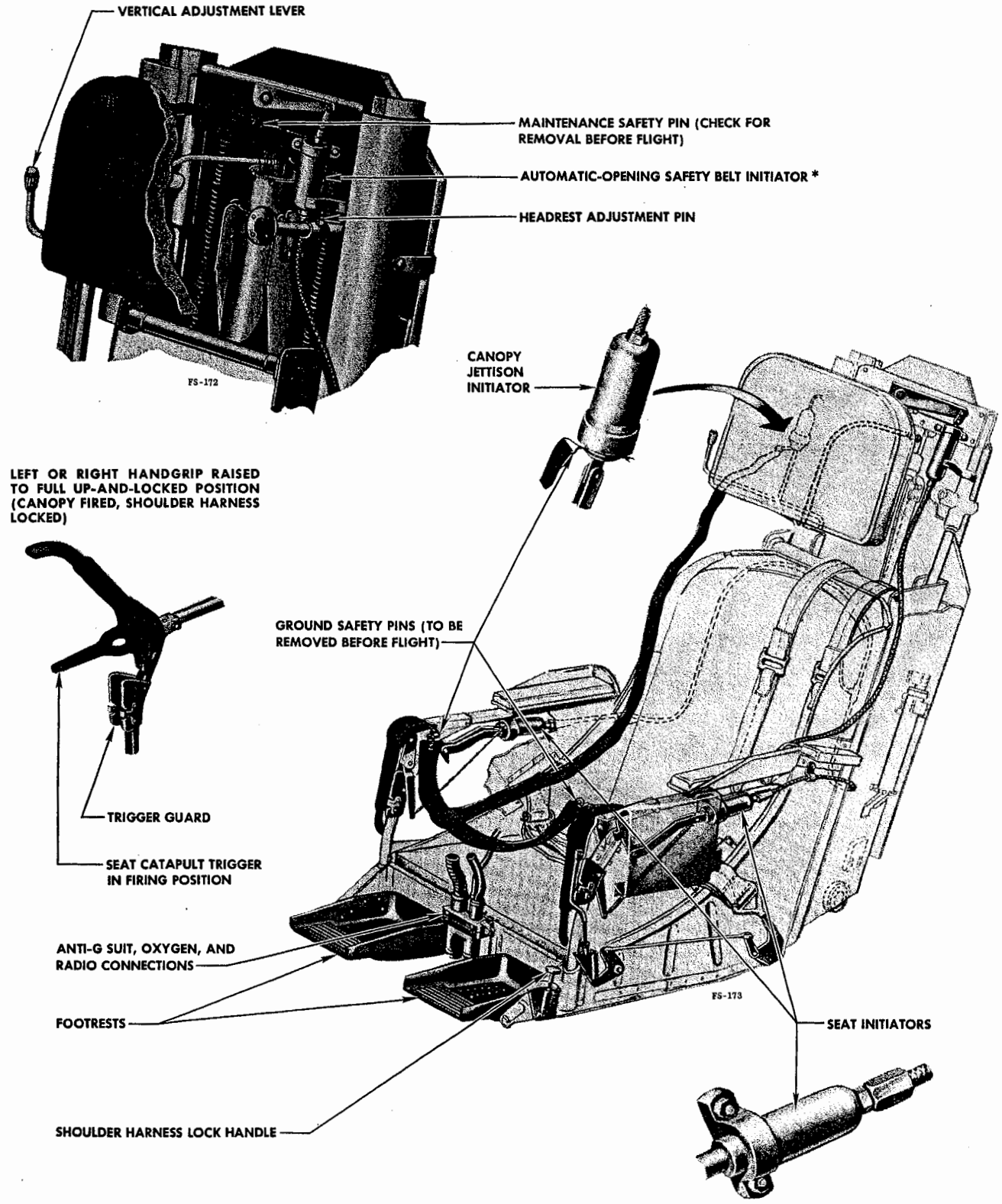
Figure 1-25

ejection seat

AIRPLANES CHANGED BY T.O. 1F-86-227



* Some airplanes. (Refer to applicable text.)

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Figure 1-26

emergency ejection still can be accomplished (even through the canopy if it has not jettisoned). To prevent inadvertent use of the left handgrip and to maintain the correct sequence during the ejection procedure on these airplanes, the left handgrip cannot be raised until the right handgrip has been pulled up and locked in the canopy firing position. On airplanes changed by T.O. 1F-86-227, raising the left handgrip to the full-up-and-locked position fires the canopy from the airplane. Raising the grip also lifts the seat catapult trigger from its guard. The trigger cannot be squeezed until the grip is full up and locked.

WARNING

On airplanes changed by T.O. 1F-86-227, the left handgrip should not be raised solely to lock the shoulder harness, because this action will jettison the canopy. The shoulder harness on these airplanes will lock automatically when either handgrip is raised.

Seat Catapult Trigger.

The seat catapult trigger, beneath the right handgrip (airplanes not changed by T.O. 1F-86-227) or both handgrips (airplanes changed by T.O. 1F-86-227) is protected by a guard and a clip. As the handgrip is raised, the clip is opened and the trigger is raised out of its guard into the firing position. The handgrip locks into the full-up position, and the trigger is within reach of the fingers. Squeezing (rotating) the trigger against the full-up-and-locked handgrip fires the seat catapult. On airplanes changed by T.O. 1F-86-227, the seat catapult is fired through either of two initiator systems. One initiator is connected to each trigger, and each initiator operates independently of the other. Squeezing either trigger fires a cartridge in its respective initiator. The gases thus produced move a piston-type firing pin in the seat catapult causing the catapult to fire.

WARNING

On airplanes not changed by T.O. 1F-86-227, before the trigger is squeezed to fire the seat, the seat handgrip must be raised to the full-up-and-locked position to fire the canopy and to pull the seat catapult safety pin. If handgrip and trigger are raised and squeezed simultaneously on these airplanes, the firing mechanism may not function properly. On airplanes changed by T.O. 1F-86-227, the handgrip must be in the full-up-and-locked position before the trigger can be squeezed.

Note

On airplanes not changed by T.O. 1F-86-161, a safety pin in the seat catapult firing mechanism (released when the canopy is jettisoned) prevents the trigger from firing the seat until after the canopy has been jettisoned. On airplanes changed by T.O. 1F-86-161, if the canopy fails to jettison and to release the seat catapult sear safety pin or jettisons and fails to release the pin, the pin can be withdrawn by raising the left handgrip, and the seat can then be ejected (even through the canopy if it has not jettisoned) when the trigger is squeezed.

Seat Vertical Adjustment Lever.

Mechanical seat adjustment is provided by a handle on the right side of the pilot's headrest. Pulling the handle down releases the seat for adjustment; when the pilot lifts his weight from the seat, the seat can be raised. After adjustment, the seat should be checked to make sure that it is locked.

Headrest Adjustment Pins.

The seat headrest may be adjusted fore and aft on the ground. Pulling up the spring-loaded pin in each of the two tubes aft of the headrest releases the headrest for adjustment.

Shoulder Harness Lock Handle.

The shoulder harness inertia reel lock handle, on the left side of the seat, outboard of the left footrest, is operated for manually locking and unlocking the shoulder harness. The shoulder harness inertia reel is actuated mechanically when the top of the handle is moved fore and aft. Forward is the locked position; aft, the unlocked position. It is recommended that the shoulder harness be locked manually during maneuvers and flight in rough air, or as a safety precaution in event of a forced landing. On airplanes not changed by T.O. 1F-86-227, the shoulder harness is locked automatically when the left handgrip on the seat is raised during seat ejection. On airplanes changed by T.O. 1F-86-227, the shoulder harness is locked automatically when either handgrip is raised.

Note

Because of the design characteristics of the shoulder harness inertia reel, there is no

preflight check to be made. The shoulder harness inertia reel will automatically lock under a 2 to 3 G forward deceleration, as in a crash landing. Pulling on the shoulder harness straps by hand will not check the inertia reel.

If the harness is manually locked while the pilot is leaning forward, the harness will retract with him as he straightens up, moving into successive locked positions as he moves back against the seat. To unlock the harness, the pilot must be able to lean back enough to relieve the tension on the lock. Therefore, if the harness is locked while the pilot is leaning back hard against the seat, he may not be able to unlock the harness without first releasing it momentarily at the safety belt or releasing the harness buckles. After automatic locking of the harness, it will remain locked until the lock handle is moved to the locked position and then back to the unlocked position.

SAFETY BELT.

The airplane is equipped with an MA-1, MA-3 or MA-4, or MA-5 or MA-6 automatic-opening type safety belt.

Automatic-opening Safety Belt.

The primary purpose of the automatic belt is to raise the maximum and lower the minimum altitudes at which escape may be successfully accomplished with the ejection seat. In high-altitude ejections (above 15,000 ft), use of the automatic belt *in conjunction with the automatic-opening parachute* avoids parachute deployment at an altitude where sufficient oxygen would not be available to permit safe parachute descent. In a low-altitude ejection, use of the automatic belt greatly reduces the time required for separation from the seat. If an automatic parachute is used in conjunction with the automatic belt, the time for full parachute deployment also is reduced. Consequently, use of the automatic belt and automatic parachute would lower the altitude required for safe ejection. Until you have become thoroughly familiar with the automatic belt and have been convinced that the automatic belt has been designed to save your life, you may have a tendency to distrust the automatic feature and feel that you can only be sure of its operation by manually operating it. However, the automatic belt has been thoroughly tested and is completely reliable. *Under no circumstances should the automatic belt be manually opened prior to ejection, regardless of altitude.* No matter how fast your reactions are, you cannot beat the automatic operation. Prior to the use of automatic belts, instructions were issued that when ejection was necessary below 2000 feet above the terrain the conventional safety belt should be opened manually prior to ejection. However, manual release of automatic belts is not only undesirable, but dangerous. The escape operation using the automatic feature is not only faster, since the belt automatically opens 2 seconds after ejection, but it also protects the pilot from severe injury at high speeds. (If the airplane is equipped with an M-12 automatic belt initiator, the belt opens 1 second after ejection.) Since the drag-to-weight ratio of the seat is considerably greater than that of the pilot, immediate separation would result if the belt were opened manually prior to ejection. This could result in accidental opening of the parachute due to the pack being blown open, and the high opening shock of the parachute could cause serious or fatal injuries. So remember, *the automatic operation can't be beaten.*

MA-1, MA-3 and MA-4 Automatic Safety Belts. The Type MA-1, MA-3 or MA-4 automatic safety belt is a cartridge-operated device designed for use with the same webbing and fittings as used with the standard B-18 (manual) safety belt, but differs in the center section or release portion of the belt. Release of the MA-1, MA-3 or MA-4 belt is accomplished either by manual operation by the pilot or by gas pressure from a separate automatically controlled source, the M-4 (or M-12) initiator on the back of the seat. The initiator supplies approximately 1500 psi pressure through a high-pressure hose which actuates a piston inside the belt, retracting the latch tongue and releasing the link. The release incorporates a key which is attached to a lanyard leading to the automatic rip cord release. The key provides an anchor for the static line to the timer of the automatic parachute. The release is so designed that the belt cannot be locked until the key is first inserted into the belt locking mechanism. This is a feature of the design so that the pilot will not neglect to tie in the automatic parachute into the system. Use of the key is necessary for proper operation of the automatic belt. If the automatic parachute is used, the key attached to the parachute lanyard is inserted into the belt locking mechanism. If the automatic parachute is not used, a spare key which is attached to the automatic belt must be inserted into the belt locking mechanism. (This spare key must not be removed from the belt.) When the belt is manually opened, the key is ejected automatically so that inadvertent actuation of the automatic parachute will not occur. During automatic operation of the safety belt, the key remains firmly locked in the belt release, thereby arming the automatic parachute timer as the pilot separates from the seat. Manual operation of the automatic belt can override the automatic function at any time. For example, it is possible to manually open the belt even though initiator action has started. The parachute automatic feature may likewise be overriden

MA-1 automatic-opening safety belt

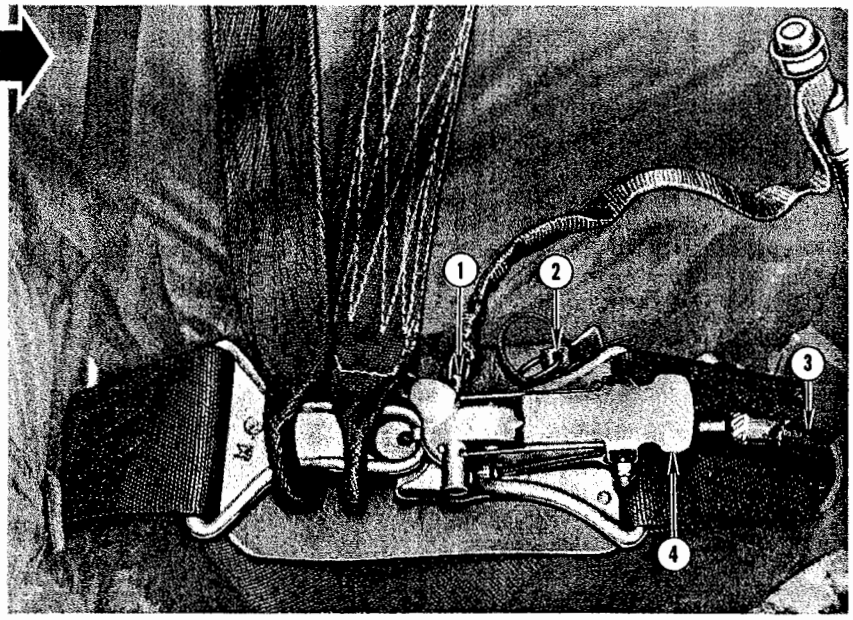
LOCKED

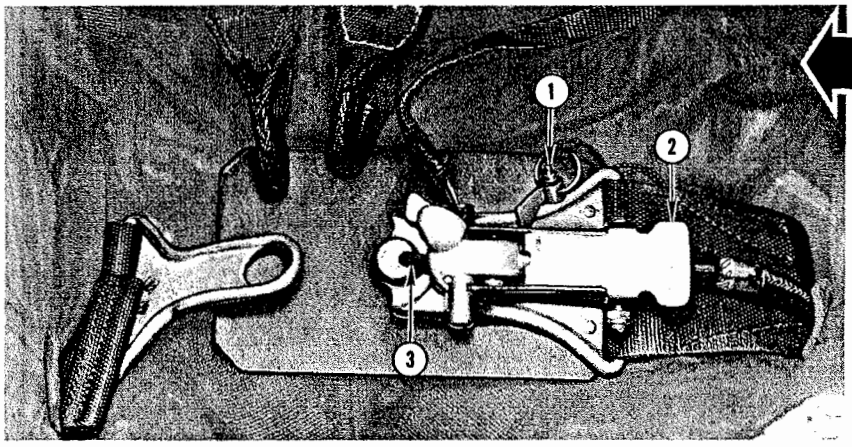
1. Belt locking key (attached to automatic parachute arming lanyard) inserted in belt locking mechanism.

WARNING

- This key must be used when an automatic parachute is worn, in order for the parachute to function automatically if ejection is necessary.
- Lanyard must be outside parachute harness and not fouled on any equipment, to permit clean separation from seat.

2. Belt locking key (attached to belt). Used to close belt only when automatic parachute is *not* worn.
3. Initiator hose.
4. Manual release lever closed (shown with NAA type handle extension).





AUTOMATICALLY OPENED

1. Belt locking key (from automatic parachute arming lanyard) retained in belt locking mechanism.
2. Manual release lever closed.
3. Belt latch opened by gas pressure from initiator.

MANUALLY OPENED

1. Belt locking key ejected from locking mechanism when manual release lever is opened.

WARNING

If automatic parachute is worn and belt is manually opened during ejection, parachute will *not* open automatically upon separation from seat.

2. Manual release lever opened.
3. Belt latch opened by manual release lever.

NOTE

Manual release lever can be used to unlock belt at any time, even if automatic-opening sequence already has been initiated.

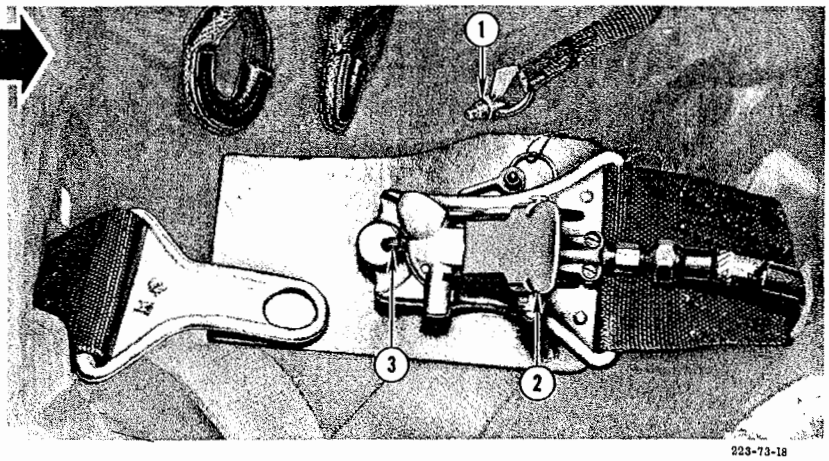


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Figure 1-27

MA-3 and -4 automatic-opening safety belt

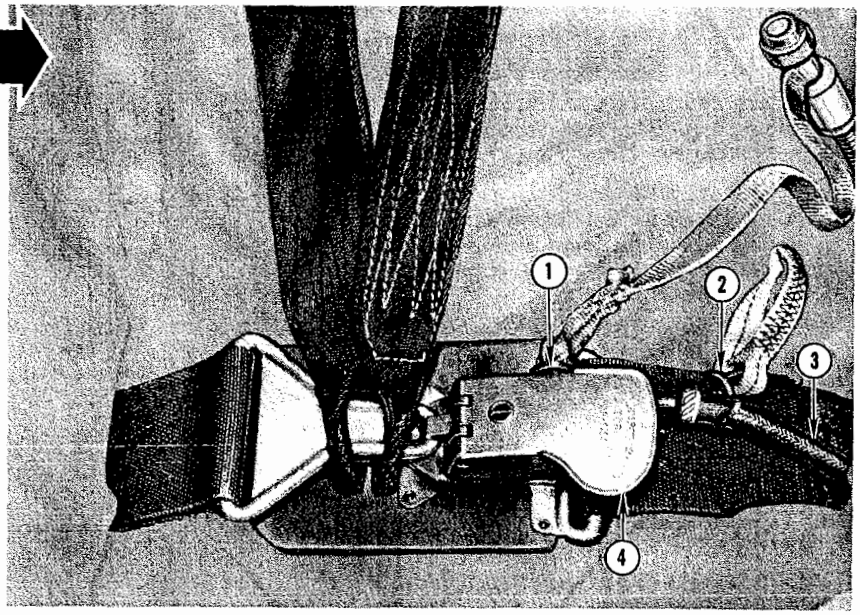
LOCKED

1. Belt locking key (attached to automatic parachute arming lanyard) inserted in belt locking mechanism.

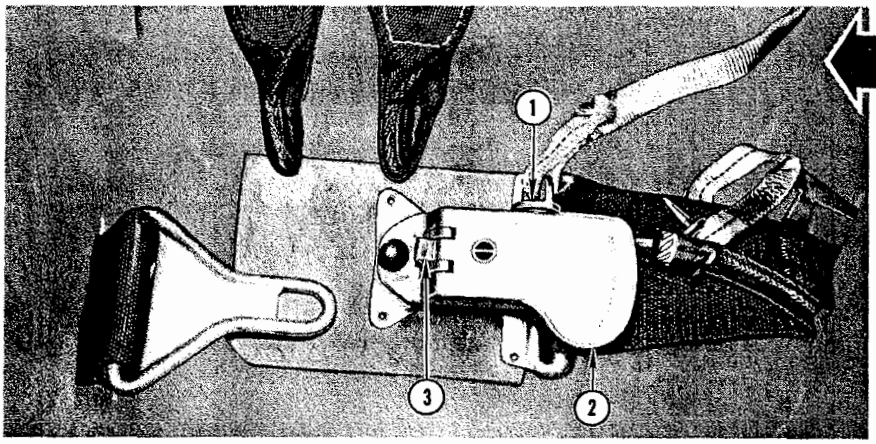
WARNING

- This key must be used when an automatic parachute is worn, in order for the parachute to function automatically if ejection is necessary.
- Lanyard must be outside parachute harness and not fouled on any equipment, to permit clean separation from seat.

2. Belt locking key (attached to belt). Used to close belt only when automatic parachute is *not* worn.
3. Initiator hose.
4. Manual release lever closed.



AUTOMATICALLY OPENED



1. Belt locking key (from automatic parachute arming lanyard) retained in belt locking mechanism.
2. Manual release lever closed.
3. Belt latch opened by gas pressure from initiator.

MANUALLY OPENED

1. Belt locking key ejected from locking mechanism when manual release lever is opened.

WARNING

If automatic parachute is worn and belt is manually opened during ejection, parachute will *not* open automatically upon separation from seat.

2. Manual release lever opened.
3. Belt latch opened by manual release lever.

NOTE

Manual release lever can be used to unlock belt at any time, even if automatic-opening sequence already has been initiated.

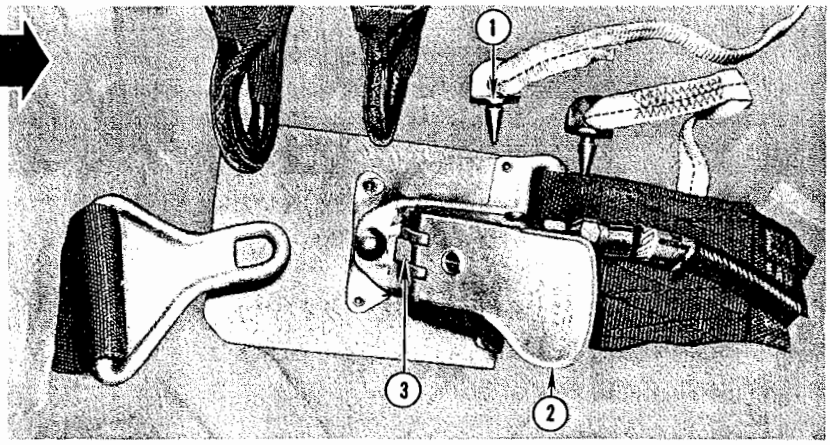


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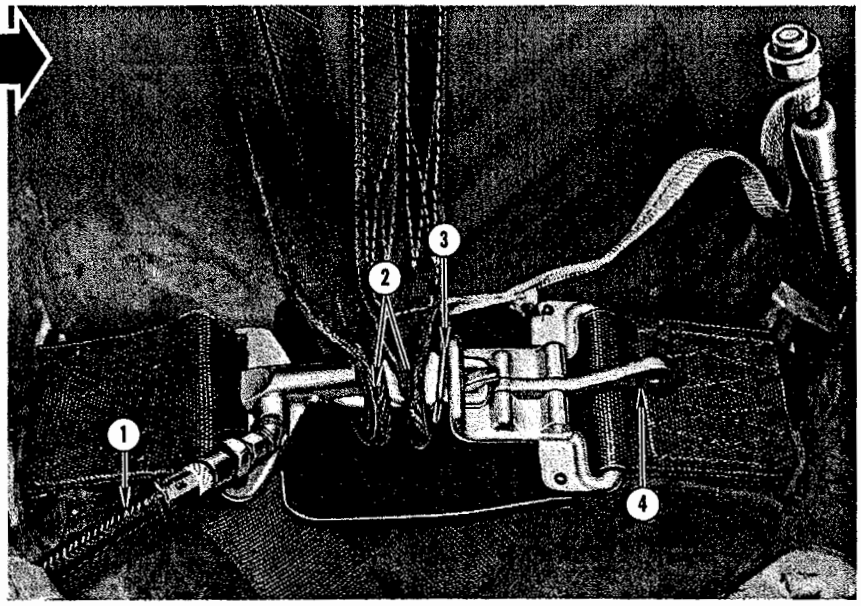
Figure 1-28

MA-5 and -6 automatic-opening safety belt

LOCKED



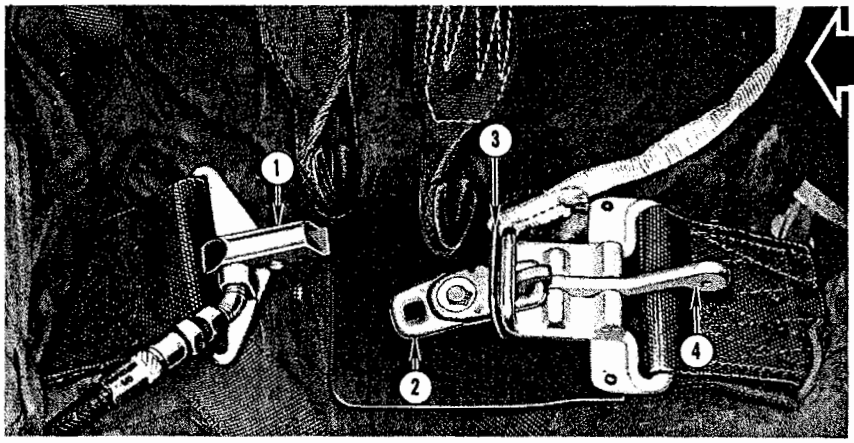
1. Initiator hose to automatic release mechanism.
2. Shoulder harness loops over swivel link.
3. Anchor (from automatic parachute arming lanyard) slipped over swivel link.

WARNING

- Although not necessary to close belt, anchor must be installed, when automatic parachute is worn, so that parachute will function automatically if ejection is necessary.
- Lanyard must be outside parachute harness and not fouled on any equipment, to permit clean separation from seat.

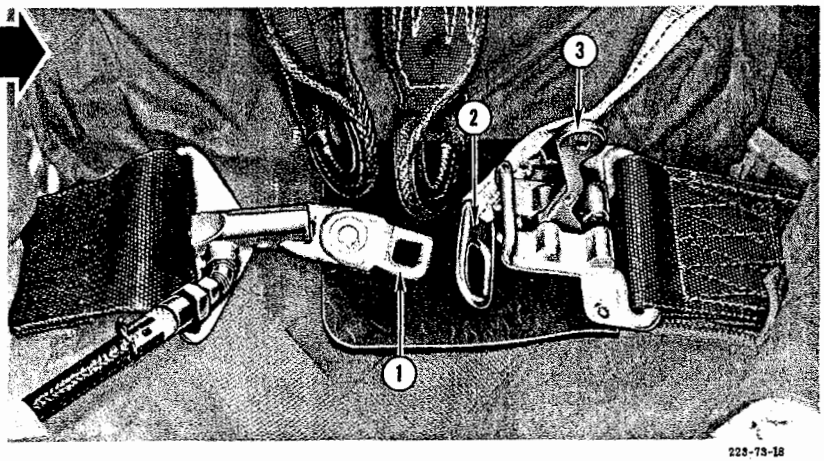
4. Manual release lever closed.

AUTOMATICALLY OPENED



1. Automatic release mechanism actuated by gas pressure from initiator, detaching swivel link on automatic release side.
2. Swivel link retained by manual release lever.
3. Anchor (from automatic parachute arming lanyard) retained by swivel link.
4. Manual release lever closed.

MANUALLY OPENED



223-73-18

1. Swivel link released by manual release lever (automatic release mechanism not actuated).
2. Anchor (from automatic parachute arming lanyard) freed from swivel link.

WARNING

If automatic parachute is worn and belt is manually opened during ejection, parachute will not open automatically upon separation from seat.

3. Manual release lever opened.

NOTE

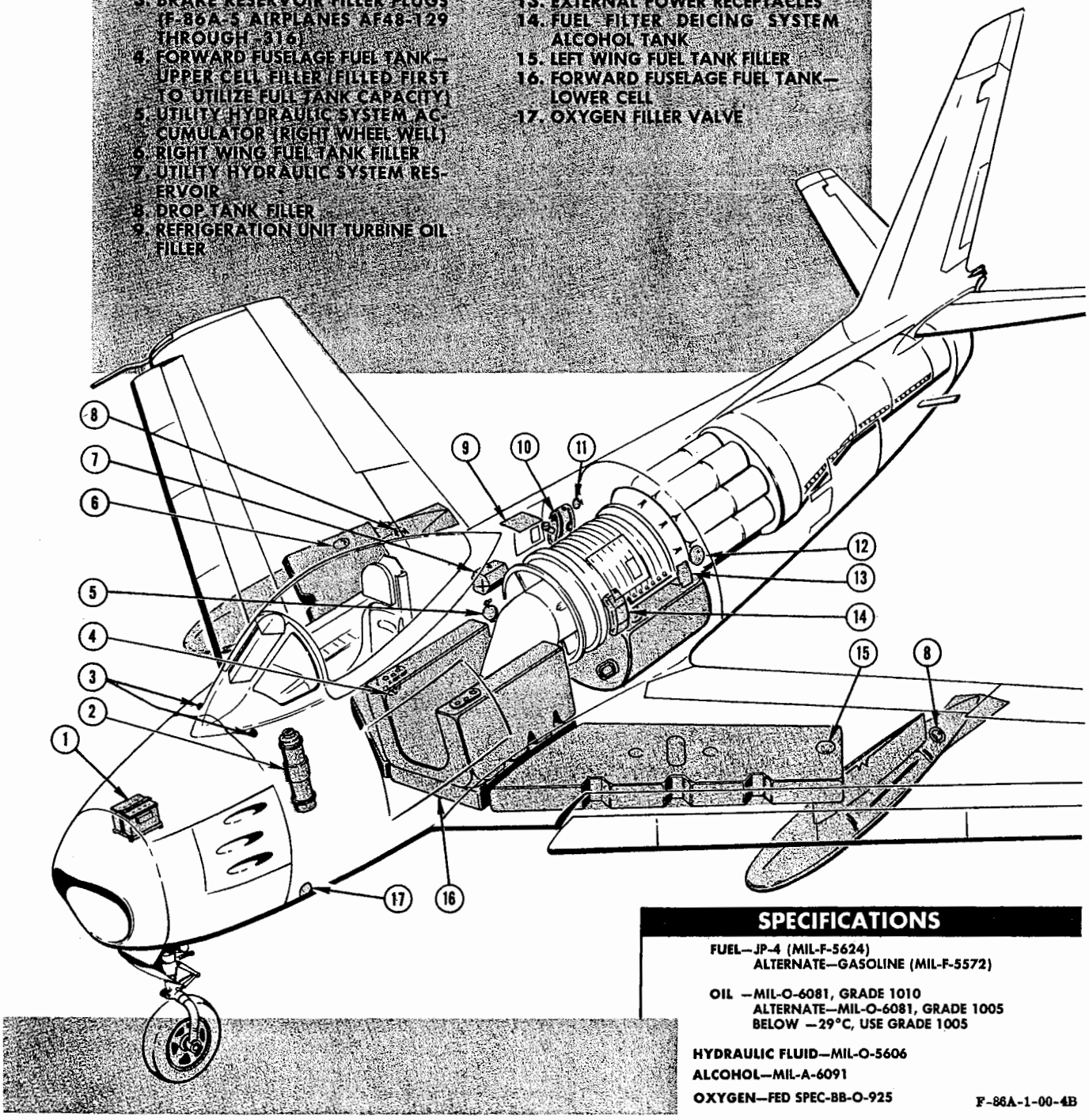
Manual release lever can be used to unlock belt at any time, even if automatic-opening sequence has been initiated.

F-86A-1-73-18

Figure 1-29

servicing diagram

1. BATTERY
2. NOSE GEAR EMERGENCY EXTENSION SYSTEM ACCUMULATOR (RIGHT SIDE)
3. BRAKE RESERVOIR FILLER PLUGS (F-86A-5 AIRPLANES AF48-129 THROUGH -316)
4. FORWARD FUSELAGE FUEL TANK—UPPER CELL FILLER (FILLED FIRST TO UTILIZE FULL TANK CAPACITY)
5. UTILITY HYDRAULIC SYSTEM ACCUMULATOR (RIGHT WHEEL WELL)
6. RIGHT WING FUEL TANK FILLER
7. UTILITY HYDRAULIC SYSTEM RESERVOIR
8. DROP TANK FILLER
9. REFRIGERATION UNIT TURBINE OIL FILLER
10. ENGINE OIL TANK
11. HYDRAULIC EXTERNAL POWER CONNECTIONS
12. AFT FUSELAGE FUEL TANK FILLER
13. EXTERNAL POWER RECEPTACLES
14. FUEL FILTER DEICING SYSTEM ALCOHOL TANK
15. LEFT WING FUEL TANK FILLER
16. FORWARD FUSELAGE FUEL TANK—LOWER CELL
17. OXYGEN FILLER VALVE



SPECIFICATIONS

FUEL—JP-4 (MIL-F-5624)
ALTERNATE—GASOLINE (MIL-F-5572)

OIL —MIL-O-6081, GRADE 1010
ALTERNATE—MIL-O-6081, GRADE 1005
BELOW —29°C, USE GRADE 1005

HYDRAULIC FLUID—MIL-O-5606

ALCOHOL—MIL-A-6091

OXYGEN—FED SPEC-BB-O-925

F-86A-1-00-4B

Figure 1-30

by manually pulling the "D" ring even though the automatic parachute rip cord release has been actuated.

WARNING

If the safety belt is opened manually, the parachute must be opened manually (for automatic-opening parachutes, the aneroid-timer arming lanyard should be pulled to open parachute if above 14,000 feet).

Figure 1-27 shows the MA-1 automatic belt closed with shoulder harness attached, automatically opened, and manually opened. Figure 1-28 shows the MA-3 and -4 automatic belt for the same conditions.

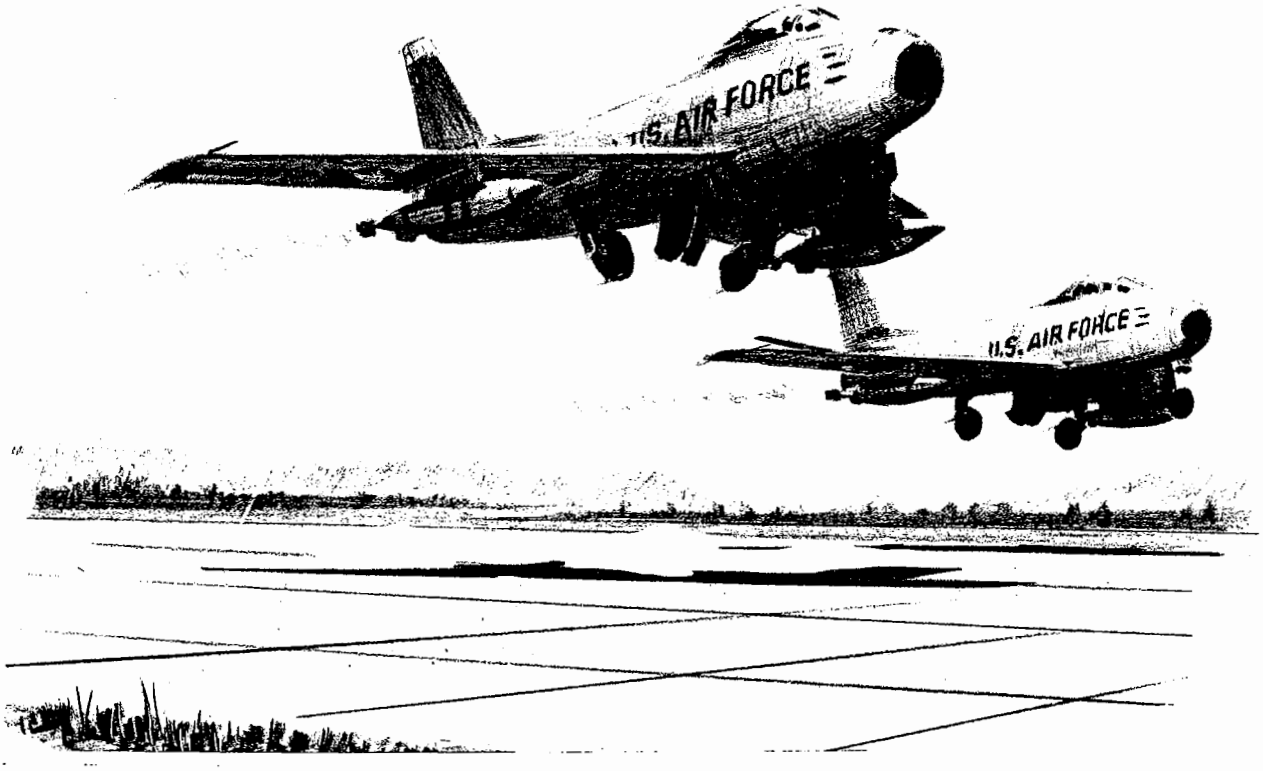
MA-5 and MA-6 Automatic Safety Belts. The MA-5 and MA-6 automatic safety belts are similar in design and function to the MA-1, MA-3, and MA-4 belts. However, the MA-5 and MA-6 belts have a swivel link. When the belt is fully locked, the swivel is attached on one end to the manual release lever and on the other end to the automatic release. The swivel link is detached from the automatic release by actuation of the automatic release initiator. In addition, the MA-5 and MA-6 belts are designed to retain a ring-type anchor for actuating the automatic parachute, in place of a key. It is not mechanically necessary that the anchor, which slips over the manual release end of the swivel link, be used to close the belt. However, when the MA-5 or MA-6 belt is used in conjunction with an automatic parachute, the ring-type anchor *must* be attached to the parachute arming lanyard and then slipped over the swivel link in order for the parachute to function automatically when ejection is necessary. Figure 1-29 shows the MA-5 and MA-6 belts closed with shoulder harness and automatic parachute anchor attached, automatically opened, and manually opened. Manual operation of the automatic belt can override the automatic function at any time. For example, it is possible to manually open the belt even though initiator action has started. The parachute automatic feature may likewise be overridden by manually pulling the "D" ring even though the automatic parachute rip cord release has been actuated.

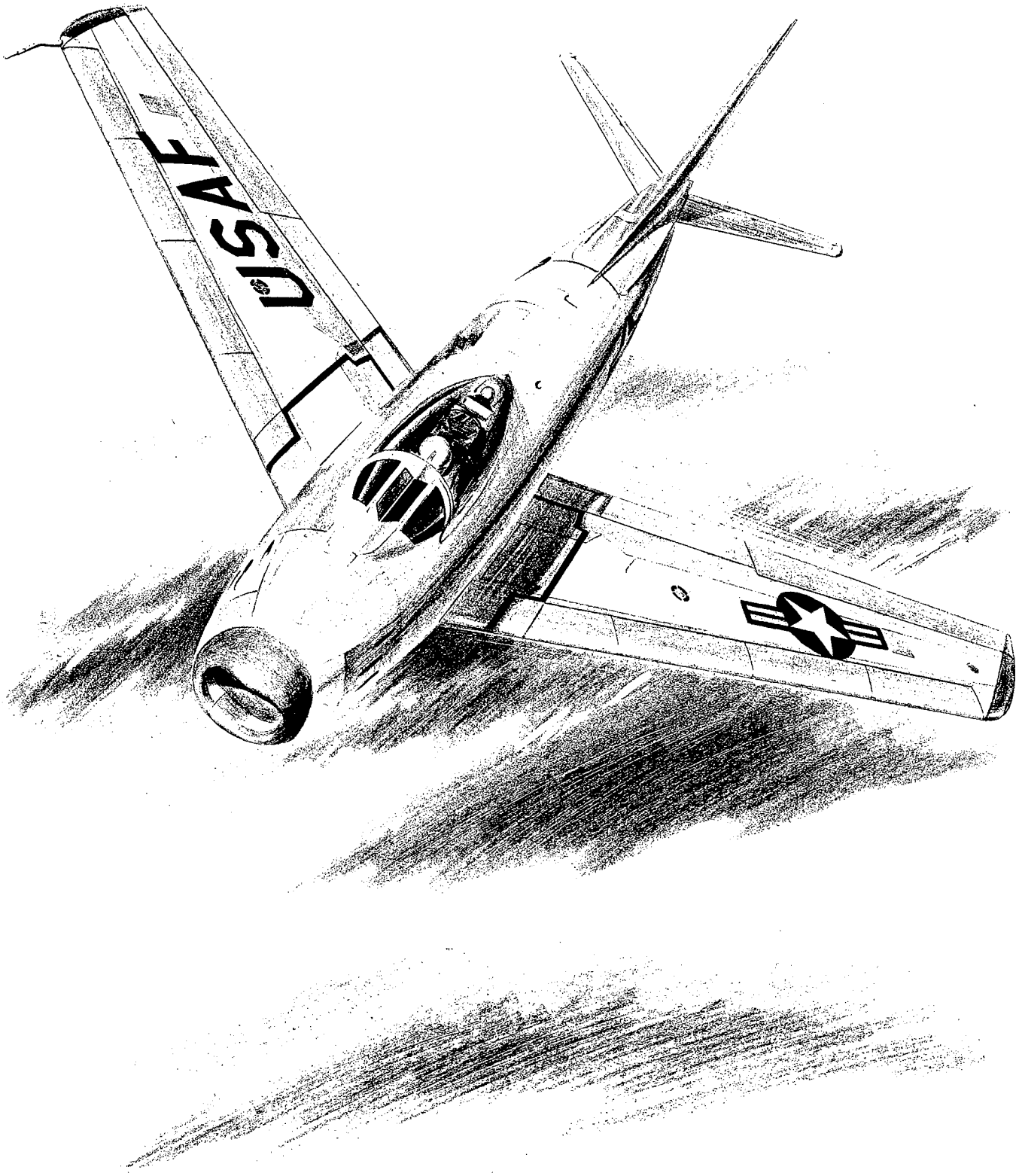
WARNING

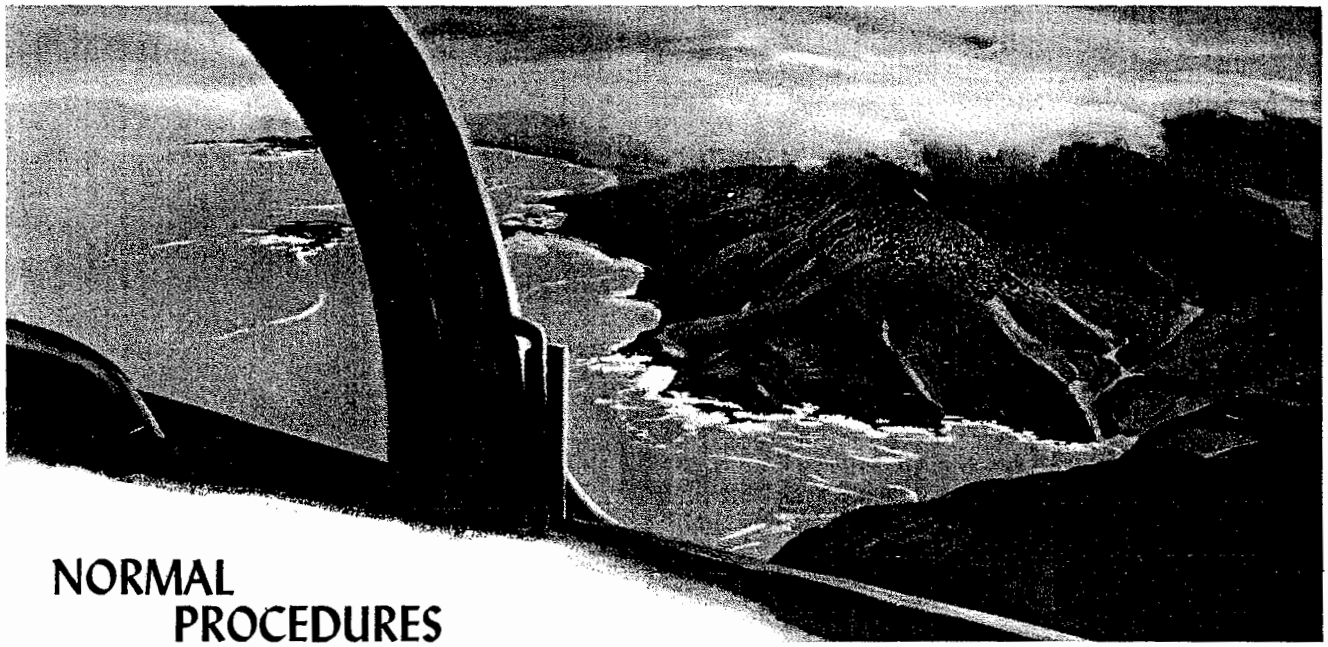
If the safety belt is opened manually, the parachute *must* be opened manually (for automatic-opening parachutes, the aneroid-timer arming lanyard should be pulled to open parachute if above 14,000 feet).

AUXILIARY EQUIPMENT.

Information concerning the following auxiliary equipment is supplied in Section IV: cockpit air conditioning and pressurization systems, anti-icing and defrosting systems, communication and associated electronic equipment, lighting equipment, oxygen system, armament equipment, and miscellaneous equipment.




USAF



SECTION II

NORMAL PROCEDURES

F-86A-1-00-10

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STATUS OF THE AIRPLANE.

FLIGHT RESTRICTIONS.

Refer to Section V for detailed airplane and engine operating limitations.

FLIGHT PLANNING.

Refer to Appendix I for performance data necessary in systematically planning the proposed flight.

WEIGHT AND BALANCE.

Refer to Section V for weight and balance limitations. Refer to Handbook of Weight and Balance Data, T.O. 1-1B-40, for loading information. Before each mission, check take-off and anticipated landing gross weight and balance and check that weight and balance clearance DD Form 365F is satisfactory. If guns or ammunition are not installed, check for proper ballast installation.

CAUTION

The airplane should be loaded with full ammunition or equivalent ballast for take-off, to produce more stable take-off, flight, and landing characteristics.

Check that fuel, oil, armament, oxygen, and special equipment carried are sufficient for mission to be accomplished.

ENTRANCE.

The cockpit can be entered from either side of the airplane. The ammunition compartment access door on

either side of the fuselage hinges down to serve as a step. A kick step and a hinged extendible handle are provided on the side of the fuselage above the ammunition compartment access door. (See figure 2-1.)

Note

The ammunition compartment access door cannot be closed from the cockpit; it must be closed by the ground crew.

PREFLIGHT CHECK.

BEFORE EXTERIOR INSPECTION.

1. DD Form 781—Check.
   Check DD Form 781 for engineering status and make sure airplane has been properly serviced. See figure 1-30 for complete servicing data.

EXTERIOR INSPECTION.

The exterior inspection should be accomplished as shown in figure 2-2.

CAUTION

DO NOT USE HANDLE ON FUSELAGE SIDE FOR A STEP, AND DO NOT STEP ON CANOPY SEAL OR TRACK.

F-86A-1-0-14

CANOPY AND EJECTION SEAT CHECK.

Before entering the cockpit, open canopy fully and check canopy remover and ejection seat as follows:

1. Handgrips and triggers—Check.
   Visually check connections from seat handgrips and triggers to canopy remover, seat catapult, and initiators, as applicable to the modification of seat and canopy ejection systems on the airplane.
2. Safety pins—Check.

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Figure 2-1

Check that seat catapult sear safety pin on airplanes not changed by T.O. 1F-86-227 is connected and that safety pins are in both seat grips or right handgrip, as applicable to the seat modification on the airplane. (See figures 1-24, 1-25, and 1-26.)

Note

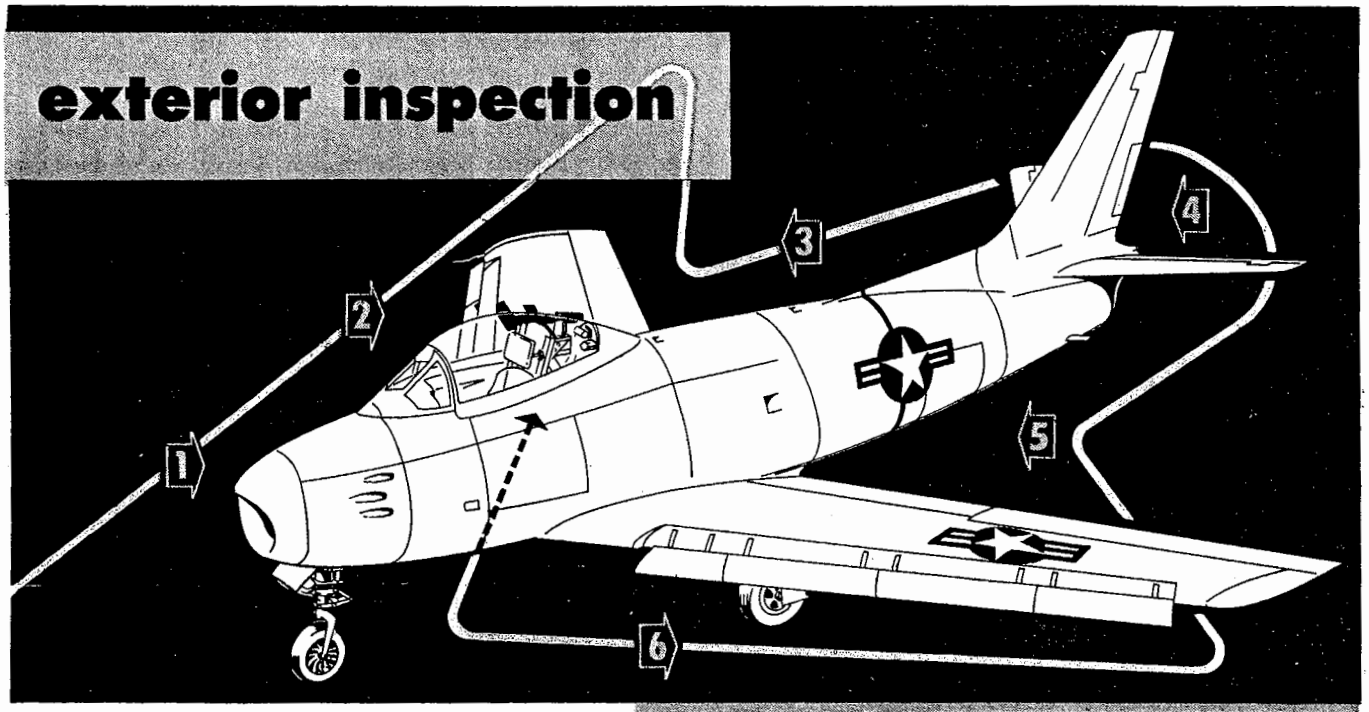
On airplanes changed by T.O. 1F-86-227, remove safety pin from left seat handgrip only.

Check that all other safety pins *which have red streamers attached* (maintenance safety pins) have been removed, except for the canopy initiator safety pin on airplanes changed by T.O. 1F-86-227.

WARNING

If any safety belt or ejection system maintenance safety pin is installed, do not remove it until you have checked the status of the ejection system with maintenance personnel.

exterior inspection



- When making exterior inspection, check all surfaces for cracks, distortion, loose rivets, and indications of damage; check for signs of hydraulic fluid, fuel, and oil leaks; check tires for general condition, slippage, and proper inflation; check that all access doors, panels, and filler caps are secured; and check position of gear doors, gear strut extension, and condition of wheels.
- Accumulator gage pressures (given on placard next to gage) are for 70°F; pressure will be higher on hotter days.

Starting at nose of airplane, make the following checks:

1 NOSE

- Nose wheel chock—Removed.
- Nose gear ground safety lock—Removed.
- Tow pin safety cap—Tight.
- Nose gear emergency extension accumulator gage (in nose wheel well) pressure—Within limits.*
- Intake duct—Clear (except nose screen installed).
- Gun port plugs—Installed.
- Landing and taxi lights—Retracted.

2 FORWARD FUSELAGE AND RIGHT WING LEADING EDGE

- Emergency nose gear extension control valve—Reset (pushed full back).*
- Gun charger system air pressure—1700 psi.*
- Slats—Check for freedom of movement.
- Main gear wheel—Chocked.
- External load—Check for proper installation and security of mounting.
- Position light and wing tip—Check general condition and security of mounting.
- Pitot head—Uncovered.

RIGHT WING TRAILING EDGE AND AFT FUSELAGE 3

- Aileron and flap—Check general condition.
- Speed brake—Check general condition.
- Utility hydraulic system accumulator gage (in right wheel well) pressure—Within limits.*

EMPENNAGE 4

- Elevator and tail surfaces—Check general condition.
- Tail pipe cover—Removed.
- Tail cone and position lights—Check general condition and security of mounting.
- Aspirator fuel drain—Check for freedom of movement.

AFT FUSELAGE AND LEFT WING TRAILING EDGE 5

- Speed brake—Check general condition.
- IFF destructors—Installed.*
- Aileron and flap—Check general condition.

LEFT WING LEADING EDGE AND FORWARD FUSELAGE 6

- Position light and wing tip—Check general condition and security of mounting.
- External load—Check for proper installation and security of mounting.
- Main gear wheel—Chocked.
- Slats—Check for freedom of movement.

* You may rely on your crew chief to check these items if you desire. However, if preflight inspection or servicing was performed at a base where ground personnel are not completely familiar with your airplane, you should check these items yourself.

F-86A-1-00-5B

Figure 2-2

3. Seat quick-disconnects—Check.
   Check that seat quick-disconnects for oxygen, radio, and anti-G suit are properly mated. Check bail-out bottle connection.
4. Lead seals—Check.
   Check that neither lead seal on seat catapult (airplanes not changed by T.O. 1F-86-227) nor lead seal on canopy remover is broken.

INTERIOR CHECK.

Note

A pilot's check list is on a sliding board under the right side of the instrument panel.

1. Control stick grip—Check.
   Check control stick grip for firmness of attachment.
2. Safety belt and shoulder harness—Check.

WARNING

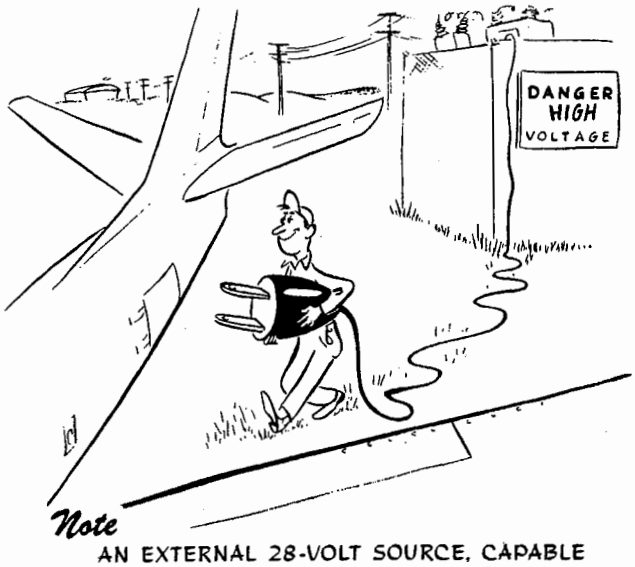
If the airplane has an automatic-opening safety belt, the belt must be properly fastened to ensure safe operation if ejection is necessary. (See figures 1-27, 1-28, and 1-29 for proper methods to secure the type of automatic belt and automatic parachute you may be wearing.)

3. Seat—Adjust.
4. Flight control lock—UNLOCK (in).
5. Armament switches—OFF.

CAUTION

Armament switches must be off before starting and during ground operation, because low voltages will cause damage to the sight electronic inverter with the switches on.

6. Throttle—OFF (adjust friction).
7. Landing gear handle—DOWN.
8. Speed brake switch—HOLD (neutral).
9. Engine master, emergency ignition, and battery-starter switches—OFF.
10. External power—Connected.



Note

AN EXTERNAL 28-VOLT SOURCE, CAPABLE OF SUPPLYING A MINIMUM OF 500 AMPERES CONTINUOUS POWER AND 1200 AMPERES SURGE POWER, MUST BE CONNECTED TO BOTH EXTERNAL RECEPTACLES FOR STARTING. EXTERNAL POWER UNITS SUITABLE FOR USE ON THIS AIRPLANE (PROPERLY MAINTAINED TO PRODUCE THEIR RATE OUTPUT) ARE THE A3, A4, C-22, C-26, NASA, AND V-1.

F-86A-1-0-4A

11. Landing gear position indicators—Check.
12. Oxygen regulator—Check.
    Refer to "Oxygen System Preflight Check (A-14 Regulator)" or "Oxygen System Preflight Check (D-2 Regulator)" in Section IV.

WARNING

If the airplane is to be operated on the ground under possible conditions of carbon monoxide contamination, such as directly behind another operating jet airplane or during operation with tail into the wind, use oxygen with diluter lever at 100% OXYGEN.

13. Left circuit breakers—IN.
14. Anti-G suit regulator valve—Check.
    Anti-G suit regulator valve HI or LO, as desired.
15. Drop tank pressure shutoff valve—OFF.
16. Ammunition compartment heat emergency shutoff handle—IN.
17. Cockpit air temperature control switch—AUTOMATIC.
18. Cockpit air temperature control rheostat—As desired.
19. Cabin pressure control lever—As desired.
20. Air outlet selector lever—FLOOR.
21. Windshield deicing lever—OFF.

22. Rudder trim switch—OFF.
23. Aileron alternate trim switch—NORMAL.
24. Aileron boost switch—ON.
25. Speed brake emergency lever—NORMAL.
26. Wing flap lever—UP, then HOLD.
27. Horizontal stabilizer alternate trim switch—NORMAL STICK GRIP.
28. Emergency jettison handle—IN.
29. Pitot heater switch—ON, then OFF.
    Check, with crew chief, operation of pitot heater while switch is ON.
30. Landing light position and selector switches—OFF (center).
    Check with crew chief that lights are retracted.
31. Parking brake handle—IN.

Note

If handle is not full in, brakes will be inoperative.

32. Slat lock lever (some airplanes)—UNLOCK.
33. Emergency fuel switch—OFF.
34. Clock, accelerometer, and altimeter—Set.
    Note error against field elevation for consideration when resetting altimeter during flight.

Note

If error exceeds 75 feet, do not accept airplane for IFR operation.

35. Fuel quantity—Check; totalizer dial—Set.
36. Warning lights and indicators and test warning systems—Check.
37. Attitude indicator—Check.
    Check erection and retraction of warning "OFF" flag. For quick erection during scramble operation, cage and uncage gyro 30 seconds after power has been turned on.
38. Directional indicator—Check against stand-by compass.
    Check for stabilization of needle and for 180-degree ambiguity.
39. Vertical velocity indicator—Set.
40. Sight mechanical caging lever (A-1CM sight)—CAGE.
41. Canopy alternate emergency jettison handle (airplanes so equipped)—IN.
42. Generator switch—ON.
43. All interior and exterior lighting (night flights)—Check operation.
44. Interior, position, and fuselage light switches—As required.
45. Communication equipment switches—As desired.
46. Right circuit breakers—IN.
47. Map case—Flight Handbook, Radio Facilities Charts, Pilot's Handbook—Jet, and other necessary publications and charts available.
48. Instrument power switch—NORMAL, then ALT.
    Check operation of main and alternate inverters.
49. Emergency hydraulic selector (some airplanes)—OFF.
50. Landing gear emergency release handle—IN.
51. Canopy declutch handle—IN.
52. Flight controls—Check.
    Operate trim and flight controls through complete cycle, checking for proper response to control action.
53. Normal trim switch—Check.
    Operate normal trim switch on stick grip in all actuated positions, and note that switch automatically returns to OFF (center) position when released.

CAUTION

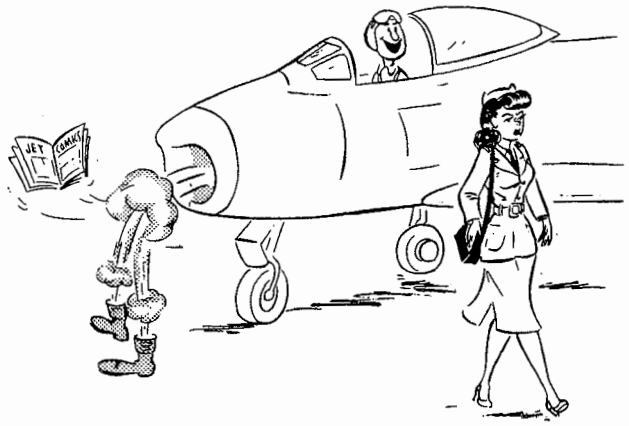
The normal trim switch is subject to sticking in any or all of the actuated positions, resulting in application of extreme trim. If the switch sticks in any actuated position during ground check, enter this fact with a red cross on DD Form 781, and do not fly the airplane.

54. Radio compass—Check.
    Check frequency alignment, antenna reception, manual loop rotation, and ADF operation. Tune in low-frequency range or homer that serves field of departure. Identify station, and turn function selector switch to COMP and check compass indicator for correct bearing reading. (Canopy must be closed.)
55. Flashlight—Check.
    Check that a properly operating flashlight is included in personal gear (night flights).

STARTING ENGINE.

CAUTION

Start engine with airplane headed into, or at right angles to, the wind whenever possible, as exhaust temperatures may be increased, or an engine fire during starting will be aggravated by a tail wind.



Warning

INTAKE DUCT SUCTION CAN DRAW PERSONNEL INTO OR AGAINST DUCT, CAUSING DEATH OR SERIOUS INJURY. HIGH EXHAUST TEMPERATURES AND BLAST CREATE DANGER AFT OF AIRPLANE.

F-86A-1-0-13

WARNING

- Before starting engine, make sure that main gear wheels are chocked and that danger areas fore and aft of airplane are clear of personnel, aircraft, and vehicles. (See figure 2-3.) Danger aft of the airplane is created by high exhaust temperatures and blast from the tail pipe.
- Whenever possible, start and run up engine on a concrete surface to minimize opportunities for dirt and foreign objects to be drawn into compressor and damage engine.
- When operating within jet blast of another F-86A Airplane, maintain a minimum of 80 feet distance, to prevent damage to canopy.

Start engine as follows:

1. Throttle—OFF.
2. Engine master switch—ON.
3. Battery-starter switch—STARTER (momentarily), then BATTERY.

Note

It is not necessary to position battery-starter switch at OFF during engine start, as battery is automatically cut out when starter is in operation.

CAUTION

- The starter is limited to three starts of one-minute duration during any 30-minute period; if more than three starts are required, allow starter to cool 30 minutes before using again.
- If generator voltmeter reading drops below 15 volts during start, immediately abort start by depressing stop-starter button; otherwise relays in starter-controller and generator circuits may be damaged. If voltmeter reading does drop below 15 volts during start, external power unit is inadequate. Therefore, have external power unit replaced by suitable unit before another start is attempted.
- If there is no audible indication of engine rotation or if tachometer fails to register within a few seconds, depress stop-starter button immediately. The high current required for starting will burn out the starter within a few seconds if the turbine does not turn as soon as the starter is engaged.

CAUTION

IF IGNITION DOESN'T OCCUR WITHIN 10 SECONDS OR WHEN ENGINE RPM REACHES 9%, CLOSE THROTTLE AND PUSH STOP-STARTER BUTTON. ALLOW FUEL TO DRAIN 3 MINUTES BEFORE ATTEMPTING RESTART.

F-86A-1-0-12

4. 3% rpm—Throttle outboard.
   At 3% rpm, move throttle outboard to engage fuel booster pumps and energize ignition system.
5. 6% rpm—Throttle halfway between IDLE and OFF.
   At 6% rpm, open throttle slowly to a position

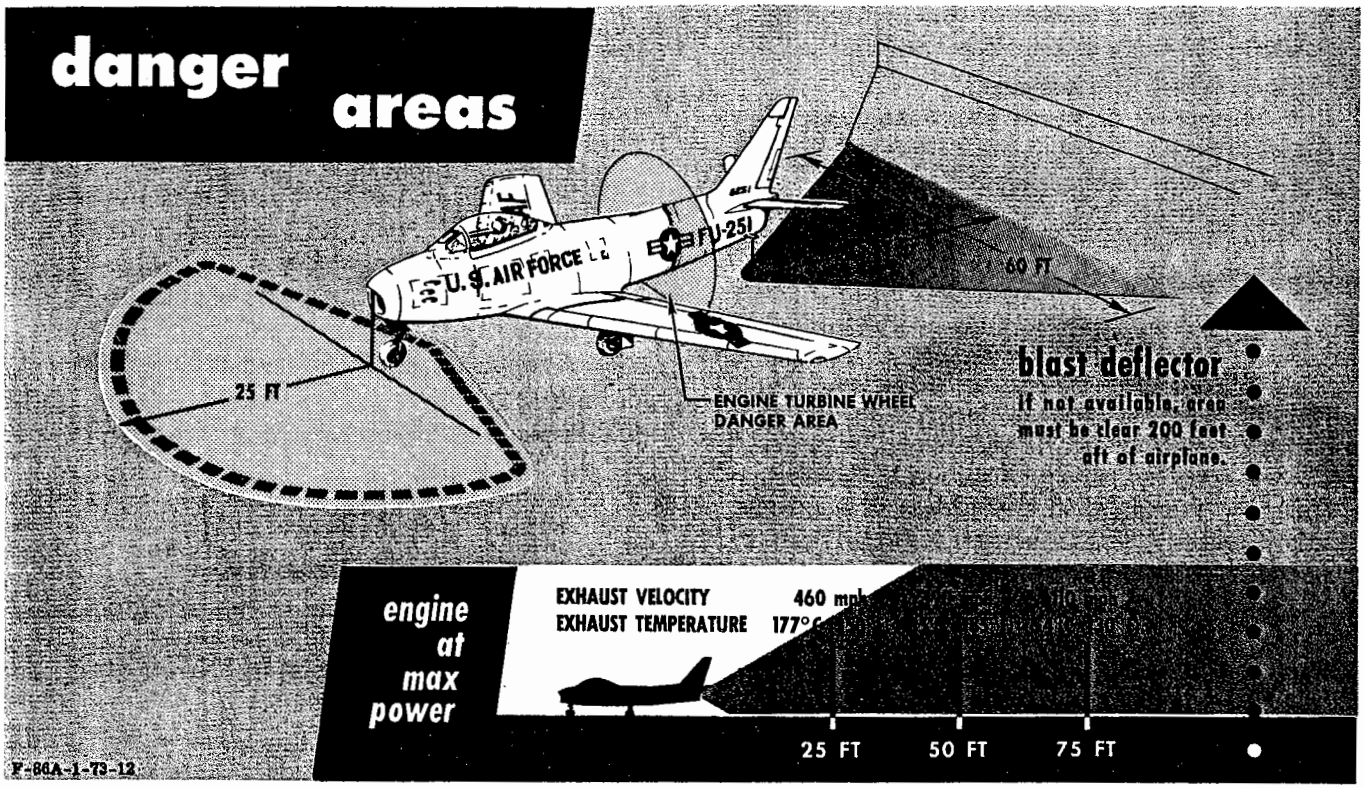


Figure 2-3

approximately halfway between IDLE and OFF positions. Check that fuel pressure does not exceed 30 to 35 psi, to minimize the possibility of hot starts. Watch exhaust temperature gage for sign of ignition.

6. Throttle—Adjust for proper exhaust temperature.
   After ignition, advance throttle to idle rpm without exceeding temperature of approximately 690°C.

WARNING

- If engine speed does not reach 23% rpm in one minute, shut down engine and investigate. Excessive operation below 23% rpm can cause extensive damage to starter and engine.
- If starter becomes de-energized before engine reaches approximately 20% rpm, shut down engine immediately. No attempt should be made to accelerate engine.

CAUTION

Do not use stop-starter button to disengage starter after normal starts, because this will cause rapid deterioration of starter control relay and may also cut out starter too soon, slowing rate of acceleration. The starter is designed to cut out automatically at approximately 23% rpm.

WARNING

- The engine must be shut down and inspected when any overtemperature condition occurs during ground operation. The following conditions constitute overtemperature operation.

  During engine start up to idle rpm (within 2 minutes):
  950°C or above for 2 seconds.

  All engine operation except starting:
  690°C to 750°C for 40 seconds
  750°C to 800°C for 10 seconds
  800°C or above for 2 seconds

- The temperature and duration of all overtemperature operation must be entered on DD Form 781.

7. Oil pressure—Check.
   If there is no indication of oil pressure within 30 seconds, shut down engine and investigate.
8. Engine instruments—Check.
   Check engine instruments for desired readings.

9. Drop tank pressure shutoff valve—ON (drop tanks installed)—OFF (drop tanks not installed).
10. External power—Disconnected.
    Have external dc power source disconnected at approximately 25% rpm.
11. Generator warning light—Out.

ENGINE GROUND OPERATION.

No engine warm-up is necessary. As soon as the engine stabilizes at idling speed with normal gage readings, the throttle may be slowly opened to full power. Idle rpm should be between 34% and 38% rpm, but will vary with altitude and outside air temperature. (See figure 7-1 for idle speed variation with altitude.) The idle rpm also depends somewhat on the manner in which the throttle is retarded; that is, whether it is eased back to IDLE or pulled back abruptly.

Note

Engine has poor acceleration characteristics between IDLE and 63% rpm.

CAUTION

- Rapid acceleration to 100% rpm on a cold engine usually results in the exhaust temperature exceeding the limits.
- Be sure that wheels are chocked, and in addition, hold toe brakes on.

GROUND TESTS.

Make following hydraulic boost flight control system checks:

1. Throttle—IDLE.
2. Move control stick from full aft to full forward through three complete cycles.
3. Hold control stick in one extreme (forward or aft) position and watch for a pressure build-up on the hydraulic boost system pressure gage.
4. Repeat in the opposite direction.
5. Hold control stick hard over to one extreme (left or right) position and check for pressure build-up.
6. Aileron boost switch—BYPASS; pressure should drop to 250-300 psi.
7. Continue holding control stick full over for 15 seconds; then turn boost switch back to ON.
8. Repeat procedure with control stick held at opposite side.
9. Repeat steps 5 through 8 three times.

Note

This procedure is necessary to ensure that all air is removed from the hydraulic boost system; otherwise, if air is in the system, spongy control action will result.

10. Flight controls — Check for free and correct movement.
11. Utility hydraulic system—Check.
    a. Speed brake switch—OUT, IN, then HOLD (neutral).
       Operate speed brakes through one complete cycle.
    b. Pressure—Approximately 2600 to 3000 psi.

WARNING

Before operating speed brakes, be sure aft side fuselage areas are clear, as speed brakes move with such force that personnel would be injured if struck by them.

12. Loadmeter and voltmeter—Check.
    At 45% engine rpm, check loadmeter reading; check voltmeter for approximately 28.5 volts (generator will not produce operating voltage below this rpm).

TAXIING.

1. Main gear wheel chocks—Removed.

Note

The airplane has excellent ground handling characteristics.

2. Throttle—Advance, then return to IDLE.
   To obtain initial taxi roll, open throttle to approximately 60% rpm; then retard throttle immediately. Once the airplane is rolling, it can be taxied at idling rpm on hard surface.
3. Turn-and-slip indicator—Check deflection of turn needle during turns.
4. Radio compass—Check relative bearing to selected station.
5. Directional indicator—Check actual changes of heading against instrument indications.

CAUTION

- As initial taxi roll is started, test wheel brakes to ensure proper braking action.
- Care should be used when taxiing (and turning sharply) while carrying 206½-gallon

drop tanks, because the ground clearance of the tanks in the normal attitude is only 6½ inches.

- While taxiing, do not operate speed brakes, because hydraulic pressure is inadequate for wheel brakes and nose wheel steering during speed brake operation.

6. Nose wheel steering switch—Depress (for directional control).
   With the nose wheel steering switch constantly depressed, maintain directional control through use of the rudder pedals. (Nose wheel and rudder pedals must be coordinated before steering mechanism will engage.)

Note

- Avoid excessive or rapid jockeying of throttle during taxiing.
- Minimize taxi time, because airplane range is considerably decreased by high fuel consumption during ground operation. Fuel consumption with engine operating at 35% to 40% rpm is approximately 3 gallons (20 pounds) per minute.

BEFORE TAKE-OFF.

PREFLIGHT AIRPLANE CHECK.

After taxiing to take-off position, complete the following checks:

1. Nose screen—Removed.

WARNING

Nose screen must be removed before preflight engine check and with engine at idle rpm. Ground personnel removing screen must not wear articles of loose clothing or carry equipment likely to be drawn into intake duct.

2. Safety belt—Tighten; shoulder harness—Adjust.
3. Shoulder harness lock handle—UNLOCKED (aft).
4. Safety pins—Remove.
   Remove safety pins from both seat handgrips (or from right handgrip), and on airplanes changed by T.O. 1F-86-227, from canopy initiator. Stow in map case.
5. Armament switches—OFF.
   If external loads have to be jettisoned on take-off, they may be jettisoned unarmed by means of the bomb-rocket jettison button or by the emergency jettison handle.

Note

Rockets cannot be jettisoned by means of the emergency jettison handle.

6. Trim for take-off—Check.
   Trim horizontal stabilizer −5 to −7 degrees nose up; rudder and aileron trimmed individually to neutral as indicated by the trim tab neutral light. (On early airplanes,* the indicator light does not function for aileron trim; therefore, trim aileron trim tab to neutral visually.)
7. Wing flap lever—DOWN, then HOLD.
8. Canopy switch—CLOSE.
9. Oxygen regulator diluter lever—NORMAL OXYGEN (100% OXYGEN if carbon monoxide is suspected).
   If carbon monoxide contamination is suspected, use 100 percent oxygen as long as considered necessary.

WARNING

Oxygen diluter lever should be returned to NORMAL OXYGEN as soon as possible, because use of 100 percent oxygen will deplete the oxygen supply enough to be hazardous.

10. Take-off position—Check.
    Make sure airplane is headed straight down runway with nose wheel centered.
11. Toe brakes—Hold.

PREFLIGHT ENGINE CHECK.

The emergency fuel system check is to be made only before the first flight of the day. Perform check in take-off position, making sure airplane does not move forward and cause the nose wheel to cant.

Emergency Fuel System Check.

1. Throttle—80% rpm.
2. Emergency fuel switch—ON.

CAUTION

If for any reason it becomes necessary to retard the throttle to a position that will result in less than 80% rpm, the emergency fuel switch must be returned to OFF before readvancing the throttle. Advancing the throttle rapidly with the emergency fuel switch at ON could result in compressor stall.

***F-86A-5 Airplanes AF48-129 through -316 and AF49-1007 through -1066**

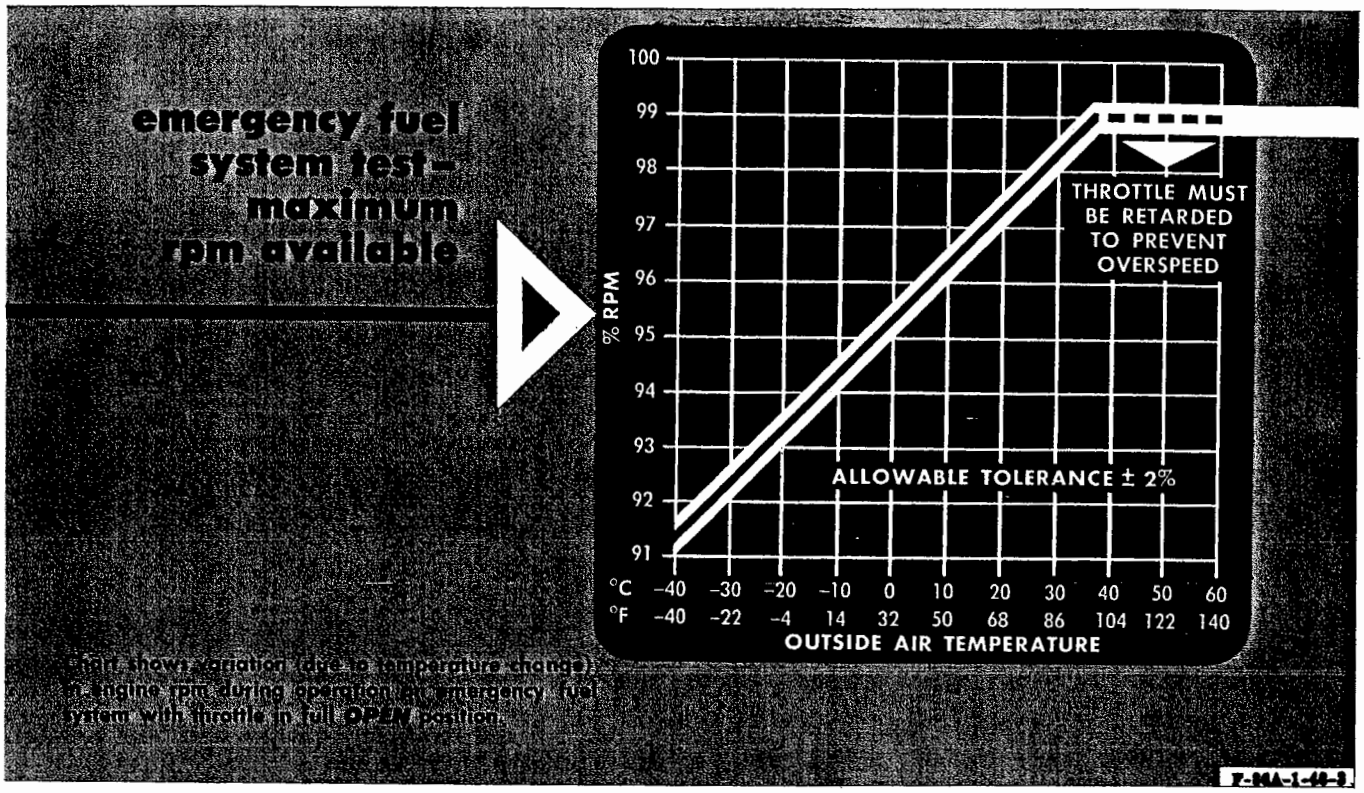


Figure 2-4

3. Throttle—full OPEN; rpm—Check.
   Advance throttle to full OPEN and allow engine rpm to stabilize.

WARNING

Be prepared to retard throttle immediately to prevent engine overspeeding in case the emergency fuel regulator is defective. If the engine overspeeds more than 104% rpm, with or without an overtemperature condition, the engine must be removed for overhaul.

4. Emergency fuel switch—OFF.
5. Emergency fuel switch—ON.
6. Observe recovery time and stabilized rpm.
   Recovery time is the time measured from the instant the emergency fuel switch is moved from OFF to ON to the instant the fuel pressure or fuel flow starts to increase. If recovery time exceeds 3 seconds, do not fly the airplane. The stabilized rpm value should conform to the limits shown graphically in figure 2-4. If the stabilized rpm value does not conform to these limits, the emergency fuel regulator will require adjustment.
7. Emergency fuel switch—OFF.
   Return emergency fuel switch to OFF for take-off.

CAUTION

- The emergency fuel switch should be OFF at all times except in case of main fuel system failure.
- Engine rpm should drop off (it may drop to as low as 80% rpm) when the emergency fuel switch is moved from ON to OFF, because of the time required for the main fuel regulator to recover from the disabled condition. This drop-off is normal and does not indicate main regulator malfunction. If engine rpm drop does not occur, it should be suspected that the emergency fuel system has not been disabled. Under such conditions the airplane should not be flown until the system has been checked; otherwise, compressor stall may occur during rapid throttle advancement, resulting in overtemperature operation and possible complete loss of power.

Note

Repeated checks of the emergency fuel system on the same engine run-up should result in the same stabilized rpm within 1%. If this tolerance cannot be maintained, the emergency fuel regulator must be replaced.

Engine Instrument Check.

1. Throttle—Full OPEN.
2. Engine instruments—Check.
   a. Tachometer—not less than 98% rpm nor greater than 100% rpm.
   b. Exhaust temperature—Between 675°C and 690°C.
   c. Oil pressure—Between 10 and 45 psi.

WARNING

Do not take off if exhaust temperature is below 675°C.

TAKE-OFF.

NORMAL TAKE-OFF.

Note

The following procedures will produce the results tabulated in Appendix I.

For normal take-off, with or without external load, proceed as follows:

1. Throttle—Full OPEN.
2. Toe brakes—Release.
3. Maintain directional control.
   Maintain directional control during first part of take-off run by use of nose wheel steering until rudder control becomes effective. Rudder control becomes effective at approximately 50 knots IAS.

Note

Use of brakes to maintain directional control on take-off will increase take-off run.

4. Maintain near-level attitude until take-off speed is attained.
   During take-off, the airplane should be held in a near-level attitude at nose wheel lift-off. In this attitude, the nose wheel will be just slightly off the runway. This attitude should be held until the recommended take-off speed is attained and the airplane lifts off.

WARNING

Do not assume a nose-high attitude before reaching the recommended take-off speed. Any attempt to take off at lower than recommended speeds can bring about a stalled condition. This could be disastrous because of the resultant excessively long take-off run. If a ground stall does occur, indicated by failure of the airplane to lift off and by loss of acceleration, the nose must be lowered to a three-point attitude to eliminate the stalled condition of the wings.

Take-off speeds (with wing flaps down and speed brakes retracted) are as follows:

GROSS WEIGHT	NOSE-WHEEL LIFT-OFF	TAKE-OFF SPEED
13,000 lb	90 knots IAS	105 knots IAS
15,000 lb	100 knots IAS	115 knots IAS
17,000 lb	110 knots IAS	125 knots IAS

See figure A-3 for required take-off distances.

5. Assume nose-high attitude when take-off speed is attained.
   At take-off speed, nose-high attitude must be maintained for take-off. (After take-off, the airplane will assume a more normal attitude as airspeed increases and the flaps are raised.)

WARNING

- Abrupt or steep pull-ups immediately after take-off must be avoided.
- When outside air temperature is less than 50°F, rapid throttle movement during operation on the main fuel system below 10,000 feet, when engine speed is below 70% rpm, may produce compressor stall or total loss of power.

TAKE-OFF WITH HIGH OUTSIDE AIR AND RUNWAY TEMPERATURES.

Caution must be used to prevent premature nose wheel and airplane lift-off during take-off with high outside air and runway temperatures. Since take-off roll distance is increased under these conditions, it is imperative that the recommended take-off speed be followed. See figure A-3 for required take-off distances.

MINIMUM-RUN TAKE-OFF.

A minimum-run take-off is a maximum performance maneuver with the airplane lifted off near stalling speed. It is closely related to slow flying with the airplane in a high-angle-of-attack attitude; consequently, you should be familiar with the characteristics of this maneuver in order to be able to maintain the necessary safe margin above the stall. In addition to the complete "Before Take-off" check, set the horizontal stabilizer trim at −8 to −10 degrees nose up and wing flaps full down. The initial take-off run is the same as for a normal take-off. In the clean configuration, with the stick held in the full aft position, nose wheel lift-off should occur as indicated in figure 2-5. It is necessary to pull approximately 20 pounds stick force before lift-off when full nose-up trim

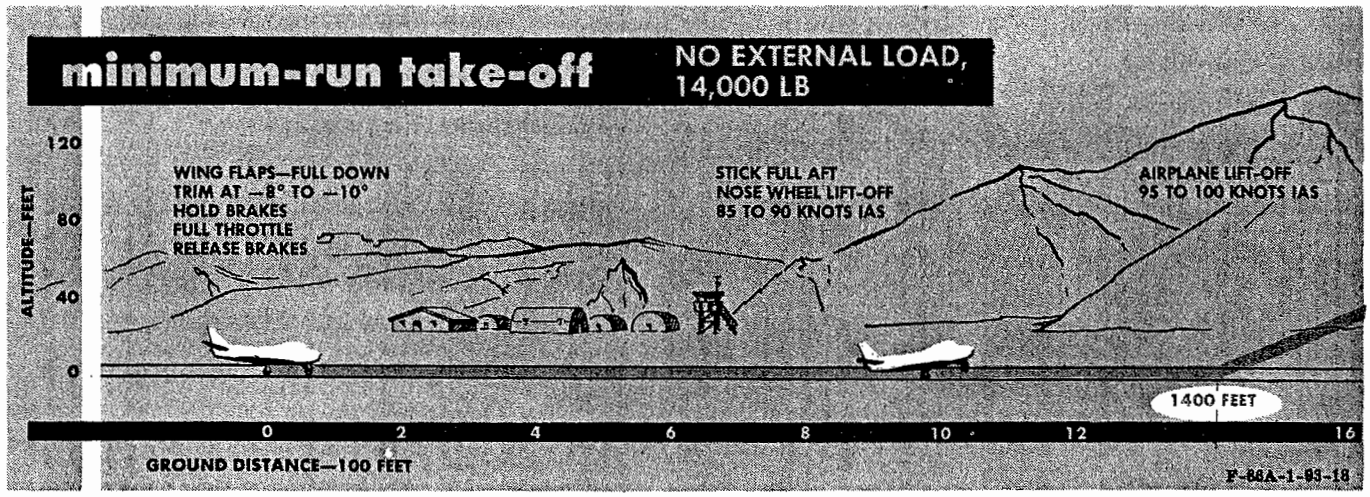


Figure 2-5

is used. This force is reduced to 0 pounds to maintain the proper attitude when the airplane breaks ground. Therefore, as the airplane lifts off, reduce back pressure sufficiently to maintain minimum airspeed build-up and maximum climb angle to effect the shortest air run that will clear all obstacles. After all obstacles are cleared, retrim the airplane to reduce stick forces, and accelerate to best climb speed.

CROSS-WIND TAKE-OFF.

In addition to the procedures used in a normal take-off, be prepared to counteract airplane drift at lift-off by lowering upwind wing or crabbing into the wind. Also, increase nose wheel lift-off speed approximately 10 to 15 knots IAS by holding nose wheel down a little longer during ground run.

Note

Increased speed is necessary to counteract reduced controllability caused by loss of lift on the downwind wing at normal speeds.

AFTER TAKE-OFF—CLIMB.

When airplane is definitely air-borne:

1. Landing gear handle—UP, then COMBAT.
   Landing gear handle UP. When gear unsafe warning light goes out return handle to COMBAT (below geardown limit speed). Check landing gear position indicators.

WARNING

Do not retract landing gear until the airplane accelerates to normal take-off speed, which is approximately 5 knots higher than the minimum-run take-off speed for the particular weight and external loading. If the gear is retracted very close to stall speed, the nose may pitch up enough to cause a stall. Delaying gear retraction until normal take-off speed is reached will eliminate this hazard.

CAUTION

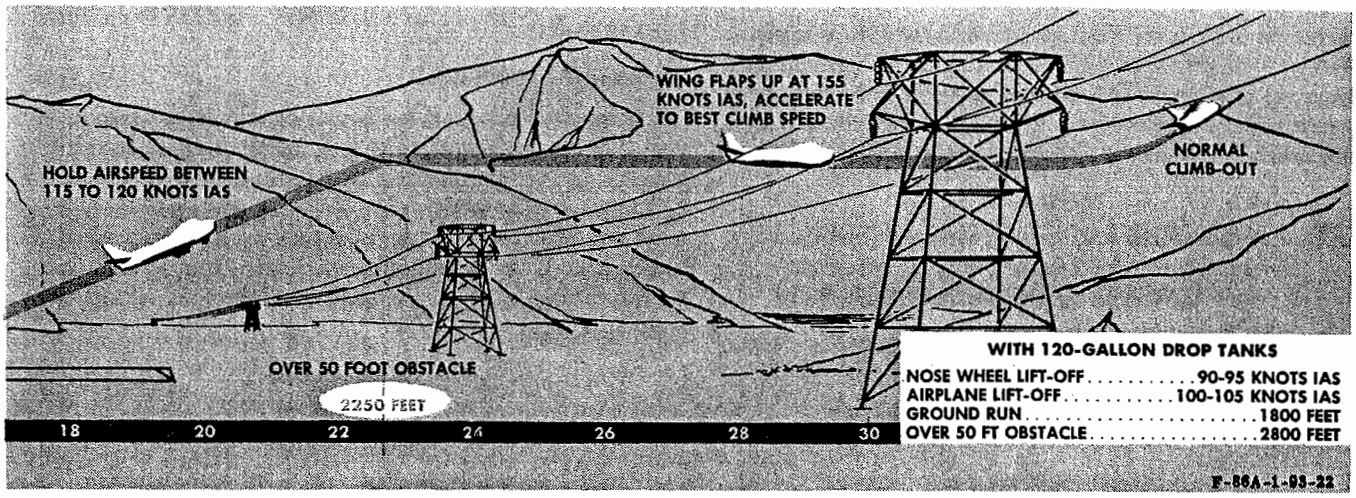
- Do not retract landing gear while airplane is yawing or slipping, because the gear doors may be damaged.
- If landing gear unsafe warning light remains on, have tower check gear on a fly-by, or have a formation member check it before handle is moved.

2. Wing flap lever—UP, then HOLD.
   Wing flap lever UP at 155 knots IAS. Rapid acceleration will prevent any tendency for the airplane to sink. When flaps are full up, move wing flap lever to HOLD.

CAUTION

- Raise gear and flaps below gear- and flaps-down limit airspeed; otherwise, excessive air loads may damage gear or flap operating mechanism and prevent subsequent operation.
- If flaps do not fully retract, avoid high-speed pull-up. The flap actuating mechanism may fail if the flaps are not supported against the up-stop (fully retracted) during accelerated maneuvers at high speed.

3. Horizontal stabilizer—Trim as required.
   After take-off, use a slight push or pull stick force, as necessary, to maintain take-off attitude. It is recommended that stick forces be trimmed out after the airplane is safely air-borne.



4. Slat lock lever (some airplanes)—LOCK.

Note

Because of different slat installations, slats will close on airplanes with the slat lock at 290 knots IAS; 340 knots IAS with external load. (Slats may be closed at a lower speed if the stick is pushed forward slightly.) On airplanes without the slat lock, slats will close at 180 knots IAS either with or without external load.

5. Level off and accelerate to best climb speed.
   Climb at Military Power (time limit 30 minutes). Refer to climb charts (figures A-4 and A-5) for recommended indicated airspeeds to be used during climb and for estimated rates of climb and fuel consumption. Initial climb speed after accelerating from take-off should be approximately 430 knots IAS at sea level with no external load. Airspeed should decrease approximately 50 knots IAS for every 10,000 feet increase of altitude.

CAUTION

During extended climbs to high altitude wherein an extreme nose-high attitude is maintained, level off for at least one minute between 18,000 and 20,000 feet, to permit adequate scavenging of engine oil. If the airplane is not leveled off in this manner, severe engine surging may occur because of inadequate engine oil supply for main fuel regulator control. (Refer to "Engine Surge" in Section VII.)

Note

During flight, do not move canopy switch to CLOSE when the canopy is already fully closed, because the canopy seal will deflate and cockpit pressure will be lost as long as the switch is actuated.

6. Oxygen regulator diluter lever—NORMAL OXYGEN (100% OXYGEN if carbon monoxide suspected).
   If 100% OXYGEN was used for take-off, return oxygen regulator diluter lever to NORMAL OXYGEN, unless carbon monoxide contamination is suspected. If such is the case, continue use of 100 percent oxygen as long as considered necessary.

WARNING

- Oxygen regulator diluter lever should be returned to NORMAL OXYGEN as soon as possible, because use of 100 percent oxygen will deplete the oxygen supply to hazardous level.
- Carefully trim airplane for "hands-off" flight occasionally, because an uncontrollable roll might result from out-of-trim condition if boost system fails.

CRUISE.

Refer to performance charts in Appendix I for cruise data.

FLIGHT CHARACTERISTICS.

Refer to Section VI.

SYSTEMS OPERATION.

Refer to Section VII.

DESCENT.

Circumstances may arise which require a descent from high altitude in the shortest possible time. The maximum rate of descent can be obtained when dive angle is

increased until limit airspeed or Mach number is reached. Refer to "Cockpit Air Conditioning and Pressurization Systems" in Section IV for minimum throttle settings at various altitudes to maintain cockpit pressurization during descent. See figure A-6 for descent information.

Note

The windshield and canopy defrosting system provides sufficient heating of the transparent surfaces to effectively eliminate formation of frost or fog during descent.

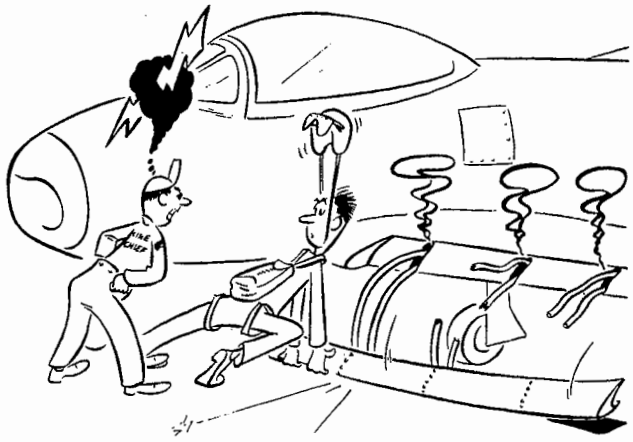
BEFORE LANDING.

CAUTION

When landing, the emergency fuel switch should be OFF unless the main fuel regulator has failed. Otherwise, any rapid throttle advancement would cause compressor stall or flame-out.

During approach to field, perform the following checks:

1. Safety belt and shoulder harness—Tighten.
2. Shoulder harness lock handle—UNLOCKED (aft).
3. Gun sight caging lever (A-1CM sight)—CAGE.
4. Armament switches—OFF.
5. Hydraulic pressure—Normal.
6. Slat lock lever (some airplanes)—UNLOCK.



CAUTION

ON AIRPLANES WITH SLAT LOCKS, UNLOCK SLATS ABOVE 250 KNOTS IAS; IF UNLOCKED BELOW THIS SPEED, THEY WILL OPEN RAPIDLY TO FULL EXTENSION, DAMAGING TRACKS AND ROLLERS.

F-86A-1-0-11

7. Oxygen regulator diluter lever—NORMAL OXYGEN.

LANDING.

NORMAL LANDING.

See figure 2-6 for complete approach and landing procedures. When properly followed, these procedures will produce the results given in Appendix I. Rapid increases in thrust are possible only above approximately 63% rpm; therefore, to ensure adequate acceleration in an emergency, it is desirable to use full flaps and speed brakes, and to hold a minimum of 60% to 70% rpm on final approach.

CAUTION

Do not lower landing gear in turns or pull-ups, above gear- and flaps-down limit airspeed, or while airplane is yawing or slipping, because the gear doors may be damaged.

Note

The full length of the runway should be used during the landing roll so that the brakes can be used as little and as lightly as possible when bringing the airplane to a stop.

CAUTION

- Reduced flight control boost system output occurs at low engine rpm and causes control surface reactions to be slower than usual. Therefore, during landing, be alert to immediately counteract any sudden or unusual changes in attitude resulting from severe gust or jet-wash conditions.
- Do not attempt a full-stall landing, because the angle of attack would be so high that the aft section of the fuselage would drag.
- Do not apply brakes hard before nose wheel has touched down and speed has diminished enough for effective braking.

After rudder control loses effectiveness, use differential braking to maintain directional control.

HEAVY-WEIGHT LANDING.

The same technique for normal landing applies for heavy-weight landing, except for necessary increases in power settings. As gross weight increases, approach and touchdown speeds should be increased accordingly. A stall landing should be avoided, if possible, to keep the G to a minimum at point of touchdown.

Note

If a hard, heavy-weight landing is made, the airplane should be checked before the next flight for signs of overstress.

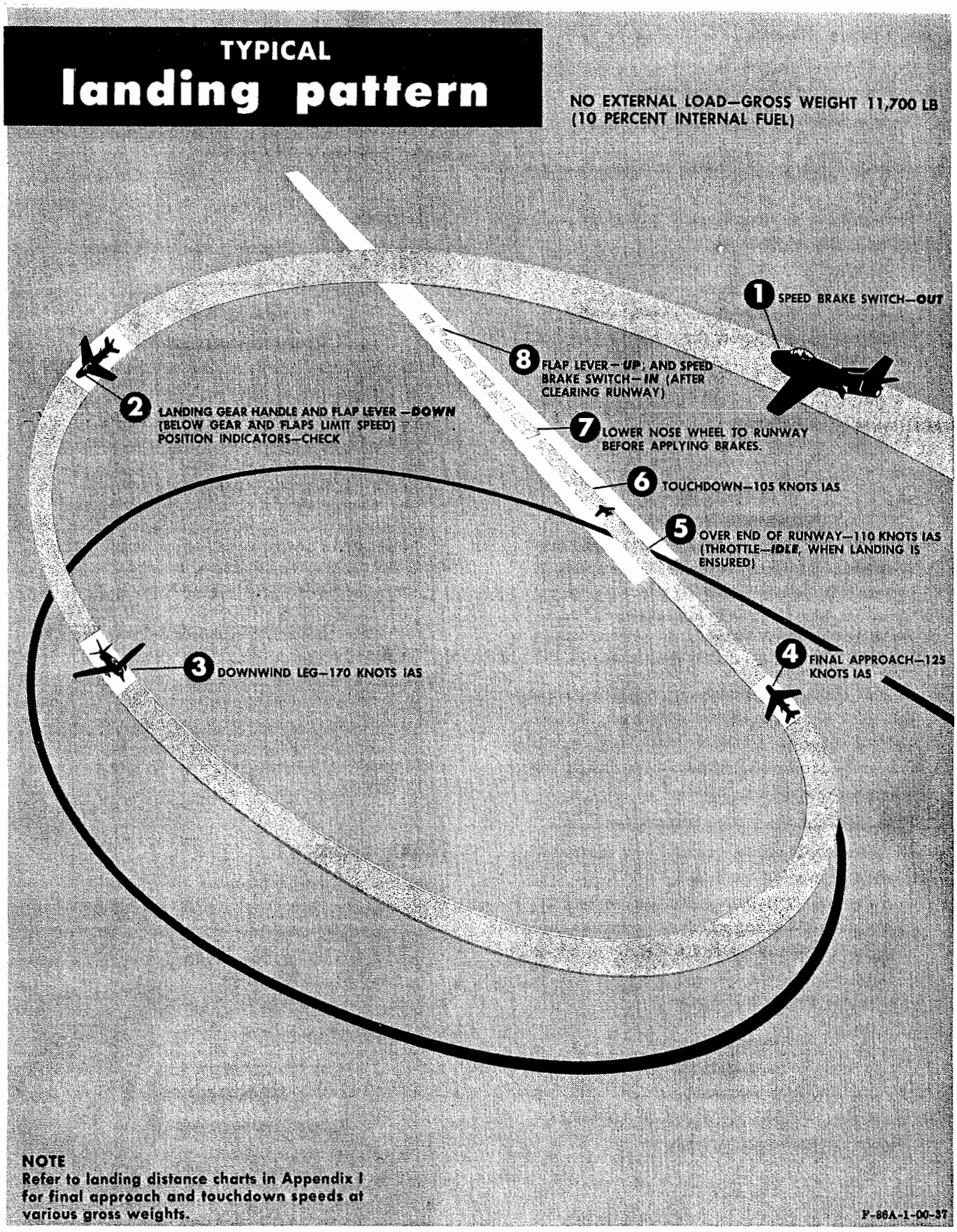

TYPICAL
landing pattern
NO EXTERNAL LOAD—GROSS WEIGHT 11,700 LB
(10 PERCENT INTERNAL FUEL)
1 SPEED BRAKE SWITCH—OUT
2 LANDING GEAR HANDLE AND FLAP LEVER —DOWN
(BELOW GEAR AND FLAPS LIMIT SPEED)
POSITION INDICATORS—CHECK
3 DOWNWIND LEG—170 KNOTS IAS
4 FINAL APPROACH—125 KNOTS IAS
5 OVER END OF RUNWAY—110 KNOTS IAS
(THROTTLE—IDLE, WHEN LANDING IS ENSURED)
6 TOUCHDOWN—105 KNOTS IAS
7 LOWER NOSE WHEEL TO RUNWAY BEFORE APPLYING BRAKES.
8 FLAP LEVER—UP, AND SPEED BRAKE SWITCH—IN (AFTER CLEARING RUNWAY)
NOTE
Refer to landing distance charts in Appendix I for final approach and touchdown speeds at various gross weights.
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Figure 2-6

CROSS-WIND LANDING.

In addition to the procedures used for a normal landing, the following steps should be accomplished:

1. On final approach, crab or drop wing to keep aligned with runway.
2. If crabbing, align airplane with runway just before touchdown.
3. At touchdown, lower nose wheel to runway as quickly and smoothly as possible.

Note

Approach and touchdown speeds should be increased about 5 knots for every 10 knots of direct cross wind.

MINIMUM-RUN LANDING.

WARNING

Since a minimum-run landing is a maximum performance maneuver, and final approach speeds will be nearer to stall than in a normal landing, use a straight-in final approach; otherwise, stall will be more likely to occur when G-loads are imposed during shallow turns.

1. On final approach, maintain airspeed 20 percent above stall speed for the particular weight you are flying.
   Final approach speeds would vary from approximately 110 knots IAS at 12,000 pounds to 135 knots IAS at 17,300 pounds.
2. Throttle—OFF, when sure of making field.
3. Set nose wheel down quickly and smoothly after touchdown to allow for braking.
   Apply brakes smoothly and steadily to the point just short of locking wheels; then release and apply brakes intermittently and forcefully at one-second intervals, holding for approximately 2 to 3 seconds, but avoid skidding the tires.

CAUTION

If brakes are applied above 100 knots IAS, be alert to prevent locking wheels.

Note

Opening the canopy will help decrease the roll, especially with a landing speed in excess of 120 knots.

WET-RUNWAY LANDING.

When landing on a wet runway, care must be taken during braking action to prevent the locking of wheel brakes, causing skidding and loss of directional control. Braking effectiveness is greatly reduced, and landing roll is increased when the runway is wet.

GO-AROUND.

See figure 2-7 for complete go-around procedure.

WARNING

- The emergency fuel switch should be OFF for a normal go-around procedure.
- On a go-around procedure, the emergency fuel system would be operating as though in stand-by condition if any of the following situations is present: Emergency fuel switch is ON, primary bus fails, battery-starter switch is moved to OFF upon generator failure, or generator switch is OFF when battery-starter switch is OFF. Therefore, under such conditions, rapid throttle advancement must be avoided to avert complete power failure caused by engine overspeeding or compressor stall.
- When outside air temperature is less than 50°F and engine speed is below 70% rpm, rapid throttle movement during operation on the main fuel system below 10,000 feet may produce compressor stall or total loss of power.

AFTER LANDING.

1. Maintain directional control.
   Maintain directional control by differential braking on the landing roll. Engage nose wheel steering after clearing the runway and when slow taxiing becomes necessary.
2. Speed brake switch—HOLD (neutral).
3. Nose screen—Installed.

WARNING

If required by base procedure, nose screen must be installed before taxiing and with engine at idle rpm. Ground personnel installing screen must not wear articles of loose clothing or carry equipment likely to be drawn into the intake duct.

STOPPING ENGINE.

To stop the engine, proceed as follows:

1. Toe brakes—Hold.
2. Engine—65% to 70% rpm for 2 minutes.

Note

This permits engine stabilization at the lowest temperature which minimizes the possibility of shroud ring rub. If required by emergency, engine may be shut down immediately.

3. Throttle—OFF.

Note

If operation at idling speed is performed for more than 3 minutes, operate engine at 100% rpm for 30 seconds, to reduce carbon accumulation on spark plugs. Then operate engine at 65% to 70% rpm for 2 minutes and shut down engine.

4. Engine master switch—OFF.

   Turn engine master switch to OFF below 10% rpm.

5. Speed brake switch—OUT.

   Dump utility hydraulic system pressure by operating speed brakes.

WARNING

If speed brakes are to be extended to dump hydraulic pressure, be sure aft fuselage area is clear. The speed brakes move rapidly and can injure any personnel in their path.

6. Battery-starter switch—OFF.

go-around

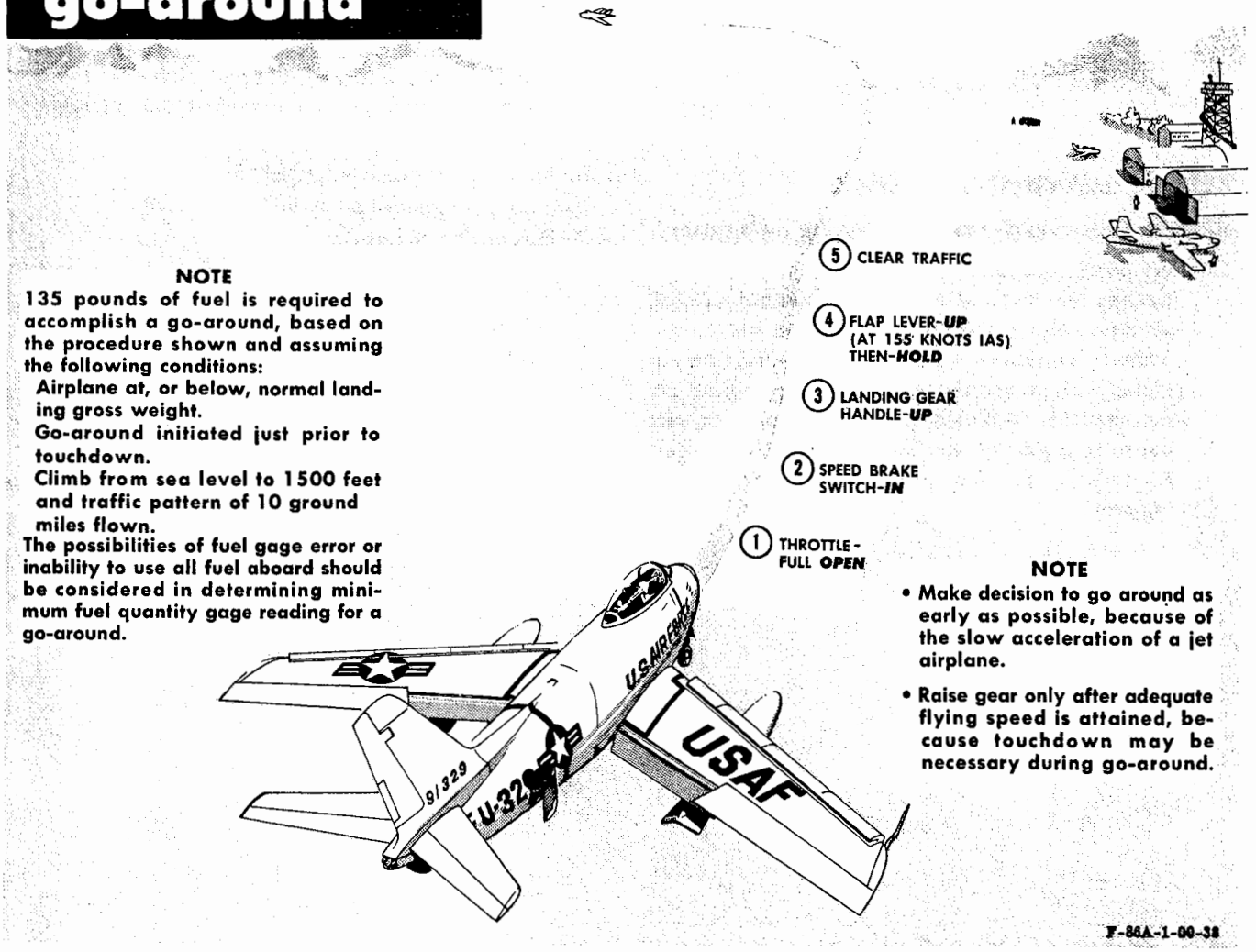
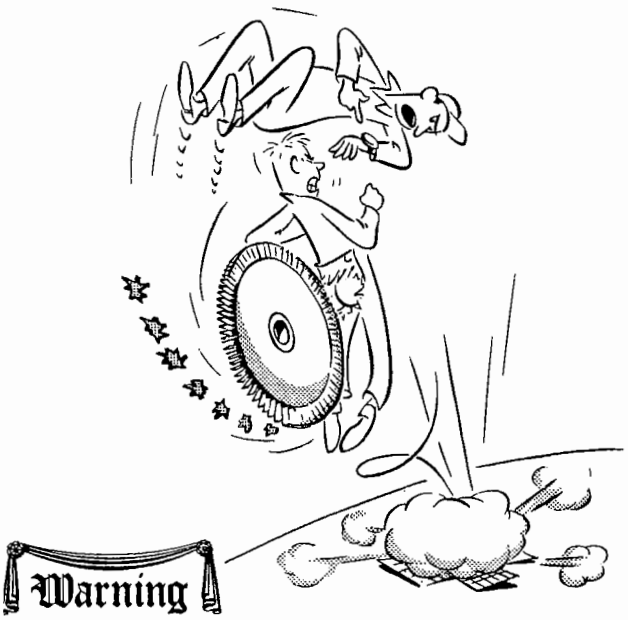


Figure 2-7

7. All switches except generator switch—OFF.



BEFORE LEAVING AIRPLANE.

Make the following checks before leaving the airplane:

1. Safety pins—Installed.

   Canopy remover and seat catapult systems safetied, as applicable to the seat modification on the airplane. (See figures 1-24, 1-25, and 1-26.) On airplanes with seat initiators, if ground personnel are not available to obtain seat initiator pins, be sure not to foul gear on ejection mechanism when leaving seat. Insert safety pins in initiators after leaving seat.

CAUTION

If the airplane is equipped with an automatic-opening safety belt and you are wearing an automatic-opening parachute that has a key or a ring-type anchor attached to the aneroid arming lanyard, make sure key or anchor and lanyard are not fouled in any equipment before leaving seat, to prevent chute from opening accidentally.

2. Drop tank pressure shutoff valve—OFF.
3. Flight control lock—LOCK (out).
4. DD Form 781—Complete.

CAUTION

Make appropriate entries in Form 781 covering any limits in the Flight Handbook that have been exceeded during flight. Entries must also be made when, in the pilot's judgment, the airplane has been exposed to unusual or excessive operations such as hard landings, excessive braking action during aborted take-offs, long and fast landings, and long taxi runs at high speeds, etc.

5. Main gear wheels—Chocked.
6. Nose gear ground safety lock—Installed.
7. Parking brake handle—IN.

Note

If parking brake handle is not full in, brakes will be inoperative.

CONDENSED CHECK LIST.

Refer to pages 2-19 through 2-28 for the condensed check list.

CUT ON SOLID LINE

F-86A CONDENSED CHECK LIST

NOTE

The following check list is a condensed version of the procedures presented in Section II. This condensed check list is arranged so that you may remove it from your Flight Handbook and insert it into a flip pad for convenient use. It is arranged so that each action is in sequence with the expanded procedure given in Section II. Presentation of this condensed check list does not imply that you need not read and thoroughly understand the expanded version. To fly the airplane safely and efficiently, you *must* know the reason why each step is performed and why the steps occur in certain sequence.

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1

CUT ON SOLID LINE

PREFLIGHT CHECK.

BEFORE EXTERIOR INSPECTION.

1. DD Form 781—Check.

EXTERIOR INSPECTION.

Check all surfaces for cracks, distortion, loose rivets, and indications of damage; check for signs of hydraulic fluid, fuel, and oil leaks; check tires for general condition, slippage, and proper inflation; check for access doors and panels, and all filler caps secured; check position of gear doors, gear strut extension, and condition of wheels.

1. Nose:

Nose wheel chock—Removed.
Nose gear ground safety lock—Removed.
Tow pin safety cap—Tight.
Nose gear emergency extension accumulator gage pressure—Within limits.
Intake duct—Clear (except nose screen installed).
Gun port plugs—Installed.
Landing and taxi lights—Retracted.

2. Forward Fuselage and Right Wing Leading Edge:

Emergency nose gear extension control valve—Reset (pushed full back).
Gun charger system air pressure—1700 psi.
Slats—Check for freedom of movement.
Main gear wheel—Chocked.
External load—Check for proper installation and security of mounting.
Position light and wing tip—Check general condition and security of mounting.
Pitot head—Uncovered.

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CUT ON SOLID LINE

3. Right Wing Trailing Edge and Aft Fuselage:

Aileron and flap—Check general condition.
Speed brake—Check general condition.
Utility hydraulic system accumulator gage pressure—Within limits.

4. Empennage:

Elevator and tail surfaces—Check general condition.
Tail-pipe cover—Removed.
Tail cone and position lights—Check general condition and security of mounting.
Aspirator fuel drain—Check for freedom of movement.

5. Aft Fuselage and Left Wing Trailing Edge:

Speed brake—Check general condition.
IFF destructor—Installed.
Aileron and flap—Check general condition.

6. Left Wing Leading Edge and Forward Fuselage:

Position light and wing tip—Check general condition and security of mounting.
External load—Check for proper installation and security of mounting.
Main gear wheel—Chocked.
Slats—Check for freedom of movement.

CANOPY AND EJECTION SEAT CHECK.

1. Handgrips and triggers—Check.
2. Safety pins—Check.
3. Seat quick-disconnects—Check.
4. Lead seals—Check.

CUT ON SOLID LINE

INTERIOR CHECK.

1. Control stick grip—Check.
2. Safety belt and shoulder harness—Check.
3. Seat—Adjust.
4. Flight control lock—UNLOCK (in).
5. Armament switches—OFF.
6. Throttle—OFF (adjust friction).
7. Landing gear handle—DOWN.
8. Speed brake switch—HOLD (neutral).
9. Engine master, emergency ignition, and battery-starter switches—OFF.
10. External power—Connected.
11. Landing gear position indicators—Check.
12. Oxygen regulator—Check.
13. Left circuit breakers—IN.
14. Anti-G suit regulator valve—Check
15. Drop tank pressure shutoff valve—OFF.
16. Ammunition compartment heat emergency shutoff handle—IN.
17. Cockpit air temperature control switch—AUTOMATIC.
18. Cockpit air temperature control rheostat—As desired.
19. Cabin pressure control lever—As desired.
20. Air outlet selector lever—FLOOR.
21. Windshield deicing lever—OFF.
22. Rudder trim switch—OFF.
23. Aileron alternate trim switch—NORMAL.
24. Aileron boost switch—ON.
25. Speed brake emergency lever—NORMAL.
26. Wing flap lever—UP, then HOLD.
27. Horizontal stabilizer alternate trim switch—NORMAL STICK GRIP.
28. Emergency jettison handle—IN.
29. Pitot heater switch—ON, then OFF.
30. Landing light position and selector switches—OFF (center).
31. Parking brake handle—IN.
32. Slat lock lever (some airplanes)—UNLOCK.
33. Emergency fuel switch—OFF.

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34. Clock, accelerometer, and altimeter—Set.
35. Fuel quantity—Check; totalizer dial—Set.
36. Warning lights and indicators and test warning systems—Check.
37. Attitude indicator—Check.
38. Directional indicator—Check against stand-by compass.
39. Vertical velocity indicator—Set.
40. Sight mechanical caging lever (A-1CM sight)—CAGE.
41. Canopy alternate emergency jettison handle (airplanes so equipped) —IN.
42. Generator switch—ON.
43. All interior and exterior lighting (night flights)—Check operation.
44. Interior, position, and fuselage light switches—As required.
45. Communication equipment switches—As desired.
46. Right circuit breakers—IN.
47. Map case—Flight Handbook, Radio Facilities Charts, Pilot's Handbook—Jet, and other necessary publications and charts available.
48. Instrument power switch—NORMAL, then ALT.
49. Emergency hydraulic selector (some airplanes)—OFF.
50. Landing gear emergency release handle—IN.
51. Canopy declutch handle—IN.
52. Flight controls—Check.
53. Normal trim switch—Check.
54. Radio compass—Check.
55. Flashlight—Check.

CUT ON SOLID LINE

STARTING ENGINE.

1. Throttle—OFF.
2. Engine master switch—ON.
3. Battery-starter switch—STARTER (momentarily), then BATTERY.
4. 3% rpm—Throttle outboard.
5. 6% rpm—Throttle halfway between IDLE and OFF.
6. Throttle—Adjust for proper exhaust temperature.
7. Oil pressure—Check.
8. Engine instruments—Check.
9. Drop tank pressure shutoff valve—ON (drop tanks installed)—OFF (drop tanks not installed).
10. External power—Disconnected.
11. Generator warning light—Out.

GROUND TESTS.

1. Throttle—IDLE.
2. Move control stick from full aft to full forward through three complete cycles.
3. Hold control stick in one extreme (forward or aft) position and watch for a pressure build-up on the hydraulic boost system pressure gage.
4. Repeat in the opposite direction.
5. Hold control stick hard over to one extreme (left or right) position and check for pressure build-up.
6. Aileron boost switch—BYPASS; pressure should drop to 250-300 psi.
7. Continue holding control stick full over 15 seconds; then turn boost switch back to ON.
8. Repeat procedure with control stick held at opposite side.
9. Repeat steps 5 through 8 three times.
10. Flight controls—Check for free and correct movement.
11. Utility hydraulic system—Check.
    a. Speed brake switch—OUT, IN, then HOLD (neutral).
    b. Pressure—Approximately 2600 to 3000 psi.
12. Loadmeter and voltmeter—Check.

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TAXIING.

1. Main gear wheel chocks—Removed.
2. Throttle—Advance, then return to IDLE.
3. Turn-and-slip indicator—Check deflection of turn needle during turns.
4. Radio compass—Check relative bearing to selected station.
5. Directional indicator—Check actual changes of heading against instrument indications.
6. Nose wheel steering switch—Depress (for directional control).

BEFORE TAKE-OFF.

PREFLIGHT AIRPLANE CHECK.

1. Nose screen—Removed.
2. Safety belt—Tighten; shoulder harness—Adjust.
3. Shoulder harness lock handle—UNLOCKED (aft).
4. Safety pins—Remove.
5. Armament switches—OFF.
6. Trim for take-off—Check.
7. Wing flap lever—DOWN, then HOLD.
8. Canopy switch—CLOSE.
9. Oxygen regulator diluter lever—NORMAL OXYGEN (100% OXYGEN if carbon monoxide suspected).
10. Take-off position—Check.
11. Toe brakes—Hold.

CUT ON SOLID LINE

PREFLIGHT ENGINE CHECK.

Emergency Fuel System Check.

1. Throttle—80% rpm.
2. Emergency fuel switch—ON.
3. Throttle—Full OPEN; rpm—Check.
4. Emergency fuel switch—OFF.
5. Emergency fuel switch—ON.
6. Observe recovery time and stabilized rpm.
7. Emergency fuel switch—OFF.

Engine Instrument Check.

1. Throttle—Full OPEN.
2. Engine instruments—Check.

TAKE-OFF.

NORMAL TAKE-OFF.

1. Throttle—Full OPEN.
2. Toe brakes—Release.
3. Maintain directional control.
4. Maintain near-level attitude until take-off speed is attained.
5. Assume nose-high attitude when take-off speed is attained.

AFTER TAKE-OFF—CLIMB.

1. Landing gear handle—UP, then COMBAT.
2. Wing flap lever—UP, then HOLD.
3. Horizontal stabilizer—Trim as required.
4. Slat lock lever (some airplanes)—LOCK.
5. Level off and accelerate to best climb speed.
6. Oxygen regulator diluter lever—NORMAL OXYGEN (100% OXYGEN if carbon monoxide suspected).

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CUT ON SOLID LINE

BEFORE LANDING.

1. Safety belt and shoulder harness—Tighten.
2. Shoulder harness lock handle—UNLOCKED (aft).
3. Gun sight caging lever (A-1CM sight)—CAGE.
4. Armament switches—OFF.
5. Hydraulic pressure—Normal.
6. Slat lock lever (some airplanes)—UNLOCK.
7. Oxygen regulator diluter lever—NORMAL OXYGEN.

LANDING.

NORMAL LANDING.

1. Speed brake switch—OUT.
2. Landing gear handle and flap lever—DOWN, position indicators—Check.
3. Downwind leg—Hold recommended speed.
4. Final approach—Hold recommended speed.
5. Over end of runway—At recommended speed.
6. Touchdown—At recommended speed.
7. Lower nose wheel to runway before applying brakes.
8. Flap lever—UP; speed brake switch—IN (after clearing runway).

CROSS-WIND LANDING.

1. On final approach, crab or drop wing to keep aligned with runway.
2. If crabbing, align airplane with runway just before touchdown.
3. At touchdown, lower nose wheel to runway as quickly and smoothly as possible.

CUT ON SOLID LINE

MINIMUM-RUN LANDING.

1. On final approach, maintain airspeed 20 percent above stall speed for the particular weight you are flying.
2. Throttle—OFF, when sure of making field.
3. Set nose wheel down quickly and smoothly after touchdown to allow for braking.

GO-AROUND.

1. Throttle—Full OPEN.
2. Speed brake switch—IN.
3. Landing gear handle—UP.
4. Flap lever—UP (155 knots IAS); then—HOLD.
5. Clear traffic.

AFTER LANDING.

1. Maintain directional control.
2. Speed brake switch—HOLD (neutral).
3. Nose screen—Installed.

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CUT ON SOLID LINE

STOPPING ENGINE.

1. Toe brakes—Hold.
2. Engine—65% to 70% rpm for 2 minutes.
3. Throttle—OFF.
4. Engine master switch—OFF.
5. Speed brake switch—OUT.
6. Battery-starter switch—OFF.
7. All switches except generator switch—OFF.

BEFORE LEAVING AIRPLANE.

1. Safety pins—Installed.
2. Drop tank pressure shutoff valve—OFF.
3. Flight control lock—LOCK (out).
4. DD Form 781—Complete.
5. Main gear wheels—Chocked.
6. Nose gear ground safety lock—Installed.
7. Parking brake handle—IN.

EMERGENCY PROCEDURES

SECTION III

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ENGINE FAILURE.

The majority of jet-engine flame-outs are the result of improper fuel flow caused by fuel control system malfunction or incorrect operating techniques during certain critical flight conditions. Specific information on this type of engine failure is given in "Fuel System Failure" in this section. The engine instruments often provide indications of fuel control system failures before the engine actually stops. If engine failure is due to malfunctions of the fuel control system or improper operating technique, an air start can usually be accomplished when time and altitude permit. In the event of obvious mechanical failure within the engine, air starts should not be attempted. The airplane has normal flight characteristics with a dead engine, and no sudden trim changes are necessary.

ENGINE FAILURE DURING TAKE-OFF RUN (NO RUNWAY OVERRUN BARRIER).

Note

For procedure when using a runway equipped with overrun barrier, refer to "Engaging Runway Overrun Barrier" in this section.

If engine fails, or take-off is aborted before airplane leaves the ground, and landing gear must be retracted because of insufficient runway, proceed as follows:

1. Emergency fuel switch—ON (if engine rpm is above 80%).

   If engine power loss is indicated by rpm or exhaust temperature drop but rpm has not fallen below 80%, move emergency fuel switch to ON.

WARNING

If engine rpm has fallen below 80%, abort take-off. There would not be enough time to retard throttle to IDLE, switch emergency fuel switch to ON, and then readvance throttle.

2. Bomb-rocket-tank salvo (jettison) button—Depress (or emergency jettison handle—Pull).

WARNING

Rockets cannot be jettisoned by actuation of the salvo button when the weight of the airplane is on the gear.

Note

If engine does not immediately recover sufficient power to continue take-off when emergency fuel switch is moved to ON, proceed to step 3.

3. Throttle—OFF.
4. Landing gear handle—UP.
5. Landing gear emergency-up button—Depress and hold.

   Hold landing gear emergency-up button depressed until gear completely retracts.

Note

Gear retraction can be accelerated by yawing the airplane to relieve load on main gear downlock pins through alternate application of right and left wheel brakes, or by applying rudder alternately with nose wheel steering engaged.

6. Right seat handgrip—Lower head, then pull handgrip full up before airplane comes to a complete stop (lower head, then pull canopy alternate emergency jettison handle on airplanes so equipped).

   On airplanes equipped with the alternate emergency jettison handle, pull handle to jettison canopy without arming the seat catapult.

WARNING

If the canopy has not been jettisoned before the airplane stops and if spilled fuel is in the vicinity of the airplane, use the mechanical or the electrical means to open the canopy if time permits. If these systems fail, the canopy jettison mechanism may be used.

7. Engine master and battery-starter switches—OFF.

CAUTION

Turn engine master switch OFF while battery-starter switch is still at BATTERY, so that power will still be available to close the fuel shutoff valve.

8. Shoulder harness lock handle—LOCKED (forward).

ENGINE FAILURE DURING TAKE-OFF (AIR-BORNE).

If the engine fails on take-off after the airplane is airborne, prepare for an emergency landing, accomplishing as much of the following as time permits:

1. Emergency fuel switch—ON (if engine rpm is above 80%).

   If engine power loss is indicated by rpm or exhaust temperature drop but rpm has not fallen below 80%, move emergency fuel switch immediately to ON.

WARNING

If engine rpm has fallen below 80%, abort take-off. You would not have time to retard throttle to IDLE, to switch emergency fuel switch to ON, and then to readvance throttle. Therefore, proceed to steps 2 through 9.

2. Bomb-rocket-tank salvo (jettison) button—Depress (or emergency jettison handle—Pull).

Note

If engine does not immediately recover sufficient power to sustain flight when the emergency fuel switch is moved to ON, proceed to step 3.

3. Throttle—OFF.
4. Landing gear handle—DOWN.
5. Wing flap lever—DOWN.
6. Right seat handgrip—Lower head, then pull handgrip full up (lower head, then pull canopy alternate emergency jettison handle on airplanes so equipped).

   On airplanes equipped with the alternate emergency jettison handle, pull handle to jettison canopy without arming the seat catapult.

7. Engine master, generator, and battery-starter switches —OFF.

CAUTION

Turn engine master switch OFF while battery-starter switch is still at BATTERY, so that power will still be available to close the fuel shutoff valve.

8. Shoulder harness lock handle—LOCKED (forward).
9. Land straight ahead, changing course only enough to miss obstacles.

ENGINE FAILURE DURING FLIGHT.

If engine failure occurs during flight, follow this procedure:

1. Throttle—OFF.
2. Glide—185 knots IAS.
   Establish glide at 185 knots IAS with gear and flaps up and speed brakes in for maximum glide distance. (Refer to "Maximum Glide" in this section.)
3. Nonessential electrical equipment—OFF.

WARNING

At normal gliding speeds, engine windmilling does not provide adequate generator output, and the battery is then the only source of electrical power. With the engine master switch, radio, pitot heater, and lights turned off, the battery can supply power for only 7 to 28 minutes (approximately). If engine damage prevents windmilling (causing flight control normal hydraulic system pressure failure), the automatic operation of the flight control alternate hydraulic pump imposes the maximum drain on battery power and results in minimum battery output time.

4. Attempt air start.
   Refer to "Engine Air Start" in this section.

ENGINE AIR START.

It is possible to restart the engine at altitudes up to 20,000 feet. However if altitude and terrain permit, descend to 15,000 feet before attempting to start engine. Careful attention should be given to maximum engine windmilling speed, shown in step 4. Exceeding the recommended windmilling speed is likely to cause an overtemperature operation, with resultant engine damage. For air starting, follow these procedures:

1. Engine master and generator switches—ON.
2. Battery-starter switch—BATTERY.
3. Hold airplane level for 5 seconds.
   If altitude is available, hold airplane as level as possible for at least 5 seconds, to drain any fuel that may have accumulated in the combustion chambers or the turbine section.
4. Windmilling rpm—Up to 25%.
5. Maintain 185 knots IAS.

Note

If necessary, reduce airspeed to obtain engine windmilling speed of not more than 25% rpm.

6. Emergency fuel switch—OFF (ON, if main fuel regulator failure suspected).
   If main fuel control system failure is suspected, as shown by a complete or partial drop in fuel flow indication, turn emergency fuel switch ON.

Note

If flame-out was caused by too rapid throttle movement, do not turn on emergency fuel system unless main system has actually failed. Starts made with the main fuel system in operation have a greater chance of success.

7. Emergency ignition switch—ON.
8. Throttle—Outboard, then toward IDLE.
   Hold throttle outboard to energize the ignition circuit; then move it toward IDLE position to obtain minimum fuel flow indication.
9. Exhaust temperature gage—Check.
   Watch exhaust temperature gage for signs of ignition.

CAUTION

If there is no indication of fuel ignition after 45 seconds, slowly retard throttle, then readvance throttle to the original position. If after one minute the engine has not started, pull throttle OFF and turn emergency ignition switch OFF. Level airplane to permit fuel drainage, and repeat starting procedure.

10. Throttle—Advance slowly to 90% rpm while maintaining exhaust temperature within limits.

CAUTION

- During air starts at high altitude, the engine may be on the verge of compressor stall with the throttle at IDLE, and any attempt to advance the throttle will cause a complete stall. If a stall occurs, reduce throttle setting and increase airspeed. If stall cannot be eliminated, close the throttle. Then reattempt starting, using a slightly lower throttle position to avoid repetition of stall.

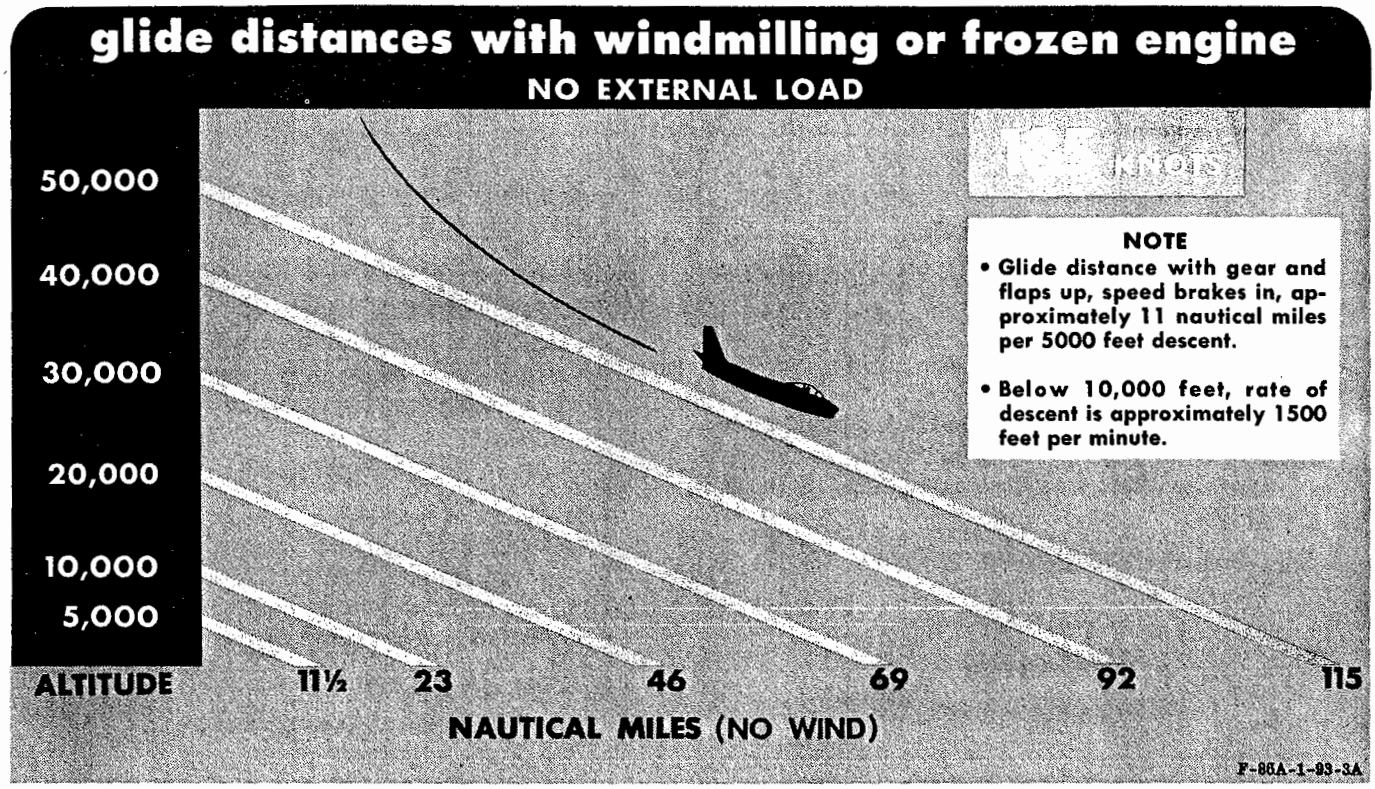


Figure 3-1

- If start is evidenced by low exhaust temperature (approximately 200°C) and temperature does not increase when throttle is advanced, shut off engine and restart, as this condition indicates that some burners are not lighted. The engine may be damaged if this condition is allowed to continue.

11. Emergency ignition switch—OFF.

CAUTION

Ignition transformers may be damaged if emergency ignition switch is left ON more than 3 minutes per start.

12. If engine fails to start:
    a. Throttle—OFF.
    b. Emergency ignition, engine master, and generator switches—OFF.
    c. Bomb-rocket-tank salvo (jettison) button—Depress (or emergency jettison handle—Pull).
    d. Aileron boost switch—BYPASS.
    e. Prepare for forced landing or eject.
    (Refer to "Forced Landing—Dead Engine" in this section.)

MAXIMUM GLIDE.

For maximum glide distance with engine windmilling or frozen, the optimum gliding speed is 185 knots IAS with gear and flaps up, speed brakes in, and no external load. (See figure 3-1.) When speed is maintained at 185 knots IAS, glide ratio and rate of descent with various airplane configurations are as follows:

CONFIGURATION	GLIDE RATIO	RATE OF DESCENT
Gear and flaps up—speed brakes in	14 to 1	2700 fpm at 40,000 ft 1500 fpm at 10,000 ft
Gear down, flaps up—speed brakes in	7.3 to 1	3000 fpm at 10,000 ft
Gear down, flaps up—speed brakes out	4.8 to 1	4500 fpm at 10,000 ft

FORCED LANDING—DEAD ENGINE.

If a forced landing is contemplated, maintaining glide at 185 knots IAS (gear and flaps up, speed brakes in) will provide maximum gliding distance. Unless the engine is damaged, it will windmill at sufficient speed to produce power for the hydraulic systems, although landing gear operation may be slower than usual.

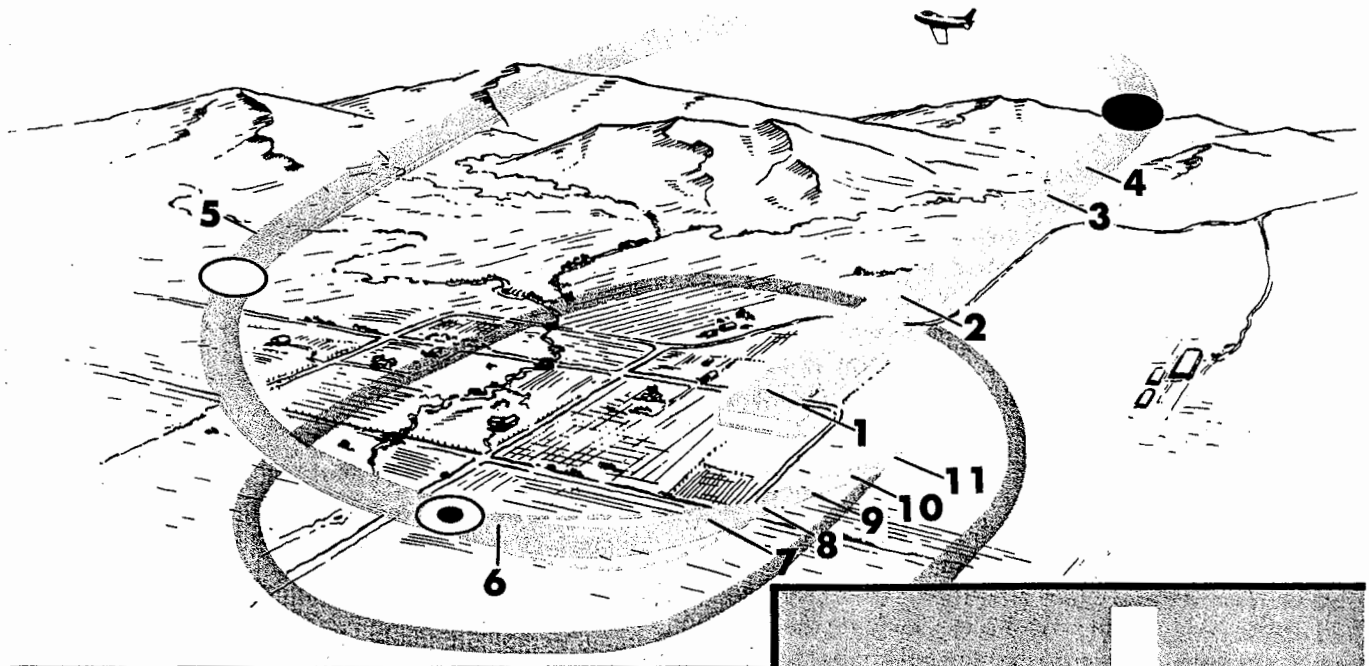
CAUTION

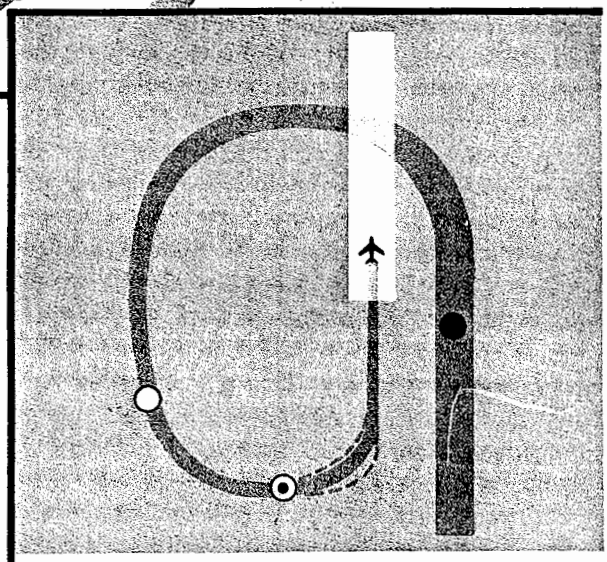
The speed brakes will not operate if the utility hydraulic system has failed.

forced landing—dead engine

GROSS WEIGHT 11,900 LB—500 LB FUEL REMAINING

WARNING
If terrain is unknown or unsuitable for forced landing, eject.





● High key point, 6000 feet above terrain.
○ Low key point, 3000 feet above terrain.
◉ Base key point, 1500 feet above terrain.

1 Bomb-rocket-tank salvo (jettison) button—Depress (or emergency jettison handle—Pull). Maintain glide at 185 knots IAS.

2 Landing gear handle—***DOWN*** above 12,000 feet (field made); then establish glide at 170 knots IAS.
If altitude is too low to enter pattern at high key point, leave gear up until a subsequent key point can be reached.

WARNING

Do not leave gear up for landing. Investigation has shown that emergency landings with gear down minimize pilot injury and damage to airplane.

NOTE

If engine is "frozen," lower gear by means of landing gear emergency release handle, because utility hydraulic pressure will not be available. (Gear cannot be retracted.)

3 Slat lever*—***UNLOCK***.

4 Fly pattern at 170 knots IAS.
Vary flight path to make key points. Aim for one-third point of runway.

5 Canopy switch—***OPEN*** at low key point, if landing on unprepared surface (jettison canopy if necessary). Pull helmet visor down before opening canopy.

6 Fly turn "long" or "short" for accurate touchdown.

7 Final approach—Hold 145 knots IAS† and use straight-in approach.

8 Flap lever and speed brake switch—As required when sure of reaching landing spot.

CAUTION

Speed brake operation will be slower than usual. If engine is "frozen," speed brakes will be inoperative.

9 Battery-starter switch—***OFF***, only after speed brake operation is no longer necessary.

10 Shoulder harness lock handle — Forward (***LOCKED***).

11 Over end of runway—At 130 knots IAS.†

* Some airplanes. (Refer to applicable text.)

† For each additional 1000 pounds of fuel, add 5 knots IAS.

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Figure 3-2

The flight control normal hydraulic system will operate normally when the engine is windmilling if recommended speeds are maintained during the forced landing. See figure 3-2 for procedure to follow in case of a forced landing.

SIMULATED FORCED LANDING.

The normal concept of retarding the throttle to IDLE to practice a forced landing does not apply to airplanes powered by turbojet engines. With the throttle at IDLE, this engine continues to provide thrust (about 300 pounds), whereas with complete power failure, the windmilling engine creates drag. Thus, if the throttle is retarded to IDLE to simulate engine failure, the thrust still produced will cause the rate of descent to be less and the glide distance to be greater than during an actual flame-out forced landing. The drag of a windmilling engine can be simulated for practice forced landings by opening the speed brakes. However, the drag created by the open speed brakes is actually greater than that of the windmilling engine; as a result, a certain amount of engine power is required to offset this excessive drag. Rate of descent, glide distance, and flight characteristics with the windmilling engine can be simulated above 12,000 feet by reducing the engine rpm to 72%, opening speed brakes, and establishing a glide speed of 185 knots IAS. Landing gear should be lowered at 12,000 feet and a glide speed of 170 knots IAS initiated. To simulate the drag of a windmilling engine at 170 knots IAS, the rpm should be reduced to 69%, because of decrease in drag at the lower glide speed. Familiarization with forced landing techniques and procedures (figure 3-2) can be attained by practicing the use of recommended engine power and extended speed brakes to simulate a flame-out condition. During an actual forced landing, the speed brakes may be used as desired, to prevent possible overshoot. On practice forced landings, however, since the speed brakes have been opened previously, it is necessary to retard the throttle to IDLE when speed brake effect is desired. It should be remembered that since the idling engine produces some thrust, landings made during practice will be slightly farther down the runway than a landing made with a dead engine. If approach during practice forced landing is not as desired, make a normal go-around and repeat the forced landing procedures until desired proficiency is attained.

FIRE.

Note

There is no fire extinguishing system on this airplane.

The fire-warning system consists of two detector circuits, each circuit controlling a red cockpit warning light. The forward circuit senses fire in the forward engine compartment. The aft circuit senses overheat or fire in the engine compartment aft of the engine fire wall. The aft compartment is substantially more resistant to immediate fire damage than the forward compartment. This permits less drastic action in case the aft warning light comes on, as indicated in the following procedures.

ENGINE FIRE DURING STARTING.

If there is an indication of fire:

1. Throttle—OFF.
2. Engine master switch—OFF.
   Engine master switch at OFF, to close main fuel shutoff valve.

Note

With starter already locked in, moving engine master switch to OFF will not cause the starter to disengage.

3. Keep engine turning.
4. If fire persists:
   a. Stop-starter button—Depress.
   b. Battery-starter switch—OFF.
   c. Leave airplane as quickly as possible.

ENGINE FIRE DURING TAKE-OFF.

Illumination of the forward fire-warning light during take-off indicates a fire in the forward engine section, necessitating immediate action. Illumination of the aft fire-warning light indicates an overheat condition or possible fire in the aft section. The exact procedure to follow will vary with each set of circumstances, and will depend upon altitude, airspeed, length of runway, overrun clearing remaining, availability of arresting barrier, location of populated areas, etc. The decision you make will depend on these factors. To help you make a decision, the following procedures are presented for your consideration:

Forward Fire-warning Light (Ground Roll).

If the forward fire-warning light comes on during ground roll and sufficient runway or overrun area is available to allow for aborting the take-off, proceed as follows:

1. Throttle—OFF.
2. Bomb-rocket-tank salvo (jettison) button—Depress (or emergency jettison handle—Pull).

3. Landing gear handle—UP; gear emergency-up button—Depress and hold, if necessary, to retract gear.
4. Leave airplane immediately upon stopping, if fire is apparent.

Forward Fire-warning Light (Air-borne).

If the forward fire-warning light comes on after airplane becomes air-borne, and sufficient runway is not available and overrun area is congested, preventing aborting of take-off, the following is recommended if altitude is too low for a safe ejection.

1. Bomb-rocket-tank salvo (jettison) button—Depress (or emergency jettison handle—Pull).
2. Throttle—Maintain power.
   Maintain take-off power and begin immediate climb.
3. Maximum climb.
   Immediately climb to safe ejection altitude.
4. Throttle—Adjust to minimum practical power.
   Adjust throttle to minimum practical power to maintain safe ejection altitude.
5. Check for fire.
   Determine whether a fire actually exists by a report from another airplane, abnormal instrument readings or airplane or engine response to controls, explosion, unusual noise or vibration, fumes, heat, cockpit smoke, or trailing smoke noted following a turn.
6. If fire is confirmed—Eject.

WARNING

Whenever existence of fire is confirmed prompt ejection will assure greatest chance for survival.

7. If fire cannot be confirmed—Land as soon as possible.

   If existence of fire cannot be confirmed, maintain a safe ejection altitude at minimum practical power. Establish controllability of airplane and try to obtain assistance from other airplanes in the area in determining existence of fire. If no assistance is available, reconfirm controllability prior to descent below safe ejection altitude, and land as soon as possible.

Aft Fire-warning Light (Ground Roll).

If the aft fire-warning light comes on during ground roll and sufficient runway and overrun area is available to abort the take-off proceed as follows:

1. Throttle—OFF.
2. Bomb-rocket-tank salvo (jettison) button—Depress (or emergency jettison handle—Pull).
3. Use maximum braking.
4. Warning light—Check.
   a. If light remains on after stopping—Leave airplane immediately.
   b. If light goes out—Engine master switch—OFF; then battery-starter switch—OFF.

Aft Fire-warning Light (Air-borne).

If the aft fire-warning light comes on after becoming air-borne and take-off cannot be safely aborted, proceed as follows:

1. Throttle—Retard and continue climb-out.
   Do not retard throttle below an rpm range where a safe climb cannot be maintained.
2. Warning light—Check.
   a. If light goes out—Continue flight at reduced power and land as soon as possible.
   b. If light remains on—Maintain climb at reduced power and check for other indications of fire, such as trailing smoke, long exhaust flame, etc.
   c. If no fire is apparent—Continue flight at reduced power and land as soon as possible.
   d. If positive fire indication exists—Maintain power and immediately climb to minimum safe ejection altitude, then eject.
   (See figures 3-4 and 3-5 for minimum safe ejection altitudes.)

ENGINE FIRE DURING FLIGHT.

Forward Fire-warning Light.

If the forward fire-warning light comes on, proceed as follows:

1. Throttle—Adjust to minimum practical power.
   Adjust throttle to minimum practical power to maintain safe ejection altitude.
2. Check for fire.
   Determine whether a fire actually exists by a report from another airplane, abnormal instrument readings, airplane or engine response to controls, explosion, unusual noise or vibration, fumes, heat, cockpit smoke, or trailing smoke noted following a turn.
3. If fire is confirmed—Eject.

WARNING

Whenever existence of fire is confirmed, prompt ejection will assure greatest chance for survival.

4. If fire cannot be confirmed—Land as soon as possible.

   If existence of fire cannot be confirmed, maintain a safe ejection altitude at minimum practical power. Establish controllability of airplane enroute to nearest available base and try to obtain assistance from other airplanes in the area in determining existence of fire. If no assistance is available, reconfirm controllability prior to descent below safe ejection altitude, and land as soon as possible.

Aft Fire-warning Light.

Illumination of the aft fire-warning light indicates an overheat condition or possible fire in the aft section, necessitating action as follows:

1. Warning light—Check.

   a. Reduce power in attempt to extinguish light.

   b. If light goes out—Continue flight at reduced power and land as soon as possible.

   c. If light remains on with throttle retarded to IDLE, indicating possible fire rather than overheat—Proceed to step 2.

2. Check for other indications of fire, such as trailing smoke, engine noise, verification from another airplane, etc.

   a. If no fire is apparent—Continue flight at minimum power and land as soon as possible.
   b. If positive indication of fire exists—Proceed to step 3.

3. Throttle—OFF.
4. Engine master switch—OFF.
5. If fire continues—Eject.
6. If fire ceases—Make forced landing, or eject.

ENGINE FIRE AFTER SHUTDOWN.

If there is indication of fire in the engine or tail-pipe section after engine shutdown:

1. External power—Connected to both receptacles.
2. Throttle—OFF.
3. Battery-starter switch—Maintain at STARTER.
4. Engine master switch—ON, until starter locks in.
5. Engine master switch—OFF (to close main fuel shutoff valve).

Note

Once starter has locked in, moving engine master switch to OFF will not cause starter to disengage.

6. Engine rpm—Approximately 6% (20 seconds maximum).
7. Stop-starter button—Depress.
8. Generator and battery-starter switches—OFF.
9. Leave airplane as quickly as possible.

ELECTRICAL FIRE.

Circuit breakers and fuses protect most of the circuits and will tend to isolate an electrical fire. However, if electrical fire occurs, proceed as follows:

1. Battery-starter and generator switches—OFF.
2. Land as soon as possible.

CAUTION

When the electrical power source is turned off, most of the electrical equipment (including fire-warning lights) and some instruments will be inoperative.

WARNING

With battery-starter and generator switches OFF, the emergency fuel system is automatically operating as though in stand-by condition, regardless of emergency fuel switch setting. Use caution when moving throttle, as rapid throttle advancement with emergency fuel system in the stand-by condition can cause the emergency system to override the main fuel system, resulting in complete power failure because of engine overspeeding or compressor stall.

ELIMINATION OF SMOKE OR FUMES.

If smoke or fumes enter the cockpit, proceed as follows:

1. Cockpit pressure control lever—OFF (RAM AIR ON—DUMP OPEN).
2. Oxygen regulator diluter lever—100% OXYGEN.
3. Oxygen regulator pressure-breathing knob (A-14 regulator)—Set as required by cockpit altitude.
4. Oxygen regulator emergency toggle lever (D-2 regulator)—Push to left or right.

TAKE-OFF AND LANDING EMERGENCIES.

ENGAGING RUNWAY OVERRUN BARRIER.

In this airplane, successful engagements of the runway overrun barrier have been made up to 130 knots ground speed. However, minimum speeds have been established

which must be exceeded to ensure successful engagement. Whenever the runway overrun barrier is to be engaged, engage it as close to the recommended minimum speeds as possible. Off-center engagements can be made successfully but will result in the airplane swerving as a result of the webbing pulling the nose wheel unevenly. This momentary swerve is not dangerous and therefore should be disregarded. If unable to bring the airplane to a stop or to a safe taxiing speed before reaching the end of the runway, and if the runway is equipped with a runway overrun barrier, observe the following:

1. Throttle—OFF.
2. 206½-gallon drop tanks—Jettison, if installed.

   Jettison 206½-gallon drop tanks over an open area, if installed; otherwise, main landing gear will not engage the barrier.

Note

In cases of known emergency in flight, jettison external load over an open area before landing.

3. Engine master, generator, and battery-starter switches —OFF.

CAUTION

Do not turn battery-starter switch off until engine master switch has been turned off, so that power will be available to close fuel shutoff valve.

4. Brakes—Avoid excessive use during engagement of barrier, to prevent tire blowouts.
5. Aim for center of barrier.
6. Engage barrier—At recommended speed.

   If no external load is installed, exceed minimum speed of 17 knots ground speed to engage the barrier. If 120-gallon drop tanks are installed, exceed minimum speed of 40 knots ground speed to engage the barrier.

BELLY LANDING.

If a belly landing is unavoidable, these steps should be followed:

1. Bomb-rocket-tank salvo (jettison) button—Depress (or emergency jettison handle—Pull).

Note

If landing on a prepared surface, retain empty drop tanks to reduce possible pilot injury, impact damage, and fire hazard.

2. Canopy switch—OPEN prior to final approach (jettison canopy if necessary). Pull helmet visor down before opening canopy.

   Prior to final approach, canopy switch at OPEN below 215 knots IAS. Lower head, and raise right seat handgrip to jettison canopy if it fails to open. (On airplanes equipped with the alternate emergency jettison handle, pull handle to jettison canopy without arming the seat catapult.)
3. Flap lever—DOWN, on final approach.
4. Speed brake switch—OUT.
5. Throttle—OFF, when landing ensured.
6. Engine master, generator, and battery-starter switches —OFF, just before touchdown.

   Just before touchdown, turn engine master, generator, and battery-starter switches OFF. Battery-starter switch should be turned off last, so that power will be available to close fuel shutoff valve when engine master switch is turned OFF.
7. Shoulder harness lock handle—LOCKED (forward).
8. Touch down in normal landing attitude.
9. Leave airplane immediately after it stops.

ANY ONE GEAR UP OR UNLOCKED.

If any one gear will not extend or lock down, leave remaining gear down and proceed as follows:

1. Bomb-rocket-tank salvo (jettison) button—Depress (or emergency jettison handle—Pull).
2. Fire ammunition and expend excess fuel, if time and conditions permit.

   Fire all ammunition and expend excess fuel to establish an aft CG condition and to minimize possible fire hazard.

Note

If landing on a prepared surface, retain empty drop tanks to reduce possible pilot injury, impact damage, and fire hazard.

3. Canopy switch—OPEN, prior to final approach (jettison canopy if necessary). Pull helmet visor down before opening canopy.

   Prior to final approach, canopy switch at OPEN below 215 knots IAS. Lower head, and raise right seat handgrip to jettison canopy if it fails to open. (On airplanes equipped with the alternate emergency jettison handle, pull handle to jettison canopy without arming the seat catapult.)
4. Plan approach to touch down as near end of runway as possible.
5. Flap lever—DOWN, on final approach.

6. Speed brake switch—OUT.

Note

If nose gear is down but not locked, you can attempt to snap it down and locked by making a touch-and-go landing. Attempt this procedure only after all other emergency measures are exhausted.

7. Throttle—OFF, just before touchdown.
8. Engine master switch—OFF.
9. Battery-starter switch—OFF.

   Wait one second to allow fuel shutoff valve to close; then move battery-starter switch to OFF.
10. Generator switch—OFF, if time permits.
11. Shoulder harness lock handle—LOCKED (forward).
12. After touchdown—Hold unsafe gear off runway as long as possible.

    After touchdown, hold unsafe gear off runway as long as possible, easing unsafe gear down before flight controls become ineffective.
13. Brakes—Do not use, if stop can be made without them.
14. Leave airplane immediately after stopping.

LANDING WITH FLAT TIRE.

Nose Gear Tire Flat.

When a landing is to be made with the nose gear tire flat, lower the landing gear in the normal manner and proceed as follows:

1. Touchdown—Hold nose gear off runway as long as possible.
2. Directional control—After nose wheel touchdown, use combination of braking and nose wheel steering.

Main Gear Tire Flat.

When a landing is to be made with a main gear tire flat, lower the landing gear in the normal manner and proceed as follows:

1. Touchdown—Land on side of runway away from flat tire.

Note

This is necessary to minimize the amount of differential braking required if the airplane pulls toward the flat tire.

2. Directional control—After nose wheel touchdown, use combination of differential braking and nose wheel steering.

NO-FLAP LANDING.

No special technique is required for landing without wing flaps. Speed during final approach and touchdown should be increased 10 percent over recommended speeds for load and configuration.

EMERGENCY ENTRANCE.

See figure 3-3 for emergency access to cockpit on the ground.

DITCHING.

Note

Inspect emergency equipment, life vest, and raft pack before each overwater flight.

Ditching the airplane is not recommended, since all emergency survival equipment is carried by the pilot; consequently, there is no advantage in riding the ship down. However, if altitude is not sufficient for bail-out, and ditching is unavoidable, proceed as follows:

1. Follow radio distress procedure.
2. Bomb-rocket-tank salvo (jettison) button—Depress (or emergency jettison handle—Pull).
3. Personal equipment—Check that it will not foul when leaving cockpit.
4. Anti-G suit—Disconnect.
5. Oxygen regulator diluter lever—100% OXYGEN.

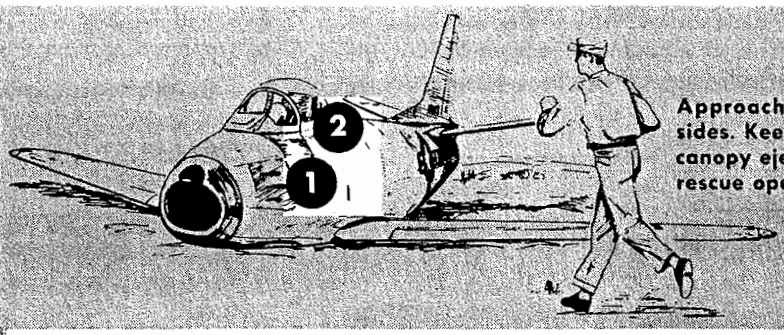
Note

In the event of ditching and sinking in water where you find yourself unable to immediately escape due to any number of factors, it is possible for you to survive under water with your oxygen equipment until you can free yourself and escape. The A-14 or A-13A pressure-demand type oxygen mask and either the A-14 or D-2 oxygen regulator are suitable underwater breathing devices when the regulator is set at 100% OXYGEN. It is essential that the mask be in place and tightly strapped, and that the regulator be set at 100% OXYGEN. The bail-out bottle cannot be used under water.

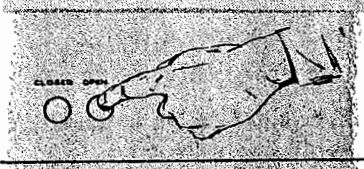
6. Landing gear handle—UP.
7. Slat lock lever (airplanes so equipped)—UNLOCK.
8. Speed brake switch—IN.
9. Canopy switch—OPEN (jettison canopy if necessary). Pull helmet visor down before opening canopy.

   Canopy switch OPEN below 215 knots IAS. Lower head, and raise right seat handgrip to jettison

emergency entrance



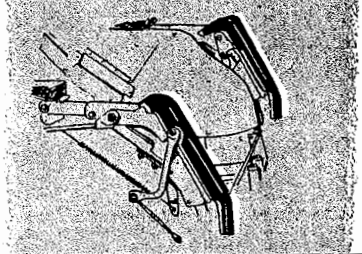
Approach airplane from sides. Keep clear of line of canopy ejection throughout rescue operation.



1 If canopy has not been jettisoned by pilot, and time and conditions permit, depress canopy control button marked "OPEN" until canopy is fully open. Canopy control buttons are on each side of the fuselage.

2 If canopy will not open electrically, pull and hold canopy external emergency release handle to release canopy latches; then slide canopy off with hinged handles and remove from airplane.

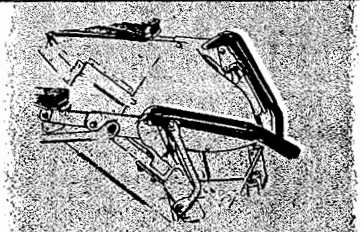
NOTE: Should all normal attempts fail to open canopy, use a fire ax or similar implement to break canopy aft of armor plate.



3 If both seat handgrips are in the normal or stowed position, complete rescue operation.

WARNING

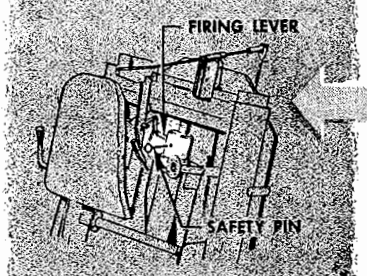
Keep clear of handgrips at all times. If handgrip is inadvertently raised by rescue personnel, the canopy remover will be fired, and the trigger may be accidentally actuated and the seat ejected.



4 If either handgrip is raised:

WARNING

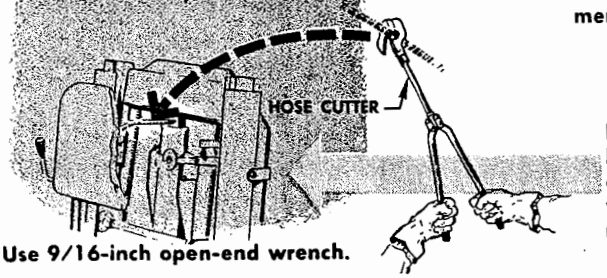
If the pilot has jettisoned or attempted to jettison the canopy, one or both seat handgrips may be raised. Use extreme caution in safetying seat catapult.



On airplanes with mechanically actuated seat catapults, insert a safety pin through the fore-and-aft hole in the seat catapult. If original pin has been pulled, the catapult firing lever may be moved *UP* slightly to allow insertion of the pin through the catapult. Then complete rescue operation.

WARNING

- If original safety pin is in seat catapult, DO NOT REMOVE IT.
- Do not move firing lever *DOWN* to align hole, since such movement will set off seat catapult charge and eject the seat.



On airplanes with gas-actuated seat catapults, disconnect hose* leading from "T" fitting to catapult at the catapult, or cut the hose as close to the catapult as possible; then complete rescue operation. Make sure loose hose ends are not aligned; otherwise, if seat initiators fire accidentally, expanding gases still may actuate catapult exactor and cause seat to fire.

*Use 9/16-inch open-end wrench.

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Figure 3-3

canopy if it fails to open. (On airplanes equipped with the alternate emergency jettison handle, pull handle to jettison canopy without arming the seat catapult.)

10. Throttle—OFF.
11. Flap lever—DOWN.
    Flaps collapse on impact and do not cause airplane to dive.
12. Engine master, generator, and battery-starter switches —OFF.
    Turn battery-starter switch OFF last, so that power will be available to close fuel shutoff valve when engine master switch is turned OFF.
13. Safety belt and shoulder harness—Tighten.
14. Shoulder harness lock handle—LOCKED (forward).
15. Surface conditions—Check.
    Unless wind is high or sea is rough, plan approach heading parallel to any uniform swell pattern and try to touch down along wave crest or just after crest passes. If wind is as high as 25 knots or surface is irregular, the best procedure is to approach into the wind and touch down on the falling side of a wave.
16. Approach and flare—Normal.
17. Touchdown—Keep nose high, and attempt to touch down at minimum flying speed.

WARNING

If airplane is ditched in a near-level attitude, it will dive violently soon after contact.

18. Oxygen mask—Remove.
19. Leave airplane.

EJECTION.

Escape from the airplane in flight should be made with the ejection seat. The basic seat ejection procedure is shown in figures 3-4 and 3-5.

WARNING

- If ejection is necessary, it should not be delayed when the airplane is in a descending attitude, or cannot be leveled, as the chance of successful ejection at low altitude under these conditions is greatly reduced.
- If overwater ejection is made, remove oxygen mask before hitting water, to prevent sucking water into mask.

Study and analysis of ejection techniques by means of the ejection seat have revealed that:

a. Ejection accomplished at airspeeds ranging from stall speed to 525 knots IAS results in relatively minor forces being exerted on the body, thus reducing the injury hazard.

b. The body will undergo appreciable forces when ejection is performed at airspeeds of 525 to 600 knots IAS, and escape is more hazardous than at lower speeds.

c. Above 600 knots IAS, ejection is extremely hazardous because of the excessive forces on the body.

For ejections below 2000 feet, the technique which will result in the highest possible parachute deployment altitude is to pull the airplane nose above the horizon before ejection (zoom-up maneuver). Ejection seat trajectory will be closer to the vertical, resulting in an increase in altitude and time available for separation from the seat and parachute deployment. Therefore, using the zoom-up maneuver during low-altitude ejection will help to attain maximum parachute deployment altitude, and slowing the airplane before ejection at any altitude will reduce the forces exerted on the body. On airplanes equipped with the automatic-opening safety belt, the belt should never be opened manually before ejection, for the following reasons:

a. If the belt is opened manually, the escape operation is prolonged.

b. Manual opening of the belt creates a hazard to survival during uncontrollable flight because the pilot cannot stay in the seat before ejection if negative G is encountered.

c. Manual opening of the belt creates a hazard to survival if the pilot decides to crash-land the airplane. He probably will not be able to fasten the belt and shoulder harness, as both hands may be needed to control the airplane.

d. Manual opening of the belt will eliminate the automatic-opening feature of the automatic-opening parachute. The pilot would have to arm the parachute manually by pulling the parachute arming lanyard.

e. If the belt is manually opened before ejection, the pilot will probably separate from the seat immediately. When this happens, the chances of clearing the tail are reduced.

f. At high speeds, the peak deceleration due to air loads on the pilot and seat together approaches the limits of human tolerance. Since deceleration of the pilot alone is considerably greater than that of pilot and seat together, immediate separation at high speeds could result in severe injury.

g. Immediate separation of pilot and seat at high speeds could result in the parachute pack being acci-

dentally blown open at the time of ejection. In this event, fatal injuries would probably be incurred because of the extremely high opening shock or because of serious damage to the parachute when it opens.

Note

- The automatic safety belt opens about 2 seconds (one second, for airplanes equipped with an M-12 automatic safety belt initiator) after ejection. This is sufficient time for safe deceleration of the pilot.
- The preceding information does not imply that the pilot should not open the manual safety belt before low-altitude ejections. Opening of the manual belt before low-altitude ejections is essential because of the time element involved. If the zoom-up maneuver is used during low-altitude ejection, the reduced airspeed will result in lower forces on the pilot, even if he separates from the seat immediately.

FAILURE OF CANOPY TO JETTISON.

Unmodified Airplanes.

On airplanes not changed by T.O. 1F-86-161, if the canopy fails to jettison when the right seat handgrip is raised, proceed as follows:

1. Slow airplane to below 215 knots IAS.
2. Canopy alternate emergency jettison handle (airplanes so equipped)—Lower head and pull handle.
3. If canopy fails to jettison, or if airplane is not equipped with the alternate emergency jettison handle:
   a. Canopy switch—OPEN.
   b. Canopy declutch handle—Pull.
   c. After canopy jettisons—Eject.
4. If canopy cannot be moved aft electrically:
   a. Canopy declutch handle—Pull.
   b. Canopy—Pull aft manually.
   c. After canopy jettisons—Eject.
5. If canopy fails to jettison after being pulled aft:
   a. Invert airplans, then push free of seat.

Modified Airplanes.

On airplanes changed by T.O. 1F-86-161, if canopy fails to jettison when the right handgrip (either handgrip on airplanes changed by T.O. 1F-86-227) is raised, proceed as follows:

1. Slow airplane to below 215 knots IAS.
2. Canopy alternate emergency jettison handle (airplanes so equipped)—Lower head and pull handle.
3. If canopy fails to jettison, or if airplane is not equipped with the alternate emergency jettison handle:
   a. Canopy switch—OPEN.
   b. Canopy declutch handle—Pull.
   c. After canopy jettisons—Eject.
4. If canopy cannot be moved aft electrically and canopy bow is not in ejection path:
   a. Left handgrip—Raise.
   b. Handgrip trigger—Squeeze, to eject through canopy.

FAILURE OF SEAT TO EJECT.

If the seat does not eject when the trigger is squeezed, proceed as follows:

1. Safety belt—Unfasten.
2. Bail-out bottle—Actuate, if necessary.
3. Personal leads (oxygen, radio, and anti-G suit—Disconnect.
4. Invert airplane and then push free of seat, or bail out over side.
   If you have control of the airplane, trim nose down and pull stick back to slow airplane as much as possible; then invert airplane. Maintain positive G-load until inverted; then sharply release stick and push free of seat. If you do not have control of the airplane, slow airplane as much as possible; then bail out over the side.
5. Parachute-arming lanyard (automatic parachute), or "D" ring (manual parachute)—Pull.

WARNING

If bail-out occurs below 14,000 feet, pull "D" ring immediately whether parachute is automatic or manual type.

Note

If you lose your oxygen mask and you do not have an automatic parachute, you should free-fall to 14,000 feet if possible, and then pull "D" ring. The length of time you can free-fall before anoxia prevents you from pulling the "D" ring depends upon your physical condition and the bail-out altitude.

FUEL SYSTEM FAILURE.

Erratic fluctuations of the fuel pressure gage at high altitudes, accompanied by an increase or variation of exhaust temperature, may indicate fuel booster pump failure. A sudden loss of fuel pressure and a rapid decrease in

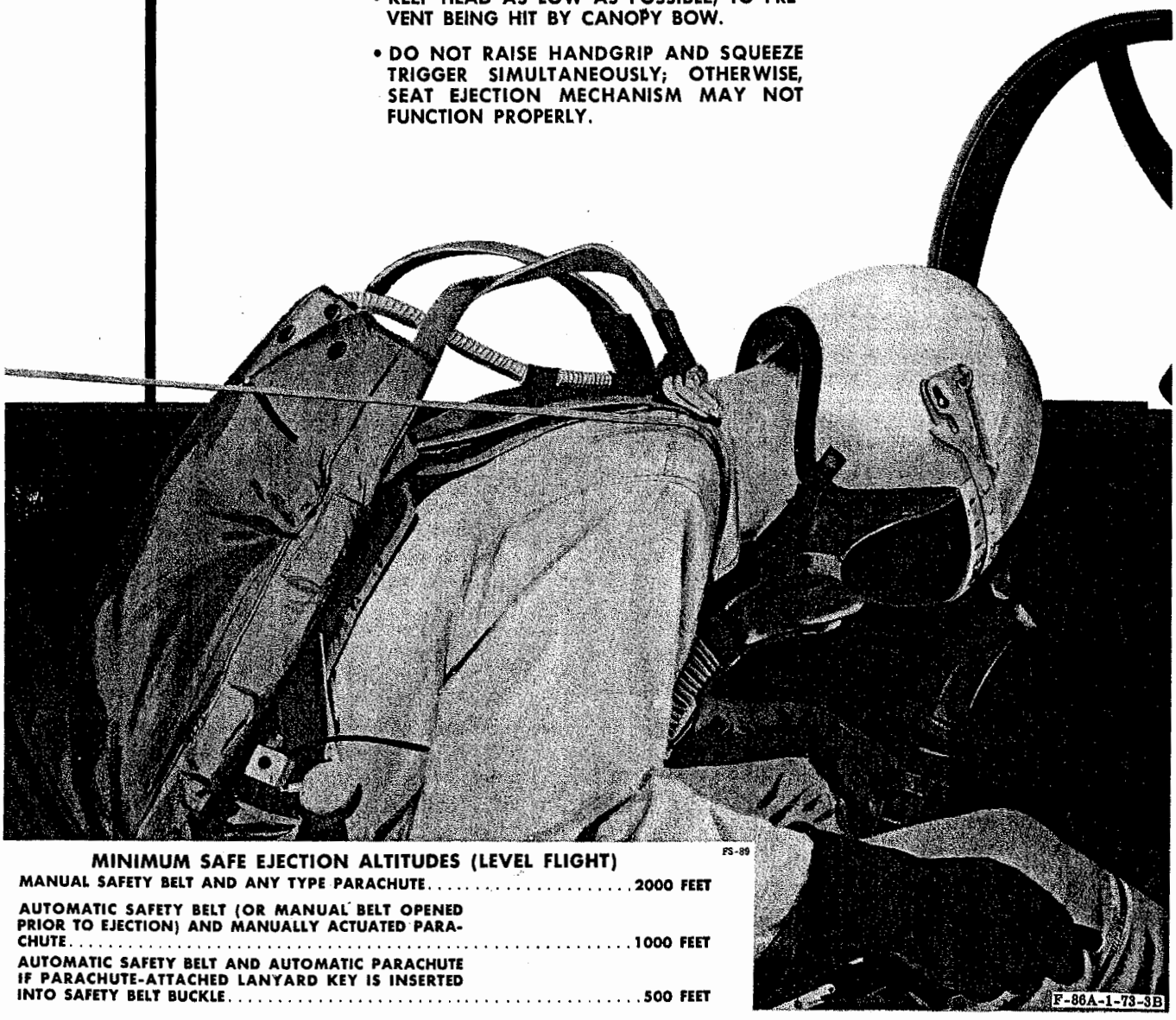
ejection procedures

AIRPLANES NOT CHANGED BY T.O. 1F-86-227

1 LOWER HEAD; THEN PULL RIGHT SEAT HANDGRIP FULL UP TO JETTISON CANOPY.

WARNING

- KEEP HEAD AS LOW AS POSSIBLE, TO PREVENT BEING HIT BY CANOPY BOW.
- DO NOT RAISE HANDGRIP AND SQUEEZE TRIGGER SIMULTANEOUSLY; OTHERWISE, SEAT EJECTION MECHANISM MAY NOT FUNCTION PROPERLY.



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MINIMUM SAFE EJECTION ALTITUDES (LEVEL FLIGHT)

MANUAL SAFETY BELT AND ANY TYPE PARACHUTE	2000 FEET
AUTOMATIC SAFETY BELT (OR MANUAL BELT OPENED PRIOR TO EJECTION) AND MANUALLY ACTUATED PARACHUTE	1000 FEET
AUTOMATIC SAFETY BELT AND AUTOMATIC PARACHUTE IF PARACHUTE-ATTACHED LANYARD KEY IS INSERTED INTO SAFETY BELT BUCKLE	500 FEET

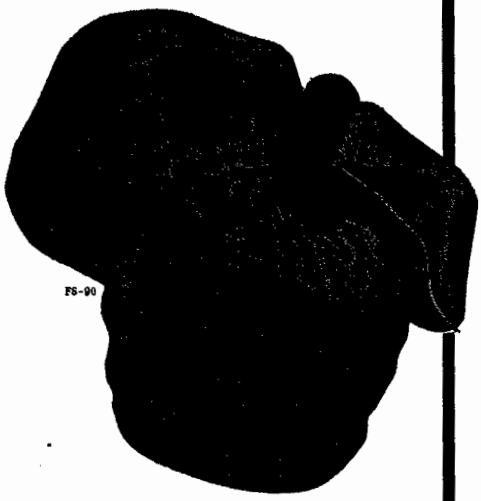
Figure 3-4

2

HOOK HEELS IN FOOTRESTS AND BRACE ARMS IN ARMRESTS. SIT ERECT, HEAD HARD BACK AGAINST HEADREST, CHIN TUCKED IN.

NOTE

TO LOCK SHOULDER HARNESS, PULL UP LEFT HANDGRIP.



3

SQUEEZE TRIGGER TO EJECT SEAT.

NOTE

RAISING LEFT HANDGRIP ON SOME AIRPLANES* ALSO PULLS SEAT SEAR SAFETY PIN. THIS PREPARES SEAT TO BE FIRED THROUGH CANOPY IF CANOPY FAILS TO JETTISON OR TO BE FIRED IF CANOPY JETTISONS BUT DOES NOT PULL SEAT CATAPULT SEAR SAFETY PIN. (EJECT THROUGH CANOPY ONLY AS A LAST RESORT.) LEFT HANDGRIP CANNOT BE ACTUATED UNTIL RIGHT HANDGRIP HAS BEEN RAISED FULL UP.

* Airplanes changed by T.O. 1F-86-161

WARNING

- During low-altitude ejections (below 2000 feet above terrain), unfasten manual belt before ejection, to aid in separating from seat. In a dive at high speeds, the manual belt should be unfastened before ejection at altitudes up to 5000 feet above the terrain to permit rapid separation from the seat and opening of parachute. After separation from seat, pull "D" ring to open either conventional or automatic parachute.
- Do not manually open automatic-opening safety belt before ejection at any altitude or at any airspeed.

BEFORE EJECTION, IF TIME AND CONDITIONS PERMIT . . .

- Actuate bail-out oxygen bottle.
- Stow all loose equipment.

AFTER SEAT EJECTS . . .

AIRPLANES WITH MANUAL SAFETY BELT:

- Unfasten safety belt and kick free of seat.
- If wearing conventional, manually operated parachute, pull "D" ring when altitude is reached where normal breathing is possible.
- If wearing automatic parachute, pull arming lanyard manually. Parachute will open at a preset altitude. If below preset altitude parachute will open at a preset time interval.

AIRPLANES WITH AUTOMATIC-OPENING SAFETY BELT:

- *If safety belt fails to open automatically after 2 seconds (one second for airplanes equipped with an M-12 automatic-opening safety belt initiator),* manually unfasten belt and kick free of seat. Then, pull parachute arming lanyard.
- *If pilot is wearing automatic parachute* ***WITH*** *lanyard key inserted into safety belt buckle,* parachute opens at a preset altitude after pilot kicks free of seat. (Parachute opens after a preset time interval if below preset altitude.)
- *If wearing automatic parachute* ***WITHOUT*** *lanyard key inserted into safety belt buckle,* kick free of seat and pull parachute arming lanyard.
- *If wearing manually operated parachute,* kick free of seat; pull "D" ring at altitude where normal breathing is possible.

WARNING

After leaving seat, manually pull "D" ring for all ejections below 14,000 feet to open parachute immediately.

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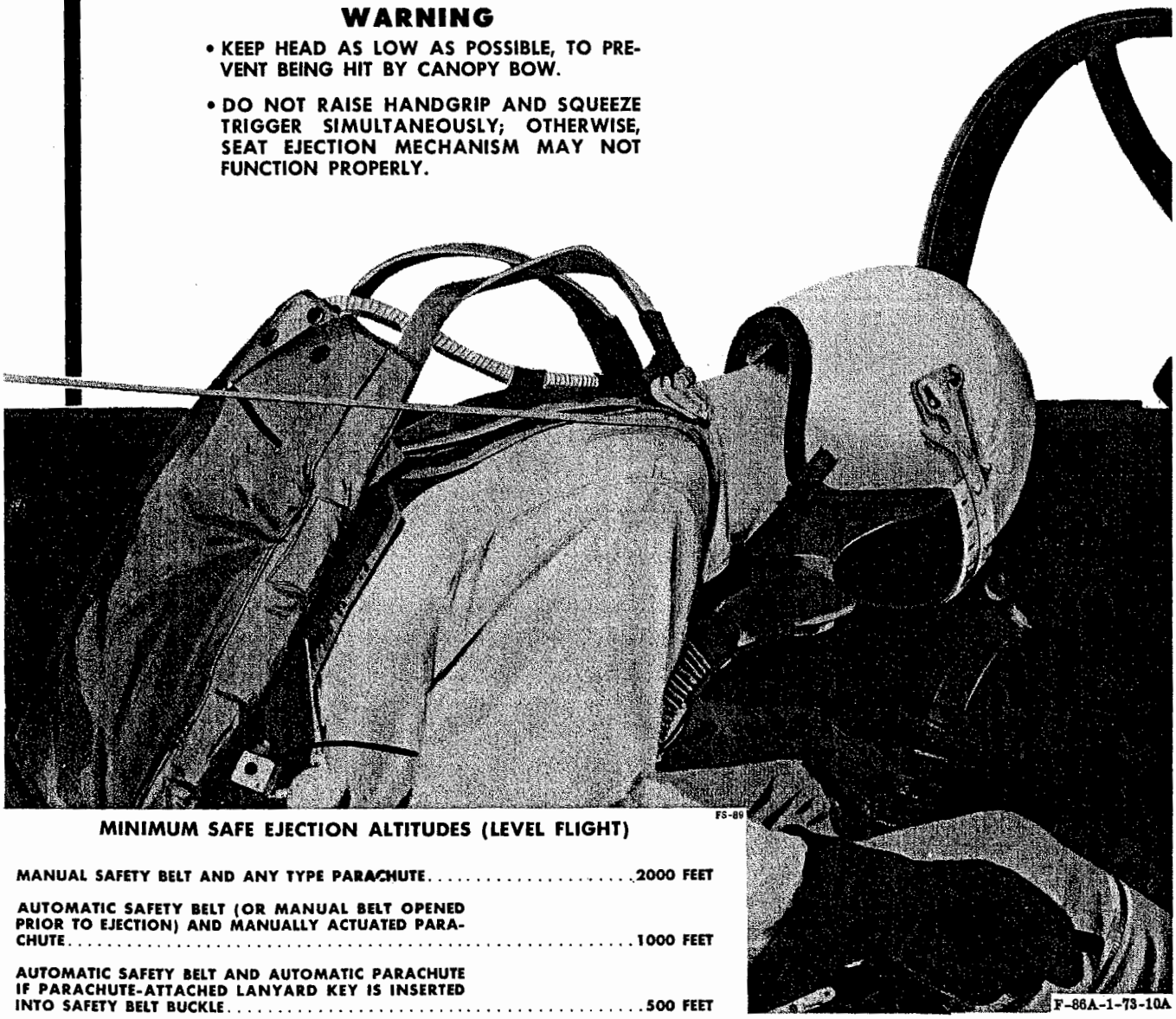
ejection procedures

AIRPLANES CHANGED BY T.O. 1F-86-227

1 LOWER HEAD; PULL EITHER RIGHT OR LEFT SEAT HANDGRIP FULL UP TO JETTISON CANOPY. (SHOULDER HARNESS LOCKS AUTOMATICALLY WHEN EITHER HANDGRIP IS RAISED.)

WARNING

- KEEP HEAD AS LOW AS POSSIBLE, TO PREVENT BEING HIT BY CANOPY BOW.
- DO NOT RAISE HANDGRIP AND SQUEEZE TRIGGER SIMULTANEOUSLY; OTHERWISE, SEAT EJECTION MECHANISM MAY NOT FUNCTION PROPERLY.



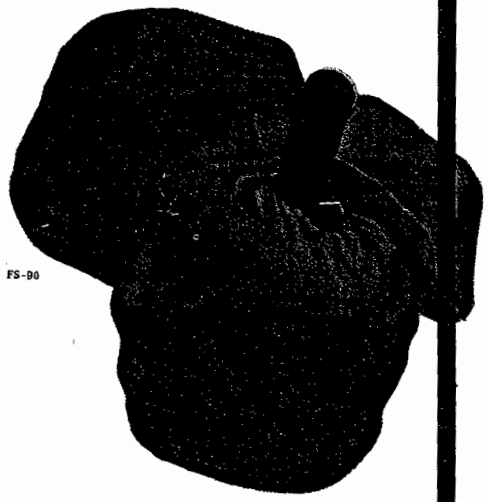
MINIMUM SAFE EJECTION ALTITUDES (LEVEL FLIGHT)

MANUAL SAFETY BELT AND ANY TYPE PARACHUTE	2000 FEET
AUTOMATIC SAFETY BELT (OR MANUAL BELT OPENED PRIOR TO EJECTION) AND MANUALLY ACTUATED PARACHUTE	1000 FEET
AUTOMATIC SAFETY BELT AND AUTOMATIC PARACHUTE IF PARACHUTE-ATTACHED LANYARD KEY IS INSERTED INTO SAFETY BELT BUCKLE	500 FEET

Figure 3-5

2

HOOK HEELS IN FOOTRESTS AND BRACE ARMS IN ARMRESTS. SIT ERECT, HEAD HARD BACK AGAINST HEADREST, CHIN TUCKED IN.



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3

SQUEEZE TRIGGER UNDER RAISED HANDGRIP TO EJECT SEAT.

WARNING

IF CANOPY FAILS TO JETTISON WHEN HANDGRIPS ARE RAISED, SEAT WILL BE EJECTED THROUGH CANOPY WHEN EITHER TRIGGER IS SQUEEZED.

WARNING

- During low-altitude ejections (below 2000 feet above terrain), unfasten manual belt before ejection, to aid in separating from seat. In a dive at high speeds, the manual belt should be unfastened before ejection at altitudes up to 5000 feet above the terrain to permit rapid separation from the seat and opening of parachute. After separation from seat, pull "D" ring to open either conventional or automatic parachute.
- Do not manually open automatic-opening safety belt before ejection at any altitude or at any airspeed.

BEFORE EJECTION, IF TIME AND CONDITIONS PERMIT . . .

- Actuate bail-out oxygen bottle.
- Stow all loose equipment.

AFTER SEAT EJECTS . . .

AIRPLANES WITH MANUAL SAFETY BELT:

- Unfasten safety belt and kick free of seat.
- If wearing conventional, manually operated parachute, pull "D" ring when altitude is reached where normal breathing is possible.
- If wearing automatic parachute, pull arming lanyard manually. Parachute will open at a preset altitude. If below preset altitude, parachute will open at a preset time interval.

AIRPLANES WITH AUTOMATIC-OPENING SAFETY BELT:

- *If safety belt fails to open automatically after 2 seconds (one second for airplanes equipped with an M-12 automatic-opening safety belt initiator)*, manually unfasten belt and kick free of seat. Then, pull parachute arming lanyard.
- *If pilot is wearing automatic parachute **WITH** lanyard key inserted into safety belt buckle*, parachute opens at a preset altitude after pilot kicks free of seat. (Parachute opens after a preset time interval if below preset altitude.)
- *If wearing automatic parachute **WITHOUT** lanyard key inserted into safety belt buckle*, kick free of seat and pull parachute arming lanyard.
- *If wearing manually operated parachute*, kick free of seat; pull "D" ring at altitude where normal breathing is possible.

WARNING

After leaving seat, manually pull "D" ring for all ejections below 14,000 feet to open parachute immediately.

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exhaust temperature indicate a failure within the main fuel regulator. This could result in engine flame-out, and an attempt to recover power should be made as follows:

1. Throttle—IDLE.
2. Emergency fuel switch—ON.

WARNING

If rpm is below 80%, do not turn on emergency fuel switch without first retarding throttle to IDLE. To do so may cause dangerous engine overheating or compressor stall.

3. Throttle—Advance gradually to obtain desired exhaust temperature and rpm.

CAUTION

No automatic engine overspeed protection is provided when the emergency fuel control system is being used; therefore, throttle movement must be smooth and gradual to avoid flame-out or engine overspeeding, particularly at high altitude.

4. If engine does not respond:
   a. Emergency fuel switch—OFF.
   b. Throttle—OFF.
   c. Establish normal glide and attempt air start. At low altitudes, booster pump failure may cause partial or complete engine flame-out if the fuel supply is low and the airplane is subjected to negative acceleration.
5. If partial flame-out occurs:
   a. Throttle—IDLE.
   b. Emergency ignition and emergency fuel switches—ON.
6. Emergency ignition and emergency fuel switches—OFF, when exhaust temperature and engine rpm indicate combustion stabilized.

CAUTION

Do not leave emergency ignition switch ON for more than 3 minutes per start. Prolonged operation will damage the ignition transformers.

7. Throttle—Advance slowly until engine rpm and exhaust temperature are as desired.

ENGINE OIL SYSTEM MALFUNCTION.

A decrease in oil pressure may be caused by an insufficient oil supply, a broken line, or a broken oil jet. An increase in oil pressure may be caused by an obstruction in the line, or a clogged oil jet. In the event of an oil system malfunction, possible oil starvation accompanied by failure of one or more of the main bearings may occur. If engine rpm is reduced after oil starvation of one or more main bearings, the resistance to rotation offered by a failed bearing may be great enough to cause further deceleration of the engine. Engine seizure would probably occur regardless of the fact that the throttle may be advanced after the engine has begun to decelerate. The engine may operate for a longer period with one or more failed main bearings if the rpm is increased immediately after oil malfunction is detected. Extremely high oil pressure could cause the oil lines to rupture and cause damage to the main fuel controller. This would not prevent operation of the engine on the emergency fuel system. However, engine operation on the emergency fuel system should be avoided unless absolutely necessary, since switching from the main fuel system to the emergency fuel system results in momentary engine deceleration. Such a deceleration could cause complete engine failure. In case of high or low engine oil pressure indication, follow this procedure:

1. If power setting is above 80% rpm—Do not move throttle until landing is ensured.
2. If power setting is below 80% rpm—Advance throttle to 80% rpm or more and do not move throttle until landing is ensured.

WARNING

- Retarding the throttle during an oil system malfunction may result in engine seizure and subsequent forced landing.
- In case of oil system malfunction, switching to the emergency fuel system is not recommended unless malfunction of the main fuel controller is detected. Switching fuel systems will generally cause momentary engine deceleration and possible engine seizure.

3. Land as soon as possible, using forced landing pattern to ensure landing in the event of complete power failure.

Note

During extreme cold weather operation, the oil pressure may exceed maximum limits until the oil temperature reaches normal.

ELECTRICAL POWER SYSTEM FAILURE.

COMPLETE ELECTRICAL FAILURE.

If a complete electrical failure occurs or if for any reason it becomes necessary to turn off both the battery and the generator, much of the equipment and many controls will be inoperable. Flight under this condition will be limited, and the following precautionary measures should be observed:

WARNING

When primary bus failure occurs, or if battery-starter switch is OFF when generator output is not available, the emergency fuel system would be operating as though in stand-by condition, regardless of emergency fuel switch setting. Use caution when moving throttle, as rapid throttle advancement with emergency fuel system in stand-by condition can cause the system to override the main fuel system, and complete power failure may occur as a result of engine overspeeding or compressor stall.

1. Airspeed—Reduce, and readjust trim.
   If possible, reduce airspeed and readjust trim before turning off electrical power, as the horizontal stabilizer and trim tabs will not be controllable without electrical power.
2. Altitude and rpm—Reduce as necessary.
   The fuel booster pumps will be inoperative when power is shut off; consequently, it may be necessary to reduce altitude and rpm in order to maintain satisfactory engine operation. (This condition will be aggravated by high outside air temperature and high airspeed.)
3. Airplane attitude—Lower nose as necessary to drain trapped fuel.
   If reduction in rpm is necessary, airplane may have to be held in a slightly nose-high attitude to maintain altitude. If prolonged flight in this attitude is necessary, a small amount of fuel will be trapped in the aft fuselage tank. If sufficient altitude is available, nose airplane down slightly for a short period to drain some of the trapped fuel into the forward fuselage tank lower cell.
4. Land as soon as possible.

Note

Use gear emergency lowering system to ensure that gear lowers and locks. (See figure 3-6.) When electrical power is not available to the primary bus, landing gear position indicators will be inoperative and will continuously show an unsafe condition.

GENERATOR IRREGULARITY.

Generator Failure or Undervoltage.

All equipment powered by the secondary bus will be inoperative and equipment on the primary bus will be operated by battery power when a generator failure or lowering of output occurs. This condition is indicated by the voltmeter and illumination of the generator warning light. Circuits for units powered by the single-phase inverter are controlled by the secondary bus and are also rendered inoperative when generator output fails or is reduced. (Refer to "Inverter Failure" in this section.) When generator output drops or fails, proceed as follows:

1. Nonessential electrical equipment—OFF.
   All nonessential electrical equipment should be turned off to reduce load on battery. The length of time that usable battery power is available for continued operation is approximately 7 to 28 minutes. Battery output duration may be decreased, however, by a number of variable factors including low state of battery charge, excessive electrical loads, and low battery temperature.
2. Engine master switch—OFF, if generator output is lost because of engine failure.
   If generator output is lost because of engine failure, the engine master switch should be moved to OFF to lessen battery loads.
3. Landing gear handle—DOWN.
4. Landing gear emergency release handle—Pull full out and hold extended momentarily for all landings where generator failure has occurred.
   For all landings where generator failure has occurred, lower the landing gear by the emergency system, to ensure that gear will extend and lock. (See figure 3-6.) Battery power may not be sufficient to position landing gear and door control valves when the normal gear lowering system is used.

Note

If the generator has failed and either battery power is not available to the primary bus or the battery switch is turned off, the landing gear position indicators will be inoperative and will continuously show an unsafe condition.

Generator Overvoltage.

A generator overvoltage condition is indicated by the voltmeter and illumination of the generator overvoltage warning light. Attempt to bring the generator back into the circuit as follows:

1. Generator switch—Hold at RESET momentarily, then OFF.

2. If voltmeter shows normal system voltage:
   a. Generator switch—ON.

      If the voltmeter shows normal system voltage, it indicates that overvoltage was temporary. Turn generator switch ON (generator overvoltage warning light will go out).

3. If generator overvoltage is still indicated by voltmeter:
   a. Generator switch—OFF.
   b. Voltage regulator rheostat—Adjust.

      Attempt to bring voltage down to 28 volts by adjusting voltage regulator rheostat. A maximum of 31 volts is allowable in an emergency if voltage cannot be decreased to 28 volts.

   c. Generator switch—Hold momentarily at RESET, then ON.
4. If generator overvoltage warning light remains out:
   a. Check voltage and readjust regulator rheostat as necessary.
5. If voltage cannot be brought within allowable limits:
   a. Generator switch—OFF.
   b. Land as soon as possible.

INVERTER FAILURE.

If failure of the single-phase inverter is indicated by illumination of the inverter warning light, proceed as follows:

1. Instrument power switch—ALT.

   Move instrument power switch to ALT to change to the three-phase inverter. (Inverter warning light will remain on.) When generator failure occurs, in turn causing failure of the single-phase inverter, the inverter warning light will not illuminate. However, transfer to the three-phase inverter is automatic, and the instrument power switch does not have to be moved to ALT.

CAUTION

Failure of both inverters, resulting in the loss of ac power, will cause the fuel flowmeter, fuel and oil pressure gages, and the directional and attitude indicators to become inoperative. However, these instruments, while inoperative, will provide erroneous indications by continuing to show the condition that existed at the time of power failure.

FLIGHT CONTROL BOOST SYSTEM FAILURE.

Loss of elevator boost is not considered dangerous, and the airplane will be controllable. However, loss of aileron boost can be serious for two reasons. First, if airplane is not in trim or is in a maneuver when boost failure occurs, an uncontrollable roll may result. Second, aileron control is substantially reduced and is adequate only below 200 knots IAS or below 350 knots on airplanes with short-chord ailerons.* In the event of boost system failure, proceed as follows:

Note

- If hydraulic boost system fails, by-pass valves open automatically.
- If aileron boost becomes inoperative, move aileron boost switch to BYPASS.

CAUTION

If aileron boost switch is left ON and aileron boost is suddenly restored while you are moving the stick, the resultant overcontrol may put the airplane in a dangerous attitude.

1. Aileron trim—As required to reduce stick forces.
2. Maintain as near level attitude as possible.
3. Landing gear handle—DOWN at sufficiently high altitude to correct possible roll.

WARNING

Do not jettison external load above 200 knots IAS unless absolutely necessary, as this may drastically alter lateral trim.

4. Land as soon as possible.

UTILITY HYDRAULIC SYSTEM FAILURE.

There are no emergency provisions in the utility hydraulic system except the one-shot accumulators installed in the nose gear system.

LANDING GEAR EMERGENCY OPERATION.

LANDING GEAR GROUND EMERGENCY RETRACTION.

If it is necessary to retract the landing gear when the airplane is on the ground, proceed as follows:

1. Landing gear handle—UP.

*F-86A-5 Airplane AF49-1067 and all later airplanes

2. Landing gear emergency-up button—Depress until gear completely retracts.

   Gear retraction time can be reduced when emergency-up button is used, by yawing the airplane through alternate application of right and left wheel brakes, or by applying rudder alternately with nose wheel steering engaged.

CAUTION

- Gear will retract only if utility hydraulic pressure and battery power are available.
- Nose gear cannot be retracted after being lowered by means of the landing gear emergency release handle.

LANDING GEAR IN-FLIGHT EMERGENCY OPERATION.

Landing Gear In-flight Emergency Retraction.

During flight, the following condition may be encountered: The red (gear unsafe) landing gear position indicator light may remain on after the landing gear handle is placed at UP. This does not necessarily constitute an emergency condition, but under certain conditions airloads on the landing gear doors can prevent gear retraction. This would be indicated by a safe gear-down condition for all three green (gear safe) position indicator lights with the landing gear handle at UP and the red position indicator light on. If such a condition occurs, proceed as follows:

1. Landing gear handle—Leave UP, if all gear indicators show safe "down" with gear handle UP and red gear position indicator light on.
2. Maintain straight flight.
   Maintain a straight flight path to minimize G-loads on the gear doors and to eliminate yaw.
3. Airspeed—Reduce to below gear-down limit speed.
   Reduce speed to below gear-down limit speed (155 to 160 knots IAS is recommended to minimize airloads on the gear doors).
4. If safe indication is obtained:
   a. Continue flight.
5. If unsafe condition still exists:
   a. Landing gear handle—DOWN.
   b. Land as soon as possible when safe gear-down indication is obtained.

If mission is important, maintain straight flight path to minimize G-loads on the gear doors and to eliminate yaw. Hold airspeed below gear-down limit speed (155 to 160 knots IAS is recommended) and cycle gear down and up. If red gear position indicator light goes out, continue mission. If red gear position indicator light remains on, lower gear and land as soon as practicable.

CAUTION

Do not move landing gear handle when the red gear position indicator light is on and speed is above 185 knots IAS, as gear doors may be torn off when hydraulic pressure is released from door actuating cylinders.

Landing Gear In-flight Emergency Lowering.

The landing gear emergency lowering procedure is shown in figure 3-6.

CAUTION

The nose gear cannot be retracted after being lowered by means of the landing gear emergency release handle.

WING SLAT EMERGENCY OPERATION.*

On early airplanes* not changed by T.O., in case of failure of the main hydraulic system when slats are locked closed, they can be unlocked by use of the emergency hydraulic system as follows:

1. Slat lock lever—UNLOCK.
2. Emergency hydraulic selector—EMER SLAT UNLOCK.
3. Operate emergency hand-pump.

WING FLAP EMERGENCY OPERATION.

No emergency flap control system is provided. If unequal retraction or lowering of the flaps occurs during normal flap operation, hold airplane level and return flap control to original position. (Sufficient aileron control will be available to hold wings level in this condition, or to roll against the down flap if necessary.) Make a landing as soon as possible without any further attempt to operate the flaps. If position of flaps cannot be synchronized, land at approximately 10 knots above normal landing speeds.

TRIM FAILURE.

Whenever trim failure is encountered, the flight should be terminated as soon as possible. If operation of the

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*F-86A-5 Airplanes AF48-129 through -254

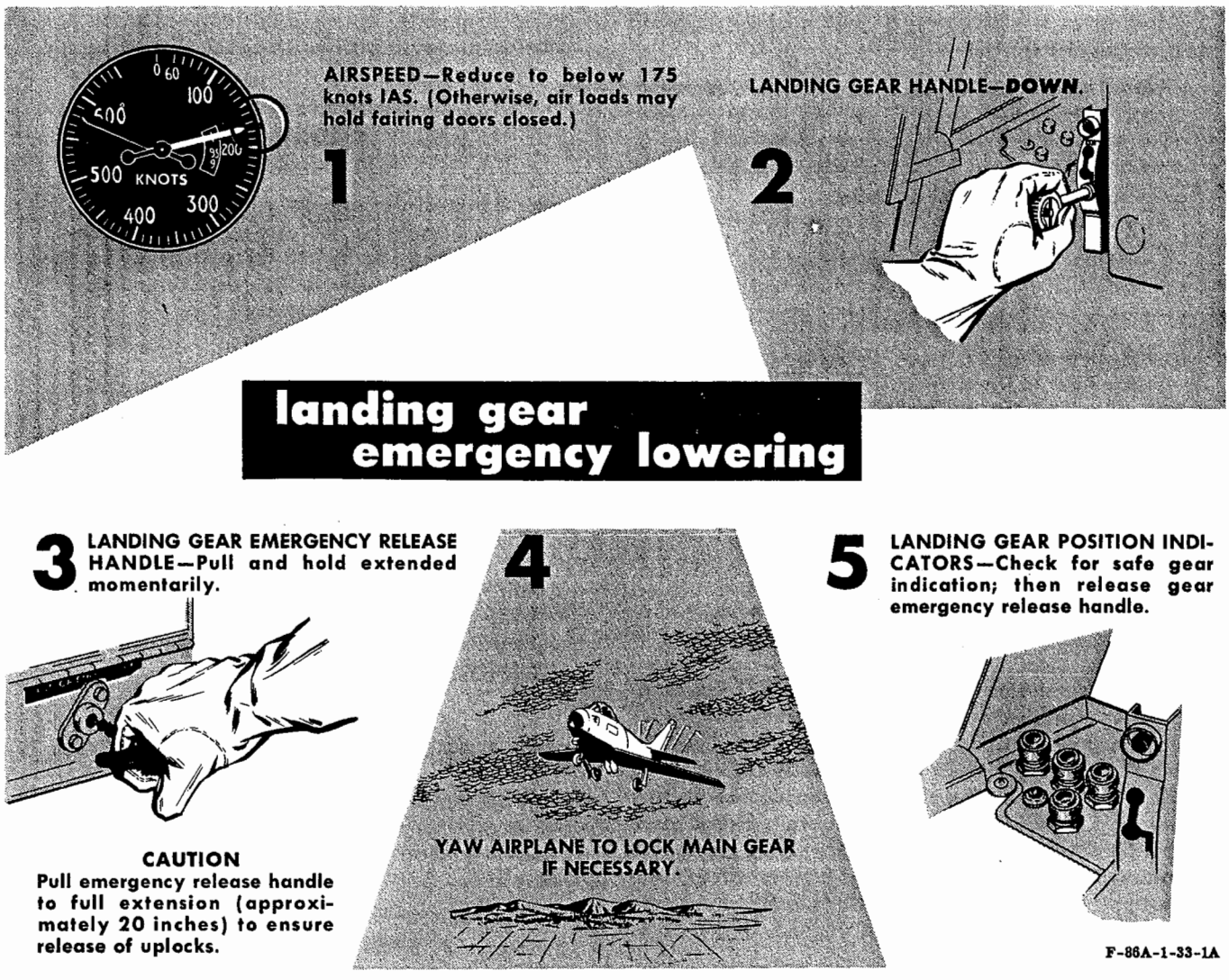


Figure 3-6

normal trim switch on the stick grip fails to provide stabilizer or aileron control, proceed as follows:

1. Circuit breakers—IN.
2. Horizontal stabilizer alternate and aileron alternate trim switches—Use as necessary.
3. Horizontal stabilizer alternate trim switch—OFF, when desired trim is obtained.

Note

The normal trim switch on top of the stick grip is inoperative whenever the horizontal stabilizer alternate trim switch is not at the NORMAL STICK GRIP position.

RUNAWAY TRIM.

Should the horizontal stabilizer continue to trim after the normal trim switch has been returned to the center position (resulting in an excessive nose-up or nose-down trim condition), the following corrective action should be taken:

1. Circuit breakers—IN.
2. Throttle—IDLE.
3. Speed brake switch—OUT, if failure has produced a nose-down trim.

   If trim failure has produced a nose-down trim, open speed brakes to effect a nose-up pitching moment and to help reduce speed.

WARNING

If trim failure has caused a nose-up attitude, do not open speed brakes, as this action will aggravate the nose-up pitch.

4. Horizontal stabilizer alternate trim switch—Use as necessary.

   Hold horizontal stabilizer alternate trim switch at

NOSE UP or NOSE DOWN as necessary to change stabilizer setting, and apply maximum pilot effort to counteract the excess trim.

5. Horizontal stabilizer alternate trim switch—OFF when desired trim is obtained.
6. If no trim response—Reduce airspeed until stick forces are minimized.

Note

If trim failure has caused a nose-up condition, the gear and flaps may be lowered to aid in keeping the nose down.

SPEED BRAKE SYSTEM FAILURE.

To close speed brakes in case of electrical or hydraulic failure, proceed as follows:

1. Speed brake emergency lever—EMERG CLOSED.

EXTERNAL LOAD EMERGENCY RELEASE.

To drop external load during an in-flight emergency, follow this procedure:

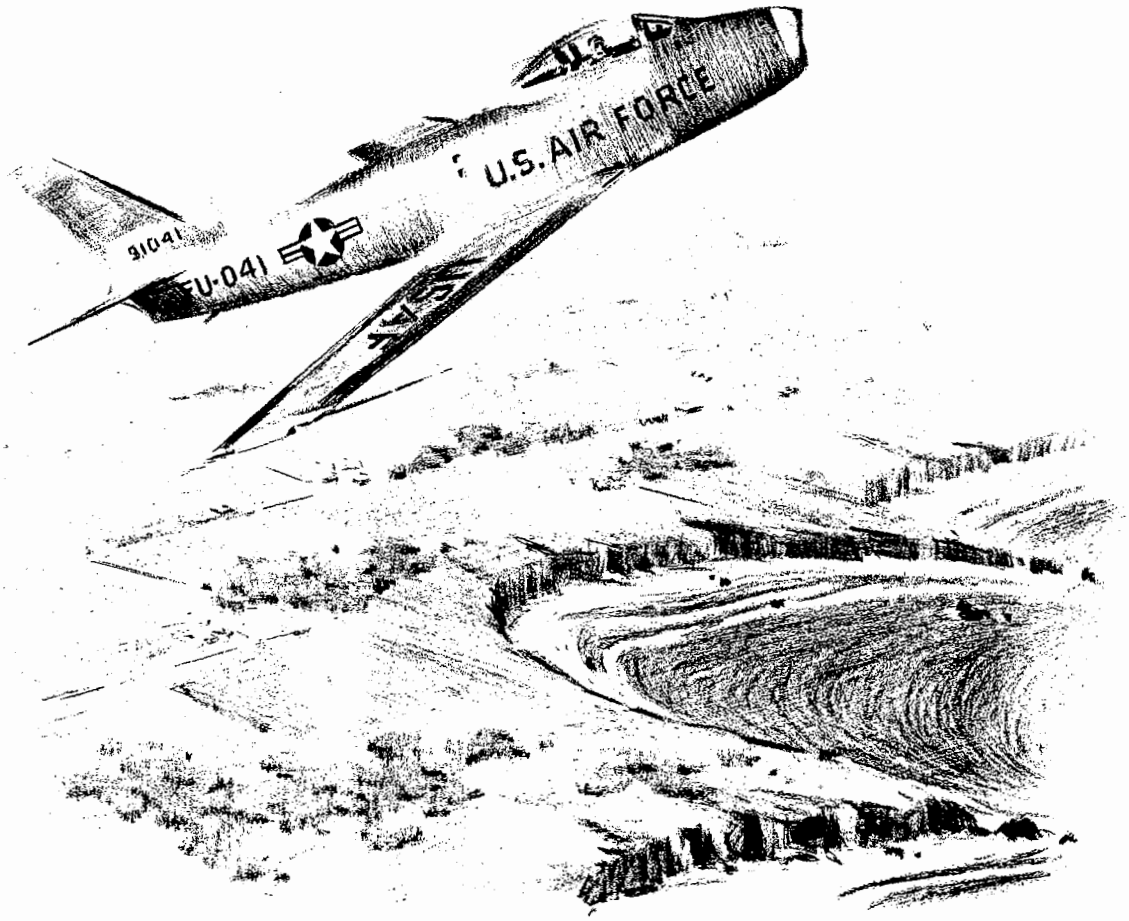
1. Bomb-rocket-tank salvo (jettison) button—Depress.
2. Load released—Check.
3. Emergency jettison handle—Pull, if no electrical power is available, or load fails to release.

Note

Rockets will not jettison when the emergency jettison handle is pulled. If it will not jeopardize other airplanes or people on the ground, fire the rockets.

CONDENSED CHECK LIST.

Refer to pages 3-25 through 3-40 for the condensed check list.



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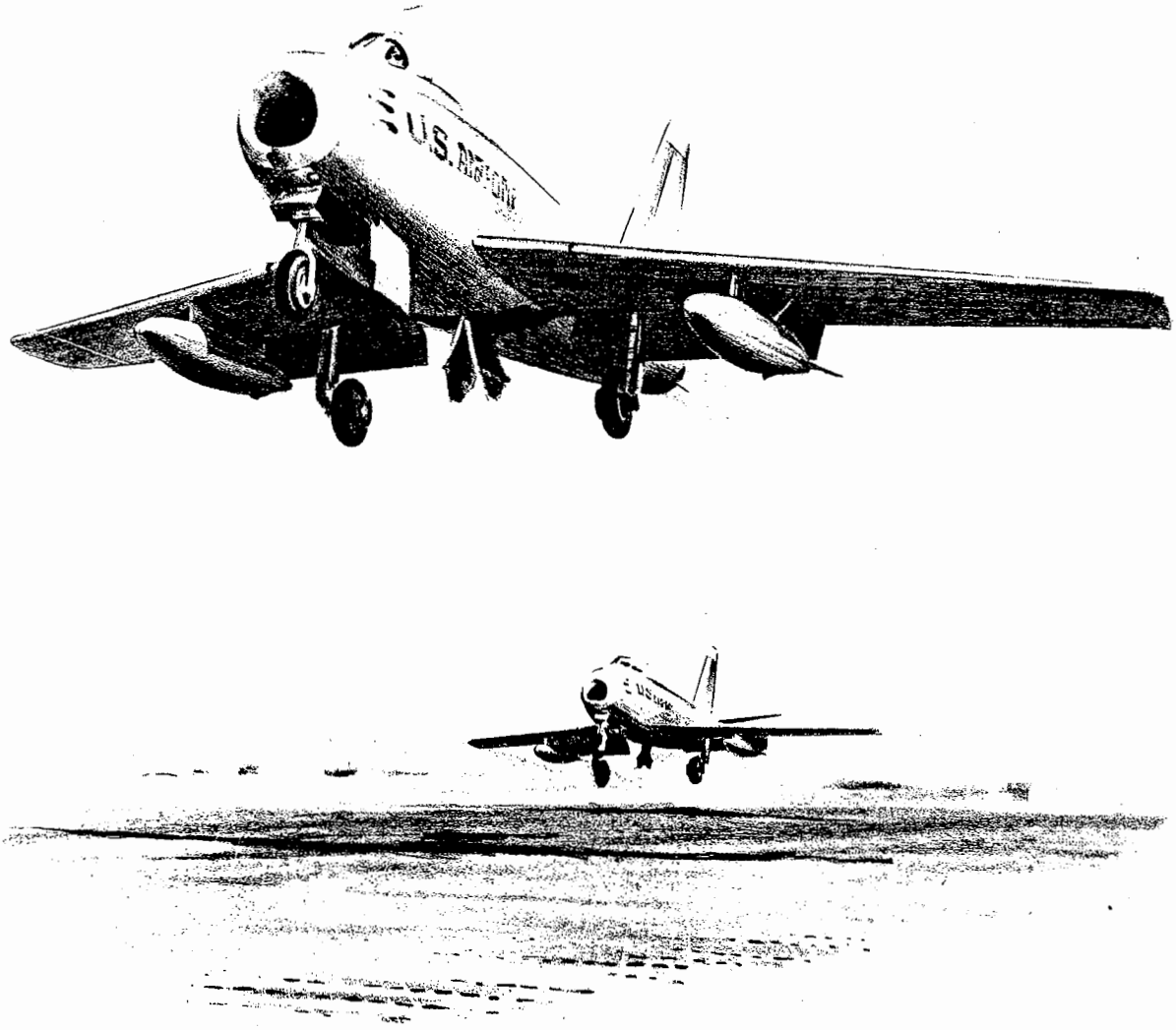

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CUT ON SOLID LINE

F-86A CONDENSED CHECK LIST

NOTE

The following check list is a condensed version of the emergency procedures presented in Section III. This condensed check list is arranged so that you may remove it from your Flight Handbook and insert it into a flip pad for convenient use. It is arranged so that each action is in sequence with the expanded procedure given in Section III. Presentation of this condensed check list does not imply that you need not read and thoroughly understand the expanded version. To handle the airplane safely and efficiently under emergency conditions, you *must* know the reason why each step is performed and why the steps occur in certain sequence.

CUT ON SOLID LINE

ENGINE FAILURE.

ENGINE FAILURE DURING TAKE-OFF RUN (NO RUNWAY OVERRUN BARRIER).

1. Emergency fuel switch—ON (if engine rpm is above 80%).
2. Bomb-rocket-tank salvo (jettison) button—Depress (or emergency jettison handle—Pull).
3. Throttle—OFF.
4. Landing gear handle—UP.
5. Landing gear emergency-up button—Depress and hold.
6. Right seat handgrip—Lower head, then pull handgrip full up before airplane comes to a complete stop (lower head, then pull canopy alternate emergency jettison handle on airplanes so equipped).
7. Engine master and battery-starter switches—OFF.
8. Shoulder harness lock handle—LOCKED (forward).

ENGINE FAILURE DURING TAKE-OFF (AIR-BORNE).

1. Emergency fuel switch—ON (if engine rpm is above 80%).
2. Bomb-rocket-tank salvo (jettison) button—Depress (or emergency jettison handle—Pull).
3. Throttle—OFF.
4. Landing gear handle—DOWN.
5. Wing flap lever—DOWN.
6. Right seat handgrip—Lower head, then pull handgrip full up (lower head, then pull canopy alternate emergency jettison handle on airplanes so equipped).
7. Engine master, generator, and battery-starter switches—OFF.
8. Shoulder harness lock handle—LOCKED (forward).
9. Land straight ahead, changing course only enough to miss obstacles.

CUT ON SOLID LINE

ENGINE FAILURE DURING FLIGHT.

1. Throttle—OFF.
2. Glide—185 knots IAS.
3. Nonessential electrical equipment—OFF.
4. Attempt air start.

ENGINE AIR START.

1. Engine master and generator switches—ON.
2. Battery-starter switch—BATTERY.
3. Hold airplane level for 5 seconds.
4. Windmilling rpm—Up to 25%.
5. Maintain 185 knots IAS.
6. Emergency fuel switch—OFF (ON, if main fuel regulator failure suspected).
7. Emergency ignition switch—ON.
8. Throttle—Outboard, then toward IDLE.
9. Exhaust temperature gage—Check.
10. Throttle—Advance slowly to 90% rpm while maintaining exhaust temperature within limits.
11. Emergency ignition switch—OFF.
12. If engine fails to start:
    a. Throttle—OFF.
    b. Emergency ignition, engine master, and generator switches—OFF.
    c. Bomb-rocket-tank salvo (jettison) button—Depress (or emergency jettison handle—Pull).
    d. Aileron boost switch—BYPASS.
    e. Prepare for forced landing or eject.

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CUT ON SOLID LINE

FORCED LANDING—DEAD ENGINE.

1. Bomb-rocket-tank salvo (jettison) button—Depress (or emergency jettison handle—Pull). Maintain glide at 185 knots IAS.
2. Landing gear handle—DOWN above 12,000 feet (field made); then establish glide at 170 knots IAS.
3. Slat lock lever (airplanes so equipped)—UNLOCK.
4. Fly pattern at 170 knots IAS.
5. Canopy switch—OPEN at low key point, if landing on unprepared surface (jettison canopy if necessary). Pull helmet visor down before opening canopy.
6. Fly turn "long" or "short" for accurate touchdown.
7. Final approach—Hold recommended speed and use straight-in approach.
8. Flap lever and speed brake switch—As required when sure of reaching landing spot.
9. Battery-starter switch—OFF, only after speed brake operation is no longer necessary.
10. Shoulder harness lock handle—LOCKED (forward).
11. Over end of runway—At recommended speed.

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CUT ON SOLID LINE

FIRE.

ENGINE FIRE DURING STARTING.

1. Throttle—OFF.
2. Engine master switch—OFF.
3. Keep engine turning.
4. If fire persists:
   a. Stop-starter button—Depress.
   b. Battery-starter switch—OFF.
   c. Leave airplane as quickly as possible.

ENGINE FIRE DURING TAKE-OFF

Forward Fire-warning Light (Ground Roll).

1. Throttle—OFF.
2. Bomb-rocket-tank salvo (jettison) button—Depress (or emergency jettison handle—Pull).
3. Landing gear handle—UP; gear emergency-up button—Depress and hold, if necessary, to retract gear.
4. Leave airplane immediately upon stopping, if fire is apparent.

Forward Fire-warning Light (Air-borne).

1. Bomb-rocket-tank salvo (jettison) button—Depress (or emergency jettison handle—Pull).
2. Throttle—Maintain power.
3. Maximum climb.
4. Throttle—Adjust to minimum practical power.
5. Check for fire.
6. If fire is confirmed—Eject.
7. If fire cannot be confirmed—Land as soon as possible.

Aft Fire-warning Light (Ground Roll).

1. Throttle—OFF.
2. Bomb-rocket-tank salvo (jettison) button—Depress (or emergency jettison handle—Pull).
3. Use maximum braking.
4. Warning light—Check.
   a. If light remains on after stopping—Leave airplane immediately.
   b. If light goes out—Engine master switch—OFF; then battery-starter switch—OFF.

Aft Fire-warning Light (Air-borne).

1. Throttle—Retard and continue climb-out.
2. Warning light—Check.
   a. If light goes out—Continue flight at reduced power and land as soon as possible.
   b. If light remains on—Maintain climb at reduced power and check for other indications of fire, such as trailing smoke, long exhaust flame, etc.
   c. If no fire is apparent—Continue flight at reduced power and land as soon as possible.
   d. If positive fire indication exists—Maintain power and immediately climb to minimum safe ejection altitude, then eject.

ENGINE FIRE DURING FLIGHT.

Forward Fire-warning Light.

1. Throttle—Adjust to minimum practical power.
2. Check for fire.
3. If fire is confirmed—Eject.
4. If fire cannot be confirmed—Land as soon as possible.

CUT ON SOLID LINE

CUT ON SOLID LINE

Aft Fire-warning Light.

1. Warning light—Check.
   a. Reduce power in attempt to extinguish light.
   b. If light goes out—Continue flight at reduced power and land as soon as possible.
   c. If light remains on with throttle retarded to IDLE, indicating possible fire rather than overheat—Proceed to step 2.
2. Check for other indications of fire, such as trailing smoke, engine noise, verification from another airplane, etc.
   a. If no fire is apparent—Continue flight at minimum power, and land as soon as possible.
   b. If positive indication of fire exists—Proceed to step 3.
3. Throttle—OFF.
4. Engine master switch—OFF.
5. If fire continues—Eject.
6. If fire ceases—Make forced landing, or eject.

ENGINE FIRE AFTER SHUTDOWN.

1. External power—Connected to both receptacles.
2. Throttle—OFF.
3. Battery-starter switch—Maintain at STARTER.
4. Engine master switch—ON, until starter locks in.
5. Engine master switch—OFF (to close main fuel shutoff valve).
6. Engine rpm—Approximately 6% (20 seconds maximum).
7. Stop-starter button—Depress.
8. Generator and battery-starter switches—OFF.
9. Leave airplane as quickly as possible.

ELECTRICAL FIRE.

1. Battery-starter and generator switches—OFF.
2. Land as soon as possible.

ELIMINATION OF SMOKE OR FUMES.

1. Cockpit pressure control lever—OFF (RAM AIR ON—DUMP OPEN).
2. Oxygen regulator diluter lever—100% OXYGEN.
3. Oxygen regulator pressure breathing knob (A-14 regulator)—Set as required by cockpit altitude.
4. Oxygen regulator emergency toggle lever (D-2 regulator)—Push to left or right.

TAKE-OFF AND LANDING EMERGENCIES.

ENGAGING RUNWAY OVERRUN BARRIER.

1. Throttle—OFF.
2. 206½-gallon drop tanks—Jettison, if installed.
3. Engine master, generator, and battery-starter switches—OFF.
4. Brakes—Avoid excessive use during engagement of barrier, to prevent tire blowouts.
5. Aim for center of barrier.
6. Engage barrier—At recommended speed.

BELLY LANDING.

1. Bomb-rocket-tank salvo (jettison) button—Depress (or emergency jettison handle—Pull).
2. Canopy switch—OPEN prior to final approach (jettison canopy if necessary). Pull helmet visor down before opening canopy.
3. Flap lever—DOWN, on final approach.
4. Speed brake switch—OUT.
5. Throttle—OFF, when landing ensured.
6. Engine master, generator, and battery-starter switches—OFF, just before touchdown.
7. Shoulder harness lock handle—LOCKED (forward).
8. Touch down in normal landing attitude.
9. Leave airplane immediately after it stops.

CUT ON SOLID LINE

CUT ON SOLID LINE

ANY ONE GEAR UP OR UNLOCKED.

1. Bomb-rocket-tank salvo (jettison) button—Depress (or emergency jettison handle—Pull).
2. Fire ammunition and expend excess fuel, if time and conditions permit.
3. Canopy switch—OPEN, prior to final approach (jettison canopy if necessary). Pull helmet visor down before opening canopy.
4. Plan approach to touch down as near end of runway as possible.
5. Flap lever—DOWN, on final approach.
6. Speed brake switch—OUT.
7. Throttle—OFF, just before touchdown.
8. Engine master switch—OFF.
9. Battery-starter switch—OFF.
10. Generator switch—OFF, if time permits.
11. Shoulder harness lock handle—LOCKED (forward).
12. After touchdown—Hold unsafe gear off runway as long as possible.
13. Brakes—Do not use, if stop can be made without them.
14. Leave airplane immediately after stopping.

LANDING WITH FLAT TIRE.

Nose Gear Tire Flat.

1. Touchdown—Hold nose gear off runway as long as possible.
2. Directional control—After nose wheel touchdown, use combination of braking and nose wheel steering.

Main Gear Tire Flat.

1. Touchdown—Land on side of runway away from flat tire.
2. Directional control—After nose wheel touchdown, use combination of differential braking and nose wheel steering.

DITCHING.

1. Follow radio distress procedure.
2. Bomb-rocket-tank salvo (jettison) button—Depress (or emergency jettison handle—Pull).
3. Personal equipment—Check that it will not foul when leaving cockpit.
4. Anti-G suit—Disconnect.
5. Oxygen regulator diluter lever—100% OXYGEN.
6. Landing gear handle—UP.
7. Slat lock lever (airplanes so equipped)—UNLOCK.
8. Speed brake switch—IN.
9. Canopy switch—OPEN (jettison canopy if necessary). Pull helmet visor down before opening canopy.
10. Throttle—OFF.
11. Flap lever—DOWN.
12. Engine master, generator, and battery-starter switches—OFF.
13. Safety belt and shoulder harness—Tighten.
14. Shoulder harness lock handle—LOCKED (forward).
15. Surface conditions—Check.
16. Approach and flare—Normal.
17. Touchdown—Keep nose high, and attempt to touch down at minimum flying speed.
18. Oxygen mask—Remove.
19. Leave airplane.

CUT ON SOLID LINE

CUT ON SOLID LINE

EJECTION.

1. Lower head; then pull right seat handgrip (either seat handgrip*) full up.
2. Hook heels in footrests and brace arms in armrests. Sit erect, head hard back against headrest, chin tucked in.
3. Squeeze trigger to eject seat.

FAILURE OF CANOPY TO JETTISON.

Unmodified Airplanes.

1. Slow airplane to below 215 knots, IAS.
2. Canopy alternate emergency jettison handle (airplanes so equipped)—Lower head and pull handle.
3. If canopy fails to jettison, or if airplane is not equipped with the alternate emergency handle:
   a. Canopy switch—OPEN.
   b. Canopy declutch handle—Pull.
   c. After canopy jettisons—Eject.
4. If canopy cannot be moved aft electrically:
   a. Canopy declutch handle—Pull.
   b. Canopy—Pull aft manually.
   c. After canopy jettisons—Eject.
5. If canopy fails to jettison after being pulled aft:
   a. Invert airplane, then push free of seat.

---

*Some airplanes

Modified Airplanes.

1. Slow airplane to below 215 knots IAS.
2. Canopy alternate emergency handle (airplanes so equipped)—Lower head and pull handle.
3. If canopy fails to jettison, or if airplane is not equipped with the alternate emergency jettison handle:
   a. Canopy switch—OPEN.
   b. Canopy declutch handle—Pull.
   c. After canopy jettisons—Eject.
4. If canopy cannot be moved aft electrically and canopy bow is not in ejection path:
   a. Left handgrip—Raise.
   b. Handgrip trigger—Squeeze, to eject through canopy.

FAILURE OF SEAT TO EJECT.

1. Safety belt—Unfasten.
2. Bail-out bottle—Actuate, if necessary.
3. Personal leads (oxygen, radio, and anti-G suit)—Disconnect.
4. Invert airplane then push free of seat, or bail out over side.
5. Parachute-arming lanyard (automatic parachute) or "D" ring (manual parachute)—Pull.

CUT ON SOLID LINE

CUT ON SOLID LINE

FUEL SYSTEM FAILURE.

1. Throttle—IDLE.
2. Emergency fuel switch—ON.
3. Throttle—Advance gradually to obtain desired exhaust temperature and rpm.
4. If engine does not respond:
   a. Emergency fuel switch—OFF.
   b. Throttle—OFF.
   c. Establish normal glide and attempt air start.
5. If partial flame-out occurs:
   a. Throttle—IDLE.
   b. Emergency ignition and emergency fuel switches—ON.
6. Emergency ignition and emergency fuel switches—OFF, when exhaust temperature and engine rpm indicate combustion stabilized.
7. Throttle—Advance slowly until engine rpm and exhaust temperature are as desired.

ENGINE OIL SYSTEM MALFUNCTION.

1. If power setting is above 80% rpm—Do not move throttle until landing is ensured.
2. If power setting is below 80% rpm—Advance throttle to 80% rpm or more and do not move throttle until landing is ensured.
3. Land as soon as possible, using forced landing pattern to ensure landing in the event of complete power failure.

ELECTRICAL POWER SYSTEM FAILURE.

COMPLETE ELECTRICAL FAILURE.

1. Airspeed—Reduce and readjust trim.
2. Altitude and rpm—Reduce as necessary.
3. Airplane attitude—Lower nose as necessary to drain trapped fuel.
4. Land as soon as possible.

GENERATOR IRREGULARITY.

Generator Failure or Undervoltage.

1. Nonessential electrical equipment—OFF.
2. Engine master switch—OFF, if generator output is lost because of engine failure.
3. Landing gear handle—DOWN.
4. Landing gear emergency release handle—Pull full out and hold extended momentarily for all landings where generator failure has occurred.

Generator Overvoltage.

1. Generator switch—Hold at RESET momentarily, then OFF.
2. If voltmeter shows normal system voltage:
   a. Generator switch—ON.
3. If generator overvoltage is still indicated by voltmeter:
   a. Generator switch—OFF.
   b. Voltage regulator rheostat—Adjust.
   c. Generator switch—Hold momentarily at RESET, then ON.
4. If generator overvoltage warning light remains out:
   a. Check voltage and readjust regulator rheostat as necessary.
5. If voltage cannot be brought within allowable limits:
   a. Generator switch—OFF.
   b. Land as soon as possible.

INVERTER FAILURE.

1. Instrument power switch—ALT.

CUT ON SOLID LINE

CUT ON SOLID LINE

FLIGHT CONTROL BOOST SYSTEM FAILURE.

1. Aileron trim—As required to reduce stick forces.
2. Maintain as near level attitude as possible.
3. Landing gear handle—DOWN, at sufficiently high altitude to correct possible roll.
4. Land as soon as possible.

LANDING GEAR EMERGENCY OPERATION.

LANDING GEAR GROUND EMERGENCY RETRACTION.

1. Landing gear handle—UP.
2. Landing gear emergency-up button—Depress until gear completely retracts.

LANDING GEAR IN-FLIGHT EMERGENCY OPERATION.

Emergency Retraction.

1. Landing gear handle—Leave UP, if all gear indicators show safe "down," with gear handle UP and red gear position indicator light on.
2. Maintain straight flight.
3. Airspeed—Reduce to below gear-down limit speed.
4. If safe indication is obtained:
   a. Continue flight.
5. If unsafe condition still exists:
   a. Landing gear handle—DOWN.
   b. Land as soon as possible when safe gear-down indication is obtained.

Emergency Lowering.

1. Airspeed—Reduce to below 175 knots IAS.
2. Landing gear handle—DOWN.
3. Landing gear emergency release handle—Pull and hold extended momentarily.
4. Yaw airplane to lock main gear, if necessary.
5. Landing gear position indicators—Check.

CUT ON SOLID LINE

WING SLAT EMERGENCY OPERATION.*

1. Slat lock lever—UNLOCK.
2. Emergency hydraulic selector—EMER SLAT UNLOCK.
3. Operate emergency hand-pump.

TRIM FAILURE.

1. Circuit breakers—IN.
2. Horizontal stabilizer alternate and aileron alternate trim switches—Use as necessary.
3. Horizontal stabilizer alternate trim switch—OFF, when desired trim is obtained.

RUNAWAY TRIM.

1. Circuit breakers—IN.
2. Throttle—IDLE.
3. Speed brake switch—OUT, if failure has produced a nose-down trim.
4. Horizontal stabilizer alternate trim switch—Use as necessary.
5. Horizontal stabilizer alternate trim switch—OFF, when desired trim is obtained.
6. If no trim response—Reduce airspeed until stick forces are minimized.

SPEED BRAKE SYSTEM FAILURE.

1. Speed brake emergency lever—EMERG CLOSED.

EXTERNAL LOAD EMERGENCY RELEASE.

1. Bomb-rocket-tank salvo (jettison) button—Depress.
2. Load released—Check.
3. Emergency jettison handle—Pull, if no electrical power is available, or load fails to release.

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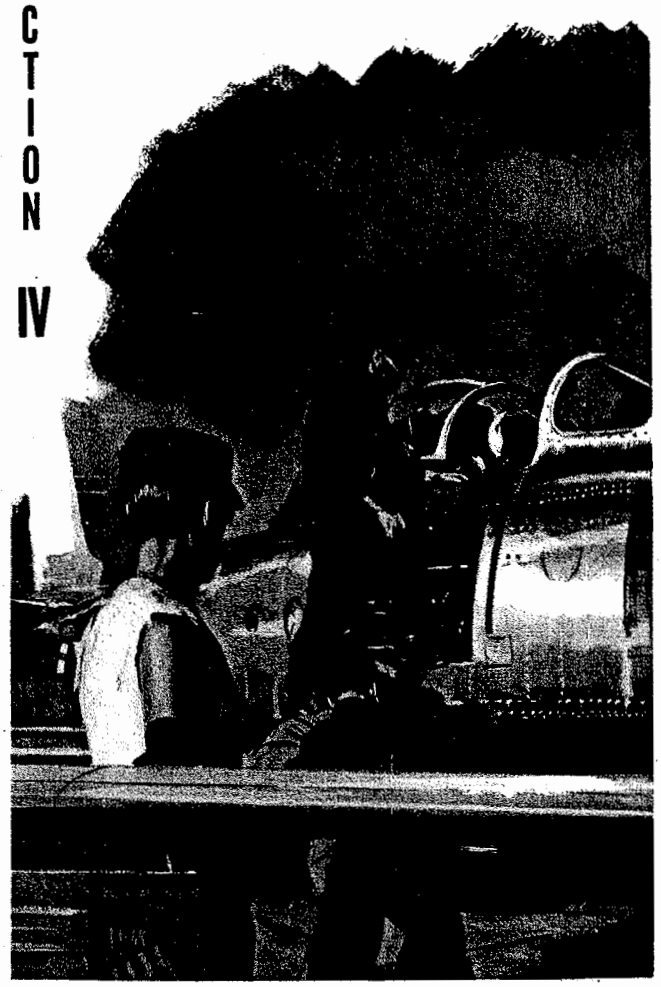
*Some airplanes

SECTION IV AUXILIARY EQUIPMENT



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COCKPIT AIR CONDITIONING AND PRESSURIZATION SYSTEMS.

The independently controlled cockpit air conditioning and pressurization systems utilize compressed, heated air from the final stage of the engine compressor to maintain desired cockpit temperature and pressure. Compressor air temperature is reduced initially by means of the ram-air cooled primary heat exchanger. The air then passes through an air mixing valve, which proportions the amount of hot and cold air furnished to the cockpit according to the positions of the temperature controls. When maximum cockpit cooling is required, the mixing valve directs all incoming air through a refrigeration unit, consisting of an air-to-air heat exchanger combined with an expansion turbine. The air mixing valve routes air around the refrigeration unit when maximum cockpit heating is needed. If additional heat is required to maintain temperatures demanded by control settings, a 4-kilowatt electric heater is energized automatically and cycled on and off as necessary for proper temperature control. In addition to supplying heat for the pressurized air, the heater can be used during direct ram-air operation. When the pressurization system is engaged, cockpit pressure from sea level to 10,000 feet is equal to the pressure at the flight altitude or 1000 feet below. From 10,000 feet to 18,000 feet, the pressure regulator automatically maintains cockpit pressure equivalent to that at 10,000 feet. Above 18,000 feet, the regulator maintains a 2.75 psi pressure differential between cockpit and flight altitude, which affords pilot comfort, yet minimizes danger in case of sudden decompression. Air conditioning and pressurization system air is also used for canopy and windshield defrosting. (Refer to "Defrosting and Anti-icing Systems" in this section.) The minimum engine rpm necessary to maintain proper air supply for the cockpit air conditioning, pressurization, and defrosting systems is as follows:

ALTITUDE-FEET	% RPM
15,000	73
20,000	75
25,000	77
30,000	80
35,000	85
40,000	92

The cockpit air conditioning and pressurization systems are shown schematically in figure 4-1.

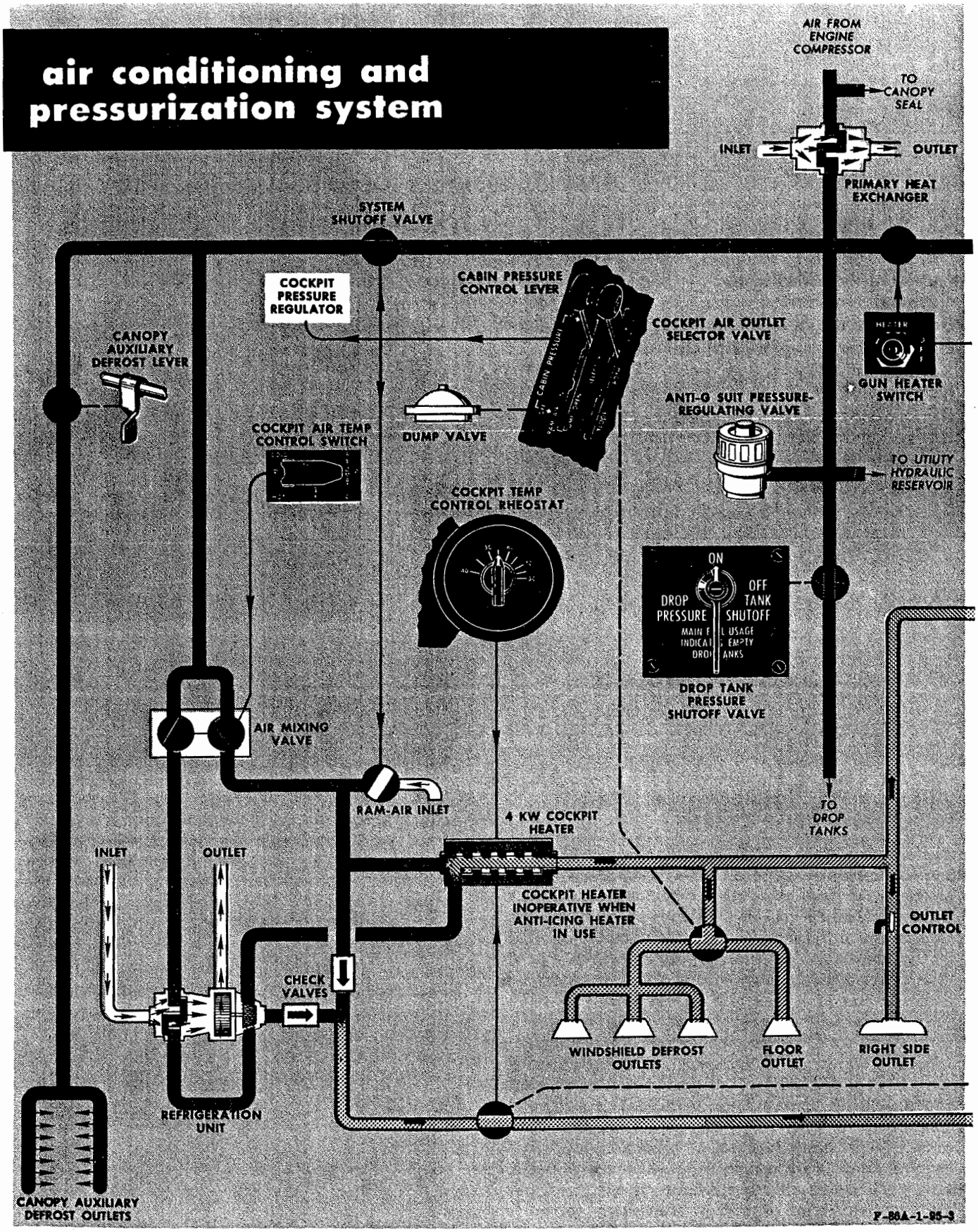
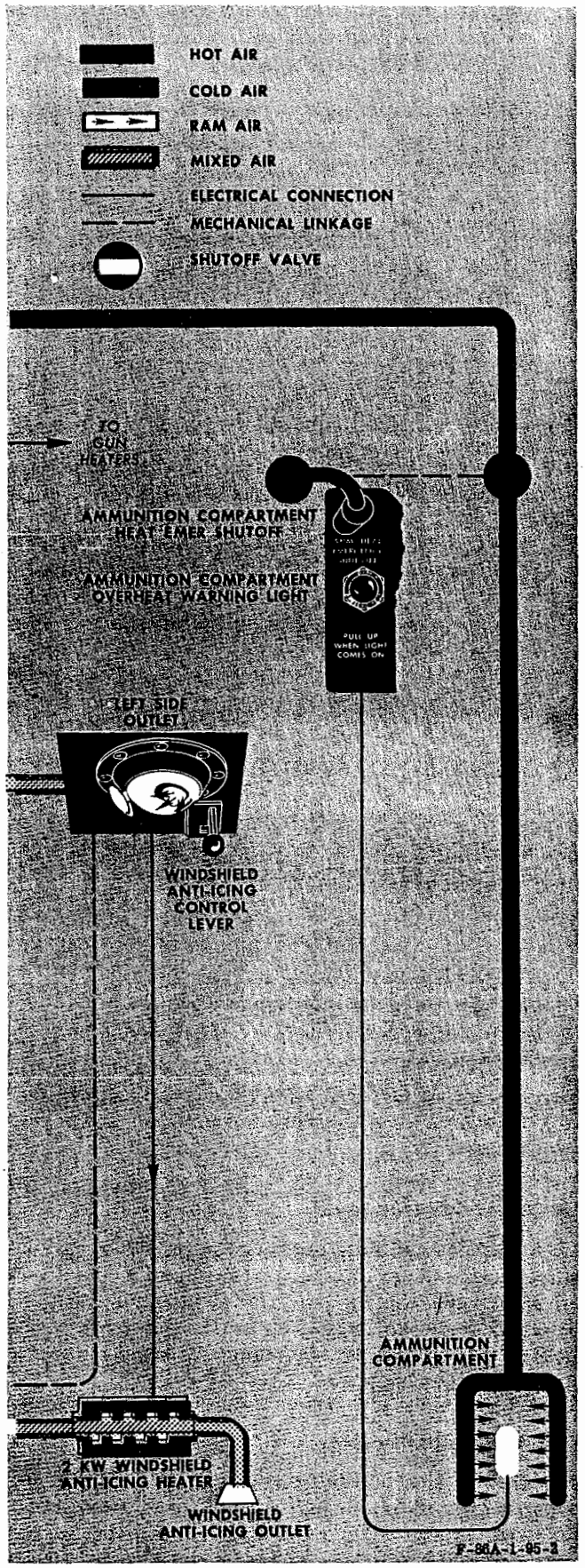

air conditioning and pressurization system
AIR FROM ENGINE COMPRESSOR
TO CANOPY SEAL
INLET
OUTLET
PRIMARY HEAT EXCHANGER
SYSTEM SHUTOFF VALVE
COCKPIT PRESSURE REGULATOR
CABIN PRESSURE CONTROL LEVER
COCKPIT AIR OUTLET SELECTOR VALVE
CANOPY AUXILIARY DEFROST LEVER
GUN HEATER SWITCH
ANTI-G SUIT PRESSURE-REGULATING VALVE
COCKPIT AIR TEMP CONTROL SWITCH
DUMP VALVE
TO UTILITY HYDRAULIC RESERVOIR
COCKPIT TEMP CONTROL RHEOSTAT
ON
OFF
DROP TANK PRESSURE SHUTOFF
DROP TANK PRESSURE SHUTOFF VALVE
AIR MIXING VALVE
RAM-AIR INLET
4 KW COCKPIT HEATER
TO DROP TANKS
INLET
OUTLET
COCKPIT HEATER INOPERATIVE WHEN ANTI-ICING HEATER IN USE
OUTLET CONTROL
CHECK VALVES
WINDSHIELD DEFROST OUTLETS
FLOOR OUTLET
RIGHT SIDE OUTLET
REFRIGERATION UNIT
CANOPY AUXILIARY DEFROST OUTLETS
F-86A-1-95-9

Figure 4-1



AIR CONDITIONING AND PRESSURIZATION AIR OUTLETS.

Air is distributed to the cockpit through side and floor outlets. The side outlets are located on each side of the cockpit above the consoles. The left side outlet is an adjustable spherical unit; the right side outlet, however, is a fixed slot having a separate shutoff valve. The floor outlet is located forward of the center pedestal and directs air down to the pilot's feet. A selector control permits air to be routed to either the side or floor outlets, or to both simultaneously. The side outlets also serve to direct air on the canopy for canopy defrosting.

COCKPIT AIR PRESSURE REGULATOR.

When the pressurization system is engaged, cockpit air pressure is maintained and regulated automatically at the predetermined pressure schedule by the pressure regulator, mounted in the aft end of the canopy. The cockpit pressure schedule is shown in figure 4-2. Excessive cockpit pressures are relieved by the regulator and discharged overboard.

COCKPIT AIR CONDITIONING AND PRESSURIZATION SYSTEM CONTROLS.

Cockpit Air Temperature Control Rheostat.

The temperature of air admitted to the cockpit is automatically controlled by a primary-bus-powered rheostat (26, figure 1-6; figure 4-3), on the left aft console. When the cockpit air temperature control switch is at AUTOMATIC, cockpit air is maintained, within the limits of the system, at the temperature corresponding to the rheostat setting. The rheostat, which permits selection of cockpit temperatures from 40°F to 80°F (4.4°C to 26.7°C), regulates a temperature control box which actuates the air mixing valve to give the desired cockpit temperature. The 4-kilowatt electric heater will be automatically engaged if additional heat is required.

Note

If cockpit air temperature exceeds the temperature for which the rheostat is set, the refrigeration unit is operating at full capacity. Turning the rheostat to a lower setting will not result in additional cockpit cooling.

The temperature control rheostat is inoperative when the cockpit air temperature control switch is OFF; however, air will be maintained at the temperature prevailing at the time the switch was turned off.

Cockpit Air Temperature Control Switch.

The four-position cockpit air temperature control switch (28, figure 1-6; figure 4-3), on the left aft console, uses

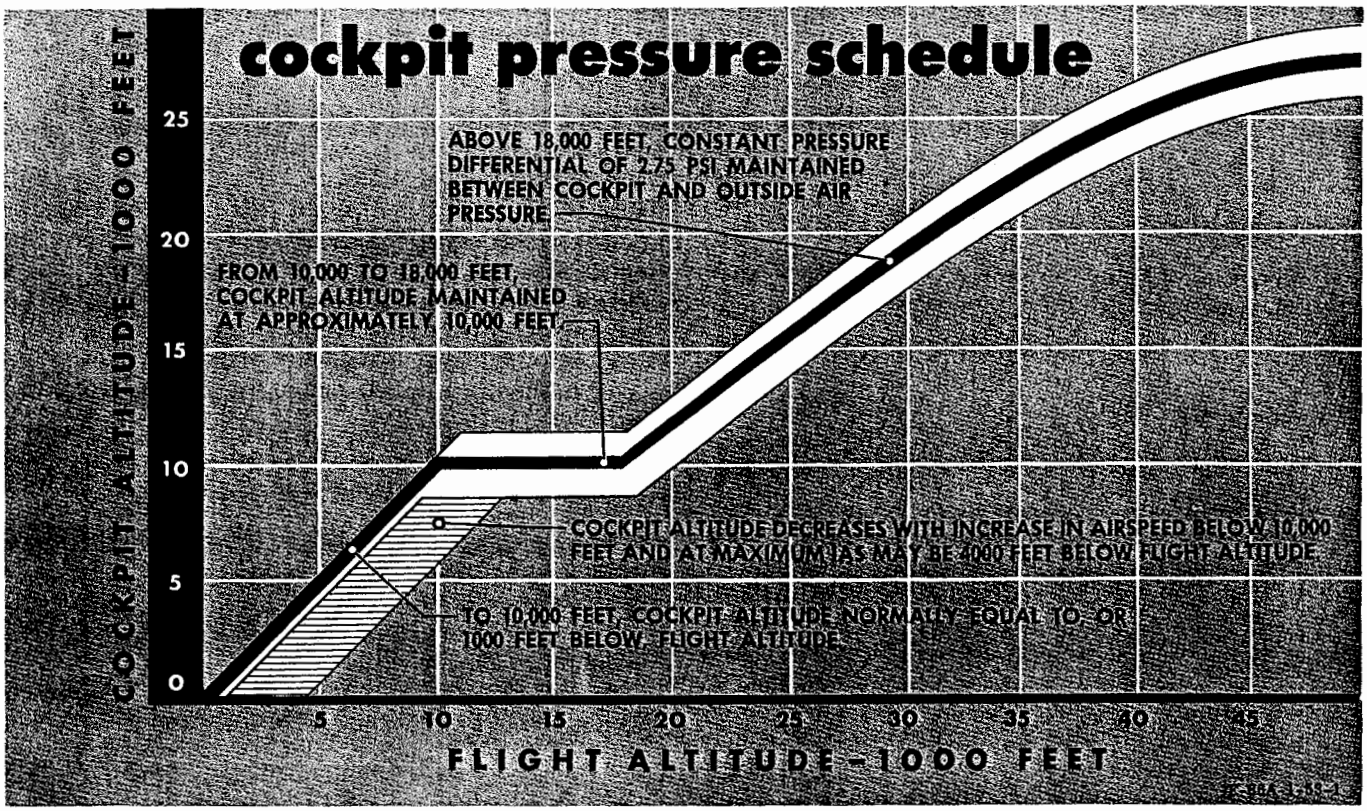


Figure 4-2

secondary bus power to provide normal control of cockpit air temperature. Temperature control is maintained automatically according to the setting of the temperature control rheostat, when the switch is in the guarded AUTOMATIC position. When the switch is OFF, the automatic control system is inoperative and cockpit air temperature is maintained at that prevailing at the time the switch was set at OFF. If the automatic temperature control system fails, or if complete manual control is desired, moving the cockpit air temperature control switch to HOT or COLD will actuate the mixing valve to produce the corresponding change in temperature. The switch should then be returned to OFF when the desired temperature has been obtained. If additional heat is required when the automatic system is not operating, the temperature control switch should be positioned at HOT to energize the electric heater.

Cabin Pressure Control Lever.

Cockpit pressurization is controlled by the cabin pressure control lever (3, figure 1-6; figure 4-3) on the left aft console. When the lever is at ON, the system shutoff valve is open, permitting air from the engine compressor section to enter the system. Cockpit pressure then is maintained automatically by the pressure regulator. Moving the cabin pressure control lever to the OFF (RAM AIR ON—DUMP OPEN) position closes the system shutoff valve, so that the engine compressor air supply to the cockpit air conditioning and pressurization system is shut off. In addition, the dump valve is opened, releasing cockpit pressure overboard, and the ram-air shutoff valve is opened, allowing ram air to enter the cockpit through the side, floor, and windshield defrost outlets.

Note

The windshield anti-icing and canopy auxiliary defrost systems are inoperative when the cabin pressure control lever is at OFF (RAM AIR ON—DUMP OPEN).

To heat ram air before it enters the cockpit, move the air temperature control switch to HOT to actuate the electric heater.

Air Outlet Selector Lever.

Air to the side and floor outlets is controlled by the air outlet selector lever (27, figure 1-6; figure 4-3) on the left aft console. Moving the lever to FLOOR or DEFROST directs air to the corresponding outlet. Air is routed to the floor and side outlets simultaneously when the selector lever is moved to BOTH.

Side Air Outlet Controls.

Two cockpit side air outlet controls are used for air conditioning and canopy defrosting. The adjustable side outlet (5, figure 1-6) above the left aft console, can be rotated to direct air in any desired direction, and can be turned to shut off airflow. A fixed air outlet (6, figure 1-7) above the right aft console, is controlled by a handle

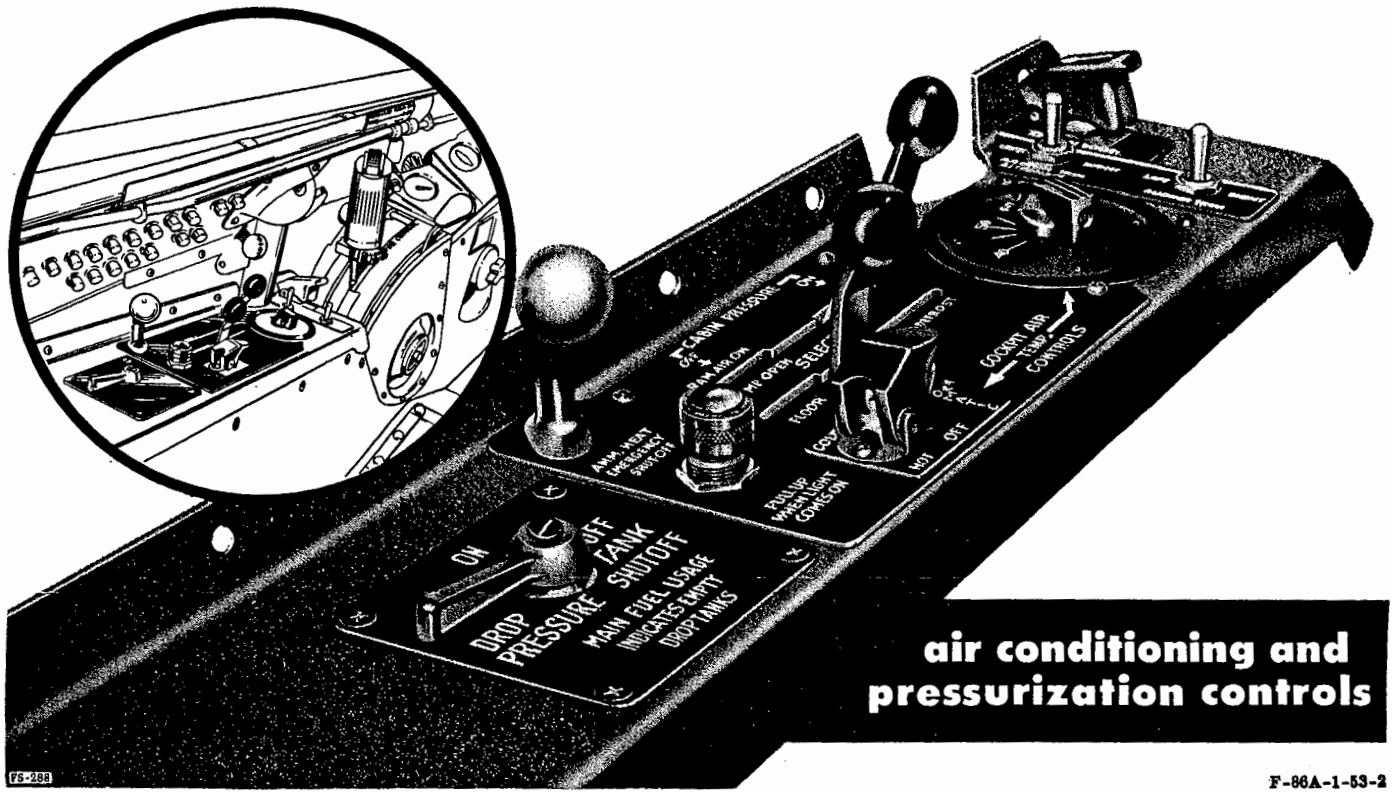


Figure 4-3

(7, figure 1-7) below and outboard of the outlet. The handle, with ON and OFF positions, opens or closes the outlet shutoff valve.

AIR CONDITIONING AND PRESSURIZATION SYSTEM INDICATORS.

Cockpit Air Temperature Gage.

The cockpit air temperature gage (7, figure 1-5) on the instrument panel, is a conventional bimetallic-type free air temperature gage. It indicates cockpit temperatures in degrees centigrade.

Cabin Pressure Altimeter.

The pressure altitude of the cockpit is indicated by the cabin pressure altimeter (10, figure 1-5) on the instrument panel. This altimeter is identical to the flight altitude altimeter, but is vented only to pressure within the cockpit.

Note

During flight at very high speeds below 10,000 feet, the cockpit altimeter will read lower than normal. At maximum allowable airspeed, however, the cockpit altitude should never be more than 4000 feet below the flight altitude to prevent excessive cockpit pressures.

NORMAL OPERATION OF COCKPIT AIR CONDITIONING AND PRESSURIZATION SYSTEMS.

Normal operation of the air conditioning and pressurization systems is accomplished as follows:

1. Cabin pressure control lever ON.
2. Air temperature control switch AUTOMATIC.
3. Air temperature control rheostat at desired cockpit temperature.
4. Air outlet selector lever at FLOOR, DEFROST, or BOTH.
5. Adjust side air outlets to direct airflow as desired.
6. Turn on canopy auxiliary defrost if necessary.

EMERGENCY OPERATION OF PRESSURIZATION SYSTEM.

If sudden depressurization of the cockpit becomes necessary:

1. Turn oxygen regulator pressure-breathing knob (A-14 regulator) to 45M ABOVE. Tighten mask to hold pressure.
2. If at high altitude, immediately descend to 20,000 feet or below.
3. Move cabin pressure control lever to the OFF (RAM AIR ON—DUMP OPEN) position.

In the event of partial loss of cockpit pressurization, indicated by a high-pitched noise in the cockpit, and by more heat than called for, do the following:

1. Descend to 20,000 feet altitude or lower.
2. Shut off pressurization system.

Note

High-pitched noise in the cockpit can be caused by either the onset of cooling turbine failure or by the cockpit side air outlets. If noise still exists after adjustment of the air outlets, it should soon stop, because the cooling turbine is designed to close tolerances and the rotating assembly will freeze before damage can be done to the remainder of the system. There is no danger of the turbine disintegrating. Therefore, leave pressurization system on at altitudes above 20,000 feet, to receive benefit of at least partial pressurization.

EMERGENCY OPERATION OF COCKPIT AIR CONDITIONING SYSTEM.

If the cockpit becomes excessively hot due to a failure of one or more components of the air conditioning system, proceed as follows:

1. Move cockpit air temperature control switch to COLD.

2. Move canopy auxiliary defrost lever OFF, and close side air outlets.

3. If temperature remains high, move cabin pressure control lever to OFF (RAM AIR ON—DUMP OPEN), and adjust oxygen pressure breathing knob (A-14 regulator) to 45M ABOVE. If at high altitude, descend to 20,000 feet or below. Slow airplane to below 215 knots IAS and open canopy if necessary.

DEFROSTING AND ANTI-ICING SYSTEMS.

For canopy defrosting and windshield defrosting and anti-icing, air is directed onto the inner surfaces of the canopy and windshield. For normal defrosting, air from the cockpit air conditioning and pressurization system is directed through the cockpit side air outlets. An auxiliary defrosting system, having perforated tubular outlets along the canopy track, can be engaged to supplement the normal canopy defrosting system during severe operating conditions. The canopy auxiliary defrosting system receives engine compressor air that has passed through the primary heat exchanger only. For windshield anti-icing, air from the windshield anti-icing outlet circulates between the armor glass and the inner surface of the windshield. A 2-kilowatt electric heater automatically furnishes additional heat for windshield anti-icing if necessary. The defrosting and anti-icing systems are shown in figure 4-1. The fuel system includes a deicing system to allow removal of ice from the fuel filter.

DEFROSTING AND ANTI-ICING CONTROLS AND INDICATOR.

Air Outlet Selector Lever.

Refer to "Cockpit Air Conditioning and Pressurization System Controls" in this section.

Cabin Pressure Control Lever.

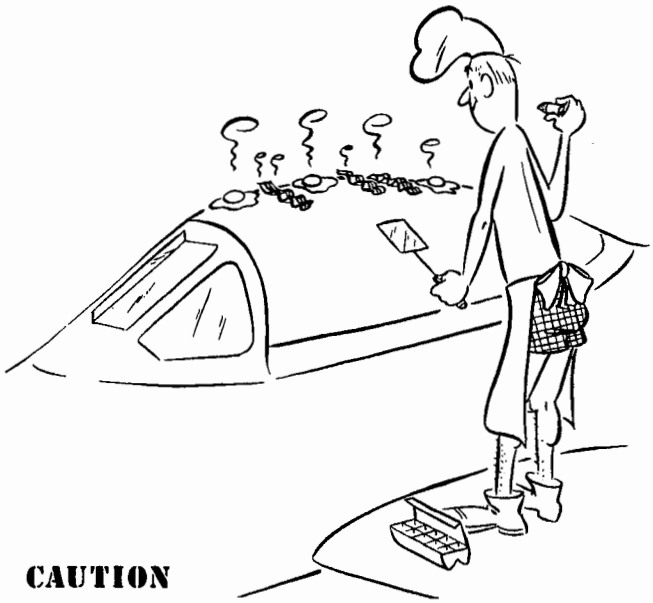
Refer to "Cockpit Air Conditioning and Pressurization System Controls" in this section.

Canopy Auxiliary Defrost Lever.

A lever (6, figure 1-6), above the left aft console, controls the airflow from both auxiliary defrost outlets. For desired airflow, the lever is moved forward from the aft OFF position to ON or to any unmarked intermediate position.

Note

The canopy defrosting system provides sufficient heating of the canopy surfaces to effectively eliminate frost or fog during descent.



CAUTION

AS CANOPY AUXILIARY DEFROST SYSTEM HAS NO OVERTEMPERATURE PROTECTION, DO NOT OPERATE IT ON THE GROUND AT ENGINE RPM ABOVE 60% IF OUTSIDE AIR TEMPERATURE IS 32°C (90°F) OR ABOVE.

F-86A-1-0-9

Side Air Outlet Controls.

Refer to "Cockpit Air Conditioning and Pressurization System Controls" in this section.

Windshield Deicing Lever.

Windshield anti-icing is controlled by the windshield deicing lever (4, figure 1-6) above the left aft console.

When set at ON, the lever directs engine compressor air to the windshield anti-icing outlet and energizes the 2-kilowatt, primary-bus-powered heater to provide additional heat for the system. Airflow to the anti-icing outlet is shut off and the heater is deactuated when the lever is moved to OFF.

Note

The 4-kilowatt cockpit heater is inoperative when the windshield deicing lever is ON.

Turn off windshield anti-icing system as soon after landing as possible, to prevent cracking of windshield.

OPERATION OF WINDSHIELD DEFROSTING AND ANTI-ICING.

If any portion of the windshield or armor glass becomes fogged or frosted, follow this procedure:

1. Move windshield deicing lever to ON.
2. If the inner (cockpit) face of the armor glass becomes fogged, move air outlet selector lever to DEFROST and close both side air outlets.
3. If atmospheric or flight conditions cause fog to be emitted from windshield defrost or side air outlets, turn cockpit air temperature control rheostat to the full hot (80°F) position.
4. Should fogging continue, move cockpit air temperature control switch to HOT. Side air outlets should be closed to direct all the airflow to the windshield outlet.

PITOT HEATER.

The pitot-static head is equipped with a conventional resistance-type electrical heater to prevent ice formations within the unit.

Pitot Heater Switch.

The pitot heater is controlled by primary bus power through an "ON-OFF" switch (figure 1-13), on the left forward console.

CAUTION

The pitot heater should not be used for extended periods of time on the ground, as the lack of sufficient airflow will cause serious overheating of the unit and may cause injury to ground personnel coming in contact with it.

FUEL FILTER DEICING SYSTEM.

In the fuel filter deicing system (figure 1-8), alcohol is injected into the fuel filter inlet line to accomplish fuel filter deicing. Alcohol flow from the tank to the filter is pilot-controlled. The one-gallon alcohol supply will last for approximately one minute of deicing operation. A warning light comes on whenever fuel flow through the filter is restricted by ice formation.

Fuel Filter Deicer Button.

The fuel filter deicer button (30, figure 1-5), on the left side of the instrument panel shroud is powered by the primary bus and controls the alcohol system for deicing the fuel filter. On some airplanes,* the button is on the right side of the shroud. When the button is depressed, a shutoff valve is opened and the alcohol pump is started to inject alcohol into the fuel filter inlet line. The button should be held in until the ice warning light goes out indicating that the fuel filter is free of ice.

Fuel Filter Ice Warning Light.

Ice formation within the fuel filter creates a pressure differential across the filter, which in turn illuminates the primary-bus-powered fuel filter ice warning light (32, figure 1-5), on the left side of the instrument panel shroud. The light is on the right side of the shroud on some airplanes.* The light goes out when ice has been removed from the filter by the alcohol.

Note

- The fuel filter ice warning light may flicker under certain engine operating conditions, such as rapid acceleration. Therefore, since the alcohol supply will last for only one minute of deicing operation, make certain that light is on steadily before depressing deicer button.
- An accumulation of dirt or other foreign matter in the fuel filter, sufficient to restrict the fuel flow, can also cause illumination of the fuel filter ice warning light. The deicing system will not remove such restrictions and ground servicing of the filter is required for cleaning.

COMMUNICATION AND ASSOCIATED ELECTRONIC EQUIPMENT.

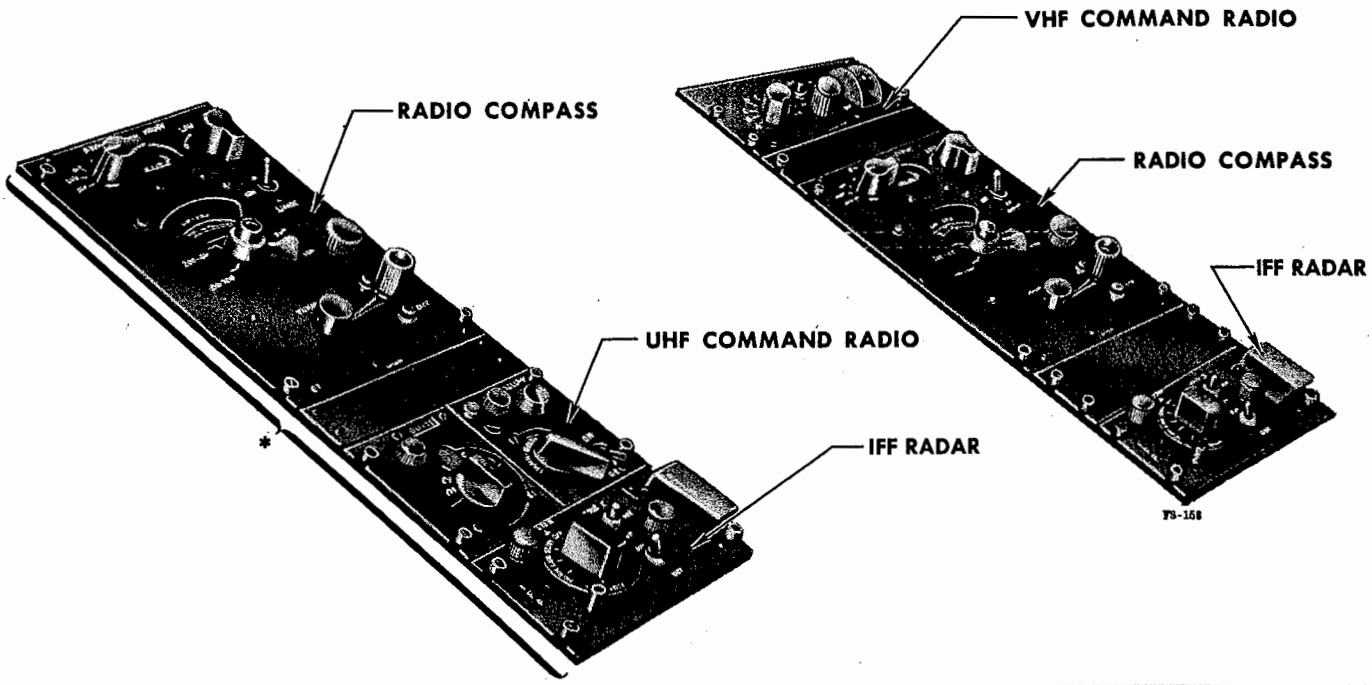
TABLE OF COMMUNICATION AND ASSOCIATED ELECTRONIC EQUIPMENT.

See figure 4-4.

*F-86A-5 Airplanes AF48-256 through -269 and AF49-1007 through -1066

communications and associated electronic equipment

RIGHT AFT CONSOLE



type	designation	function	range
VHF COMMAND RADIO	AN/ARC-3	SHORT-RANGE, TWO-WAY VOICE AND CODE COMMUNICATION	LINE OF SIGHT
UHF COMMAND RADIO*	AN/ARC-33	SHORT-RANGE, TWO-WAY VOICE AND CODE COMMUNICATION	LINE OF SIGHT
RADIO COMPASS	AN/ARN-6	RECEPTION OF VOICE AND CODE COMMUNICATION; POSITION FINDING; HOMING	20-200 MILES DEPENDING ON FREQUENCY USED AND TIME OF DAY
IFF RADAR	AN/APX-6	AUTOMATIC AIRCRAFT IDENTIFICATION	LINE OF SIGHT
NAVIGATION COMPASS†	AN/ARN-14	RECEPTION OF VOICE AND CODE COMMUNICATION; POSITION FINDING; HOMING	20-200 MILES DEPENDING ON FREQUENCY USED AND TIME OF DAY

*Some airplanes. (Refer to applicable text.)
†Space provisions only.

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Figure 4-4

VHF COMMAND SET—AN/ARC-3.

The AN/ARC-3 VHF command radio set in some airplanes provides two-way voice and code communication from air to air or from air to ground within a frequency range of 100 to 156 megacycles. The set has eight preset channels and has a line-of-sight range. Average range is approximately 30 miles at an altitude of 1000 feet and 135 miles at 10,000 feet. Range distances may increase or decrease according to prevailing atmospheric conditions. A frequency card (8, figure 1-7) for the AN/ARC-3 radio set is above the right aft console.

Operation of Command Radio.

The AN/ARC-3 command radio is operated as follows:

1. Move power switch on command radio control panel to ON.
2. Rotate command radio channel selector knob to desired frequency channel and allow 30 to 45 seconds for equipment to warm up. When the audio tone heard in the headset during the latter portion of the warm-up period stops, the set is tuned and ready for operation.
3. Adjust volume control as desired.
4. To transmit, press microphone button on throttle and speak into microphone.

Note

Transmissions should not be made on emergency (distress) frequency channels except for emergency purposes. For test, demonstration, or drill purposes, the radio equipment must be operated in a shielded room to prevent transmission of messages that could be construed as actual emergency messages.

5. To restore reception, release microphone button.
6. To transmit code, use "D-F TONE" button on AN/ARC-3 control panel as key. Maximum keying speed is limited to approximately 15 words per minute.
7. Move power switch to OFF to turn set off.

Note

Do not turn off command set immediately after any change in position of channel selector knob, as the channel selector will not have time to complete its change cycle and the set will be inoperative when turned on again. Should this occur, turn the set on, run through the complete selection of frequencies by means of the channel selector knob, and then select desired frequency. Set will resume normal operation.

UHF COMMAND SET—AN/ARC-33 (AIRPLANES CHANGED BY T.O.).

The AN/ARC-33 UHF command radio set in late airplanes provides two-way voice and code communication from air to air and from air to ground in the ultra-high-frequency region of 225 to 399.9 megacycles. Selection of any of 20 preset frequencies may be made, and a guard receiver permits monitoring of the guarded frequency while operating on any of the other channels. The unit has a "MAIN-BOTH-G" selector switch to provide a choice of operation on the selected channel (MAIN), on the guard channel (G), or on the selected channel while monitoring on the guard channel (BOTH). During warm-up and while changing frequencies, an audio tone will be heard in the earphones, reminding the pilot that the radio is inoperative during these functions. Extremely low noise level is a characteristic of the equipment, and absence of the normal background noise in the earphones does not indicate that the receiver is dead.

Operation of AN/ARC-33 Command Radio.

To operate the AN/ARC-33 command radio, proceed as follows:

1. Place power switch at ON. (A warm-up period of 30 seconds is required before the set will be operative.)
2. Move "MAIN-BOTH-G" selector switch to desired position.

CAUTION

Do not move the selector switch to REL position, as this action will release the preset frequency cylinder. This guarded switch position facilitates the presetting of channels, and it is not feasible to attempt to change the preset channels in flight.

Note

When the selector switch is placed at the G position, the set will automatically be set up to transmit and receive on the guarded frequency.

3. Rotate channel selector to desired main channel.
4. Adjust volume as necessary with volume control on panel.
5. To transmit, press microphone button on throttle.

Note

- Transmissions should not be made on emergency (distress) frequency channels except for emergency purposes. For test, demonstration, or drill purposes, the radio equipment must be operated in a shielded room to prevent transmission of messages that could be construed as actual emergency messages.
- When code transmissions are made, depressing the tone button on the control panel automatically keys the transmitter. The microphone button need not be pressed during code transmission.

6. Move power switch to OFF to turn set off.

RADIO COMPASS—AN/ARN-6.

The AN/ARN-6 radio compass set is a navigational aid used in conjunction with the radio compass indicator (28, figure 1-5), on the instrument panel. Four separate frequency bands are provided: band one, 100 to 200 kilocycles; band two, 200 to 410 kilocycles; band three, 410 to 850 kilocycles; and band four, 850 to 1750 kilocycles. Controls permit selection of automatic or manual direction finding. A tuning meter on the radio compass control panel indicates signal strength and accuracy of tuning. The radio compass loop antenna is installed within the aft portion of the canopy, and the sense antenna is in the upper arc of the canopy. (See figure 1-1.)

Operation of Radio Compass.

Operate radio compass as follows:

1. Turn function selector switch from OFF to ANT.

2. Rotate band switch to desired frequency band.

3. Use tuning crank to tune station and obtain maximum swing of tuning meter needle.

4. Turn volume control to adjust headset volume.

5. With function switch on COMP and station tuned in, place "CW-VOICE" switch to CW and check that the 900-cycle continuous tone is heard; then return switch to "VOICE."

6. Set "VAR" knob on compass indicator to adjust index.

7. When function switch is at LOOP, the "LOOP L-R" switch is used to rotate the loop to obtain aural-null orientation.

8. Return function selector switch to OFF to turn set off.

IDENTIFICATION RADAR—AN/APX-6.

The AN/APX-6 radar identification set (IFF) is powered by the primary bus. It is used to automatically identify the airplane in which it is installed, as friendly whenever it is properly challenged by suitably equipped air or surface forces. The set also has provisions for identifying the airplane in which it is installed by a specific friendly signal while the airplane is within a group of other friendly airplanes, and has means for transmitting a special distress code. The AN/APX-6 receives, challenges, and transmits replies to the source of the challenges, where the replies are displayed together with the associated radar targets on radar indicators. When a radar target is accompanied by a proper reply from the IFF set, the target is considered friendly. Three destructors, controlled by the battery bus, are mounted in the AN/APX-6 transpondor, and may be actuated by the pilot. An impact switch automatically actuates the destructors upon a crash landing.

Operation of Identification Radar.

Operate AN/APX-6 identification radar set as follows:

CAUTION

Before take-off, check that AN/APX-6 frequency counters have been set to the proper frequency channels and that the destructors have been inserted in the transpondor. (IFF units are accessible through radio compartment access door on left side of fuselage.)

1. To turn equipment on, rotate master control knob to NORM position (full sensitivity and maximum performance).

2. Rotate master control to STDBY to keep equipment inoperative but ready for instant use.

3. Do not use LOW position of the master control (partial sensitivity) except upon proper authorization.

4. Set three-position "MODE 2" and "MODE 3" switches to their OUT positions unless otherwise directed.

5. For emergency operation, press dial stop and rotate master control knob to EMERGENCY position so that the set will automatically transmit distress signals.

6. To fire destructors manually, lift guard and move destructor switch to ON position.

CAUTION

The destructors should be fired only when the AN/APX-6 equipment is in danger of falling into enemy hands. If a forced landing has to be made in an area of doubtful security, fire the destructors.

7. To turn off IFF set, rotate master control knob to OFF.

8. If the AN/APX-6 transpondor is destroyed during flight, report this information immediately after landing.

LIGHTING EQUIPMENT.

EXTERIOR LIGHTING.

Exterior lighting consists of two fuselage lights, four position (navigation) lights, a taxi light, and a landing

light. One fuselage light is located within the aft portion of the canopy frame; the other is on the lower surface of the fuselage, below the cockpit. Two clear bulbs, one large and one small, are in each fuselage light. A position (navigation) light is in each wing tip, and two are faired into the trailing edge of the empennage fillet. The retractable taxi and landing lights are set side by side in the bottom of the fuselage nose section, forward of the nose gear well.

Exterior Lighting Controls and Indicator.

Landing Light Position Switch. The landing light position switch (figure 1-13), on the left forward console, is powered by the primary bus and controls extension and retraction of the landing and taxi lights. Setting the switch at either the EXTENDED or RETRACT position moves both lights accordingly. Returning the switch to its OFF (center) position during the extension or retraction cycle stops the lights at any desired position. Limit switches automatically cut off power to the light actuation motors when the lights become fully extended or fully retracted. (The landing light extends 64 degrees from its fully retracted position; the taxi light extends 80 degrees.) The lights cannot be on when completely retracted.

CAUTION

To prevent damage to lights, do not extend landing lights at speeds above 185 knots IAS.

Landing Light Selector Switch.* Illumination of the landing and taxi lights is controlled by the primary-bus-powered, three-position landing light selector switch (figure 1-13) on the left forward console. Provided the lights have been extended from the fully retracted position, setting the switch at LAND OR TAKEOFF will turn on both lights. When the switch is moved to the TAXI position, only the taxi (left) light will be turned on. The lights are turned off automatically when they become fully retracted and cannot be illuminated when completely retracted regardless of the position of the selector switch.

Landing Light Selector Switch.† The three-position landing light selector switch (figure 1-13) is powered by the primary bus and is on the left forward console. With the lights extended from the fully retracted position, moving the switch to LAND OR TAKEOFF turns on both lights when the weight of the airplane is on the nose gear. Only the landing (right) light, however, will be on in flight or when weight of the airplane is off the nose gear. Positioning the selector switch at TAXI illuminates the taxi (left) light only when the weight of the airplane is on the nose gear. When retracted, the lights go out automatically and cannot be illuminated while in this position.

Position (Navigation) Light Selector Switch. The position (navigation) lights are controlled by the three-position selector switch (figure 4-5), on the right forward console. The lights come on continuously when the switch is moved from OFF to STEADY. When the selector switch is at the FLASH position, the lights flash at 40 cycles per minute. The switch is powered by the primary bus.

Position (Navigation) Light Dimmer Switch. The position light dimmer switch (figure 4-5), on the right forward console, controls the brilliancy of the position lights. Setting the switch at BRIGHT or DIM regulates the brightness of all position lights accordingly.

Fuselage Light Switch. Illumination of the small bulbs within the fuselage lights is controlled by the three-position fuselage light switch (figure 4-5), on the right forward console. Moving the switch from OFF to the BRIGHT or DIM position permits primary bus power to illuminate the bulbs at the selected brilliancy.

Fuselage Light Keying Button.‡ The large bulbs in the fuselage lights come on only when the keying button (figure 4-5), on the right forward console, is held depressed.

Master Code Switch and Code Selector.§ The master code switch and code selector (figure 4-5) on the right forward console control automatic flashing of the large bulbs in the fuselage lights. The master code switch controls power to the code selector, which provides a choice of 12 letters for flashing code. With the master code switch at ON, turning the code selector to the desired letter will cause the large bulbs in the fuselage lights to automatically flash the selected letter in Morse code.

Code Indicator Light.§ The code indicator light (figure 4-5), ahead of the right forward console, flashes simultaneously with the large bulbs in the fuselage lights to indicate that the selected letter is being flashed. The indicator light, powered by the primary bus, is of the

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***F-86A-5 Airplanes AF48-129 through -220**
†F-86A-5 Airplanes AF48-221 through -316 and AF49-1007 through -1339
‡F-86A-5 Airplanes AF48-129 through -316
§F-86A-5 Airplanes AF49-1007 through -1339

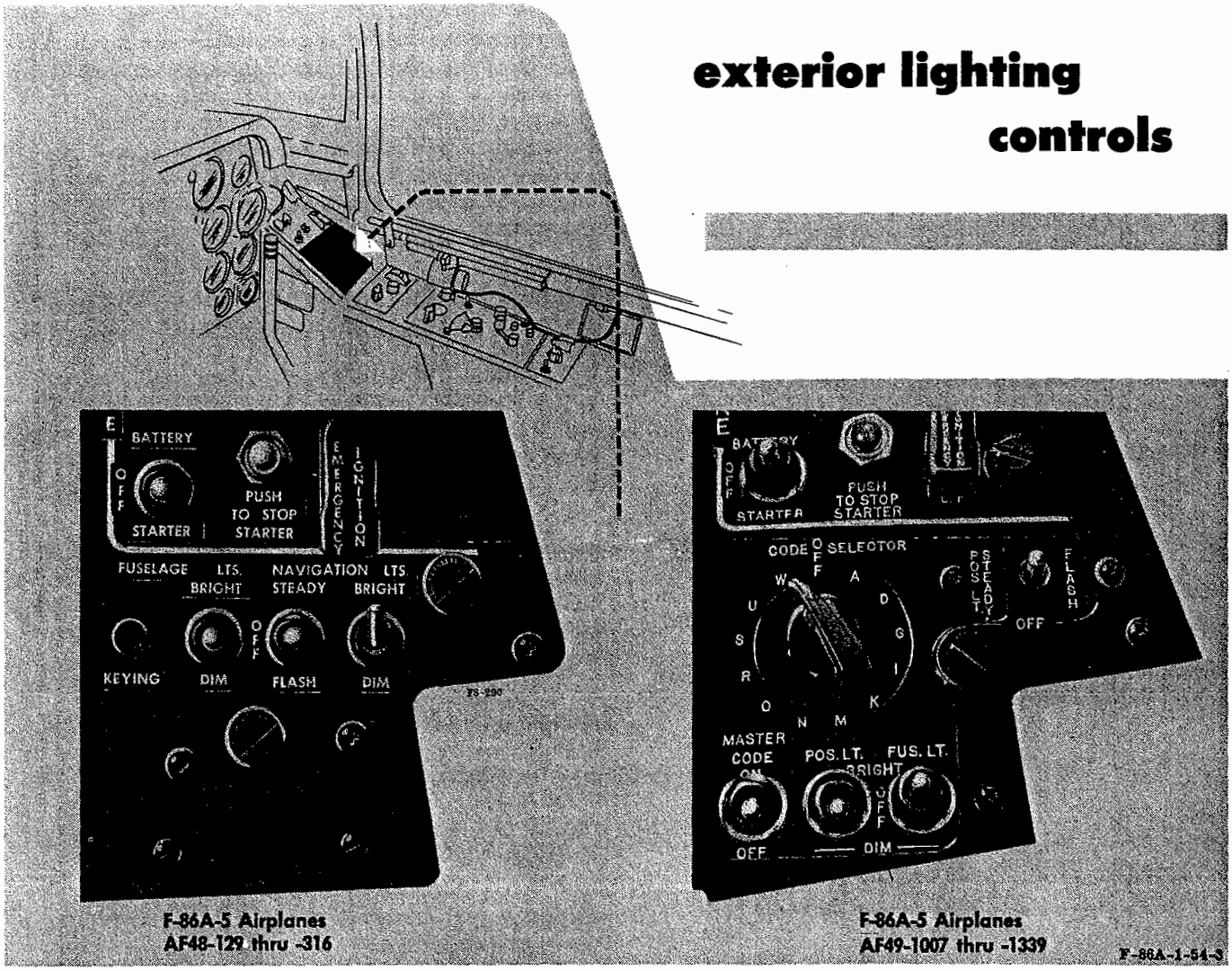

Figure 4-5

push-to-test type, permitting check of bulb illumination when the master code switch is OFF.

INTERIOR LIGHTING.

Cockpit illumination is furnished by two fluorescent lights, an extension light, and indirect console and center pedestal lighting. One fluorescent light (15, figure 1-6) is mounted at the base of the windshield bow, left of the instrument panel. The other (5, figure 1-7) is on the right side of the cockpit, above the right aft console. Alternate mountings for the fluorescent lights are on each side of the cockpit, on the upper longeron aft of the windshield bow. The fluorescent lights receive power from the battery bus and therefore, are operable regardless of battery-starter switch setting. The extension light (11, figure 1-7) is on the right side of the cockpit, forward of the right circuit-breaker panel. The consoles and center pedestal are illuminated indirectly by light transmitted edgewise through Lucite panels from bulbs mounted in the face of the units. The bulb cover can be unscrewed to replace bulbs. Spare bulbs are stored in a rack (3, figure 1-7) on the right side of the cockpit.

Interior Lighting Controls.

Fluorescent Light Rheostats. Illumination and brilliancy of each fluorescent light is controlled by a battery-bus-powered rheostat (7, figure 1-6; 9, figure 1-7) located on the corresponding side of the cockpit above the console.

Extension Light Switch. The two-position extension light control switch (10, figure 1-7) is on the right side of the cockpit, forward of, and adjacent to, the extension light. The primary bus supplies power.

Panel Light Rheostat. The illumination and brilliancy of the console and pedestal lights are simultaneously controlled by battery bus power through a rheostat (figure 4-12) on the center pedestal.

oxygen duration

HOURS

CABIN ALT. FEET	GAGE PRESSURE—PSI 400	350	300	250	200	150	100	BELOW 100
40,000	5.7	4.9	4.1	3.2	2.4	1.6	0.8	
	5.7	4.9	4.1	3.2	2.4	1.6	0.8	
35,000	5.7	4.9	4.1	3.2	2.4	1.6	0.8	
	5.7	4.9	4.1	3.2	2.4	1.6	0.8	
30,000	4.2	3.6	3.0	2.4	1.8	1.2	0.6	
	4.2	3.6	3.0	2.4	1.8	1.2	0.6	
25,000	4.0	3.4	2.8	2.3	1.7	1.1	0.6	
	3.4	2.9	2.4	1.9	1.4	1.0	0.5	
20,000	4.5	3.9	3.2	2.6	1.9	1.3	0.6	
	2.7	2.3	1.9	1.5	1.2	0.8	0.4	
15,000	5.4	4.6	3.9	3.1	2.3	1.5	0.8	
	2.1	1.8	1.5	1.2	0.9	0.6	0.3	
10,000	7.2	6.2	5.2	4.1	3.1	2.1	1.0	
	1.8	1.5	1.3	1.0	0.7	0.5	0.3	

Black figures indicate diluter lever **NORMAL OXYGEN**

Red figures indicate diluter lever **100% OXYGEN**

Cylinders: Four Type D-2

F-86A-1-73-6B

Figure 4-6

OXYGEN SYSTEM.

The gaseous oxygen system is supplied from four Type D-2 cylinders installed in the nose section, two on each side, outboard of the intake duct. Included in the system is a D-2 or A-14 regulator, a flow indicator, and a pressure gage. For combat safety, check valves are incorporated in the system to prevent total loss of oxygen in the event of system failure or cylinder rupture. If a cylinder is punctured, it will be isolated by the check valves and the pressure gage indication will remain relatively the same, although the oxygen supply available will be reduced. The oxygen system is serviced by means of a single-point refilling valve, located within an access door on the left side of the fuselage, forward of the ammunition compartment door. Normal minimum system pressure for take-off is 400 psi. An oxygen duration table for either regulator is shown in figure 4-6. See figure 1-30 for oxygen specification.

A-14 OXYGEN REGULATOR.

Airplanes not changed by T.O. have a Type A-14 pressure-breathing, diluter-demand oxygen regulator (figure 4-8), recessed in the inboard face of the left forward console. The regulator automatically mixes air with oxygen in varying amounts, according to the altitude, and delivers a quantity of this mixture each time the user inhales. The percentage of oxygen furnished by the regulator increases with an increase in altitude and becomes

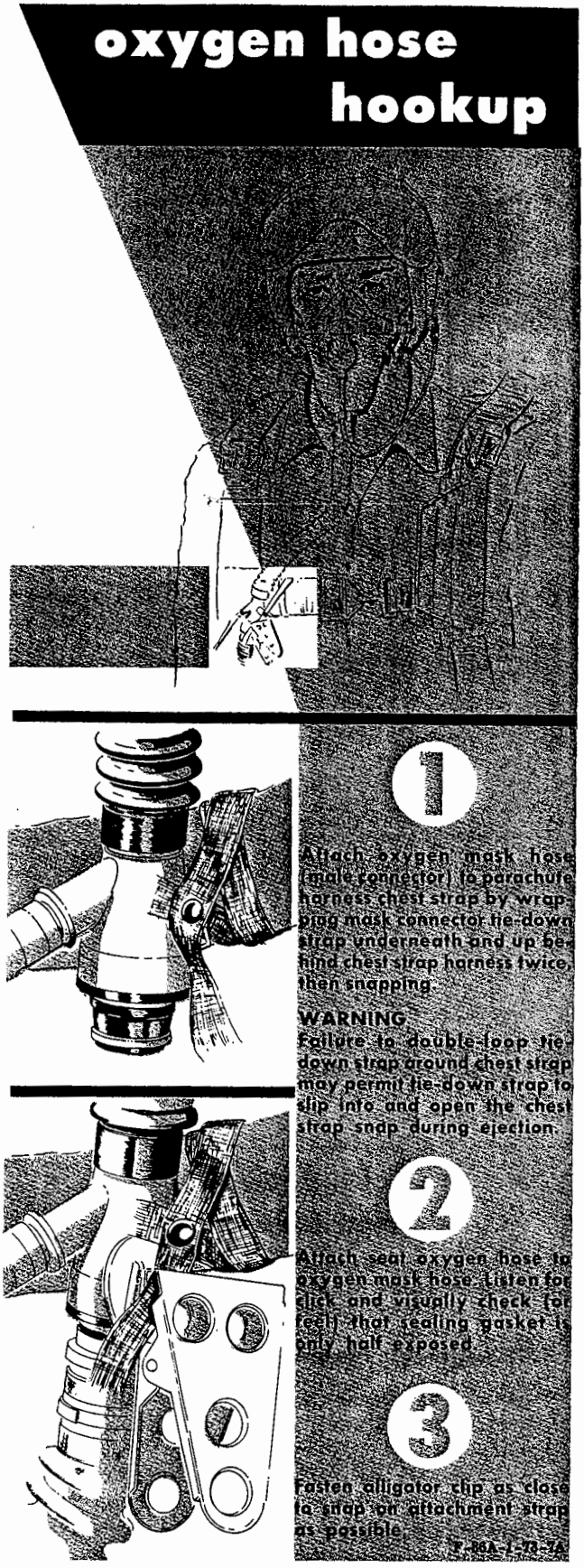

Figure 4-7

Figure 4-8

100 percent at approximately 34,000 feet. For operation above 30,000 feet, oxygen may be delivered under pressure.

WARNING

Use only a pressure-demand oxygen mask with the A-14 oxygen regulator.

A-14 Regulator Controls.

Regulator Diluter Lever. The oxygen regulator diluter lever (figure 4-8), on the face of the regulator, is a manual control for selecting the oxygen-air mixture ratio. If the oxygen regulator diluter lever is at NORMAL OXYGEN, the regulator automatically maintains the proper oxygen-air ratio for changes in altitude. When the control lever is moved to 100% OXYGEN position, the regulator delivers 100 percent oxygen regardless of the altitude.

Regulator Pressure-breathing Knob. Clockwise rotation of the pressure-breathing knob (figure 4-8), on the face of the regulator, from NORMAL delivers 100 percent oxygen under pressure. The knob should be rotated from NORMAL only above 30,000 feet or whenever the oxygen supply becomes inadequate. Whenever the pressure-breathing knob is not at NORMAL, the diluter mechanism is inoperative, and the resultant pressurized oxygen flow is uneconomical below 30,000 feet.

A-14 Regulator Indicators.

Oxygen Pressure Gage. The oxygen pressure gage (figure 1-13), on the left forward console, indicates system pressure as long as the oxygen supply lines are intact.

Note

Since the oxygen cylinders grow colder as the airplane reaches high altitudes, oxygen pressure is reduced. Sometimes, a rather rapid drop in oxygen pressure gage reading is noted. (A

100°F decrease in temperature of the oxygen cylinders causes approximately a 20 percent drop in cylinder gage pressure.) This drop in pressure generally is not cause for alarm. As the airplane descends to warmer altitudes, the cylinder pressure will tend to rise again, so that the rate of oxygen use may appear to be slower than normal. A rapid drop in oxygen pressure during level flight, or while descending may indicate oxygen leakage.

Oxygen Flow Indicator. A blinker-type flow indicator (figure 1-13), on the left forward console, provides a visual indication that oxygen is being supplied. A shutter on the face of the instrument opens and closes with each breath to show that oxygen is flowing through the regulator.

Oxygen System Preflight Check (A-14 Regulator).

1. Check mask properly connected (figure 4-7) and note oxygen pressure gage (400 psi minimum).
2. Set oxygen regulator diluter lever at 100% OXYGEN and the pressure-breathing knob at NORMAL.
3. Blow *gently* back into the mask-to-regulator hose. Any indication of free flow through the regulator indicates a leak or faulty operation.
4. Set oxygen regulator diluter lever at NORMAL OXYGEN and repeat step 3.

A-14 Regulator Normal Operation.

For normal operation, the oxygen regulator diluter lever should be set at NORMAL OXYGEN and the pressure-breathing knob should be set as follows:

1. For cockpit altitudes below 30,000 feet, leave knob at NORMAL.
2. For cockpit altitudes between 30,000 and 40,000 feet, set knob at SAFETY.
3. For cockpit altitudes above 40,000 feet, the knob should be set at the cockpit altitude.

A-14 Regulator Emergency Operation.

Oxygen system controls should be set as follows for various emergency conditions:

1. With symptoms of onset of anoxia or if smoke or fuel fumes enter cockpit, set oxygen regulator diluter lever to 100% OXYGEN.
2. In event of accidental loss of cockpit pressure, turn pressure-breathing knob to 45M ABOVE position immediately and tighten mask to hold pressure.
3. If the oxygen regulator becomes inoperative, pull cord of H-2 bail-out bottle and descend to a cockpit altitude where oxygen is not required.

Note

When emergency is over, set oxygen regulator diluter lever to NORMAL OXYGEN and pressure-breathing knob in accordance with procedure outlined in "A-14 Regulator Normal Operation" in this section.

D-2 OXYGEN REGULATOR.

On airplanes changed by T.O., a Type D-2 automatic pressure-breathing, diluter-demand oxygen regulator, (18, figure 1-6; figure 4-8), recessed in the inboard face of the left forward console, controls the oxygen system. This regulator supplies the proper mixture of oxygen and air at all times, automatically supplying positive pressure-breathing at high altitudes. Regardless of how much oxygen is being used, the pressure will always be correct for any specific altitude. On airplanes not changed by T.O., the regulator is equipped with a red warning light which was originally provided to warn the pilot when the regulator was not operating normally. The warning light system, however, has been found unreliable and should not be used. On airplanes changed by T.O., the warning light is removed. A pressure relief valve is provided on the outside of the regulator to relieve excess mask pressure. A pressure gage and flow indicator is incorporated in the regulator. The approximate duration of the oxygen supply is shown in figure 4-6.

WARNING

Use only a pressure-demand oxygen mask with the D-2 oxygen regulator.

D-2 Regulator Controls.

Regulator Diluter Lever. A diluter lever (figure 4-8) is provided in the top right corner of the regulator panel for selecting either NORMAL OXYGEN for normal use or 100% OXYGEN for emergency conditions.

Regulator Supply Lever. The regulator supply lever, (figure 4-8), on the bottom of the panel, should be safetied in the ON position at all times.

Regulator Emergency Toggle Lever. The emergency toggle lever, (figure 4-8), above the supply lever on the oxygen regulator panel, should be in the center

position at all times, unless an unscheduled pressure increase is required. Moving the toggle lever left or right provides continuous positive pressure to the oxygen mask for emergency use. When the toggle lever is depressed at the center position, it provides positive pressure to test the mask for leaks.

CAUTION

When positive pressures are required, it is mandatory that the oxygen mask be well fitted to the face. Unless special precautions are taken to ensure no leakage, continued use of positive pressure under these conditions will result in rapid depletion of the oxygen supply.

Regulator Warning Light Switch. The warning light switch, (figure 4-8) in the top left corner of the oxygen regulator panel, should be left in the OFF position at all times due to unreliability of the oxygen warning light system. On regulators changed by T.O., the warning light has been removed and a placard installed above the switch to indicate the oxygen warning light system is inoperative.

D-2 Regulator Indicators.

Pressure Gage and Flow Indicator. The pressure gage and flow indicator, (figure 4-8), on the oxygen regulator panel, combines the oxygen pressure gage and the flow indicator in a single instrument. The pressure gage shows the oxygen system pressure; the flow indicator, consisting of four small slots grouped in the lower half of the dial face, shows alternately black and white with each breath.

Note

Since the oxygen cylinders grow colder as the airplane reaches high altitudes, oxygen pressure is reduced. Sometimes, a rather rapid drop in oxygen pressure gage reading is noted. A 100°F decrease in temperature of the oxygen cylinders causes approximately a 20 percent drop in cylinder gage pressure. The drop in pressure generally is not cause for alarm. As the airplane descends to warmer altitudes, the cylinder pressure will tend to rise again, so that the rate of oxygen use may appear to be slower than normal. A rapid drop in oxygen pressure during level flight, or while descending, may indicate oxygen leakage.

Oxygen Regulator Warning Light. The oxygen regulator warning light (figure 1-13), on the left forward console, should not be used, as the oxygen warning light system is not reliable. On regulators changed by T.O., the warning light system is deactivated.

Oxygen System Preflight Check. (D-2 Regulator).

1. Check that mask unit is properly connected (figure 4-7) and note oxygen pressure gage indication (400 psi minimum).
2. Check oxygen regulator with diluter valve first at NORMAL OXYGEN position and then at 100% OXYGEN position as follows: Remove mask and blow gently into end of oxygen regulator hose as during normal exhalation. There should be resistance to blowing. Little or no resistance to blowing indicates a leak or faulty operation.
3. With regulator supply valve ON, oxygen mask connected to regulator, and diluter lever in 100% OXYGEN position, breathe normally into mask.
4. Observe flow indicator for proper operation.
5. Depress emergency toggle lever or move lever to left or right. A positive pressure should be supplied to mask. Hold breath to determine if there is leakage around mask.
6. Return emergency toggle lever to center position. Positive pressure should cease.
7. Return diluter lever to NORMAL OXYGEN.

D-2 Regulator Normal Operation.

1. Before each flight, be sure oxygen pressure gage reads at least 400 psi. If pressure is below this minimum, have the oxygen system charged to capacity before take-off.
2. Supply lever turned ON.
3. Diluter lever at NORMAL OXYGEN.

Note

Above 30,000 feet, you may sometimes notice a vibration or a wheezing sound in the mask. This noise is a normal characteristic of the regulator operation and may be overlooked.

D-2 Regulator Emergency Operation.

Oxygen system controls should be set as follows for various emergency conditions:

1. With symptoms of onset of anoxia or if smoke or fuel fumes should enter cockpit, set oxygen regulator diluter lever to 100% OXYGEN.
2. Push emergency toggle lever left or right from CENTER.
3. If oxygen regulator becomes inoperative, pull ball handle on H-2 emergency oxygen bail-out bottle and

descend to a cockpit altitude below 10,000 feet as soon as possible.

NAVIGATION EQUIPMENT.

STAND-BY COMPASS.

Refer to "Instruments" in Section I.

RADIO COMPASS.

Refer to "Communication and Associated Electronic Equipment" in this section.

DIRECTIONAL INDICATOR (SLAVED).

The directional indicator (slaved), (2, figure 1-5) on the instrument panel, indicates magnetic headings without oscillation, swinging, or northerly turning error. The directional indicator automatically indicates the magnetic heading of the airplane by means of a transmitter in the left wing, just inboard of the tip. This transmitter "senses" the south-north flow of the earth's magnetic flux. Electrical power for the directional indicator is provided when dc power from the primary bus and 400-cycle, three-phase ac power is available. The gyro is energized when the battery-starter switch is moved to BATTERY and is on a fast slaving cycle for the first 3 to 4 minutes of operation. During this time it should align with the magnetic heading. The gyro then begins a slow slaving cycle.

Note

After gyro reaches operating speed, the indicator should be checked against the stand-by compass indication to make sure indicator does not show a 180-degree ambiguity. The directional indicator is not operating properly if such ambiguity exists.

A knob at the lower left of the indicator permits the indicator course index to be rotated to a preselected heading. Indicator readings will be incorrect if the airplane exceeds 85 degrees of climb or dive, or banks left or right more than 85 degrees. Error in heading indication when the airplane is in an extreme bank or roll movement is an inherent characteristic of the gyro; however, it disappears when the airplane returns to straight-and-level flight. An additional error, however, will build up in the indication during turns. This is caused by centrifugal force, which tends to swing the transmitter flux valve into the vertical component of the earth's magnetic field. The amount of error is proportional to time and duration of the turn. Therefore, errors will result in the indicator during turns, banks, or rolls.

Figure 4-9

ARMAMENT EQUIPMENT.

The basic armament installation consists of six .50-caliber machine guns housed within the fuselage. Bombs, rockets, or chemical tanks may be mounted externally, on the lower surface of the wing when drop tanks are not carried. (See figure 4-9.) A gun sight is provided for sighting and is coupled with a radar ranging set. To record the gunnery or rocket run, provisions are made for a camera to be installed in the nose of the airplane or on the sight head.

MARK 18 SIGHT.*

The Mark 18 sight (figure 4-10), modified by North American Aviation, is a lead computing sight that includes both a gyro and a fixed sighting system and is used for gun or rocket firing. The gyro system reticle image, presented on the right side of the reflector glass, consists of a circle of six diamond-shaped images and a central dot. The diameter of the circle is variable. When the target is properly framed within the circle, the sight automatically computes the required lead. During rocket firing or strafing and in case of mechanical failure of the gyro system, the fixed sighting system is used. The reticle image of the fixed system, consisting of a circle with a center cross and a rocket scale and 100-mil arc below the cross, is projected on the left side of the reflector glass. All portions of the fixed-reticle image except the cross are normally blanked out by means of a control on the sight head. When both reticles are used, the separation of the fixed-reticle cross from the gyro reticle center dot shows the computed lead angle. Range data to the sight is supplied by a manual ranging control incorporated in the throttle grip. The sight gyro motor becomes operable whenever the primary bus is energized; power to the reticle bulbs is supplied when the gun safety switch is set at either operating position.

Mark 18 Sight Controls and Indicator.

Gun Safety Switch. Refer to "Gunnery Equipment Controls and Indicator" in this section.

Selector-Dimmer Knob. The selector-dimmer knob (figure 4-10), to the right of the sight head, controls reticle selection and adjusts reticle image brilliancy. Positioning the selector knob at FIXED illuminates the fixed reticle. When the knob is set at either GYRO-DAY OR GYRO-NIGHT, the gyro reticle is illuminated. Both the fixed and gyro reticles appear when the selector knob is at the FIXED & GYRO position. Brilliancy of reticle illumination is adjusted by rotating the knurled outer ring of the selector-dimmer control.

Span Scale Selector Lever. The dimensional wing span of the target airplane is inserted into the sight by the span scale selector lever (figure 4-10) on the face of the sight head. Graduated markings (from 30 to 120) on a semicircular dial represent the wing span, in feet, of the target. The span scale selector lever should be rotated until the index line on the lever is aligned with the dial number equivalent to the actual or estimated wing span of the target airplane. When the span scale selector lever is used, the diameter of the gyro reticle image circle is varied accordingly to provide a reference dimension for proper ranging.

Fixed-reticle Masking Lever. The fixed-reticle masking lever (figure 4-10), on the left side of the sight, permits the rocket scale and the 100-mil arc of the fixed-reticle image to be blanked out. Use of the masking lever during normal operation of the sight is limited except for superimposing the two reticle images, rocket firing or strafing, and in case of mechanical failure of the gyro.

Manual Ranging Control. When actuated, the manual ranging control, incorporated in the throttle grip (figure 1-9), supplies range input to the sight. Rotation of the grip varies the diameter of the gyro reticle image circle, and correct range can be maintained (provided the span scale selector has been set to correspond to the span of target) if the target is kept framed within the reticle circle. Clockwise rotation of the grip decreases the range; counterclockwise movement increases the range. The range control is spring-loaded to the maximum range position.

Range Dial. Located on the left side of the sight head, the range dial (figure 4-10) is operated by, and in conjunction with, the manual range control. The dial provides visual indication of the range between 200 and 800 yards.

Preflight Check of Mark 18 Sight.

Before take-off, check the sight as follows:

1. Gun safety switch at SIGHT CAMERA RADAR.
2. Selector-dimmer control selector knob at FIXED & GYRO. Both reticle images should appear on reflector glass. If arc and rocket scale of fixed-reticle image are visible, use masking lever to blank them out.
3. Rotate outer ring of selector-dimmer knob to obtain desired reticle brilliance.
4. By aiming at point on horizon, make sure gyro reticle image dot is superimposed on fixed-reticle cross.
5. Set selector-dimmer knob at GYRO OR FIXED & GYRO as desired.
6. Rotate manual ranging control to check operation of gyro reticle circle from minimum to maximum range.

*F-86A-5 Airplanes AF48-129 through -316 and AF49-1007 through -1315

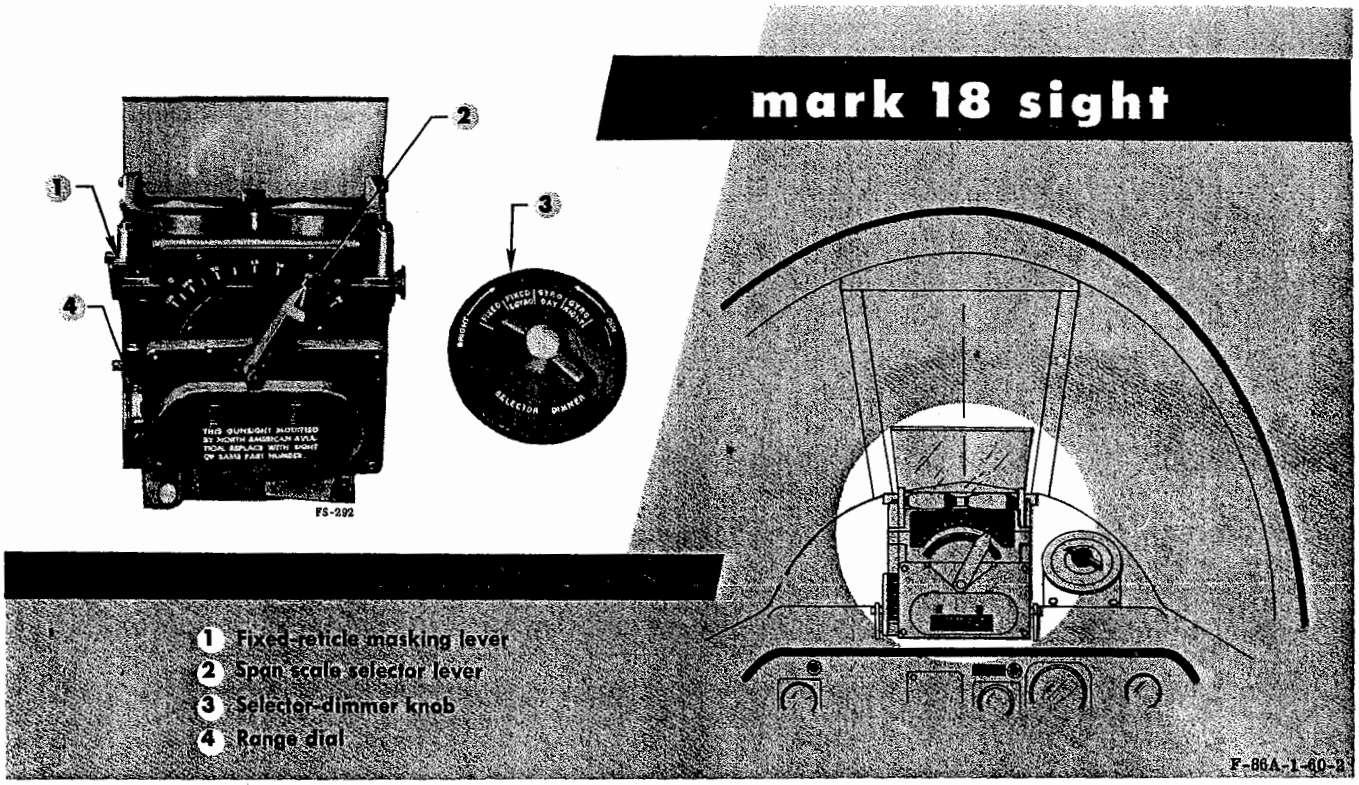

Figure 4-10

Operation of Mark 18 Sight.

Normal operation of the Mark 18 sight is accomplished as follows:

1. Identify target; then set span scale selector lever to correspond with span of target airplane.

2. Fly airplane so that target appears within gyro reticle circle, and rotate range control until the diameter of the gyro reticle circle corresponds to size of target.

3. Keep target with gyro reticle circle by rotating range control as range changes. Track target for one second; then fire.

Mark 18 Sight Operational Notes.

For most effective use of Mark 18 sight, observe following:

1. Keep sight operating whenever its use is probable.

2. When maneuvering into position for attack, keep sight set at shortest range (large-diameter gyro reticle image circle) and decrease diameter to correspond to size of target.

3. Always track target before firing. By operating ranging control, continually frame the target while tracking for a minimum period of one second; then fire. Only after such tracking will the lead be correctly compensated.

4. Learn to use the sight instead of flight instruments. Notice that when selector knob is set for normal operation (FIXED & GYRO), the relative positions of the fixed and gyro reticle images indicate what the airplane is doing. If the cross and dot are superimposed, the flight path is a straight line.

5. For firing at stationary ground targets, use the fixed system of the sight.

A-1CM GUN-BOMB-ROCKET SIGHT.*

The Type A-1CM sight (figure 4-11), mounted above the instrument panel shroud, is an automatic lead and ballistic computing sight used for gun and rocket firing and bomb release. It is operable as a gun sight from sea level up to 50,000 feet, and as a bombsight from sea level to 10,000 feet. The sight reticle image, projected on the windshield armor glass, consists of a circle and a central dot and indicates the required lead for gun and rocket firing. When the sight is used as a bombsight, the sight reticle is depressed 10 degrees, requiring the approach to be made so that the flight path becomes tangent to the bomb trajectory. The point of tangency is the proper bomb release point and is indicated by automatic extinction of the reticle image

*F-86A-5 Airplanes AF49-1316 through -1339, and F-86A-6 and F-86A-7 Airplanes

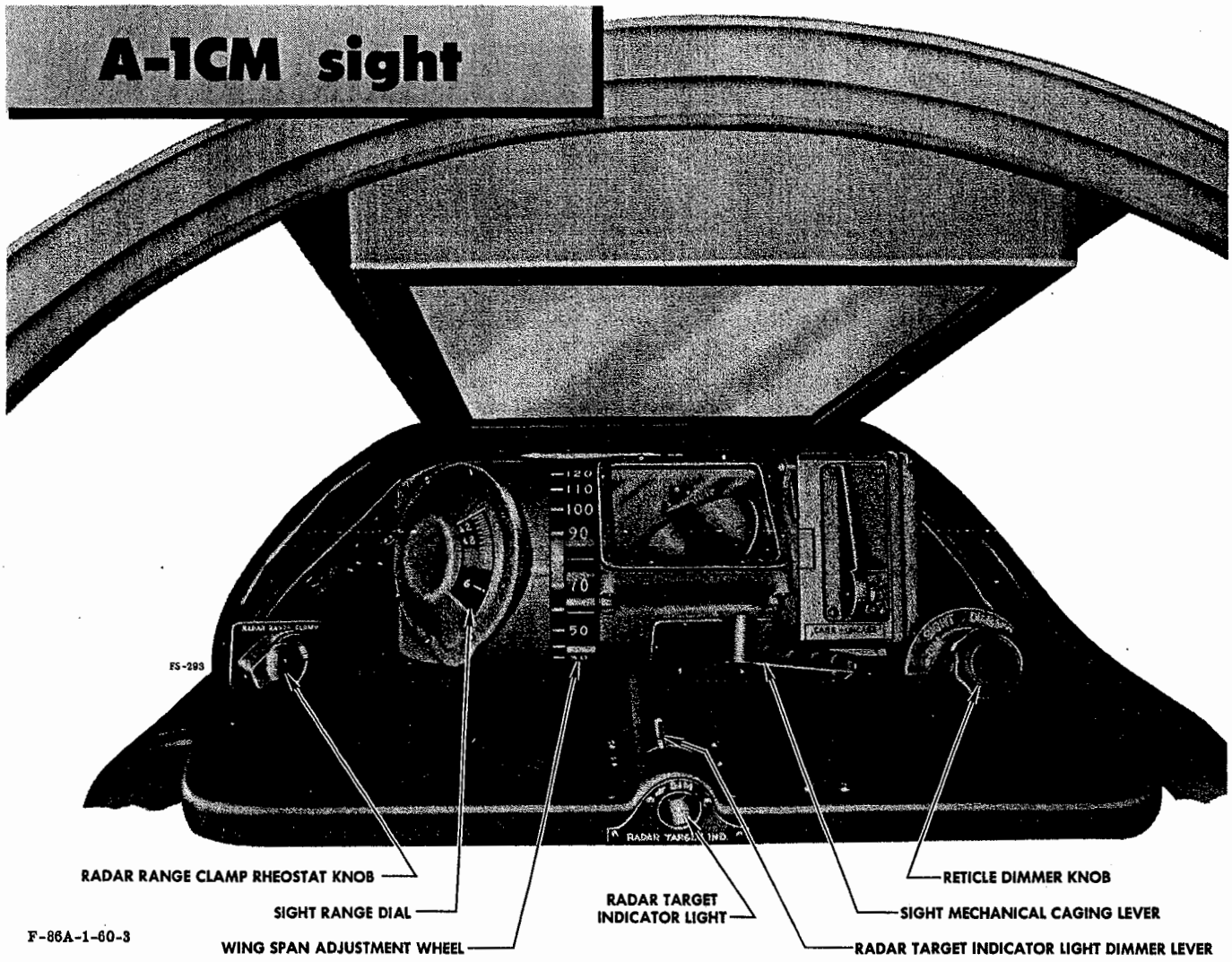

Figure 4-11

circle. Bomb release may be accomplished at this point by a mechanism within the sight or manually. The sight reflects a flashing red light on the windshield armor glass to indicate actual bomb release. Electrical power (ac and dc) to the sight is controlled by the gun safety switch. Loss of ac power will eliminate the computing features of the sight; however, the sight can be operated as a fixed-reticle sight as long as dc power is available. On airplanes equipped with the Type A-1CM sight, a manual range control inserts range data into the sight system. On F-86A-6 and F-86A-7 Airplanes, a radar ranging unit furnishes range input to the sight. F-86A-6 Airplanes have an AN/APG-5C radar set; and AN/APG-30 set is installed on F-86A-7 Airplanes. The radar ranging system also affords automatic search within its range. (Sweep range of the AN/APG-5C radar is approximately 150 to 1800 yards. The AN/APG-30 radar has a sweep range of approximately 150 to 3000 yards.) It automatically locks onto and tracks a target within its range and provides an indication when the lock-on has been accomplished. A manual ranging control supplements the radar set. On overland targets below 6000 feet, radar ranging is usually erratic due to ground effects. During such conditions, radar ranging distances may be reduced by use of the radar range clamp, or manual ranging may be employed. On some airplanes, the gun camera is mounted on the A-1CM sight head, instead of in the nose of the airplane, to photograph the sight reticle pattern and the target simultaneously. The resulting film record helps analyze the pilot's aiming technique and accuracy.

A-1CM Sight Controls.

Gun Safety Switch. Refer to "Gunnery Equipment Controls and Indicator" in this section.

Reticle Dimmer Knob. The sight reticle dimmer knob (figure 4-11), located to the right of the sight head, is used to regulate the intensity of sight reticle illumination from full brilliance to extinction. The dimmer knob

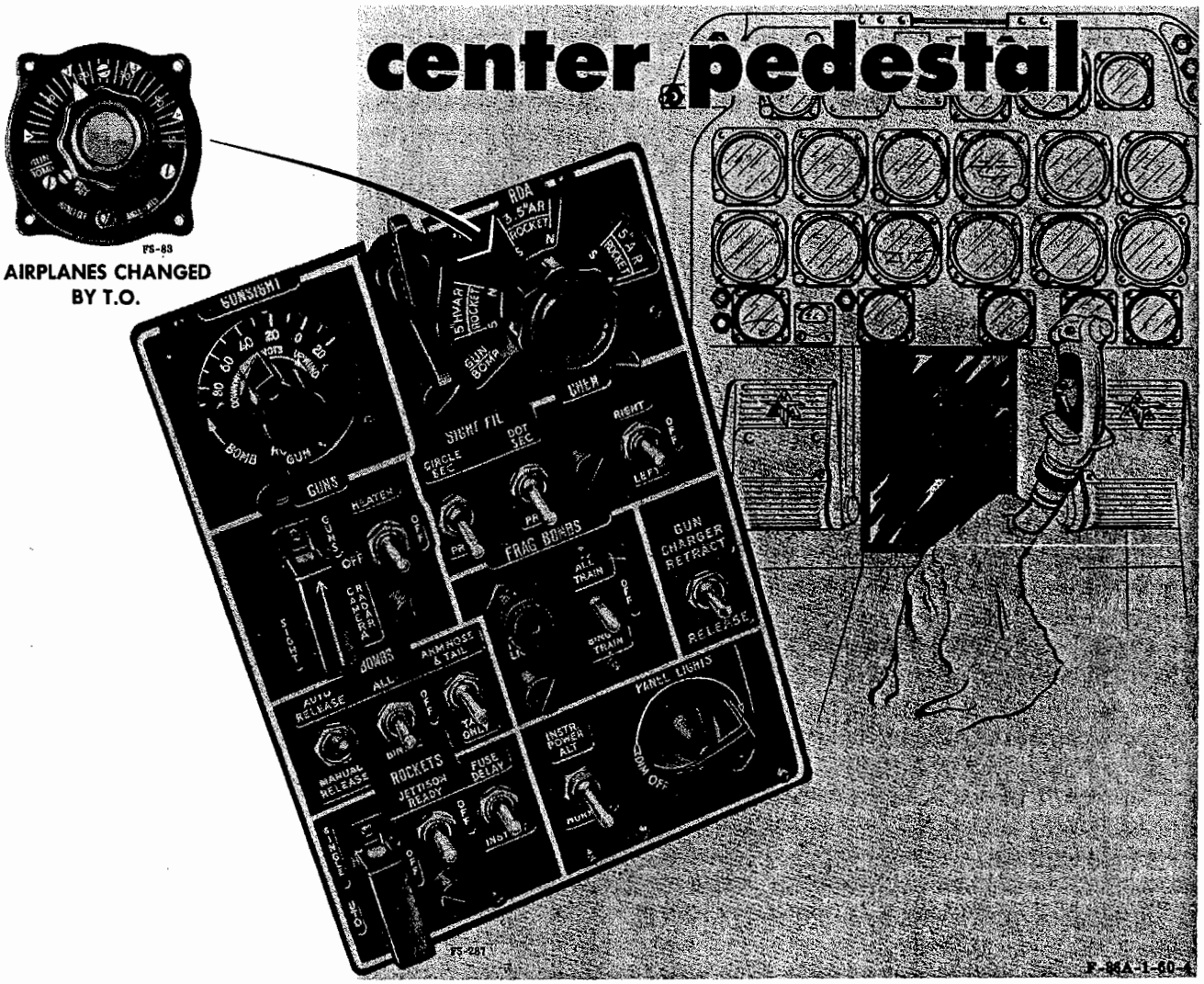

Figure 4-12

should be set at DIM when the sight is not in use to prevent damage to the reticle bulb in event of voltage surges.

Filament Selector Switches. Either the primary or secondary filaments in the bulbs that illuminate the reticle image is selected by means of the two filament selector switches (figure 4-12) on the center pedestal. One switch controls the filaments in the reticle circle bulb; the other is for the reticle dot bulb. Both switches should normally be set at PRIM and moved to SEC if the primary filament in the respective bulb fails.

Rocket Setting Unit. For rocket firing, the rocket setting unit (figure 4-12) depresses the sight reticle image to correspond with the type of rocket to be fired and the intended dive angle of the attack. The unit, mounted on the center pedestal, has a control knob and a dial which has settings for three types of rockets. Each dial setting has two detents, marked "S" and "N" respectively, for inserting the intended dive angle into the sight system. For attack angles between 0 and 40 degrees, the control knob is moved to the N (normal) detent of the applicable rocket setting; for angles between 40 and 60 degrees, the knob is set at S (steep). When the sight is used for gunnery or bomb release, the knob must be set at the GUN BOMB position. For rocket firing on modified airplanes, the rocket setting unit (figure 4-12) incorporates a single control with variable sight capabilities. The rocket setting unit acts as a rocket depression angle selector for sight reticle image depression; the scale is calibrated in mils on the upper segment of the unit. There are no specific rocket settings. Movement of the control knob depresses the sight reticle image in increasing amounts through the full range of the mil scale, according to the position chosen. The nominal rocket depression setting for the 5-inch HVAR at a normal dive angle (0 to 40 degrees) is 17 mils. The pilot should determine, through test-firing runs, the settings for various dive angles most suitable to his own technique. The data thus obtained should be set on the mil scale variable index markers so provided. The index markers, numbered from 1 through 4,

are for reference only and have no function in the sight system. When turned, a slotted screw on the lower segment of the unit face unlocks the index markers for adjustment. When the sight is used for firing guns or dropping bombs, the control should be placed at the GUN BOMB position.

Bomb-Target Wind Control Knob. The bomb-target wind control knob (figure 4-12), on the center pedestal, adjusts the sight system for dive-bombing operations. Clockwise rotation of the control knob from the ROCKET GUN position depresses the sight reticle image to determine the proper approach on the target. If, during the attack, the path of the airplane is parallel to the wind or to the direction of a moving target, the bomb-target wind control is used to compensate the sight system accordingly. For attacks on stationary targets, corrections for wind speed are made on either the "UPWIND" or "DOWNWIND" portion of the scale to correspond with known or estimated wind velocity. ("UPWIND" scale is used when attack is made into a head wind; "DOWNWIND," for attacks made with a tail wind.) If the wind direction is not parallel to the course of the attacking airplane, the amount of wind correction adjustment must be estimated. This correction approaches 0 as the wind direction becomes 90 degrees to the airplane course. During attack on moving targets, additional corrections must be made to compensate for target velocity. For approaching targets, the correction is DOWNWIND; for receding targets, correction is UPWIND. No correction is necessary when the target is moving at right angles to the path of attack. The bomb-target wind control knob must be set at the ROCKET GUN position when the sight is to be used for gun or rocket firing.

Wing Span Adjustment Wheel. The serrated wing span adjustment wheel (figure 4-11) is mounted vertically in the sight head and is used only for gunnery operations when ranging is accomplished manually. Graduated markings (from 30 to 120) on the outer edge of the wheel represent the wing span, in feet, of the target airplane. The span adjustment wheel should be rotated until the applicable span marking on the wheel (equivalent to the known or estimated span of the target) is aligned with the index mark on the sight head. Actuation of the wheel inserts target size data into the sight, varying the reticle image circle diameter in proportion to target size. The reticle size thus formed serves as a reference dimension to aid in obtaining proper range with the manual range control.

Sight Mechanical Caging Lever. Sight caging is accomplished mechanically by means of the caging lever (figure 4-11) on the sight head. The lever is set at the UNCAGE position for normal automatic operation of the sight. For ground attacks, or in the event of sight failure, the lever should be moved to CAGE to provide a 100-mil fixed-reticle image circle.

CAUTION

The sight should be mechanically caged during taxiing, take-off, and landing, to prevent damage to the sight.

Electrical Caging Button. The sight is caged electrically when the caging button (figure 1-9), on the throttle grip, is held depressed. Prior to an attack, the sight should be caged in this manner to stabilize the sight reticle image. Image stabilization is necessary to prevent false data being supplied to the sight as the result of maneuvering on the initial approach to the target. The sight should also be caged during tracking when the range is between 1000 and 1500 yards, as the resultant leads at these distances are too great to give proper reticle presentations. When the range is reduced to approximately 500 yards, the sight should be uncaged to permit normal operation.

Note

To prevent damage to the sight, the electrical caging button should be depressed whenever severe turbulence is encountered.

Manual Ranging Control. A twist-grip control is incorporated in the throttle (figure 1-9) to provide a means of manually supplying range data to the sight system. On airplanes having the Type A-1CM sight, the manual ranging control provides the only source of range input to the sight. On F-86A-6 and F-86A-7 Airplanes, manual ranging is used to supplement the normally used radar ranging equipment in case the radar fails. Manual ranging is also employed below 6000 feet on overland targets, as radar ranging is often erratic due to ground effects. Clockwise rotation of the twist grip reduces the range (increases reticle diameter); counterclockwise rotation increases range (decreases reticle diameter). The range sweep of manual ranging is from approximately 1200 feet to 2700 feet. The control is spring-loaded to the full counterclockwise position, where it must be for normal operation of radar ranging on those airplanes so equipped.

Radar Target Selector Button (F-86A-6 and F-86A-7 Airplanes). After detecting a target, the radar locks on it and measures the range. To override the radar lock-on and shift the radar to another target, it is necessary to actuate the target selector button (figure 1-17) on the control stick grip. To reject the target,

the selector button should be depressed for several seconds. The radar can then lock on targets at ranges greater than the one rejected until the maximum sweep range of the radar is reached. It then automatically recycles, commencing to sweep from the minimum sweep range.

Radar Range Clamp Rheostat Knob (F-86A-6 and F-86A-7 Airplanes). The radar range clamp rheostat knob (figure 4-11), to the left of the sight head on the instrument panel shroud, controls the reduction of radar ranging distances. Use of the rheostat will prevent the radar from locking on the ground or ground objects during low-altitude attacks. Rotating the rheostat knob toward MINIMUM decreases range distance; the range is increased when the rheostat is rotated toward MAXIMUM. Radar ranging distance is normal with the rheostat at MAXIMUM.

A-1CM Sight Indicators.

Sight Range Dial. Target range in hundreds of feet is indicated by the range dial (figure 4-11), visible through a window in the sight head. The dial is graduated from 600 to 6000 feet and presents range distances as determined by either the manual range control, or when applicable, by the radar ranging system.

Radar Target Indicator Light (F-86A-6 and F-86A-7 Airplanes). The radar target indicator light (figure 4-11) comes on when the radar ranging equipment has locked onto the target during tracking. On some airplanes, the light is on the sight head; on others, the light is in the center of the instrument panel shroud. Rotating the bezel of the unit adjusts the intensity of the sight-mounted indicator light. A lever on top of the light housing controls the intensity of the indicator light in the shroud.

GUNNERY EQUIPMENT.

The six Type M-3 .50-caliber machine guns are arranged in a vertical bank of three in each of the two gun compartments. One compartment is on each side of the fuselage, outboard of the cockpit. Three removable ammunition containers are located below each gun compartment, and containers are provided in the lower portion of the fuselage for retaining ejected cases and links. A maximum of three hundred rounds of ammunition may be carried for each gun. Simultaneous charging of all guns may be selectively controlled from the cockpit by means of the gun charger switch. The system includes an air storage tank and a pressure-controlled compressor to maintain adequate and continuous air pressure for gun charger operation. The guns are normally bore-sighted parallel to both the fuselage reference line and the fuselage centerline. For gun firing, the gun sight line is bore-sighted down to intersect the mean gun bore at 750 yards. The bore-sighting configuration considers an airplane gross weight of 12,258 pounds (full ammunition load, half fuel, and no external load) and an unaccelerated flight condition. The gun blast panels have open-type gun muzzle openings which are plugged with plastic plugs. The plugs are blown off without damage to the airplane when the guns are fired. The ammunition compartments can be heated when necessary to maintain suitable ammunition temperatures. Controlled by the gun heater switch, the ammunition compartment heating system uses hot air from the engine compressor section which is extracted from the pressurization system supply duct. (See figure 4-1.) The air is supplied to both ammunition compartments simultaneously and is automatically controlled by thermostats to maintain the proper ammunition temperature range. A pilot-operated emergency shutoff valve is included in the system to close off the hot-air supply in the event of sudden overheating, indicated by illumination of an overheat warning light.

Gun Camera.

To record the gunnery or rocket run, a gun camera is mounted in the lower portion of the intake duct on some airplanes or on the A-1CM sight head on other airplanes. When the primary-bus-powered camera is mounted on the sight head, it facilitates analysis of the pilot's aiming technique and accuracy. This camera is equipped with an erector assembly that permits mounting the camera below the pilot's line of vision, yet still maintains full camera view of the sight reticle image during gunnery or rocket operation. The nose camera, if installed, is electrically connected in parallel with the camera mounted on the sight, so that when both cameras are installed, they operate together. The camera is operated automatically when the guns or rockets are fired, or it may be operated independently.

Gunnery Equipment Controls and Indicator.

Gun Safety Switch. AC and dc power for operation of the guns, gun camera, sight, and on F-86A-6 and F-86A-7 Airplanes, the radar ranging equipment is selectively controlled by the guarded gun safety switch (figure 4-12) on the center pedestal. The sight and radar equipment receive power when the switch is at the SIGHT CAMERA RADAR position and power is available to permit the gun camera to operate when the trigger is pressed. Setting the gun safety switch at GUNS also energizes the sight and radar, and in addition, provides power to actuate the guns and the gun camera

when the trigger is pressed. The switch is off and related equipment is inoperative when the switch guard is down.

Trigger. The gun-firing and gun camera circuits are actuated when the trigger (figure 1-17) on the control stick grip is depressed. The trigger has two definite detent positions. With the gun safety switch at GUNS, the first trigger position starts the gun camera; and on late airplanes,* the ammunition boost motors are energized. At the second, or fully depressed position, gun camera operation continues, the ammunition boost motors are energized on early airplanes,† and the guns are fired. If the gun safety switch is set at SIGHT CAMERA RADAR, only the gun camera is operable at both trigger positions.

Gun Charger Switch. Selective control of the gun charging system is provided by the gun charger switch (figure 4-12), on the center pedestal. The three-position switch, powered by the primary bus, actuates all gun chargers simultaneously, and is spring-loaded from the RETRACT and RELEASE positions to the OFF (center) position. Momentarily holding the switch at RETRACT causes the gun bolts to be brought to the rear and held in this position. Momentarily holding the switch at RELEASE or depressing the trigger causes the bolts to be released and guns to be charged. Since the charging system automatically charges the guns whenever stoppages occur during gun firing, the charger switch is normally used only for initial charging of the guns before firing or for moving the gun bolts to desired positions. The RETRACT position is utilized when it is necessary to have the bolts at the rear for safety (preventing "cook-offs") or gun-cooling purposes. The RELEASE position allows the bolts to go forward to aid gun heating.

Gun Heater Switch. The Type J-4 electric gun heaters, one attached to each gun, are controlled by the gun heater switch (figure 4-12) on the center pedestal. Moving the switch, which is powered by the secondary bus, from OFF to HEATER turns on the heater and actuates the ammunition compartment heating system.

Ammunition Compartment Heat Emergency Shutoff Handle. If the ammunition compartment heating system does not function properly and an overheat condition results (as evidenced by illumination of the overheat warning light), the emergency shutoff handle (figure 4-3), on the left aft console, permits the hot-air supply to the compartments to be turned off immediately. Pulling the emergency shutoff handle closes a valve in the hot-air supply duct. The handle cannot be reset in flight; therefore, it should not be pulled until it is certain that the ammunition compartment overheat warning light will remain on.

Ammunition Compartment Overheat Warning Light. Indication of excessive temperatures within the ammunition compartments is provided by illumination of the red warning light (figure 4-3) on the left aft console. The light is the push-to-test type and is powered by the primary bus.

Note

Momentary illumination of the ammunition compartment overheat warning light does not necessarily indicate a malfunction of the heat control system.

Firing Guns.

Radar Ranging. To fire the guns using the A-1CM sight and radar ranging, proceed as follows:

1. Check instrument power switch at NORMAL; inverter warning light OUT.
2. Before using sight, place gun safety switch at SIGHT CAMERA RADAR to allow a 10- to 15-minute warm-up period for sight and radar. Check mechanical caging lever at CAGE.
3. Move sight mechanical caging lever to UNCAGE.

Note

When firing at stationary ground targets, or in case of sight failure, move caging lever to CAGE and use sight as conventional 100-mil fixed-reticle sight.

4. Sight filament selector switches at PRIM, or move to SEC if primary filaments are inoperative.
5. Make sure throttle twist grip is at the full counterclockwise position (radar ranging engaged).
6. Gun heater switch at HEATER if outside air temperature is 35°F or below.
7. Bomb-target wind control knob at ROCKET GUN; rocket setting unit at GUN BOMB.
8. Move gun safety switch to GUNS.
9. Set wing span adjustment wheel to wing span of target airplane so that manual ranging can be set up in a minimum of time should radar ranging fail.
10. Sight reticle dimmer knob adjusted for desired reticle image brilliance.

*F-86A-5 Airplanes AF49-1207 through -1339
†F-86A-5 Airplanes AF48-129 through -316 and AF49-1007 through -1206

11. Depress electrical caging button to stabilize reticle image, and begin tracking, estimating the lead.

12. After radar target indicator light is on (at target range of approximately 1800 yards), release electrical caging button.

Note

If more than one target along the airplane flight path is within range, make sure radar is tracking the desired target. As range decreases, the reticle should grow larger to span target continuously. Check range dial indication against estimated range of target. If radar has locked on undesired target, reject it by depressing radar target selector button on stick grip.

13. Continue to track target smoothly, without slipping or skidding, for approximately one second after releasing caging button; then fire.

Manual Ranging. To accomplish gunnery if radar ranging fails (as indicated by the radar target indicator light going out or by improper range indications), or at any other time it is necessary or desirable to employ manual ranging:

1. Check wing span adjustment wheel at correct setting.

2. Rotate throttle grip clockwise to engage manual ranging. Continue to rotate grip until reticle image circle is reduced to minimum diameter.

3. Depress electrical caging button to stabilize the reticle image and frame target within reticle circle.

4. Continue to rotate throttle grip so that reticle circle continuously frames the target, and begin tracking.

5. When approaching target range, release gyro caging button.

6. After releasing caging button, continue tracking target smoothly for about one second; then fire.

BOMBING EQUIPMENT.

A removable bomb rack may be attached to the lower surface of each outer wing panel. Each rack can carry single bombs of various types, ranging from 100 to 1000 pounds, bomb clusters from 100- to 500-pound sizes, and an M10 smoke tank. The A-1CM sight is used for bomb sighting and may be employed to release the bombs automatically. Separate controls are provided for normal or emergency bomb release; during normal release, bombs may be dropped singly or simultaneously. The arming condition of the bomb fuses is selectively controlled upon a normal release. Bombing system controls are also used to release the drop tanks, which may be installed instead of the bomb racks.

WARNING

- Parafragmentation bombs must not be carried at any time because of the danger of the parachutes opening in the bomb rack.
- Because of restricted clearances, do not lower wing flaps over 20 degrees when 1000-pound bombs are carried.
- To avoid damage to the airplane, do not release bombs weighing 500 pounds or more when using the automatic function of the sight, or while negative G is being applied to the airplane, because these bombs tend to strike portions of the airplane under such release conditions.

Bombing Equipment Controls.

Bomb-Rocket-Tank Release Button. Bomb and rocket release circuits are energized from the primary bus (after the applicable selector switches have been positioned for the desired release condition) when the release button (figure 1-17) on the control stick grip is depressed. Used primarily for the normal release of bombs and rockets, the release button can also effect the release of the drop tanks and chemical tanks, as well as discharge of chemical tank contents, depending on selector switch positioning. If the rocket release selector switch is at SINGLE or AUTO, the gun camera will operate when the bomb-rocket-tank release button is depressed. If necessary, all external loads can be released simultaneously by means of the bomb-rocket-tank release button when bomb and rocket selector switches have been set accordingly.

WARNING

Before actuating the bomb-rocket-tank release button, make sure the bomb and rocket release selector switches and the rocket jettison switch are positioned correctly for the desired release condition. Failure to check switch positioning may cause accidental bomb or rocket release.

Demolition Bomb Single-All Selector Switch. The single-all selector switch (figure 4-12) on the center pedestal is powered by the primary bus. The switch can be positioned for single or simultaneous release of bombs (except fragmentation and 3-pound practice bombs) when the bomb-rocket-tank release button is depressed. With the selector switch set at the SINGLE position, the left bomb rack is tripped when the release

button is pressed. A transfer circuit within the racks permits the right bomb rack to be tripped when the release button is actuated again. Both bomb racks release simultaneously when the selector switch has been set at the ALL position and the release button is depressed. The demolition bomb single-all selector switch can also be used to release the drop tanks.

Note

Only the left drop tank can be released when the selector switch is at SINGLE as there is no transfer circuit to the right tank. The selector switch must be moved to ALL for simultaneous release of all tanks.

When fragmentation or 3-pound practice bomb racks are installed, the demolition bomb single-all selector switch should be OFF to prevent release of the bomb containers.

Note

The demolition bomb single-all selector switch is inoperative if the fragmentation bomb selector switch is not OFF.

Demolition Bomb Release Selector Switch. The two-position release selector switch (figure 4-12), on the center pedestal, is powered by the secondary bus and permits selection of either manual or automatic bomb release. When the release selector switch is set at MANUAL RELEASE, bomb release occurs when the release button is depressed. If the switch is at AUTO RELEASE position and the release button is held closed, the mechanism within the A-1CM sight automatically accomplishes bomb release when the path of airplane during the bombing run becomes tangent to a bomb trajectory. The release selector must be at MANUAL RELEASE when fragmentation or 3-pound practice bomb racks are installed.

Bomb-Arming Switch. The arming condition of bombs, except fragmentation and 3-pound practice bombs, is controlled by the battery-bus-powered bomb-arming switch (figure 4-12) on the center pedestal. The bombs are armed to explode instantly upon impact when the arming switch is set at the ARM NOSE & TAIL position. Setting the arming switch at TAIL ONLY arms the the bombs for delayed detonation. The bombs will be released unarmed if the switch is in the OFF position.

Fragmentation Bomb Selector Switch. The fragmentation bomb selector switch (figure 4-12), located on the center pedestal, is used only for release of fragmentation or 3-pound practice bombs. It is powered by the primary bus. Placing the switch at SINGLE TRAIN results in release of fragmentation bombs in a train from the left rack and then from the right, as long as the release button is held depressed. When the fragmentation bomb selector switch is at the ALL TRAIN position, holding the release button depressed releases the bombs in a train from left and right racks simultaneously. The arming condition of fragmentation bombs cannot be controlled during a normal release, as the bombs are automatically armed upon leaving the racks.

Bomb-Rocket-Tank Salvo (Jettison) Button. When the battery-bus-powered salvo (jettison) button (figure 1-13), inset in the left forward console, is depressed, all external loads (including all types of bombs, rockets, and tanks) are released simultaneously from left and right racks. Regardless of the position of bomb or rocket arming switches, bombs and rockets are dropped unarmed when the button is depressed. The button is operable whenever battery power is available, as the salvo circuit receives electrical power from the battery bus.

Note

Rockets cannot be salvoed when airplane is on the ground, as the salvo circuit is broken when weight of airplane is on the landing gear.

Emergency Jettison Handle. Bombs or drop tanks are released simultaneously when the emergency jettison handle (16, figure 1-6), recessed in the inboard face of the left forward console, is pulled. If electrical release fails, the handle is used to jettison bombs or tanks mechanically, independently of any of the electrical release systems. The bomb-arming circuit is interrupted automatically when the emergency jettison handle is pulled, and bombs are dropped unarmed, regardless of the bomb-arming switch position. Rockets cannot be jettisoned with the emergency jettison handle.

Bombing Equipment Indicators.

A-1CM Sight Bomb Release Indicators. When the sight controls are set for the bombing functions, the sight will indicate bomb release. During the bombing run, the proper bomb release point (point at which path of the airplane becomes tangent to the bomb trajectory) is indicated by automatic extinction of the reticle image circle. This indication occurs whether the bomb release system is set for automatic or manual release. Upon release of the bomb, a red flashing bombs-away light is reflected onto the windshield armor glass from within the sight.

Fragmentation Bomb Indicator Light. The fragmentation bomb indicator light (figure 4-12) on the center pedestal is illuminated by primary bus power when

fragmentation bombs are installed and the release circuit is engaged. The light comes on when the fragmentation bomb selector switch is moved to either SINGLE TRAIN or ALL TRAIN position and extinguishes automatically as the last fragmentation bomb is released.

Releasing Bombs.

Releasing Demolition Bombs. To release demolition bombs using the Type A-1CM sight, proceed as follows:

WARNING

To avoid damage to the airplane, do not release bombs weighing 500 pounds or more when using the automatic function of the A-1CM sight, or while negative G is being applied to the airplane, because these bombs tend to strike portions of the airplane under such release conditions.

1. Check instrument power switch at NORMAL; inverter warning light OFF.
2. Gun safety switch at SIGHT CAMERA RADAR; allow 10- to 15-minute warm-up period for sight. Check mechanical caging lever at CAGE.
3. Move mechanical caging lever to UNCAGE.
4. Sight filament switches at PRIM, or move to SEC if primary filaments are inoperative.
5. Make sure throttle twist grip is at the full counterclockwise position (radar ranging engaged).
6. Adjust sight reticle dimmer control for desired brilliance of reticle image.
7. Demolition bomb release selector switch at AUTO RELEASE for automatic release by means of the sight, or at MANUAL RELEASE for selective manual release.
8. Demolition bomb selector switch at ALL or SINGLE. Check fragmentation bomb selector switch OFF.
9. Set rocket setting unit at GUN BOMB.
10. After sighting target and before starting approach, set bomb arming switch at ARM NOSE & TAIL or TAIL ONLY.
11. Turn bomb-target wind control knob from ROCKET GUN to known or estimated target and wind velocities.
12. Make approach to target that will give desired dive angle during bombing run.
13. Depress electrical caging button to stabilize reticle image before pushing over into dive.
14. Place reticle image dot on target.
15. After establishing dive, keep dot on target and release electrical caging button. If automatic release has been selected, depress bomb-rocket-tank release button at this point.
16. Track smoothly, keeping dot on target.
17. On an automatic release, bomb release will occur automatically at correct release point as indicated by disappearance of reticle circle image. If release is manual, depress bomb-rocket-tank release button as circle image is extinguished. (Bomb release is indicated by a flashing red light reflected from the sight onto the windshield armor glass.)

Releasing Fragmentation Bombs. Fragmentation or 3-pound practice bombs are released as follows:

Note

The A-1CM sight is used for dive bombing only and therefore is not applicable for release of fragmentation or 3-pound practice bombs.

CAUTION

To prevent excessive damage to the racks, fin-stabilized fragmentation bombs must not be released at speeds above 480 knots IAS.

1. Check demolition bomb release selector switch at MANUAL RELEASE.
2. Set fragmentation bomb selector switch at SINGLE TRAIN or ALL TRAIN for type of release desired. Check fragmentation bomb indicator light on.
3. Depress bomb-racket-tank release button to release the bombs.

Note

All bombs within the fragmentation bomb rack are released when the release button is held depressed for approximately 3½ seconds.

4. When last bomb is released, check fragmentation bomb indicator light is out.

Bomb Emergency Release. The bomb-rocket-tank salvo (jettison) button is used to jettison demolition bombs unarmed. Demolition bombs can also be dropped safe simultaneously when the demolition bomb single-all selector switch is set at ALL, the bomb-arming switch is positioned to OFF, and the bomb-rocket-tank release button is pressed.

Note

Emergency or simultaneous release of drop tanks is done in the same manner.

As fragmentation bombs are automatically armed upon release from the rack, unarmed release of individual

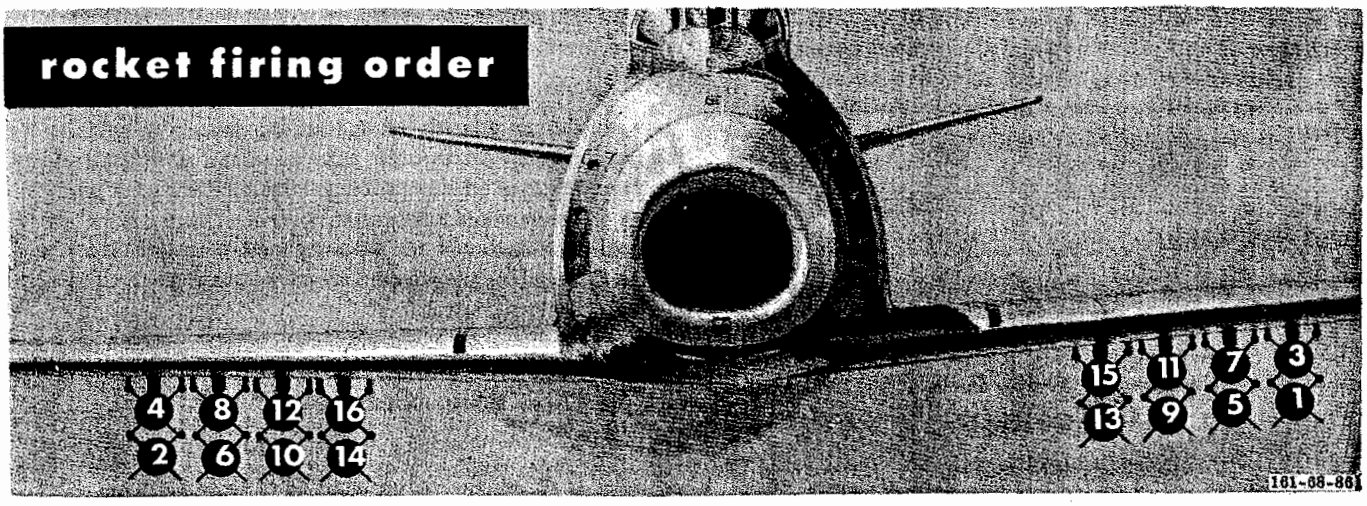

Figure 4-13

fragmentation bombs is impossible. However, if the fragmentation bomb rack is released with bombs installed, the bombs will be dropped in a safe condition. Depressing the bomb-rocket-tank salvo (jettison) button releases the rack and unarmed bombs. Fragmentation bombs can also be released unarmed when the bomb-rocket-tank release button is depressed after the fragmentation bomb selector switch has been set at OFF and the demolition bomb single-all selector switch at ALL. The emergency jettison handle may be used to jettison bombs mechanically in case of electrical failure. Demolition bombs are released unarmed, because the bomb-arming circuit is broken. Fragmentation bombs are also dropped safe, because the fragmentation bomb racks are released when the emergency jettison handle is pulled.

ROCKET EQUIPMENT.

Eight removable, zero-rail rocket launcher assemblies may be installed to permit mounting 16 rockets. The launchers are fitted to the lower surface of the outer wing panels, four on each side. Two rockets, one mounted directly below the other, are hung from each launcher assembly. The A-1CM sight is used for rocket aiming, and controls permit normal or emergency rocket release. During normal release conditions, rocket arming can be selectively controlled. The gun camera operates automatically when the rockets are fired. Rocket-firing order is illustrated in figure 4-13.

Rocket Equipment Controls.

Bomb-Rocket-Tank Release Button. Refer to "Bombing Equipment Controls."

Rocket Release Selector Switch. The guarded, three-position rocket release selector switch (figure 4-12) on the center pedestal is powered by the primary bus. When the selector is at SINGLE, one rocket is fired each time the bomb-rocket-tank release button is depressed; if the selector is positioned at AUTO, all rockets are released in train with one maintained depression of the release button. Automatic firing stops when the button is released. The rocket release sequence is normally applicable during single or automatic release conditions. The rocket release circuit is inoperative when the switch is OFF.

Rocket Fuze (Arming) Switch. The arming condition of the rocket nose fuzes can be controlled during normal release conditions by primary bus power through the rocket fuze switch (figure 4-12) on the center pedestal. With the switch set at INSTANT, the nose fuze is armed upon release to provide instantaneous detonation on contact. The nose fuze is unarmed if the switch is at DELAY or OFF; however, an internal fuze will cause delayed detonation after impact following a normal release. If the rockets are jettisoned by means of the salvo (jettison) button, the nose fuze is automatically unarmed and the internal fuze is inoperative.

Rocket Intervalometer (Projector Release) Control. Rocket-firing sequence during manual and automatic release is controlled by the rocket intervalometer (8, figure 1-6) above the left aft console. When the rocket selector switch has been set at SINGLE, one rocket is released each time the bomb-rocket-tank release button is depressed, and the intervalometer automatically maintains the correct firing sequence for each successive release. When the selector switch is positioned at AUTO and the release button depressed, the intervalometer causes the rockets to be fired in proper sequence at approximately 1/10-second intervals as long as the release button is held depressed. A numbered dial, visible through a window in the intervalometer housing, indicates the rocket to be fired. The dial is set at the time of rocket loading and should be at 1 when a normal complement of rockets is carried. The reset knob on the intervalometer is used to select release of any particular

rocket in case of misfire or other malfunction during a "single" release.

Note

If a lower rocket fails to fire during a normal release, the upper rocket on the same mount cannot be fired.

Rocket Jettison Switch. The rocket jettison switch (figure 4-12), on the center pedestal, permits all rockets to be dropped from the mounts simultaneously with the nose fuze armed or unarmed by means of the bomb-rocket-tank release button. The jettison circuit is powered by the battery bus on late airplanes,* and by the primary bus on all other airplanes. For rocket jettison release, the rocket fuze (arming) switch is set at the desired position, the jettison switch moved to JETTISON READY, and the release button depressed.

CAUTION

The rocket fuze (arming) switch must be preset at OFF or DELAY to jettison the rockets in a nose-fuze unarmed condition. The internal fuze is inoperative during a jettison release.

Note

Rockets cannot be jettisoned when the airplane is on the ground, because the jettison circuit is interrupted when the weight of the airplane is on the landing gear.

Bomb-Rocket-Tank Salvo (Jettison) Button. Refer to "Bombing Equipment Controls" in this section.

Firing Rockets.

Sight and armament controls should be set as follows for rocket firing:

1. Check instrument power switch at NORMAL; inverter warning light out.

2. Gun safety switch at SIGHT CAMERA RADAR to allow a 10- to 15-minute warm-up period for sight. Check mechanical caging lever at CAGE.

3. Sight filament selector switches at PRIM or at SEC if primary filaments are inoperative.

4. Before initial rocket firing, make sure intervalometer dial is at position 1 to ensure proper release of all rockets carried.

5. Move sight mechanical caging lever to UNCAGE.

6. Bomb-target wind control knob at ROCKET GUN.

7. Rocket setting unit set for type of rocket to be fired and the intended dive angle.

8. Rocket release selector switch at SINGLE or AUTO.

9. Rocket jettison switch OFF.

10. Rocket fuze (arming) switch at INSTANT or DELAY.

11. Sight reticle dimmer knob adjusted to obtain desired reticle image brilliancy.

12. Make approach to target that will give desired dive angle during firing.

13. Before pushing over into the dive, depress electrical caging button to stabilize reticle image.

14. Put reticle image dot on target.

15. After establishing dive, keep dot on target and release electrical caging button when range is between 700 and 1000 yards.

16. Track smoothly, without skidding or slipping, keeping dot on target for approximately 3 seconds; then depress bomb-rocket-tank release button to fire the rockets.

CAUTION

To prevent damage to units within the rocket release circuit, do not keep bomb-rocket-tank release button depressed more than 5 seconds when the rocket release selector switch is at SINGLE.

Rocket Emergency Release.

To drop all rockets simultaneously in a safe condition, the bomb-rocket-tank salvo (jettison) button should be depressed. All the rockets may also be dropped unarmed simultaneously if the rocket jettison switch is at JETTISON READY, and the bomb-rocket-tank release button is depressed.

CHEMICAL TANK EQUIPMENT.

One M10 airplane smoke tank may be hung from each bomb rack in lieu of bombs. A switch on the center pedestal provides for tank selection. Following the discharge of chemicals, the tanks may be dropped by means of the bomb-rocket-tank salvo (jettison) button or the normal bomb release system.

CAUTION

When discharging chemicals, the demolition bomb single-all selector switch must be at OFF to prevent tank release.

*F-86A-5 Airplanes AF49-1227 through -1339

Chemical Tank Selector Switch.

The chemical tank selector switch (figure 4-12) on the center pedestal is powered by the primary bus and controls selection of the tank to be discharged. Moving the switch to its RIGHT or LEFT position sets up the circuit to the corresponding tank. After selection, tank contents are discharged when the bomb-rocket-tank release button is depressed.

Bomb-Rocket-Tank Release Button.

Refer to "Bombing Equipment Controls" in this section.

MISCELLANEOUS EQUIPMENT.

ANTI-G SUIT PROVISIONS.

Air pressure for the anti-G suit bladders is taken from the final stage of the engine compressor and is then routed through a pressure-regulating valve to the suit attachment fitting. The line from the regulating valve to the attachment fitting passes through the quick-disconnect fitting on the front of the seat (figures 1-24, 1-25, and 1-26), so that the line will sever automatically upon ejection. The Type M-4 pressure-regulating valve (31, figure 1-6), on the left aft console, regulates air pressure to the suit and permits inflation of the suit only when positive G is encountered. The valve operates automatically and begins to function at approximately 1.75 G, whether the cap has been rotated to the HI (clockwise) or LO (counterclockwise) detent. When the valve is at LO, one psi of air pressure is exerted in the suit for each additional 1G increase; the valve delivers 1.5 psi per G increase when set at HI. Depressing the button on top of the valve permits valve operation to be checked manually and also allows the suit to be inflated momentarily when desired. Use of the suit in this manner will lessen fatigue during prolonged flights.

DATA CASE.

The data case (3, figure 1-1) is located within the aft fuselage below the engine. Access to the data case is provided by a hinged door on the left side of the fuselage, just forward of the turbine wheel warning stripe. The door is secured by two push-button type latches.

MAP CASE.

The map case (12, figure 1-7) is recessed in the right aft console, directly below the right circuit-breaker panel.

CHECK LIST.

The pilot's check list, mounted horizontally below the right side of the instrument panel, can be pulled out for reference.

MOORING EQUIPMENT.

Mooring rings are furnished in the mooring and jacking kit, and equipment for anchoring the mooring eyes into the ground is included in the airplane mooring kit. On nontactical missions, the mooring kits are stowed in the left rear ammunition container. Two fuselage fittings and two wing fittings are provided for attaching the mooring eyes. Both fuselage fittings are on the lower surface of the fuselage on the airplane centerline. The forward mooring ring is screwed into the jack pad fitting just aft of the nose wheel door; the aft mooring ring is screwed into a fitting forward of the tail-pipe aperture. The wing mooring rings screw into the attaching holes for the forward rocket mounts. All mooring-ring fittings are identified by suitable markings on the adjacent skin. When the airplane is tied down for extreme weather, it should be headed into the wind with the surface controls locked and wheel chocks installed. A ¼-inch cable or ¾-inch rope should be used for tie-down.

RELIEF TUBE.

The relief tube is located beneath the seat.

PROTECTIVE COVERS.

The removable covers, furnished for protecting the airplane while it is on the ground, include wing walkway covers, a cockpit canopy and intake duct cover, and air intake duct plug, a tail-pipe cover, and a pitot head cover.

CAUTION

To prevent formation of excessive moisture, intake duct plug and tail-pipe covers should not be installed until the engine has cooled.

REAR-VISION MIRROR.

An adjustable rear-vision mirror (9, figure 1-1) is suspended from the inner upper surface of the canopy just aft of the canopy bow.

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INSTRUMENT MARKINGS.

Careful attention must be given to the instrument markings (figure 5-1), because the limitations shown on these instruments and noted in the captions are not necessarily repeated in the text of this or other sections.

ENGINE LIMITATIONS.

All normal engine limitations are shown in figure 5-1.

Note

- Military Power is defined as the power obtained at full open throttle (or 100% engine rpm, or 690°C, whichever is lower) and is limited to 30 minutes.
- Maximum Continuous Power (Normal Rated Power) is defined as the power obtained at 96% engine rpm or 655°C, whichever is lower. There is no time limit for operation at this power setting.

ENGINE OVERSPEED.

The maximum permissible engine rpm is 104%. If this rpm is exceeded under any condition, a notation must be made on the DD Form 781, and the engine removed for overhaul.

ENGINE OVERTEMPERATURE.

The following conditions constitute overtemperature operation.

DURING ENGINE STARTS UP TO IDLE RPM (WITHIN 2 MINUTES)

950°C or above for 2 seconds or more

ALL ENGINE OPERATION EXCEPT STARTING

690°C to 750°C for 40 seconds or more
750°C to 800°C for 10 seconds or more
Above 800°C for 2 seconds or more

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The temperature and duration of all overtemperature operation should be entered on the DD Form 781.

AIRSPEED LIMITATIONS.

LANDING GEAR AND WING FLAP LOWERING SPEEDS.

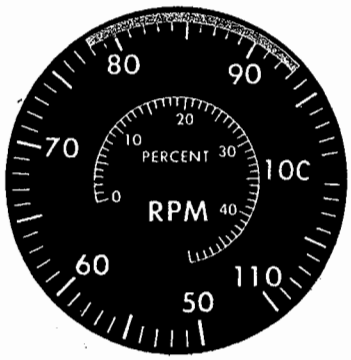
The maximum airspeed when lowering the gear and flaps is 185 knots IAS and is denoted on the airspeed indicator by a yellow radial. (See figure 5-1.) Lowering the gear or flaps at a speed in excess of this value may cause damage to the fairings or the operating mechanism.

LANDING LIGHT EXTENSION SPEED.

The landing lights are designed for extension after the landing gear and wing flaps are lowered. Do not extend these lights at speeds above 185 knots IAS.

instrument markings

TACHOMETER



	78% to 93% rpm	Continuous
	100% rpm	Military Power

EXHAUST TEMPERATURE GAGE

	200°C	Minimum
	200°C—655°C	Continuous
	690°C	Maximum (Take-off and Military Power—30 min max)
	950°C*	Max during start up to idle rpm within 2 minutes

* Refer to "Engine Overtemperature" in this section.

OIL PRESSURE GAGE

	2 psi	Minimum
	2-45 psi	Continuous
	50 psi	Maximum at 100% rpm during cold weather starts until oil temperature stabilizes.

Above 70% rpm, minimum oil pressure limit is 5 psi.

FUEL PRESSURE GAGE

	40 psi	Minimum
	40-400 psi	Continuous
	600 psi	Maximum

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Figure 5-1

BASED ON ALL FUEL GRADES

AIRSPEED INDICATOR

The instrument setting is such that the red pointer will move to indicate the limiting structural airspeed of 580 knots or the airspeed representing the limiting Mach number of .95, whichever is less.

Maximum gear- or flaps-down airspeed: 185 knots IAS.

Airspeed and Mach number are unlimited above 25,000 feet unless excessive lateral stick forces are encountered.

NOTE

For airspeed limitations with external loads, refer to "Airspeed Limitations," in this section.

HYDRAULIC PRESSURE GAGE

(UTILITY SYSTEM)

2600-3000 psi Normal
3600 psi Maximum

ACCELEROMETER

3 G max with 206-1/2 gal drop tanks.

CAUTION

When 206-1/2 gallon drop tanks are installed, do not exceed 2 G for first 15 minutes after starting engine.

6 G max (clean, Types I and III, 120-gallon drop tanks, or rockets).†

† For G-limits with external loads, refer to "Acceleration Limitations" in this section.

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airspeed and acceleration limitations

CONFIGURATION	AIRSPEED LIMITATIONS	G-LIMITATIONS MAX POS	G-LIMITATIONS MAX NEG
NO EXTERNAL LOAD	ABOVE 25,000 FEET: Unlimited unless excessive aileron stick forces are encountered BELOW 25,000 FEET: 580 knots IAS or Mach .95, whichever is less	6 G*	−3 G
SIXTEEN 5 IN. ROCKETS	ABOVE 25,000 FEET: Unlimited unless excessive aileron stick forces are encountered BELOW 25,000 FEET: 580 knots IAS or Mach .95, whichever is less NO CONTINUOUS ROLLS	6 G	−2 G
TWO 120 GAL DROP TANKS (FULL OR EMPTY)	TYPE I AND III TANKS ABOVE 25,000 FEET: Unlimited unless excessive aileron stick forces are encountered BELOW 25,000 FEET: 550 knots IAS or Mach .90, whichever is less	6 G	−2 G
	TYPE II AND IV TANKS 500 knots IAS or Mach .90, whichever is less No abrupt maneuvers, no continuous rolls, rate of roll limited to 90 degrees per second	4 G	−2 G
TWO 206-1/2 GAL DROP TANKS (FULL OR EMPTY)	450 knots IAS or Mach .82, whichever is less NO CONTINUOUS ROLLS	2 G (During first 15 minutes of engine operation.) 3 G (After first 15 minutes of engine operation.)	−1 G
TWO 100 OR 1000 LB GP BOMBS WITH T-42 OR BOX FINS	Mach .85 NO CONTINUOUS ROLLS	5.5 G	−2 G
TWO 500 LB GP BOMBS	Mach .70 NO CONTINUOUS ROLLS	5.5 G	−2 G
TWO 500 LB GP BOMBS WITH T-127 FINS	ABOVE 25,000 FEET: Mach .90 BELOW 25,000 FEET: 500 knots IAS or Mach .85, whichever is less NO CONTINUOUS ROLLS	5.5 G	−2 G
TWO 1000 LB EX-10 OR TWO 500 LB EX-12 BOMBS	ABOVE 25,000 FEET: Unlimited unless excessive aileron stick forces are encountered BELOW 25,000 FEET: 580 knots IAS or Mach .95, whichever is less NO CONTINUOUS ROLLS	5.5 G	−2 G

*G-limit for rolling pull-outs: Max pos 4.9 G

NOTE: Positive G-limits for rolling pull-outs are two thirds of limits shown, except as noted. Negative G-limit for rolling push-downs is −1.0 G.

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Figure 5-2

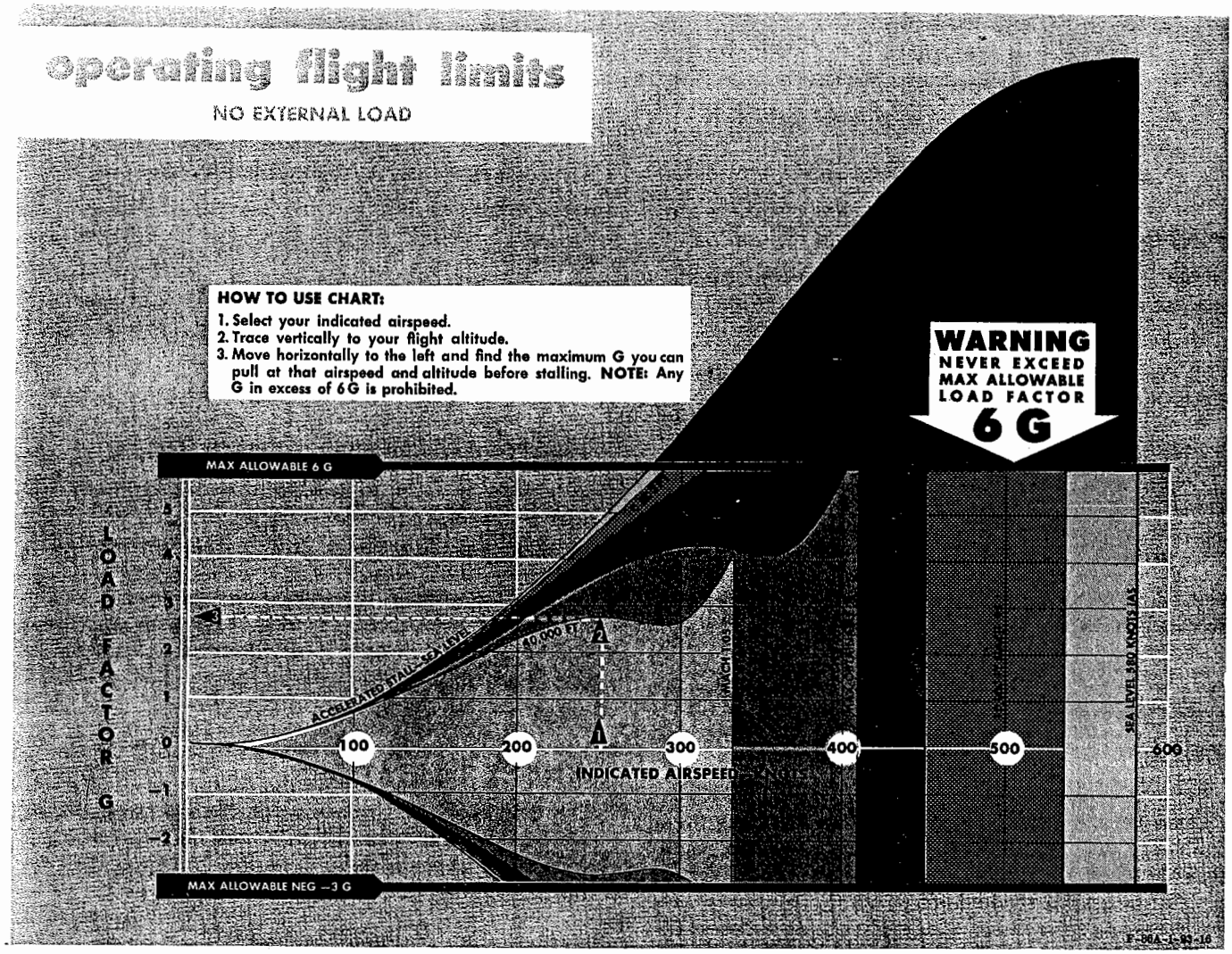


Figure 5-3

CANOPY OPERATING SPEED.

The maximum airspeed when opening the canopy is 215 knots IAS. At speeds in excess of this value, the air loads tend to hold the canopy in the closed position.

MAXIMUM ALLOWABLE AIRSPEEDS.

Maximum allowable indicated airspeeds or Mach numbers are shown in figure 5-2. High-speed flight with external loads is further restricted by general airplane buffet. This buffet may be experienced in the higher speed ranges and provides, consequently, an airspeed limit. With no external load, high-speed flight in the transonic region is limited by airplane rolling tendencies. Above 25,000 feet, wing heaviness is still evident, but may be checked more readily. Airspeed limitations with no external load at these higher altitudes are set only by the controllability of the wing heaviness and general flight characteristics. However, Mach limits for airplanes with external loads must still be observed.

DROP TANK RELEASE LIMITATIONS.

The following limitations must be observed when releasing drop tanks:

206½-GALLON TANKS

Full, partially full, or empty tanks.....Drop above 185 knots IAS and below 450 knots IAS or Mach .81.

120-GALLON TANKS

Full tanks.....Drop at any speed in a symmetrical (no-roll) flight at 1 G.

Empty or partially full tanks.....Drop at any speed above 220 knots IAS in symmetrical (no-roll) flight at 1 G.

CAUTION

Be sure wing flaps are up, because tanks may strike bottom of wing.

PROHIBITED MANEUVERS.

The airplane is restricted from performing the following maneuvers:

1. Snap rolls or any snap maneuvers.
2. Spins with bombs, rockets, or drop tanks installed.

Note

Inverted flight, or any maneuver resulting in negative acceleration, must be limited to 10 seconds duration, because there is no means of ensuring a continuous flow of fuel while in this attitude.

3. Continuous rolls when certain external loads are installed. (See figure 5-2.)

ACCELERATION LIMITATIONS.

AIRPLANE.

The acceleration limitations of the airplane in all configurations are given in figure 5-2. The operating flight limits for the airplane with no external load are graphically shown in figure 5-3. The limit load factors presented are for straight pull-outs. Since rolling pull-outs impose considerably more stress on the airplane, the maximum allowable positive load factor during these maneuvers is correspondingly reduced to two thirds the values shown. The maximum negative load factor during rolling push-downs is −1 G. Although 7.33 G is the structural design limit for the airplane, an aerodynamic limit of 6 G is imposed to minimize the possibility of overshoot.

CAUTION

If the accelerometer indicates over 7.33 G during flight, the airplane must be inspected after landing for signs of structural damage.

ENGINE.

If the engine has been subjected to a load factor in excess of 10 G, it must be removed and a special inspection performed.

CENTER-OF-GRAVITY LIMITATIONS.

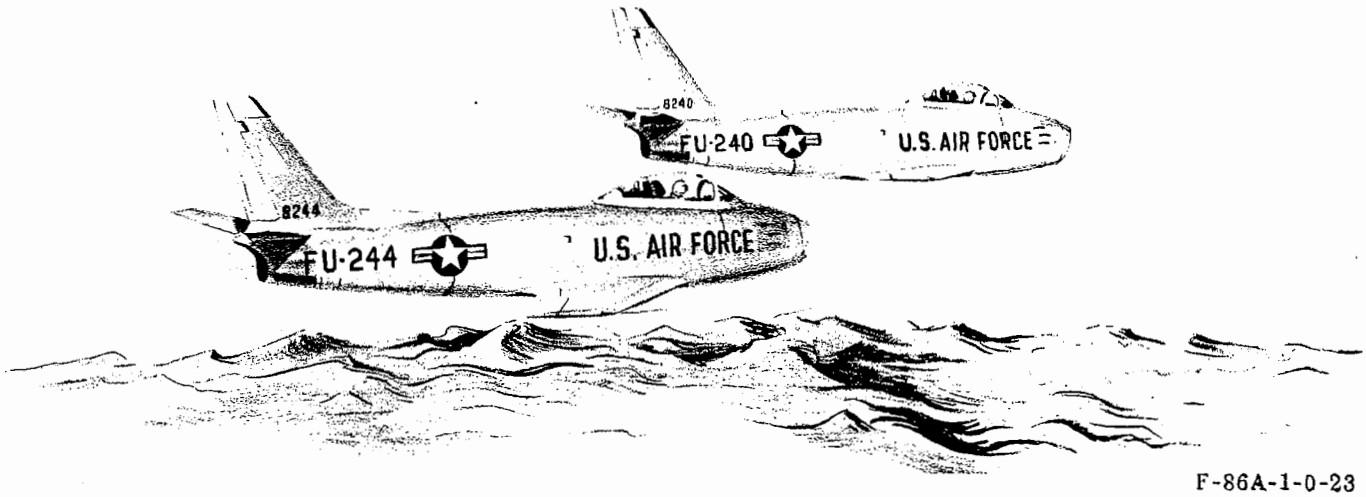
Since there is no in-flight control of CG position other than the normal expenditure of ammunition, major factors affecting CG position such as installation of guns, ammunition, etc, must be checked before flight. If any guns or ammunition is removed from the airplane, the ammunition boxes must be ballasted with an equivalent weight to maintain the CG within limits. (Refer to Handbook of Weight and Balance Data, T.O. 1-1B-40.)

WEIGHT LIMITATIONS.

The design of the airplane precludes the possibility of overloading; consequently, there are no weight limitations to be observed as long as standard drop tanks as described in Section I are carried.

CAUTION

If a hard landing is made while external loads are carried, the airplane should be inspected for signs of structural damage prior to the next flight.



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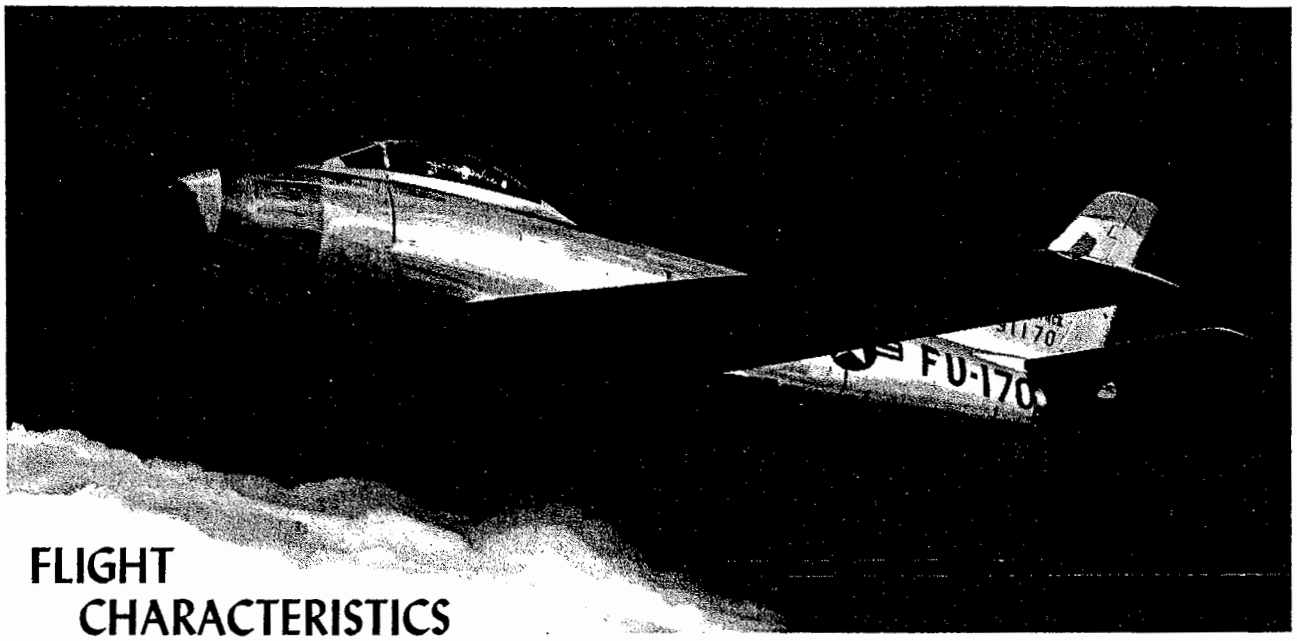

SECTION VI

FLIGHT CHARACTERISTICS

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INTRODUCTION.

The outstanding feature of this airplane is the extremely high speeds at which it can be flown. At high speed—in fact, throughout the entire speed range—the flight characteristics are excellent. The major contribution to the ability to operate at high speed is made by the thin, swept wing. Wing sweep and thin airfoil act to reduce drag, to offset the adverse effects of compressibility, and consequently permit superior maneuverability at high speed. Because of the reduced lift provided by this wing at low speeds, wing slats are fitted to reduce the stalling speed and to improve lateral control at or near the stall. Speed brakes provide a means of rapidly decelerating the airplane from any airspeed.

MACH NUMBER.

For easier association, the speeds in this section are given in terms of Mach number rather than indicated airspeeds. In order to relate a flight characteristic to an indicated airspeed, it would be necessary to know a different airspeed at which that characteristic occurred for every altitude. However, if a flight characteristic is related to Mach number, you will notice that this flight characteristic will occur at the same Mach number at any altitude and will vary only in intensity, depending upon the altitude at which you are flying. The lower the altitude, the higher will be the indicated airspeed for a given Mach number. This higher indicated airspeed is an indication of the greater pressure forces that air exerts at lower altitude. Consequently, you will notice that, although a specific handling quality will occur at the same Mach number at all altitudes, the effect on the airplane and on the controls will be more pronounced, and possibly even dangerous, at the low altitudes. In addition to being very useful in high-speed and maneuvering flight, the Machmeter provides an excellent means of cruise control. Maximum range is attained by flying at high altitude and holding a constant Mach number and constant throttle setting. (Exact power setting and Mach number depend upon airplane gross weight at start of cruising flight.) Constant-Mach-number cruising is economical, because, as fuel is consumed and gross weight is reduced, you will climb slightly as long as you fly at the same Mach number. This means that at a constant Mach number the airplane will always seek the optimum cruising altitude for the particular gross weight and will, therefore, obtain maximum range. To obtain this type of cruising flight using the airspeed indicator, you would have to know a different airspeed for every slight change in gross weight. Since this airplane is designed

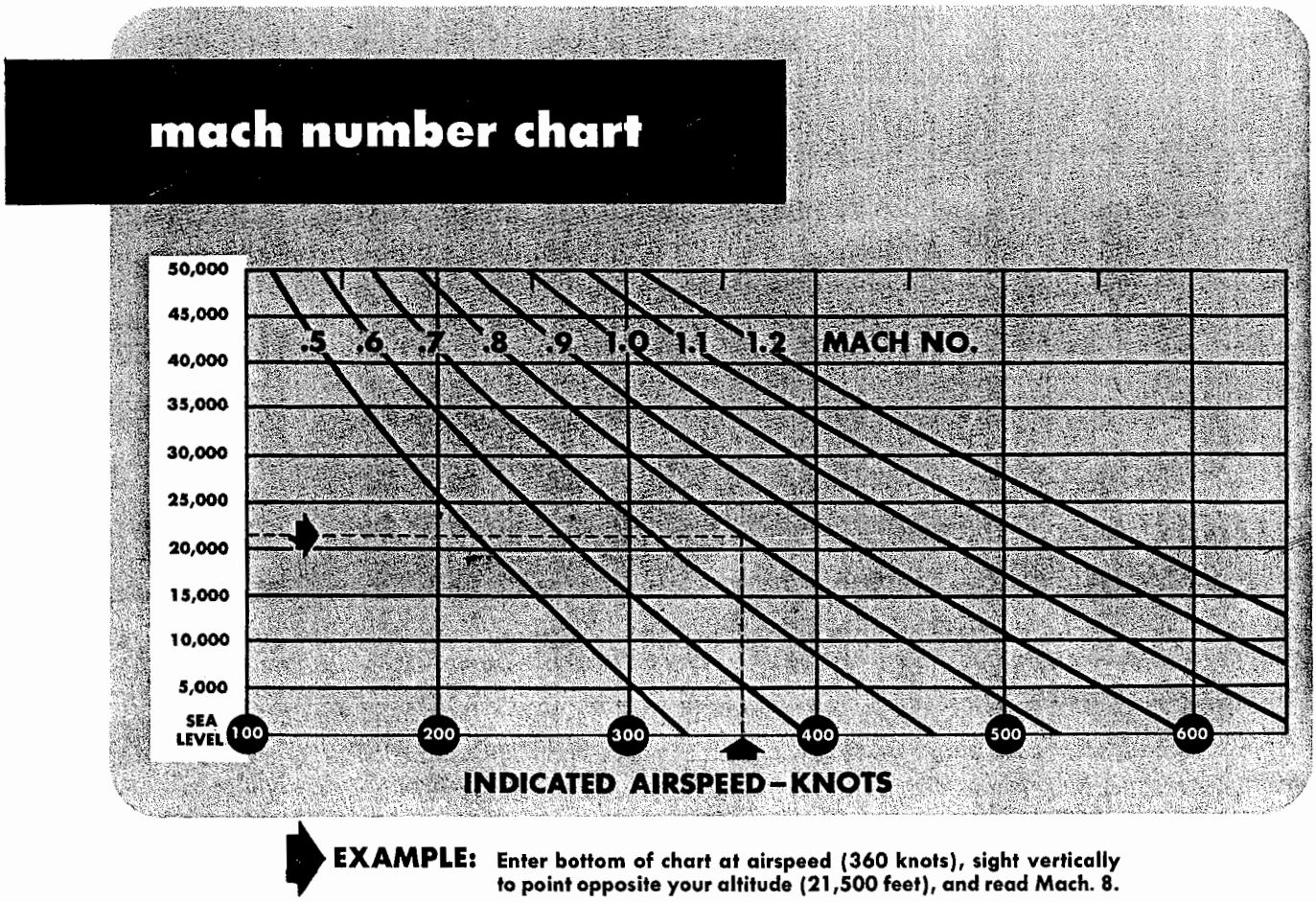


Figure 6-1

specifically for high-speed, high-altitude flight, you should be very familiar with the Machmeter and know how to use it if you are to obtain maximum performance from the airplane. A Mach number chart (figure 6-1) illustrates the variation of indicated airspeed with altitude for given Mach numbers. The Mach number chart also serves to clarify the movement of the red limit hand on the airspeed indicator. A limit of Mach .95, applicable below 25,000 feet, has been established as a result of the rolling tendency produced by compressibility effects encountered above this limit. However, this Mach number applies as a limit only down to the altitude at which it equals the structural limit airspeed of the airplane (580 knots IAS at 5000 feet). Since, below this altitude, flight at Mach .95 would exceed the structural limit airspeed, the red limit hand indicates a constant 580 knots from sea level to 5000 feet, then moves counterclockwise with an increase in altitude to indicate the airspeed that corresponds to Mach .95. Above 25,000 feet, there are no speed limitations, and the red limit hand should be disregarded.

STALLS.

The airplane has very mild stall characteristics, and the stall warnings are received far enough in advance for corrective measures. The swept wing has no unusual effect on the stall other than the higher angle of attack at the stalling point. There is no severe rolling or yawing tendency, and positive aileron control is maintained up to the stall and throughout recovery. See figure 6-2 for stall speeds in various configurations.

STALLS WITH GEAR AND FLAPS DOWN.

Power On.

As the stall is approached, the first indication is a light general airplane buffet appearing about 10 knots above stall speed. A medium rudder buffet will be felt just before the stall. In this condition (power on) the nose drops at the stall point, and there is a mild wing roll.

stall speeds

NOTE

- **For stall speeds on some airplanes* not changed by T.O. with slats locked, add 11 knots.**
- **For power-on stall speeds, subtract 4 knots.**

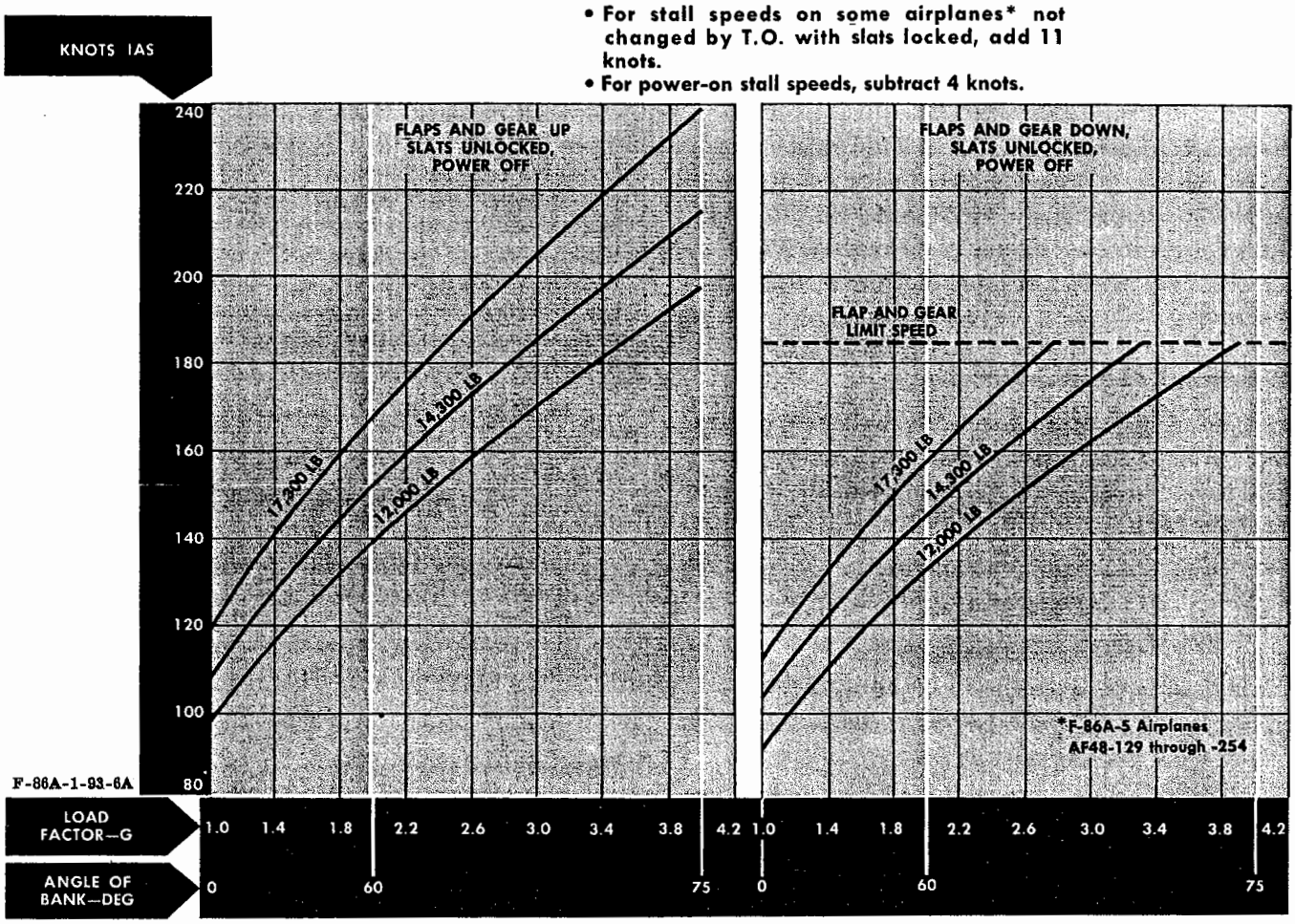


Figure 6-2

Because of the additional lift derived from engine thrust at these higher angles of attack, stall speeds during power-on stalls are about 3 knots less than the power-off values at the same weight.

Power Off.

The characteristics of these stalls are similar to those of power-on stalls; however, the stall point is identified by a slight pitch, and the airplane drops straight through with no roll.

STALLS WITH GEAR AND FLAPS UP.

Power On.

With the airplane in the clean condition, power-on stalls are preceded by aileron and rudder buffet about 10 knots above the stall, the buffeting becoming heavy just before the stall. At the stall point, the airplane pitches slightly and rolls about 10 degrees as the nose drops. Again, speeds for power-on stalls are about 3 knots less than power-off values at the same gross weight because of the additional lift obtained from engine thrust.

Power Off.

The flight characteristics during power-off stalls are similar to those experienced during power-on stalls with the airplane in the clean condition.

ACCELERATED STALLS.

An accelerated stall (sometimes referred to as a "high-speed stall") is primarily a stall with G in excess of 1 G. It is the result of pulling into a tight turn and rapidly increasing G through the buffet region to the stall point.

G will build up fast, possibly becoming excessive and resulting in an overshoot condition or "dig-in" tendency. Therefore, be alert for the buffet warning that precedes the stall.

Low-speed Accelerated Stalls.

Low-speed accelerated stalls, with the airplane in any configuration, are always preceded by a heavy rudder buffet and a medium-to-heavy airplane buffet. This buffeting gives adequate warning to avoid the stall by reducing back pressure or using push force on the stick, if necessary.

High-Speed Accelerated Stalls.

An impending high-speed stall is preceded by two distinct warnings. As the stall is approached, you will notice considerable airplane buffet, and stick forces will lighten just before stall.

WARNING

A high-speed accelerated stall can damage the airplane below 25,000 feet, or it can cause you to black out and possibly lose control of the airplane.

When operating under G, be alert for any signs of general airplane buffet; be prepared to relax stick back pressure, and if necessary, apply forward stick pressure to avoid the stall. It is also advantageous to apply power, if available, to avoid the approaching stall. However, it is permissible to fly in the buffet region if you do not exceed the limit load factor of 6 G. To prevent inadvertent high-speed stalls, do not pull stick back while the speed brakes are opening and do not trim out all feel during pull-ups.

STALL RECOVERY.

Stall recovery is made in the normal manner by applying forward stick and increasing the power. If the gear or flaps are down, avoid exceeding the maximum gear-and-flaps-down airspeed during the recovery.

PRACTICE STALLS.

The normal altitude loss during stall and recovery is 1000 feet. However, because of the ever-present possibility of entering a spin during these maneuvers, stalls should be practiced at a minimum altitude of 25,000 feet.

SPINS.

NORMAL SPINS.

Spin characteristics of the airplane are normal. The airplane spins at the beginning of the turn in a 60-degree nose-down attitude. As the spin progresses, the nose comes up to about 45 degrees below the horizon and then drops again rapidly. Each turn takes approximately 4 seconds. The airplane loses between 1500 and 2000 feet per turn. You will notice heavy buffeting at the beginning of the spin, but it will be localized to a rudder buffet as the spin progresses. Do not spin the airplane with gear and flaps down; if you do enter such a spin inadvertently, retract the gear and flaps immediately to prevent damage resulting from exceeding the gear-and-flaps-down limit airspeed during recovery.

WARNING

Spins with bombs, rockets, or drop tanks installed are prohibited. If a spin is entered inadvertently when external stores are carried, attempt a normal recovery. If the airplane does not respond, drop external load and repeat normal recovery procedure.

NONOSCILLATORY SPINS.

You may encounter a different kind of spin, a nonoscillatory type, in which the normal rise and fall of the nose of the airplane through each turn does not occur. Instead, the airplane will spin rapidly with a steady pitch angle. The nonoscillatory spin can be encountered on airplanes which do not have slat locks and is caused when the outboard or inboard ends of the slats stick closed while the other ends rack open. These spins usually require more turns for recovery after recovery controls are applied.

INVERTED SPINS.

Inverted spins are characterized by a roll upright into 45-degree dive attitude approximately every three fourths of a turn, followed by a roll into the inverted-spin position, repeating the initial spin. Each turn takes approximately 6 seconds. You can initiate recovery at any time by neutralizing the controls and dropping the nose as the airplane rolls upright.

WARNING

Flame-outs could occur during an inverted spin, because of interrupted flow of fuel to the engine while the airplane is in the inverted position.

SPIN RECOVERY.

Normal and rapid spin recovery is characteristic of the airplane. The horizontal stabilizer is the primary recovery control; therefore, spin recovery technique for the airplane is similar to that for conventional airplanes. To recover from a spin, proceed as follows:

1. Retard throttle to IDLE upon spin entry, to prevent excessive loss of altitude.

2. Apply full opposite rudder and almost simultaneously neutralize the stick.

WARNING

- Do not hold stick *back* during recovery, as this may cause a spin in the opposite direction as the turn is stopped.
- Hold ailerons neutral during all spin recoveries, since recovery may be prolonged by improper use of ailerons.

Note

If possible, move horizontal stabilizer trim to between 0 and 2 degrees tail heavy to facilitate a more rapid spin recovery.

3. If the spin is nonoscillatory (as indicated by failure of the nose of the airplane to rise and fall through each turn), maintain standard recovery control for a minimum of three turns, if necessary, and make sure that your ailerons are neutral and that you have neutral or slightly forward stick by orienting the stick to the cockpit visually—do not depend on stick force for this orientation. If the airplane still does not respond properly, continue to hold recovery control and apply power.

4. After turn is stopped, neutralize rudder and get nose down to regain flying speed before opening speed brakes or starting pull-out.

WARNING

Failure to hold the nose down to regain flying speed before opening speed brakes or before beginning pull-out may cause the airplane to stall and snap into another spin. However, full-forward stick is not recommended, because of recovery attitude.

Spin recovery is completed within one-fourth to one-half turn after recovery control is initiated. As recovery control is applied, the spin speeds up momentarily just before the airplane stops rotating. Therefore, do not be misled into thinking your recovery technique is ineffective.

Note

If altitude permits, you can recover from a normal or inverted spin by merely releasing the controls. Spin rotation should cease within three turns.

Flight tests show that speed brakes have no adverse effect on the spin characteristics or recovery. Therefore, if the speed brakes are open when a spin is entered, complete the recovery with them open, if desired, being sure to hold forward stick to allow airspeed to build up above stall speed to about 135 knots IAS (gear and flaps up).

WARNING

- If the airplane snaps out of a turn at any speed, enters a spin from a low-speed, straight-ahead stall, or enters any form of spinning-type maneuver, apply opposite rudder and almost simultaneously neutralize the stick to effect immediate recovery.
- Do not trim into a turn, since the stick may not return to neutral if the controls are released to accomplish a spin recovery.

Minimum Altitude for Spin Recovery.

Flight test data indicates that 7000 feet is the terrain clearance required to complete a recovery from normal and inverted spins. To effect a recovery from a one-turn spin (plus a one-turn recovery and a 4 G pull-out), the altitude loss will be about 6500 feet. Therefore, if you get into a spin with less than the required 7000-foot terrain clearance, bail out, since the margin of safety is too small to try a recovery. Practice spins generally should be entered at about 30,000 to 35,000 feet.

FLIGHT CONTROL EFFECTIVENESS.

ELEVATOR CONTROL.

The hydraulically boosted elevators, in combination with the adjustable horizontal stabilizer, provide good longitudinal control throughout the speed range. Since the boost ratio on the elevators is only 15 to 1 and immediate retrim is available by the trim switch on the stick, the requirement for keeping in longitudinal trim is not as stringent as that for keeping in lateral trim. A valuable adjunct to the elevator is the adjustable horizontal stabilizer, which is discussed under "Trim Tab Control" in this section.

AILERON CONTROL.

The large ailerons with their hydraulic boost systems provide a powerful lateral control, and until you are familiar with aileron effectiveness, you should use caution not to overcontrol during abrupt or consecutive rolls. Boost ratios to accomplish this highly effective aileron control may be as high as 50 to 1, which means that for every pound exerted on the stick, the hydraulic boost will supply 50 pounds to actuate the ailerons. A hydraulic boost failure will exert a sudden, opposite side force of about 50 pounds on the control stick for every pound held by the pilot. For this reason, the ailerons must be trimmed periodically for hands-off flight, so that the airplane will not roll violently should a boost failure occur.

Note

To improve boost-out control characteristics on late airplanes,* a high-speed trim tab and different ailerons (called "short-cord" ailerons) are installed.

RUDDER CONTROL.

The conventional, cable-operated rudder provides directional control during take-off and landing and at the lower airspeeds. At higher airspeeds, inherent stability of the airplane is such that coordinated maneuvers can be made with minimum use of the rudder. However, should an extraordinary condition of unbalanced drag occur, such as external loads being carried on one wing only, use of the rudder and ailerons is required to maintain correct heading.

TRIM TAB CONTROL.

Aileron.

An electrically operated aileron tab trims the airplane laterally for various flight conditions. The high-speed aileron trim, controlled by the trim switch on the stick, is especially effective in case of an aileron boost failure, where the tab can be used to rapidly reduce the heavy stick forces encountered in case of an out-of-trim condition. In normal operation, it is recommended that an attempt not be made to trim out high Mach number wing heaviness, since the tab is ineffective at these speeds and will only cause a strong, opposite roll when speed is reduced.

Rudder.

An electrically operated trim tab is provided to neutralize rudder pedal forces for a particular flight attitude or airspeed.

Adjustable Horizontal Stabilizer.

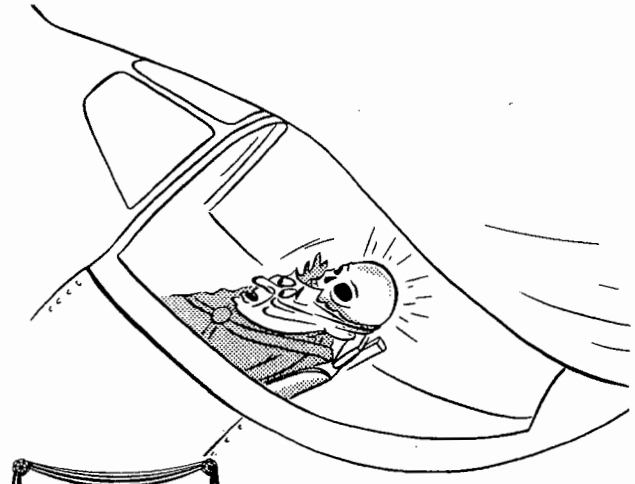
This unusual trim arrangement has been found to serve a dual function; in addition to fulfilling normal trim requirements, it effectively improves longitudinal control. It is, in effect, a primary flight control, of use in all maneuvers and providing pitch control at both low and high speeds. Should accelerated maneuvers be performed at high Mach numbers, adjustment of the stabilizer is mandatory if the control forces are to be kept at a comfortable level. However, the stabilizer should not be so adjusted that all control feel is lost, since this might lead to inadvertent overshooting of the maximum allowable G.

CAUTION

Trim should be used to reduce stick force during normal flight but not during aerobatics, since maximum allowable G may be exceeded.

SPEED BRAKES.

Any time that deceleration is desired, and especially in high-speed turns or formation flying, speed brakes may be used without objectionable buffeting or uncontrollable changes in trim. In a pull-out, recovery may be effected with minimum altitude loss by opening the speed brakes and pulling the maximum permissible G. Opening the speed brakes, without pulling on the stick at all, results in an automatic increase of about 2 G. (See figure 6-3.)



Warning

OPENING SPEED BRAKES AT HIGH SPEEDS IMPOSES AN ADDITIONAL 2G. THEREFORE, IF SPEED BRAKES ARE OPENING, MAKE ALLOWANCE WHEN PULLING STICK BACK OR USING NOSE-UP TRIM, TO AVOID EXCEEDING G-LIMIT.

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*F-86A-5 Airplanes AF49-1067 through -1339

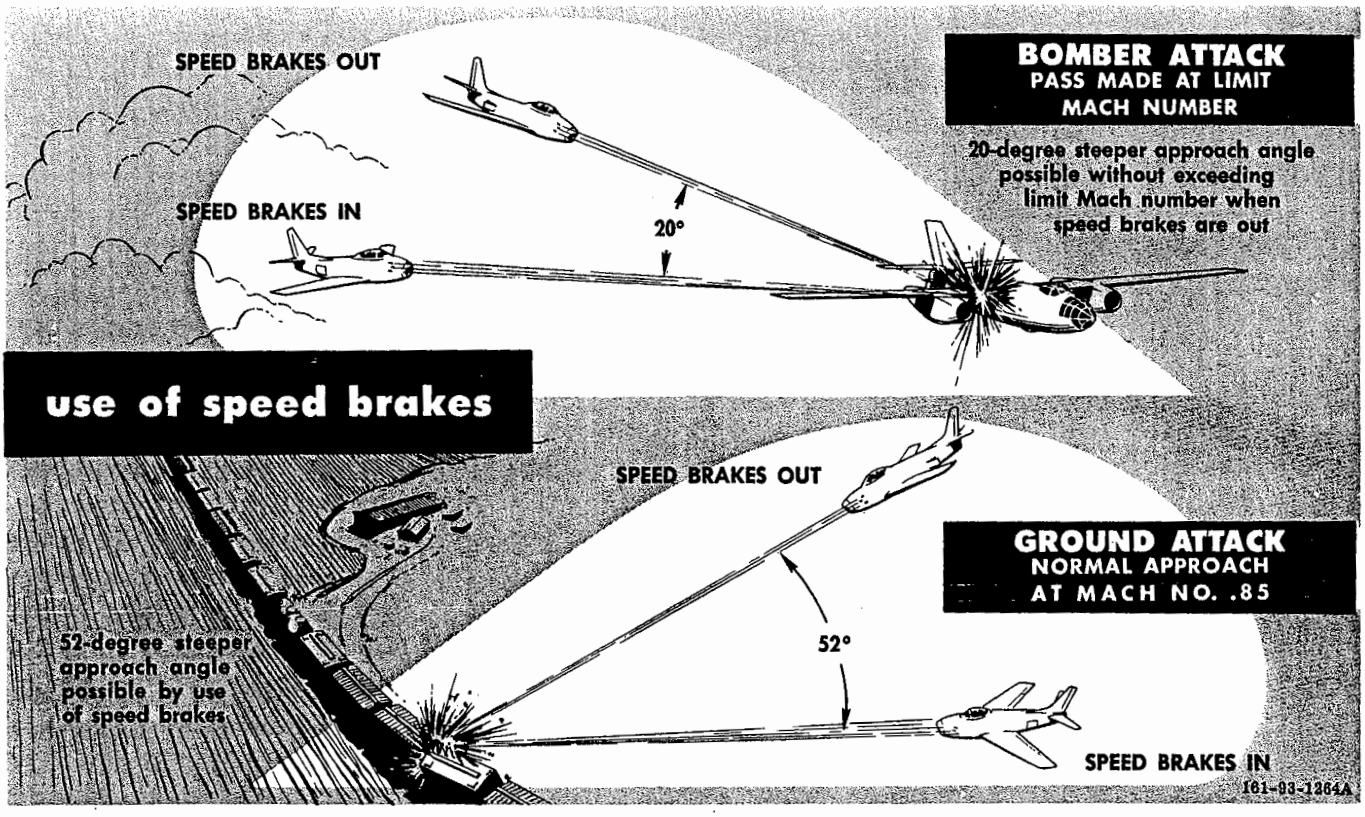

Figure 6-3

WING SLATS.

Leading edge wing slats are installed to reduce the stalling speed. Whether open or closed, the slats do not appreciably alter the handling qualities of the airplane. When unlocked, the slats will automatically float to a position that is determined by air loads and angle of attack. A reduction in airspeed during stabilized flight causes the slats to extend further; conversely, an increase in airspeed causes the slats to retract. Slat operation is illustrated in figure 6-4.

Slats With Locks.

On airplanes with slat locks installed, the slats should be locked as soon as practicable after take-off in order to obtain best performance for climb and subsequent cruising flight. If slats are left unlocked, it will be difficult to close them at altitudes above 35,000 feet (25,000 feet with 206½-gallon drop tanks) because of the high speed required. Slat closing speed can be decreased about 50 knots by pushing over to about ½ G. You should use a slight, sharp dip of the nose for slat locking, because this procedure will snap the slats firmly in place so that all locks can function. After locking the slats, apply positive G and make a visual check of the slats to determine whether all locks are holding. If any of the locks will not function properly after repeated attempts to lock the slats, move slat lock lever to UNLOCK and leave it there for the duration of the flight. When unlocked, the slats will normally remain closed at high Mach numbers and the handling characteristics of the airplane will not be affected. However, in maneuvers, the slats will open, causing a considerable increase in drag. If they pop open in a turn, your speed will drop off considerably. To unlock the slats in flight, unlock them in level flight and at speeds above 250 knots IAS. Unlocking the slats during an accelerated maneuver or at lower airspeeds may cause them to extend abruptly and damage the tracks and rollers.

Slats Without Locks.

On airplanes without slat locks, the slats will open and close at airspeeds below climb and cruise speeds and will remain closed during maneuvers in the normal speed range; i.e., above Mach .65. Below Mach .65, an increase in G will cause the slats to extend, and a decrease in G will make them retract. (See figure 6-4.)

LEVEL-FLIGHT CHARACTERISTICS.

LEVEL-FLIGHT STABILITY.

Generally, elevator stick forces are light but positive as you increase or decrease airspeed in level flight. At very high Mach numbers (above .9), however, you will notice

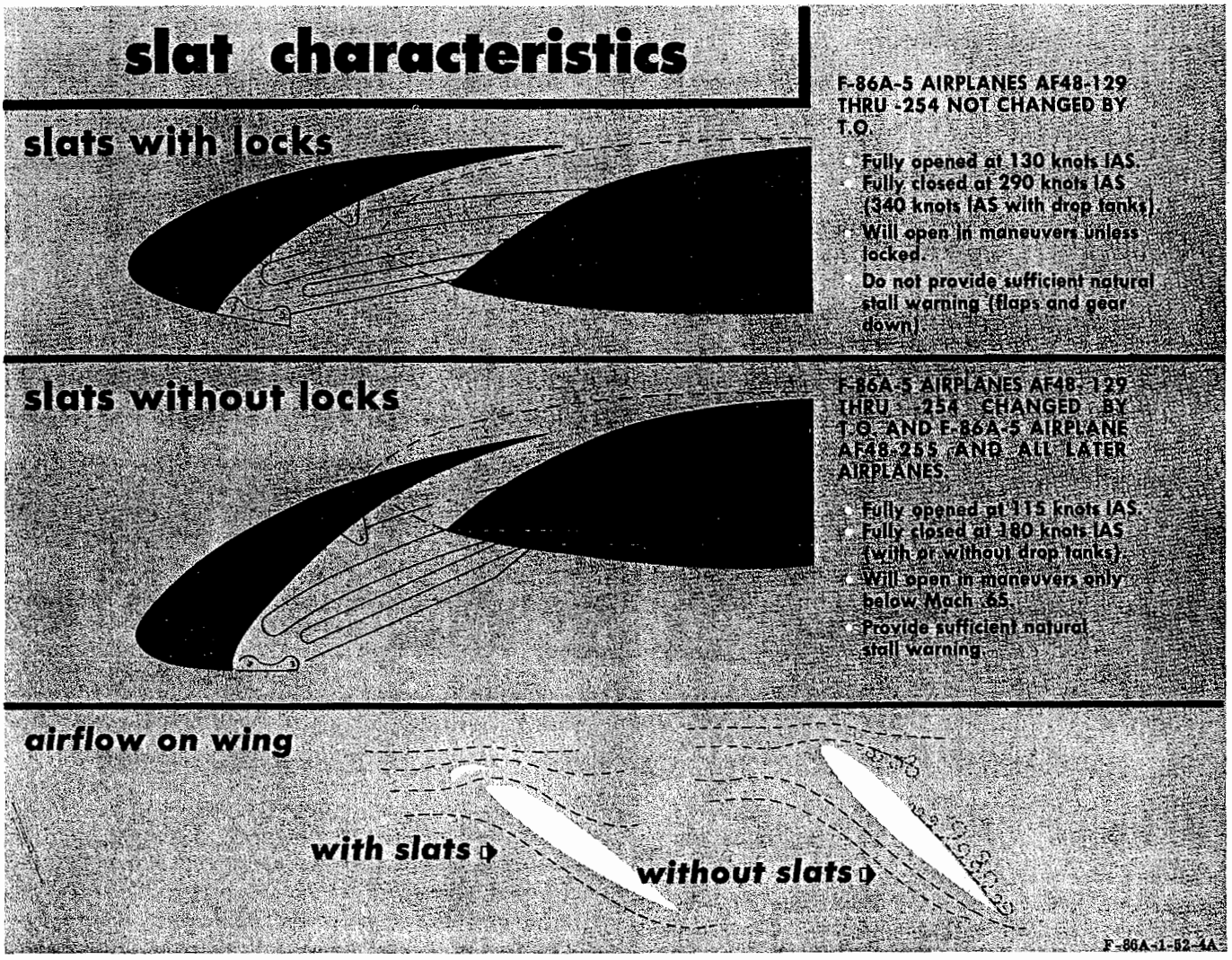

Figure 6-4

heavy push forces as your speed increases. With the airplane trimmed for level flight at Mach .6, elevator forces follow the approximate pattern illustrated in figure 6-5. From this pattern you can see that, as you increase airspeed, you have light push forces up to about Mach .8, where forces become lighter. You will experience a mild stick force reversal (tucking) at about Mach .87. A light pull force is noticeable at Mach .9. Past this point, stick push forces again will build up rapidly as speed is increased. This stick force pattern is approximately the same with or without external loads. You can, of course, reduce stick forces at any time during level flight by adjusting the horizontal stabilizer.

LOW SPEED.

Except for a higher angle of attack during take-off and landing, which is a characteristic of the swept wing, there are no outstanding differences between this airplane and straight-wing fighters insofar as low-speed flight is concerned. Rate of roll is high, and the flight controls are effective down through the stall.

CLIMB AND CRUISE SPEED.

In the climb and cruise speed range, the airplane is near its peak efficiency in maneuvering. The maximum rate of roll at any one altitude occurs near your best climb Mach number for that altitude, and the peak airplane G response for the pull force exerted will occur in this speed range. Also, minimum speed in any maneuvers should never fall below the best climb Mach number for that altitude.

HIGH SPEED.

Stability and control of the airplane in high-speed flight are unaffected by compressibility to the Mach .95 limit.

Figure 6-5

The present limit of Mach .95 below 25,000 feet has been established, because above that speed, wing heaviness occurs, causing the airplane to roll either to the right or the left. Above 25,000 feet, the wing heaviness is more easily controlled and speeds are unrestricted. Also, above Mach .95, a heavy nose-up tendency may appear, which requires increasing push force, forward stick movement, or nose-down trim to increase the speed of the airplane. These same characteristics apply for flight at speeds above Mach 1.

MANEUVERING FLIGHT.

MANEUVERING-FLIGHT STABILITY.

Elevator stick forces during maneuvering flight (flight under various applied G-loads) are generally heavy at high speed and moderate at low speeds. (See figure 6-6.) There is a definite increase in the stick forces required to pull G as you increase airspeed above Mach .8, regardless of altitude. At lower Mach numbers (around .6), however, stick forces required to build up G are lighter, particularly at high altitude. *Never trim horizontal stabilizer so that maneuvering stick forces are reduced to zero.* This merely means that some discretion should be used in applying horizontal trim. It is a good idea to maintain the stick force at a level corresponding to the limit of boost assist, which is about the limit you can hold comfortably with one hand for any length of time.

SPEED AND MANEUVERABILITY.

Speed is the first essential in a fighter airplane, because it gives you the ability to make or break contact during combat. Although speed is of primary importance, three other factors enter into any discussion on the subject of maneuverability; climb potential, radius of turn, and time to turn. The best climb speed increases from about Mach .65 at sea level to about Mach .80 at 40,000 feet. These best climb speeds are those Mach numbers, at different altitudes, which will give the most efficient climb performance. They represent the point of greatest difference between the curves of power available and power required for straight-and-level flight at any given altitude. (See figure 6-7.) The distance between the two curves in the thrust comparison chart represents the excess thrust or power available for maneuvering flight; i.e., the extra thrust or power available for increasing a climb, speeding up, or increasing your G. *It is this range (from best climb Mach number to maximum Mach number) at any altitude which should be considered the best combat Mach number range for the airplane. Therefore, always fly at or above best climb Mach number to retain the maximum possible speed advantage in combat.*

TURNING-RADIUS CONTROL.

Radius of turn or time to turn is important because it determines whether you can bring your guns to bear on a target or cease being a target yourself. At any constant Mach number, your radius will increase as you go up in altitude. Also, radius of turn will increase as speed increases. These two factors are of primary importance to the control of radius of turn. The increase in turning radius with speed at any one altitude is gradual up to approximately Mach .85 and then begins to rise quite rapidly; this is a direct result of the fact that at these speeds, almost all of the engine thrust is being used to maintain speed and very little is left to maintain altitude during the turn. In this Mach range (above .85), you may obtain a considerably shorter turn radius by diving into a turn, because of the effective thrust (airplane

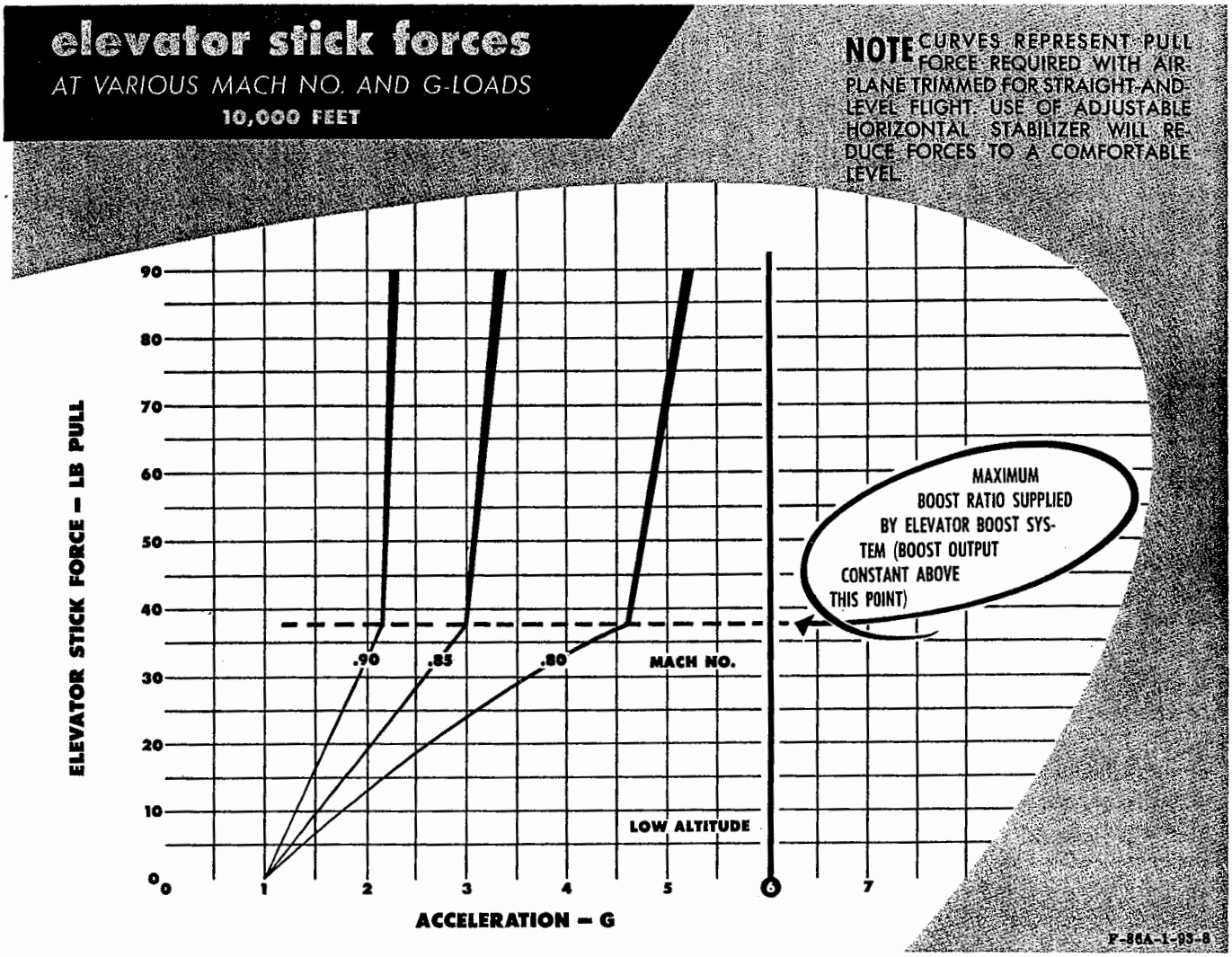

Figure 6-6

weight plus engine thrust). Since loss of altitude is sometimes a disadvantage in combat, a reduction in speed is the more important factor in turning-radius control. One method of slowing down is exchanging excess speed for altitude, as in a sharp climbing turn or Immelmann. Another is by pulling into a level turn and opening your speed brakes, remembering to ease off on the stick when the brakes are opening to maintain your G-load. However, in both conditions, make sure your speed does not fall below best climb Mach number. Figure 6-8 gives an example of the use of speed brakes in a high-speed turn at 40,000 feet. Speeds are given as true airspeed, since you are conscious of speed in terms of closure on a target (true speed changes) rather than changes of indicated airspeed. Note how much tighter a turn can be made by opening the speed brakes; also note that speed is lost rapidly with the brakes open. Therefore, use brakes only to tighten the turn; then close them again before you fall below best climb Mach number.

RECOMMENDED SPEED FOR MINIMUM-RADIUS TURNS.

The recommended combat speed for minimum-radius turns is the best climb Mach number at any altitude. Therefore, in combat, you should not turn with a slower airplane (which generally has a lower best climb speed), because it would outturn your airplane every time. You would gain a distinct advantage by inducing a faster airplane (which generally has a higher best climb speed) to turn with you. In both cases, your best operating range will generally fall between your best climb Mach number and high speed. Therefore, if operating above best climb Mach number, open the speed brakes or lose speed by gaining altitude to make the fastest practical turn, but do not allow the speed to drop below that for best climb. If operating at or very near best climb Mach number, use full throttle to make the fastest practical turn, pulling only enough G to allow best climb Mach number to be maintained. These, of course, are only general rules of procedure; in actual practice, situations

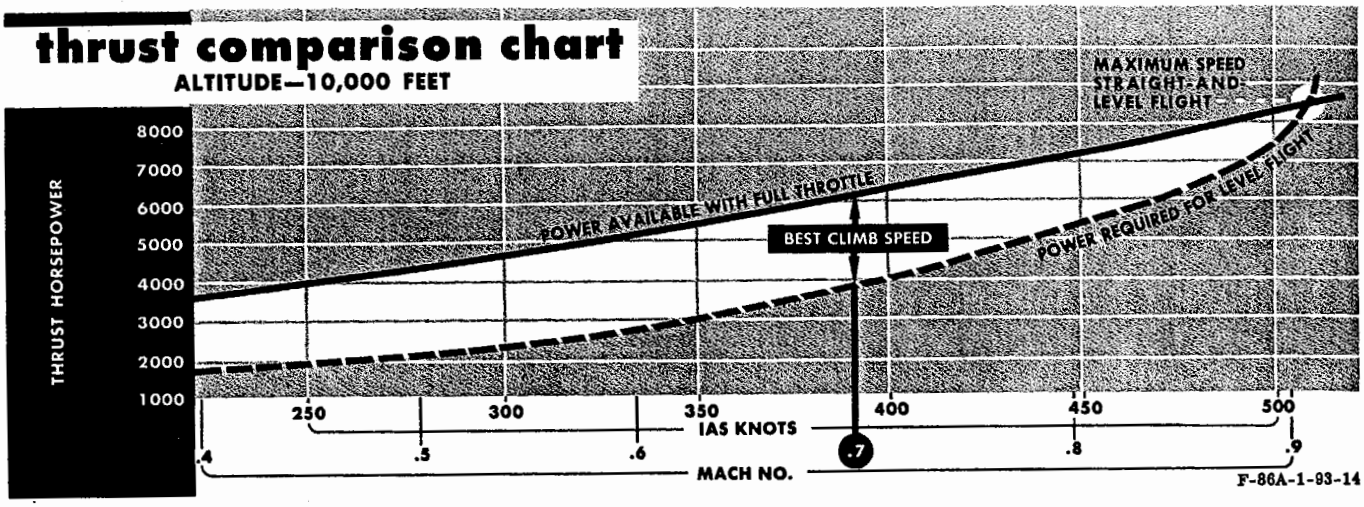

Figure 6-7

may arise in which further loss of speed or even a loss of altitude, to maintain speed, is desirable.

DIVES.

DIVES AND ACCELERATED FLIGHT.

In high Mach number dives or maneuvers, stability and control are good; however, above Mach .8, elevator control becomes very heavy in accelerated maneuvers at any altitude. The heaviest stick forces are generally encountered during flight at low altitudes, as stick forces are roughly proportional to G pulled and the indicated airspeed. Because of higher air density at lower altitudes, indicated airspeeds are higher, and more G may be produced before stalling. Effects of compressibility on stick forces are shown in figure 6-6. As Mach number increases, the pilot effort required to pull a given G-load is gradually greater up to the point where the boost output limit is reached. Above this point, the help from the boost system remains constant at its maximum output, and further elevator deflection is obtained by direct pilot effort. Therefore, stick forces are very high. For example, above Mach .90 only 2½ to 3½ G can be obtained by pulling on the stick as hard as possible. Consequently, be extremely careful in judging pull-out from a high-speed dive near the ground. These high forces can be easily reduced to a comfortable level by adjustment of the horizontal stabilizer. Although the stabilizer adjustment is very convenient and effective for a pull-out, its use tends to eliminate the "feel" which is necessary for safe control of the airplane. Just enough trim should be used to reduce stick forces to a comfortable level.

G-OVERSHOOT.

A characteristic of the airplane with which you must become completely familiar is its response to rapid pull-outs at higher Mach numbers. The basic pitch characteristics may cause the airplane to "dig in" or automatically increase G during a turn or pull-out. This condition, known as overshoot, may cause you to inadvertently exceed the maximum allowable G-limit. The conditions under which overshoot may occur vary with Mach number, altitude, gross weight, and G. However, it is not necessary to remember various combinations of these factors in order to safeguard both yourself and the airplane. Sufficient data has been obtained through flight testing to indicate that overshoot is likely to begin at the "buffet boundary"; i.e., the G at which you will notice a distinct increase in the vibration or buffet of the airplane. This buffet increase, or "boundary," should be regarded as a warning, and you should be prepared to apply immediate recovery control when encountering it. This does not mean that you cannot fly in the buffet region, *but it does mean that pulling up very rapidly into it is dangerous.* The region of buffet and possible overshoot is shown graphically in figure 6-9.

To avoid G-limit overshoot, remember these precautions:

1. The airplane is limited to 6 G. Never deliberately exceed this limit.

2. When flying under G in the buffet zone, be prepared to counteract any overshoot tendencies that may develop.

3. Never pull up to or through the buffet boundary rapidly. Slow your rate of pull-up immediately when encountering buffet, under G, by releasing back pressure or using push force, if necessary.

DIVE RECOVERY.

Because of the danger of overshoot that might occur during pull-ups at high Mach numbers, the following

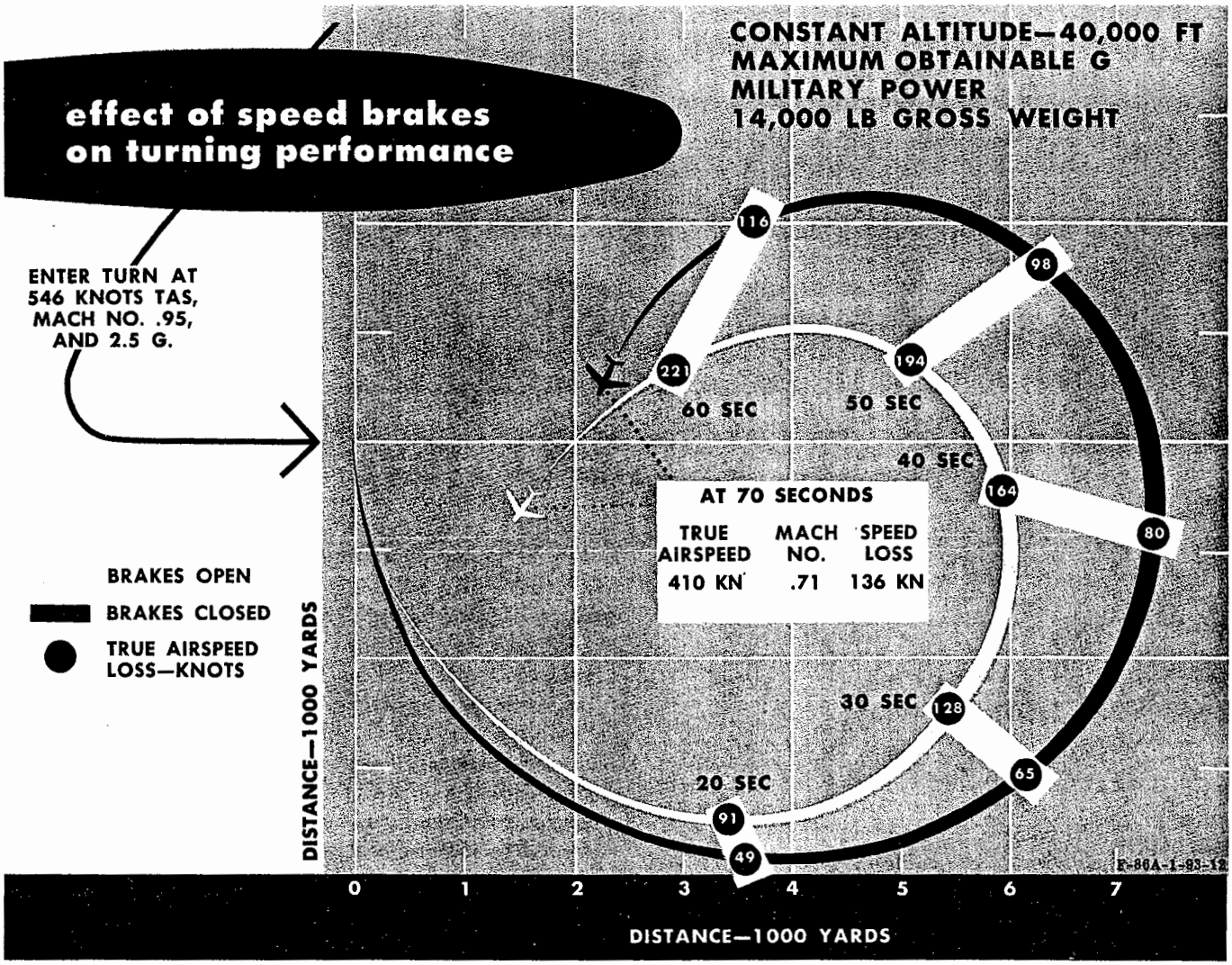

Figure 6-8

procedure is recommended for recovering from high-speed dives and maneuvers:

1. Do not change stabilizer trim.

2. Open speed brakes. Don't pull back on stick until after speed brakes are open and nose-up pitch due to brake extension has developed.

3. Pull stick back as necessary to effect desired pull-out without adding nose-up trim.

4. If stick seems frozen and airplane does not respond to a very high pull force on the stick, use stabilizer trim carefully to reduce force to a level where control is restored.

Altitude Loss in Dive Recovery.

The altitude lost during dive recovery is determined by four interdependent factors: (1) angle of dive, (2) altitude at start of pull-out, (3) airspeed at start of pull-out, and (4) G maintained during pull-out. Because these factors must be considered collectively in estimating altitude required for recovery from any dive, their relationship is best presented in chart form as shown in figure 6-10. Note that one of the charts is based on a 4 G pull-out, and the other on a 6 G pull-out. Compare the altitude lost during recovery from a 4 G pull-out with that lost during recovery from a 6 G pull-out; also compare the effects of variations in the other three factors. Remember that a value obtained from either chart is the altitude lost during recovery—not the altitude at which recovery is completed. Therefore, in planning maneuvers which involve dives, consider first the altitude of the terrain and then use the charts to determine the altitude at which recovery must be started for pull-out with adequate terrain clearance. In using the charts, you should allow for the fact that, without considerable experience in this airplane, you cannot determine exactly what your dive angle and speed are going to be at the start of the pull-out. If you come out of a split "S" or other high-speed maneuver in a near-vertical dive, speed builds up rapidly. Consequently, until you know the airplane well, go into the chart at the highest speed and dive angle you

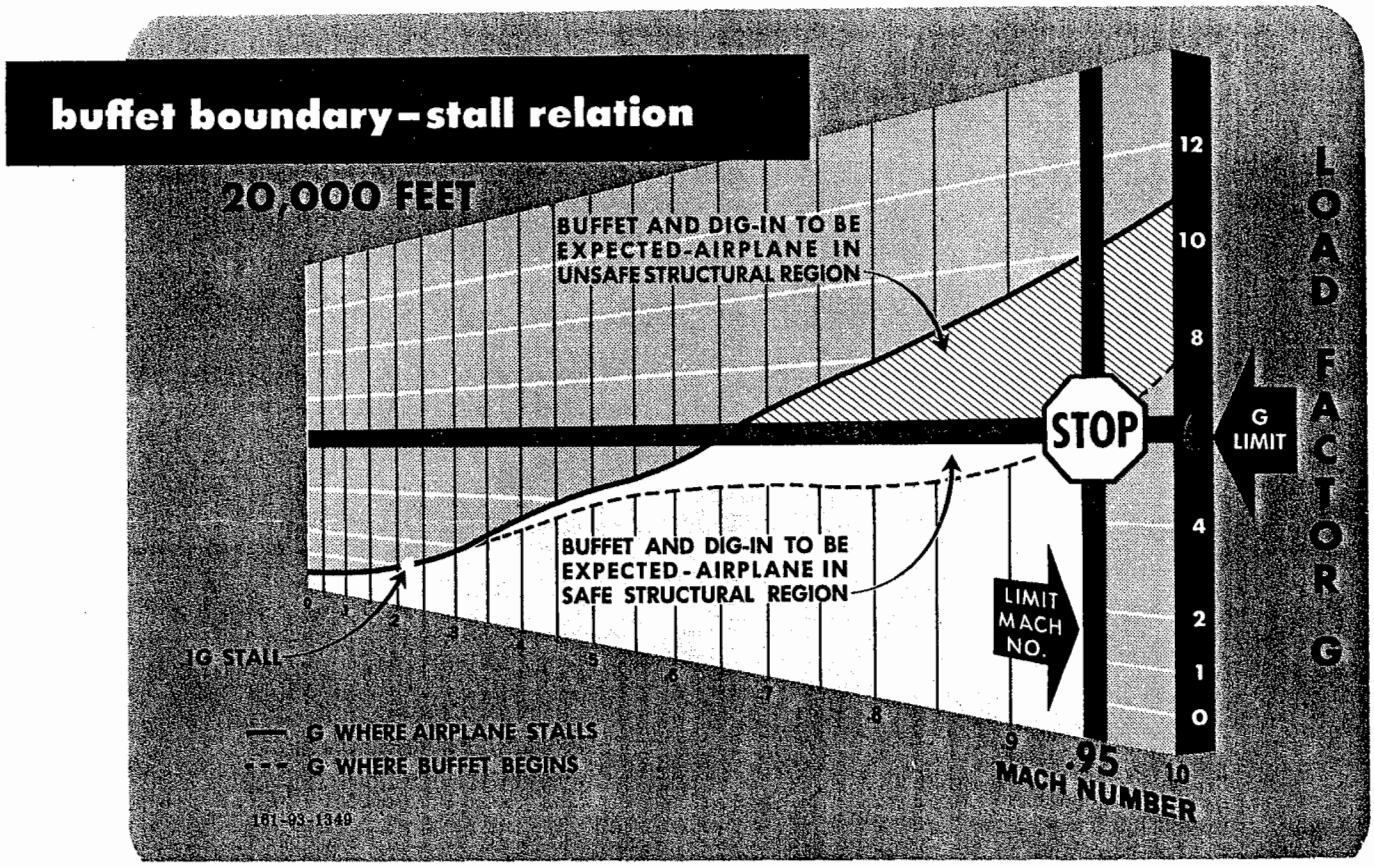

Figure 6-9

might expect to reach after completing your maneuvers. If, for instance, you should be in a 90-degree dive at any airspeed above Mach .8 and should wait until 10,000 feet to start your pull-out, you wouldn't make it. (See figure 6-11.) If your maneuvers will terminate in a near-vertical dive, plan to come out at a low speed and pull the airplane through to a shallow dive angle before speed becomes excessive.

Note

It is a good idea to memorize a few specific conditions from the dive charts so that you have a basis for judgments on pull-outs.

LETDOWN.

Normally, the most economical letdown with the clean airplane is at Mach .8 with the throttle setting at IDLE. For emergency letdown, you can obtain rates of descent as high as 27,000 feet per minute by closing the throttle, opening speed brakes, and diving to maintain Mach .95.

FLIGHT WITH EXTERNAL LOADS.

120-GALLON DROP TANKS.

Flying qualities of the airplane are essentially unaffected by the 120-gallon drop tanks. There are no restrictions on flight above 25,000 feet with the tanks installed other than the limitations for the clean airplane. Below 25,000 feet with the tanks installed, full or empty, do not exceed Mach .90 or 550 knots IAS, whichever is less. As a result of the increased drag and weight, take-off distances will be greater and the rate of climb and acceleration will be reduced.

206½-GALLON DROP TANKS.

Handling qualities may be adversely affected by installation of the 206½-gallon tanks. These tanks will cause a lightening of stick forces when pulling G. This force reduction can lead to inadvertent overshooting of the maximum allowable G, and you are cautioned to observe the 3 G limit established for the large tanks. Limit Mach number is approximately .82; however, the approach to

altitude loss in dive recovery

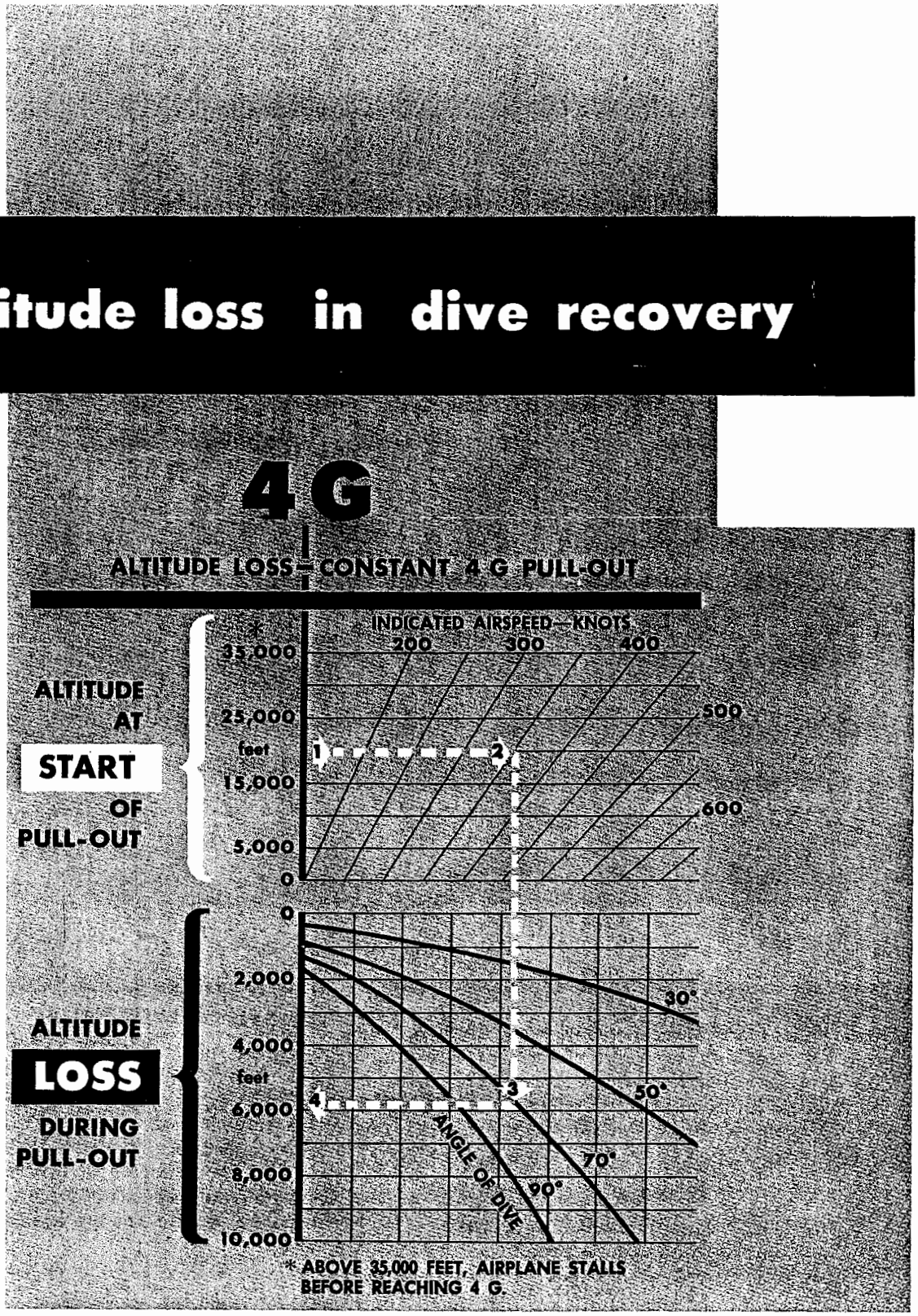

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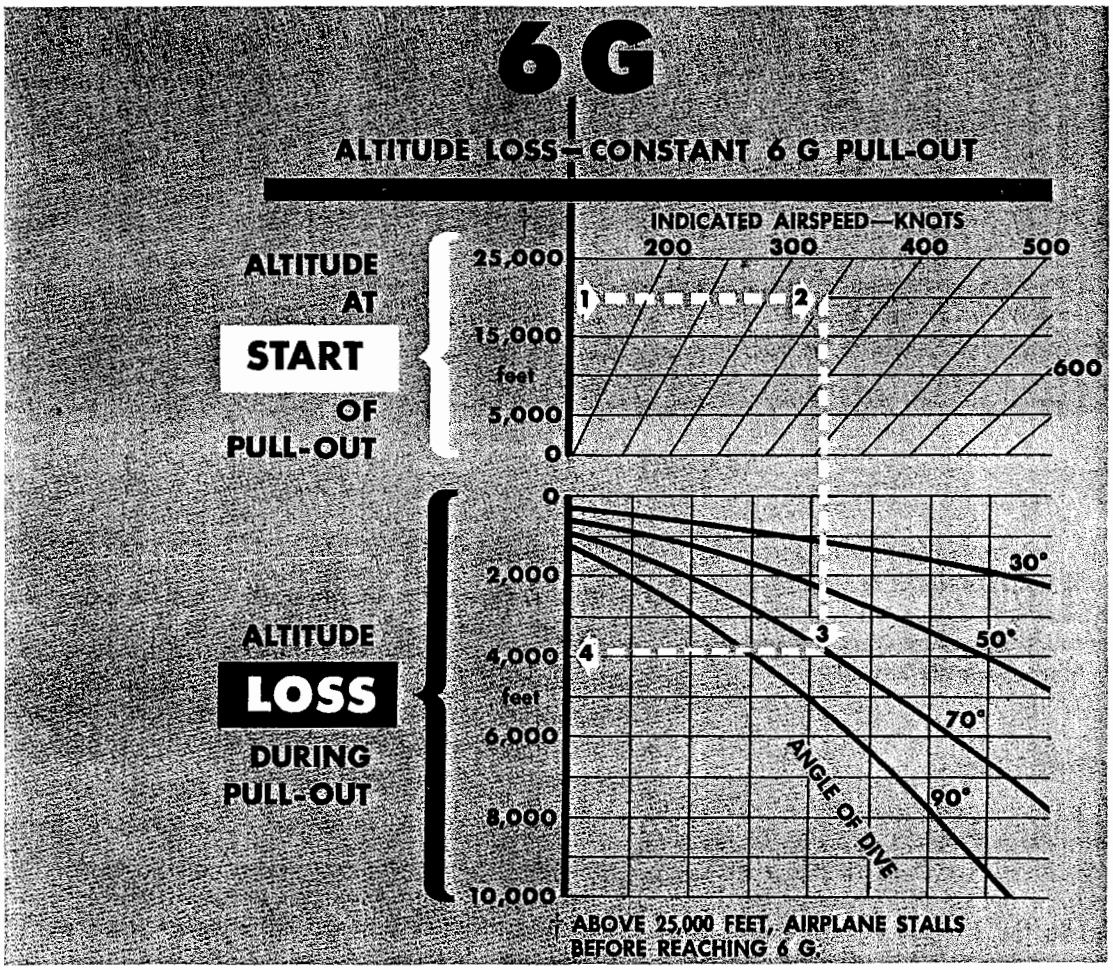
Figure 6-10

how to use charts

Select appropriate chart, depending upon acceleration (4 G or 6 G) to be held in pull-out; then—

1. Enter chart at altitude line nearest actual altitude at start of pull-out (for example, 20,000 feet).
2. On scale along altitude line, select point nearest the IAS at which pull-out is started (350 knots IAS).
3. Sight vertically down to point on curve of dive angle (70°) directly below airspeed.
4. Sight back horizontally to scale at left, to read altitude lost during pull-out (constant 4 G pull-out, 5700 feet; constant 6 G pull-out, 3800 feet).



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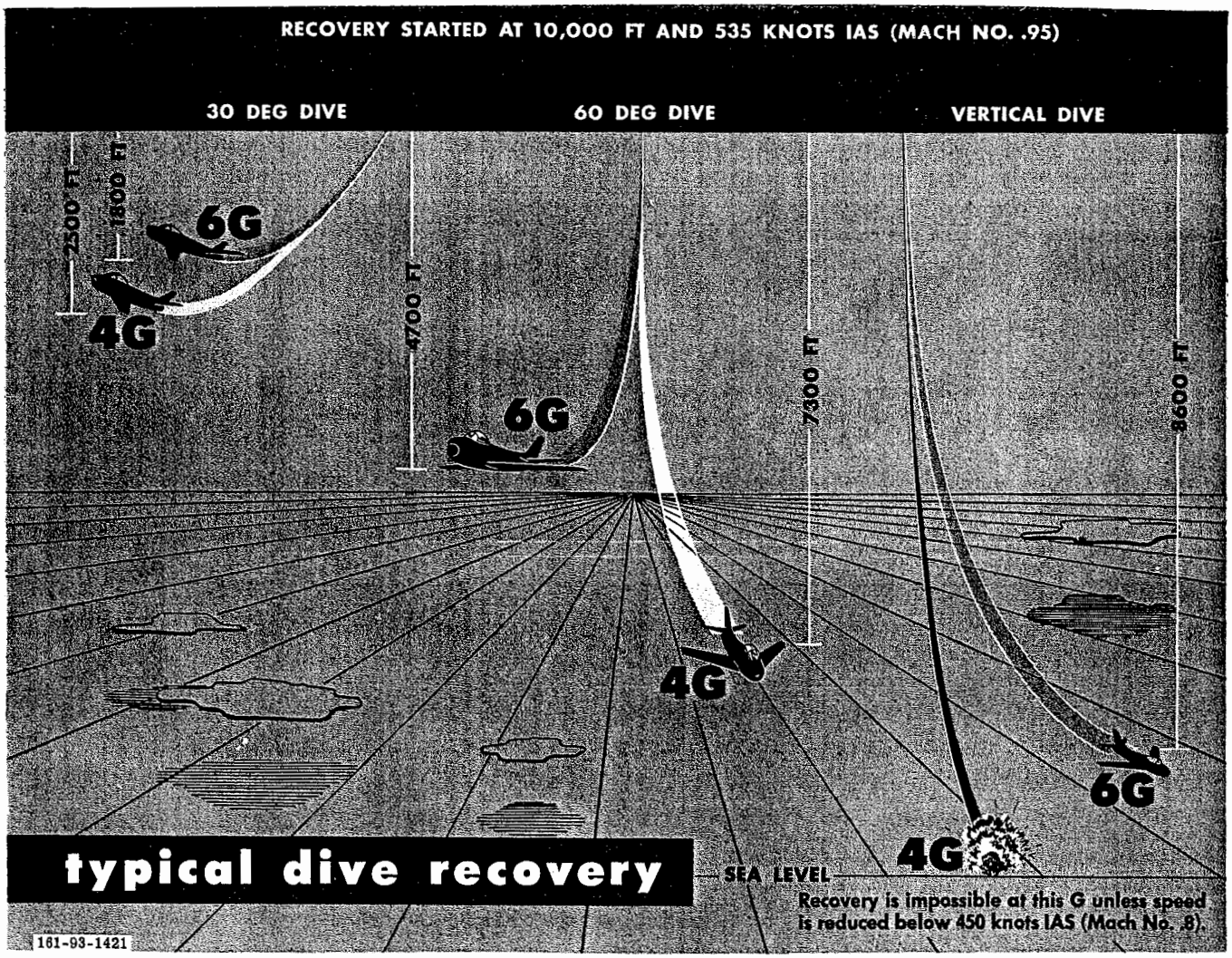


Figure 6-11

the limit Mach number is clearly defined by tank and airplane buffet, and this buffet warning is more positive than reference to the Machmeter. Take-off distances will be increased and general performance reduced because of the additional drag when tanks are installed.

100- OR 1000-POUND BOMBS.

Don't exceed Mach .85 when carrying 100- or 1000-pound bombs. At slightly higher speeds, excessive buffeting of the flaps occurs. In excess of Mach .85, aileron vibration or lateral oscillation of the airplane will be noticed, depending upon the type of bomb load. The vibration or oscillation increases as Mach number is increased, and at greater than Mach .9, the buffeting becomes so pronounced you can feel it in the stick. Bombs may be released at all speeds up to the limit Mach number, and the bomb dropping will be evidenced by a longitudinal lurch of the airplane. However, the airplane immediately returns to trim, and the lurch is not objectionable.

500-POUND BOMBS.

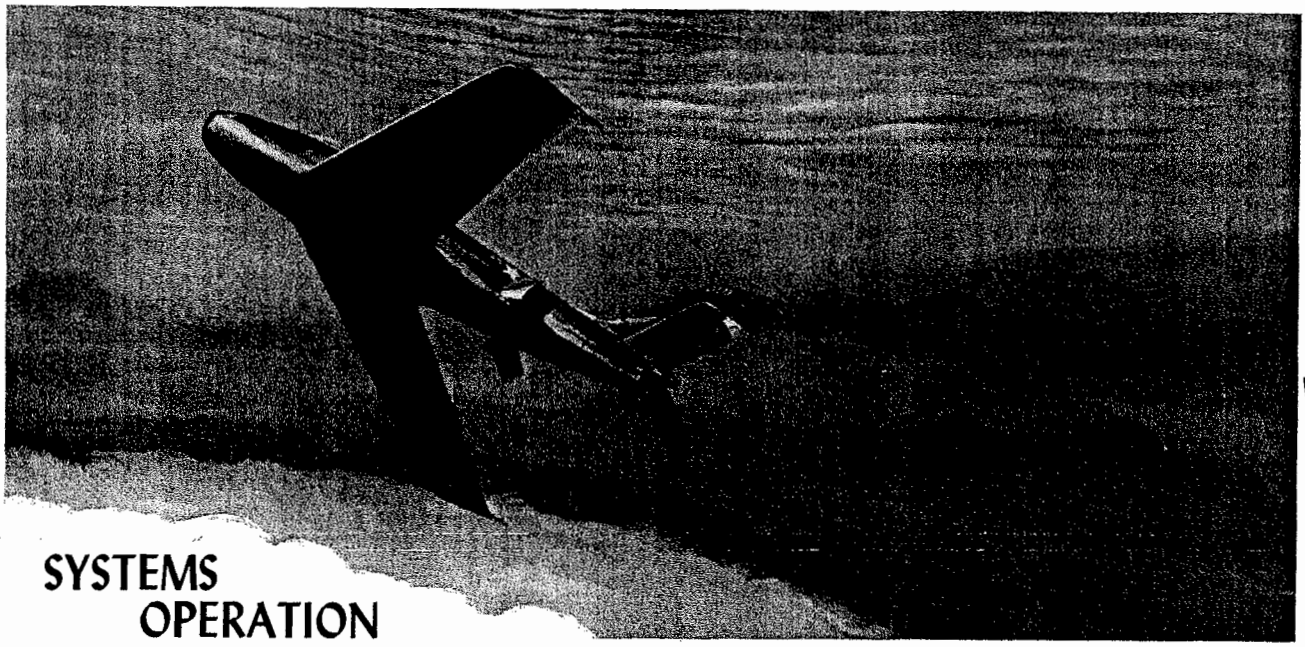
With 500-pound bombs installed, the Mach limit is .7. The lower limit for this bomb is due to the bomb itself, which at high speeds causes turbulence severe enough to damage the wing flaps. However, when 500-pound bombs with T-127 fins are installed, the limit is Mach .9 above 25,000 feet and Mach .85 or 500 knots IAS (whichever occurs first) below 25,000 feet.

Note

Regardless of the type of external load carried, it is considered good practice to stay slightly below the point of buffet initiation, even though this may be slightly lower than the limits given.

ROCKETS.

The speed restrictions when carrying rockets are the same as for the clean airplane. The airplane can be dived to about Mach .90 without difficulty, with stability and control unaffected by the presence of the rockets.



SECTION VII

SYSTEMS OPERATION

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ENGINE ACCELERATION.

At all altitudes up to 40,000 feet, very rapid accelerations are possible during operation on the main fuel regulator. However, for accelerations above 40,000 feet, slower throttle movement must be used to avoid flame-out. When power is added, the throttle should be moved slowly at first and then advanced more rapidly as rpm increases. The emergency fuel switch should not be ON during operation on the main fuel system, because the emergency system will probably take over during rapid advancement of the throttle and cause compressor stall or flame-out.

MAIN FUEL REGULATOR CHARACTERISTICS.

The main fuel regulator determines the amount of fuel delivered to the combustion chambers, by operating the fuel control valve according to the throttle setting, the flight conditions, and the allowable limits of the engine. It is designed to hold a fixed minimum fuel pressure sufficient to maintain combustion at all altitudes. While the minimum fuel pressure remains constant, the resultant minimum rpm increases with altitude. (See figure 7-1.) Overspeed protection is provided through a built-in governor. Although the governor section of the main fuel regulator is designed to produce constant engine rpm for a given throttle setting, minimum idle rpm increases with altitude. This characteristic causes the first portion of the throttle travel to be less effective at high altitudes. (See figure 7-1.) During acceleration (by enriching fuel mixture) and deceleration (by leaning fuel mixture), the main fuel regulator because of its design normally holds the fuel schedule within a certain range of fuel-air ratios where combustion can be maintained. It is very difficult, however, for the fuel regulator to maintain the proper fuel-air ratio when operating at very high altitudes. If the fuel schedule cannot be held within the combustion range, the resultant improper fuel-air mixture will not support combustion and a flame-out will result. An increased possibility of flame-

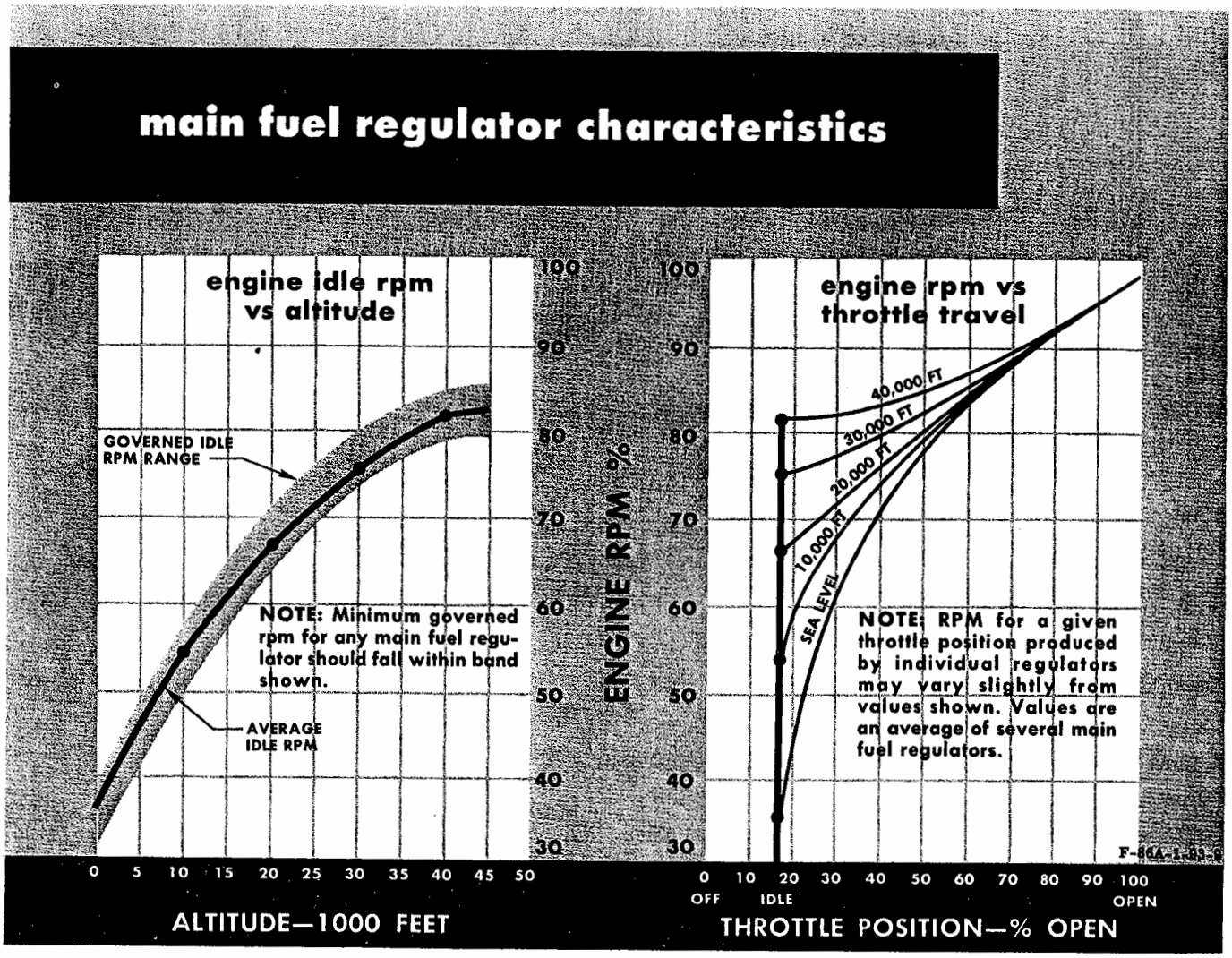


Figure 7-1

out at high altitudes exists, since the fuel regulator schedule is a compromise, designed to provide rapid engine acceleration and yet prevent flame-outs at high altitudes. Because of this characteristic, flame-out may result at altitudes above 40,000 feet whenever the throttle is advanced rapidly from IDLE to full OPEN at a low airspeed. Under these conditions, the possibility of flame-out is minimized by slow, careful movement of the throttle.

WARNING

When outside air temperature is less than 50°F, rapid throttle movement during operation on the main fuel system below 10,000 feet when engine speed is below 70% may produce compressor stall or total loss of power.

ENGINE SURGE.

ENGINE SURGE DUE TO MAIN FUEL REGULATOR CONTROL OIL STARVATION.

During extended climbs to high altitude where an extreme nose-up attitude is maintained, you may experience engine surge caused by interruption of the control oil supply to the main fuel regulator. Flight tests, as well as reports from the field, show a very definite relationship between oil system malfunctions and airplane flight attitude. For instance, oil pressure loss or power loss resulting from fuel regulator malfunctions due to interruption of oil supply to the regulator occurs most frequently during prolonged climbs, especially in the extreme nose-up attitude common to climbs from sea level to 20,000 feet. This is believed to be due to the failure of the aft scavenge pump to scavenge the No. 4 bearing sump properly. To minimize the loss of oil and to prevent engine surging during climbs to altitude

from take-off, you should level off for at least one minute between 18,000 and 20,000 feet. This will permit the aft scavenge pump to return all excess oil in the aft frame to the engine oil tank.

ENGINE SURGE DUE TO MAIN FUEL REGULATOR MALFUNCTION.

Thrust surge accompanied by large synchronized fluctuation in fuel flow, exhaust temperature, and engine rpm during stabilized level flight indicates malfunction and impending failure of the main fuel system. Normally, fuel flow fluctuations less than 600 pounds per hour are acceptable; however, synchronized surge of any magnitude is considered undesirable. If synchronized surge is observed during level-flight operation, proceed as follows:

1. Retard throttle until surge is eliminated.
2. If surge persists or if there is not enough power available at resulting throttle setting to maintain level flight, retard throttle to IDLE and move emergency fuel switch to ON. (The emergency fuel system will be in full control of fuel flow to the engine.)
3. Gradually advance throttle to obtain desired exhaust temperature and rpm.

CAUTION

No automatic engine overspeed protection is provided when the emergency fuel control system is being used; therefore, throttle movement must be smooth and gradual to avoid flame-out or engine overspeed, particularly at high altitude.

COMPRESSOR STALL.

Compressor stall can occur at any altitude as a result of rapid advancement of the throttle during operation on either the main or the emergency fuel system. Although the possibility of such compressor stall is considerably reduced during operation on the main fuel system, it can occur in case of main fuel regulator malfunction or improper fuel scheduling, or at low airspeeds even though the regulator is functioning normally. During operation on the emergency fuel system, compressor stall is likely to occur when the throttle is advanced rapidly because the emergency fuel regulator schedules fuel as a function of the compressor inlet pressure (altitude and airspeed) and throttle position, affording no acceleration fuel schedule for stall protection such as that provided by the main fuel regulator. Stall occurs when rapid throttle advancement injects more fuel into the combustion chamber than the engine can use for acceleration at the existing rpm. The burning of this additional fuel increases the combustion pressures. As these pressures increase, they create a corresponding increase in the pressures against the compressor discharge air. This increase of pressure against the compressor discharge air results in a breakdown of the airflow through the last stages of the compressor, which is the condition known as compressor stall. As a result of the stall, the mass airflow through the compressor is reduced, causing a reduction in airflow through the turbine; thus the energy available to the turbine wheel is decreased. A roaring, pulsating noise and heavy vibration usually accompany compressor stall and may precede any engine instrument indication of changing engine conditions. In addition to the pulsating noise and vibration, the following signs of compressor stall may be present, depending upon the severity of the stall: rapidly rising exhaust temperature, failure of the engine to accelerate, a long flame from the tail pipe, and loss of thrust. If the engine is allowed to continue operating in this stalled condition, the increased temperature of the burning gases will cause serious damage to the hot section (combustion, turbine, and exhaust sections) of the engine, resulting in possible engine failure. If stall is encountered during a rapid engine acceleration, action should be taken to eliminate it as follows:

1. Immediately retard throttle to IDLE.
2. If exhaust temperature stabilizes at a normal value, readvance throttle slowly while carefully monitoring exhaust temperature. If the exhaust temperature continues to drop after the throttle is retarded, flame-out has occurred and an air start should be attempted.

"COLD" OR "PARTIAL" STALL.

On rare occasions during operation on the main fuel system at low airspeeds, a stall condition that may be described as a "cold" or "partial" stall will be encountered during rapid engine acceleration. The main distinguishing characteristics of this stall condition are the inability of the engine to exceed a maximum rpm of about 70%, an exhaust temperature of from 500°C to 700°C, and little or no vibration or pulsating. No immediate damage will normally result from this condition, but stall recovery should be started as soon as the condition is recognized in order to clear the stall and to increase power. Occasionally, retarding the throttle to IDLE will not eliminate this partial stall. If this condition persists when the throttle is slowly readvanced, as shown by inability of engine rpm to advance above about 70%, proceed as follows:

1. Retard throttle to IDLE.
2. Increase airspeed by lowering nose of airplane, to increase ram-air pressure at compressor inlet. An exhaust

temperature drop to normal stabilized values (200°C to 300°C) at IDLE will show that the stall has been cleared.

3. Advance throttle slowly to desired power setting.

WARNING

Do not switch to the emergency fuel system even with the throttle at IDLE *if there is any possibility that a compressor stall is still present,* because switching to the emergency fuel system with the engine stalled may result in serious overtemperature.

FLAME-OUT.

Flame-out is just what the name implies and can occur during acceleration or deceleration of the engine. Acceleration flame-out, like compressor stall, occurs when more fuel is injected into the combustion chambers than the engine can utilize for acceleration at the existing rpm. But, unlike the compressor stall condition, this mixture is so excessively rich that it cannot burn, so the flame goes out. Flame-out during rapid engine deceleration results whenever the amount of fuel injected into the combustion chambers is reduced to too low a level to sustain combustion at the existing rpm. Flame-outs are indicated by loss in thrust, drop in exhaust temperature, and possibly by loud noise similar to engine backfire. During a partial flame-out, some of the combustion chambers may still be lighted if the exhaust temperature does not drop below 260°C. The throttle should be retarded to IDLE and readvanced slowly, in an attempt to relight the other chambers. If exhaust temperature continues to decrease below 260°C, the flame-out is complete and an air start is necessary. During any rapid throttle movement above approximately 25,000 feet, flame-out may occur because of malfunction or improper scheduling of the fuel regulator or if the emergency fuel switch is left ON. Flame-outs do not normally occur, but can occur above 40,000 feet during a rapid engine acceleration at low airspeed.

ENGINE NOISE AND ROUGHNESS.

Any unusual noise or roughness noticed in flight, that can be attributed to the engine and cannot be eliminated when the engine speed or altitude is varied, indicates some mechanical failure and an immediate landing should be made. The most probable source of noise in flight is the pressurization system. When cabin pressure is dumped for a few minutes, noise should stop. If noise continues, engine should be checked during shutdown after landing. On some airplanes, roughness may develop in the engine during operation at high power above 15,000 feet. Engine roughness attributable to irregular combustion can usually be eliminated if the rpm is changed; however, if the roughness continues, the pilot should land as soon as possible.

OVERTEMPERATURE VERSUS ENGINE LIFE.

The useful life of any jet engine is greatly shortened by operation at high rpm and temperature. Jet engine hot section parts are required to operate at temperatures near their safe structural limit when maximum performance is required of the engine. The turbine wheel, in particular, which operates with a rim temperature close to the peak of tolerance for the metal from which it is manufactured, is subject to early failure when subjected to serious overtemperatures, or to repeated "minor" overtemperatures. The J-47 turbine wheel can be expected to operate satisfactorily for at least 1000 hours at a steady-state exhaust temperature of 685°C, if it is not subjected to overtemperatures. However, a 15°C increase in steady-state exhaust temperature will reduce the turbine wheel life by approximately 55 percent and transient temperatures that exceed 950°C for as little as two seconds can render the turbine wheel unserviceable. Thus it can be seen that "minor" overtemperatures are not minor at all, but a definite hazard to flight safety. The careful monitoring of exhaust temperature by the pilot, and the recording of all overtemperature operation is imperative. Particularly during starting, the pilot should, with a clear understanding of fuel flow characteristics and their relation to exhaust temperature, be alert for an incipient overtemperature condition and recognize it in time to take rapid corrective action. You should be thoroughly familiar with the exhaust temperature limits given in Section V. When the engine is properly adjusted, the exhaust temperature indicating system properly calibrated, and the engine controls are properly handled, all operating temperatures including transients will fall within the serviceability limits established for the engine. Careful monitoring of the exhaust temperature detects any maladjustment or malfunction. The importance of careful monitoring cannot be overemphasized.

EXHAUST TEMPERATURE VARIATION.

Since exhaust temperature is not directly controlled in the operation of turbojet engines equipped with fixed-area exhaust nozzles, it is essential that the pilot be familiar with, and understand, certain engine characteristics to obtain maximum available airplane performance. As this airplane is equipped with a fixed-area engine exhaust nozzle, the nozzle cannot be adjusted in

flight to control the exhaust temperature. Therefore, engine rpm must be reduced, as necessary, to hold exhaust temperature within limits. The exhaust temperature varies with changes in temperature and density of engine inlet air, as well as with changing thermal conditions within the engine. Generally, an increase in outside temperature or altitude causes the exhaust temperature to rise, whereas an increase in airspeed lowers the exhaust temperature. As all three factors can change singly or simultaneously, the effect on exhaust temperature is inconsistent for any given rpm. Exhaust temperature may be expected to be relatively high at 100% rpm when the airplane is not moving, but, as the airspeed increases during a take-off run, the exhaust temperature drops well below the maximum operating limit. After take-off, the exhaust temperature remains below the maximum operating limit until approximately 35,000 feet is reached. Above this altitude, the exhaust temperature rises at a gradually increasing rate until a reduction in rpm may be necessary to hold the exhaust temperature below maximum operating limit. Any rpm reduction up to 7% under these conditions does not result in loss of thrust. When rpm is reduced to 93% while maximum operating exhaust temperature is maintained at 690°C, the thrust obtainable is as great as that obtained at 100% rpm with 690°C exhaust temperature. Only at extreme altitudes, is it necessary to reduce rpm to as low as 93% to keep the exhaust temperature below the maximum operating limit. Normal variation of exhaust temperature due to changes in outside air temperature is approximately 2¾°C per 10°F. Typical exhaust temperature variation due to the changing thermal conditions of the engine occurs during static ground run-up after engine stabilizes at 100% rpm. The exhaust temperature increases during the first minute to an initial peak of 15°C to 20°C above the final stabilized value, which is reached 5 to 10 minutes after rpm stabilizes. Since take-offs are usually started within one minute after full throttle is reached, most take-offs are made with unstabilized engines. In flight, there is no way for the pilot to compensate for low exhaust temperatures, although it should be remembered that thrust decreases as temperature decreases during operation at a constant rpm. Near 100% rpm, each degree centigrade change in exhaust temperature produces a change of approximately 7 pounds in static thrust. Thus, a 25°C reduction in exhaust temperature reduces engine thrust approximately 175 pounds.

TURBINE NOISE DURING SHUTDOWN.

The light scraping or squealing noise sometimes heard during engine shutdown results from interference between the turbine buckets and turbine shroud. Contact of the two parts is due to the tendency of the shroud to shift and distort under varying temperature conditions, as induced by engine shutdown. The scraping, while undesirable, does not damage either part. To minimize the scraping, it is necessary to operate the engine for 2 minutes at 65% to 70% rpm before shutdown after any high-power operation (either flight or ground). If, despite this precaution, heavy scraping does occur on shutdown, no attempt to restart the engine should be made until the turbine temperature has dropped sufficiently to provide adequate clearance between the buckets and shroud, because a starting attempt might result in destruction of the starter. If a start must be made when interference is suspected, a check should be made by listening that the engine begins to turn as the starter is engaged, or the tachometer indication should be noted. If the engine does not begin turning when the starter is engaged, the stop-starter button must be depressed immediately.

SMOKE FROM TURBINE DURING SHUTDOWN.

WHITE SMOKE.

During engine shutdown, fuel may accumulate in the turbine housing where the heat of the turbine section causes the fuel to boil. (Although a turbine housing drain is provided, it may not prevent accumulation of some fuel.) Presence of this residual fuel in the engine will be indicated by emission of fuel vapor or smoke from the tail pipe or intake duct, depending on ground wind conditions. Boiling fuel, indicated by the appearance of white fuel vapor, is not injurious to the engine, but does create a hazard to personnel, because the vapor may ignite with explosive violence if allowed to accumulate in the engine and fuselage. Therefore, all personnel should keep clear of the tail pipe for at least 3 minutes after shutdown and at all times when fuel vapor or smoke issues from the tail pipe.

BLACK SMOKE.

The appearance of black smoke out of the tail pipe after shutdown indicates burning fuel. This will damage the engine and should be cleared immediately, as follows:

1. Connect external power source.
2. Place throttle OFF.
3. Hold battery-starter switch at STARTER.
4. Turn engine master switch ON until starter locks in, and then OFF to close main fuel shutoff valve.

Note

Once the starter has engaged, moving the engine master switch to OFF will not cause the starter to disengage.

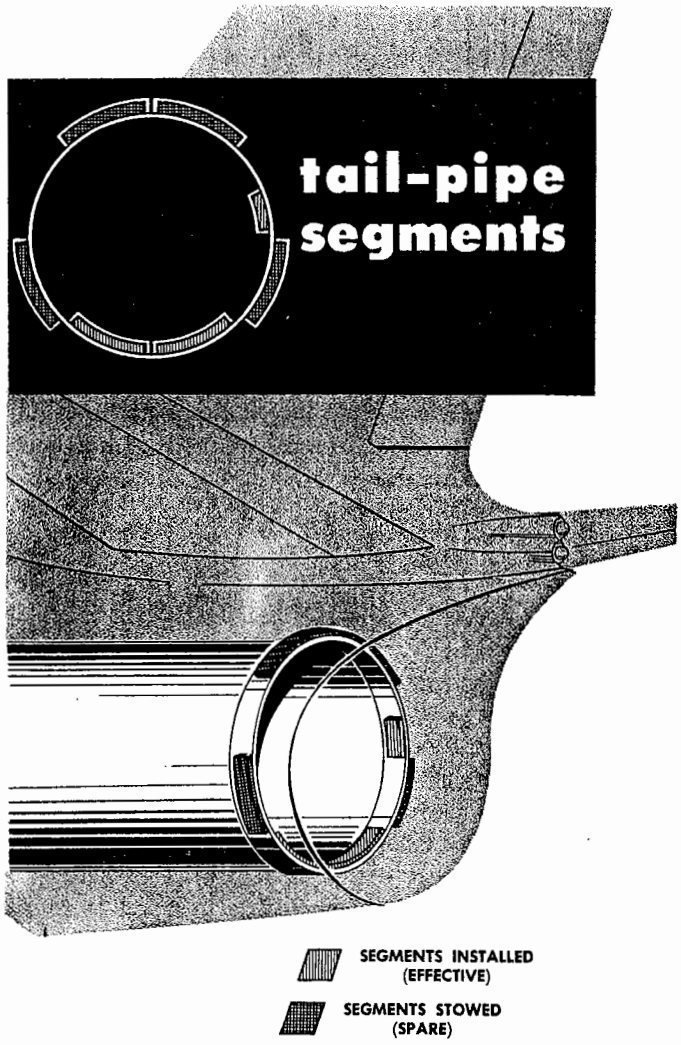


Figure 7-2

5. Listen to confirm that engine begins to turn as starter is engaged, or note tachometer indication.

6. Allow engine to crank to approximately 6% rpm (20 seconds maximum); then depress stop-starter button. Turn battery-starter switch OFF.

TAIL-PIPE SEGMENTS.

On turbojet engines equipped with fixed-area nozzles, the exhaust temperature is a direct indication of thrust output, or power, at a given engine speed. As the exhaust temperature is increased, the velocity of the exhaust jet, and hence the thrust, is increased. It is apparent that, although exhaust temperature should be kept below the maximum operating limit to prevent excessive engine wear, it must be held near the limit to obtain maximum thrust output. In order to obtain maximum operating exhaust temperature, exhaust temperature adjusting segments (figure 7-2) are added or removed in the aft end of the tail pipe. These segments correctly adjust the exhaust nozzle area to produce as near as possible a stabilized exhaust temperature of 690°C at 100% rpm during ground run-up. Fixed-area nozzles can be adjusted for only one set of operating conditions; thus, for a majority of operating conditions, the exhaust nozzle is usually too large or too small, resulting in low or high exhaust temperatures, respectively. When tail-pipe segments are added, increased thrust is evidenced on an engine previously operating with low exhaust temperature. The initial segments are installed at the bottom of the tail pipe. As additional segments are needed, they are installed as symmetrically as possible, starting from the bottom of the tail pipe. Initial segment installation beginning at the top of the tail pipe is not recommended, because it reduces the down-tail load. Down-tail loading aids nose-wheel lift-off and is a reaction caused from the tendency of the jet exhaust stream to cling to the upper fairing shelf, aft of the tail pipe. Whenever this tendency to cling is spoiled, the normal down-tail load is lost. When this down-tail loading is reduced or lost, nose-wheel lift-off speed increases substantially. Efficient minimum-run take-offs depend upon early nose-wheel lift-off; thus, if the tail-pipe segments are improperly located, an excessive ground run is required during take-off.

FUEL SYSTEM.

Operation of the fuel system is essentially automatic, requiring no action from the pilot during flight. However, it is essential that the pilot keep the following precautions in mind.

1. Keep emergency fuel switch OFF for all operation, except in case of main fuel system failure.

2. Check drop tank pressure shutoff valve ON at all times when drop tanks are installed to ensure that all drop tank fuel is consumed. This will also prevent collapsing of the 120-gallon drop tanks during rapid descent from altitude.

3. Before depressing fuel filter deicer button, be sure fuel filter ice warning light burns steadily.

HYDRAULIC SYSTEM.

The utility hydraulic system pressure gage should be checked periodically during flight. The pressure regulator is set to reload the system (up to 3000 psi) whenever pressure drops below 2600 psi. When the regulator cuts in to reload the utility system, a slight "kick" or "nibble" is felt on the stick. If the system pressure reloads in less than 3 minutes when all hydraulic controls are in normal flight position, it may indicate a leak in the system, probably in the lines, and it would be wise to terminate the flight.

LANDING GEAR.

If the landing gear unsafe light should come on during flight, indicating an unsafe landing gear condition, airspeed should be reduced below 185 knots IAS before the landing gear handle is moved to the UP position. Moving the landing gear handle from COMBAT position may cause the gear doors to cycle; if airspeed is above 185 knots IAS, the doors may be torn off. When the warning light goes out, the gear handle should be returned to COMBAT (below 185 knots IAS). If the warning light comes on again, land as soon as practicable after a gear check is made.

WHEEL BRAKE OPERATION.

To reduce maintenance difficulties and accidents due to brake failure, it is important that wheel brakes be used properly. Frequently, operating personnel attempt to stop the airplane as quickly as possible, regardless of the length of runway. They also use the brakes consistently for speeding up turns, and they drag the brakes while taxiing. Brakes should not be used to their maximum potential to make all landing rolls as short as possible. The full landing roll should be utilized to take advantage of aerodynamic braking so that brakes can be used as little and as lightly as possible. To minimize brake wear, the following precautions should be observed insofar as practicable:

1. Immediately after touchdown or when there is considerable lift on the wings, use extreme care when applying brakes to prevent skidding tires and causing flat spots. A heavy brake pressure can result in locking the wheel more easily if the brakes are applied immediately after touchdown than if the same pressure is applied after the full weight of the airplane is on the wheels. A wheel once locked in this manner, immediately after touchdown, will not become unlocked until brake pressure has been greatly reduced. Proper braking action cannot be expected until the tires are carrying heavy loads.

Note

Brakes can merely stop the wheel from turning, but stopping the airplane is dependent on the friction of the tires on the runway. There are two reasons for the loss of 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. If one wheel is locked during application of brakes, there is a tendency for the airplane to turn away from that wheel and further application of brake pressure will offer no corrective action. Since friction goes down when the wheel begins to skid, it is apparent that a wheel, once locked, will never free itself until brake pressure is less than the turning moment.

2. If maximum braking is required after touchdown, first decrease lift as much as possible by raising flaps and dropping nose before hard application of brakes.

3. For short landing rolls, use brakes intermittently and hard, but not hard enough to lock wheels. Apply brakes for about 2 to 3 seconds, allowing a one-second release between applications.

4. After the brakes have been used excessively for an emergency stop and are in a heated condition, do not taxi airplane into a crowded parking area. Peak temperatures occur in the wheel and brake assembly from 5 to 15 minutes after a maximum braking operation. If maximum braking has been used, notify ground personnel to cool wheel and tire assemblies immediately. Overheated wheel and brake assemblies should be cooled by means of an air blast from any source available such as a fan, blower, air compressor (except ground starting unit compressor), ground heater (utilizing the blower only, with the heating cycle turned off), etc. Cooling time may be accelerated by parking the airplane at right angles to any surface wind. If compressed air is not available to cool the wheel and tire assemblies, warn all personnel to remain clear of wheel area because of danger of possible explosion.

WARNING

No attempt should be made to cool an overheated wheel and tire assembly with CO_2, water spray, foam, or any other fire-extinguishing agent, because such practice may cause the assembly to fail with explosive force.

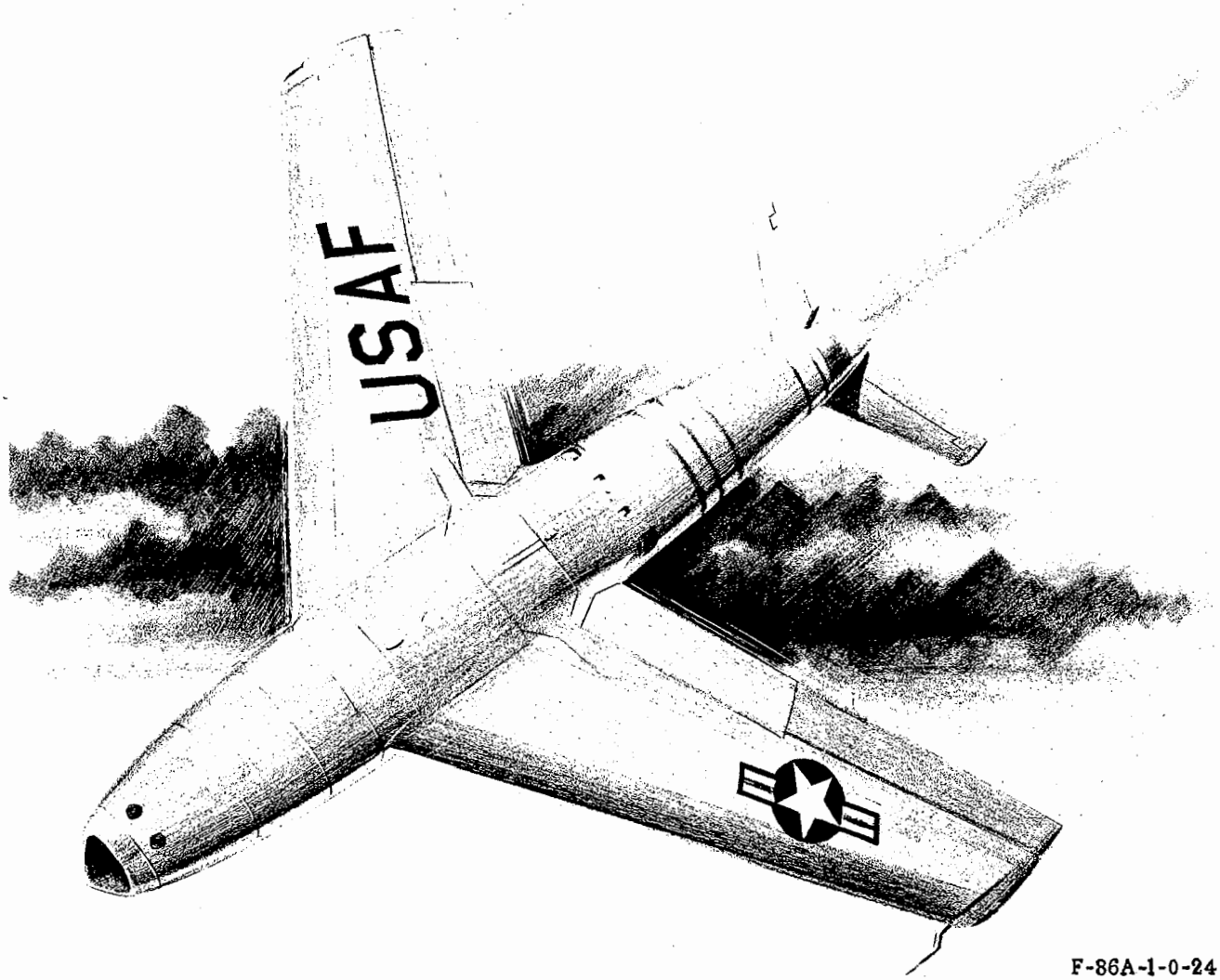
5. If a wheel brake fire does occur, extinguish fire with a minimum amount of CB (bromochloromethane) fire extinguishing agent. A guard should be maintained until the wheel has cooled sufficiently to preclude any danger of a reflash.

WARNING

- The use of CO_2, water spray, foam or any other similar extinguishing agent to extinguish a fire in wheel and tire assembly is not recommended as thermal shock can cause the wheel to fail with explosive force. This

failure can occur as long as 15 minutes after the use of the above extinguishing agents.

- When approaching the wheel with cooling apparatus, fire fighting equipment, or for inspection purposes immediately after a maximum braking operation, the approach direction should be in the plane of wheel rotation to minimize personnel danger from possible explosion.



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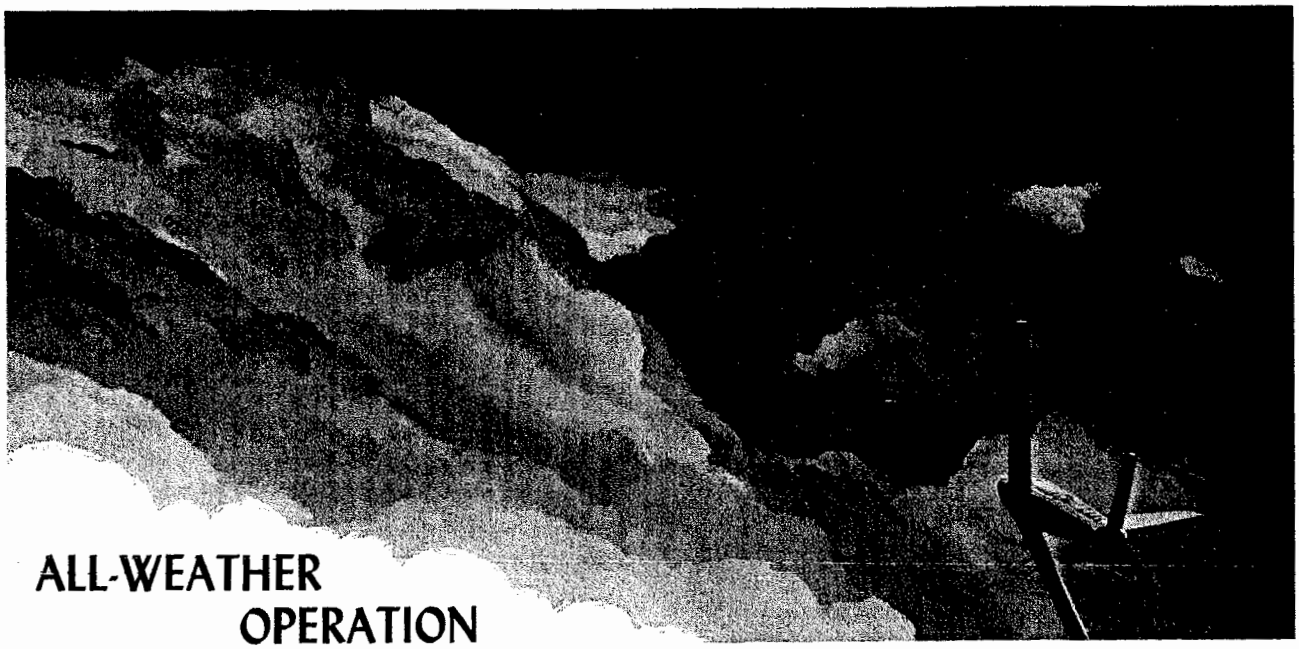
Section VIII
CREW DUTIES

Not applicable to this airplane.



SECTION IX

ALL-WEATHER OPERATION

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This section contains only those procedures that differ from, or are in addition to, the normal operating procedures in Section II.

INSTRUMENT FLIGHT PROCEDURES

Instrument flight should not be undertaken unless you are a qualified instrument pilot and a holder of AF Form 8A (green) or AF Form 8 (white) instrument certificate. You should be thoroughly familiar with existing Air Force regulations, Technical Orders, and other publications applicable to all-weather operation. Special attention should be given to the fuel planning phase of the preflight planning of IFR flights. Because certain phases of instrument flying may require delays in departure and additional time for letdown procedures, which are often made at low altitudes, the endurance factor is critical. Therefore, it is necessary to plan your flight accurately, with special attention to the traffic density and the types of approaches available at your destination. The effect of a go-around on fuel reserve (because of missed-approach or traffic control emergencies) must also be considered. This airplane has satisfactory stability while being flown on instruments, and its flight handling characteristics during all-weather operation are excellent. Flight instruments provided for basic instrument flying and radio navigation equipment will enable the pilot to make low-frequency range, automatic direction finding (ADF), manual direction finding (MDF), and ground-controlled approach (GCA) type instrument approaches.

ON ENTERING AIRPLANE.

Using command radio, check the tower, and check approach control, ground-controlled intercept (GCI), GCA, and CAA channels.

CAUTION

Make radio check after external power is connected to prevent depleting battery power.

AFTER STARTING ENGINE.

With IFF master control switch at STDBY, check operation of unit after warm-up if radar coverage is available.

BEFORE INSTRUMENT TAKE-OFF.

1. Line up visually with centerline of runway.
2. Pitot heater switch—ON.

WARNING

Warm-up time for the pitot heater is approximately one minute at 32°F. Allow sufficient heating time if taking off into freezing rain or other visible moisture with surface temperature at or near freezing.

3. Directional indicator—Rotate course index until runway heading is aligned with top of dial.
4. Attitude indicator—Adjust reference airplane for level indication by aligning it with indices on each side of instrument face.
5. Windshield deicing lever and canopy defroster—ON, if icing is anticipated.

INSTRUMENT TAKE-OFF.

1. Recheck all instruments, and release brakes.
2. As airplane breaks ground, immediately establish an initial climb attitude on attitude indicator at a rate of 500 fpm.

WARNING

A slight amount of pitch error in the indication of the Type J-8 attitude indicator will result from accelerations or decelerations. It will appear as a slight climb indication after a forward acceleration and as a slight dive indication after deceleration when the airplane is flying straight and level. This error will be most noticeable at the time the airplane breaks ground during the take-off run. At this time, climb indication error of about 1½ bar widths will normally be noticed; however, the exact amount of error will depend upon the acceleration and elapsed time of each individual take-off. The erection system will automatically remove the error after the acceleration ceases.

3. Landing gear handle—UP as soon as altimeter indicates a gain of altitude.

INSTRUMENT CLIMB.

1. Flap lever—UP at 160 knots IAS with a 1500 fpm climb established.

Note

Airplane will sink during flap retraction if sufficient airspeed is not attained. Normally, nose-down trim will be required immediately after wing flaps are retracted, because of rapid acceleration.

2. Holding a 1500 fpm rate of climb, accelerate to best VFR climbing speed.
3. Do not turn until 500-foot altitude above terrain is reached.
4. Limit angle of bank to 30 degrees.
5. Maintain a careful watch for exhaust temperature rise, for indications of intake duct icing while flying in visible moisture.

INSTRUMENT CRUISING FLIGHT.

The airplane has satisfactory handling characteristics at cruising speeds and can be flown with ease if properly trimmed and controlled primarily by reference to the attitude indicator. At higher speeds, it becomes more difficult to maintain longitudinal (pitch) control, with resultant gains and losses in altitude. During maneuvers at these speeds, use of the horizontal stabilizer for nose-up or nose-down corrections should be kept at a minimum, or overcontrolling will result, with subsequent altitude changes of 800 or 1000 feet.

RADIO-NAVIGATION EQUIPMENT.

The AN/ARN-6 radio compass is the only radio equipment provided for en route radio navigation. Because this equipment is highly susceptible to precipitation and electrical static, its reliability at high altitudes is considerably reduced by thin overcasts, haze, and dust. For this reason, the automatic operation of the radio compass should not be relied on entirely to establish fixes. The signals of the station should be monitored at all times to ascertain station passage and that the station is still transmitting. With the function switch turned to

the ANT. position, the radio compass serves as a normal low-frequency receiver. Use of the loop provides better reception during extreme static conditions. Flights should be thoroughly planned, and elapsed flight time between compulsory check points should be plotted against the estimated times, to maintain constant watch on the progress of the flight.

DESCENT.

Descent can be accomplished without difficulty at speeds up to the limiting Mach number or airspeed of the airplane. It is not recommended that descents at high Mach number be continued below 10,000 feet because of the very steep angle and high rate of descent. Instrument descent can be made with or without speed brakes extended. However, to limit the airspeed and distance covered at high rates of descent, use of speed brakes is recommended.

Note

The canopy defrosting system provides sufficient heating of the canopy to effectively eliminate frost or fog during descent.

WARNING

During descents, it is imperative that the altimeter be accurately read, with particular attention given to the 1000-foot and 10,000-foot pointers.

Recommended Procedure.

For typical descents, proceed as follows:

1. Speed brake switch OUT. [Return switch to HOLD (neutral) position after speed brakes are fully extended.]
2. Throttle IDLE.

Note

In steep dives during high rates of descent with idle power and speed brakes out, the horizon bar of the attitude indicator rises to a very high position, making accurate determination of pitch angle very difficult. The airspeed indicator becomes very important in limiting the pitch angle under these conditions.

3. Limit angle of bank to 30 degrees.

CAUTION

A descending turn at a high rate of descent becomes progressively more difficult to control as bank angle is increased, and there is danger of falling into an uncontrolled spiral unless caution is used.

INSTRUMENT LETDOWNS.

Jet Penetrations.

Jet penetrations have been set up to provide a high-speed and a high-rate-of-descent letdown from cruising altitude to a point where a VFR approach or an instrument approach (such as GCA, low-frequency range, or ADF) can be made. Penetration procedures for specific fields are given on JAL (jet approach and landing) charts. The Pilot's Handbook—Jet, in two parts for the eastern and western United States, has the JAL charts for all fields where jet penetration procedures have been established. Figure 9-1 shows a typical jet penetration and low approach, using radio range, which is made by beginning a letdown at the penetration cone (cruising altitude) on the heading specified in the JAL chart. The initial phase of the penetration is set up to avoid interference with altitudes occupied by other airplanes. After the high cone is crossed, a conventional instrument approach is begun. A typical penetration and low approach using ADF is shown in figure 9-2.

Note

- Flight paths illustrated in figures 9-1 and 9-2 can be used on both types of penetrations and low approaches. Check the current JAL chart for your destination.
- The conditions set up in the JAL charts should be given careful consideration during flight planning. Availability of GCA, alternates, and operational problems in high-density traffic areas should be analyzed.

Low-frequency Range Approach.

Low-frequency range approach procedures may be used in conjunction with jet penetration procedures, as shown in figure 9-1. JAL charts specify where combined procedures are necessary. A close inspection of the JAL charts shows that although the altitudes for range approaches are usually the same as those shown in the

jet penetration and low approach using radio range (TYPICAL)

NOTE

If icing is anticipated, maintain a minimum of 75% engine rpm to ensure that sufficient airflow is available for deicing.

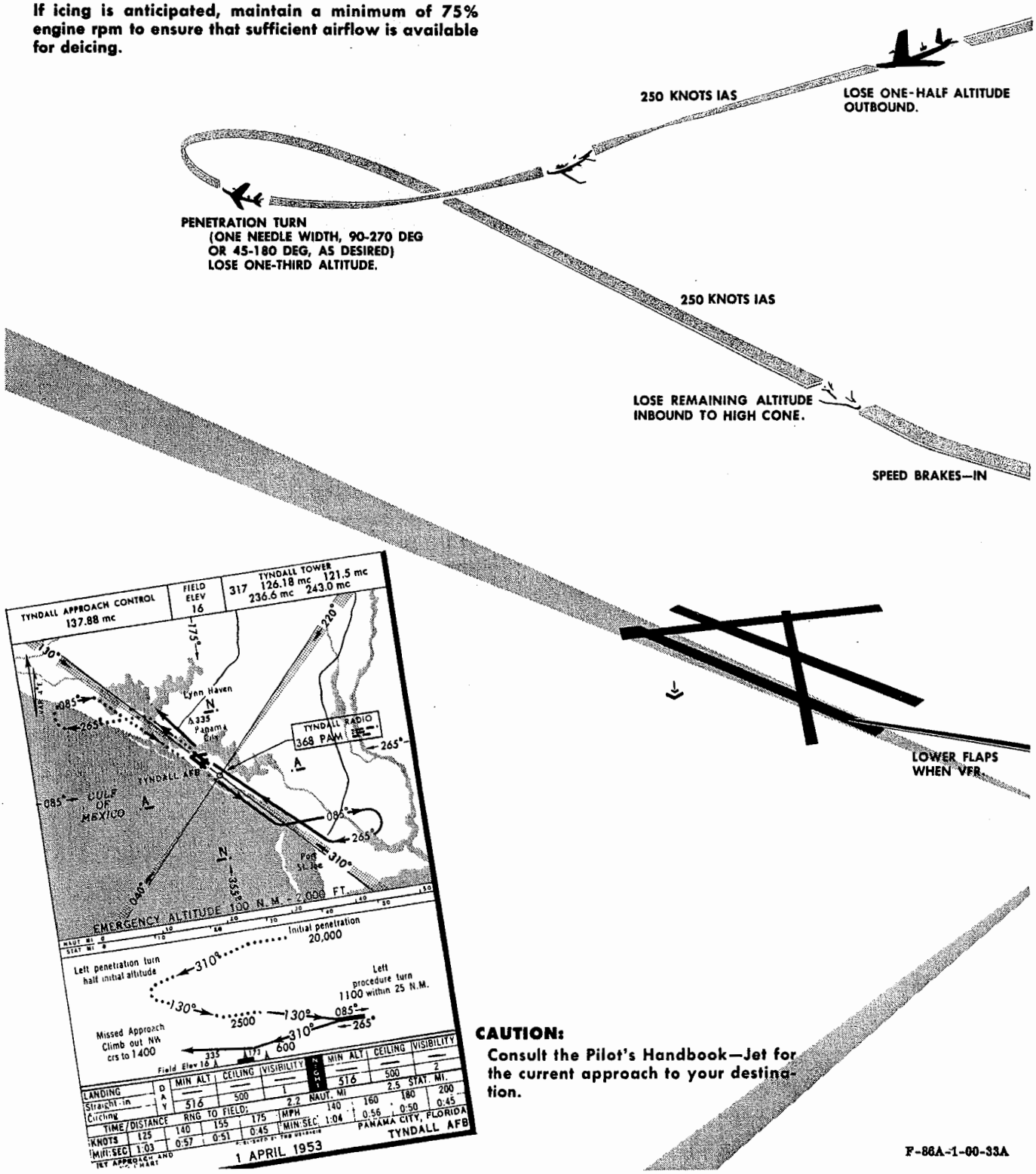

Figure 9-1

PENETRATION CONE.
SPEED BRAKE—OUT
GEAR AND FLAPS—UP
SLAT LOCK LEVER*—*UNLOCK*

NOTE

- Use power as required to maintain desired rate of descent at the speeds indicated.
- For minimum terrain coverage, lower gear and flaps at penetration cone (below gear-and-flaps-down limit speed); then maintain 160 knots IAS to high cone.

MAINTAIN SPEED AND PENETRATION ALTITUDE TO THE RANGE STATION.

NOTE:

1. Maintain altitudes assigned by ATC in preference to JAL chart altitudes.
2. Use standard terminology to advise controller of positions and maneuvers in the pattern.

HIGH CONE (COMMENCE LOW-FREQUENCY RANGE APPROACH)

NOTE: Raise gear and flaps if lowered at penetration cone.

180 KNOTS IAS

ONE MIN OUTBOUND (MAX 2 MIN)

ONE MIN, 15 SEC

LOW CONE

PROCEDURE TURN (TWO NEEDLE WIDTHS)

160 KNOTS IAS
GEAR—DOWN

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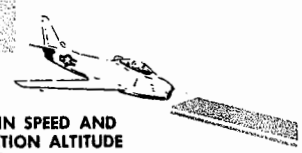
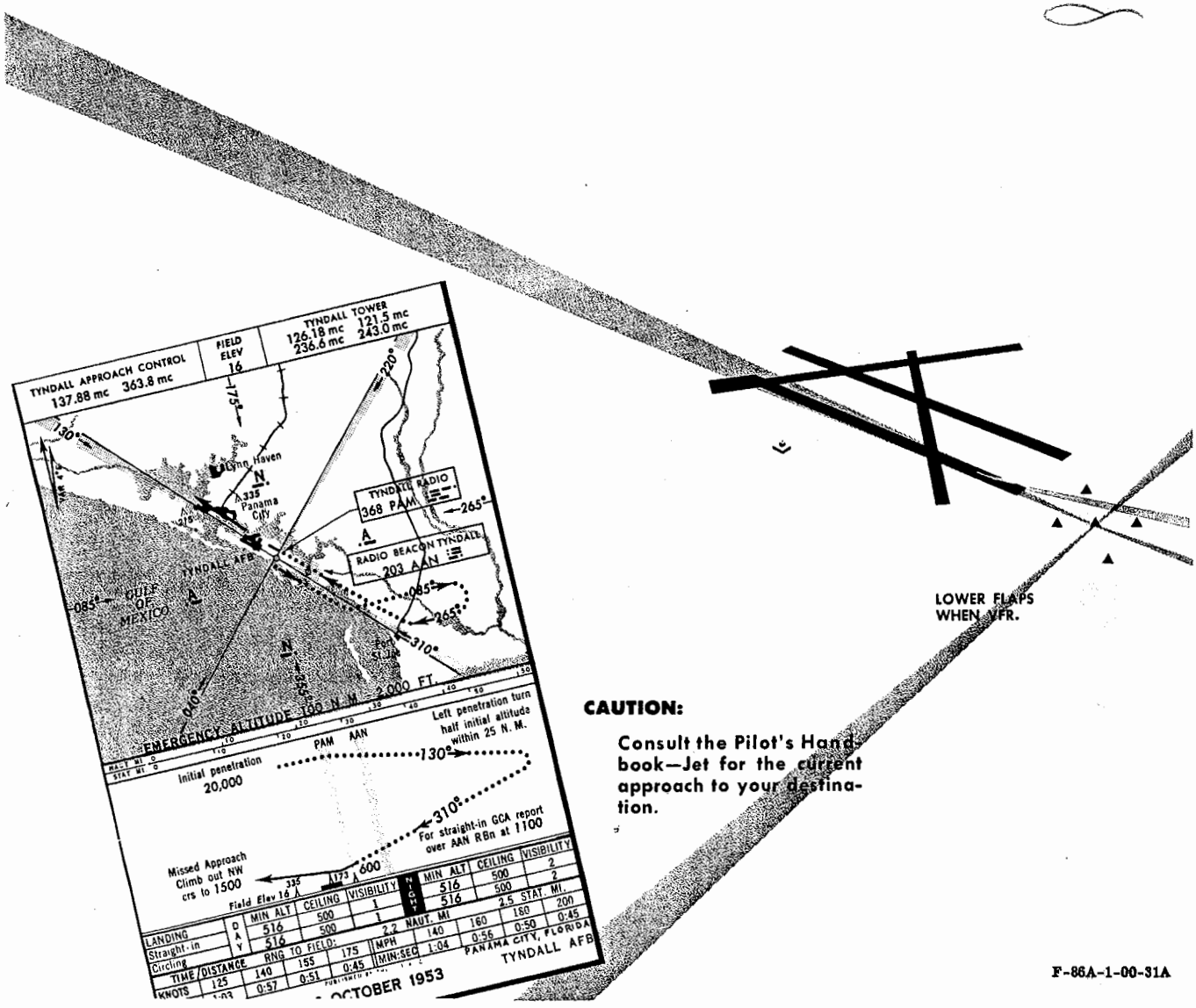
* Some airplanes. (Refer to applicable text.)

NOTE

If icing is anticipated, maintain a minimum of 75% engine rpm to ensure that sufficient airflow is available for deicing.



MAINTAIN SPEED AND PENETRATION ALTITUDE TO THE RANGE STATION.



LOWER FLAPS WHEN VFR.

CAUTION:

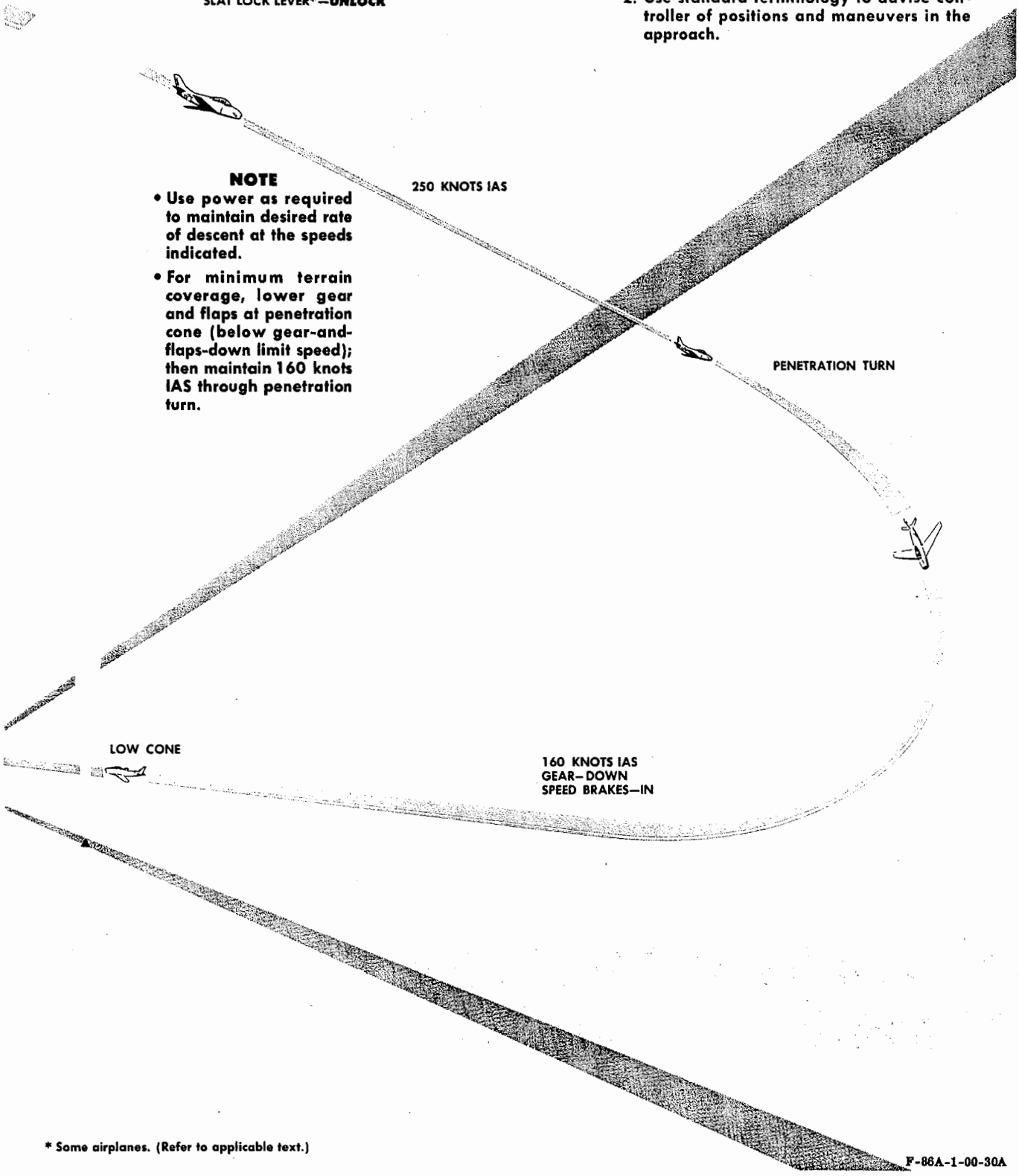
Consult the Pilot's Handbook—Jet for the current approach to your destination.

F-86A-1-00-31A

Figure 9-2

NOTE:

1. Maintain altitudes assigned by ATC in preference to JAL chart altitudes.
2. Use standard terminology to advise controller of positions and maneuvers in the approach.



* Some airplanes. (Refer to applicable text.)

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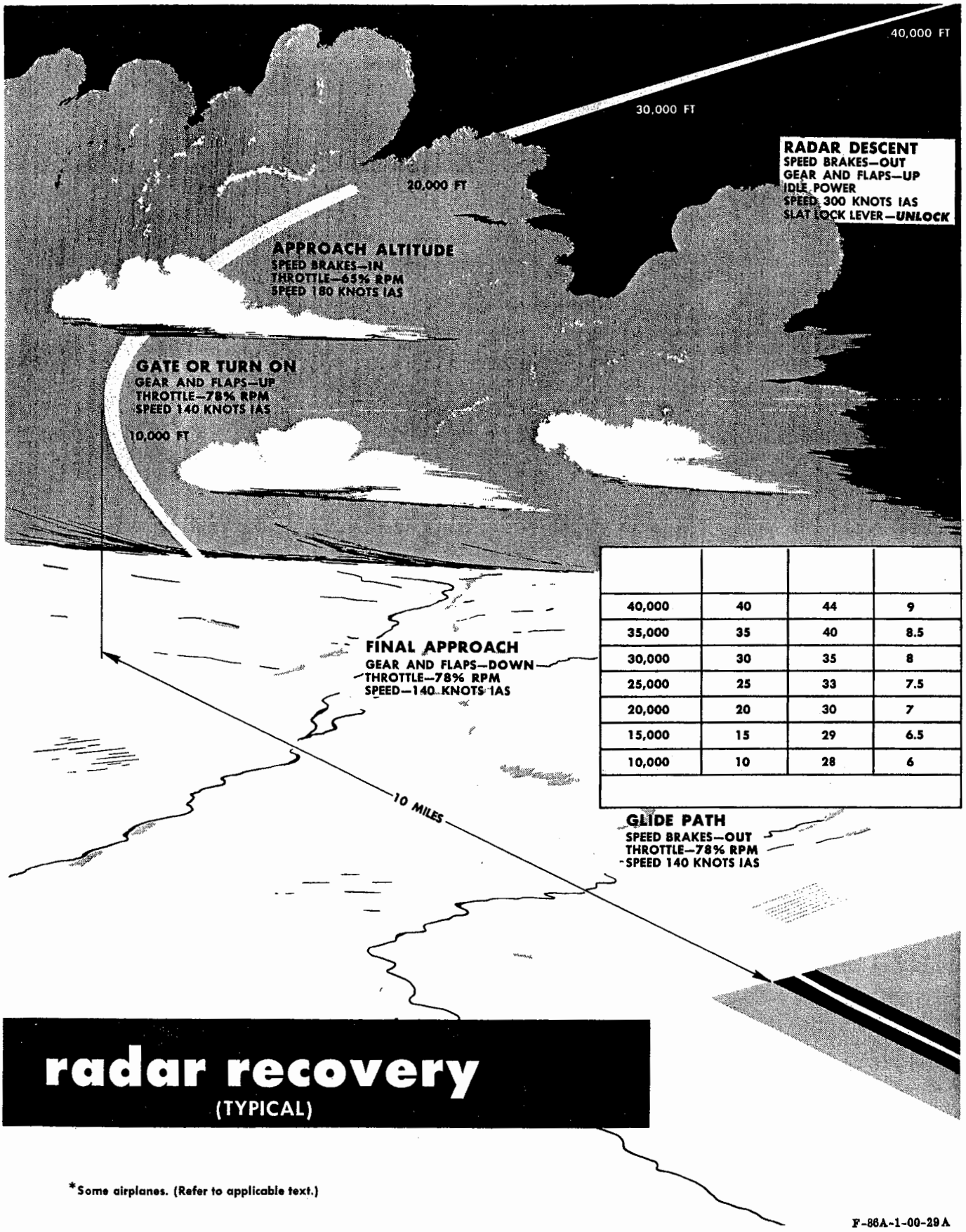


40,000	40	44	9
35,000	35	40	8.5
30,000	30	35	8
25,000	25	33	7.5
20,000	20	30	7
15,000	15	29	6.5
10,000	10	28	6

radar recovery
(TYPICAL)

*Some airplanes. (Refer to applicable text.)

Figure 9-3

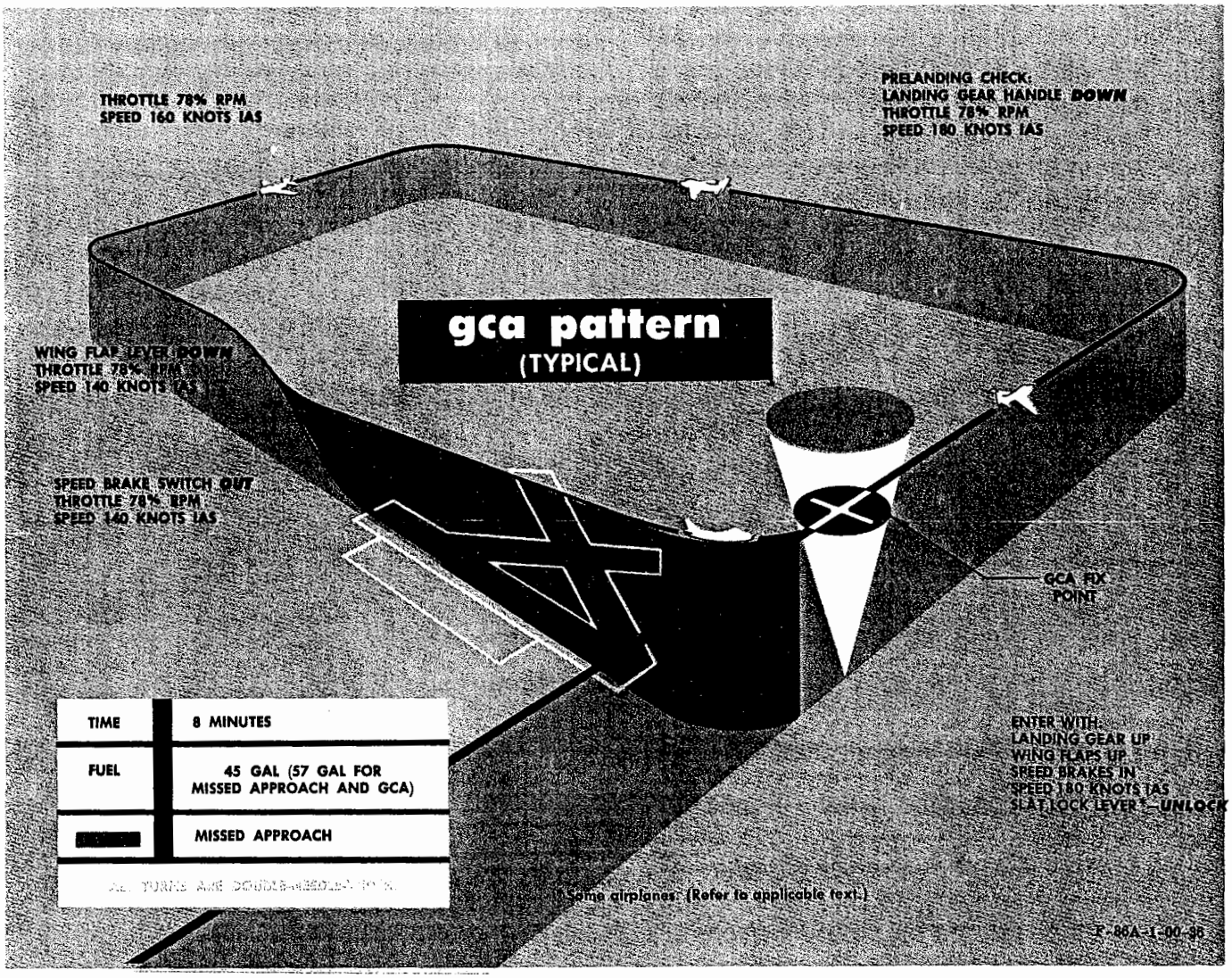


Figure 9-4

regular Pilot's Handbook, the pattern is often abbreviated or altered in some way for jet airplanes.

ADF Approach.

A great many of the JAL charts in the Pilot's Handbook—Jet call for ADF (automatic direction finding) procedures to be used during the letdown. This approach is preferred to that of the low-frequency range because it is easier to do and can be made on homers. The procedure shown in figure 9-2 permits simple tracking with the radio compass, eliminating the need for bracketing and cone passage.

Radar Recovery.

Radar letdowns with GCA landings are optimum for conserving fuel under instrument conditions. For a typical letdown, see figure 9-3. When planning the use of this aid upon an IFR arrival, remember that heavy precipitation can seriously reduce the capabilities of the controller to bring you in.

Note

To ensure a satisfactory radar recovery, the IFF should be turned on to aid the controller in seeing your airplane.

Ground-controlled Approach.

The airplane has excellent handling qualities during GCA. On a normal GCA glide slope, the airplane is in its approximate landing attitude, and only small control movement is required for the touchdown. For a typical pattern and the time required to complete a standard

ground-controlled approach, see figure 9-4. On IFR cross-country flights, the GCA procedure at the destinations should be checked and fuel allowances made as part of preflight planning. Emergency GCA approaches can be made with less fuel by requesting that the GCA controllers shorten the pattern. Fuel can also be conserved by delaying the cockpit check until on base leg of final approach, but before reaching the glide slope.

Note

Double-needle-width (3-degree-per-second) turns should be made in the GCA pattern.

ICE AND RAIN

Ice will normally adhere to the windshield, wing leading edge, empennage, and the forward portion of the drop tanks. Altitude should be changed immediately upon the first sign of ice accumulation. The resultant drag and weight increase associated with airplane icing acts to reduce the airspeed and to increase the power requirements, with consequent reductions in range.

WARNING

Heavy ice accumulation will greatly increase the stalling speed; therefore, airspeed should be increased during low-altitude flight, approach, and landing under such conditions.

Icing of the engine air intake area is possible during operation in weather with temperatures near the freezing point. An increase in fuel flow and decrease of rpm with a loss of thrust (no mechanical difficulties present) can indicate engine icing. A major rise in exhaust temperature with a decrease in thrust is one of the normal indications of icing on this type of engine.

WARNING

If icing conditions are encountered and exhaust temperature increases, the throttle should be retarded immediately and an effort made to leave the icing area. Low airspeed and high engine rpm are more conducive to engine icing.

During take-off into fog or low clouds, when temperature is at or near freezing, the engine will be subject to icing. When these conditions exist, climb should be made at higher-than-normal indicated airspeeds as an additional precaution. Avoid atmospheric icing conditions whenever possible. The most proficient weather service cannot always predict accurately just when or where icing may be encountered. However, many areas of probable icing conditions can be avoided by careful flight planning with available weather information. If possible, avoid take-offs when the temperature is between −10°C (14°F) and 5°C (41°F) if fog is present or the dew point is within 4°C (7°F) of the ambient temperature. These are conditions under which engine icing can occur without wing icing. If the ambient temperature is in the range of 0°C (32°F) to 5°C (41°F), the speed of the airplane should be maintained at 250 knots IAS or above, to prevent intake duct icing. If icing conditions are encountered at freezing atmospheric temperatures, immediate action should be taken as follows:

1. Change altitude rapidly by climb or descent in layer clouds, or vary course as appropriate to avoid cloud formations.
2. Reduce airspeed to minimize rate of ice build-up.
3. Maintain close watch of exhaust temperature, and reduce engine rpm as necessary to prevent excessive exhaust temperature.
4. If ice forms on windshield, move windshield deicing lever to ON. (See figure 9-5.)

TURBULENCE AND THUNDERSTORMS

Throttle setting and pitch attitude are the keys to proper flight technique in turbulent air. The throttle setting and pitch attitude required for desired penetration airspeed should be established before entering the storm. This throttle setting and pitch attitude, if maintained throughout the storm, must result in a constant airspeed, regardless of any false readings of the airspeed indicator. Specific instructions for preparing to enter a storm and flying in it are given in the following paragraphs.

CAUTION

Flight through a thunderstorm should be avoided if possible. Thunderstorm flying demands considerable instrument experience and should be intentionally undertaken only by well-qualified pilots. However, many routine flight operations require a certain amount of thunderstorm flying, since it is not always possible to avoid storm areas. At night, it is often impossible to detect individual storms and find the in-between clear areas. A pilot, using modern equipment and possessing a combination of proper experience, common sense, and instrument flying proficiency, can safely fly through thunderstorms.

BEFORE TAKE-OFF.

Before take-off, note the following precautions:

1. Make a thorough analysis of the general weather situation to determine thunderstorm areas, and prepare a flight plan that will avoid thunderstorm areas whenever possible.

2. Check proper operation of all flight instruments, navigation equipment, pitot heater, instrument panel lights, and anti-icing equipment before attempting flight into thunderstorm areas.

APPROACHING THE STORM.

If the storm cannot be seen, its proximity can be detected by radio crash static. Prepare the airplane before entering a zone of turbulent air, as follows:

1. Throttle—adjust as necessary to obtain safe penetration speed.

Note

275 KNOTS IAS IS A COMFORTABLE SPEED FOR PENETRATING A STORM OR AN AREA OF TURBULENCE.

F-86A-1-0-18

2. Pitot heater switch—ON.

3. Safety belt—Tightened; shoulder harness lock handle—LOCKED (forward).

4. Turn off any radio equipment made useless by static.

5. At night, turn cockpit lights full bright to minimize blinding effect of lightning.

CAUTION

Do not lower gear and flaps, because they decrease the aerodynamic efficiency of the airplane.

IN THE STORM

When in the storm, follow these procedures:

1. Maintain throttle setting and pitch attitude (established before entering) throughout the storm. Hold these constant and your airspeed will be constant, regardless of airspeed indications.

2. Devote all attention to flying the airplane.

3. Expect turbulence, precipitation and lightning. Don't allow these conditions to cause undue concern.

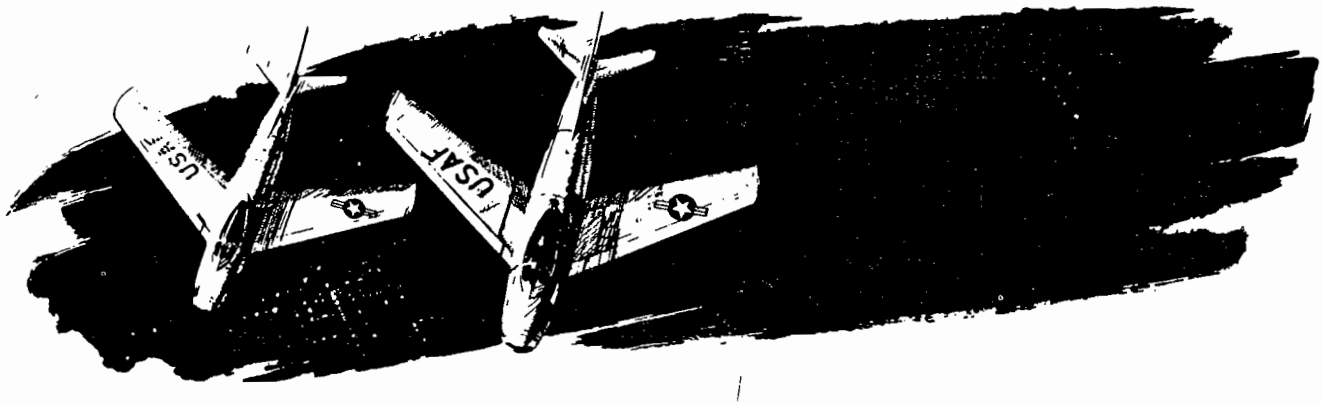
4. Maintain attitude. Concentrate principally on holding a level attitude by reference to attitude indicator.

5. Maintain original heading. Do not make turns unless absolutely necessary.

6. Don't chase airspeed indicator, because doing so will result in extreme airplane attitudes. If a sudden gust should be encountered while airplane is in a nose-high attitude, a stall may result.

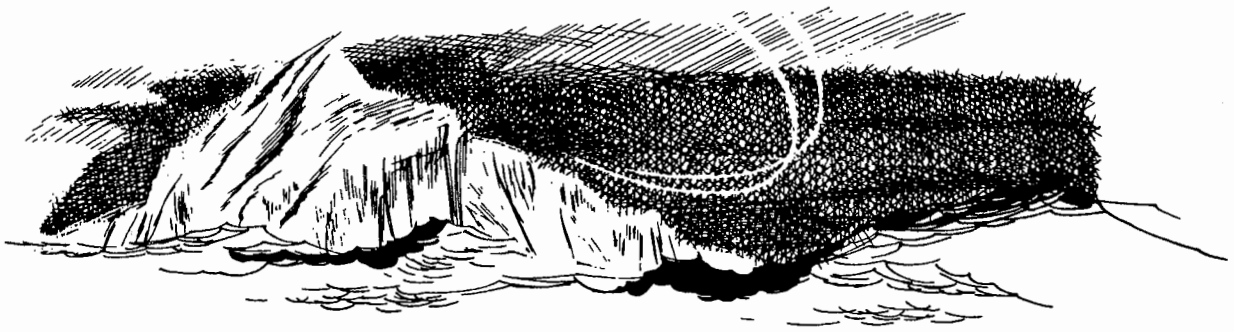
7. Use as little elevator control as possible in maintaining your attitude, to minimize stresses imposed on airplane.

8. The altimeter may be unreliable in thunderstorms because of differential barometric pressure within the storm. A gain or loss of several thousand feet may be expected. Make allowance for this error in determining minimum safe altitude.



NIGHT FLYING

There are no specific techniques for flying this airplane at night which differ from those required for daylight operation.



COLD-WEATHER PROCEDURES

While still a factor in successful cold-weather operation, cold-weather postflight preparations are considerably reduced with jet engines because of the lack of oil dilution requirements and other difficulties associated with reciprocating engines. Icing conditions are not considered here. For information applying to icing problems, refer to "Ice and Rain" in this section. To expedite preflight inspection and ensure satisfactory operation for the next flight, normal operating procedures outlined in Section II should be followed, with the following additions and exceptions.

BEFORE ENTERING AIRPLANE.

1. Check that all protective covers and dust plugs have been removed.

2. Check that the airplane—including surfaces, controls, ducts, shock struts, drains, etc—has been cleared of all snow and ice.

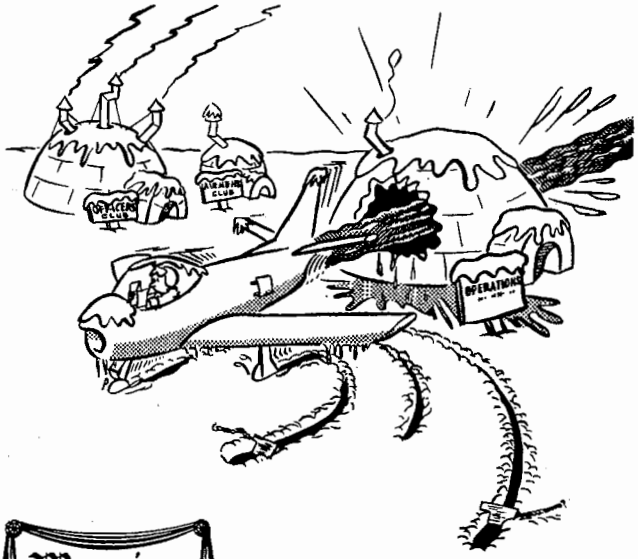
WARNING

A take-off should not be attempted with snow and ice on the airplane surfaces. Snow and ice on the airplane surfaces cause a loss of lift and create dangerous stalling characteristics.

3. Inspect lower portion of engine compressor section for evidence of ice formation on forward stator and rotor blades. If accumulation of ice is present or suspected, check engine for freedom of rotation.

CAUTION

Any attempt to start engine, if engine is not free, will cause starter failure. External heat must be applied to forward section of engine to remove ice. The engine should be started as soon as possible after heating, to prevent moisture from refreezing.



Warning

HAVE CHOCKS FIRMLY ANCHORED AND AIRPLANE SECURELY TIED DOWN BEFORE ENGINE RUN-UP, AS THRUST IS HIGHER THAN NORMAL AT LOW OUTSIDE AIR TEMPERATURES.

F-86A-1-0-6

ON ENTERING AIRPLANE.

On entering airplane, make sure that the canopy can be fully closed.

STARTING ENGINE.

When starting at very low temperatures, best results can be achieved by first obtaining 6% to 8% cranking

rpm, then advancing throttle to IDLE position until ignition occurs, and immediately retarding throttle to a near-closed position to maintain exhaust temperature below the limit.

CAUTION

During cold-weather operation, avoid engine speeds above 70% rpm until oil pressure stabilizes at idle rpm.

WARM-UP AND GROUND CHECK.

WARNING

Because of low outside air temperatures, the thrust developed at all engine speeds is noticeably greater than normal. The airplane should be tied down securely and wheels chocked before attempting a full-power run-up.

1. Turn on cabin heat and windshield defrosting systems, as required, immediately after engine start.

2. Check surface controls, speed brakes, trim tabs, and adjustable horizontal stabilizer for proper operation.

Note

Cycle controls four to six times, noting hydraulic pressure for normal indications.

3. Check wing flap operation. Sluggish operation can usually be corrected by cycling flaps three or four times.

CAUTION

Make sure all instruments are warmed up sufficiently to ensure normal operation. Check flight instruments for sluggishness during taxiing.

TAXIING.

1. Avoid taxiing in deep snow, as taxiing and steering are extremely difficult and frozen brakes may result.

2. Use only essential electrical equipment to preserve battery life while taxiing at low engine speeds.

3. Increase taxi interval at subfreezing temperatures to ensure safe stopping distance and to prevent icing of airplane surfaces by melted snow and ice in the jet blast of a preceding airplane.

4. Minimize taxi time to conserve fuel and reduce amount of ice fog generated by the engine.

BEFORE TAKE-OFF.

1. Pitot heater switch—ON.

WARNING

Warm-up time for the pitot heater is approximately one minute at 32°F. Allow enough heating time if taking off into freezing rain or other visible moisture with surface temperature at or near freezing.

2. Make normal full-power check if on a dry, clear runway; however, if take-off is started on ice or snow, make check during the initial part of the take-off roll. Do not attempt to hold the brakes while the engine is accelerating and the take-off roll is beginning, as you may lose control of the airplane if one wheel begins to slide ahead of the other.

TAKE-OFF.

At low temperatures, excessive exhaust temperatures may result at high engine speeds and zero or low ram-air pressures. Therefore, exhaust temperatures may be a limiting factor for take-off rpm during the first part of the take-off roll. Any reduction in engine speed necessary to reduce exhaust temperature to permissible limit will be more than compensated for by the thrust augmentation resulting from increased air density; e.g., 100 percent rated thrust is reached at 94% rpm at −18°C (0°F) and at 88% rpm at −54°C (−65°F). See figure A-3 for take-off distance data.

Note

This airplane may be safely taken off with light frost on the lifting surfaces.

AFTER TAKE-OFF.

1. After take-off from a wet-snow-covered or slush-covered field, operate landing gear and flaps through several complete cycles to preclude their freezing in retracted position. (Expect considerably slower operation of the landing gear and wing flaps in cold weather, due to stiffening of all lubricants.)

CAUTION

Do not exceed gear-and-flaps-down limit speed during the operation.

2. Turn on gun heaters immediately after take-off.

3. Check instruments. Many flight instruments may be unreliable at extremely low temperatures.

DURING FLIGHT.

1. Use cockpit heat and defroster as required.
2. Operate fuel filter deicing system as required.

Note

The filter deicer warning light sometimes flickers under certain engine operating conditions, such as rapid acceleration. Therefore, since the deicing alcohol supply will last for only one minute of deicing operation, make sure the light burns steadily before depressing the deicer button.

DESCENT.

Note

The windshield and canopy defrosting system provides sufficient heating of the transparent surfaces to effectively eliminate frost or fog during descent.

Check engine operating temperatures during descents and in traffic pattern, because low temperatures, caused by frequent temperature inversions, are common at low altitudes.

APPROACH.

WARNING

Heavy ice accumulation will greatly increase stalling speed; therefore, extreme caution must be exercised when landing under such conditions.

1. Make normal pattern and landing, but allow for flatter glide due to thrust augmentation caused by extremely low outside air temperatures.

2. Turn off all unnecessary electrical equipment at least one minute before final approach, to reduce battery load when rpm is lowered and generator cuts out.

3. Pump brake pedals several times.*

AFTER LANDING.

1. If snow and ice tires are installed on airplane, apply brakes smoothly and steadily to the point just short of locking the wheels; then release and apply brakes intermittently and carefully to keep treads from filling and glazing over.

CAUTION

Do not use brakes above 100 knots IAS.

Note

- The best technique for obtaining minimum ground roll on slippery runways is to maintain a high angle of attack for as long as possible, keep flaps full down, and apply brakes only after nose wheel touches the runway.
- Opening the canopy will help in decreasing the roll, especially with a landing speed of 120 knots.

2. If conditions permit, taxi with sufficient rpm to cut in generator, as low temperatures decrease battery output.

3. Pitot heater switch—OFF.

BEFORE LEAVING AIRPLANE.

1. Leave canopy partly open if it is not snowing or raining, to allow circulation within the cockpit, to prevent canopy cracking from differential contraction, and to decrease windshield and canopy defrosting.

2. Leave airplane parked with full fuel tanks, whenever possible. Every effort should be made during servicing to prevent moisture from entering the fuel system.

3. Check that battery is removed when airplane is parker outside for more than 4 hours at temperatures below −29°C (−20°F).

*F-86A-5 Airplane AF49-1007 and all later airplanes

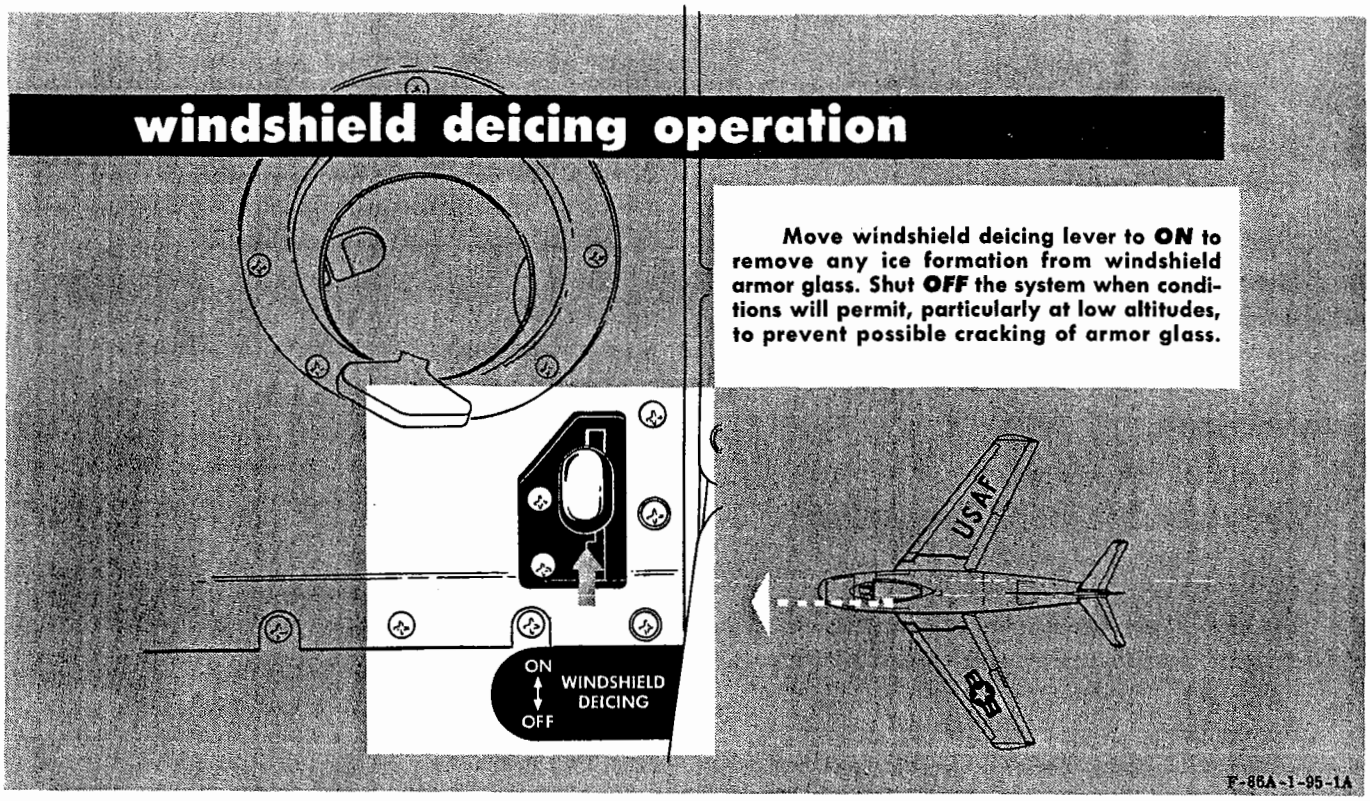


Figure 9-5

HOT-WEATHER AND DESERT PROCEDURES

In general, hot-weather and desert procedures differ from normal procedures mainly in that additional precautions must be taken to protect the airplane from damage due to high temperatures and dust. Particular care should be taken to prevent the entrance of sand into the various airplane components and systems (engine, fuel system, pitot-static system, etc). All filters should be checked more often than under normal conditions. Units which have plastic and rubber parts should be protected as much as possible from excessive temperatures. Tires should be checked frequently for signs of blistering, etc.

BEFORE TAKE-OFF.

The emergency fuel regulator is set to give 99% rpm on a 100°F day and does not compensate for temperature changes. If the emergency fuel system is turned on at maximum rpm when temperature is above 100°F, the engine will overspeed. The following procedure is recommended for testing the emergency fuel system at excessively high outside air temperatures before take-off.

1. Run up engine to 80% rpm.

2. Move emergency fuel switch to ON and advance throttle until 100% rpm is obtained. If 100% rpm is

obtained at less than the full open position, and the main fuel regulator fails during take-off, necessitating a changeover to the emergency fuel system (emergency fuel switch ON), be prepared to retard throttle immediately to prevent engine overspeeding. Take-off will normally be made on the main fuel system (emergency fuel switch OFF), and the throttle will be full OPEN.

Note

- If airplane is based at a field where normal temperature range is above 100°F, the emergency regulator should be reset to give a maximum of 99% rpm at the maximum outside air temperature.
- At high outside air temperatures, it may be necessary to have exhaust nozzle tabs reset to avoid excessive exhaust temperatures at maximum rpm.

TAKE-OFF.

Note

Do not attempt a take-off in a sand or dust storm. Park airplane cross-wind and shut down engine.

The increase in required take-off distances commonly associated with hot-weather operation of airplanes with reciprocating engines is even greater for jet airplanes. (See figure A-3.)

AFTER TAKE-OFF.

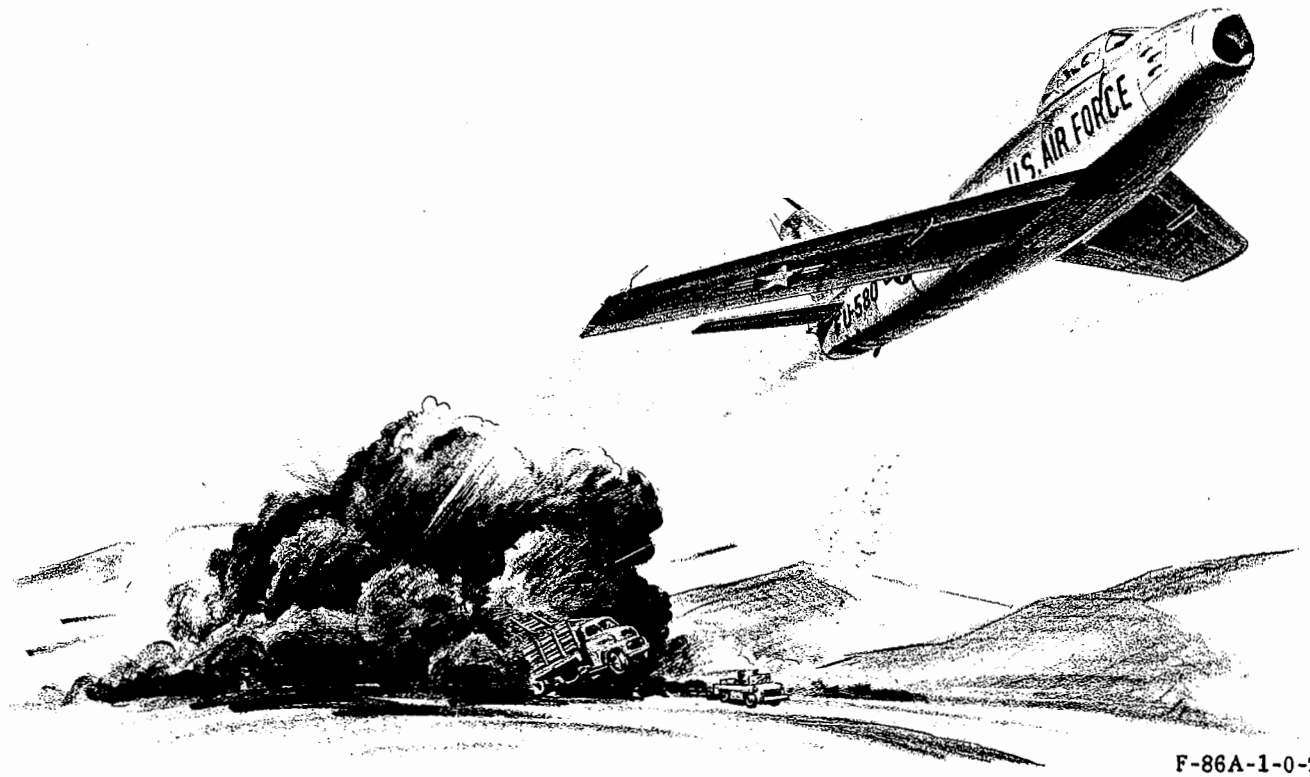
Follow normal flight procedures, being particularly careful to maintain a power setting that will keep the exhaust temperature within its prescribed limits.

APPROACH AND LANDING.

1. Maintain recommended indicated approach and touchdown speeds. Because of high outside air temperatures, speed relative to the ground will be higher than normal.
2. Expect a longer landing roll due to higher ground speed at touchdown.

BEFORE LEAVING AIRPLANE.

1. Leave canopy slightly open if sand or dust is not blowing, to permit air circulation within cockpit.
2. Make sure that protective covers are installed on pitot head, canopy, and intake and exhaust ducts.



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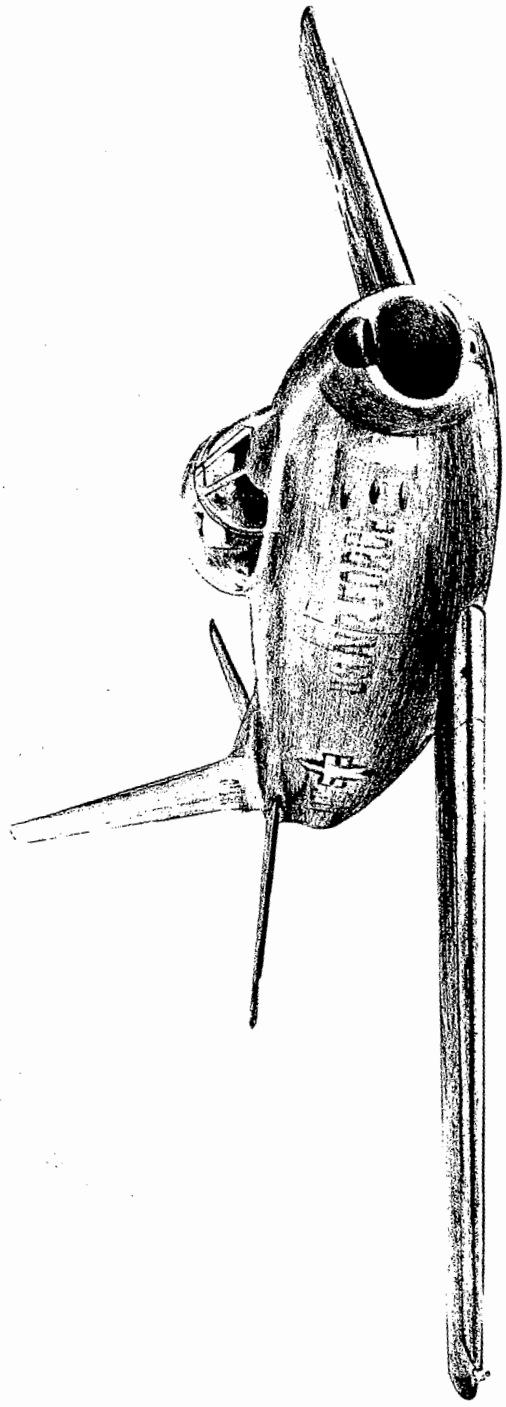

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APPENDIX I

PERFORMANCE DATA

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INTRODUCTION.

The Appendix is for the purpose of facilitating preflight and in-flight planning. This information has been prepared from actual flight tests and will enable you to use your airplane to the point of maximum efficiency. All charts are based on NACA Standard Day conditions unless otherwise indicated; however, the flight operation instruction charts are applicable for nonstandard atmosphere if recommended CAS values are maintained. Fuel quantities are given in pounds so that the charts can be used for all grades of fuel.

AIRSPEED INSTALLATION CORRECTION.

Airspeed installation error is very minor and may be considered negligible with the airplane in any configuration. Therefore, calibrated airspeed (CAS) is considered equal to indicated airspeed (IAS).

COMPRESSIBILTY CORRECTION.

A compressibility correction table (figure A-1) is provided for computing equivalent airspeed (EAS) from calibrated airspeed (CAS). For direct conversion of calibrated airspeed to true airspeed on an NACA Standard Day, an airspeed conversion graph (figure A-2) is provided.

EXAMPLE—USE OF CORRECTION TABLE.

An airplane is flying at 20,000 feet, with a true free air temperature of −29°C at an indicated airspeed of 393 knots. The value of 393 knots is also the calibrated airspeed (CAS), because installation error is negligible in any configuration. Use CAS and true air temperature with a Type D-4 or Type G-1 airspeed computer to determine true airspeed (TAS) of 512 knots. When the dead-reckoning computer (AN5835-1) is used, the CAS (393 knots) must be corrected for compressibility error. The compressibility correction table shows that 17 knots must

compressibility correction

SUBTRACT CORRECTION from calibrated airspeed to obtain equivalent airspeed.

PRESSURE ALTITUDE	CALIBRATED AIRSPEED — KNOTS									
	150	200	250	300	350	400	450	500	550	600
5,000	0	0	1	2	2	3	5	6	8	10
10,000	0	1	2	3	5	7	10	13	17	21
15,000	1	2	3	6	8	12	16	21	27	
20,000	1	3	5	8	12	17	23	31		
25,000	2	4	7	11	17	24	32			
30,000	2	5	9	15	23	32				
35,000	3	7	12	20	29					
40,000	4	9	16	25						

Figure A-2

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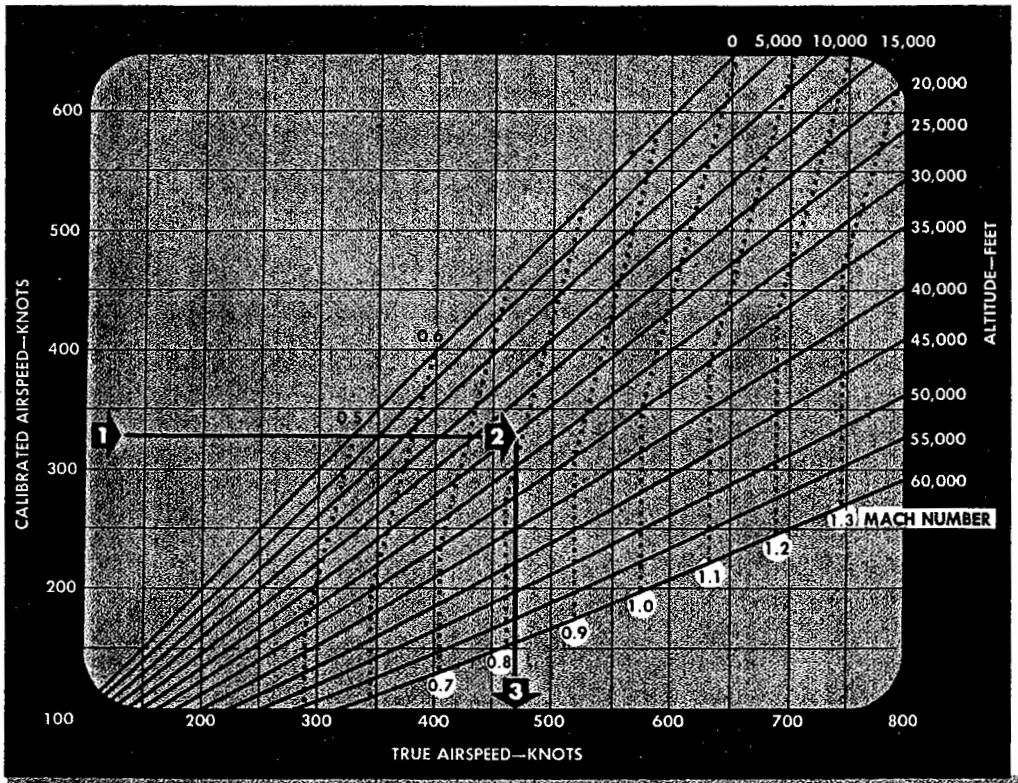
Figure A-1. Compressibility Correction

airspeed conversion



TO USE CHART:

Enter with CAS 1; move horizontally to altitude 2 to find true Mach number. Drop vertically to find TAS 3.

TAS values from the graph are correct only on an NACA standard day. Otherwise, TAS values will tend to be conservative when true free air temperature is higher than standard, and optimistic when true free air temperature is lower than standard.

EXAMPLE:

On an NACA standard day, 330 knots CAS at 25,000 feet is .78 Mach number and 470 knots TAS.

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Figure A-2. Airspeed Conversion

be subtracted from CAS (393 knots) to obtain equivalent airspeed (376 knots). Use the dead-reckoning computer and the values of 376 knots and −29°C to determine the true airspeed of 512 knots.

Note

Indicated airspeed (IAS) is the airspeed indicator reading. Calibrated airspeed (CAS) is indicated airspeed corrected for installation error. Equivalent airspeed (EAS) is calibrated airspeed corrected for compressibility error. True airspeed (TAS) is equivalent airspeed corrected for atmospheric density.

TAKE-OFF DISTANCES.

Ground-run distances and total distances to clear a 50-foot obstacle are tabulated in figure A-3. The distances shown are for an average take-off on a dry, hard-surface runway, with zero wind and a 30-knot wind, and with varying degrees of temperature. The charted distances are based on actual flight test data, assuming the use of normal take-off technique.

CLIMB.

From the Normal Power climb and Military Power climb charts (figures A-4 and A-5) can be determined the best climb speed, fuel consumed, time to climb, distance covered, and rate of climb for either Maximum Continuous Power (Normal Rated Power) or Military Power. A fuel allowance for warm-up and take-off is listed at sea level. Fuel requirements at other altitudes include this allowance plus the fuel needed to climb from sea level. Fuel required for an in-flight climb from one altitude to another is the difference of the tabulated fuel required to climb to each altitude from sea level. Time and distance covered during an in-flight climb can be obtained in the same manner.

DESCENT.

The descent chart (figure A-6) is based on airspeeds corresponding to approximately Mach .5 for descents with speed brakes in and approximately Mach .6 to Mach .8 with speed brakes out. To minimize fuel consumption, the lowest allowable fuel pressure is used.

LANDING DISTANCES.

Figure A-7 shows landing distances, both ground roll and total distance to clear 50-foot obstacle, for landings with speed brakes out. A percentage increase noted on the chart may be applied to estimate the additional distance required for landings with speed brakes in. A dry, hard-surface runway and no wind are the only landing conditions considered. The tabulated distances are 125 percent of the distances obtainable in high-performance landings.

COMBAT ALLOWANCE.

The combat allowance chart (figure A-8) presents fuel flow at Military Power and at Maximum Continuous Power (Normal Rated Power).

MAXIMUM ENDURANCE.

The maximum endurance chart (figure A-9 gives the best rpm and airspeed to use in obtaining the lowest possible fuel consumption in level flight.

MAXIMUM CONTINUOUS POWER.

Airspeeds and fuel flow rates in level flight at Maximum Continuous Power (Normal Rated Power) are shown in the Maximum Continuous Power chart (figure A-10) for different gross weights and altitudes.

MAXIMUM RANGE SUMMARY.

The maximum range summary chart (figure A-11) summarizes the cruising operating procedures for no-wind condition entered on the flight operation instruction charts.

FLIGHT OPERATION INSTRUCTION CHARTS.

The flight operation instruction charts (figures A-12 through A-17) are provided to facilitate flight planning. They show the range of the airplane at maximum-range airspeeds and the procedure required to obtain this range. The charts contain columns for each 5000-foot increase in altitude up to the maximum altitude at which 93% rpm operation is possible. On the line opposite available fuel in the upper half of the chart, ranges are shown for each initial altitude. In general, two range values are quoted for each altitude and fuel quantity. One is for continued flight at the initial altitude, and the other is for the maximum range obtainable by climbing to a high altitude. The charted ranges do not include fuel consumed and distance covered during warm-up, take-off, and initial climb at the start of a flight. However, fuel used and distance covered during let-down or during in-flight climb to an optimum altitude are taken into account. The lower half of each chart presents operating procedure to obtain the ranges quoted in the upper half. When altitude is

changed, operating instructions in the column according to the new altitude must be used if the ranges listed are to be obtained. Under different wind conditions, ranges (in ground miles) are varied by the effect of wind on ground speed. Letdown distances are affected for the same reason. Recommended CAS also may change in order to maintain the most favorable ground miles per pound. To facilitate range computation under wind conditions, the operating procedure in the lower half of each chart contains instructions for various winds at each altitude listed. Ground miles in a wind are obtained by multiplying chart air miles by the range factor found opposite the effective wind at the cruising altitude. Thus, range factors may be used to determine the best altitude for cruising when there is a known wind difference at different altitudes. Although a wind may be from any direction with respect to the airplane course, it may be expressed as an effective wind. An effective wind has the same effect on the airplane ground speed as if it were a straight ahead wind or tail wind. In other words, the wind component in the direction of the airplane heading is the effective wind. For example, a 100-knot wind at 30 degrees to the course is an effective head wind of approximately 85 knots. If the true airspeed is 485 knots, the true ground speed is approximately 400 knots. The approximate rpm values quoted on any one chart are based on the gross weight equal to the high limit of the chart weight band. If the recommended CAS values are maintained, the rpm values will decrease slightly as the gross weight decreases. No allowances are made for navigational errors, combat, formation flight, landing, or other contingencies. Such allowances must be made as required.

USE OF CHARTS.

PREFLIGHT RANGE PLANNING.

Select applicable flight operation instruction chart. Determine amount of fuel available for flight planning. Available fuel is equal to the total amount in the airplane before the engine is started, minus the amount needed for warm-up, taxi, take-off, initial climb, and necessary reserves. Select a figure in the fuel column equal to, or less than, the amount available for flight planning. Interpolate if desired. To determine maximum range at a given altitude, move horizontally right or left to the desired altitude column. Multiply the range value thus obtained by the correct range factor, and add the distance covered in initial climb to obtain total range with a given wind at altitude. Fly according to the instructions in the lower half of the chart. To fly a given distance, determine range factors for the effective winds and altitudes to be considered. From the desired distance, subtract the miles covered in climb. Divide the resultant figure by the range factor to obtain miles to be covered in cruise and descent. Select a figure in fuel column equal to, or less than, the amount available for flight; then move horizontally right or left to a range figure which exceeds the calculated air distance to be covered in cruise and descent. Fly according to the instructions for the altitude so obtained. If altitude, wind, or external load does not remain reasonably constant, break the flight up into several sections and plan each section separately.

IN-FLIGHT RANGE PLANNING.

To use the charts in flight, determine altitude, available fuel, and effective wind. Available fuel is equal to fuel on board minus necessary reserves. Enter the appropriate flight operation instruction chart at a fuel quantity equal to or less than the available fuel. Move horizontally right or left to the applicable altitude column. From the ranges and wind factors listed, determine the altitude at which the flight will be continued. For continued cruising at the present altitude, refer to the instructions directly below. When changing charts, refer to cruising instructions on the new chart at the altitude of flight. To obtain the range shown at optimum altitude when flying at a given altitude, climb immediately according to the recommended climb procedure. For cruising instructions at the new altitude, refer to the lower half of the chart in the column under the new altitude. When changing charts, refer to cruising instructions on the new chart at the new altitude of flight.

Note

For absolute maximum range, climb (using Military Power) until rate of climb is 500 fpm; then hold Mach .75 at 95% rpm and allow airplane to seek its own altitude.

SAMPLE PROBLEMS BASED ON JP-4 FUEL.

Problem 1.

To illustrate use of the charts for planning a flight, suppose an airplane must be ferried 500 nautical miles. For unexpected difficulties, a general reserve of 900 pounds (140 gallons JP-4 fuel) is considered necessary. From the flight operation instruction charts, it is apparent that drop tanks must be carried; however, it is desired to keep the tanks. Use of 120-gallon drop tanks will give a maximum fuel capacity of 670 gallons × 6.5 (pounds per gallon JP-4 fuel), or 4350 pounds. The initial, known conditions are as follows:

Required range.....500 nautical miles

Effective winds.....40-knot head wind at 30,000 feet and below

80-knot head wind at 35,000 feet

From the Military Power climb chart (figure A-5) and the flight operation instruction chart for 120-gallon drop tanks (figure A-13), the following data are obtained:

a. Cruising altitude, feet	20,000	25,000	35,000
b. Fuel capacity, pounds	4,350	4,350	4,350
c. Reserve fuel, pounds	900	900	900
d. Fuel used to altitude, pounds (climb at 100% rpm)	640	750	1,020
e. Available cruise fuel, pounds (b—c—d)	2,810	2,700	2,430
f. Distance covered in initial climb, nautical miles	30	40	80
g. Cruise and descent air distance, nautical miles interpolate as necessary)	505	530	555
h. Range, zero wind (f+g)	535	570	635
i. Range factor	0.85	0.9	0.8
j. Total range in nautical ground miles (h × i)	455	510	505

Therefore, the flight can be made at 25,000 feet or higher with no change in range due to the variable winds assumed. The cruise airspeed at 25,000 feet for a 40-knot head wind would be 290 knots CAS, and the letdown would begin 15 nautical miles from destination.

Problem 2.

Suppose that during the descent at the end of this theoretical flight, the pilot has reached 5000 feet when he learns that the field is closed and he must use an alternate airport some 100 nautical miles farther. Fuel remaining is only the 900 pounds originally planned for general reserve. Reference to the flight operation instruction chart for 120-gallon drop tanks (figure A-14) shows that with the existing head wind and with the empty tanks still on, available range with 1000 pounds of fuel is approximately $130 \times 0.85 = 110$ nautical miles at 5000 feet (120 nautical miles at optimum altitude, 30,000 feet), with no reserve for landing. It is evident, therefore, that the empty drop tanks should be jettisoned immediately. Reference to the flight operation instruction chart for no external load (figure A-12) shows that even without the drop tanks, only $140 \times 0.85 = 120$ nautical miles can be covered at 5000 feet with 1000 pounds of fuel and a 40-knot head wind. However, by climbing immediately to 35,000 feet (optimum altitude) at 100% rpm, a range of 200 miles with zero wind or $200 \times 0.8 = 160$ nautical miles with an 80-knot head wind can be attained. At 35,000 feet, the cruise conditions will be 280 knots CAS, 1600 pounds per hour fuel flow, 395 knots ground speed, and letdown begun 20 miles from destination. Since the required range is only 100 nautical miles, the difference between 160 and 100 miles is the reserve which, expressed in time, is 9 minutes (60 miles ÷ 395 knots ground speed = 0.15 hour or 9 minutes). The corresponding fuel reserve is 240 pounds (0.15 hour × 1600 pounds per hour = 240 pounds). However, this was figured for 1000 pounds of fuel at 5000 feet and only 900 pounds was available, so the landing reserve will be 100 pounds less, or 140 pounds. In other words, judging from this sample problem, when you have to get all you can out of the fuel available, climb immediately to optimum altitude. Empty drop tanks may be jettisoned if necessary. When operating on a limited fuel reserve, it is best to determine the conditions at the intended destination before descending from altitude.

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WADC Form 241G (11 Jun 51)

TAKE-OFF DISTANCES

(FEET)

HARD-SURFACE RUNWAY

MODEL: F-86A

ENGINE (S): (1) J47-GE-7 OR -13

CONFIGURATION AND GROSS WEIGHT	PRESSURE ALTITUDE	−5 DEGREES CENTIGRADE				+15 DEGREES CENTIGRADE				+35 DEGREES CENTIGRADE				+55 DEGREES CENTIGRADE			
		ZERO WIND		30-KNOT WIND		ZERO WIND		30-KNOT WIND		ZERO WIND		30-KNOT WIND		ZERO WIND		30-KNOT WIND	
		GROUND RUN	TO CLEAR 50 FT OBST.	GROUND RUN	TO CLEAR 50 FT OBST.	GROUND RUN	TO CLEAR 50 FT OBST.	GROUND RUN	TO CLEAR 50 FT OBST.	GROUND RUN	TO CLEAR 50 FT OBST.	GROUND RUN	TO CLEAR 50 FT OBST.	GROUND RUN	TO CLEAR 50 FT OBST.	GROUND RUN	TO CLEAR 50 FT OBST.
16 ROCKETS 16,100 LB	SL	2300	3700	1300	2300	2900	4400	1700	2800	3800	5600	2300	3600	5000	7500	3100	4900
	1000	2500	3900	1400	2500	3100	4700	1900	3100	4100	6000	2500	3900	5400	8300	3400	5400
	2000	2700	4200	1600	2700	3400	5100	2100	3300	4500	6600	2800	4300	6000	9300	3800	6100
	3000	2900	4500	1800	2900	3700	5500	2300	3600	4900	7200	3100	4800	6600	10600	4200	7000
	4000	3200	4900	2000	3200	4100	6000	2500	3900	5400	7900	3400	5400	7200	12400	4600	8200
	5000	3500	5300	2200	3500	4500	6500	2800	4300	6000	8800	3900	6000	----	-----	----	----
TWO 120 GAL DROP TANKS 15,800 LB	SL	2100	3500	1200	2200	2800	4300	1600	2700	3600	5300	2200	3400	4800	7100	3000	4600
	1000	2300	3800	1300	2300	3000	4600	1800	2900	3900	5700	2400	3700	5300	7800	3300	5100
	2000	2500	4100	1500	2500	3300	4900	2000	3200	4200	6200	2600	4100	5800	8500	3600	5700
	3000	2800	4400	1700	2800	3600	5300	2200	3500	4600	6800	2900	4500	6300	9400	4000	6500
	4000	3100	4700	1800	3000	3900	5700	2400	3800	5100	7400	3200	5000	6900	10400	4400	7600
	5000	3400	5000	2000	3200	4200	6200	2600	4100	5600	8200	3600	5500	7600	12900	4900	9100
CLEAN 14,000 LB	SL	1600	2700	900	1700	2100	3400	1200	2100	2700	4200	1600	2600	3600	5400	2100	3400
	1000	1700	2900	1000	1800	2300	3600	1300	2200	2900	4500	1700	2800	3900	5800	2300	3700
	2000	1900	3100	1100	1900	2500	3900	1400	2400	3200	4800	1900	3100	4200	6200	2500	4100
	3000	2100	3300	1200	2100	2700	4200	1600	2600	3500	5200	2100	3400	4600	6700	2800	4400
	4000	2300	3600	1300	2300	3000	4500	1700	2800	3800	5600	2300	3700	5000	7300	3100	4900
	5000	2500	3900	1400	2500	3300	4900	1900	3100	4200	6100	2500	4000	5500	8200	3500	5600
	SL																
	1000																
	2000																
	3000																
	4000																
	5000																

REMARKS:
1. Take-off distances are aircraft requirements under normal service conditions.
2. Take-off with full flaps, slats unlocked, and 100% rpm.

DATA AS OF 3-17-52
BASED ON FLIGHT TEST, NA REPORT 49-580(7-6-49)

161-93-1394A

FUEL GRADE: JP-4 or Gasoline (MIL-F-5572)

Figure A-3. Take-off Distances

WADC Form 241J (11 Jun 51)

NORMAL POWER CLIMB CHART

STANDARD DAY

93% RPM

MODEL: F-86A ENGINE(S): (1) J47-GE-7 OR -13

CONFIGURATION: TWO 206-1/2 GAL DROP TANKS

GROSS WEIGHT: 16,800 POUNDS

APPROXIMATE				CAS (KNOTS)	PRESSURE ALTITUDE (FEET)	CAS (KNOTS)	APPROXIMATE			
RATE OF CLIMB	FROM SEA LEVEL						FROM SEA LEVEL			RATE OF CLIMB
	DISTANCE	TIME	FUEL				FUEL	TIME	DISTANCE	
2600	0	0	200(5)	300	SEA LEVEL	295	200(5)	0	0	3300
2200	10	2.0	390	285	5,000	280	340	1.5	5	2800
1700	20	4.5	570	270	10,000	270	490	3.5	15	2300
1250	40	8.0	800	255	15,000	255	650	6.0	30	1800
800	70	13.0	1080	240	20,000	240	840	9.0	45	1300
400	150	21.0	1500	225	25,000	225	1080	14.0	70	850
					30,000	215	1450	22.0	115	400
					35,000					
					40,000					
					45,000					

CONFIGURATION: TWO 120 GAL DROP TANKS

GROSS WEIGHT: 15,600 POUNDS

APPROXIMATE				CAS (KNOTS)	PRESSURE ALTITUDE (FEET)	CAS (KNOTS)	APPROXIMATE			
RATE OF CLIMB	FROM SEA LEVEL						FROM SEA LEVEL			RATE OF CLIMB
	DISTANCE	TIME	FUEL				FUEL	TIME	DISTANCE	
3150	0	0	200(5)	330	SEA LEVEL	325	200(5)	0	0	3600
2700	10	2.0	350	310	5,000	305	330	1.5	5	3100
2200	20	4.0	500	295	10,000	290	460	3.5	15	2600
1750	35	6.5	670	275	15,000	275	600	5.5	30	2100
1300	50	9.5	860	260	20,000	260	760	8.0	45	1600
850	80	14.0	1100	245	25,000	245	950	12.0	65	1150
400	125	22.0	1450	225	30,000	225	1200	17.0	95	700
					35,000	210	1600	28.0	160	250
					40,000					
					45,000					

CONFIGURATION: TWO 120 GAL DROP TANKS

GROSS WEIGHT: 14,000 POUNDS

REMARKS:
1. Divide pounds by 6.5 to obtain gallons of MIL-F-5624A, JP-4 fuel.
2. Divide pounds by 6.0 to obtain gallons of MIL-F-5572 fuel (gasoline).
3. Warm-up and take-off allowance.
4. Multiply nautical units by 1.15 to obtain statute units.

LEGEND

RATE OF CLIMB - FEET PER MINUTE
DISTANCE - NAUTICAL MILES
TIME - MINUTES
FUEL - POUNDS
CAS - CALIBRATED AIRSPEED - KNOTS

DATA AS OF 9-1-49
BASED ON FLIGHT TEST

FUEL GRADE: Any fuel listed in remarks

161-93-1395A

Figure A-4. Normal Power Climb (Sheet 1 of 2)

WADC Form 241J (11 Jun 51)

NORMAL POWER CLIMB CHART

STANDARD DAY
93% RPM

MODEL: F-86A

ENGINE(S): (1) J47-GE-7 OR -13

CONFIGURATION: 16 ROCKETS

GROSS WEIGHT: 16,100 POUNDS

APPROXIMATE FROM SEA LEVEL RATE OF CLIMB	DISTANCE	TIME	FUEL	CAS (KNOTS)	PRESSURE ALTITUDE (FEET)	CAS (KNOTS)	APPROXIMATE FROM SEA LEVEL FUEL	TIME	DISTANCE	RATE OF CLIMB
2500	0	0	200 (5)	280	SEA LEVEL	355	200 (5)	0	0	4300
2100	10	2.0	390	265	5,000	340	310	1.5	5	3700
1600	25	5.0	590	250	10,000	325	420	2.5	15	3200
1100	40	8.5	830	240	15,000	310	530	4.5	25	2600
700	65	14.0	1150	225	20,000	295	660	6.5	40	2100
300	120	24.0	1650	215	25,000	280	800	9.0	65	1600
					30,000	265	960	13.0	85	1200
					35,000	245	1170	18.0	120	700
					40,000	225	1550	31.0	210	150
					45,000					

CONFIGURATION:

GROSS WEIGHT:

APPROXIMATE FROM SEA LEVEL RATE OF CLIMB	DISTANCE	TIME	FUEL	CAS (KNOTS)	PRESSURE ALTITUDE (FEET)	CAS (KNOTS)	APPROXIMATE FROM SEA LEVEL FUEL	TIME	DISTANCE	RATE OF CLIMB
					SEA LEVEL					
					5,000					
					10,000					
					15,000					
					20,000					
					25,000					
					30,000					
					35,000					
					40,000					
					45,000					

CONFIGURATION:

GROSS WEIGHT:

REMARKS:
1. Divide pounds by 6.5 to obtain gallons of MIL-F-5624A, JP-4 fuel.
2. Divide pounds by 6.0 to obtain gallons of MIL-F-5572 fuel (gasoline).
3. Warm-up and take-off allowance.
4. Multiply nautical units by 1.15 to obtain statute units.

LEGEND
RATE OF CLIMB - FEET PER MINUTE
DISTANCE - NAUTICAL MILES
TIME - MINUTES
FUEL - POUNDS
CAS - CALIBRATED AIRSPEED - KNOTS

DATA AS OF 9-1-49
BASED ON FLIGHT TEST

FUEL GRADE: Any fuel listed in remarks

161-93-1396A

Figure A-4. Normal Power Climb (Sheet 2 of 2)

WADC Form 241J (11 Jun 51)

MILITARY POWER CLIMB CHART

STANDARD DAY

100% RPM

MODEL: F-86A

ENGINE(S): (1) J47-GE-7 OR -13

CONFIGURATION: TWO 206-1/2 GAL DROP TANKS

GROSS WEIGHT: 16,800 POUNDS

APPROXIMATE				CAS (KNOTS)	PRESSURE ALTITUDE (FEET)	CAS (KNOTS)	APPROXIMATE			
RATE OF CLIMB	FROM SEA LEVEL						FROM SEA LEVEL			RATE OF CLIMB
	DISTANCE	TIME	FUEL				FUEL	TIME	DISTANCE	
4600	0	0	200 (5)	360	SEA LEVEL	355	200 (5)	0	0	5700
4000	5	1.5	340	335	5,000	330	320	1.0	5	5000
3400	15	2.5	490	315	10,000	310	430	2.0	10	4300
2800	25	4.0	640	295	15,000	290	550	3.5	15	3700
2300	35	6.0	790	275	20,000	275	670	5.0	25	3000
1700	50	9.0	960	255	25,000	255	790	7.0	40	2400
1100	70	12.0	1170	235	30,000	235	930	9.0	55	1700
500	110	19.0	1460	220	35,000	220	1100	13.0	75	1000
					40,000	205	1450	22.0	135	200
					45,000					

CONFIGURATION: TWO 120 GAL DROP TANKS

GROSS WEIGHT: 15,600 POUNDS

APPROXIMATE				CAS (KNOTS)	PRESSURE ALTITUDE (FEET)	CAS (KNOTS)	APPROXIMATE			
RATE OF CLIMB	FROM SEA LEVEL						FROM SEA LEVEL			RATE OF CLIMB
	DISTANCE	TIME	FUEL				FUEL	TIME	DISTANCE	
5700	0	0	200 (5)	400	SEA LEVEL	400	200 (5)	0	0	6500
5100	5	1.0	310	375	5,000	370	300	1.0	5	5800
4400	10	2.0	420	350	10,000	350	400	2.0	10	5100
3800	20	3.5	530	330	15,000	325	500	3.0	15	4400
3200	30	4.5	640	310	20,000	310	590	4.0	25	3700
2500	40	6.5	750	290	25,000	290	680	5.5	35	3000
1900	55	8.5	870	275	30,000	270	790	7.5	50	2200
1200	80	12.0	1020	255	35,000	250	900	10.0	65	1600
350	130	19.0	1250	230	40,000	230	1050	15.0	100	700
					45,000					

CONFIGURATION: TWO 206-1/2 GAL DROP TANKS

GROSS WEIGHT: 14,000 POUNDS

CONFIGURATION: TWO 120 GAL DROP TANKS

GROSS WEIGHT: 14,000 POUNDS

REMARKS:

1. Divide pounds by 6.5 to obtain gallons of MIL-F-5624A, JP-4 fuel.
2. Divide pounds by 6.0 to obtain gallons of MIL-F-5572 fuel (gasoline).
3. Warm-up and take-off allowance.
4. Multiply nautical units by 1.15 to obtain statute units.

LEGEND

RATE OF CLIMB - FEET PER MINUTE
DISTANCE - NAUTICAL MILES
TIME - MINUTES
FUEL - POUNDS
CAS - CALIBRATED AIRSPEED - KNOTS

DATA AS OF 9-1-49
BASED ON FLIGHT TEST

FUEL GRADE: Any fuel listed in remarks

161-93-1397A

Figure A-5. Military Power Climb (Sheet 1 of 2)

WADC Form 241J (11 Jun 51)

MILITARY POWER CLIMB CHART

STANDARD DAY

100% RPM

MODEL: F-86A

ENGINE(S): (1) J47-GE-7 or -13

CONFIGURATION: 16 ROCKETS

GROSS WEIGHT: 16,100 POUNDS

CONFIGURATION: CLEAN

GROSS WEIGHT: 14,000 POUNDS

APPROXIMATE FROM SEA LEVEL				CAS (KNOTS)	PRESSURE ALTITUDE (FEET)	CAS (KNOTS)	APPROXIMATE FROM SEA LEVEL			
RATE OF CLIMB	DISTANCE	TIME	FUEL				FUEL	TIME	DISTANCE	RATE OF CLIMB
4500	0	0	200(5)	330	SEA LEVEL	430	200(5)	0	0	7500
3900	5	1.5	350	310	5,000	410	290	1.0	5	6600
3300	15	2.5	500	295	10,000	390	380	1.5	10	5800
2700	25	4.5	650	275	15,000	365	470	2.5	15	5000
2100	35	6.5	810	255	20,000	340	560	3.5	25	4200
1600	50	9.0	1000	240	25,000	320	650	5.0	35	3500
1000	75	13.0	1220	220	30,000	295	740	6.5	45	2700
400	115	21.0	1580	205	35,000	270	840	9.0	65	2000
					40,000	240	960	12.0	90	1000
					45,000					

CONFIGURATION:

GROSS WEIGHT:

CONFIGURATION:

GROSS WEIGHT:

APPROXIMATE FROM SEA LEVEL				CAS (KNOTS)	PRESSURE ALTITUDE (FEET)	CAS (KNOTS)	APPROXIMATE FROM SEA LEVEL			
RATE OF CLIMB	DISTANCE	TIME	FUEL				FUEL	TIME	DISTANCE	RATE OF CLIMB
					SEA LEVEL					
					5,000					
					10,000					
					15,000					
					20,000					
					25,000					
					30,000					
					35,000					
					40,000					
					45,000					

REMARKS:

1. Divide pounds by 6.5 to obtain gallons of MIL-F-5624A, JP-4 fuel.
2. Divide pounds by 6.0 to obtain gallons of MIL-F-5572 fuel (gasoline).
3. Warm-up and take-off allowance.
4. Multiply nautical units by 1.15 to obtain statute units.

LEGEND

RATE OF CLIMB - FEET PER MINUTE
DISTANCE - NAUTICAL MILES
TIME - MINUTES
FUEL - POUNDS
CAS - KNOTS

DATA AS OF 9-1-49
BASED ON FLIGHT TEST

FUEL GRADE: Any fuel listed in remarks

161-93-1398A

Figure A-5. Military Power Climb (Sheet 2 of 2)

WADC Form 2410 (11 Jun 51)

DESCENT CHART

STANDARD DAY

MODEL: F-86A ENGINE(S): (1) J47-GE-7 OR -13

CONFIGURATION: SPEED BRAKES OPEN - WITH OR WITHOUT DROP TANKS

GROSS WEIGHT: 13,000

APPROXIMATE				CAS (KNOTS)	PRESSURE ALTITUDE (FEET)
RATE OF DESCENT	TO SEA LEVEL				
	DISTANCE	TIME	FUEL		
14,000	16	3.0	35	180	40,000
15,000	14	2.5	30	210	35,000
16,000	12	2.0	25	270	30,000
17,000	10	1.5	25	320	25,000
18,500	8	1.0	20	370	20,000
19,000	6	1.0	15	390	15,000
17,500	4	0.5	10	400	10,000
15,000	2	0.5	5	410	5,000
0	0	0	0	420	SEA LEVEL

CONFIGURATION: SPEED BRAKES CLOSED - WITH OR WITHOUT DROP TANKS

GROSS WEIGHT: 12,000

CAS (KNOTS)	APPROXIMATE				PRESSURE ALTITUDE (FEET)
	TO SEA LEVEL			RATE OF DESCENT	
	FUEL	TIME	DISTANCE		
155	120	7.0	35	3,000	40,000
175	95	5.5	25	3,500	35,000
190	75	4.0	20	4,000	30,000
210	55	3.0	15	5,000	25,000
225	40	2.0	10	6,500	20,000
245	30	1.5	10	7,500	15,000
260	20	1.0	5	9,000	10,000
280	10	0.5	5	10,000	5,000
295	0	0	0	0	SEA LEVEL

CONFIGURATION:

GROSS WEIGHT:

APPROXIMATE				CAS (KNOTS)	PRESSURE ALTITUDE (FEET)
RATE OF DESCENT	TO SEA LEVEL				
	DISTANCE	TIME	FUEL		
					45,000
					40,000
					35,000
					30,000
					25,000
					20,000
					15,000
					10,000
					5,000
					SEA LEVEL

CONFIGURATION:

GROSS WEIGHT:

CAS (KNOTS)	APPROXIMATE				PRESSURE ALTITUDE (FEET)
	TO SEA LEVEL			RATE OF DESCENT	
	FUEL	TIME	DISTANCE		
					45,000
					40,000
					35,000
					30,000
					25,000
					20,000
					15,000
					10,000
					5,000
					SEA LEVEL

REMARKS:

1. Speed brakes open - maintain 40 psi.
2. For maximum range without power, descend at 185 knots CAS with speed brakes closed.

LEGEND

RATE OF DESCENT - FEET PER MINUTE
DISTANCE - NAUTICAL MILES
TIME - MINUTES
FUEL - POUNDS
CAS - CALIBRATED AIRSPEED - KNOTS

DATA AS OF 9-1-49
BASED ON FLIGHT TEST

161-93-1399A

Figure A-6. Descent

WADC Form 241Q (11 Jun 51)

LANDING DISTANCES

(FEET)

STANDARD DAY

MODEL: F-86A ENGINE(S): (1) J47-GE-7 OR -13

GROSS WEIGHT (LB)	AIRSPEED—KNOTS IAS			HARD-SURFACE—NO WIND							
				AT SEA LEVEL		AT 2000 FT		AT 4000 FT		AT 6000 FT	
	FINAL APPROACH	OVER 50-FOOT OBSTACLE	TOUCH-DOWN	GROUND ROLL	TO CLEAR 50 FT OBST.	GROUND ROLL	TO CLEAR 50 FT OBST.	GROUND ROLL	TO CLEAR 50 FT OBST.	GROUND ROLL	TO CLEAR 50 FT OBST.
16,000	150	130	125	2600	4300	2700	4500	2900	4700	3100	4900
14,000	140	120	115	2200	3900	2400	4000	2500	4200	2700	4400
12,000	130	110	105	1900	3500	2000	3600	2200	3800	2300	4000

REMARKS:
1. Landing distances are airplane requirements under normal service conditions.
2. Distances are for full wing flaps, slats unlocked, and speed brakes open. Speed brakes closed increases distance 20 percent.

LEGEND
IAS - INDICATED AIRSPEED - KNOTS
OBST - OBSTACLE

DATA AS OF 30 SEPT. 1955
BASED ON FLIGHT TEST

F-86A-1-93-21

Figure A-7. Landing Distances

COMBAT ALLOWANCE CHART

STANDARD DAY

MODEL: F-86A ENGINE(S): (1) J47-GE-7 OR -13

PRESSURE ALTITUDE (FEET)	FUEL REQUIRED (POUNDS PER MINUTE)	
	MILITARY POWER 100% RPM (30 MIN LIMIT)	NORMAL POWER 93% RPM (NO LIMIT)
SEA LEVEL	135	95
5,000	120	85
10,000	100	75
15,000	85	65
20,000	75	60
25,000	65	50
30,000	55	40
35,000	45	35
40,000	35	30
45,000	30	25
50,000		

REMARKS:
1. Military Power exhaust temperature limits 690°C.
2. Normal Power exhaust temperature limit 655°C.
3. Divide pm by 6.5 to obtain gpm of JP-4 fuel.
4. Divide pm by 6.0 to obtain gpm of MIL-F-5572 fuel (gasoline).

DATA AS OF 9-1-49
BASED ON FLIGHT TEST

FUEL GRADE: Any fuel listed in remarks

161-93-1407A

Figure A-8. Combat Allowance

WADC Form 241R (11 Jun 51)

MAXIMUM ENDURANCE CHART

STANDARD DAY

MODEL: F-86A ENGINE(S): (1) J47-GE-7 OR -13

CONFIGURATION: TWO 206-1/2 GAL DROP TANKS
GROSS WEIGHT: 16,800 POUNDS

APPROXIMATE		CAS	PRESSURE ALTITUDE	CAS	APPROXIMATE	
LB/HR	% RPM	(KNOTS)	(FEET)	(KNOTS)	% RPM	LB/HR
1920	74	185	SEA LEVEL	165	70	1620
1920	76	185	5,000	165	72	1560
1920	79	190	10,000	170	75	1560
1920	82	195	15,000	175	78	1560
1980	84	200	20,000	180	80	1620
2040	87	205	25,000	180	83	1620
2100	90	210	30,000	185	85	1680
			35,000	190	89	1680
			40,000			
			45,000			
			50,000			

CONFIGURATION: TWO 206-1/2 GAL DROP TANKS
GROSS WEIGHT: 14,000 POUNDS

APPROXIMATE		CAS	PRESSURE ALTITUDE	CAS	APPROXIMATE	
LB/HR	% RPM	(KNOTS)	(FEET)	(KNOTS)	% RPM	LB/HR
1920	74	180	SEA LEVEL	160	71	1680
1920	76	180	5,000	165	73	1620
1920	79	180	10,000	170	76	1620
1920	81	185	15,000	175	79	1680
1980	84	190	20,000	175	82	1680
2040	87	195	25,000	175	84	1740
2100	90	195	30,000	180	87	1800
			35,000			
			40,000			
			45,000			
			50,000			

CONFIGURATION: 16 ROCKETS
GROSS WEIGHT: 16,100 POUNDS

CONFIGURATION: 16 ROCKETS
GROSS WEIGHT: 14,000 POUNDS

REMARKS:

1. Divide lb/hr by 6.5 to obtain gph of MIL-F-5624A, JP-4 fuel.
2. Divide lb/hr by 6.0 to obtain gph of MIL-F-5572 fuel (gasoline).

LEGEND

CAS – CALIBRATED AIRSPEED IN KNOTS
LB/HR – FUEL CONSUMPTION

DATA AS OF 4-22-50
BASED ON FLIGHT TEST

FUEL GRADE: Any fuel listed in remarks

161-93-1405A

Figure A-9. Maximum Endurance (Sheet 1 of 2)

WADC Form 241R (11 Jun 51)

MAXIMUM ENDURANCE CHART

STANDARD DAY

MODEL: F-86A ENGINE(S): (1) J47-GE-7 OR -13

CONFIGURATION: TWO 120 GAL DROP TANKS
GROSS WEIGHT: 15,800 TO 14,000 POUNDS

APPROXIMATE		CAS	PRESSURE ALTITUDE
LB/HR	% RPM	(KNOTS)	(FEET)
1740	71	180	SEA LEVEL
1680	73	185	5,000
1620	76	190	10,000
1620	79	195	15,000
1620	81	200	20,000
1680	83	205	25,000
1680	86	210	30,000
1740	89	215	35,000
			40,000
			45,000
			50,000

CONFIGURATION: TWO 120 GAL DROP TANKS
GROSS WEIGHT: 14,000 POUNDS OR LESS

CAS	APPROXIMATE	
(KNOTS)	% RPM	LB/HR
170	69	1560
170	71	1500
175	73	1500
180	76	1440
185	79	1440
190	81	1440
195	84	1440
200	86	1500
205	92	1620

CONFIGURATION: CLEAN
GROSS WEIGHT: 14,000 POUNDS

APPROXIMATE		CAS	PRESSURE ALTITUDE
LB/HR	% RPM	(KNOTS)	(FEET)
1500	67	170	SEA LEVEL
1440	70	175	5,000
1380	72	180	10,000
1380	75	185	15,000
1320	77	190	20,000
1320	79	195	25,000
1260	82	200	30,000
1320	84	210	35,000
1320	88	215	40,000
1380	93	220	45,000
			50,000

CONFIGURATION:
GROSS WEIGHT:

CAS	APPROXIMATE	
(KNOTS)	% RPM	LB/HR

REMARKS:
1. Divide lb/hr by 6.5 to obtain gph of MIL-F-5624A, JP-4 fuel.
2. Divide lb/hr by 6.0 to obtain gph of MIL-F-5572 fuel (gasoline).

LEGEND
CAS – CALIBRATED AIRSPEED IN KNOTS
LB/HR – FUEL CONSUMPTION

DATA AS OF 4-22-50
BASED ON FLIGHT TEST

FUEL GRADE: Any fuel listed in remarks

161-93-1406A

Figure A-9. Maximum Endurance (Sheet 2 of 2)

WADC Form 241T (11 Jun 51)

MAXIMUM CONTINUOUS POWER CHART

STANDARD DAY

MODEL: F-86A ENGINE(S): (1) J47-GE-7 OR -13

CONFIGURATION: TWO 206-1/2 GAL DROP TANKS

GROSS WEIGHT: 16,800 to 14,000 POUNDS

APPROXIMATE			% RPM	PRESSURE ALTITUDE (FEET)	% RPM	APPROXIMATE		
LB/HR	TAS (KNOTS)	CAS (KNOTS)				CAS (KNOTS)	TAS (KNOTS)	LB/HR
5500	425	425	93	SEA LEVEL	93	425	425	5450
4900	430	405	93	5,000	93	405	435	4900
4350	435	380	93	10,000	93	385	440	4350
3850	440	360	93	15,000	93	365	450	3900
3400	445	335	93	20,000	93	345	455	3400
2950	440	305	93	25,000	93	315	450	2900
2500	430	275	93	30,000	93	290	450	2500
2050	375	215	93	35,000	93	255	435	2100
				40,000				
				45,000				
				50,000				

CONFIGURATION: TWO 120 GAL DROP TANKS

GROSS WEIGHT: 15,600 to 14,000 POUNDS

APPROXIMATE			% RPM	PRESSURE ALTITUDE (FEET)	% RPM	APPROXIMATE		
LB/HR	TAS (KNOTS)	CAS (KNOTS)				CAS (KNOTS)	TAS (KNOTS)	LB/HR
5500	460	460	93	SEA LEVEL	93	460	460	5500
4950	470	440	93	5,000	93	440	470	4950
4400	475	420	93	10,000	93	420	480	4400
3900	485	395	93	15,000	93	400	490	3900
3450	490	370	93	20,000	93	370	490	3400
2950	485	340	93	25,000	93	340	485	2900
2500	475	305	93	30,000	93	310	480	2500
2100	460	270	93	35,000	93	275	470	2100
				40,000	93	225	435	1650
				45,000				
				50,000				

CONFIGURATION: TWO 206-1/2 GAL DROP TANKS

GROSS WEIGHT: 14,000 POUNDS OR LESS

CONFIGURATION: TWO 120 GAL DROP TANKS

GROSS WEIGHT: 14,000 POUNDS OR LESS

REMARKS:

1. Maximum exhaust temperature, 655°C.
2. Divide lb/hr by 6.5 to obtain gph of MIL-F-5624A, JP-4 fuel.
3. Divide lb/hr by 6.0 to obtain gph of MIL-F-5572 fuel (gasoline).

LEGEND

LB/HR-FUEL CONSUMPTION
TAS -TRUE AIRSPEED - KNOTS
CAS -CALIBRATED AIRSPEED - KNOTS

DATA AS OF 3-17-52
BASED ON FLIGHT TEST, NA Report 49-580 (7-6-49)

161-93-1401A

FUEL GRADE: Any fuel listed in remarks

Figure A-10. Maximum Continuous Power (Sheet 1 of 2)

WADC Form 241T (11 Jun 51)

MAXIMUM CONTINUOUS POWER CHART

STANDARD DAY

MODEL: F-86A ENGINE(S): (1) J47-GE-7 OR -13

CONFIGURATION: 16 ROCKETS

GROSS WEIGHT: 16,100 POUNDS OR LESS

CONFIGURATION: CLEAN

GROSS WEIGHT: 14,000 POUNDS OR LESS

APPROXIMATE			% RPM	PRESSURE ALTITUDE (FEET)	% RPM	APPROXIMATE		
LB/HR	TAS (KNOTS)	CAS (KNOTS)				CAS (KNOTS)	TAS (KNOTS)	LB/HR
5500	395	395	93	SEA LEVEL	93	520	520	5550
4900	400	375	93	5,000	93	500	535	5000
4350	405	355	93	10,000	93	475	540	4450
3850	410	335	93	15,000	93	445	540	3950
3400	410	310	93	20,000	93	411	540	3450
2900	405	280	93	25,000	93	375	530	2950
2600	390	250	93	30,000	93	340	520	2550
				35,000	93	305	510	2100
				40,000	93	265	500	1700
				45,000	93	225	475	1300
				50,000				

CONFIGURATION:

GROSS WEIGHT:

CONFIGURATION:

GROSS WEIGHT:

APPROXIMATE			% RPM	PRESSURE ALTITUDE (FEET)	% RPM	APPROXIMATE		
LB/HR	TAS (KNOTS)	CAS (KNOTS)				CAS (KNOTS)	TAS (KNOTS)	LB/HR
				SEA LEVEL				
				5,000				
				10,000				
				15,000				
				20,000				
				25,000				
				30,000				
				35,000				
				40,000				
				45,000				
				50,000				

REMARKS:

1. Maximum exhaust temperature, 655°C.
2. Divide lb/hr by 6.5 to obtain gph of MIL-F-5624A, JP-4 fuel.
3. Divide lb/hr by 6.0 to obtain gph of MIL-F-5572 fuel (gasoline).

LEGEND

LB/HR-FUEL CONSUMPTION
TAS -TRUE AIRSPEED - KNOTS
CAS -CALIBRATED AIRSPEED - KNOTS

DATA AS OF 3-17-52
BASED ON FLIGHT TEST, NA Report 49-580 (7-6-49)

FUEL GRADE: Any fuel listed in remarks

161-93-1402A

Figure A-10. Maximum Continuous Power (Sheet 2 of 2)

WADC Form 241S (11 Jun 51)

MAXIMUM RANGE SUMMARY CHART

STANDARD DAY

MODEL: F-86A ENGINE(S): (1) J47-GE-7 OR -13

CONFIGURATION: TWO 206-1/2 GAL DROP TANKS

GROSS WEIGHT: 16,800 TO 14,000 POUNDS

APPROXIMATE		MACH NO.	CAS (KNOTS)	PRESSURE ALTITUDE (FEET)	CAS (KNOTS)	MACH NO.	APPROXIMATE	
% RPM	MI/LB						MI/LB	% RPM
80	.103	.42	280	SEA LEVEL	260	.40	.111	77
82	.114	.46	280	5,000	250	.42	.125	78
84	.125	.51	280	10,000	250	.45	.139	80
86	.137	.56	280	15,000	250	.50	.152	82
87	.150	.59	270	20,000	250	.55	.167	84
90	.160	.67	275	25,000	250	.60	.183	86
93	.172	.72	275	30,000	245	.66	.197	88
93	.182	.65	215	35,000	255	.75	.208	93
				40,000				
				45,000				
				50,000				

CONFIGURATION: TWO 206-1/2 GAL DROP TANKS

GROSS WEIGHT: 14,000 POUNDS OR LESS

APPROXIMATE		MACH NO.	CAS (KNOTS)	PRESSURE ALTITUDE (FEET)	CAS (KNOTS)	MACH NO.	APPROXIMATE	
% RPM	MI/LB						MI/LB	% RPM
79	.113	.45	295	SEA LEVEL	280	.42	.117	77
80	.128	.47	285	5,000	270	.45	.133	78
81	.144	.50	275	10,000	270	.49	.149	80
83	.159	.54	275	15,000	270	.54	.165	82
85	.175	.61	280	20,000	265	.58	.186	83
87	.192	.67	280	25,000	265	.63	.205	85
89	.208	.73	275	30,000	260	.70	.223	87
93	.221	.80	270	35,000	260	.77	.241	90
				40,000	230	.75	.262	93
				45,000				
				50,000				

CONFIGURATION: TWO 120 GAL DROP TANKS

GROSS WEIGHT: 15,600 TO 14,000 POUNDS

CONFIGURATION: TWO 120 GAL DROP TANKS

GROSS WEIGHT: 14,000 POUNDS OR LESS

REMARKS:

1. Divide lb/hr by 6.5 to obtain gph of MIL-F-5624A, JP-4 fuel.
2. Divide lb/hr by 6.0 to obtain gph of MIL-F-5572 fuel (gasoline).

LEGEND
CAS - CALIBRATED AIRSPEED - KNOTS
MI/LB - NAUTICAL MILES PER POUND OF FUEL CONSUMED

DATA AS OF 3-17-52
BASED ON FLIGHT TEST, NA Report 49-580 (7-6-49)

FUEL GRADE: Any fuel listed in remarks

161-93-1403A

Figure A-11. Maximum Range Summary (Sheet 1 of 2)

WADC Form 241S (11 Jun 51)

MAXIMUM RANGE SUMMARY CHART

STANDARD DAY

MODEL: F-86A

ENGINE(S): (1) J47-GE-7 OR -13

CONFIGURATION: 16 ROCKETS

GROSS WEIGHT: 16,100 POUNDS OR LESS

APPROXIMATE		MACH NO.	CAS (KNOTS)	PRESSURE ALTITUDE (FEET)	CAS (KNOTS)	MACH NO.	APPROXIMATE	
% RPM	MI/LB						MI/LB	% RPM
79	.100	.39	255	SEA LEVEL	320	.49	.125	78
81	.110	.42	255	5,000	315	.51	.144	79
83	.120	.46	250	10,000	305	.55	.166	80
86	.128	.52	260	15,000	300	.59	.189	81
88	.138	.57	260	20,000	290	.63	.214	82
90	.149	.61	255	25,000	295	.71	.241	84
93	.157	.66	245	30,000	290	.76	.273	85
				35,000	275	.81	.305	86
				40,000	255	.84	.324	90
				45,000	220	.82	.366	93
				50,000				

CONFIGURATION: CLEAN

GROSS WEIGHT: 14,000 POUNDS OR LESS

CONFIGURATION:

GROSS WEIGHT:

CONFIGURATION:

GROSS WEIGHT:

APPROXIMATE		MACH NO.	CAS (KNOTS)	PRESSURE ALTITUDE (FEET)	CAS (KNOTS)	MACH NO.	APPROXIMATE	
% RPM	MI/LB						MI/LB	% RPM
				SEA LEVEL				
				5,000				
				10,000				
				15,000				
				20,000				
				25,000				
				30,000				
				35,000				
				40,000				
				45,000				
				50,000				

REMARKS:

1. Divide lb/hr by 6.5 to obtain gph of MIL-F-5624A, JP-4 fuel.
2. Divide lb/hr by 6.0 to obtain gph of MIL-F-5572 fuel (gasoline).

LEGEND

CAS - CALIBRATED AIRSPEED - KNOTS
MI/LB - NAUTICAL MILES PER POUND OF FUEL CONSUMED

DATA AS OF 3-17-52
BASED ON FLIGHT TEST, NA Report 49-580 (7-6-49)

FUEL GRADE: Any fuel listed in remarks

161-93-1404A

Figure A-11. Maximum Range Summary (Sheet 2 of 2)

WADC Form 241M (11 Jun 51)

MODEL F-86A

FLIGHT OPERATION INSTRUCTION CHART

STANDARD DAY

EXTERNAL LOAD ITEM NONE

ENGINE(S): (1) J47-GE-7 OR -13

CHART WEIGHT LIMITS: 14,000 POUNDS OR LESS

NUMBER OF ENGINES OPERATING: ONE

POWER LIMITS	TIME LIMIT	% RPM	TAIL PIPE TEMP(°C)	OIL PRESS. (PSI)	OIL TEMP (°C)	FUEL PRESS (PSI)
MILITARY	30	100	690	50	70	600
NORMAL	NONE	93	655	50	70	400

INSTRUCTIONS FOR USING CHART: (A) IN FLIGHT—Select figure in fuel column equal to, or less than, fuel available for cruise (fuel on board minus allowance for reserve, combat, navigational errors, formation flights, etc). Move horizontally right or left to section according to present altitude and read total range available (no wind) by cruising at that altitude or by climbing to another altitude of maximum range. For a flight at initial altitude, operating instructions are given directly below. For a flight at higher altitude, climb immediately to desired altitude and read cruising instruction in appropriate cruising altitude section. (B) FLIGHT PLANNING—From initial fuel on board subtract fuel required for take-off and climb to desired cruising altitude and all other necessary allowances. Then use chart as for IN FLIGHT above, adding initial climb distance to range values. DATA BELOW CONTAINS NO FUEL RESERVE FOR LANDING.

NOTES: Ranges shown at optimum altitudes are maximum. In order to obtain maximum range on flights requiring more than one chart (because of external configuration or gross weight changes), it is necessary to observe the optimum cruising altitude on each chart; i.e., when changing charts, a climb may be required to obtain a maximum range. All range values include allowances for descent distance and fuel. Climb distance and fuel are included where climbs are indicated.

DATA AS OF: 9-1-49

BASED ON: FLIGHT TEST

LOW-ALTITUDE CHART

161-93-1408

IF YOU ARE AT SEA LEVEL			FUEL	IF YOU ARE AT 5000 FT			IF YOU ARE AT 10,000 FT			IF YOU ARE AT 15,000 FT			FUEL	IF YOU ARE AT 20,000 FT		
RANGE IN AIR MILES				RANGE IN AIR MILES			RANGE IN AIR MILES			RANGE IN AIR MILES				RANGE IN AIR MILES		
BY CRUISING AT SL	OPT. ALT (1000 FT)	BY CRUISING AT OPT. ALT	(POUNDS)	BY CRUISING AT 5000 FT	OPT. ALT (1000 FT)	BY CRUISING AT OPT. ALT	BY CRUISING AT 10,000 FT	OPT. ALT (1000 FT)	BY CRUISING AT OPT. ALT	BY CRUISING AT 15,000 FT	OPT. ALT (1000 FT)	BY CRUISING AT OPT. ALT	(POUNDS)	BY CRUISING AT 20,000 FT	OPT. ALT (1000 FT)	BY CRUISING AT OPT. ALT
(RANGE FIGURES INCLUDE ALLOWANCES FOR PRESCRIBED CLIMB AND DESCENT TO SEA LEVEL)																
(370)	45	(890)	3000	(430)	45	(920)	(500)	45	(940)	(570)	45	(970)	3000	(640)	45	(990)
310	45	710	2500	360	45	730	410	45	760	470	45	780	2500	530	45	800
250	45	520	2000	290	45	550	330	45	580	380	45	600	2000	430	45	620
180	40	340	1500	210	45	370	260	45	390	290	45	420	1500	320	45	440
120	35	180	1000	140	35	200	170	35	220	190	35	240	1000	210	40	260
60	--	---	500	70	15	80	80	20	90	100	--	---	500	110	--	---

CRUISING AT SEA LEVEL						EFFECTIVE WIND	CRUISING AT 5000 FT						CRUISING AT 10,000 FT						CRUISING AT 15,000 FT						EFFECTIVE WIND	CRUISING AT 20,000 FT					
	APPROXIMATE							APPROXIMATE						APPROXIMATE						APPROXIMATE						APPROXIMATE				
CAS	% RPM	LB/HR	G.S.	RANGE FACTOR	LET-DN DIST.	(KNOTS)	CAS	% RPM	LB/HR	G.S.	RANGE FACTOR	LET-DN DIST.	CAS	% RPM	LB/HR	G.S.	RANGE FACTOR	LET-DN DIST.	CAS	% RPM	LB/HR	G.S.	RANGE FACTOR	LET-DN DIST.	(KNOTS)	CAS	% RPM	LB/HR	G.S.	RANGE FACTOR	LET-DN DIST.
						120 H.W.																			120 H.W.	360	87	2450	355	.70	10
						80 H.W.							355	84	2650	325	.75	5	350	85	2450	350	.75	10	80 H.W.	330	85	2150	360	.80	10
345	80	2800	305	.85	0	40 H.W.	335	81	2550	320	.85	0	330	82	2350	335	.85	5	325	83	2200	360	.90	10	40 H.W.	320	84	2050	385	.90	10
320	78	2550	320	1.00	0	0	315	79	2350	335	1.00	0	305	80	2150	350	1.00	5	300	81	1950	370	1.00	10	0	290	82	1800	385	1.00	10
290	75	2250	330	1.15	0	40 T.W.	290	77	2100	350	1.15	0	280	78	1950	365	1.15	5	285	80	1850	390	1.15	10	40 T.W.	275	81	1700	410	1.10	15
						80 T.W.							265	77	1850	390	1.30	5	270	79	1750	415	1.25	10	80 T.W.	275	81	1700	450	1.25	15
						120 T.W.																			120 T.W.	260	80	1600	470	1.35	15

Figure A-12. Flight Operation Instruction Chart—No External Load, 14,000 Pounds or Less (Sheet 1 of 2)

HIGH-ALTITUDE CHART

MODEL: F-86A ENG: (1) J47-GE-7 OR -13 CHART WT LIMITS: 14,000LB OR LESS EXT LOAD: NONE NO. OF ENGINES OPERATING: ONE

IF YOU ARE AT 25,000 FT			FUEL	IF YOU ARE AT 30,000 FT			IF YOU ARE AT 35,000 FT			IF YOU ARE AT 40,000 FT			FUEL	IF YOU ARE AT 45,000 FT		
RANGE IN AIR MILES				RANGE IN AIR MILES			RANGE IN AIR MILES			RANGE IN AIR MILES				RANGE IN AIR MILES		
BY CRUISING AT 25,000 FT	OPT. ALT (1000 FT)	BY CRUISING AT OPT. ALT	(POUNDS)	BY CRUISING AT 30,000 FT	OPT. ALT (1000 FT)	BY CRUISING AT OPT. ALT	BY CRUISING AT 35,000 FT	OPT. ALT (1000 FT)	BY CRUISING AT OPT. ALT	BY CRUISING AT 40,000 FT	OPT. ALT (1000 FT)	BY CRUISING AT OPT. ALT	(POUNDS)	BY CRUISING AT 45,000 FT	OPT. ALT (1000 FT)	BY CRUISING AT OPT. ALT
(RANGE FIGURES INCLUDE ALLOWANCES FOR PRESCRIBED CLIMB AND DESCENT TO SEA LEVEL)																
(720)	45	(1010)	3000	(810)	45	(1030)	(910)	45	(1050)	(960)	45	(1060)	3000	(1080)	--	--
600	45	830	2500	(680)	45	(850)	(760)	45	(860)	(800)	45	(880)	2500	(900)	--	--
480	45	640	2000	540	45	670	600	45	680	640	45	700	2000	720	--	--
360	45	460	1500	400	45	480	450	45	500	480	45	510	1500	530	--	--
240	45	280	1000	270	45	300	300	45	310	320	45	330	1000	350	--	--
120	--	---	500	130	--	---	140	--	---	150	--	---	500	170	--	--

CRUISING AT 25,000 FT						EFFECTIVE WIND	CRUISING AT 30,000 FT						CRUISING AT 35,000 FT						CRUISING AT 40,000 FT						EFFECTIVE WIND	CRUISING AT 45,000 FT					
	APPROXIMATE							APPROXIMATE						APPROXIMATE						APPROXIMATE						APPROXIMATE				
CAS	% RPM	LB/HR	G.S.	RANGE FACTOR	LET-DN DIST.	(KNOTS)	CAS	% RPM	LB/HR	G.S.	RANGE FACTOR	LET-DN DIST.	CAS	% RPM	LB/HR	G.S.	RANGE FACTOR	LET-DN DIST.	CAS	% RPM	LB/HR	G.S.	RANGE FACTOR	LET-DN DIST.	(KNOTS)	CAS	% RPM	LB/HR	G.S.	RANGE FACTOR	LET-DN DIST.
340	87	2200	365	.70	10	120 H.W.	320	87	1950	370	.70	10	290	88	1700	365	.70	15	260	91	1550	370	.75	20	120 H.W.	220	93	1300	350	.75	30
325	86	2050	385	.80	10	80 H.W.	305	86	1800	395	.80	15	280	87	1600	395	.80	20	260	91	1550	410	.80	25	80 H.W.	220	93	1300	390	.85	35
310	85	1900	405	.90	15	40 H.W.	305	86	1800	435	.90	20	280	87	1600	435	.90	20	260	91	1550	450	.90	30	40 H.W.	220	93	1300	430	.90	40
295	84	1800	425	1.00	15	0	290	85	1650	450	1.00	20	275	86	1550	465	1.00	25	255	90	1500	480	1.00	35	0	220	93	1300	470	1.00	45
280	83	1700	445	1.10	15	40 T.W.	290	85	1650	490	1.10	20	275	86	1550	505	1.10	30	255	90	1500	520	1.10	40	40 T.W.	220	93	1300	510	1.10	50
280	83	1700	485	1.20	20	80 T.W.	275	84	1550	510	1.20	25	275	86	1550	545	1.20	30	255	90	1500	560	1.15	45	80 T.W.	220	93	1300	550	1.15	55
265	82	1600	505	1,35	20	120 T.W.	275	84	1550	550	1.30	30	260	85	1450	565	1.30	35	255	90	1500	600	1.25	50	120 T.W.	220	93	1300	590	1.25	60

REMARKS:

1. Climb at 100% rpm.
2. All distances and speeds are in nautical units.
3. Multiply all nautical units by 1.15 to obtain statute units.
4. Divide lb/hr by 6.5 to obtain gph of MIL-F-5624A, JP-4 fuel. Divide lb/hr by 6.0 to obtain gph of MIL-F-5572 fuel (gasoline).
5. Multiply gallons by factor in note 4 to obtain pounds.
6. Multiply 430 gallons by factor in note 4 to obtain maximum available fuel in pounds.

EXAMPLE

If you are at 10,000 feet with 2500 pounds of available fuel, you can fly 410 nautical air miles by holding 305 knots CAS. However, you can fly 760 nautical air miles by immediately climbing to 45,000 feet, using 100% rpm. At 45,000 feet, cruise at 220 knots CAS and start letdown 45 nautical miles from home. With an 80-knot head wind, the range at 45,000 feet would be .85 x 760 or 640 nautical miles. Cruise at 220 knots CAS with this wind and start letdown 35 nautical miles from destination.

LEGEND

EFFECTIVE WIND -H.W., HEAD WIND; T.W., TAIL WIND
RANGE FACTOR -RATIO OF GROUND DISTANCE TO AIR MILES FOR CORRESPONDING WINDS
G.S. -GROUND SPEED IN KNOTS
CAS -CALIBRATED AIRSPEED IN KNOTS
LB/HR -FUEL CONSUMPTION-POUNDS PER HOUR
RANGE -NAUTICAL MILES
KN -KNOTS
OPT. ALT -OPTIMUM ALTITUDE
DISTANCE -NAUTICAL MILES
( ) -RANGE IN PARENTHESES AVAILABLE ONLY AFTER EXTERNAL LOAD IS DROPPED

DATA AS OF: 9-1-49

BASED ON: FLIGHT TESTS

BASED ON ANY FUEL LISTED IN NOTE 4

161-93-1409A

WADC Form 241N (11 Jun 51)

Figure A-12. Flight Operation Instruction Chart—No External Load, 14,000 Pounds or Less (Sheet 2 of 2)

WADC Form 241M (11 Jun 51)

MODEL F-86A

FLIGHT OPERATION INSTRUCTION CHART

STANDARD DAY

EXTERNAL LOAD ITEM
TWO 120 GAL DROP TANKS

ENGINE(S): (1) J47-GE-7 OR -13

CHART WEIGHT LIMITS: 15,600 TO 14,000 POUNDS

NUMBER OF ENGINES OPERATING: ONE

POWER LIMITS	TIME LIMIT	% RPM	TAIL PIPE TEMP(°C)	OIL PRESS. (PSI)	OIL TEMP (°C)	FUEL PRESS. (PSI)
MILITARY	30	100	690	50	70	600
NORMAL	NONE	93	655	50	70	400

INSTRUCTIONS FOR USING CHART: (A) IN FLIGHT—Select figure in fuel column equal to, or less than, fuel available for cruise (fuel on board minus allowance for reserve, combat, navigational errors, formation flights, etc). Move horizontally right or left to section according to present altitude and read total range available (no wind) by cruising at that altitude or by climbing to another altitude of maximum range. For a flight at initial altitude, operating instructions are given directly below. For a flight at higher altitude, climb immediately to desired altitude and read cruising instruction in appropriate cruising altitude section. (B) FLIGHT PLANNING—From initial fuel on board subtract fuel required for take-off and climb to desired cruising altitude and all other necessary allowances. Then use chart as for IN FLIGHT above, adding initial climb distance to range values. DATA BELOW CONTAINS NO FUEL RESERVE FOR LANDING.

NOTES: Ranges shown at optimum altitudes are maximum. In order to obtain maximum range on flights requiring more than one chart (because of external configuration or gross weight changes), it is necessary to observe the optimum cruising altitude on each chart; i.e., when changing charts, a climb may be required to obtain a maximum range. All range values include allowances for descent distance and fuel. Climb distance and fuel are included where climbs are indicated.

DATA AS OF: 9-1-49
BASED ON: FLIGHT TESTS

LOW-ALTITUDE CHART

161-93-1410

IF YOU ARE AT SEA LEVEL			FUEL	IF YOU ARE AT 5000 FT			IF YOU ARE AT 10,000 FT			IF YOU ARE AT 15,000 FT			FUEL	IF YOU ARE AT 20,000 FT		
RANGE IN AIR MILES				RANGE IN AIR MILES			RANGE IN AIR MILES			RANGE IN AIR MILES				RANGE IN AIR MILES		
BY CRUISING AT SL	OPT. ALT (1000 FT)	BY CRUISING AT OPT. ALT	(POUNDS)	BY CRUISING AT 5000 FT	OPT. ALT (1000 FT)	BY CRUISING AT OPT. ALT	BY CRUISING AT 10,000 FT	OPT. ALT (1000 FT)	BY CRUISING AT OPT. ALT	BY CRUISING AT 15,000 FT	OPT. ALT (1000 FT)	BY CRUISING AT OPT. ALT	(POUNDS)	BY CRUISING AT 20,000 FT	OPT. ALT (1000 FT)	BY CRUISING AT OPT. ALT
(RANGE FIGURES INCLUDE ALLOWANCES FOR PRESCRIBED CLIMB AND DESCENT TO SEA LEVEL)																
(520)	35	(990)	4500	(590)	35	(1010)	(660)	35	(1030)	(740)	35	(1050)	4500	--	--	--
460	35	860	4000	520	35	880	590	35	900	650	35	920	4000	(720)	35	(930)
400	35	730	3500	460	35	750	510	35	770	570	35	790	3500	630	35	800
340	35	600	3000	390	35	620	440	35	640	490	35	660	3000	540	35	670
280	35	470	2500	320	35	490	360	35	510	410	35	520	2500	450	35	540

CRUISING AT SEA LEVEL						EFFECTIVE WIND	CRUISING AT 5000 FT						CRUISING AT 10,000 FT						CRUISING AT 15,000 FT						EFFECTIVE WIND	CRUISING AT 20,000 FT					
	APPROXIMATE							APPROXIMATE						APPROXIMATE						APPROXIMATE						APPROXIMATE				
CAS	% RPM	LB/HR	G.S.	RANGE FACTOR	LET-DN DIST.	(KNOTS)	CAS	% RPM	LB/HR	G.S.	RANGE FACTOR	LET-DN DIST.	CAS	% RPM	LB/HR	G.S.	RANGE FACTOR	LET-DN DIST.	CAS	% RPM	LB/HR	G.S.	RANGE FACTOR	LET-DN DIST.	(KNOTS)	CAS	% RPM	LB/HR	G.S.	RANGE FACTOR	LET-DN DIST.
						120 H.W.																			120 H.W.	330	89	2750	315	.65	10
						80 H.W.							320	85	2750	290	.75	5	315	86	2600	310	.75	10	80 H.W.	305	87	2400	325	.75	10
315	81	2900	275	.85	0	40 H.W.	310	82	2700	290	.85	0	300	83	2450	305	.85	5	305	85	2450	335	.85	10	40 H.W.	295	86	2250	350	.85	10
295	79	2650	295	1.00	0	0	285	80	2400	305	1.00	0	275	81	2200	315	1.00	5	275	83	2150	340	1.00	10	0	280	85	2150	375	1.00	10
265	76	2300	305	1.15	0	40 T.W.	265	78	2200	325	1.15	0	260	80	2100	340	1.15	5	255	82	2000	360	1.15	10	40 T.W.	270	84	2050	400	1.10	15
						80 T.W.							250	79	2000	370	1.30	5	255	82	2000	400	1.25	10	80 T.W.	270	84	2050	440	1.25	15
						120 T.W.																			120 T.W.	255	83	1900	460	1.35	15

Figure A-13. Flight Operation Instruction Chart—Two 120 Gallon Drop Tanks—15,600 to 14,000 Pounds or Less (Sheet 1 of 2)

HIGH-ALTITUDE CHART

MODEL: F-86A ENG: (1) J47-GE-7 OR -13 CHART WT LIMITS: 15,600 TO 14,000 LB EXT LOAD: TWO 120 GAL DROP TANKS NO. OF ENGINES OPERATING: ONE

IF YOU ARE AT 25,000 FT			FUEL	IF YOU ARE AT 30,000 FT			IF YOU ARE AT 35,000 FT			IF YOU ARE AT 40,000 FT			FUEL	IF YOU ARE AT 45,000 FT		
RANGE IN AIR MILES				RANGE IN AIR MILES			RANGE IN AIR MILES			RANGE IN AIR MILES				RANGE IN AIR MILES		
BY CRUISING AT 25,000 FT	OPT. ALT (1000 FT)	BY CRUISING AT OPT. ALT	(POUNDS)	BY CRUISING AT 30,000 FT	OPT. ALT (1000 FT)	BY CRUISING AT OPT. ALT	BY CRUISING AT 35,000 FT	OPT. ALT (1000 FT)	BY CRUISING AT OPT. ALT	BY CRUISING AT 40,000 FT	OPT. ALT (1000 FT)	BY CRUISING AT OPT. ALT	(POUNDS)	BY CRUISING AT 45,000 FT	OPT. ALT (1000 FT)	BY CRUISING AT OPT. ALT
(RANGE FIGURES INCLUDE ALLOWANCES FOR PRESCRIBED CLIMB AND DESCENT TO SEA LEVEL)																
- -	--	- -	4500	- -	--	- -	- -	--	- -				4500			
(800)	35	(950)	4000	(870)	35	(960)	(930)	35	(970)				4000			
690	35	820	3500	760	35	830	810	35	840				3500			
590	35	680	3000	640	35	700	690	35	700				3000			
490	35	550	2500	530	35	570	570	35	580				2500			

CRUISING AT 25,000 FT						EFFECTIVE WIND	CRUISING AT 30,000 FT						CRUISING AT 35,000 FT						CRUISING AT 40,000 FT						EFFECTIVE WIND	CRUISING AT 45,000 FT					
	APPROXIMATE							APPROXIMATE						APPROXIMATE						APPROXIMATE						APPROXIMATE				
CAS	% RPM	LB/HR	G.S.	RANGE FACTOR	LET-DN DIST.	(KNOTS)	CAS	% RPM	LB/HR	G.S.	RANGE FACTOR	LET-DN DIST.	CAS	% RPM	LB/HR	G.S.	RANGE FACTOR	LET-DN DIST.	CAS	% RPM	LB/HR	G.S.	RANGE FACTOR	LET-DN DIST.	(KNOTS)	CAS	% RPM	LB/HR	G.S.	RANGE FACTOR	LET-DN DIST.
315	90	2550	330	.70	10	120 H.W.	295	91	2300	340	.70	10	270	93	2100	340	.75	15							120 H.W.						
305	89	2350	355	.80	10	80 H.W.	285	90	2200	365	.80	15	270	93	2100	380	.80	20							80 H.W.						
290	88	2250	380	.90	15	40 H.W.	285	90	2200	405	.90	20	270	93	2100	420	.90	20							40 H.W.						
280	87	2100	405	1.00	15	0	275	89	2100	430	1.00	20	270	93	2100	460	1.00	25							0						
280	87	2100	445	1.10	15	40 T.W.	275	89	2100	470	1.10	20	265	92	2000	490	1.10	30							40 T.W.						
265	86	2000	465	1.20	20	80 T.W.	265	88	2000	495	1.20	25	265	92	2000	530	1.20	30							80 T.W.						
265	86	2000	505	1.30	20	120 T.W.	265	88	2000	535	1.30	30	255	91	1900	555	1.30	35							120 T.W.						

REMARKS:

1. Climb at 100% rpm.
2. All distances and speeds are in nautical units.
3. Multiply all nautical units by 1.15 to obtain statute units.
4. Divide lb/hr by 6.5 to obtain gph of MIL-F-5624A, JP-4 fuel. Divide lb/hr by 6.0 to obtain gph of MIL-F-5572 fuel (gasoline).
5. Multiply gallons by factor in note 4 to obtain pounds.
6. Multiply 670 gallons by factor in note 4 to obtain maximum available fuel in pounds.

EXAMPLE

If you are at 10,000 feet with 4000 pounds of available fuel, you can fly 590 nautical air miles by holding 275 knots CAS. However, you can fly 900 nautical air miles by immediately climbing to 35,000 feet, using 100% rpm. At 35,000 feet, cruise at 270 knots CAS and start letdown 25 nautical miles from home. With an 80-knot head wind, the range at 35,000 feet would be .8 x 900 or 720 nautical miles. Cruise at 270 knots CAS with this wind and start letdown 20 nautical miles from destination.

LEGEND

EFFECTIVE WIND -H.W., HEAD WIND; T.W., TAIL WIND
RANGE FACTOR -RATIO OF GROUND DISTANCE TO AIR MILES FOR CORRESPONDING WINDS
G.S. -GROUND SPEED IN KNOTS
CAS -CALIBRATED AIRSPEED IN KNOTS
LB/HR -FUEL CONSUMPTION-POUNDS PER HOUR
RANGE -NAUTICAL MILES
KN -KNOTS
OPT. ALT -OPTIMUM ALTITUDE
DISTANCE -NAUTICAL MILES
( ) -RANGE IN PARENTHESES FOR INTERPOLATION PURPOSES ONLY

DATA AS OF: 9-1-49

BASED ON: FLIGHT TESTS

BASED ON ANY FUEL LISTED IN NOTE 4

161-93-1411A

WADC Form 241N (11 Jun 51)

Figure A-13. Flight Operation Instruction Chart—Two 120 Gallon Drop Tanks—15,600 to 14,000 Pounds or Less (Sheet 2 of 2)

WADC Form 241M (11 Jun 51)

MODEL F-86A

FLIGHT OPERATION INSTRUCTION CHART

STANDARD DAY

EXTERNAL LOAD ITEM TWO 120 GAL DROP TANKS

ENGINE(S): (1) J47-GE-7 OR -13

CHART WEIGHT LIMITS: 14,000 POUNDS OR LESS

NUMBER OF ENGINES OPERATING: ONE

POWER LIMITS	TIME LIMIT	% RPM	TAIL PIPE TEMP(°C)	OIL PRESS. (PSI)	OIL TEMP (°C)	FUEL PRESS. (PSI)
MILITARY	30	100	690	50	70	600
NORMAL	NONE	93	655	50	70	400

INSTRUCTIONS FOR USING CHART: (A) IN FLIGHT—Select figure in fuel column equal to, or less than, fuel available for cruise (fuel on board minus allowance for reserve, combat, navigational errors, formation flights, etc). Move horizontally right or left to section according to present altitude and read total range available (no wind) by cruising at that altitude or by climbing to another altitude of maximum range. For a flight at initial altitude, operating instructions are given directly below. For a flight at higher altitude, climb immediately to desired altitude and read cruising instruction in appropriate cruising altitude section. (B) FLIGHT PLANNING—From initial fuel on board subtract fuel required for take-off and climb to desired cruising altitude and all other necessary allowances. Then use chart as for IN FLIGHT above, adding initial climb distance to range values. DATA BELOW CONTAINS NO FUEL RESERVE FOR LANDING.

NOTES: Ranges shown at optimum altitudes are maximum. In order to obtain maximum range on flights requiring more than one chart (because of external configuration or gross weight changes), it is necessary to observe the optimum cruising altitude on each chart; i.e., when changing charts, a climb may be required to obtain a maximum range. All range values include allowances for descent distance and fuel. Climb distance and fuel are included where climbs are indicated.

DATA AS OF: 9-1-49

BASED ON: FLIGHT TESTS

LOW-ALTITUDE CHART

161-93-1412

IF YOU ARE AT SEA LEVEL			FUEL	IF YOU ARE AT 5000 FT			IF YOU ARE AT 10,000 FT			IF YOU ARE AT 15,000 FT			FUEL	IF YOU ARE AT 20,000 FT		
RANGE IN AIR MILES				RANGE IN AIR MILES			RANGE IN AIR MILES			RANGE IN AIR MILES				RANGE IN AIR MILES		
BY CRUISING AT SL	OPT. ALT (1000 FT)	BY CRUISING AT OPT. ALT	(POUNDS)	BY CRUISING AT 5000 FT	OPT. ALT (1000 FT)	BY CRUISING AT OPT. ALT	BY CRUISING AT 10,000 FT	OPT. ALT (1000 FT)	BY CRUISING AT OPT. ALT	BY CRUISING AT 15,000 FT	OPT. ALT (1000 FT)	BY CRUISING AT OPT. ALT	(POUNDS)	BY CRUISING AT 20,000 FT	OPT. ALT (1000 FT)	BY CRUISING AT OPT. ALT
(RANGE FIGURES INCLUDE ALLOWANCES FOR PRESCRIBED CLIMB AND DESCENT TO SEA LEVEL.)																
350	40	650	3000	400	40	670	450	40	690	500	40	710	3000	560	40	730
290	40	520	2500	330	40	540	370	40	560	420	40	580	2500	460	40	600
230	40	390	2000	260	40	410	300	40	430	330	40	450	2000	370	40	470
170	40	260	1500	200	40	280	230	40	300	250	40	320	1500	280	40	340
110	20	140	1000	130	30	150	150	30	170	170	35	190	1000	190	40	200
50	5	60	500	60	10	70	70	--	---	80	--	---	500	90	--	---

CRUISING AT SEA LEVEL						EFFECTIVE WIND	CRUISING AT 5000 FT						CRUISING AT 10,000 FT						CRUISING AT 15,000 FT						EFFECTIVE WIND	CRUISING AT 20,000 FT					
	APPROXIMATE							APPROXIMATE						APPROXIMATE						APPROXIMATE						APPROXIMATE				
CAS	% RPM	LB/HR	G.S.	RANGE FACTOR	LET-DN DIST.	(KNOTS)	CAS	% RPM	LB/HR	G.S.	RANGE FACTOR	LET-DN DIST.	CAS	% RPM	LB/HR	G.S.	RANGE FACTOR	LET-DN DIST.	CAS	% RPM	LB/HR	G.S.	RANGE FACTOR	LET-DN DIST.	(KNOTS)	CAS	% RPM	LB/HR	G.S.	RANGE FACTOR	LET-DN DIST.
						120 H.W.																			120 H.W.	310	87	2450	295	.65	10
						80 H.W.							315	84	2600	280	.75	5	305	85	2400	300	.75	10	80 H.W.	300	86	2300	320	.75	10
300	79	2650	260	.85	0	40 H.W.	290	80	2450	270	.85	0	290	82	2350	295	.85	5	280	83	2150	310	.85	10	40 H.W.	275	84	2050	330	.85	10
280	77	2400	280	1.00	0	0	270	78	2200	290	1.00	0	270	80	2100	310	1.00	5	270	82	2050	335	1.00	10	0	265	83	1900	350	1.00	10
260	75	2200	300	1.15	0	40 T.W.	260	77	2100	320	1.15	0	260	79	2000	340	1.15	5	260	81	1950	360	1.15	10	40 T.W.	265	83	1900	390	1.10	15
						80 T.W.							235	77	1800	350	1.30	5	245	80	1850	385	1.30	10	80 T.W.	250	82	1800	415	1.25	15
						120 T.W.																			120 T.W.	235	81	1700	440	1.40	15

Figure A-14. Flight Operation Instruction Chart—Two 120 Gallon Drop Tanks—14,000 Pounds or Less (Sheet 1 of 2)

HIGH-ALTITUDE CHART

MODEL: F-86A ENG:(1) J47-GE-7 OR -13 CHART WT LIMITS: 14,000 LB OR LESS EXT LOAD: TWO 120 GAL DROP TANKS NO. OF ENGINES OPERATING: ONE

IF YOU ARE AT 25,000 FT			FUEL	IF YOU ARE AT 30,000 FT			IF YOU ARE AT 35,000 FT			IF YOU ARE AT 40,000 FT			FUEL	IF YOU ARE AT 45,000 FT		
RANGE IN AIR MILES				RANGE IN AIR MILES			RANGE IN AIR MILES			RANGE IN AIR MILES				RANGE IN AIR MILES		
BY CRUISING AT 25,000 FT	OPT. ALT (1000 FT)	BY CRUISING AT OPT. ALT	(POUNDS)	BY CRUISING AT 30,000 FT	OPT. ALT (1000 FT)	BY CRUISING AT OPT. ALT	BY CRUISING AT 35,000 FT	OPT. ALT (1000 FT)	BY CRUISING AT OPT. ALT	BY CRUISING AT 40,000 FT	OPT. ALT (1000 FT)	BY CRUISING AT OPT. ALT	(POUNDS)	BY CRUISING AT 45,000 FT	OPT. ALT (1000 FT)	BY CRUISING AT OPT. ALT
(RANGE FIGURES INCLUDE ALLOWANCES FOR PRESCRIBED CLIMB AND DESCENT TO SEA LEVEL.)																
610	40	740	3000	670	40	760	720	40	770	780	--	---	3000			
510	40	610	2500	560	40	630	600	40	640	650	--	---	2500			
410	40	480	2000	450	40	500	480	40	510	520	--	---	2000			
310	40	350	1500	330	40	370	360	40	380	390	--	---	1500			
200	40	220	1000	220	40	230	240	40	250	260	--	---	1000			
100	--	---	500	110	--	---	120	--	---	130	--	---	500			

CRUISING AT 25,000 FT						EFFECTIVE WIND	CRUISING AT 30,000 FT						CRUISING AT 35,000 FT						CRUISING AT 40,000 FT						EFFECTIVE WIND	CRUISING AT 45,000 FT					
	APPROXIMATE							APPROXIMATE						APPROXIMATE						APPROXIMATE						APPROXIMATE				
CAS	% RPM	LB/HR	G.S.	RANGE FACTOR	LET-DN DIST.	(KNOTS)	CAS	% RPM	LB/HR	G.S.	RANGE FACTOR	LET-DN DIST.	CAS	% RPM	LB/HR	G.S.	RANGE FACTOR	LET-DN DIST.	CAS	% RPM	LB/HR	G.S.	RANGE FACTOR	LET-DN DIST.	(KNOTS)	CAS	% RPM	LB/HR	G.S.	RANGE FACTOR	LET-DN DIST.
300	88	2250	310	.65	10	120 H.W.	295	90	2200	335	.70	10	275	92	2000	340	.70	15	230	93	1650	315	.70	20	120 H.W.						
290	87	2150	335	.75	10	80 H.W.	285	89	2100	365	.80	15	270	91	1950	375	.80	20	230	93	1650	355	.80	25	80 H.W.						
275	86	2000	360	.90	15	40 H.W.	275	88	2000	390	.90	20	270	91	1950	415	.90	20	230	93	1650	395	.90	30	40 H.W.						
265	85	1850	380	1.00	15	0	260	87	1850	410	1.00	20	260	90	1850	445	1.00	25	230	93	1650	435	1.00	35	0						
265	85	1850	420	1.10	15	40 T.W.	260	87	1850	450	1.10	20	260	90	1850	485	1.10	30	230	93	1650	475	1.10	40	40 T.W.						
250	84	1750	440	1.25	20	80 T.W.	250	86	1750	470	1.20	25	250	89	1750	505	1.20	30	230	93	1650	515	1.20	45	80 T.W.						
250	84	1750	480	1.35	20	120 T.W.	250	86	1750	510	1.30	30	250	89	1750	545	1.30	35	230	93	1650	555	1.30	50	120 T.W.						

REMARKS:
1. Climb at 100% rpm.
2. All distances and speeds are in nautical units.
3. Multiply all nautical units by 1.15 to obtain statute units.
4. Divide lb/hr by 6.5 to obtain gph of MIL-F-5624A, JP-4 fuel. Divide lb/hr by 6.0 to obtain gph of MIL-F-5572 fuel (gasoline).
5. Multiply gallons by factor in note 4 to obtain pounds.

EXAMPLE

If you are at 10,000 feet with 2500 pounds of available fuel, you can fly 370 nautical air miles by holding 270 knots CAS. However, you can fly 560 nautical air miles by immediately climbing to 40,000 feet, using 100% rpm. At 40,000 feet, cruise at 230 knots CAS and start letdown 35 nautical miles from home. With an 80-knot head wind, the range at 40,000 feet would be .80 x 560 or 440 nautical miles. Cruise at 230 knots CAS with this wind and start letdown 25 nautical miles from destination.

LEGEND

EFFECTIVE WIND – H.W., HEAD WIND; T.W., TAIL WIND
RANGE FACTOR – RATIO OF GROUND DISTANCE TO AIR MILES FOR CORRESPONDING WINDS
G.S. – GROUND SPEED IN KNOTS
CAS – CALIBRATED AIRSPEED IN KNOTS
LB/HR – FUEL CONSUMPTION—POUNDS PER HOUR
RANGE – NAUTICAL MILES
OPT. ALT – OPTIMUM ALTITUDE
DISTANCE – NAUTICAL MILES

DATA AS OF: 9-1-49

BASED ON: FLIGHT TEST

BASED ON ANY FUEL LISTED IN NOTE 4

161-93-1413A

WADC Form 241N (11 Jun 51)

Figure A-14. Flight Operation Instruction Chart—Two 120 Gallon Drop Tanks—14,000 Pounds or Less (Sheet 2 of 2)

WADC Form 241M (11 Jun 51)

MODEL F-86A

FLIGHT OPERATION INSTRUCTION CHART

STANDARD DAY

EXTERNAL LOAD ITEM
TWO 206-1/2 GAL DROP TANKS

ENGINE(S): (1) J47-GE-7 OR -13

CHART WEIGHT LIMITS: 16,800 TO 14,000 POUNDS

NUMBER OF ENGINES OPERATING: ONE

POWER LIMITS	TIME LIMIT	% RPM	TAIL PIPE TEMP(°C)	OIL PRESS. (PSI)	OIL TEMP (°C)	FUEL PRESS. (PSI)
MILITARY	30	100	690	50	70	600
NORMAL	NONE	93	655	50	70	400

INSTRUCTIONS FOR USING CHART: (A) IN FLIGHT—Select figure in fuel column equal to, or less than, fuel available for cruise (fuel on board minus allowance for reserve, combat, navigational errors, formation flights, etc). Move horizontally right or left to section according to present altitude and read total range available (no wind) by cruising at that altitude or by climbing to another altitude of maximum range. For a flight at initial altitude, operating instructions are given directly below. For a flight at higher altitude, climb immediately to desired altitude and read cruising instruction in appropriate cruising altitude section. (B) FLIGHT PLANNING—From initial fuel on board subtract fuel required for take-off and climb to desired cruising altitude and all other necessary allowances. Then use chart as for IN FLIGHT above, adding initial climb distance to range values. DATA BELOW CONTAINS NO FUEL RESERVE FOR LANDING.

NOTES: Ranges shown at optimum altitudes are maximum. In order to obtain maximum range on flights requiring more than one chart (because of external configuration or gross weight changes), it is necessary to observe the optimum cruising altitude on each chart; i.e., when changing charts, a climb may be required to obtain a maximum range. All range values include allowances for descent distance and fuel. Climb distance and fuel are included where climbs are indicated.

DATA AS OF: 9-1-49

BASED ON: FLIGHT TEST

LOW-ALTITUDE CHART

161-93-1414

IF YOU ARE AT SEA LEVEL			FUEL	IF YOU ARE AT 5000 FT			IF YOU ARE AT 10,000 FT			IF YOU ARE AT 15,000 FT			FUEL	IF YOU ARE AT 20,000 FT		
RANGE IN AIR MILES				RANGE IN AIR MILES			RANGE IN AIR MILES			RANGE IN AIR MILES				RANGE IN AIR MILES		
BY CRUISING AT SL	OPT. ALT (1000 FT)	BY CRUISING AT OPT. ALT	(POUNDS)	BY CRUISING AT 5000 FT	OPT. ALT (1000 FT)	BY CRUISING AT OPT. ALT	BY CRUISING AT 10,000 FT	OPT. ALT (1000 FT)	BY CRUISING AT OPT. ALT	BY CRUISING AT 15,000 FT	OPT. ALT (1000 FT)	BY CRUISING AT OPT. ALT	(POUNDS)	BY CRUISING AT 20,000 FT	OPT. ALT (1000 FT)	BY CRUISING AT OPT. ALT
(RANGE FIGURES INCLUDE ALLOWANCES FOR PRESCRIBED CLIMB AND DESCENT TO SEA LEVEL)																
590	35	970	5500	(650)	35	(990)	(730)	35	(1010)	(800)	35	(1020)	5500	(870)	35	(1040)
530	35	870	5000	590	35	890	660	35	900	720	35	920	5000	790	35	940
470	35	760	4500	530	35	780	590	35	800	640	35	810	4500	710	35	830
420	35	660	4000	470	35	680	520	35	690	570	35	710	4000	620	35	730
360	35	560	3500	400	35	570	450	35	590	490	35	610	3500	540	35	620
310	35	450	3000	340	35	470	380	35	490	410	35	500	3000	460	35	520
250	35	360	2500	280	35	380	310	35	390	340	35	410	2500	380	35	420

CRUISING AT SEA LEVEL						EFFECTIVE WIND	CRUISING AT 5000 FT						CRUISING AT 10,000 FT						CRUISING AT 15,000 FT						EFFECTIVE WIND	CRUISING AT 20,000 FT					
	APPROXIMATE							APPROXIMATE						APPROXIMATE						APPROXIMATE						APPROXIMATE				
CAS	% RPM	LB/HR	G.S.	RANGE FACTOR	LET-DN DIST.	(KNOTS)	CAS	% RPM	LB/HR	G.S.	RANGE FACTOR	LET-DN DIST.	CAS	% RPM	LB/HR	G.S.	RANGE FACTOR	LET-DN DIST.	CAS	% RPM	LB/HR	G.S.	RANGE FACTOR	LET-DN DIST.	(KNOTS)	CAS	% RPM	LB/HR	G.S.	RANGE FACTOR	LET-DN DIST.
						120 H.W.																			120 H.W.	315	91	3050	300	.65	10
						80 H.W.							315	87	3050	280	.75	5	305	88	2900	295	.75	10	80 H.W.	295	89	2700	310	.75	10
300	82	3000	260	.85	0	40 H.W.	290	83	2800	270	.85	0	290	85	2750	295	.85	5	290	87	2700	320	.85	10	40 H.W.	280	88	2550	335	.85	10
280	80	2750	280	1.00	0	0	280	82	2650	300	1.00	0	280	84	2600	325	1.00	5	280	86	2550	345	1.00	10	0	270	87	2400	360	1.00	10
255	78	2450	295	1.15	0	40 T.W.	260	80	2400	315	1.15	0	270	83	2450	350	1.15	5	270	85	2400	370	1.15	10	40 T.W.	270	87	2400	400	1.10	15
						80 T.W.							255	82	2300	375	1.30	5	255	84	2250	395	1.30	10	80 T.W.	255	86	2250	425	1.25	15
						120 T.W.																			120 T.W.	255	86	2250	465	1.35	15

Figure A-15. Flight Operation Instruction Chart—Two 206½ Gallon Drop Tanks—16,800 to 14,000 Pounds (Sheet 1 of 2)

HIGH-ALTITUDE CHART

MODEL: F-86A ENG: (1) J47-GE-7 OR -13 CHART WT LIMITS: 16,800 TO 14,000 LB EXT LOAD: TWO 206-1/2 GAL DROP TANKS NO. OF ENGINES OPERATING: ONE

IF YOU ARE AT 25,000 FT			FUEL	IF YOU ARE AT 30,000 FT			IF YOU ARE AT 35,000 FT			IF YOU ARE AT 40,000 FT			FUEL	IF YOU ARE AT 45,000 FT		
RANGE IN AIR MILES				RANGE IN AIR MILES			RANGE IN AIR MILES			RANGE IN AIR MILES				RANGE IN AIR MILES		
BY CRUISING AT 25,000 FT	OPT. ALT (1000 FT)	BY CRUISING AT OPT. ALT	(POUNDS)	BY CRUISING AT 30,000 FT	OPT. ALT (1000 FT)	BY CRUISING AT OPT. ALT	BY CRUISING AT 35,000 FT	OPT. ALT (1000 FT)	BY CRUISING AT OPT. ALT	BY CRUISING AT 40,000 FT	OPT. ALT (1000 FT)	BY CRUISING AT OPT. ALT	(POUNDS)	BY CRUISING AT 45,000 FT	OPT. ALT (1000 FT)	BY CRUISING AT OPT. ALT
(RANGE FIGURES INCLUDE ALLOWANCES FOR PRESCRIBED CLIMB AND DESCENT TO SEA LEVEL.)																
---	--	---	5500	---	--	---	---	--	---				5500			
(850)	35	(950)	5000	(920)	35	(960)	---	--	---				5000			
760	35	840	4500	820	35	850	(870)	--	---				4500			
670	35	740	4000	720	35	750	760	--	---				4000			
580	35	640	3500	620	35	650	660	--	---				3500			
490	35	530	3000	520	35	540	550	--	---				3000			
400	35	440	2500	430	35	450	460	--	---				2500			

CRUISING AT 25,000 FT						EFFECTIVE WIND	CRUISING AT 30,000 FT						CRUISING AT 35,000 FT						CRUISING AT 40,000 FT						EFFECTIVE WIND	CRUISING AT 45,000 FT					
	APPROXIMATE							APPROXIMATE						APPROXIMATE						APPROXIMATE						APPROXIMATE				
CAS	% RPM	LB/HR	G.S.	RANGE FACTOR	LET-DN DIST.	(KNOTS)	CAS	% RPM	LB/HR	G.S.	RANGE FACTOR	LET-DN DIST.	CAS	% RPM	LB/HR	G.S.	RANGE FACTOR	LET-DN DIST.	CAS	% RPM	LB/HR	G.S.	RANGE FACTOR	LET-DN DIST.	(KNOTS)	CAS	% RPM	LB/HR	G.S.	RANGE FACTOR	LET-DN DIST.
305	93	2900	320	.70	10	120 H.W.	275	93	2500	305	.70	10	215	93	2050	255	.70	15							120 H.W.						
295	92	2750	345	.80	10	80 H.W.	275	93	2500	345	.80	15	215	93	2050	295	.80	20							80 H.W.						
285	91	2650	375	.90	15	40 H.W.	275	93	2500	385	.90	20	215	93	2050	335	.90	20							40 H.W.						
275	90	2500	400	1.00	15	0	275	93	2500	425	1.00	20	215	93	2050	375	1.00	25							0						
265	89	2400	425	1.10	15	40 T.W.	275	93	2500	465	1.10	20	215	93	2050	415	1.10	30							40 T.W.						
250	88	2250	445	1.25	20	80 T.W.	265	92	2400	495	1.20	25	215	93	2050	455	1.20	30							80 T.W.						
250	88	2250	485	1.35	20	120 T.W.	265	92	2400	535	1.30	30	215	93	2050	495	1.30	35							120 T.W.						

REMARKS:

1. Climb at 100% rpm.
2. All distances and speeds are in nautical units.
3. Multiply all nautical units by 1.15 to obtain statute units.
4. Divide lb/hr by 6.5 to obtain gph of MIL-F-5624A, JP-4 fuel. Divide lb/hr by 6.0 to obtain gph of MIL-F-5572 fuel (gasoline).
5. Multiply gallons by factor in note 4 to obtain pounds.
6. Multiply 840 gallons by factor in note 4 to obtain maximum available fuel in pounds.

EXAMPLE

If you are at 10,000 feet with 5000 pounds of available fuel, you can fly 660 nautical air miles by holding 280 knots CAS. However, you can fly 900 nautical air miles by immediately climbing to 35,000 feet, using 100% rpm. At 35,000 feet, cruise at 215 knots CAS and start letdown 25 nautical miles from home. With an 80-knot head wind, the range at 35,000 feet would be .80 x 900 or 720 nautical miles. Cruise at 215 knots CAS with this wind and start letdown 20 nautical miles from destination.

LEGEND

EFFECTIVE WIND -H.W., HEAD WIND; T.W., TAIL WIND
RANGE FACTOR -RATIO OF GROUND DISTANCE TO AIR MILES FOR CORRESPONDING WINDS
G.S. -GROUND SPEED IN KNOTS
CAS -CALIBRATED AIRSPEED IN KNOTS
LB/HR -FUEL CONSUMPTION-POUNDS PER HOUR
RANGE -NAUTICAL MILES
KN -KNOTS
OPT. ALT -OPTIMUM ALTITUDE
DISTANCE -NAUTICAL MILES
( ) -RANGE IN PARENTHESES FOR INTERPOLATION PURPOSES ONLY

BASED ON ANY FUEL LISTED IN NOTE 4

DATA AS OF: 9-1-49

BASED ON: FLIGHT TEST

161-93-1415A

WADC Form 241N (11 Jun 51)

Figure A-15. Flight Operation Instruction Chart—Two 206½ Gallon Drop Tanks—16,800 to 14,000 Pounds (Sheet 2 of 2)

WADC Form 241M (11 Jun 51)

MODEL F-86A

FLIGHT OPERATION INSTRUCTION CHART

STANDARD DAY

EXTERNAL LOAD ITEM
TWO 206 1/2 GAL DROP TANKS

ENGINE(S): (1) J47-GE-7 OR -13

CHART WEIGHT LIMITS: 14,000 POUNDS OR LESS

NUMBER OF ENGINES OPERATING: ONE

POWER LIMITS	TIME LIMIT	% RPM	TAIL PIPE TEMP(°C)	OIL PRESS. (PSI)	OIL TEMP (°C)	FUEL PRESS. (PSI)
MILITARY	30	100	690	50	70	600
NORMAL	NONE	93	655	50	70	400

INSTRUCTIONS FOR USING CHART: (A) IN FLIGHT—Select figure in fuel column equal to, or less than, fuel available for cruise (fuel on board minus allowance for reserve, combat, navigational errors, formation flights, etc). Move horizontally right or left to section according to present altitude and read total range available (no wind) by cruising at that altitude or by climbing to another altitude of maximum range. For a flight at initial altitude, operating instructions are given directly below. For a flight at higher altitude, climb immediately to desired altitude and read cruising instruction in appropriate cruising altitude section. (B) FLIGHT PLANNING—From initial fuel on board subtract fuel required for take-off and climb to desired cruising altitude and all other necessary allowances. Then use chart as for IN FLIGHT above, adding initial climb distance to range values. DATA BELOW CONTAINS NO FUEL RESERVE FOR LANDING.

NOTES: Ranges shown at optimum altitudes are maximum. In order to obtain maximum range on flights requiring more than one chart (because of external configuration or gross weight changes), it is necessary to observe the optimum cruising altitude on each chart; i.e., when changing charts, a climb may be required to obtain a maximum range. All range values include allowances for descent distance and fuel. Climb distance and fuel are included where climbs are indicated.

DATA AS OF: 9-1-49

BASED ON: FLIGHT TEST

LOW-ALTITUDE CHART

161-93-1416

IF YOU ARE AT SEA LEVEL			FUEL	IF YOU ARE AT 5000 FT			IF YOU ARE AT 10,000 FT			IF YOU ARE AT 15,000 FT			FUEL	IF YOU ARE AT 20,000 FT		
RANGE IN AIR MILES				RANGE IN AIR MILES			RANGE IN AIR MILES			RANGE IN AIR MILES				RANGE IN AIR MILES		
BY CRUISING AT SL	OPT. ALT (1000 FT)	BY CRUISING AT OPT. ALT	(POUNDS)	BY CRUISING AT 5000 FT	OPT. ALT (1000 FT)	BY CRUISING AT OPT. ALT	BY CRUISING AT 10,000 FT	OPT. ALT (1000 FT)	BY CRUISING AT OPT. ALT	BY CRUISING AT 15,000 FT	OPT. ALT (1000 FT)	BY CRUISING AT OPT. ALT	(POUNDS)	BY CRUISING AT 20,000 FT	OPT. ALT (1000 FT)	BY CRUISING AT OPT. ALT
(RANGE FIGURES INCLUDE ALLOWANCES FOR PRESCRIBED CLIMB AND DESCENT TO SEA LEVEL.)																
330	35	530	3000	370	35	540	420	35	560	460	35	580	3000	500	35	590
270	35	420	2500	310	35	440	350	35	460	380	35	470	2500	420	35	490
220	35	320	2000	250	35	340	280	35	350	310	35	370	2000	340	35	380
160	30	220	1500	180	30	230	210	30	250	230	35	270	1500	250	35	280
110	10	120	1000	120	20	130	140	25	150	150	30	160	1000	170	30	180
50	--	---	500	60	--	---	70	--	---	80	--	---	500	80	--	---

CRUISING AT SEA LEVEL						EFFECTIVE WIND	CRUISING AT 5000 FT						CRUISING AT 10,000 FT						CRUISING AT 15,000 FT						EFFECTIVE WIND	CRUISING AT 20,000 FT					
	APPROXIMATE							APPROXIMATE						APPROXIMATE						APPROXIMATE						APPROXIMATE				
CAS	% RPM	LB/HR	G.S.	RANGE FACTOR	LET-DN DIST.	(KNOTS)	CAS	% RPM	LB/HR	G.S.	RANGE FACTOR	LET-DN DIST.	CAS	% RPM	LB/HR	G.S.	RANGE FACTOR	LET-DN DIST.	CAS	% RPM	LB/HR	G.S.	RANGE FACTOR	LET-DN DIST.	(KNOTS)	CAS	% RPM	LB/HR	G.S.	RANGE FACTOR	LET-DN DIST.
						120 H.W.																			120 H.W.	295	88	2600	275	.65	10
						80 H.W.							290	84	2600	255	.70	5	280	85	2450	270	.75	10	80 H.W.	285	87	2400	300	.75	10
290	80	2750	250	.85	0	40 H.W.	280	81	2550	260	.85	0	270	82	2300	270	.85	5	270	84	2300	295	.85	10	40 H.W.	260	85	2150	310	.85	10
260	77	2350	260	1.00	0	0	250	78	2200	270	1.00	0	250	80	2100	290	1.00	5	250	82	2050	310	1.00	10	0	250	84	2000	335	1.00	10
240	75	2150	280	1.15	0	40 T.W.	240	77	2050	300	1.15	0	240	79	2000	315	1.15	5	240	81	1950	335	1.15	10	40 T.W.	240	83	1900	360	1.15	15
						80 T.W.							230	78	1900	345	1.30	5	240	81	1950	375	1.30	10	80 T.W.	240	83	1900	400	1.25	15
						120 T.W.																			120 T.W.	240	83	1900	440	1.40	15

Figure A-16. Flight Operation Instruction Chart—Two 206½ Gallon Drop Tanks—14,000 Pounds or Less (Sheet 1 of 2)

HIGH-ALTITUDE CHART

MODEL: F-86A ENG: (1) J47-GE-7 OR -13 CHART WT LIMITS: 14,000 LB OR LESS EXT LOAD: TWO 206-1/2 GAL DROP TANKS NO. OF ENGINES OPERATING: ONE

IF YOU ARE AT 25,000 FT			FUEL	IF YOU ARE AT 30,000 FT			IF YOU ARE AT 35,000 FT			IF YOU ARE AT 40,000 FT			FUEL	IF YOU ARE AT 45,000 FT		
RANGE IN AIR MILES				RANGE IN AIR MILES			RANGE IN AIR MILES			RANGE IN AIR MILES				RANGE IN AIR MILES		
BY CRUISING AT 25,000 FT	OPT. ALT (1000 FT)	BY CRUISING AT OPT. ALT	(POUNDS)	BY CRUISING AT 30,000 FT	OPT. ALT (1000 FT)	BY CRUISING AT OPT. ALT	BY CRUISING AT 35,000 FT	OPT. ALT (1000 FT)	BY CRUISING AT OPT. ALT	BY CRUISING AT 40,000 FT	OPT. ALT (1000 FT)	BY CRUISING AT OPT. ALT	(POUNDS)	BY CRUISING AT 45,000 FT	OPT. ALT (1000 FT)	BY CRUISING AT OPT. ALT
(RANGE FIGURES INCLUDE ALLOWANCES FOR PRESCRIBED CLIMB AND DESCENT TO SEA LEVEL.)																
550	35	600	3000	600	35	620	630	--	---				3000			
460	35	500	2500	500	35	510	520	--	---				2500			
370	35	400	2000	400	35	410	420	--	---				2000			
280	35	290	1500	300	--	---	310	--	---				1500			
180	30	190	1000	200	--	---	210	--	---				1000			
90	--	---	500	100	--	---	110	--	---				500			

CRUISING AT 25,000 FT						EFFEC-TIVE WIND	CRUISING AT 30,000 FT						CRUISING AT 35,000 FT						CRUISING AT 40,000 FT						EFFEC-TIVE WIND	CRUISING AT 45,000 FT					
	APPROXIMATE							APPROXIMATE						APPROXIMATE						APPROXIMATE						APPROXIMATE				
CAS	% RPM	LB/HR	G.S.	RANGE FACTOR	LET-DN DIST.	(KNOTS)	CAS	% RPM	LB/HR	G.S.	RANGE FACTOR	LET-DN DIST.	CAS	% RPM	LB/HR	G.S.	RANGE FACTOR	LET-DN DIST.	CAS	% RPM	LB/HR	G.S.	RANGE FACTOR	LET-DN DIST.	(KNOTS)	CAS	% RPM	LB/HR	G.S.	RANGE FACTOR	LET-DN DIST.
290	90	2500	300	.65	10	120 H.W.	275	91	2300	310	.70	10	255	93	2100	310	.70	15							120 H.W.						
270	88	2250	315	.75	10	80 H.W.	265	90	2200	335	.80	15	255	93	2100	350	.80	20							80 H.W.						
260	87	2100	335	.90	15	40 H.W.	255	89	2050	360	.90	20	255	93	2100	390	.90	20							40 H.W.						
250	86	2000	360	1.00	15	0	245	88	1950	385	1.00	20	255	93	2100	430	1.00	25							0						
250	86	2000	400	1.10	15	40 T.W.	245	88	1950	425	1.10	20	245	92	2000	460	1.10	30							40 T.W.						
235	85	1850	420	1.20	20	80 T.W.	235	87	1850	450	1.25	25	245	92	2000	500	1.20	30							80 T.W.						
235	85	1850	460	1.30	20	120 T.W.	235	87	1850	490	1.35	30	240	91	1900	530	1.35	35							120 T.W.						

REMARKS:

1. Climb at 100% rpm.
2. All distances and speeds are in nautical units.
3. Multiply all nautical units by 1.15 to obtain statute units.
4. Divide lb/hr by 6.5 to obtain gph of MIL-F-5624A, JP-4 fuel. Divide lb/hr by 6.0 to obtain gph of MIL-F-5572 fuel (gasoline).
5. Multiply gallons by factor in note 4 to obtain pounds.

EXAMPLE

If you are at 10,000 feet with 2500 pounds of available fuel, you can fly 350 nautical air miles by holding 250 knots CAS. However, you can fly 460 nautical air miles by immediately climbing to 35,000 feet, using 100% rpm. At 35,000 feet, cruise at 255 knots CAS and start letdown 25 nautical miles from home. With an 80-knot head wind, the range at 35,000 feet would be .80 x 460 or 360 nautical miles. Cruise at 255 knots CAS with this wind and start letdown 20 nautical miles from destination.

LEGEND

EFFECTIVE WIND – H.W., HEAD WIND; T.W., TAIL WIND
RANGE FACTOR – RATIO OF GROUND DISTANCE TO AIR MILES FOR CORRESPONDING WINDS
G.S. – GROUND SPEED IN KNOTS
CAS – CALIBRATED AIRSPEED IN KNOTS
LB/HR – FUEL CONSUMPTION – POUNDS PER HOUR
RANGE – NAUTICAL MILES
OPT. ALT – OPTIMUM ALTITUDE
DISTANCE – NAUTICAL MILES

BASED ON ANY FUEL LISTED IN NOTE 4

DATA AS OF: 9-1-49

BASED ON: FLIGHT TESTS

161-93-1417A

WADC Form 241N (11 Jun 51)

Figure A-16. Flight Operation Instruction Chart—Two 206½ Gallon Drop Tanks—14,000 Pounds or Less (Sheet 2 of 2)

WADC Form 241M (11 Jun 51)

MODEL F-86A

FLIGHT OPERATION INSTRUCTION CHART

STANDARD DAY

EXTERNAL LOAD ITEM 16 ROCKETS

ENGINE(S): (1) J47-GE-7 OR -13

CHART WEIGHT LIMITS: 16,100 OR LESS POUNDS

NUMBER OF ENGINES OPERATING: ONE

POWER LIMITS	TIME LIMIT	% RPM	TAIL PIPE TEMP(C)	OIL PRESS. (PSI)	OIL TEMP (°C)	FUEL PRESS. (PSI)
MILITARY	30	100	690	50	70	600
NORMAL	NONE	93	655	50	70	400

INSTRUCTIONS FOR USING CHART: (A) IN FLIGHT—Select figure in fuel column equal to, or less than, fuel available for cruise (fuel on board minus allowance for reserve, combat, navigational errors, formation flights, etc). Move horizontally right or left to section according to present altitude and read total range available (no wind) by cruising at that altitude or by climbing to another altitude of maximum range. For a flight at initial altitude, operating instructions are given directly below. For a flight at higher altitude, climb immediately to desired altitude and read cruising instruction in appropriate cruising altitude section. (B) FLIGHT PLANNING—From initial fuel on board subtract fuel required for take-off and climb to desired cruising altitude and all other necessary allowances. Then use chart as for IN FLIGHT above, adding initial climb distance to range values. DATA BELOW CONTAINS NO FUEL RESERVE FOR LANDING.

NOTES: Ranges shown at optimum altitudes are maximum. In order to obtain maximum range on flights requiring more than one chart (because of external configuration or gross weight changes), it is necessary to observe the optimum cruising altitude on each chart, i.e., when changing charts, a climb may be required to obtain a maximum range. All range values include allowances for descent distance and fuel. Climb distance and fuel are included where climbs are indicated.

DATA AS OF: 9-1-49

BASED ON: FLIGHT TESTS

LOW-ALTITUDE CHART

161-93-1418

IF YOU ARE AT SEA LEVEL			FUEL	IF YOU ARE AT 5000 FT			IF YOU ARE AT 10,000 FT			IF YOU ARE AT 15,000 FT			FUEL	IF YOU ARE AT 20,000 FT		
RANGE IN AIR MILES				RANGE IN AIR MILES			RANGE IN AIR MILES			RANGE IN AIR MILES				RANGE IN AIR MILES		
BY CRUISING AT SL	OPT. ALT (1000 FT)	BY CRUISING AT OPT. ALT	(POUNDS)	BY CRUISING AT 5000 FT	OPT. ALT (1000 FT)	BY CRUISING AT OPT. ALT	BY CRUISING AT 10,000 FT	OPT. ALT (1000 FT)	BY CRUISING AT OPT. ALT	BY CRUISING AT 15,000 FT	OPT. ALT (1000 FT)	BY CRUISING AT OPT. ALT	(POUNDS)	BY CRUISING AT 20,000 FT	OPT. ALT (1000 FT)	BY CRUISING AT OPT. ALT
(RANGE FIGURES INCLUDE ALLOWANCES FOR PRESCRIBED CLIMB AND DESCENT TO SEA LEVEL.)																
(300)	30	(400)	3000	(330)	30	(420)	(360)	30	(430)	(390)	30	(440)	3000	---	--	---
250	30	320	2500	270	30	340	300	30	350	320	30	360	2500	(350)	30	(380)
200	25	240	2000	220	30	260	240	30	270	260	30	290	2000	280	30	300
150	25	170	1500	160	25	180	180	25	190	200	30	210	1500	210	30	220
100	--	---	1000	110	--	---	120	--	---	130	--	---	1000	140	--	---
50	--	---	500	50	--	---	60	--	---	70	--	---	500	70	--	---

CRUISING AT SEA LEVEL						EFFECTIVE WIND	CRUISING AT 5000 FT						CRUISING AT 10,000 FT						CRUISING AT 15,000 FT						EFFECTIVE WIND	CRUISING AT 20,000 FT					
	APPROXIMATE							APPROXIMATE						APPROXIMATE						APPROXIMATE						APPROXIMATE				
CAS	% RPM	LB/HR	G.S.	RANGE FACTOR	LET-DN DIST.	(KNOTS)	CAS	% RPM	LB/HR	G.S.	RANGE FACTOR	LET-DN DIST.	CAS	% RPM	LB/HR	G.S.	RANGE FACTOR	LET-DN DIST.	CAS	% RPM	LB/HR	G.S.	RANGE FACTOR	LET-DN DIST.	(KNOTS)	CAS	% RPM	LB/HR	G.S.	RANGE FACTOR	LET-DN DIST.
						120 H.W.																			120 H.W.	290	91	3050	270	.65	10
						80 H.W.							295	87	3050	260	.70	5	285	88	2850	270	.75	10	80 H.W.	280	90	2850	295	.75	10
275	81	2850	235	.85	0	40 H.W.	275	83	2750	255	.85	0	275	85	2750	275	.85	5	275	87	2700	300	.85	10	40 H.W.	275	89	2700	325	.85	10
255	79	2550	255	1.00	0	0	255	81	2500	275	1.00	0	250	83	2450	290	1.00	5	260	86	2550	325	1.00	10	0	260	88	2550	350	1.00	10
245	78	2450	285	1.15	0	40 T.W.	245	80	2350	300	1.15	0	240	82	2300	320	1.15	5	250	85	2400	350	1.15	10	40 T.W.	250	87	2400	375	1.15	15
						80 T.W.							230	81	2200	345	1.30	5	240	84	2250	375	1.30	10	80 T.W.	235	86	2250	400	1.30	15
						120 T.W.																			120 T.W.	235	86	2250	440	1.40	15

Figure A-17. Flight Operation Instruction Chart—16 Rockets—16,000 Pounds or Less (Sheet 1 of 2)

HIGH-ALTITUDE CHART

MODEL: F-86A ENG: (1) J47-GE-7 OR -13 CHART WT LIMITS: 16,100 LB OR LESS EXT LOAD: 16 ROCKETS NO. OF ENGINES OPERATING: ONE

IF YOU ARE AT 25,000 FT			FUEL	IF YOU ARE AT 30,000 FT			IF YOU ARE AT 35,000 FT			IF YOU ARE AT 40,000 FT			FUEL	IF YOU ARE AT 45,000 FT		
RANGE IN AIR MILES				RANGE IN AIR MILES			RANGE IN AIR MILES			RANGE IN AIR MILES				RANGE IN AIR MILES		
BY CRUISING AT 25,000 FT	OPT. ALT (1000 FT)	BY CRUISING AT OPT. ALT	(POUNDS)	BY CRUISING AT 30,000 FT	OPT. ALT (1000 FT)	BY CRUISING AT OPT. ALT	BY CRUISING AT 35,000 FT	OPT. ALT (1000 FT)	BY CRUISING AT OPT. ALT	BY CRUISING AT 40,000 FT	OPT. ALT (1000 FT)	BY CRUISING AT OPT. ALT	(POUNDS)	BY CRUISING AT 45,000 FT	OPT. ALT (1000 FT)	BY CRUISING AT OPT. ALT
(RANGE FIGURES INCLUDE ALLOWANCES FOR PRESCRIBED CLIMB AND DESCENT TO SEA LEVEL)																
---	--	---	3000	---	--	---							3000			
(370)	30	(390)	2500	(400)	--	---							2500			
300	30	310	2000	(320)	--	---							2000			
230	--	---	1500	240	--	---							1500			
150	--	---	1000	160	--	---							1000			
80	--	---	500	80	--	---							500			

CRUISING AT 25,000 FT						EFFEC-TIVE WIND	CRUISING AT 30,000 FT						CRUISING AT 35,000 FT						CRUISING AT 40,000 FT						EFFEC-TIVE WIND	CRUISING AT 45,000 FT					
	APPROXIMATE							APPROXIMATE						APPROXIMATE						APPROXIMATE						APPROXIMATE				
CAS	% RPM	LB/HR	G.S.	RANGE FACTOR	LET-DN DIST.	(KNOTS)	CAS	% RPM	LB/HR	G.S.	RANGE FACTOR	LET-DN DIST.	CAS	% RPM	LB/HR	G.S.	RANGE FACTOR	LET-DN DIST.	CAS	% RPM	LB/HR	G.S.	RANGE FACTOR	LET-DN DIST.	(KNOTS)	CAS	% RPM	LB/HR	G.S.	RANGE FACTOR	LET-DN DIST.
280	93	2900	285	.65	10	120 H.W.	245	93	2500	270	.70	10													120 H.W.						
270	92	2750	315	.75	10	80 H.W.	245	93	2500	310	.80	15													80 H.W.						
265	91	2600	340	.90	15	40 H.W.	245	93	2500	350	.90	20													40 H.W.						
255	90	2500	365	1.00	15	0	245	93	2500	390	1.00	20													0						
240	89	2350	390	1.15	15	40 T.W.	245	93	2500	430	1.10	20													40 T.W.						
240	89	2350	430	1.25	20	80 T.W.	245	92	2350	455	1.20	25													80 T.W.						
240	89	2350	470	1.35	20	120 T.W.	245	92	2350	495	1.35	30													120 T.W.						

REMARKS:

1. Climb at 100% rpm.
2. All distances and speeds are in nautical units.
3. Multiply all nautical units by 1.15 to obtain statute units.
4. Divide lb/hr by 6.5 to obtain gph of MIL-F-5624A, JP-4 fuel. Divide lb/hr by 6.0 to obtain gph of MIL-F-5572 fuel (gasoline).
5. Multiply gallons by factor in note 4 to obtain pounds.
6. Multiply 430 gallons by factor in note 4 to obtain maximum available fuel in pounds.

EXAMPLE

If you are at 10,000 feet with 2500 pounds of available fuel, you can fly 300 nautical air miles by holding 250 knots CAS. However, you can fly 350 nautical air miles by immediately climbing to 30,000 feet, using 100% rpm. At 30,000 feet, cruise at 245 knots CAS and start letdown 20 nautical miles from home. With an 80-knot head wind, the range at 30,000 feet would be .80 x 350 or 280 nautical miles. Cruise at 245 knots CAS with this wind and start letdown 15 nautical miles from destination.

LEGEND

EFFECTIVE WIND - H.W., HEAD WIND; T.W., TAIL WIND
RANGE FACTOR - RATIO OF GROUND DISTANCE TO AIR MILES FOR CORRESPONDING WINDS
G.S. - GROUND SPEED IN KNOTS
CAS - CALIBRATED AIRSPEED IN KNOTS
LB/HR - FUEL CONSUMPTION-POUNDS PER HOUR
RANGE - NAUTICAL MILES
KN - KNOTS
OPT. ALT - OPTIMUM ALTITUDE
DISTANCE - NAUTICAL MILES
( ) - RANGE IN PARENTHESES FOR INTERPOLATION PURPOSES ONLY

DATA AS OF: 9-1-49

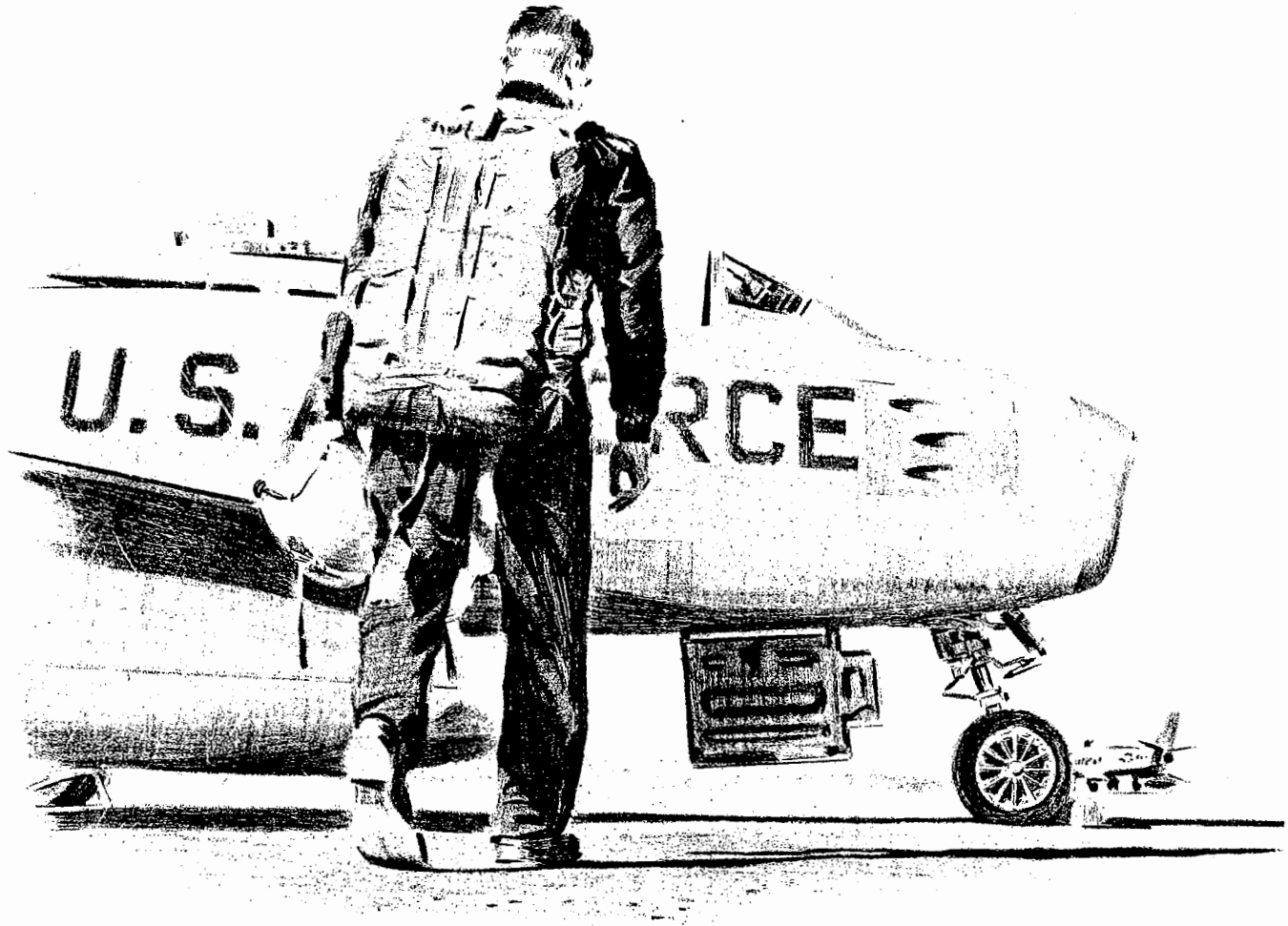
BASED ON: FLIGHT TESTS

BASED ON ANY FUEL LISTED IN NOTE 4

161-93-1419A

WADC Form 241N (11 Jun 51)

Figure A-17. Flight Operation Instruction Chart—16 Rockets—16,000 Pounds or Less (Sheet 2 of 2)



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