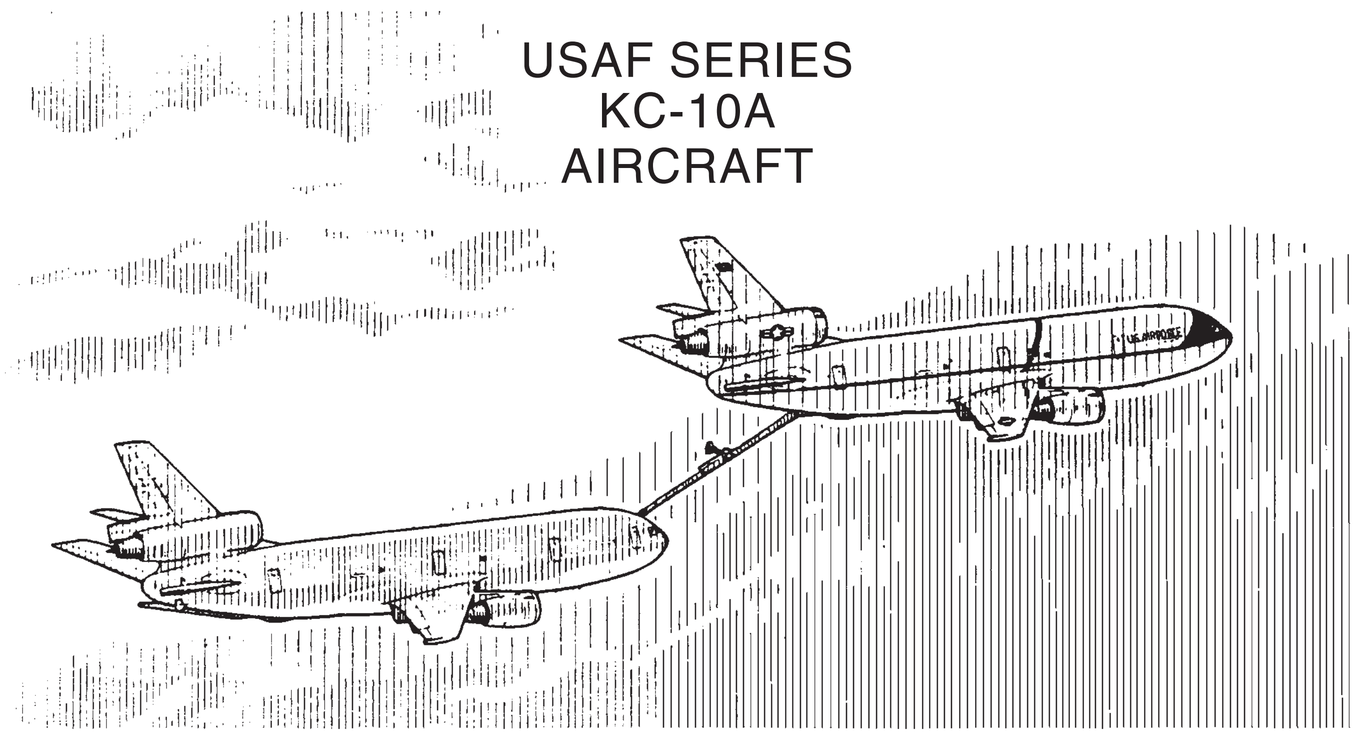
CARGO LOADING MANUAL

USAF SERIES
KC-10A
AIRCRAFT



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

Dates of issue for original and changed pages are:

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KC-10A
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ATA Chapter	Description of Systems to which the Government has UNLIMITED RIGHTS
◩ 21-00	Modifications to the Environmental Control System including:
◩ 21-24	Galley, lavatory, aerial refueling operators (ARO) ventilation, and ARO avionics rack
◩ 23-00	Modifications to the communications system, including the addition of:
■ 23-25	UHF communications system
■ 23-26	UHF satellite communications and AFSATCOM
■ 23-51	Flight interphone
■ 23-53	Secure voice
■ 23-55	Iridium Phone
◩ 25-00	Modifications to the interior, including:
■ 25-19	Environmental curtain and crew rest bunks
■ 25-21	Seat pallets
◩ 25-52	Cargo handling system
■ 25-58	ARO Compartment Equipment Racks
■ 25-90	ARO station in lower aft fuselage
■ 25-91	ARO seats
◩ 28-00	Modifications to the Fuel System, including:
■ 28-21	Tank refueling and defueling system, forward and aft fuselage tanks, isolation valve, and transfer valve
■ 28-22-5	Addition of forward and aft fuselage fuel supply tanks
■ 28-22-6	Addition of wing tip fuel pumps for tip tank transfer
■ 28-25	Fuel shroud drain
■ 28-51	Hydraulic alternate supply - auxiliary system for aerial refueling
■ 28-52	ARO viewing door actuation
■ 28-60	Aerial refueling system
■ 28-61	Fuel supply for aerial refueling
■ 28-62	Fuel pressure control for aerial refueling
■ 28-63	Aerial refueling pump low-pressure control
■ 28-64	Aerial refueling offload fuel flow indicator
■ 28-65	Refueling scavenging system
■ 28-70	Aerial refueling boom installation, boom control system, and boom control unit
■ 28-71	Boom mechanical system
■ 28-72	Boom flight control and actuation systems
■ 28-74	Boom telescopic control and actuation system
■ 28-75	Boom position indicator
■ 28-76	Aerial refueling signal and voice channel
■ 28-77	AR Pilot's director display and boom marker lighting
■ 28-78	Boom stowage and hoist system
■ 28-79	Nozzle pneumatic disconnect and indicator system
■ 28-81	Aerial refueling hose and drogue installation
■ 28-85	Aerial refueling hose and drogue lighting
■ 28-86	Boom post FOT&E
■ 28-91	Universal aerial refueling receptacle slipway installation (UARRSI)
■ 28-95	Aerial refueling receiver lighting and UARRSI lighting

◩ 31-00 Modifications to instruments:
- ■ 31-15 ARO compartment panels including boom operators instrument panel and overhead ARO instrument panel

◩ 33-00 Modifications to lighting systems, including:
- ■ 33-15 ARO refueling display and instrument panels lighting
- ■ 33-45 Anticollision and rendezvous lights
- ■ 33-49 Wing lights and fuselage lights
- ■ 33-49-1 Formation lights
- ■ 33-49-2 Aerial refueling underbody lights
- ■ 33-61 ARO instrument and panel lights
- ■ 33-62 ARO compartment lights

◩ 34-00 Modifications to navigation systems, including:
- ■ 34-21-4 TACAN radio magnetic indicators
- ■ 34-54 IFF transponder
- ■ 34-56 TACAN
- ■ 34-58 UHF ADF
- ■ 34-59-1 I-Band beacon
- ■ 34-59-2 J-Band beacon

◩ 35-00 Modifications to oxygen systems, including:
- ■ 35-10 Crew oxygen supply system
- ◩ 35-20 Passenger oxygen system excluding chemical oxygen generator

◩ 36-00 Modifications to the pneumatics systems, including:
- ■ 36-23 Manifold failure detection system

◩ 51-00 Structural modifications to the DC-10 to accommodate the above systems and stations, including:
- ■ ARO Compartment
- ■ Forward/aft fuselage tanks
- ■ UARRSI
- ■ Attachments for barrier nets
- ■ Boom installation
- ■ Drogue installation
- ■ Aerial refueling system
- ■ Revised aft cg position

◩ 52-00 Doors
- ■ 52-49 ARO sighting door
- ■ 52-57 ARO compartment door
- ■ 52-60 Crew exit/entry ladder and crew walkways

◩ 53-00 Fuselage
- ■ 53-54 ARO and boom fairings

◩ 56-00 Windows
- ■ 56-44 ARO scanning windows and mirrors

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GENERAL INFORMATION

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AIRCRAFT GENERAL DESCRIPTION

The USAF Series KC-10A aircraft, manufactured by McDonnell Douglas Corporation, is a sweptwing tri-jet monoplane designed for air refueling military aircraft and airlifting cargo and support personnel. The aircraft has fully retractable tricycle landing gear (with a load bearing center gear) and is powered by three interchangeable General Electric CF6-50C2 high-bypass turbofan engines. Each engine is flat rated at 52,500 pounds static takeoff thrust at sea level up to 86°F. A fan thrust reverser system is installed for each engine. The KC-10A is capable of operating in varying atmospheric conditions at altitudes up to and including 42,000 feet.

In addition to being equipped for air refueling military aircraft requiring either a boom or hose/drogue, the KC-10A may be refueled from another KC-10A or KC-135 tanker. The unobstructed cargo compartment will accept combinations of palletized cargo, vehicles and logistic equipment, and mixed cargo and support personnel.

AIRCRAFT DIMENSIONS

Exterior dimensions and ground clearances are shown in figure 1-1.

AIRCRAFT COMPARTMENTS

The main compartment areas throughout the aircraft are shown in figure 1-2. Each main compartment is separated from the other by structural partitions and/or floors.

As an aid in loading cargo pallets, the cargo compartment is divided, by stencilled notations on the sidewall, into multicompartments. These marked compartment areas locate corresponding fore and aft boundaries of the pallet floor-load positions (1L, 1R, 2L, 2R, etc.). On the righthand wall, single letters (A through N) identify compartments designated for longitudinal pallet loading on either side of the cargo floor. On the left-hand wall, double letters (AA through RR) identify compartments designated for lateral pallet loading on the left side of the cargo floor only. When the lettered compartments are referred to in the text of this manual, the corresponding pallet floor position is shown in parenthesis, e.g., compartment B (2L and 2R), BB (2L), etc. Figure 1-2 illustrates a typical longitudinal pallet arrangement that calls out both the pallet compartments by letter and the corresponding pallet position.

AIRCRAFT FUSELAGE STATIONS

Fuselage station locations act as orientation guides for the location of structure and equipment. Each station is part of a system, and each system has a point of origin (starting point) and direction of measurement. There are three basic station systems (reference planes) used throughout the fuselage. These systems are represented by the following symbols: X for lateral stations, Y for longitudinal stations, and Z for vertical stations. Figure 1-3 shows the three basic reference planes including their point of origin and the direction of measurement in relation to the aircraft.

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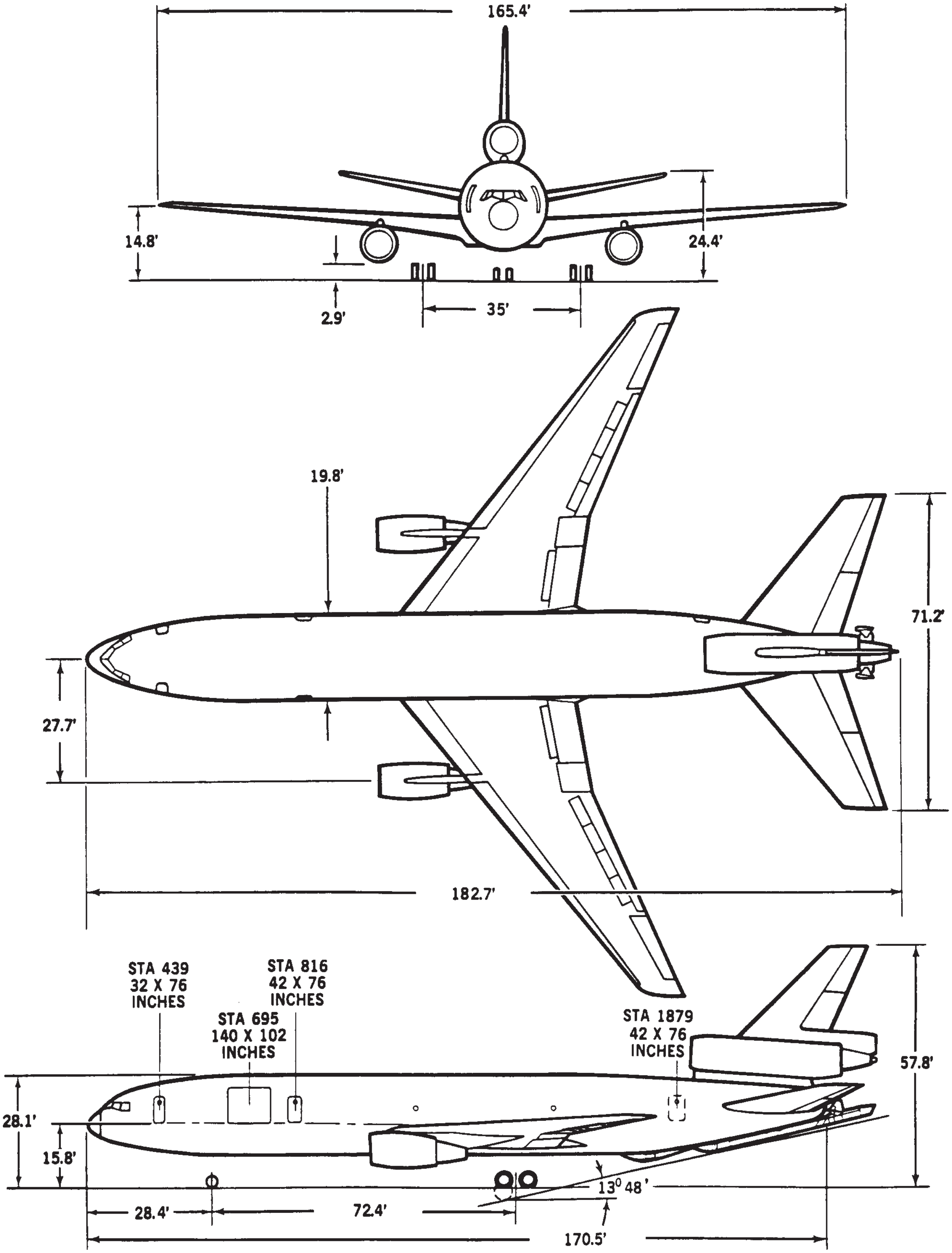

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Figure 1-1. Airplane Dimensions

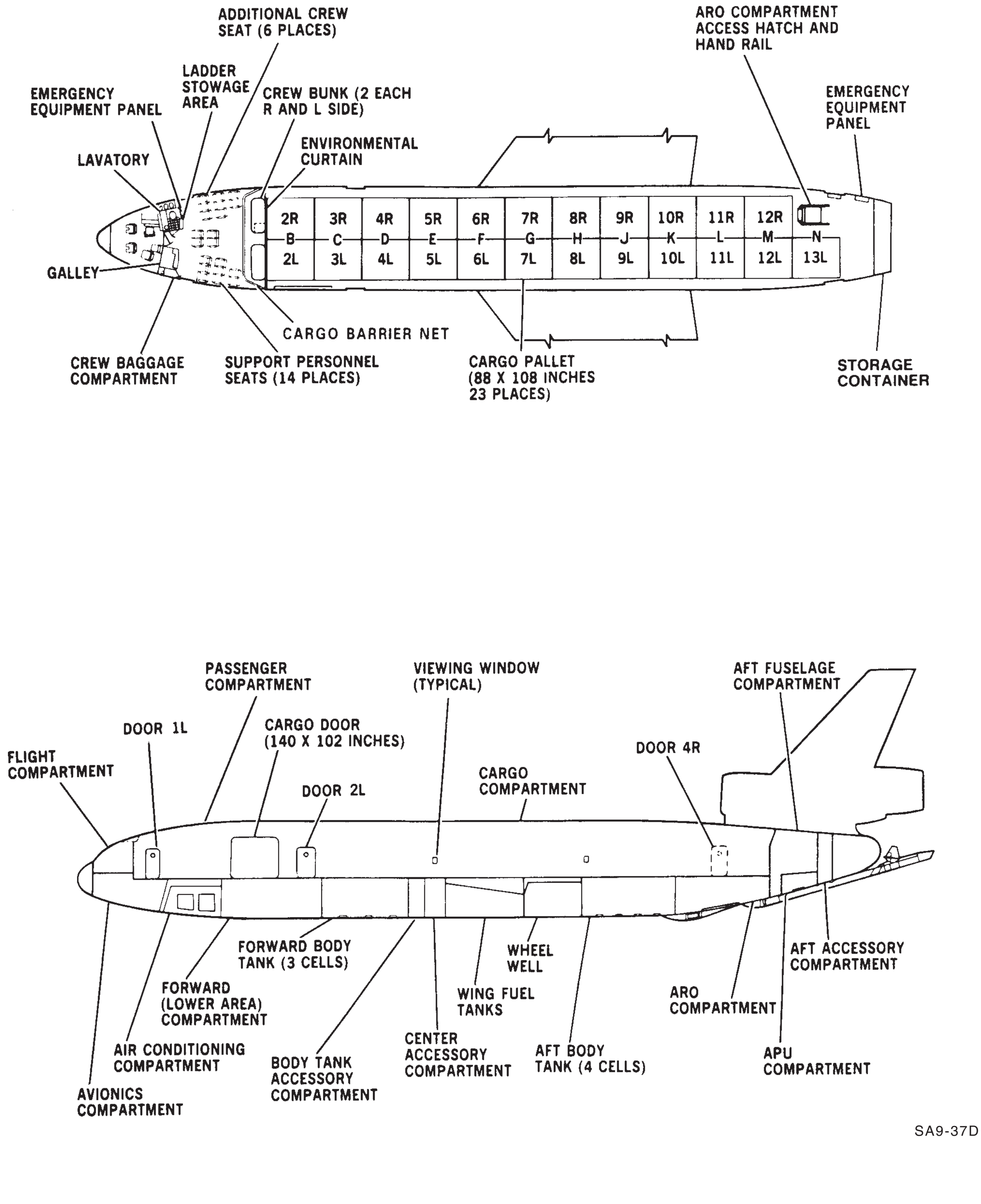

Figure 1-2. Compartment Diagram

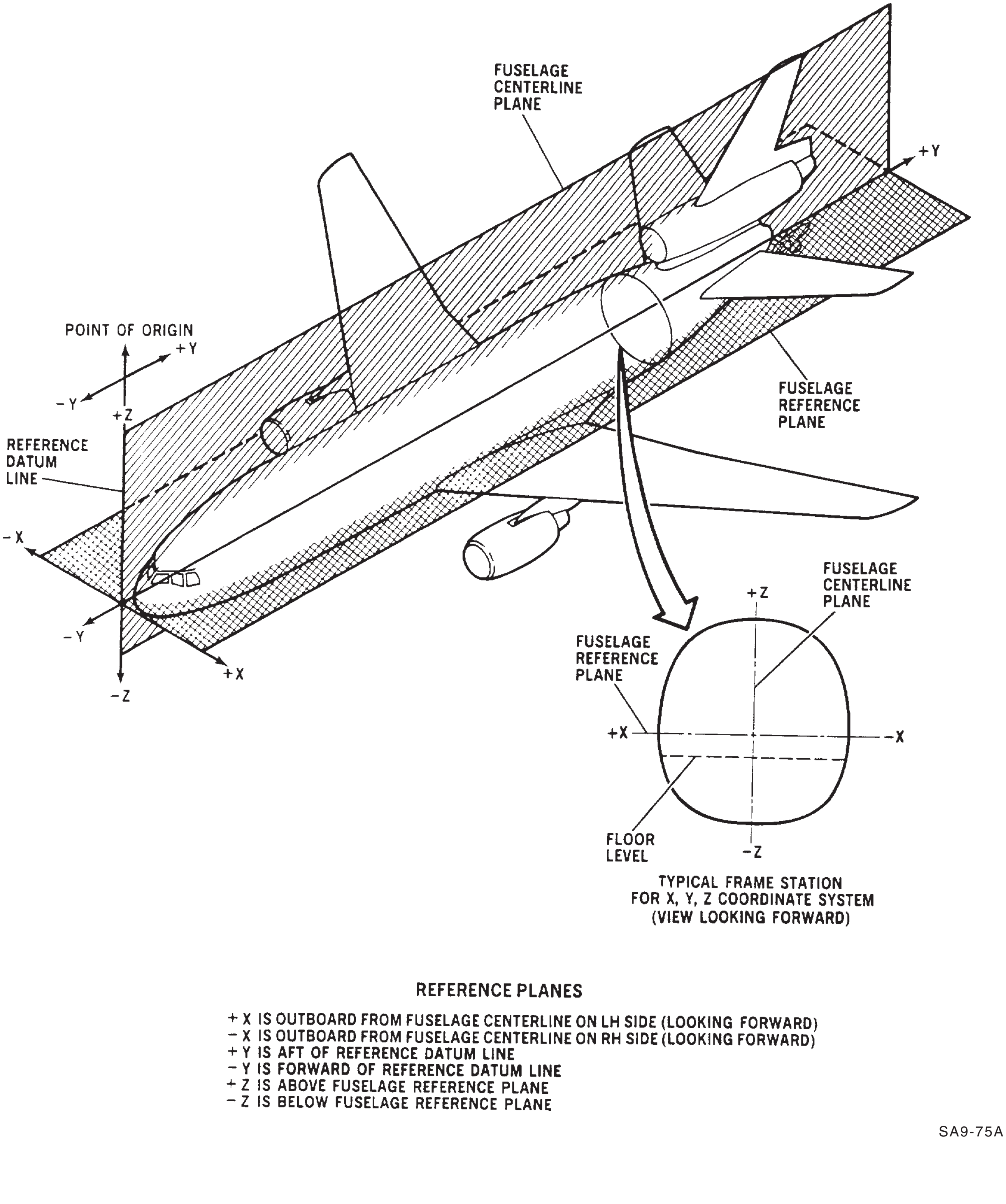

Figure 1-3. Fuselage Station Reference Planes

DANGER AREAS

During ground operations, certain areas adjacent to the aircraft are hazardous. All cargo loading personnel should familiarize themselves with the danger areas shown in figure 1-4.

PURPOSE OF MANUAL

The purpose of the manual is to provide cargo-handling personnel with sufficient information and data to plan, load, secure, and offload all types of cargo efficiently and safely, and to explain the restrictions governing these operations. The manual includes procedures pertaining to ground functions only.

PERMISSIBLE OPERATIONS

The manual takes a "positive approach" and normally states only what you can do.

NOTE

Unusual operations or configurations are prohibited unless specifically covered herein. Clearance from HQ AMC/A3VK must be obtained before any questionable operation, which is not permitted in this manual, is attempted.

MANUAL ARRANGEMENT

Information is presented, by text and illustrations, under six section headings as described in the succeeding paragraphs.

SECTION I - GENERAL INFORMATION

This section contains a general description of the aircraft, including dimensions, compartment diagrams, fuselage station reference planes, and danger areas. This section also presents the purpose and arrangement of the manual, revision information, related publications, and a glossary of words and phrases as used within the manual.

SECTION II - DESCRIPTION OF AIRCRAFT FEATURES

This section presents a general description of the cargo compartment, including its profile and cross section, loading capabilities, cargo door, cargo floor, cargo handling system components, cargo loading aids, personnel provisions and stowage provisions.

SECTION III - AIRCRAFT CONFIGURATION (APPLICATION)

This section presents aircraft preparation instructions with respect to aircraft cargo and personnel loading. These instructions include procedures for installing cargo handling system components and cargo loading aids. Also included are operating instructions for the cargo door, powered rollers system, and the cargo winch.

SECTION IV - GENERAL PROCEDURES (OPERATIONS)

This section contains general instructions relative to load planning, loading procedures, and offloading procedures for the aircraft with the cargo handling system installed. An amplified loading/offloading checklist is also included to cover each phase of the procedures.

SECTION V - SPECIFIC PROCEDURES

This section is divided into subsections. Each of the subsections

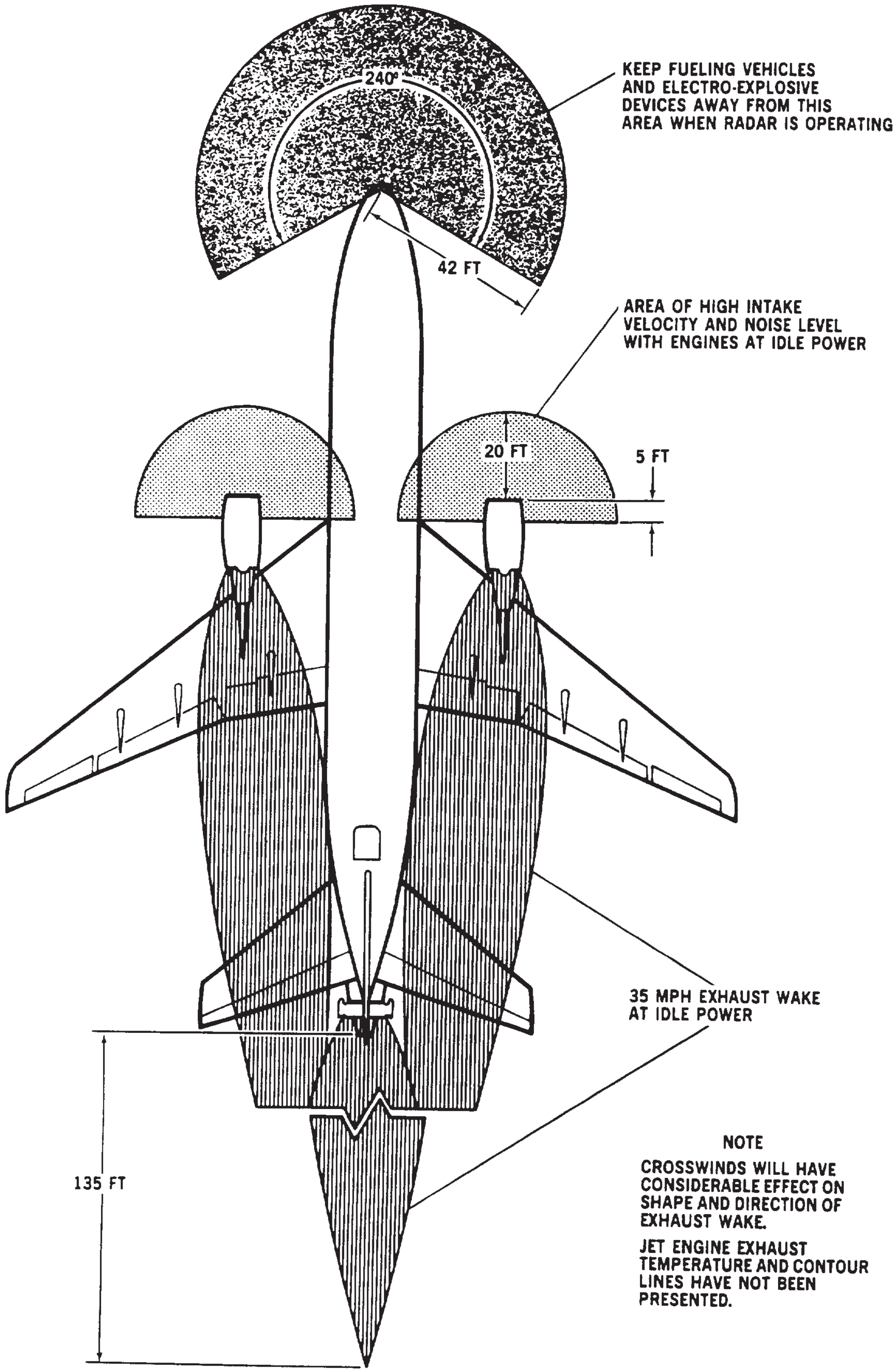

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Figure 1-4. Danger Areas

provide specific instructions for cargo items which, due to their physical characteristics, require special consideration over and above the general procedures presented in Section IV. Procedures in the subsections take precedence over instructions in Sections II, III, and IV when items covered by the subsections are being loaded.

SECTION VI - EMERGENCY PROCEDURES

This section describes ground emergency procedures.

CHECKLISTS

This manual contains an amplified checklist for loading/offloading cargo and personnel. This checklist is in Section IV. An abbreviated checklist containing these checks is issued as a separate technical order (TO 1C-10(K)A-9CL-1). See the status page in this manual for the latest issue date for the abbreviated checklist. Whenever a supplement affects the abbreviated checklist, a temporary page will be included in the supplement.

SAFETY SUPPLEMENTS

Information involving safety will be promptly forwarded to you in a safety supplement. Urgent information is published in interim safety supplements and transmitted by teletype. Formal supplements are mailed. The supplement title block and status page (published with formal supplement only) should be checked to determine the supplement's effect on the manual and other outstanding supplements.

OPERATIONAL SUPPLEMENTS

Information involving changes to operating procedures will be forwarded to you by operational supplements. The procedure for handling operational supplements is the same as for safety supplements.

WARNINGS, CAUTIONS, AND NOTES

The following definitions apply to warnings, cautions, and notes found throughout the manual:

WARNING

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

CAUTION

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

NOTE

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

SHALL/WILL, SHOULD, AND MAY

The following definitions apply to the words shall, will, should, and may:

Shall/Will - The instructions or procedures prefaced by shall or will are mandatory.

Should - Normally used to indicate a preferred but nonmandatory method of accomplishment.

May - An acceptable or suggested means of accomplishment.

HOW TO BE ASSURED OF HAVING LATEST DATA

Refer to TO 0-1-CD-1 or https://www.toindex-s.wpafb.af.mil for a listing of all current flight manuals, safety supplements, operational supplements, and checklists. Also check the manual cover page, the title block of each safety and operational supplement, and all status pages attached to formal safety and operational supplements. Clear up all discrepancies before flight.

HOW TO GET PERSONAL COPIES

Each crew member is entitled to personal copies of the Flight Manual, Safety Supplements, Operational Supplements and Checklists. The required quantities should be ordered before you need them to assure their prompt receipt. Check with your publication distribution officer - it is his job to fulfill your TO requests. Basically, you must order the required quantities from the Numerical Index and Requirement Table (NIRT). TO 00-5-1 gives detailed information for ordering these publications. Make sure a system is established at your base to deliver these publications to the flight crews immediately.

MANUAL BINDERS

Looseleaf binders and sectionalized tabs are available for use with your manual. They are obtained through local purchase procedures and are listed in the Federal Supply Schedule (FSC Group 75, Office Supplies, Part 1). Check with your local supply personnel for assistance in procuring these items.

YOUR RESPONSIBILITY TO LET US KNOW

Comments, corrections, and questions regarding this manual or any phase of the Flight Manual Program are welcome. These should be forwarded on AF Form 847 as directed by AFI 11-215 through your Command Headquarters to OC-ALC/544 ACSS, Tinker AFB, 73145-3018.

RELATED PUBLICATIONS

Publications providing additional information that may be used in conjunction with this loading manual are listed below. For a complete list of publications applicable to the KC-10A aircraft, refer to TO 1C-10(K)A-01, List of Applicable Publications, USAF Series KC-10A Aircraft. Refer to https://www.toindex-s.wpafb.af.mil for the latest publication dates for these technical orders.

Publication Number	Title
AFMAN 24-204	Preparing Hazardous Materials for Military Air Shipment
TO 00-25-172	Ground Servicing of Aircraft and Static Grounding/Bonding
TO 1-1B-50	Basic Technical Order for USAF Aircraft Weight and Balance
TO 1C-1-71	Listing of Cargo Tiedown Equipment Authorized for all Series Cargo Aircraft
TO 1C-10(K)A-1	Flight Manual, USAF Series KC-10A Aircraft
TO 1C-10(K)A-1CL-3	KC-10A Boom Operator's Emergency and Abnormal Procedures
TO 1C-10(K)A-1CL-3-1	KC-10A Boom Operator's Normal Procedures Checklist
TO 1C-10(K)A-2-12	Maintenance Manual Organizational, Servicing, USAF Series KC-10A Aircraft
TO 1C-10(K)A-2-21	Maintenance Manual Organizational, Air Conditioning, USAF Series KC-10A Aircraft
TO 1C-10(K)A-2-25	Maintenance Manual Organizational, Equipment/Furnishings, USAF Series KC-10A Aircraft
TO 1C-10(K)A-2-35	Maintenance Manual Organizational, Oxygen, USAF Series KC-10A Aircraft
TO 1C-10(K)A-5	Basic Weight Checklist and Loading Data
TO 1C-10(K)A-9CL-1	KC-10A Boom Operator's Loading/ Off-Loading Procedures, Abbreviated Checklist
TO 13C2-1-1	Cleaning, Repair and Test Instructions, Cargo Tiedown Equipment
TO 35D-33-2-2-11	Aircraft Cargo Pallet, Model HCU-6/E

GLOSSARY

The definitions in this glossary are not necessarily general definitions. They may apply only to the word or phrase as it is used in this manual.

ACL (ALLOWABLE CABIN LOAD)	Maximum payload that can be carried on a mission. It may be limited by the maximum takeoff gross weight, maximum landing gross weight, maximum zero fuel weight, or aircraft configuration. Maximum through load is limited to that which can be carried on the most restrictive leg of the mission.
ARM	The horizontal distance from a reference datum or a fulcrum, to the center of gravity of the item.
AXIS	A central line around which parts of a body are symmetrically arranged.
AXLE LOAD	The load imposed by all wheels on one axle of a vehicle.
CENTER OF GRAVITY (CG)	The center of mass, or balance point, of an object.
CLASS B COMPARTMENT	Class B cargo compartment is used for carriage of cargo, passengers, and crew members, and meets the standards of Federal Aviation Regulations, Part 25, Paragraph 25.857.
CLASS E COMPARTMENT	Class E cargo compartment is used only for carriage of cargo and crew members, and meets the standards of Federal Aviation Regulations, Part 25, Paragraph 25.857.
COEFFICIENT OF FRICTION	The ratio of force required to start or maintain a uniform velocity between two contacting surfaces to the perpendicular force holding them in contact.
COMPONENT	An ingredient or item in a system or unit.
COMPRESSIBLE CARGO	Cargo that can be deformed by crushing.
CONCENTRATED LOAD	A load which is supported by a small area compared to the size and weight of the total package.
CONFIGURATION	A relative disposition, pattern, or arrangement of parts.
CRITERIA	A standard or established rule.
CRYOGENIC CARGO	Containerized, liquefied gas such as liquid nitrogen or oxygen.
CYLINDRICAL ROLLERS	Rollers housed in the longitudinal conveyor assemblies of the cargo handling system.
FLOOR-LOADED CARGO	Any cargo loaded on shoring and secured directly on the cargo floor.

FRICTION	Resistance to relative motion between two surfaces in contact.
FULCRUM	A point where an object turns or rotates.
HORIZONTAL	Parallel to the horizon; at right angles to the vertical.
INTEGRAL	Formed as a unit with another part.
LATERAL	Of or relating to width; extending crosswise.
LINEAR FOOT	A measurement equal to the total width of the cargo floor by 12 inches in length.
LONGITUDINAL	Of or relating to length; extending lengthwise.
LONGITUDINAL CONVEYOR	A roller conveyor that allows the HCU-6/E pallets to be moved only in the forward and aft direction.
MOMENT	Weight x Arm = Moment.
OMNIDIRECTIONAL CONVEYOR	A roller conveyor that allows the HCU-6/E pallets to be moved and rotated in any direction.
ORIENTED	Arranged or aligned in relation to some specific reference.
OVERSIZE CARGO	Cargo that exceeds the dimensions of a single HCU-6/E pallet.
PACKAGE SIZE CHART	A chart showing maximum size of cargo (length, width, and height) that can be rotated through the cargo door.
PALLET CONTOURS	Dimensions of cargo that may be stacked on the HCU-6/E pallets for various locations within the aircraft.
PALLETIZED CARGO	Cargo that has been loaded and restrained on single or coupled HCU-6/E pallets prior to loading aboard the aircraft.
PALLET SUBFLOOR	Prepositioned HCU-6/E pallets secured in the cargo handling system prior to loading cargo.
PARALLEL	Extending in the same direction and at a constant distance apart, so as never to meet.
PLF (Pounds per Linear Foot)	The total load in net weight per foot of fuselage length, across the width of the pallet position.
PSF (Pounds per Square Foot)	The total load uniformly distributed over one square foot of cargo floor.
PSI (Pounds per Square Inch)	The total load uniformly distributed over one square inch of cargo floor.

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REFERENCE DATUM An imaginary vertical plane, at or near the nose of the aircraft, from which all horizontal distances along the longitudinal axis of the aircraft are measured.

SHORING Plywood, board, or planking on the cargo floor to spread the load over a larger area, or to prevent damage.

SLEEPER SHORING Shoring used with vehicle suspension systems when they cannot withstand G loads without failure or depression resulting in slack of tiedown devices. This type of shoring is placed between the pallet and a structural part of the vehicle such as the frame or axles.

SYMMETRICAL TIEDOWN Tiedown devices installed in a uniform pattern by using corresponding tiedown points on each side of the cargo unit.

UNIFORM LOAD A large contact point, where the weight is evenly distributed over the contact point.

VEHICLE Any unit of cargo which is supported by wheels or tracks.

VERTICAL Being in a position or direction perpendicular to the plane of the horizon up and down.

WHEEL LOAD The load imposed on one end of an axle, regardless of the number of wheels

DESCRIPTION OF AIRCRAFT FEATURES

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GENERAL DESCRIPTION OF AIRCRAFT FEATURES

The cargo handling system, in conjunction with cargo loading aids, is designed to expedite loading, securing, and offloading combinations of palletized cargo, vehicles, and wheeled equipment within the space and weight limitations of the cargo compartment. The system is basically a manual loading system with a lateral power-assisted transfer capability that affords loading, offloading, turning, and aligning palletized cargo. Longitudinal rollers allow fore and aft movement of palletized cargo within the cargo compartment. Seat tracks down the length of the cargo compartment floor provide for the attachment of crew/personnel seats, interior equipment, and cargo handling system components. The 140- by 102-inch cargo door, located on the left side of the fuselage between stations 625 and 765, provides access to the cargo compartment. In an all-cargo configuration, the cargo compartment is capable of accommodating up to 27 HCU-6/E cargo pallets.

For cargo missions requiring additional crew members or support personnel, three basic cargo/personnel configurations are possible, depending on the number of personnel to be carried. In addition to the normal 5-man crew (all-cargo configuration), extra seating can be provided for 6 to 20 personnel, and with the increased accommodation unit, 75 personnel can be accommodated. One double-tiered bunk is provided in the all-cargo configuration, and in the mixed cargo/personnel configurations, two double-tiered bunks are installed.

An Aerial Refueling Operator's (ARO) station hatch is located in the right side of the cargo floor between stations 1830 and 1869. To provide access to the ARO station at all times, a walkway exists down the right side of the fuselage.

The flight crew compartment is separated from the cargo compartment by a bulkhead with a centrally located access door. Five permanently installed seats are provided for the crew members.

CARGO COMPARTMENT

The cargo compartment utilizes the maximum amount of available space within the fuselage frame. With the exception of overhead panels in the forward section, and the centrally-located overhead air conditioning duct, the compartment is unobstructed throughout its height. Floor area of the cargo compartment is limited only by the required walkway extending along the right side, and the ARO compartment access hatch located aft, on the right side of the compartment.

Electrical power outlets and control switches, public address and interphone jacks and compartment lighting control switches are conveniently located within the cargo compartment. The cargo compartment is pressurized and air conditioned. A cryogenic vent is provided for overboard venting of liquefied oxygen, nitrogen and other liquefied gasses, when carried in containers as cargo.

Decals and markings, on the cargo compartment floor and walls, provide the means to locate components of the cargo handling system and properly position cargo.

CARGO COMPARTMENT ENVELOPE

The cargo compartment (figure 2-1) extends from fuselage station 496 to 2004, for an overall length of 1508 inches. The primary pallet loading zone is between fuselage stations 521 and 1937. Additional stowage area for miscellaneous equipment or cargo is provided from fuselage station 1937 to 2004.

Through the constant section of the fuselage, between station 652 and 1542, the cargo floor width is 218 inches. At 100 inches above the floor level, the compartment width is approximately 144 inches. Due to the curvature of the fuselage, the compartment area forward and aft of the constant section diminishes in height and width. Principal dimensions are shown in the cross-section views of figure 2-1.

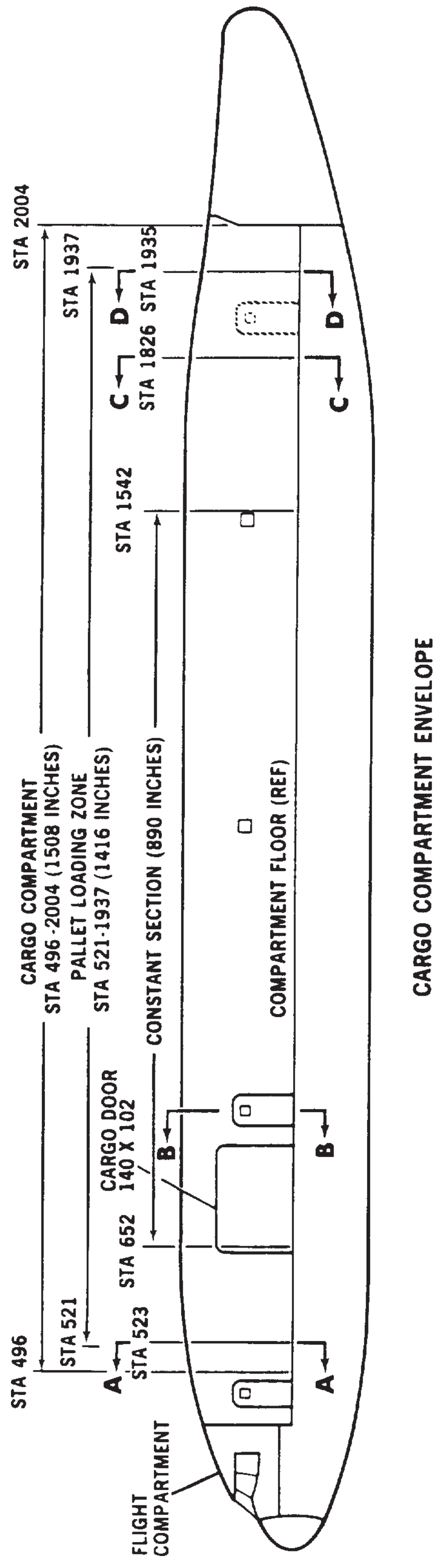
CARGO COMPARTMENT ELECTRICAL POWER SUPPLY AND OUTLETS

Electrical power for the cargo compartment area during loading and offloading operations is normally supplied by the aircraft's auxiliary power unit (APU). If required, electrical power may be supplied by an external ground power source. The aircraft's normal 28 VDC and 115/200 VAC, 400 Hz, 3-phase electrical power supply is available when either power source is activated. Operation of the electrical power system is contained in TO 1C-10(K)A-1.

The cargo compartment APU and external power control panel is located in the left-hand crew baggage compartment, inside the upper left stowage compartment, at station 420 (figure 2-2). Annunciator lights on the panel indicate availability of either power source. When the applicable power switch is moved to the ON position, the appropriate IN USE light will come on, indicating that electrical power is being supplied to the cargo compartment for the operation of the cargo door, cabin doors, lighting, powered rollers, and the cargo winch.

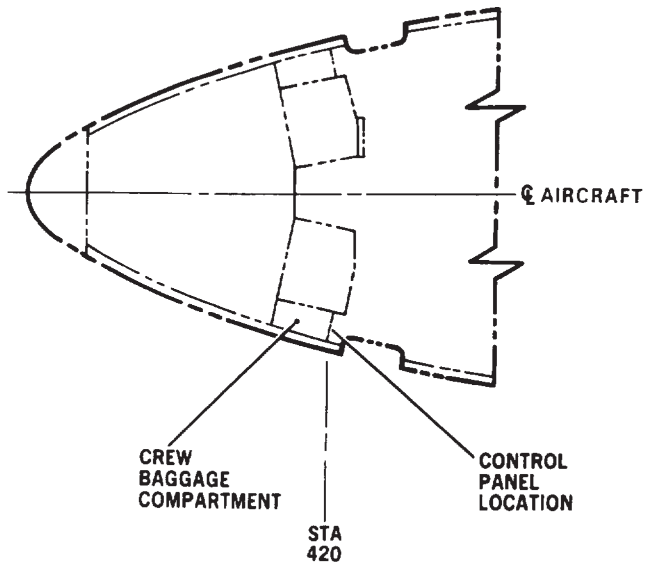
Circuit breakers for the cargo compartment electrical power supply are on three separate equipment service panels. Two panels are located overhead, behind ceiling doors, at station 516 (figure 2-3, sheets 1 and 2). The third service panel is located on the extreme upper left-hand side of the control panel in the ARO compartment (figure 2-3, sheet 3). In the event of an isolated malfunction, the boom operator can reset the applicable circuit breaker or determine if maintenance is required.

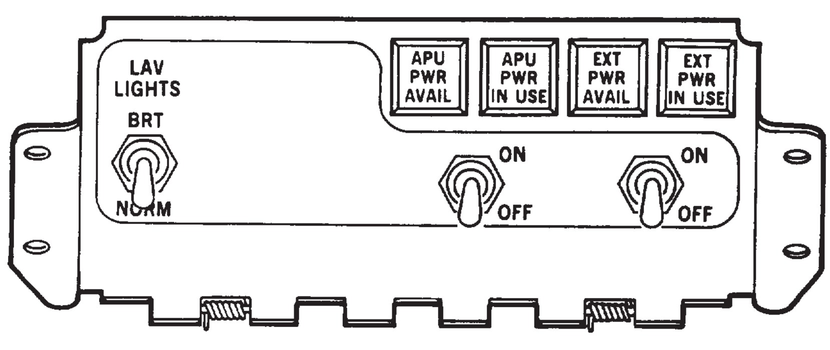
Four 115/200 VAC, 400 Hz, 3-phase power outlets (figure 2-4) are installed along the right wall of the cargo compartment, approximately 10 inches above the floor, at stations 462, 846, 1311, and 1909. These outlets provide the electrical power required for operating the portable cargo winch. The locations of the four outlets allow the winch to be installed wherever required for loading and offloading operations.



SA9-30B

Figure 2-1. Cargo Compartment Envelope

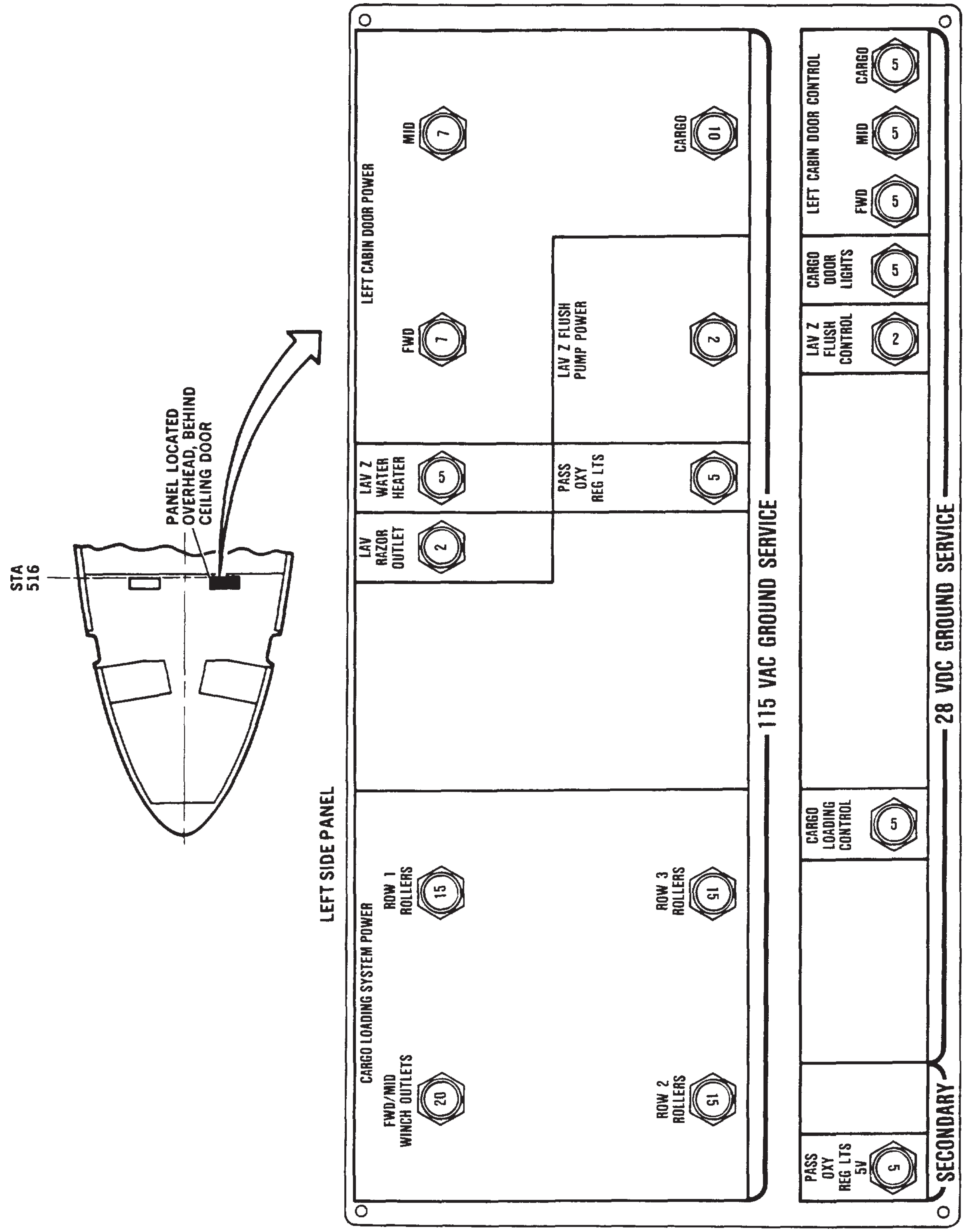




APU AND EXTERNAL POWER SWITCHES
(HINGED COVER DELETED FOR CLARITY)

SA9-53A

Figure 2-2. Cargo Compartment APU and External Power Control Panel



SA9-50

Figure 2-3. Cargo Compartment Electrical Power Circuit Breakers (Sheet 1)

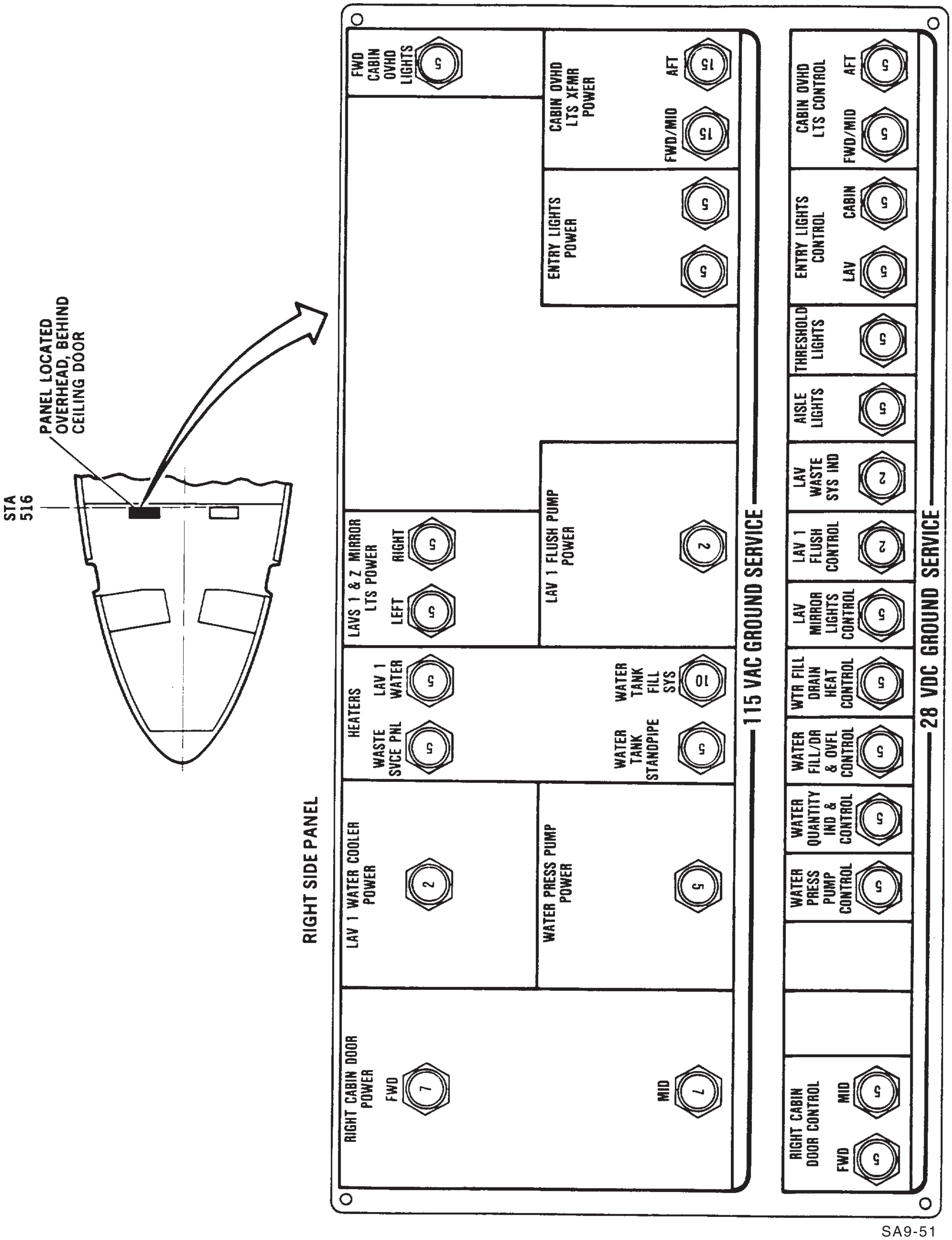


Figure 2-3. Cargo Compartment Electrical Power Circuit Breakers (Sheet 2)

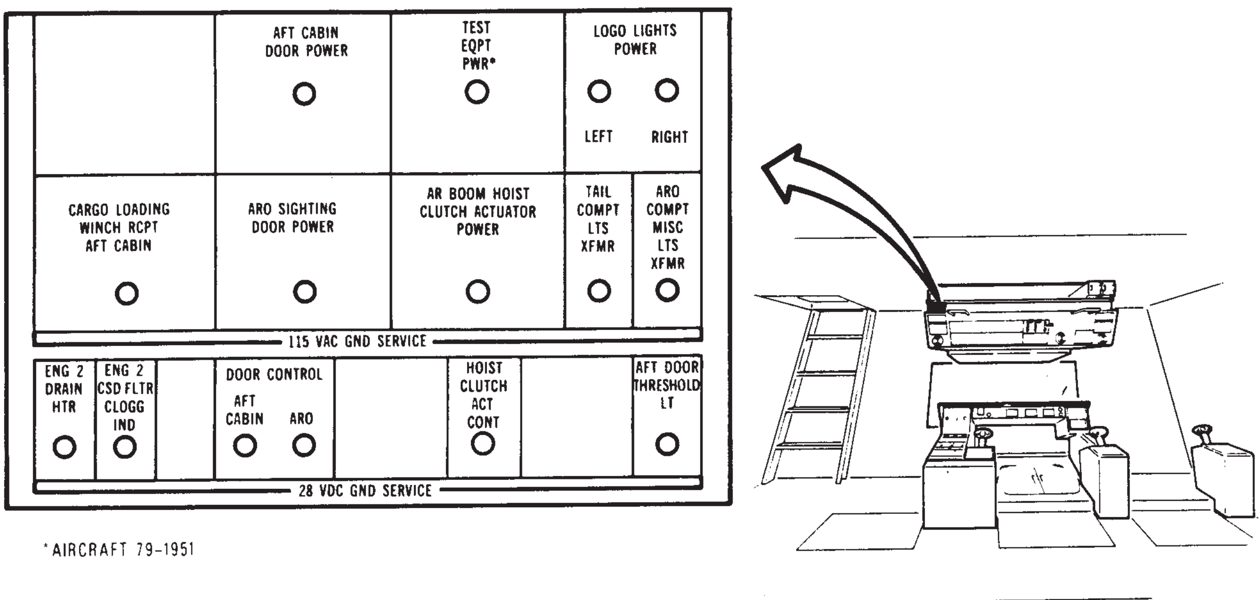


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Figure 2-3. Cargo Compartment Electrical Power Circuit Breakers (Sheet 3)

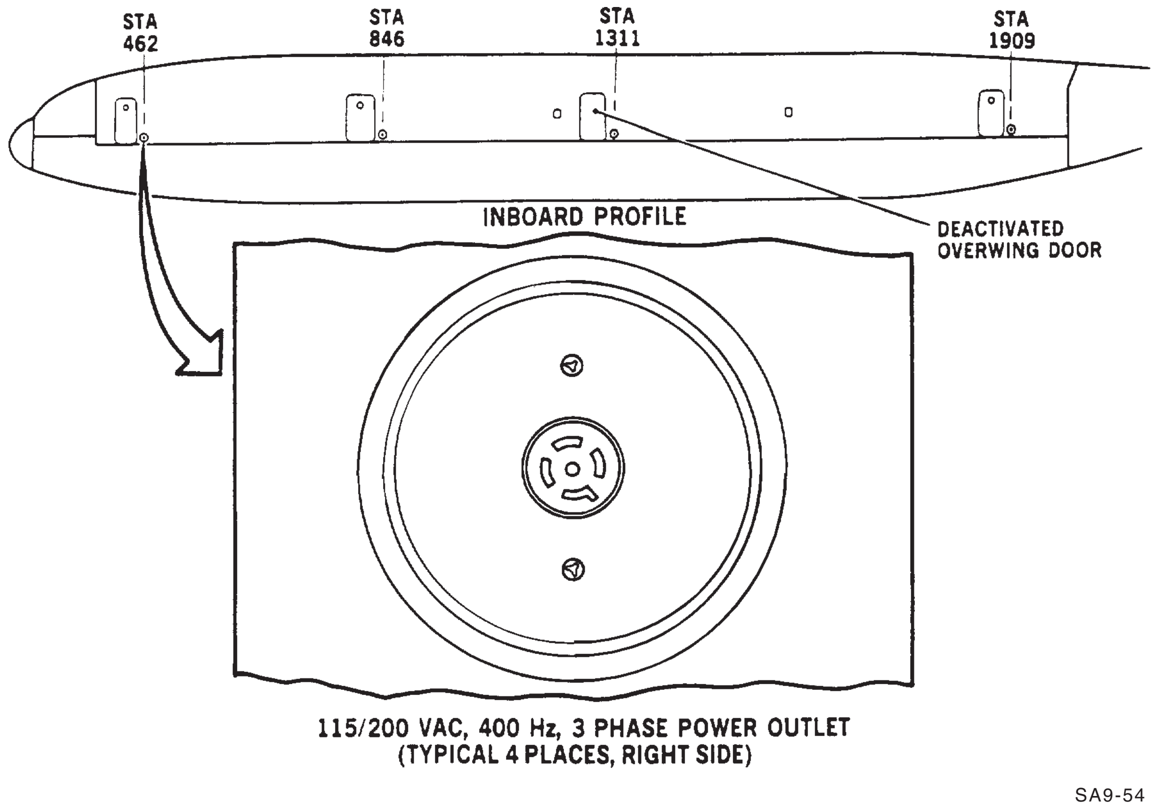


Figure 2-4. Cargo Compartment Electrical Outlets

CARGO COMPARTMENT PUBLIC ADDRESS SYSTEM

The public address system (figure 2-5) provides the means to make announcements to personnel in the passenger area. Announcements are made with a hand-held microphone containing a press-to-talk (PTT) switch. The microphone is stowed on the overhead oxygen console above the first row of left-hand personnel seats, at station 475. Announcements are heard by personnel through overhead speakers in the passenger area and the lavatories. Announcements can also be made from the flight crew compartment.

Chime tones, initiated from the flight crew compartment, alert passengers when the NO SMOKING, FASTEN SEAT BELT and RETURN TO CABIN signs are turned on. The chime tone will sound automatically if cabin altitude exceeds a preset level.

CARGO COMPARTMENT FLIGHT INTERPHONE SYSTEM

The flight interphone system (figure 2-5) is used by crew members to communicate between the flight crew, ARO and cargo compartments.

In the cargo compartment, a headset with boom microphone is stowed on the overhead oxygen console, left side, at station 475. An extension cable is stowed in a wall mounted box, just aft of the right overwing deactivated door, at station 1332. A HOT MIC-PTT selector switch is located at each of these stations. At station 475, the switch is a toggle type. At station 1332, the switch is a slide type.

Four interphone jacks are installed in the cargo compartment. One is located aft of the cargo door (station 772), two are located just aft of each deactivated overwing door (station 1330), and one is located forward of door 4R.

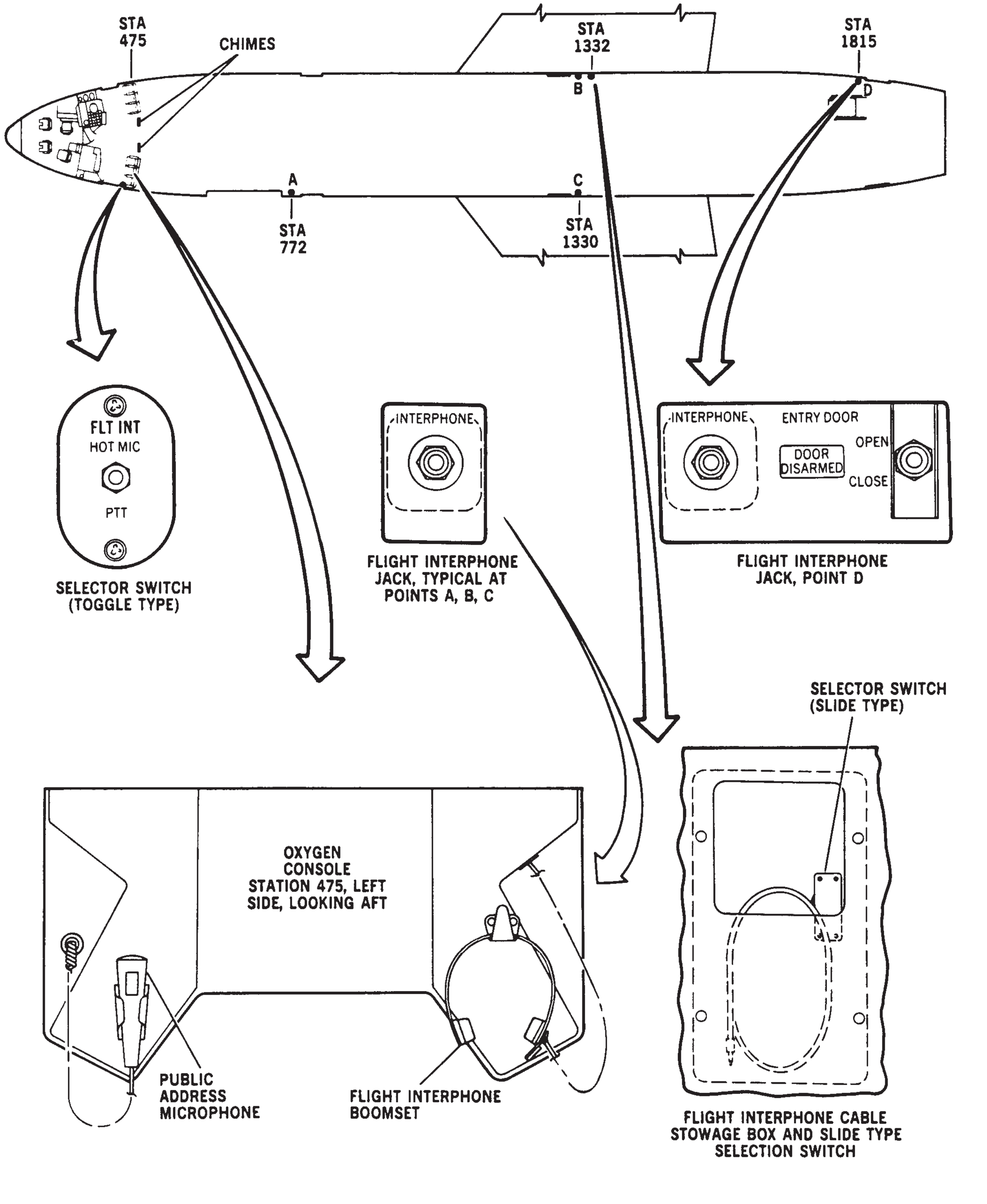


Figure 2-5. Cargo Public Address and Flight Interphone System

CARGO COMPARTMENT CRYOGENIC VENT

A cryogenic vent (figure 2-6) is installed to provide venting of liquefied oxygen, nitrogen, and other liquefied gases carried in containers as cargo. It is an integral part of the fuselage structure, and is located on the left side at station 1149, approximately 10 inches above floor level. The vent assembly consists of an integrally-fitted vent tube, a recessed pan surrounding the tube, a hose adapter, a vent plug, and a coupling to retain either the hose adapter or plug in the vent.

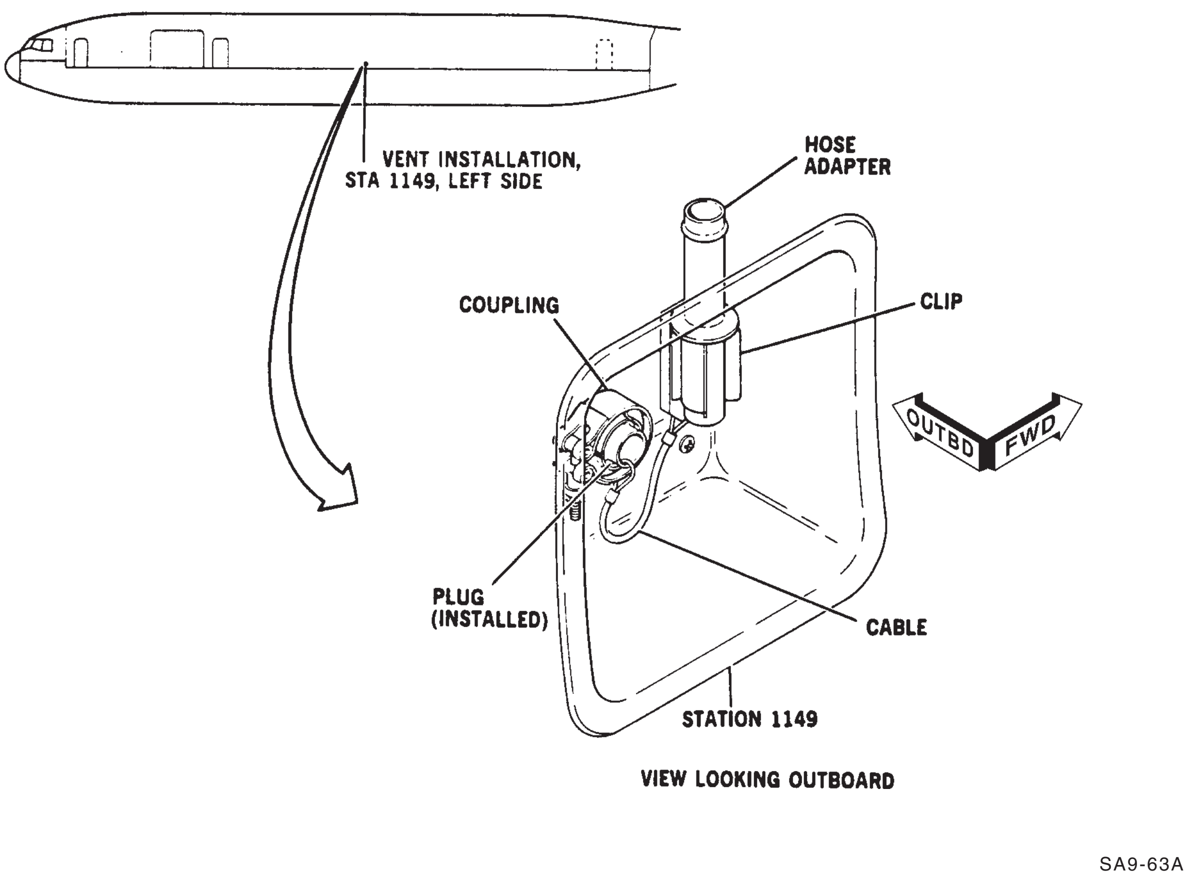


Figure 2-6. Cargo Compartment Cryogenic Vent

CARGO COMPARTMENT DECALS AND MARKINGS

Decals on the cargo compartment floor, and compartment location identifiers along the sidewalls provide the means to position cargo handling system components and load cargo in specific areas as planned.

Each decal on the cargo floor locates a specific cargo handling system component by part number. Where a component is of a particular shape or configuration, the decal pattern indicates the precise position and alignment of that component. The decals are in two different colors. Yellow decals locate cargo handling system components for longitudinal loading of HCU-6/E pallets throughout the cargo compartment. White decals, on the left side of the aircraft centerline only, locate cargo handling system components for lateral loading of HCU-6/E pallets. In addition, other decals identify pallet positions (1L, 1R, 2L, 2R, etc.). These decals are also color-coded yellow and white with respect to longitudinal and lateral loading of pallets.

Each cargo handling system component has its part number affixed to it. This is either a decal or a stencil. Where required, an arrow and the notation, FWD, indicates the direction in which the component is to be installed.

Cargo compartment identification notations are stencilled along both compartment sidewalls. The stencilled notations consist of compartment identification by letters (for each cargo floor pallet position), fore and aft compartment area boundary markers with the applicable fuselage station number, and the load-weight capacity within each compartment boundary. On the right-hand wall, single letters (A through N) identify compartments for longitudinal pallet loading on both sides of the cargo floor. On the left-hand wall, double letters (AA through RR) identify compartments for lateral pallet loading on the left side of the cargo floor only.

CARGO DOOR

The cargo door (figure 2-7) provides access to the cargo compartment for loading and offloading cargo. The door is located on the forward left side of the fuselage, between stations 625 and 765. It is 140 inches wide, and measures 102 inches high from floor level.

The door is hinged at the top and opens outboard and upward. Hold-open latches, which are linked to the door actuating piston, allow the door to be locked in the mid-open and full-open positions. Latches, located along the lower edge of the door, lock the door in the closed position.

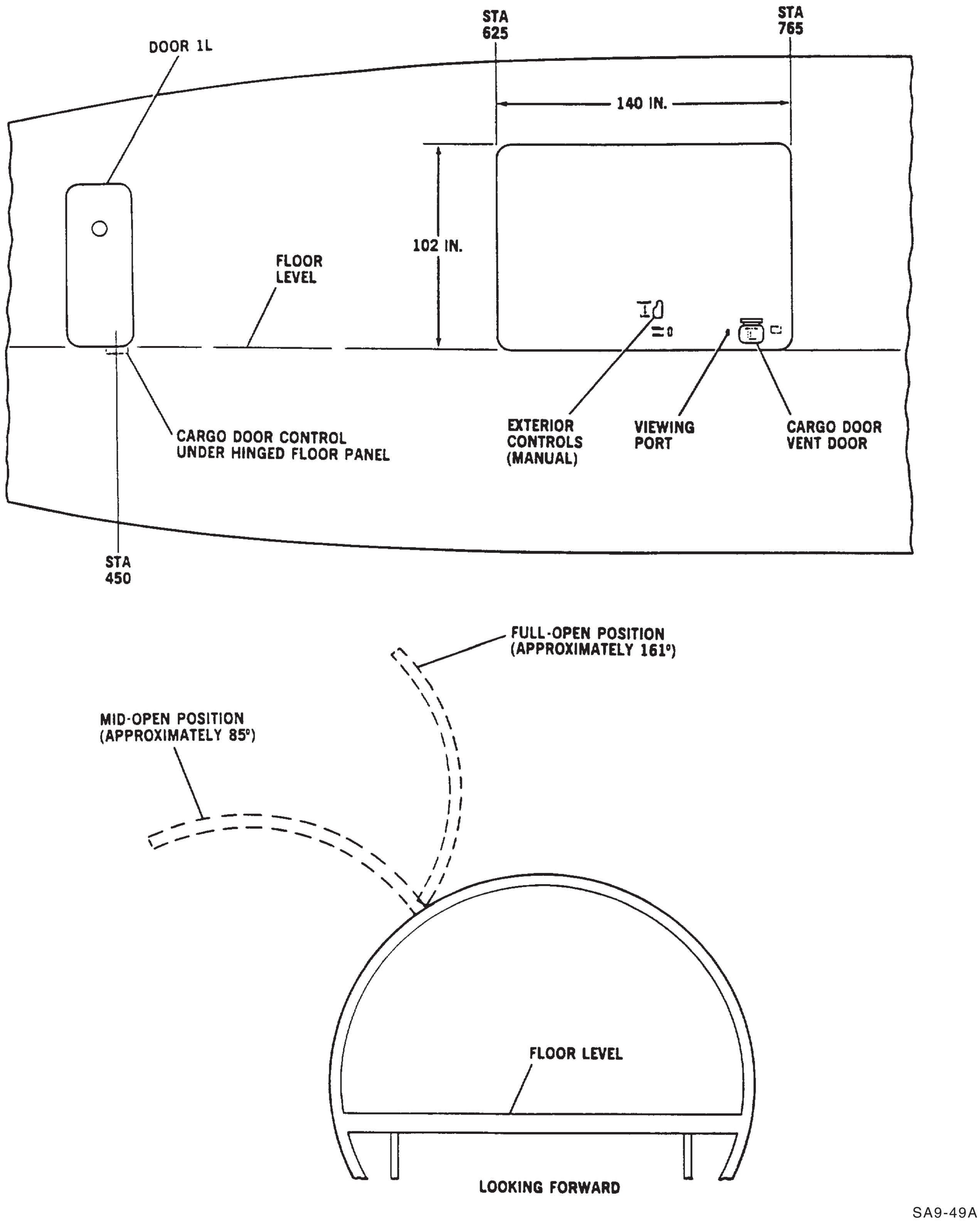


Figure 2-7. Cargo Door

CARGO COMPARTMENT FLOOR

The cargo compartment floor is capable of supporting approximately 170,000 pounds of cargo in an all-cargo mission. Built-in seat tracks make it possible to carry palletized cargo, miscellaneous cargo (properly shored), and various combinations of cargo and personnel.

CARGO FLOOR CONSTRUCTION

Basic cargo floor construction (figure 2-8) consists of seat tracks tied longitudinally to stanchion-braced floor crossbeam structures. Cargo floor panels are secured to seat track flanges and crossbeam-mounted support members with counter-sunk machine screws. The upper surface is set just below the seat track height. The floor panels are of sandwich construction, consisting of 0.016-inch aluminum sheet on the upper surface, 0.010-inch aluminum sheet on the lower surface, and an end grain balsa wood core of eight pounds per cubic foot density.

CARGO FLOOR SEAT TRACKS

Ten rows of seat tracks (figure 2-9) are arranged symmetrically to the cargo compartment centerline, from station 392 to 1942. The tracks are secured to the floor beam structure. Slots in the tracks provide for the attachment of cargo handling system components, cargo loading aids, removable lavatory, galley installation, crew bunks, and additional crew/ personnel seats.

Eight four-inch sections of seat track are installed on the floor in the aft section of the cargo compartment. They are located across the cargo floor between stations 1942 and 2007. These sections provide anchor points for tiedown fittings when securing miscellaneous equipment or cargo.

CARGO FLOOR NONSKID SURFACES

Nonskid surfaces are applied to the cargo compartment floor to provide secure footing and added convenience for aircrew and loading team members. All nonskid zones within the cargo compartment are shown in figure 2-10.

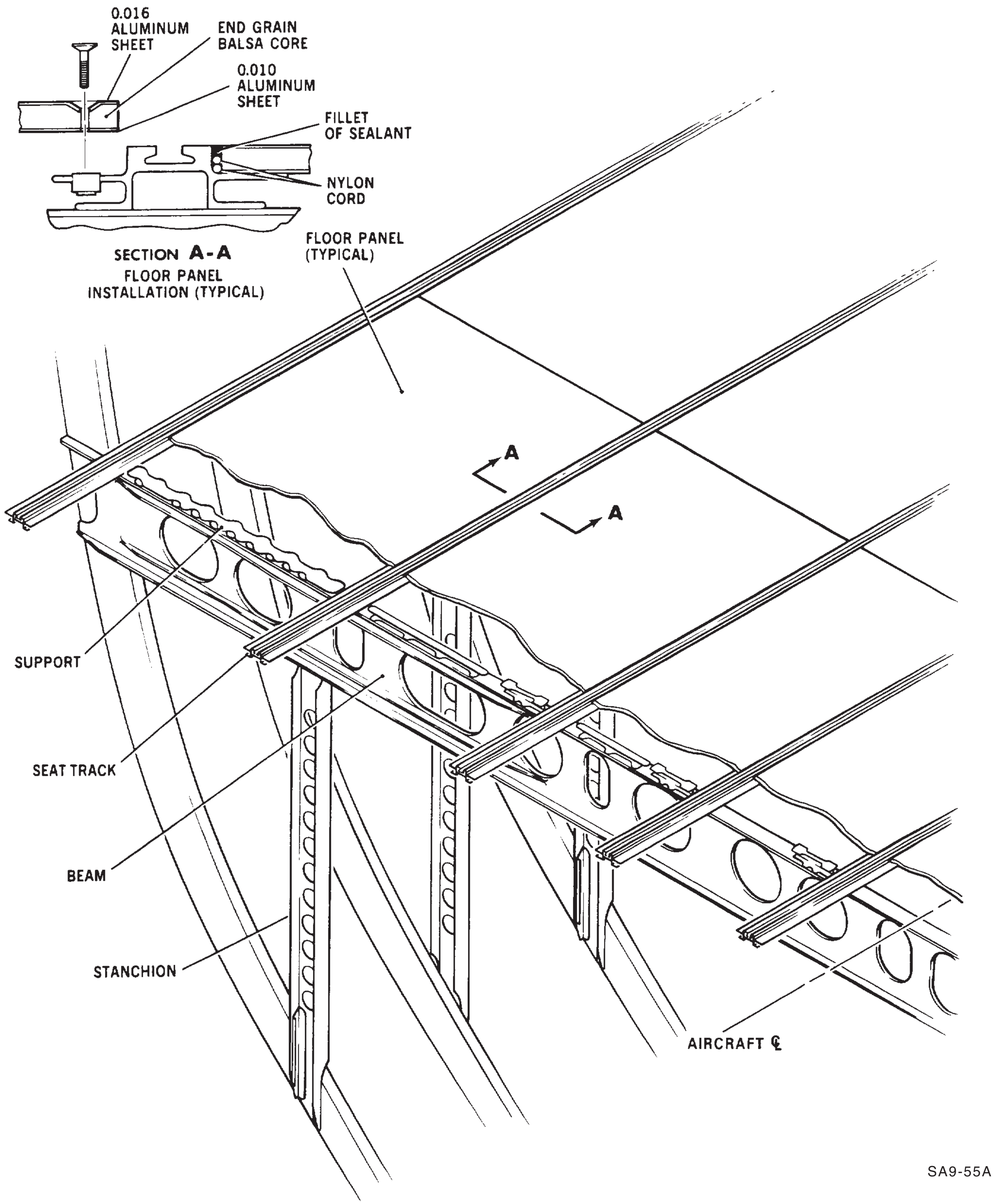


Figure 2-8. Cargo Floor Construction

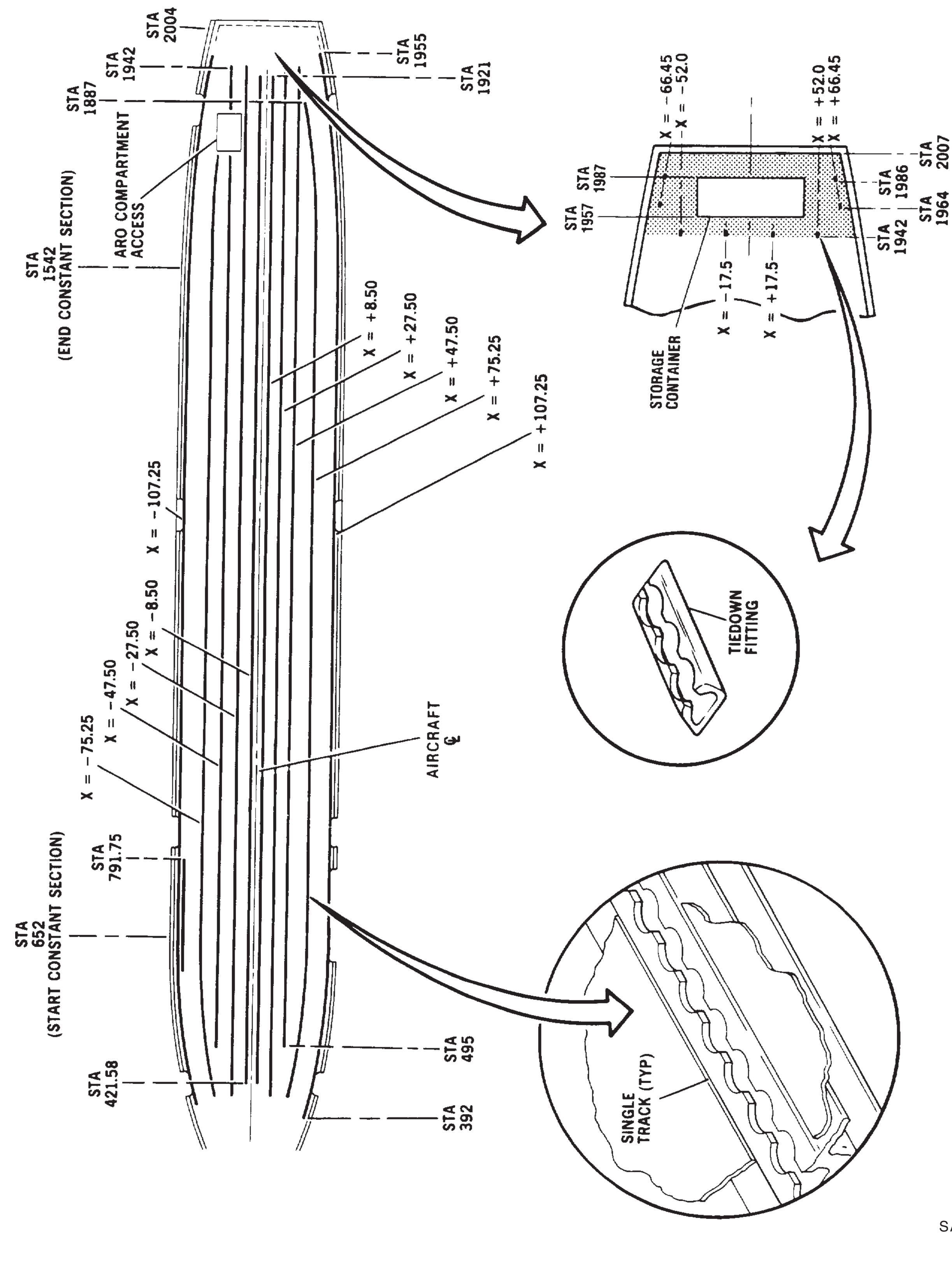


Figure 2-9. Cargo Floor Seat Tracks

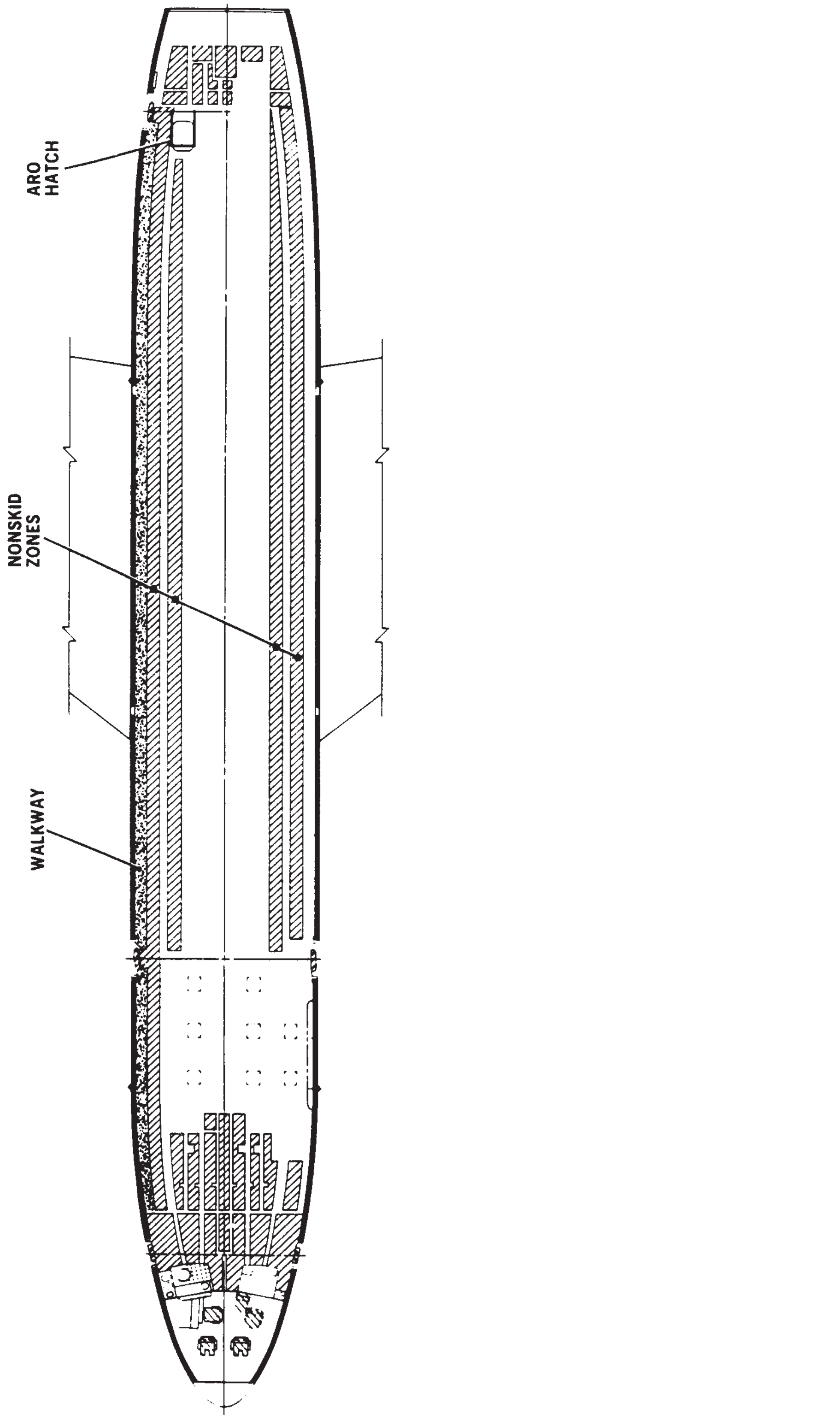


Figure 2-10. Cargo Floor Nonskid Surfaces

CARGO HANDLING SYSTEM

The cargo handling system is a manual loading system (with a powered lateral transfer assist) consisting of various separately installed components. The system is designed to accommodate the standard 88- by 108-inch HCU-6/E cargo pallet in the all-cargo or mixed cargo/personnel configurations. The components that make up the cargo handling system are as follows: Omnidirectional and longitudinal conveyer assemblies, restraint assemblies, a cargo barrier net, and a walkway. These components are installed on the cargo floor between stations 495 and 1937.

CARGO LOADING AIDS

Certain items of equipment are provided as cargo loading aids. This equipment is used to assist personnel during cargo loading and offloading operations. Equipment furnished as loading aids is as follows: A cargo door sill conveyor, powered rollers system, a pivot fitting, a cargo winch and government - inventoried pallet couplers. Except for the powered rollers system, loading aids are stowed as loose equipment when not in use.

The cargo door sill conveyor is provided to protect the door sill from damage during loading/ off loading operations.

The powered rollers system is used to load and offload cargo pallets laterally, and to assist in rotating overlength loads into a longitudinal alignment.

The pivot fitting is used as a pivot-guide when pallets are rotated into and/or out of the cargo compartment. It also protects the aft portion of the cargo doorway from pallets striking the aircraft sidewall.

A portable electric winch is provided for loading and offloading cargo that is too heavy to be conveniently handled by other means.

Pallet couplers are used for in-train coupling of pallets when required to load oversize cargo on board the aircraft.

CARGO COMPARTMENT PALLET/ PERSONNEL CONFIGURATION

Because of the unobstructed cargo compartment envelope, and the cargo handling system's design features, it is possible to arrange the compartment in various cargo/ personnel configurations.

PALLET ARRANGEMENT

The cargo compartment is designed to accommodate HCU-6/E cargo pallets in all-cargo configurations (figure 2-11) and mixed cargo/ personnel configurations (figure 2-12). Dimensions of the HCU-6/E pallets are 88 by 108 inches. A numbering system that denotes pallet positions within the cargo compartment is used for cargo load planning and loading. Corresponding position numbered decals are installed on the cargo floor. Station 521 to 632 is identified as positions 1L and 1R. The remaining pallet positions are numbered consecutively through 15L. These pallet position numbers remain the same throughout the cargo compartment, regardless of which pallets are removed for various personnel configurations.

BASIC COMPARTMENT CONFIGURATIONS

The basic compartment configurations are all-cargo, mixed cargo/6 to 20-personnel and mixed cargo/75-personnel configurations. Each configuration requires a different arrangement of the cargo handling system components.

ALL-CARGO CONFIGURATION

In an all-cargo configuration (figure 2-11), the cargo barrier net is located at station 495 and the cargo handling system components are installed between stations 495 and 1937. A double-tiered bunk is installed just forward of the cargo barrier net on the right side of the fuselage. A 25- or 27-pallet arrangement can be used in the all-cargo configuration. Either arrangement meets the requirements for a Class E compartment.

In the 25-pallet arrangement, the pallets are loaded with their 108-inch dimension oriented longitudinally in the cargo compartment. This arrangement makes it possible to have coupled pallets intermixed with single pallets. The coupled pallets can be coupled laterally or longitudinally using a special one-inch pallet coupler.

For the 27-pallet arrangement, 11 pallets are loaded with their 108-inch dimension oriented laterally in positions 2L through 12L along the left side of the cargo compartment. The remaining 16 pallets are loaded longitudinally. A walkway is provided along the right side of the cargo compartment for access to the ARO station and for inspection of the cargo load. This arrangement is best suited for single pallets. However, coupled pallets can be accommodated, but they require rotation before being moved into position.

MIXED CARGO/PERSONNEL CONFIGURATION

For missions which require the accommodation of personnel as well as cargo, a tradeoff in floor area must be made between pallets and seats. The floor-mounted cargo handling system components between stations 495 and 615 are removed and seats are installed in the seat tracks. An environmental curtain installation provides acoustical as well as environmental control, and also serves as a smoke barrier separating the personnel and cargo areas. The cargo barrier net is relocated behind the seats to protect personnel during a crash condition. Five cargo/personnel configurations are possible, depending on the number of personnel carried and the orientation of the pallets (figure 2-12).

Mixed Cargo/6- or 20-Personnel Configuration

The first cargo/personnel configuration (figure 2-12, Sheet 1) provides seating for 20 personnel consisting of 6 additional crew and 14 support personnel. These 20 seats are installed in the seat tracks. The difference between the additional crew seats and the support personnel seats is the type of emergency oxygen supplied to the seats. The additional crew seats are connected to the flight deck oxygen system and have the flight crew type masks, whereas the support personnel seats contain chemical oxygen generator units, which have a limited supply of oxygen. In this configuration, 23 HCU-6/E pallets can be loaded. The pallets must be loaded with their 108-inch dimension oriented longitudinally to the cargo compartment. The cargo barrier net is installed at station 575 and the environmental curtain is installed at station 615. Two double-tiered bunks are installed between the environmental curtain and the cargo barrier net.

The number of additional crew seats is determined by the cargo load. The following seat quantities versus the cargo loads must be strictly adhered to (figure 2-12, sheet 2). To accommodate 20 seats (6 additional crew and 14 support personnel), the cargo on each pallet must be restrained to 9g's forward force and not exceed a maximum gross weight of 2,100 pounds per pallet. If the cargo load exceeds the 20-personnel restriction outlined above, and the total cargo load is less than 100,000 pounds, the maximum number of seats is 16. If the total cargo load is greater than 100,000 pounds, the maximum number of seats is 14.

The second configuration (figure 2-12, sheet 1) consists of 25 HCU-6/E pallets loaded in the cargo area. The pallets on the left side of the compartment, constant section only, are loaded with their 108-inch dimension oriented laterally to the cargo compartment. With this pallet arrangement, only the six additional crew members can be carried. The cargo barrier net, environmental curtain and bunks are located identically to the 20-personnel configuration. This orientation of the pallets meets the requirements for a Class E compartment.

The third configuration (figure 2-12, Sheet 3) consists of 17 HCU-6/E pallets loaded in the cargo area. The cargo barrier net is installed at station 939. The environmental curtain is installed at station 615 with two double-tiered bunks installed forward of the environment curtain. Pallets are loaded in the longitudinal direction. Twenty personnel can be carried in this configuration. The locations for personnel provision are identical to the first cargo/ personnel configuration mentioned earlier.

Mixed Cargo/75-Personnel Configuration

With the increased accommodation unit, 75 personnel can be carried aboard the aircraft. This unit provides an additional 55 seats and, when combined with the 20-personnel configuration, creates the 75-personnel configuration. Eleven additional seats are installed in the seat tracks forward of the omnidirectional panels. A removable lavatory (lavatory Z) is also installed forward of the cargo door on the left side of the compartment.

This configuration allows 17 cargo pallets to be loaded (figure 2-12, sheet 4). The cargo barrier net is installed at station 939 and the environmental curtain is installed at station 879. The two double-tiered bunks are installed in the seat tracks forward of the environmental curtain.

Four seat pallets, measuring 108 by 108 inches, are loaded on the cargo handling system. These four pallets provide 44 seats. Ramps are installed at four locations to provide smooth transition from the cargo floor to the top of the seat pallet (four-inch differential) and, in an emergency situation, a smooth transition from the pallet to doors 2L and 2R.

The cargo pallets must be loaded with their 108-dimension oriented longitudinally to the cargo compartment.

Two aisles must be provided at all times for the Class B compartment.

MIXED CARGO/PERSONNEL/PATIENT SUPPORT CONFIGURATIONS

The basis for the Passenger Support Pallet (PSP) configurations is the Mixed Cargo/75 Personnel Configuration with either one or both the number 2 pallets replaced with a PSP. Each PSP has two litter tiers along the outer aspect of the pallet supporting up to three patients per tier. An alternate configuration is one-tier of litters and one row of seats for AE crew members.

NOTE

> Maximum PSP total load (PSP plus patients/equipment) will not exceed 3300 lbs per pallet.

LOCAL TRAINING SORTIE CONFIGURATION

Code J, Local Training Sortie Configuration.

WARNING

> When transitting the exposed omni panel area in the Code J configuration, exposed omni panel rollers, latch pawls, and power roller wells pose an increased tripping/falling hazard.

NOTE

> Cargo and passengers will not be carried in the Code J configuration.

Code J is a modified Code D configuration with all four IAU seat pallets removed. However, the Z Lav, IAU storage, track mounted seats, emergency oxygen, slide rafts and exit signs are still installed. The cargo barrier net will remain at station 939, the environmental curtain will remain at station 879, and the bunks at station 869. Code J will be used only for local training missions when time constraints prevent maintenance from re-configuring from a Code D to a Code B. For local training missions, Code B should be normal configuration.

63 Personnel with 6 Litters Configuration.

In this configuration a PSP replaces the forward left IAU pallet (pallet 2L) providing support for up to 6 patients (figure 2-12 sheet 5).

51 Personnel with 12 Litters.

In this configuration PSPs replace both the forward left and right IAU pallets (pallets 2L and 2R) providing support for up to 12 patients (figure 2-12 sheet 6).

CARGO/PERSONNEL CONFIGURATION CODES

Configuration code letters, assigned to the different cargo/personnel configurations, are used in the Basic Weight Checklist and Loading Data (TO 1C-10(K)A-5) and the Equipment Inventory List (TO 1C-10(K)A-21). In this manual, these codes are referenced in the figures that relate to cargo/personnel configurations. The code letters and their respective configurations are as follows:

Code	Configuration
A	14-personnel
B	16-personnel
C	20-personnel (23 pallet)
D	75-personnel (expanded)
E	25- or 27-pallets (all cargo)
F	6-additional crew
G	20-personnel, 17-pallet positions, cargo barrier net at station 948 (position 3), environmental curtain and bunk at station 576 (position 2).
H	63-personnel and 6 litters
I	51-personnel and 12 litters
J	16 useable seats, no cargo, no passengers

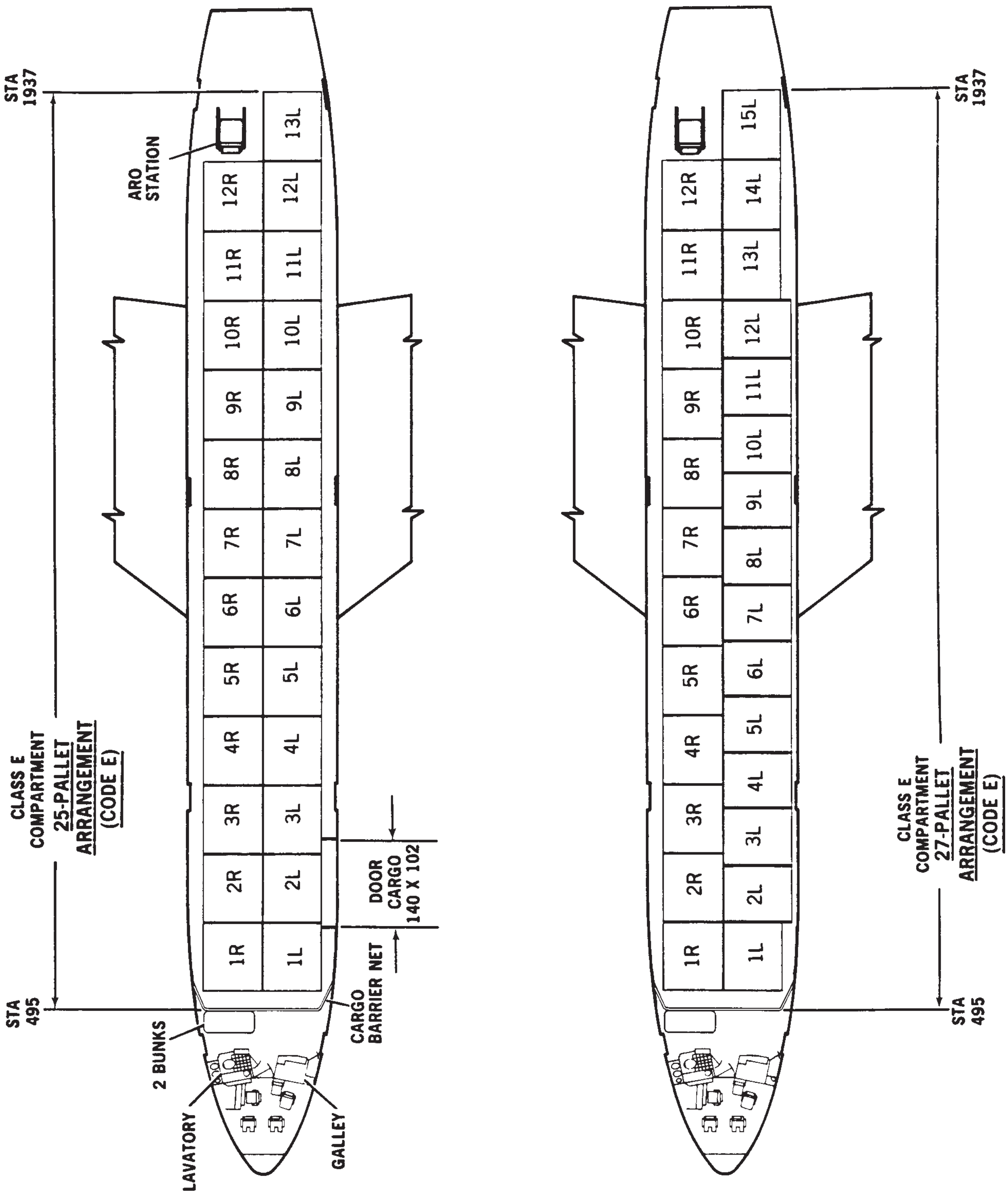
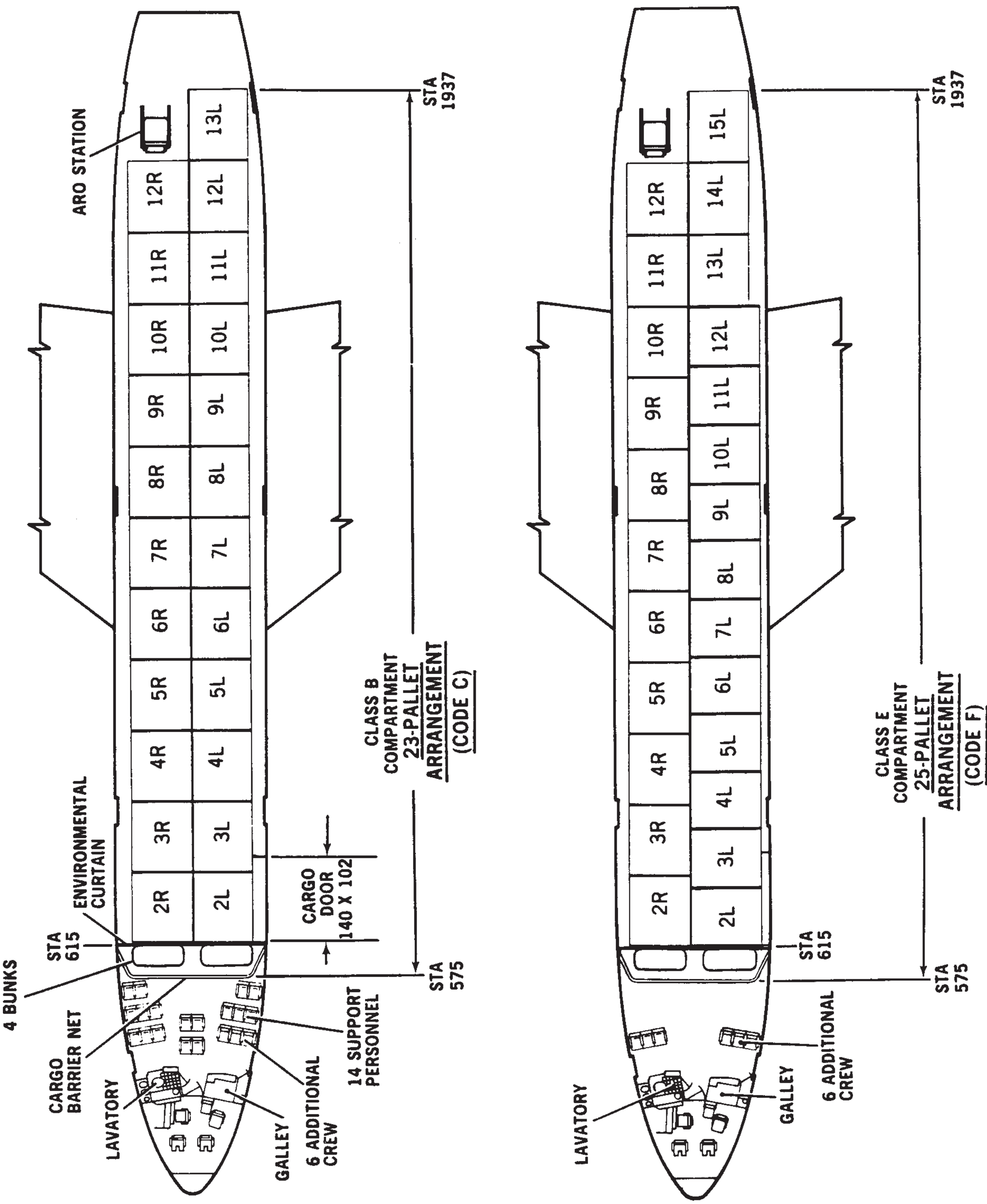


Figure 2-11. All-Cargo Configuration

KC-10A CARGO LOADING MANUAL



SA9-40A

Figure 2-12. Mixed Cargo/Personnel Configuration (Sheet 1)

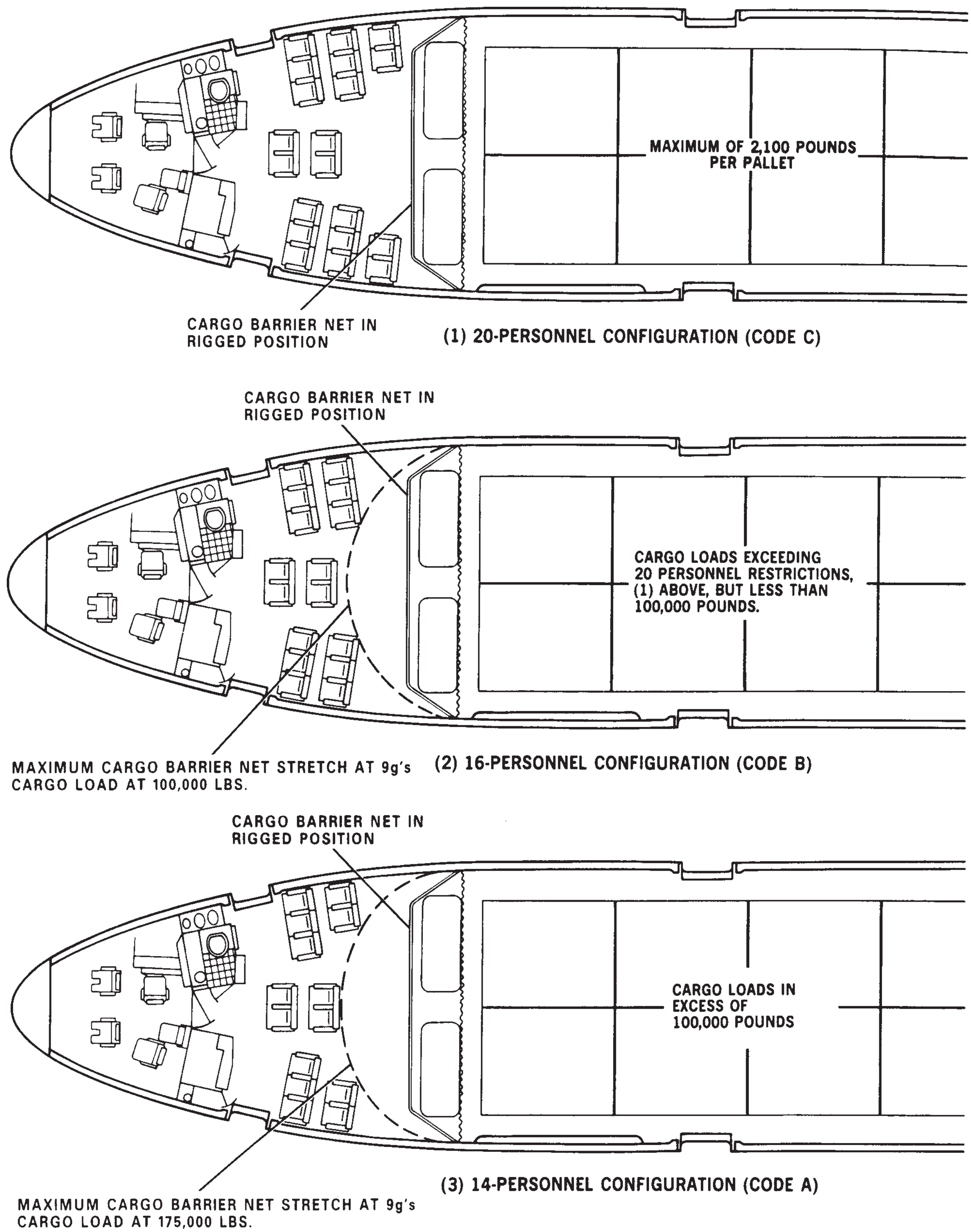
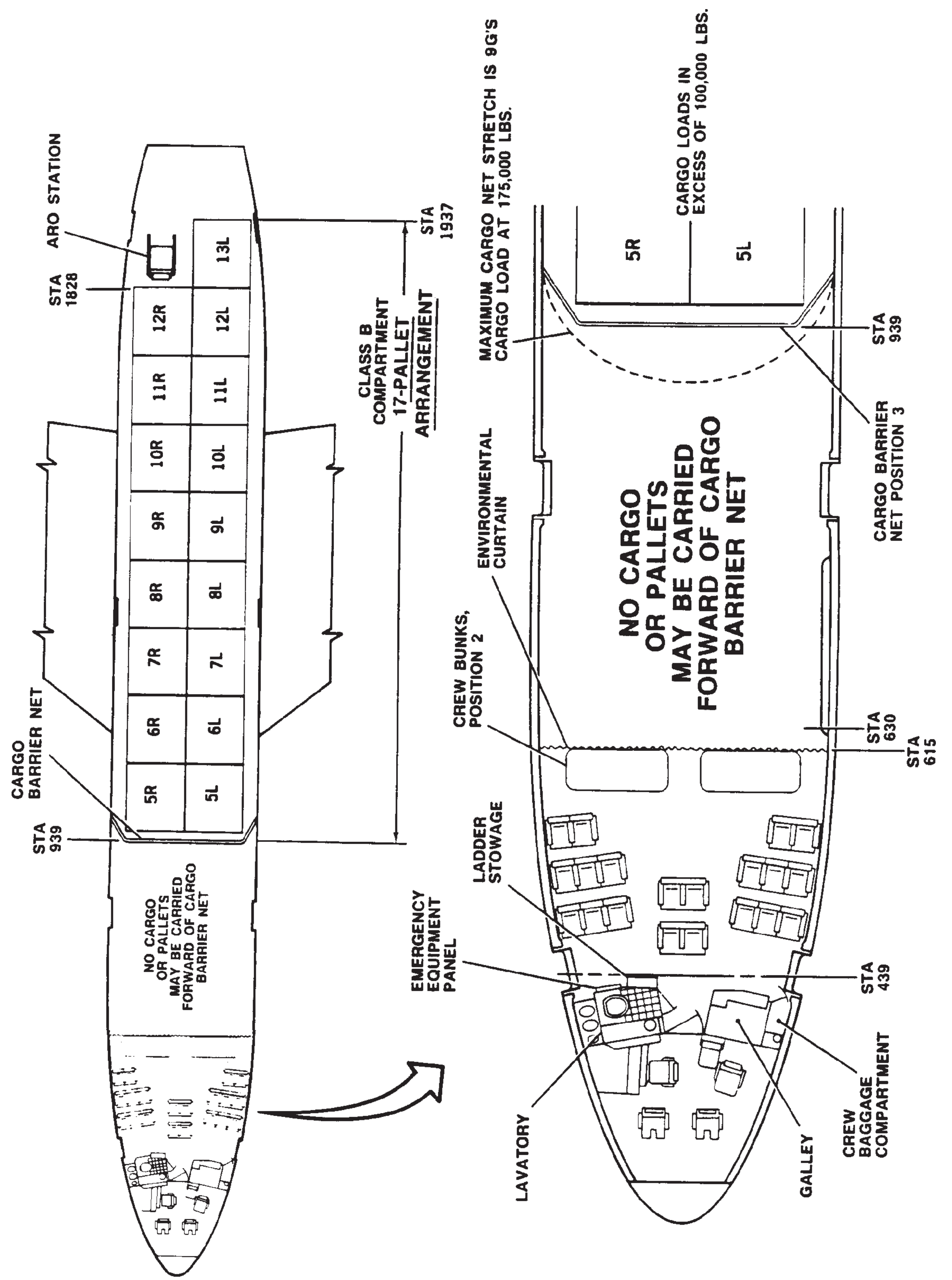


Figure 2-12. Mixed Cargo/Personnel Configuration (Sheet 2)



SA9-301

Figure 2-12. Mixed Cargo/Personnel Configuration (Sheet 3)

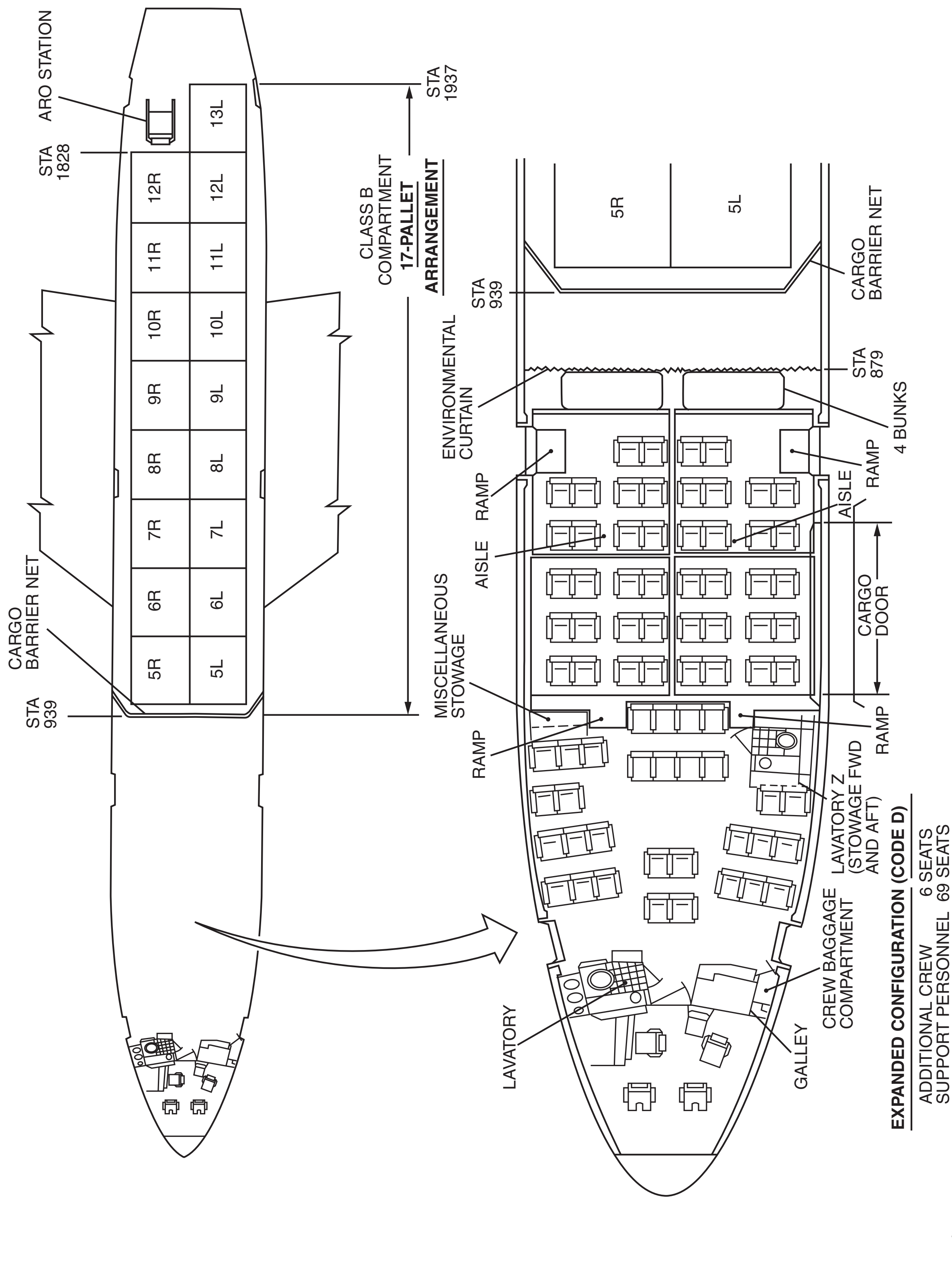


Figure 2-12. Mixed Cargo/Personnel Configuration (Sheet 4)

KC-10A CARGO LOADING MANUAL

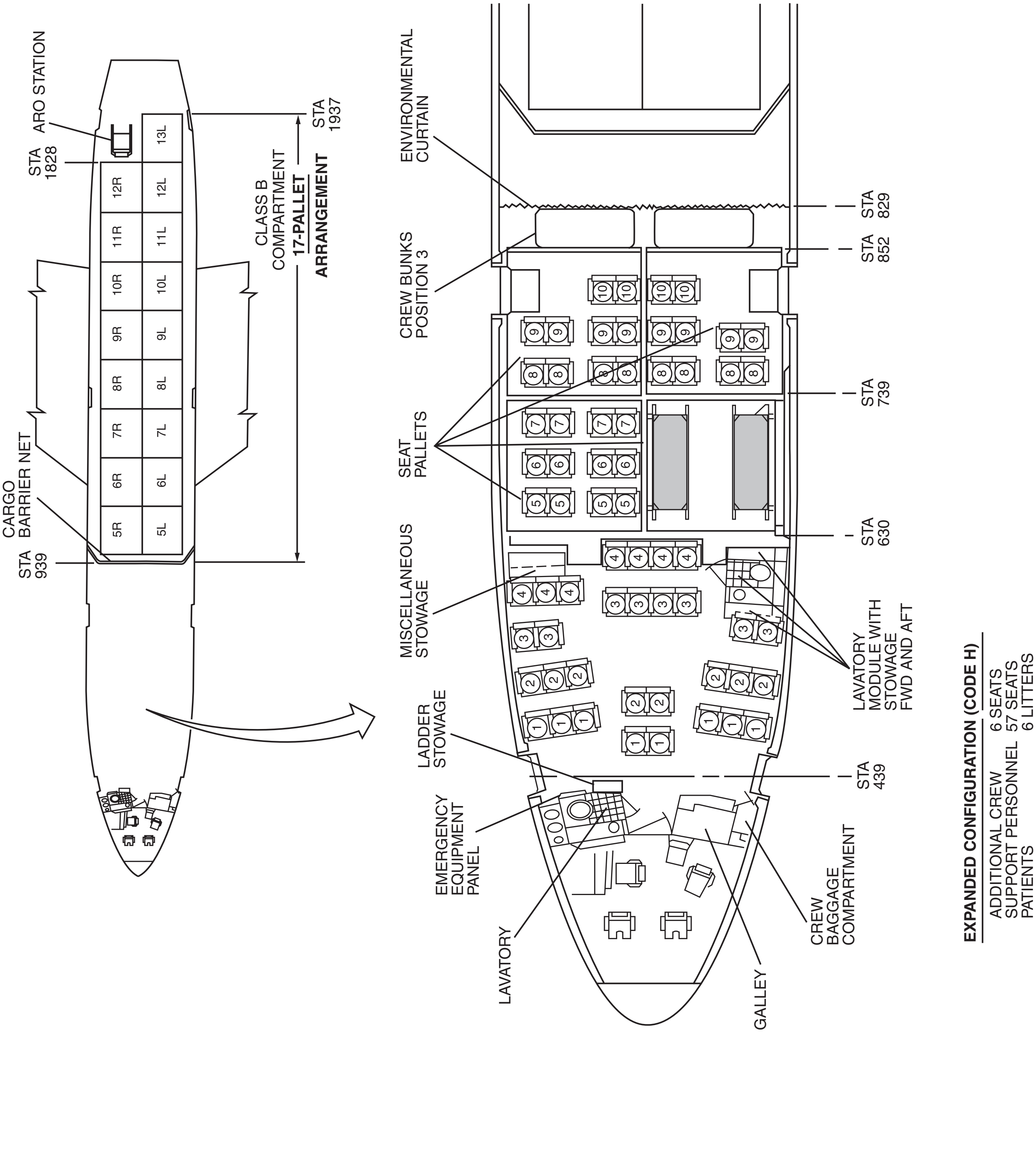


Figure 2-12. Mixed Cargo/Personnel Configuration (Sheet 5)

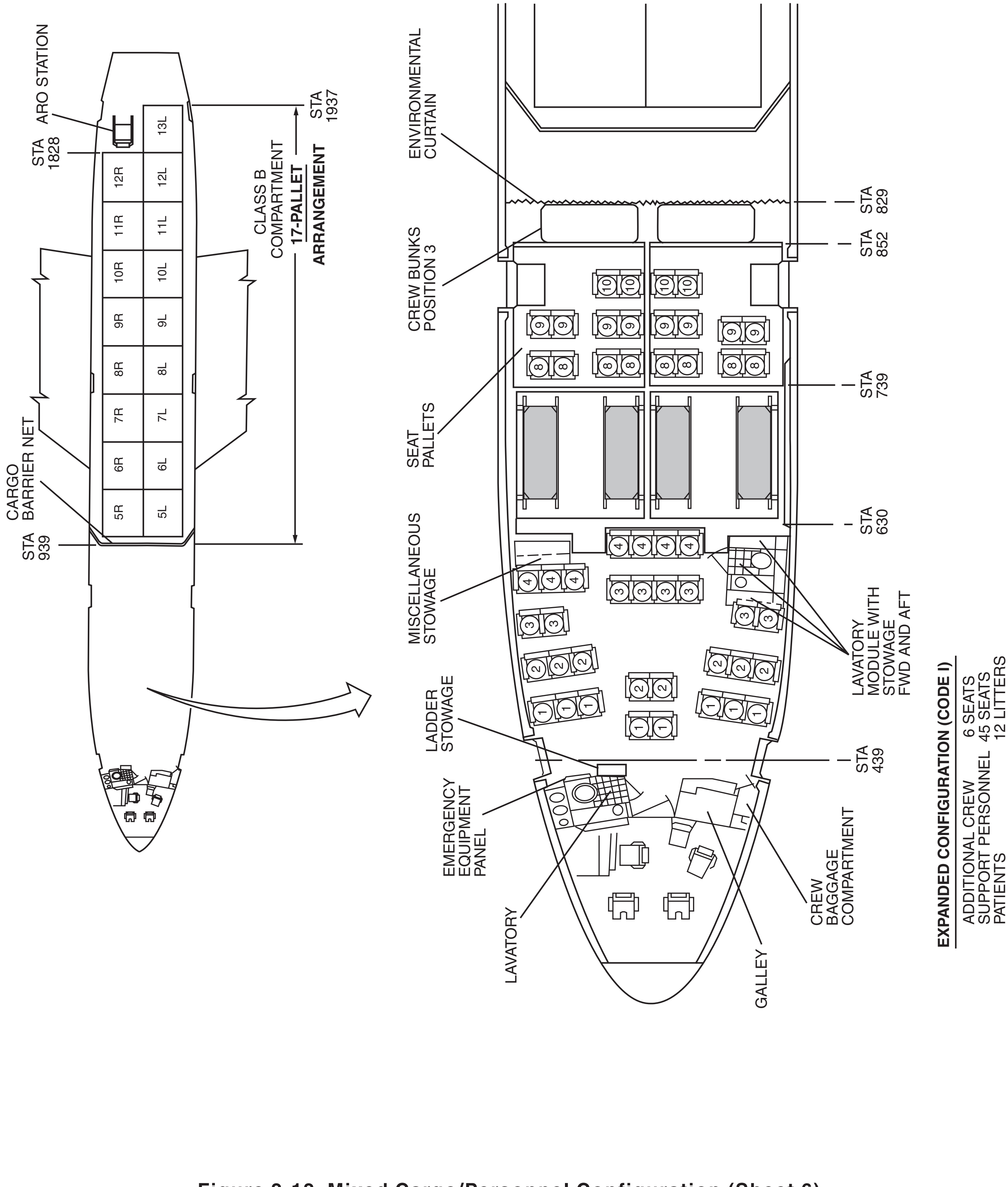


Figure 2-12. Mixed Cargo/Personnel Configuration (Sheet 6)

PERSONNEL PROVISIONS

Certain furnishings and equipment are provided for the accommodation of the flight crew, and for additional crew and support personnel. The furnishings and equipment include track-mounted and palletized seats, one or two double-tiered bunks, emergency oxygen units, one permanent and one palletized lavatory, a galley, a ground egress/entry ladder, a portable ladder assembly, and an environmental curtain.

SEATS

As described in the paragraph on Mixed Cargo/Personnel Configuration, three basic seating arrangements are available to accommodate a various number of personnel. Seat assemblies are made up of two, three, and four seats (figure 2-12, sheet 2).

Between the centerline of doors 1L, and 1R and the forward edge of the omnidirectional roller panels, the seat assemblies are installed directly on the seat tracks. The seat assemblies are equipped with built-in seat track attachment fittings, and are located in their respective positions by aligning the locking pins adjacent to orange-colored marker strips, which are taped to the floor, next to the seat tracks (figure 2-13, sheet 1 and 2). Position the front seat attachment fittings adjacent to the orange tape on aircraft floor as shown in Figure 2-13.

The palletized seats are installed on sections of seat tracks that are built into the pallets. The four seat pallets are installed and removed with the seats in place, and are secured to the omnidirectional roller panels with end restraint fittings and side rails. Anti-rattle devices are installed between the seat pallets to prevent lateral movement (figure 2-13, sheet 3 and 4).

Each seat back incorporates a literature pocket, a fold-out food tray, and provisions for automatic emergency oxygen installation. Each front-row seat (or any seat not directly behind another seat) is equipped with provisions for a plug-in food tray. Emergency oxygen units for occupants of these seats are installed in overhead or wall compartments for easy access.

The increased accommodation unit includes the 44 palletized seats and 11 track-mounted seats, for a total of 55 seats. The track-mounted seats are comprised of the two center row four-seat assemblies, installed directly in front of the palletized seats, and the aft three-seat assembly on the right side.

BUNKS

In the all-cargo configuration (figure 2-11), a double-tiered bunk is installed on the right side of the aircraft, just aft of door 1R. When extra crew and personnel are carried in the mixed cargo/personnel configuration (figure 2-12), two double-tiered bunks are installed directly forward of the environmental curtain.

The bunk frames are equipped with padded feet that rest directly on the cargo compartment floor. Stud assemblies, extending below the padded feet, are fitted into the cargo floor seat tracks. The frame is then secured by tightening the nut on the top of the stud.

Enclosure curtains are installed to provide privacy for the bunk occupants. For easy entry or exit, tie straps, stitched to the tops of the end curtains, enable the curtains to be stowed in the rolled-up position. Oxygen is available for each occupant from individually mounted oxygen bottles with passenger type mask assemblies or EPOS.

STOWAGE PROVISIONS

Stowage compartments, plus a stowage area in the aft end of the cargo compartment (figure 2-14), provide places for crew members and support personnel to put their personal effects and carry-on professional equipment.

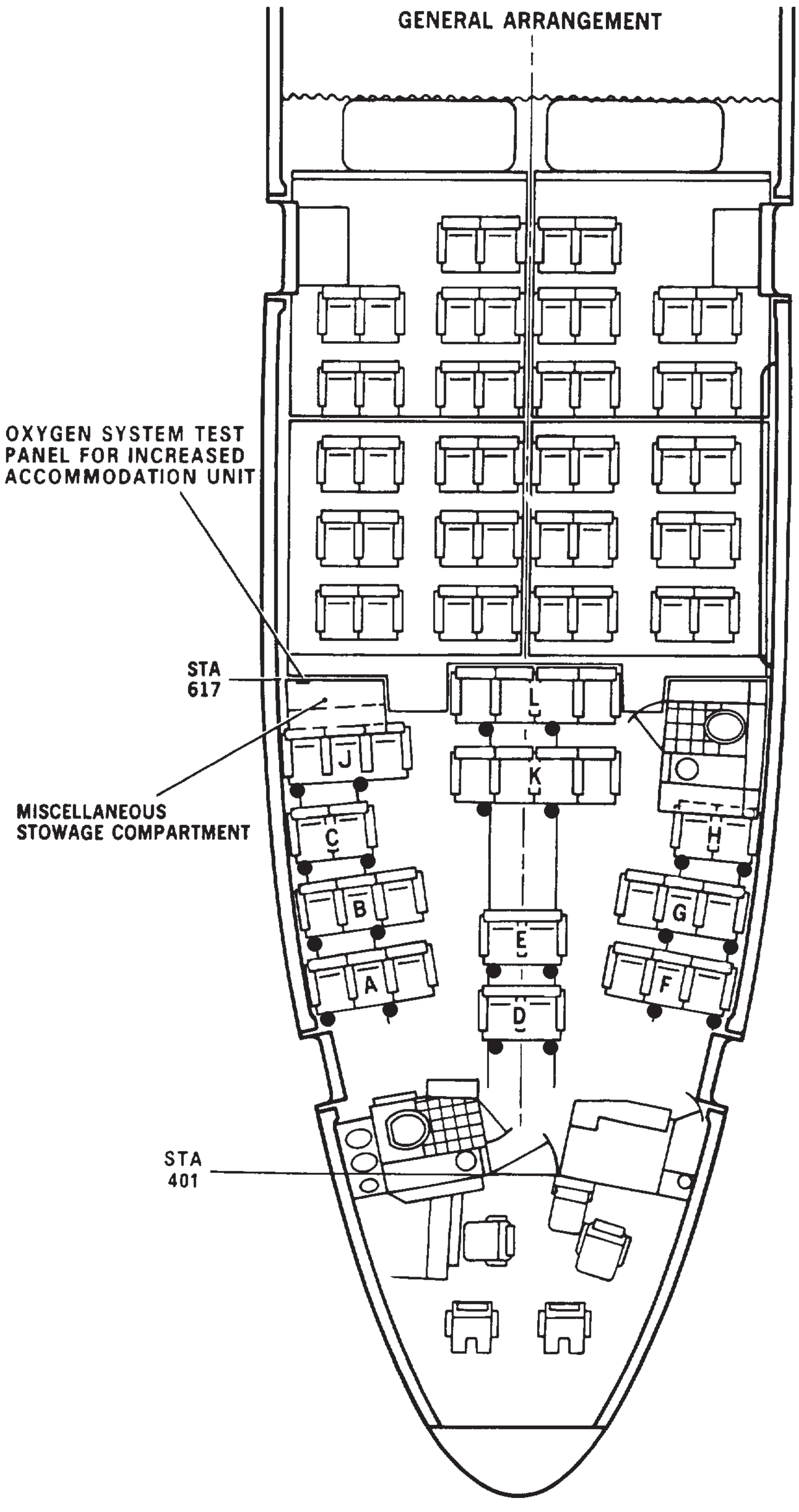
The crew baggage compartment is located just forward of door 1L, between the fuselage wall and the galley.

When the increased accommodation unit is installed, three additional stowage compartments are provided. Two compartments are an integral part of the palletized lavatory Z, which is installed against the left fuselage wall, just ahead of the cargo door. The third compartment is installed on the right side of the cargo compartment, directly across from the lavatory Z and forward of the palletized seats.

The storage area, situated between station 1942 and the aft bulkhead, is equipped to secure items directly on the floor. Eight short sections of seat track are installed in the floor.

Tiedown fittings can be attached to the seat-track sections to provide anchor points for tiedown straps used to secure loose items.

A storage container (figure 2-14) is installed between stations 1957 and 1987.



NOTES

1. DOTS (●) INDICATE LOCATION OF ORANGE TRACK MARKER TAPES USED TO ALIGN LOCKING STUDS ON TRACK-MOUNTED SEATS.
2. SEATS J,K AND L ARE PART OF INCREASED ACCOMMODATION UNIT AND ARE INSTALLED PRIOR TO INSTALLING PALLETIZED SEATS.

SEAT TRACK MARKINGS

SEAT	CENTER	INBOARD
A	-	473.463
B	-	507.001
C	-	540.720
D	457.500	-
E	491.500	-
F	-	473.463
G	-	508.979
H	-	542.708
J	-	570.573
K	564.500	-
L	600.500	-

SA9-19A

Figure 2-13. Seats Installation (Sheet 1)

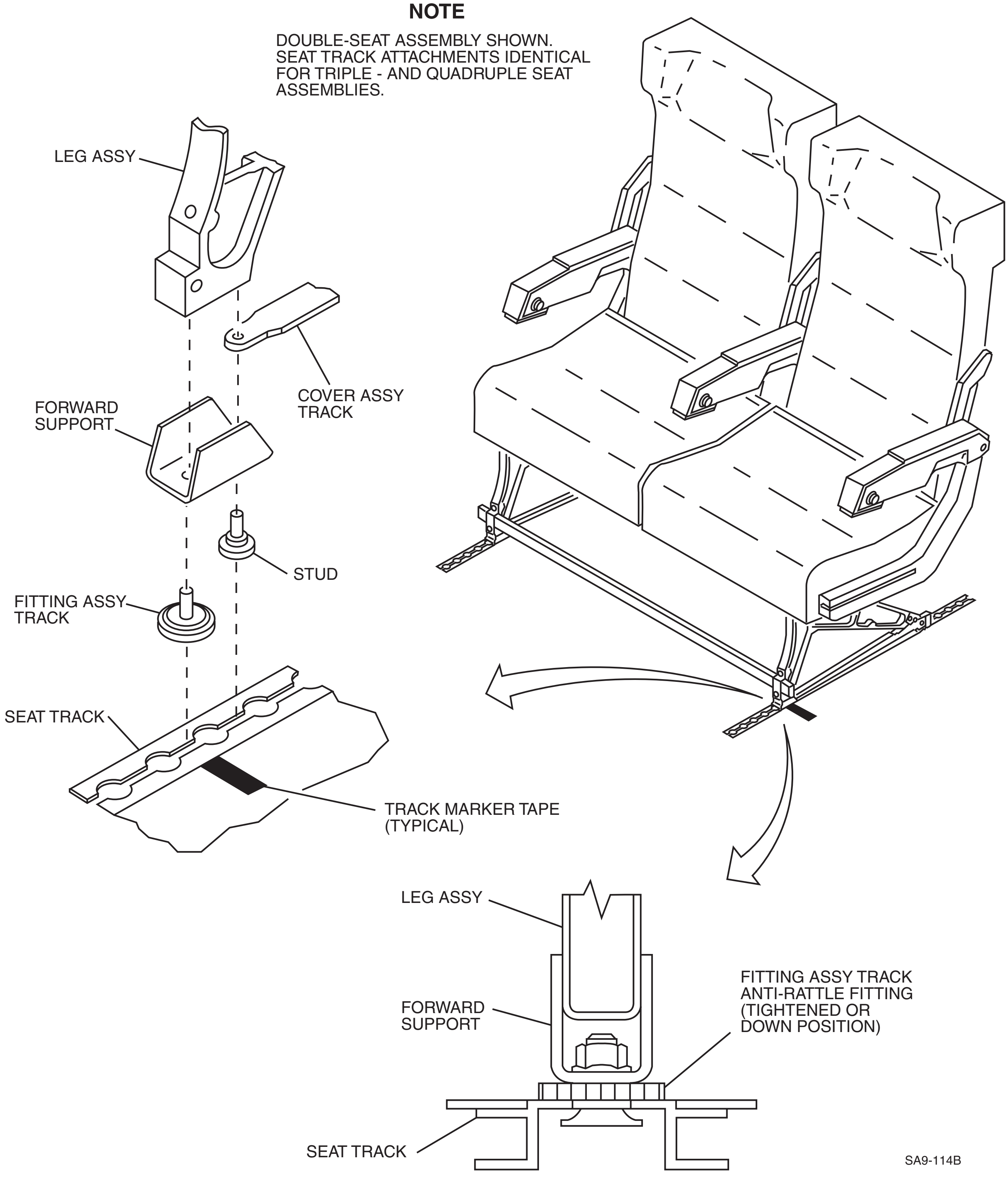


Figure 2-13. Seats Installation (Sheet 2)

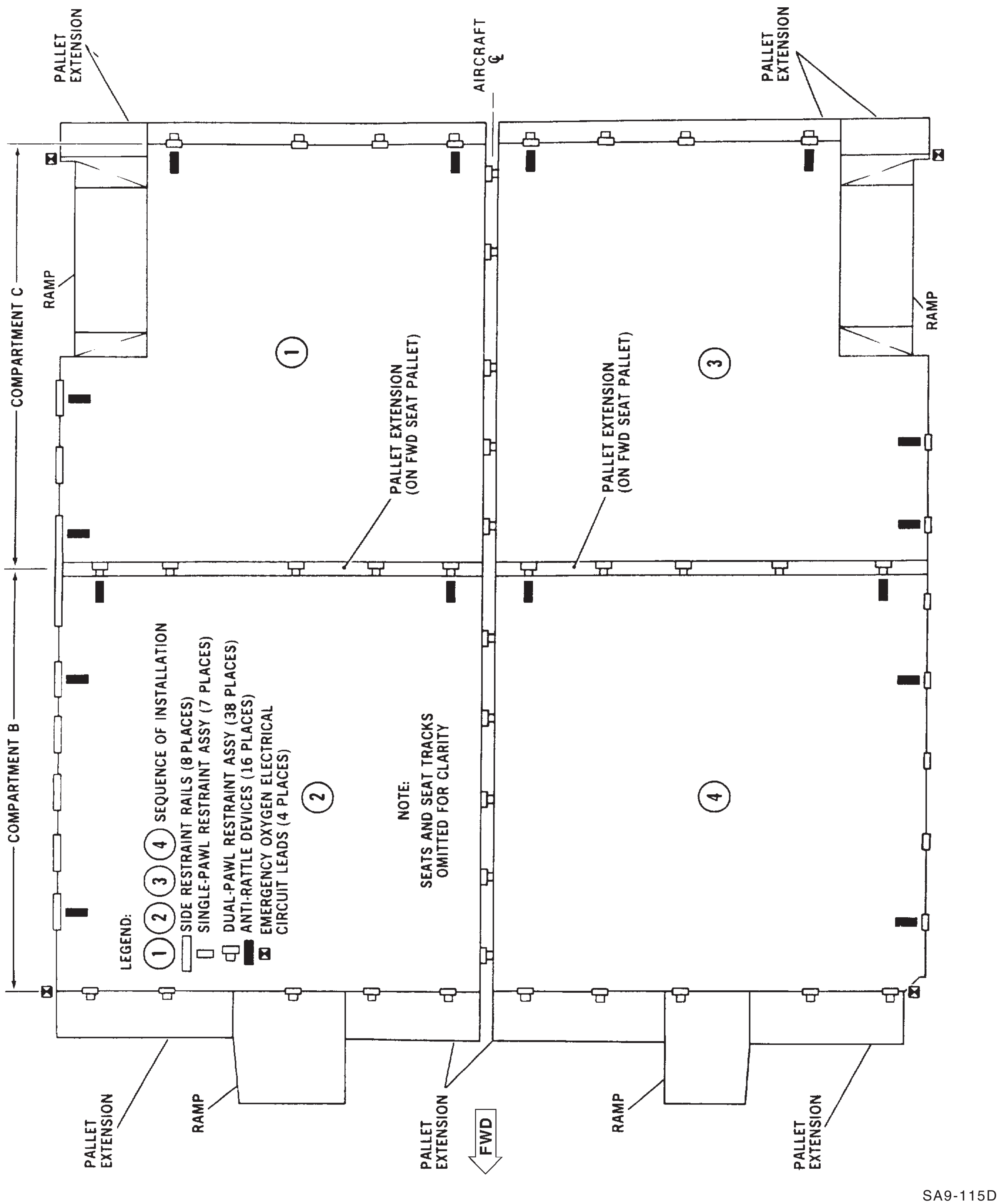


Figure 2-13. Seats Installation (Sheet 3)

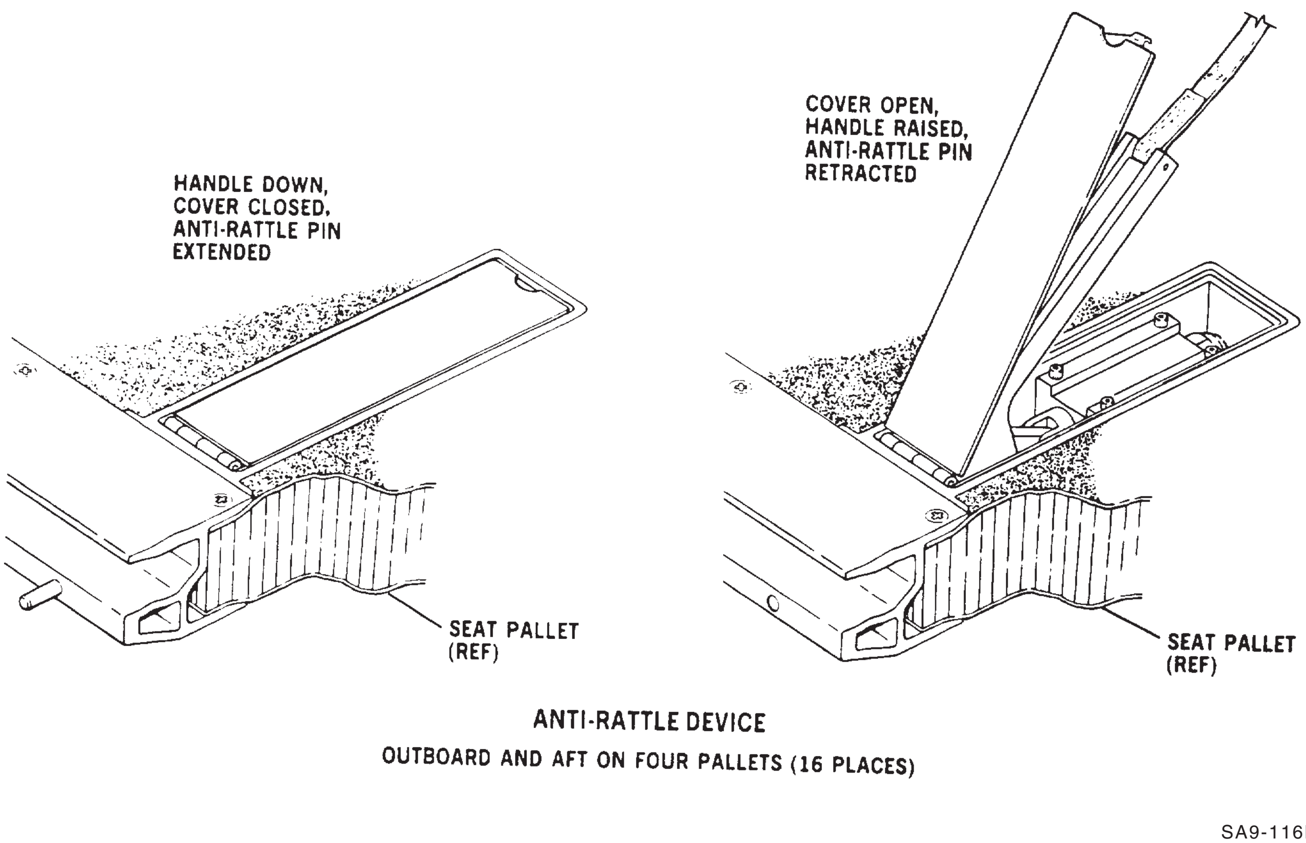
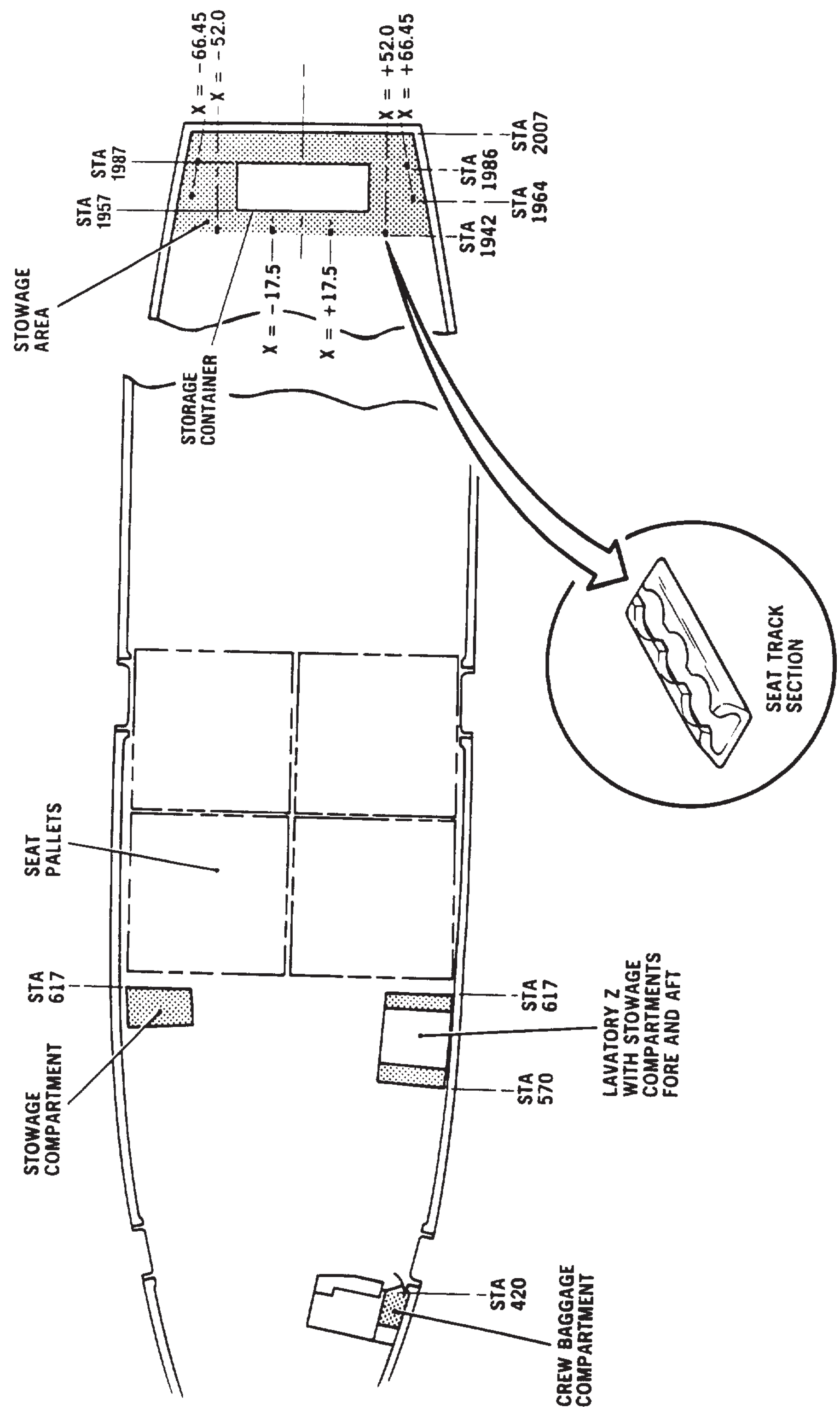


Figure 2-13. Seats Installation (Sheet 4)



SA9-96B

Figure 2-14. Stowage Provisions

AIRCRAFT CONFIGURATION (APPLICATION)

TABLE OF CONTENTS

INTRODUCTION

This section contains the instructions necessary to prepare and/or reconfigure the aircraft for loading in the all-cargo or mixed cargo/personnel configurations. Instructions for removal and installation of cargo handling system components and personnel provisions are included for information purposes only, and do not constitute a boom operator's procedural requirement. Refer to TO 1C-10(K)A-2-25 and TO 1C-10(K)A-2-35 for applicable maintenance procedures.

The instructions presented in this section cover (where applicable) operation, inspection, testing, and installation and removal of the following:

Cargo door

Cargo handling system

- Conveyor assemblies
- Pallet restraint assemblies
- Equipment restraint assemblies
- Cargo barrier net
- Walkway

Cargo loading aids

- Cargo door sill conveyor
- Powered rollers
- Pivot fitting
- Cargo winch
- Pallet couplers

Oxygen

CARGO DOOR

The cargo door is normally opened and closed by means of an independent hydraulic system with pressure supplied by an electrically-driven pump. If the cargo door fails to open electrically or electrical power is not available, the cargo door can be opened and closed with a manually-operated hydraulic handpump.

Controls for operating the cargo door are provided on a panel located in a recessed area under the cargo compartment floor just inboard of door 1L (figure 3-1, sheet 2, view B). The panel is protected by an access panel which forms part of the floor when closed. The cargo door contains two lights that are actuated by a switch in the control panel. In the event the switch is left on, the lights automatically shut off when the cargo door is closed. The lights illuminate the area outside the cargo door. These lights are only effective when the cargo door is latched in the mid-open position.

Vent Door

An outboard-opening vent door is located in the aft lower portion of the cargo door (figure 3-1, sheet 1). The vent door improves the locking feature of the cargo door. The cargo door cannot be unlocked until the vent door is opened. The vent door cannot be closed and locked when the cargo door is unlocked. If an attempt is made to pressurize the fuselage while the vent door is open, the pressure will be vented overboard.

The vent door can be opened and closed from inside or outside of the aircraft. Except when blocked by cargo, the vent door is normally opened and closed from inside the cargo compartment. To open the door, the locking handle on the door's interior is moved clockwise to the unlocked position. The door is spring-loaded and will move to the open position when the door is unlocked. A second interior handle is used to pull and hold the door closed while moving the locking handle counterclockwise to the locked position. When outside the aircraft, the vent door is opened by moving the exterior handle counterclockwise to the placarded UNLOCKED position. To close the door from outside, the door is pushed in flush with the cargo door, and held while moving the handle clockwise to the placarded LOCKED position. In the LOCKED position, the exterior handle is streamlined with the fuselage.

CARGO DOOR NORMAL OPERATION

Opening Cargo Door (Figure 3-1)

CAUTION

- Verify that cargo doorway area is clear of obstructions.
- Do not operate cargo door if wind velocity exceeds 40 knots from any direction. Structural damage could occur.
- When the cargo door is open and mechanically latched in the mid-open or full-open position, it can withstand winds up to 52 knots from any direction.

1. If wind velocity appears to be excessive, determine wind velocity prior to operating cargo door.

2. Remove pip pin from locktube actuator and stow (figure 3-1, sheet 1, view C).

NOTE

The cargo door cannot be unlocked when the vent door is closed and locked. The vent door is spring-loaded and will move to the open position when it is unlocked.

3. Unlock and open cargo door vent door as follows:

a. To open vent door from inside, move locking handle clockwise to the UNLOCKED position (figure 3-1, sheet 1, view B).

NOTE

If vent door controls are not accessible from inside aircraft, open vent door from outside.

b. To open vent door from outside, move vent locking handle counterclockwise to the UNLOCKED position (figure 3-1, sheet 1, view A).

4. Partially open door 1L to gain access to cargo door control panel.

5. Raise floor-level control panel access door (figure 3-1, sheet 2, view B).

6. Lift door control handle from stowed to upright position (figure 3-1, sheet 2, view B).

NOTE

If cargo doorway lighting is required, place CARGO DOOR LIGHTS switch in ON position. Lights will come on when door starts to open.

7. Pull door control handle up and hold in vertical position.

8. Rotate door control handle to OPEN position.

WARNING

When loading/offloading cargo, the cargo door shall be latched in either the mid-open or full-open position. At any other position, the cargo door could close and cause personal injury or loss of life.

9. Hold door control handle in OPEN position until door just passes latching point desired, then release handle to neutral position.

CAUTION

Do not lift handle when lowering door to latch. This could overload the door latch and cause structural damage.

10. Rotate door control handle to CLOSE position. Hold until door engages mechanical hold-open latch.

NOTE

If the cargo door fails to latch in the mid-open position, open the door to near the full-open position and then lower to the mid-open position. This procedure should cause the door to latch.

11. Release door control handle to neutral position and stow.

12. Close and secure control panel access door.

13. Install cargo door sill conveyor (if required).

WARNING

Install cargo door barrier net if door is to remain open without an exterior platform adjacent to entrance and an observer is not supervising the door area. Do not lean on or against barrier net.

Closing Cargo Door (Figure 3-1)

CAUTION

Verify cargo doorway area is clear of obstructions, and that pallet restraint assemblies (latches) are in the up position.

1. If wind velocity appears to be excessive, determine wind velocity prior to operating cargo door.

2. Remove cargo door sill conveyor (if installed).

3. Remove cargo door barrier net (if installed).

4. Partially open door 1L to gain access to cargo door control panel.

5. Raise floor-level control panel access door (figure 3-1, sheet 2, view B).

6. Lift door control handle from stowed to upright position (figure 3-1, sheet 2, view B).

7. Pull door control handle up and hold in vertical position.

CAUTION

> If cargo door is powered directly toward closed position, mechanical damage can occur.

8. Rotate door control handle to OPEN position and verify door raises out of the hold-open latched position.

9. Rotate door control handle to CLOSE position and hold.

10. After door closes and latches in locked position, release door control handle to neutral position and stow. Cargo door lights will go off automatically when the door is fully closed.

11. Place CARGO DOOR LIGHTS switch in OFF position (if applicable).

12. Close and secure control panel access door.

NOTE

> Pip pin location may not be accessible if cargo is loaded in pallet position 2L. In this case, it may be left out during cargo flight.

13. Insert pip pin in locktube actuator.

NOTE

- On aircraft 79-0433 and 79-0434, the CARGO DOOR SYS (A and B) lights, located on the flight engineers upper instrument panel No. 2, go off when the cargo door is closed and locked.
- On aircraft 79-1710 and subsequent, the CARGO DOOR SYS B light goes off when the cargo door is closed and locked. The CARGO DOOR SYS A light goes off only when both the cargo door and vent door are closed and locked.

14. Close vent door and move vent door locking handle to LOCKED position as follows:

a. To close vent door from inside, pull in and up on vent door pull handle and hold while moving locking handle counterclockwise to LOCKED position (figure 3-1, sheet 1, view B).

NOTE

> If vent door controls are not accessible from inside aircraft, close vent door from outside.

b. To close vent door from outside, push vent door in, flush with cargo door, and hold while moving locking handle clockwise to LOCKED position (figure 3-1, sheet 1, view A).

c. Visually check through viewing port that lockpins are engaged when vent door is required to be closed from outside of the aircraft.

CARGO DOOR MANUAL OPERATION

Opening Cargo Door (Figure 3-1)

1. If wind velocity appears to be excessive, determine wind velocity prior to operating door.

2. Remove pip pin from locktube actuator and stow (figure 3-1, sheet 1, view C).

NOTE

Cargo door cannot be unlocked when the vent door is closed and locked. The vent door is spring-loaded and will move to the open position when it is unlocked.

3. Unlock and open cargo door vent as follows:

a. To open vent door from inside, move locking handle clockwise to the UNLOCKED position (figure 3-1, sheet 1, view B).

NOTE

If vent door controls are not accessible from inside aircraft, open vent door from outside.

b. To open vent door from outside, move vent locking handle counterclockwise to the UNLOCKED position (figure 3-1, sheet 2, view A).

4. Partially open door IL to gain access to cargo door control panel.

5. Raise floor-level control panel access door (figure 3-1, sheet 2, view B).

6. Lift door control handle from stowed to upright position.

7. Remove handpump, handle from stowage well in control panel and raise handpump access door.

8. Insert handpump handle into handpump socket.

NOTE

If cargo doorway lighting is required and the electrical power system is operating, place CARGO DOOR LIGHTS switch in ON position. Lights will come on when door starts to open.

9. Pull door control handle up and hold.

10. Actuate handpump handle until pressure builds up, then rotate door control handle to OPEN position and continue to actuate handpump handle until cargo door is just above mid-open or full-open position.

NOTE

Prior to moving to the open position, the cargo door should automatically unlatch during handpump operation. If the cargo door fails to unlatch by handpump operation, it can be unlatched manually from the outside. To unlatch the cargo door from outside, proceed as follows:

a. Remove handpump handle from handpump socket and pass it to person outside aircraft.

b. Pull lock handle out and up to UNLOCK position (figure 3-1, sheet 2, view A).

c. Insert handpump handle into torque tube socket and rotate downward to UNLATCHED position.

d. Release lock handle and remove handpump handle from torque tube socket.

e. Return handpump handle to person inside aircraft.

f. Proceed with steps 8 through 16.

11. Rotate door control handle to CLOSE position. Hold until door engages hold-open latch.

NOTE

If the cargo door fails to latch in the mid-open position, open the door to near the full-open position and then lower to the mid-open position. This procedure should cause the door to latch.

12. Release door control handle to neutral position.

13. Remove and stow handpump handle.

14. Close handpump access door, then stow door control handle.

15. Close and secure control panel access door.

16. Install cargo door sill conveyor (if required).

Closing Cargo Door (Figure 3-1)

1. If wind velocity appears to be excessive, determine wind velocity prior to operating door.

2. Remove cargo door sill conveyor (if installed).

3. Partially open door 1L to gain access to cargo door control panel.

4. Raise floor-level control panel access door (figure 3-1, sheet 2, view B).

5. Lift door control handle from stowed to upright position.

6. Remove handpump handle from stowage well in control panel and raise handpump access door (figure 3-1, sheet 2, view B).

7. Insert handpump handle into handpump socket.

8. Pull door control handle up and hold.

9. Rotate door control handle to OPEN position.

10. Actuate handpump, until cargo door raises out of hold-open latch position.

NOTE

Use small cord or similar item to manually depress mechanical hold-open latches (figure 3-1, sheet 3).

11. Manually depress mechanical hold open latches (figure 3-1, sheet 3).

NOTE

Remove cord when door is below the mid-open position.

12. Remove cargo door barrier net (if installed).

NOTE

The door control handle does not need to be pulled up during the next step.

13. Rotate door control handle to CLOSE position and hold. Cargo door will gravity-fall (slowly) to full-down position.

14. When cargo door stops in full-down position, pull up on door control handle and hold in CLOSE position.

15. Actuate handpump until cargo door closes fully and mechanical latches rotate to full-latched position.

16. Release door control handle to neutral position.

NOTE

If the cargo door fails to latch by handpump operation, it can be latched manually from the outside. To latch the cargo door from outside, proceed as follows:

a. Remove handpump handle from handpump, socket and pass it to person outside of aircraft.

b. Rotate door control handle to CLOSE position and hold.

c. Insert handpump handle into torque tube socket and rotate upward to LATCHED position (figure 3-1, sheet 2, view A).

d. Release door control handle to neutral position.

e. Remove handpump handle from torque tube socket and verify lock handle is in LOCK position (flush with cargo door).

f. Return handpump handle to person inside aircraft.

g. Stow handpump handle.

h. Proceed with steps 18 through 23.

17. Remove and stow handpump handle.

18. Close handpump access door and stow door control handle.

NOTE

Cargo door lights will go off automatically when the door is fully closed.

19. Place CARGO DOOR LIGHTS switch in OFF position (if applicable).

20. Close and secure control panel access door.

NOTE

Pip pin location may not be accessible if cargo is loaded in pallet position 2L. In this case, it may be left out during cargo flight.

21. Insert pip pin in locktube.

NOTE

- On aircraft 79-0433 and 79-0434, the CARGO DOOR SYS (A and B) lights, located on the flight engineers upper instrument panel No. 2, go off when the cargo door is closed and locked.

- On aircraft 79-1710 and subsequent, the CARGO DOOR SYS B light goes off when the cargo door is closed and locked. The CARGO DOOR SYS A light goes off only when both the cargo door and vent door are closed and locked.

22. Close vent door and move vent door locking handle to LOCKED position as follows:

a. To close vent door from inside, pull in and up on vent door pull handle and hold while moving locking handle counterclockwise to LOCKED position (figure 3-1, sheet 1, view B).

NOTE

If vent door controls are not accessible from inside aircraft, close vent door from outside.

b. To close vent door from outside, push vent door in, flush with cargo door, and hold while moving locking handle clockwise to LOCKED position (figure 3-1, sheet 1, view A).

c. Visually check through viewing port that lockpins are engaged when vent door is required to be closed from outside of the aircraft.

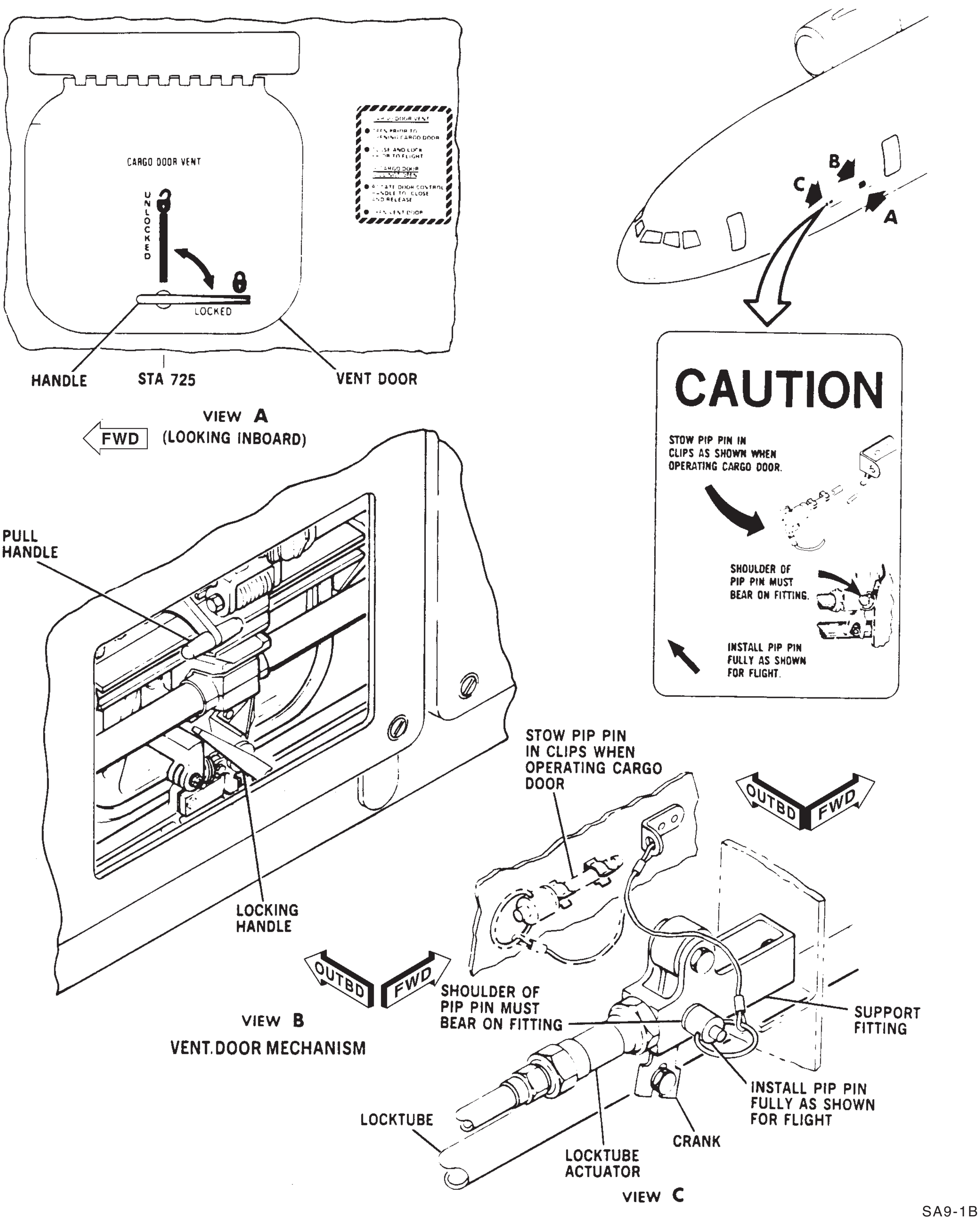


Figure 3-1. Cargo Door Operation (Sheet 1)

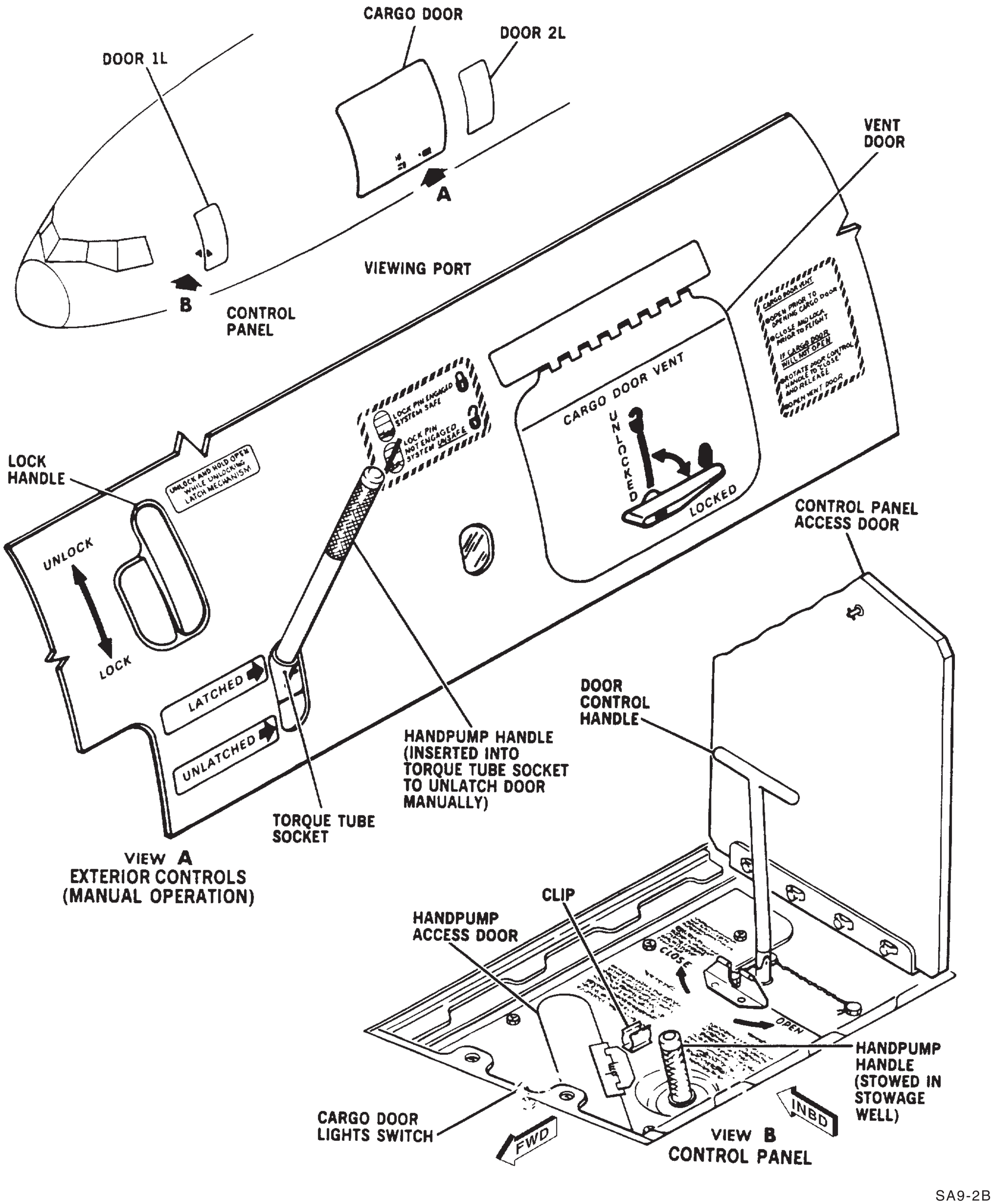


Figure 3-1. Cargo Door Operation (Sheet 2)

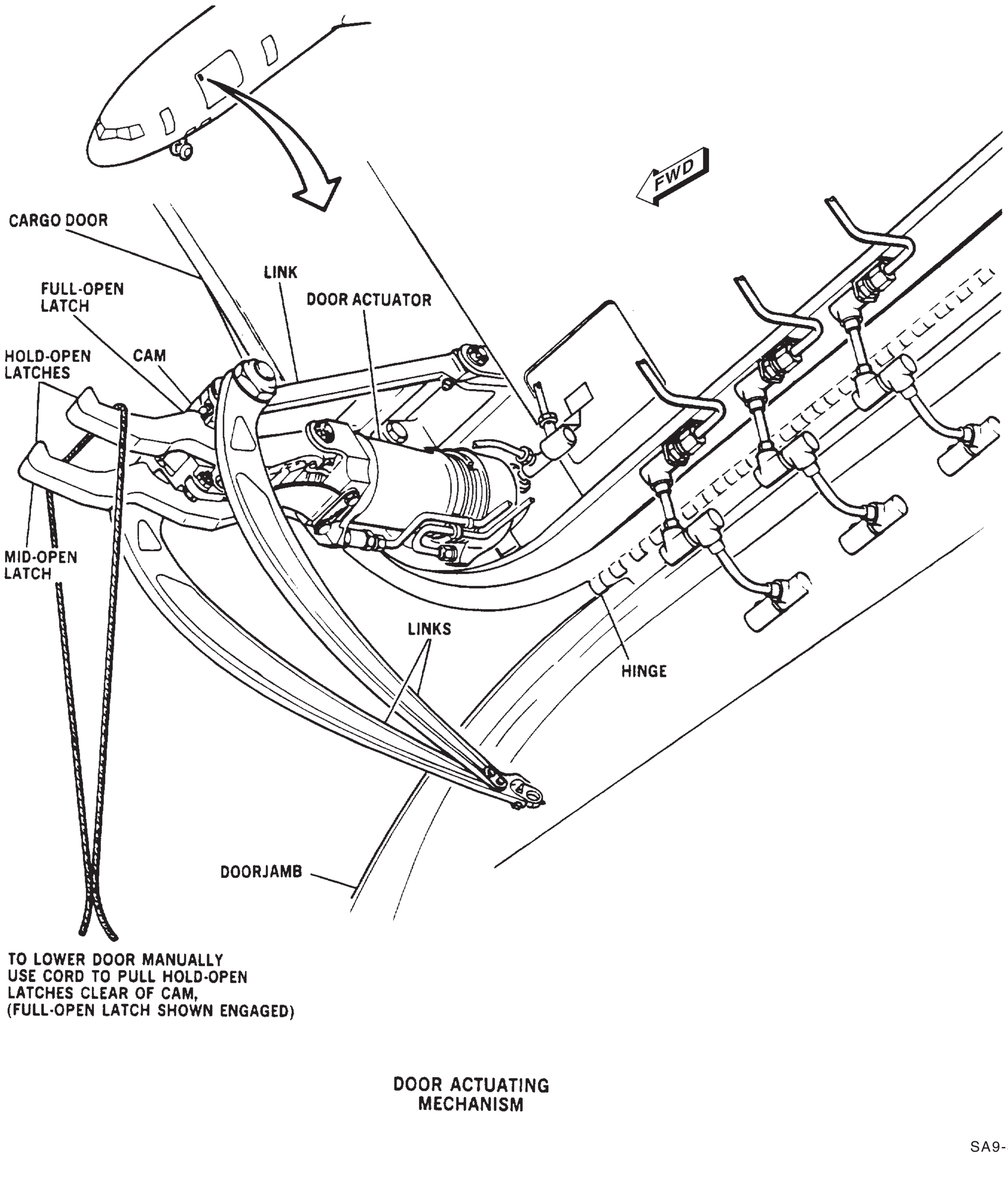


Figure 3-1. Cargo Door Operation (Sheet 3)

CARGO HANDLING SYSTEM

The cargo load and number of personnel to be transported determine the location of cargo handling system components for the three basic compartment configurations. General arrangement of the cargo handling system components is shown in figures 3-2 and 3-3. Detailed installation instructions for specific components will be found under applicable paragraph headings.

CAUTION

- Visual inspection and operational checks of components are important to the success of the mission as a whole. Obstructed or malfunctioning mechanisms, bent or misaligned conveyors and restraint rails or improperly installed components, can cause serious damage during loading operations, and delay or jeopardize the mission.

- Proper location of all loading equipment is necessary for efficient loading operations and integrity of the system. This applies particularly to repositioning components when converting the cargo compartment from one configuration to another.

OMNIDIRECTIONAL CONVEYOR ASSEMBLIES

In the cargo door area (approximately between stations 629 and 828), omnidirectional conveyor assemblies are installed across the width of the cargo compartment. These assemblies permit cargo pallets to be moved and/or rotated in order to provide easy alignment of cargo during loading and offloading operations.

The omnidirectional conveyor assemblies consist of seven honeycomb panels and two crosstrack assemblies. The two crosstrack assemblies are installed adjacent to doors 2L and 2R. The panels and assemblies are secured to the cargo floor seat tracks with AZZ7410-1 restraint assemblies.

Each panel contains castered rollers that are located in recessed pans approximately 12 inches on center. The crosstrack assemblies' castered rollers are mounted in channels.

The conveyor panels contain cutouts through which the cargo pallet restraint assemblies are attached to the seat tracks. To accommodate the several pallet arrangements, restraint assemblies are installed directly in the panels where seat tracks are not located.

LONGITUDINAL CONVEYOR ASSEMBLIES

Forward and aft of the omnidirectional conveyor area, longitudinal roller conveyor assemblies are used to provide a continuous conveyor system for moving pallets longitudinally within the cargo compartment. The assemblies consist of six rows of roller conveyor channels located symmetrically about the centerline of the aircraft. In addition, short segments of roller conveyor channels are mounted in the crosstrack assemblies located along the outboard sides of the cargo compartment. The rows of roller conveyor assemblies are located at X = +101.25, +79.00, +52.50, +32.50, +13.50, -13.50, -32.50, -52.50, and -79.00. The extra row of roller conveyor channels on the left side of the cargo compartment provide support for the outboard edge of the HCU-6/E pallet when loaded laterally in the aircraft, as in the 27 pallet all-cargo configuration. The individual rollers installed in the channels are spaced approximately 10 inches on center to provide adequate support for the pallets.

Outboard Longitudinal Conveyor Assemblies

The outboard crosstrack assemblies consist of a side restraint rail, and in some assemblies, pallet end restraint fittings as well as the roller conveyor sections. These crosstrack assemblies are secured in position with AZZ7410-1 equipment restraint assemblies inserted in the seat tracks.

Inboard Longitudinal Conveyor Assemblies

The six inboard rows of roller conveyor channels are secured to the seat tracks by means of outrigger assemblies. The outrigger assemblies contain integral studs and spring-loaded shear pins for installation in the seat tracks.

PALLET END (LONGITUDINAL) RESTRAINT ASSEMBLIES

The pallets are restrained in the forward and aft direction by retractable end restraint assemblies. In the aft end of the cargo compartment, the pallets are restrained in the aft direction by fixed end restraint rails. These assemblies also provide partial vertical restraint.

Retractable End Restraint Assemblies

Three types of retractable restraint assemblies are used for end restraint of pallets. They consist of dual-pawl assemblies, when pallets are loaded forward and aft of the restraint assemblies, and single-pawl assemblies at the forward end of pallets in position 1L and 1R.

Two types of dual-pawl assemblies are used. The most common type (AZZ7345-501) has its own base and is attached directly to the seat tracks with built-in studs and spring-loaded shear pins. The second type (AZZ7343-503) is mounted in the omnidirectional and outboard crosstrack assemblies.

The pawls in the dual-pawl assemblies are spring-loaded hooks shaped similar to an inverted J. When raised, the pawls lock in an upright position to form hooks that fit over the edge of the pallets. When released, the pawls retract below the top surface of the conveyor assemblies, which allows the pallets to be moved over the restraint assemblies.

The six single-pawl end restraint assemblies (AZZ7346-1) are similar to the dual-pawl assemblies (each having its own base). These assemblies are only used to restrain the forward end of pallets in positions in 1L and 1R.

When loading pallets in the constant section for the 25-pallet all-cargo configuration (all pallets are oriented longitudinally), four end restraints are used; three of the four restraints are installed in the seat tracks, and the fourth is mounted in the outboard crosstrack assembly. If the cargo handling system is configured for 27 pallets, five end restraints are used in the constant section for the pallets oriented laterally on the left side. The three seat-track-mounted restraints are used, plus the two end restraint assemblies located in the crosstrack assembly.

CAUTION

> All retractable end-restraint assemblies will be locked in the upright position to ensure the integrity of the system. An unlocked end-restraint assembly could cause serious damage and jeopardize safety of flight.

End Restraint Rails

Rails are used at the aft end of the cargo compartment to provide restraint for pallets in that position. The bases of the rails are attached to the seat tracks with integral studs and quick-release pins. On aircraft modified by SB 25-349, the base of the rails are attached to the seat tracks with fitting assemblies. The aft end rail just forward of the ARO hatch, are secured by eight bolts.

PALLET SIDE (LATERAL) RESTRAINT ASSEMBLIES

Pallets are restrained laterally by restraint rails and, in the omnidirectional panel area, by retractable restraint assemblies. These assemblies, along with the forward and aft restraint rails, provide for the necessary vertical restraint of the pallets. The restraint rails also act as guides when moving the pallets longitudinally in the cargo compartment.

SIDE RESTRAINT RAILS

The outboard restraint rails, except for the omnidirectional panel area, are mounted in the outboard crosstrack assemblies. The left outboard restraint rails in the constant sections can be positioned at two locations, X = +88.69 and X = + 108.69, to allow loading HCU-6/E pallets longitudinally or laterally. The right outboard restraint rails remain at X = -88.69 to allow for a walkway to the ARO compartment. These side restraint rails are mounted on the outboard crosstrack assemblies with integral quick-release mechanisms.

In the omnidirectional panels on the right side of the aircraft, opposite the cargo door, eight short segments of rails are mounted in the panels (seven AZZ7407-1 rails and one longer AZZ7438-1 rail).

These eight rail segments serve as a continuation of the right-hand longitudinal side rails. The rails are located at X = -88.69 when loading cargo pallets and can be moved outboard to X = -108.69 when seat pallets are loaded in the cargo compartment.

CENTER GUIDE RESTRAINT RAILS

The center guide restraint rails are mounted on cross tracks down the centerline of the cargo compartment. These rails are attached by quick-release mechanisms and can be easily removed for loading coupled pallets.

NOTE

- When cargo on longitudinally-coupled pallets is to be pivoted into position, the center guide rail at pallet position 4L/R(D) should be removed prior to loading operations.

- When cargo on laterally-coupled pallets is to be loaded, center guide rails must be removed, as required, to allow unobstructed movement of the pallets.

EQUIPMENT RESTRAINT ASSEMBLIES

Omnidirectional and outboard longitudinal conveyor assemblies are secured to the cargo floor seat tracks with AZZ7410-1 equipment restraint assemblies. Each restraint assembly has a formed hook with studs, and an integral spring-loaded index pin. The hook fits over the edge of the conveyor assembly to be installed, and the studs and index pin secure the assembly to the seat tracks. A total of 483 of these restraints are used to install all of the applicable conveyor assemblies in their required positions.

CARGO BARRIER NET

The cargo barrier net is used to furnish 9 g's of forward restraint for cargo loads up to 175,000 pounds. It is designed to restrain cargo during extreme conditions of a wheels-up landing or other abnormal deceleration situations.

The cargo barrier net is constructed of nylon webbing straps. The stretching of the nylon straps absorbs the energy of the cargo in motion.

WARNING

> All webbing, tacking, and stitching in the cargo barrier net shall be in good, safe condition, and all net attach fittings, attach brackets, and eyebolts must be properly installed, operable and undamaged for all cargo missions.

The cargo barrier net is attached at 38 locations around the periphery of the cargo compartment. Twenty-eight top and side net straps are fastened to fuselage-mounted eyebolts by clevises and quick-release pins. The remaining ten straps are attached to bracket assemblies that install in the seat tracks. Six bracket assemblies with pallet stops are installed in the inboard positions and must be properly aligned. Four bracket assemblies without pallet stops are installed in the outboard positions.

In the all-cargo configuration, the cargo barrier net is installed at station 495. In the cargo/personnel configurations, the net is installed at station 575 (up to 20 personnel) or at station 939 (75-personnel configuration).

NOTE

- When the cargo barrier net is to be installed at Position 3, verify cross track (AZZ7356-1) at station 939 is moved 15 inches forward to allow proper alignment of seat-tract mounted bracket assemblies.

- Maintenance and the fabrication shop will be the final authority on the serviceability of the cargo barrier net.

WALKWAY

An unobstructed walkway is provided along the right side of the cargo compartment to provide access to the ARO compartment from the flight deck. The walkway is made up of 16 panels and is installed on the outboard crosstrack assemblies. The panels are constructed similar to the cargo floor and average 20 inches in width throughout their length. The forward and aft panels have an 11° (approximately) ramp angle to provide a smooth transition from the cargo floor to the walkway, which is 2.15 inches in height. All the panels are coated with nonskid material.

An access door is located in the walkway at approximately station 964. When the cargo barrier net is installed at station 939, this door provides access to the seat track for the installation of the outboard cargo barrier net floor attach bracket.

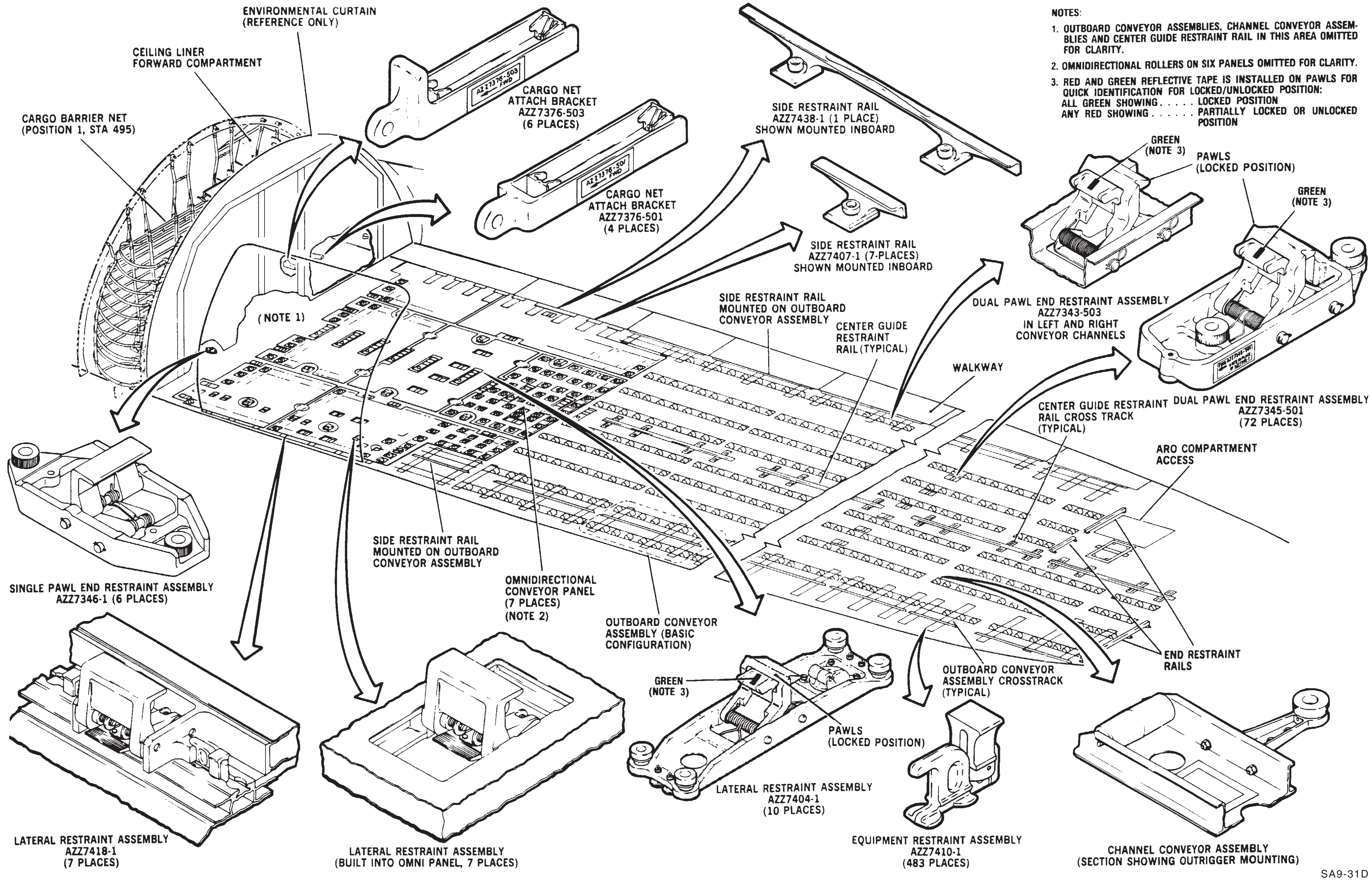


Figure 3-2. Cargo Handling System

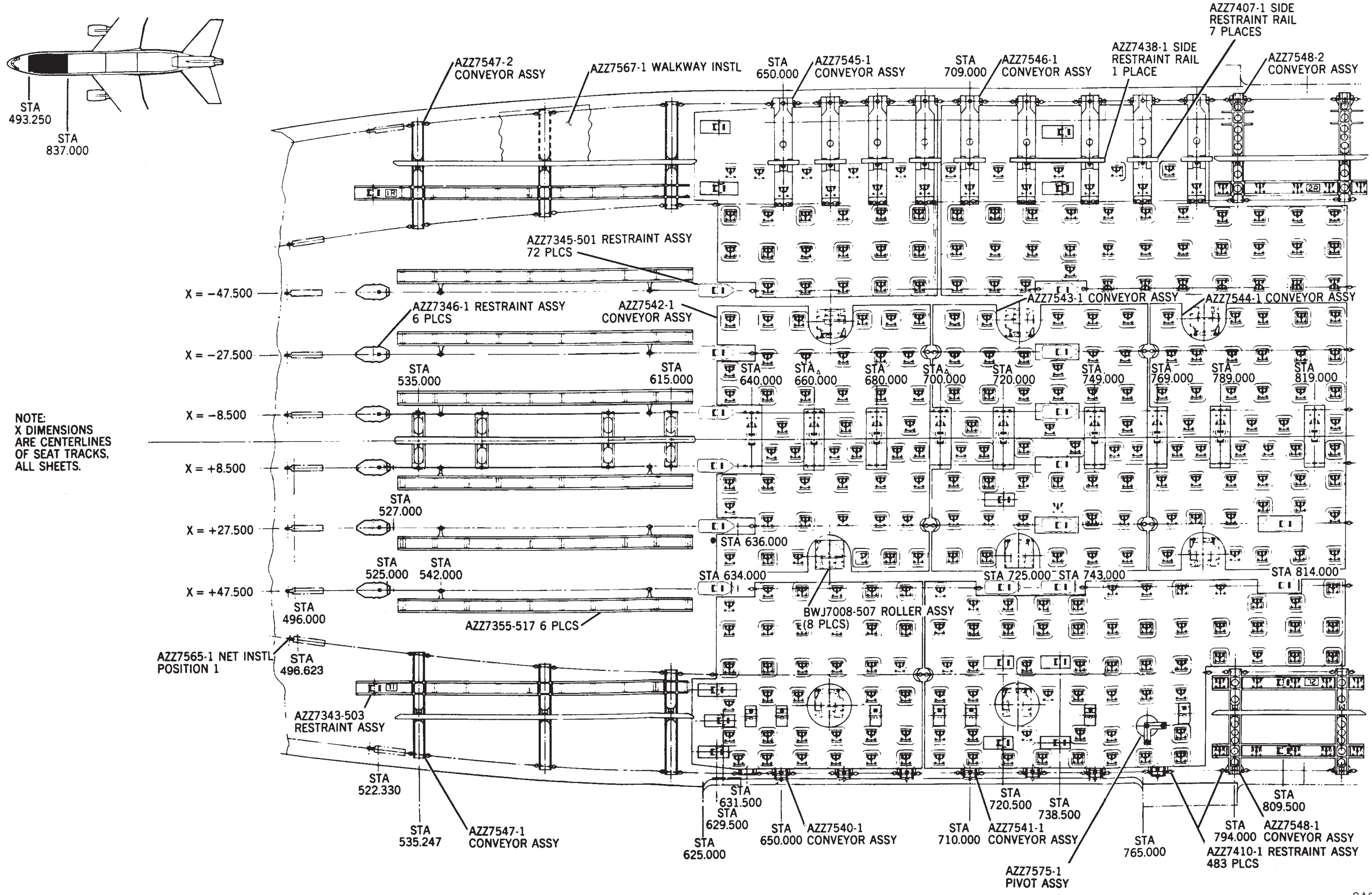


Figure 3-3. Cargo Handling System Installation (Sheet 1)

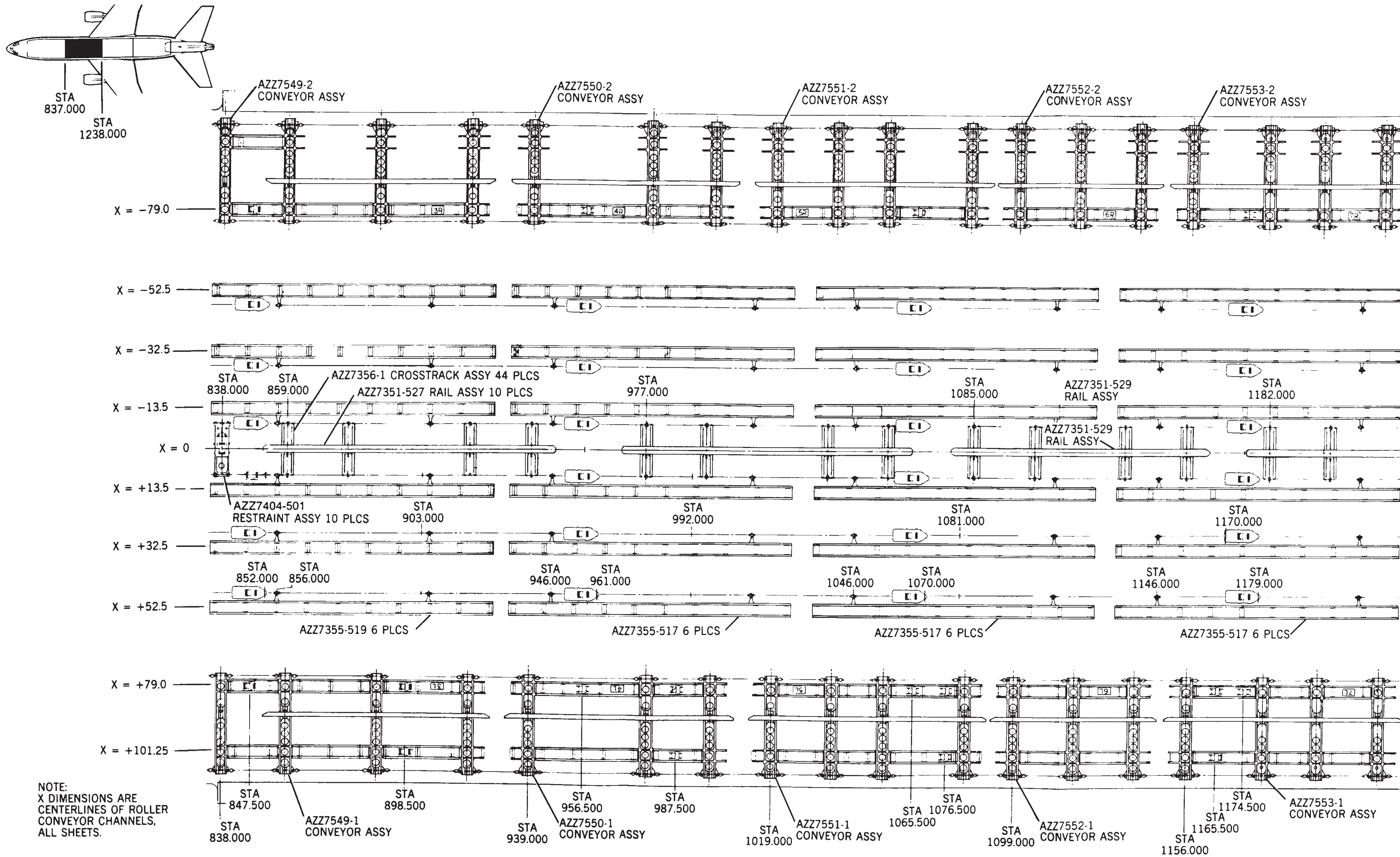
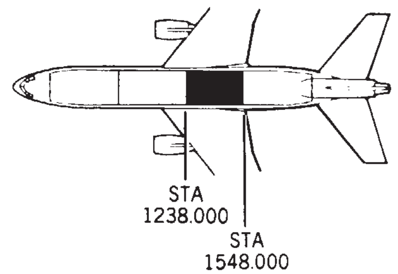


Figure 3-3. Cargo Handling System Installation (Sheet 2)



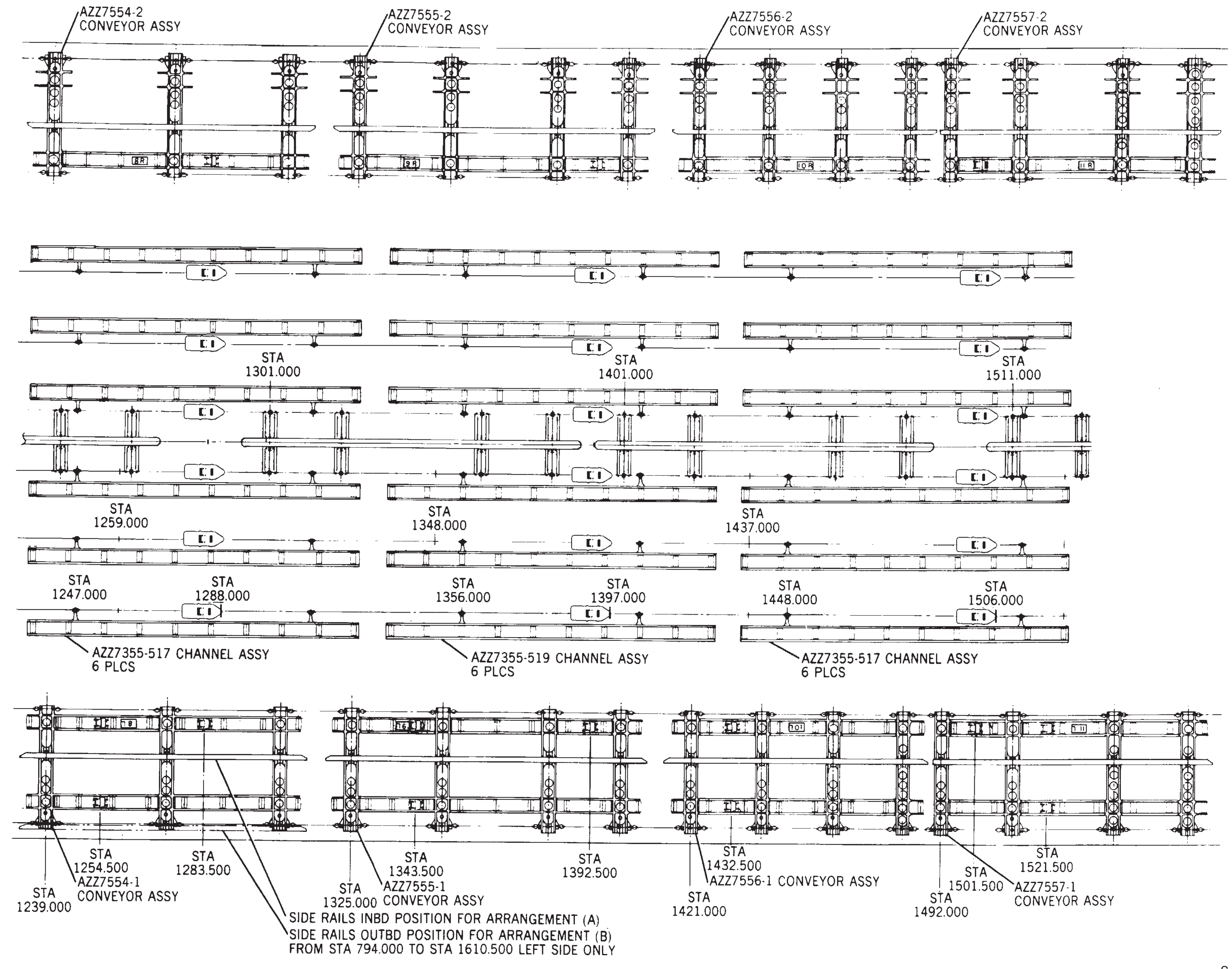


Figure 3-3. Cargo Handling System Installation (Sheet 3)

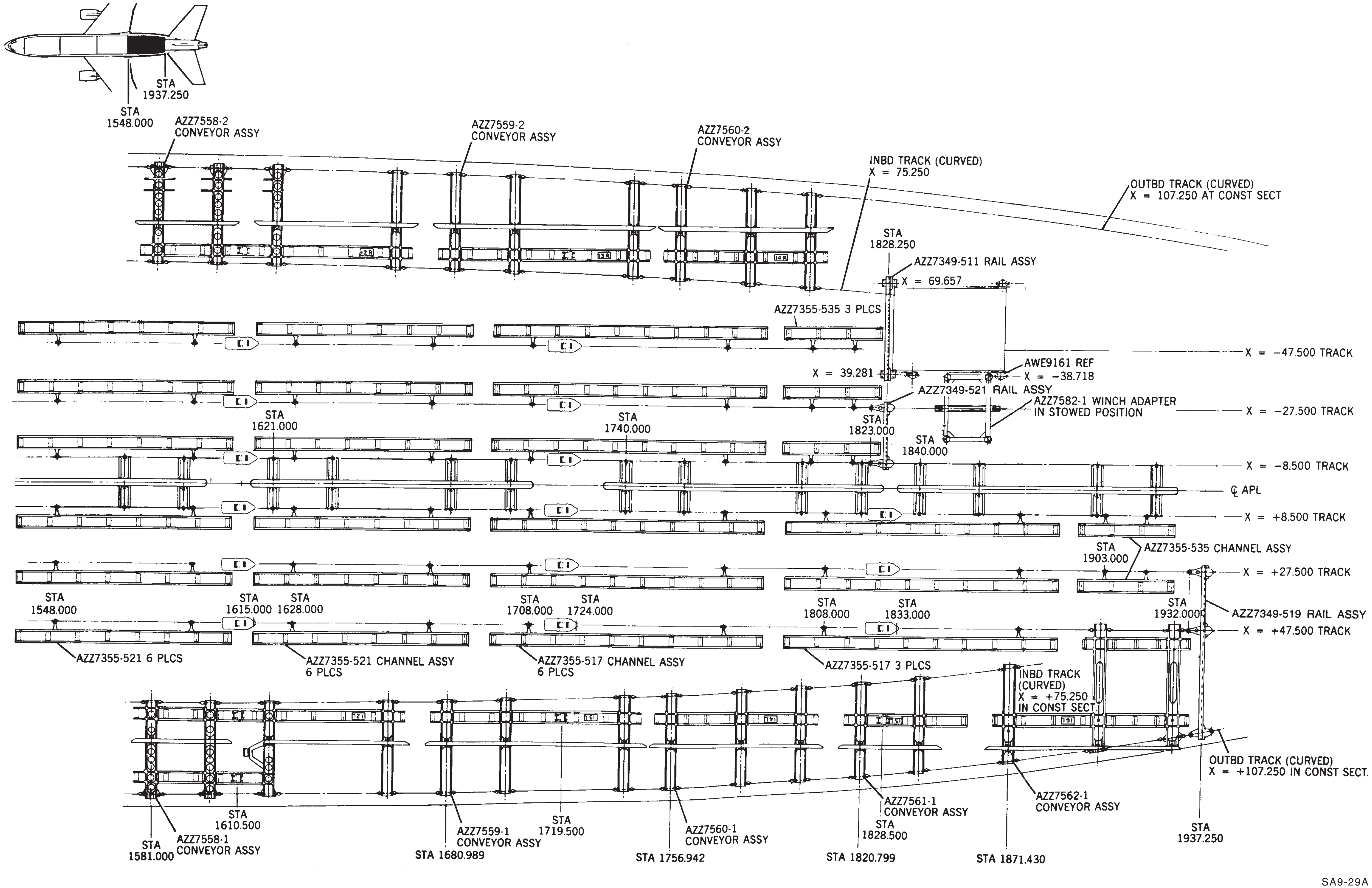


Figure 3-3. Cargo Handling System Installation (Sheet 4)

CARGO LOADING AIDS INSTALLATION

Cargo loading aids consist of the cargo door sill conveyor, powered rollers system, pivot fitting, cargo winch and pallet couplers (figure 3-13). These components, except for the powered rollers system, are portable. They require installation prior to use, and removal and stowage after loading/offloading operations. Functional tests are provided for the powered rollers system and the cargo winch.

CARGO DOOR SILL CONVEYOR

The cargo door sill conveyor consists of three assemblies that are installed on the cargo door spools and lock into place by integral spool locks. An adjustable bumper, installed on each assembly, protects the aircraft against inadvertent damage from cargo loading equipment.

A continuous row of rollers are installed in the top section of the conveyor assemblies. These rollers provide a low-friction teeter point for the transition of pallets during loading and offloading operations.

The outboard sides of the forward and aft assemblies have a vertically-mounted roller installed. The vertical rollers prevent damage to the cargo doorjamb when cargo pallets are moved in and out of the aircraft. On the center assembly, two retractable spring-loaded pallet stops can be released to prevent accidental rollout of loaded pallets.

CARGO DOOR SILL CONVEYOR INSTALLATION AND REMOVAL

The three cargo door sill conveyor assemblies must be installed or removed individually.

WARNING

- Cargo door sill conveyor installation and removal shall only be accomplished when a loader/elevator is in place and the cargo door is latched in either the mid-open or full-open position.
- Do not carry any part of the door sill conveyor with you when transiting between aircraft and loader.
- Personnel should exercise extreme care when transiting between the aircraft and loader during cargo loading/offloading operations and while installing the cargo door sill conveyor assembly.
- The Boom Operator may install/remove the aft cargo door sill conveyor assembly from inside the aircraft when gap between aircraft and loader is deemed unsafe.

CAUTION

- Use care when installing and removing cargo door sill conveyor assemblies to prevent damage to the cargo door seal.
- If the cargo door sill conveyor is not installed (when allowed by procedures), caution must be used to prevent damage to the door jamb.

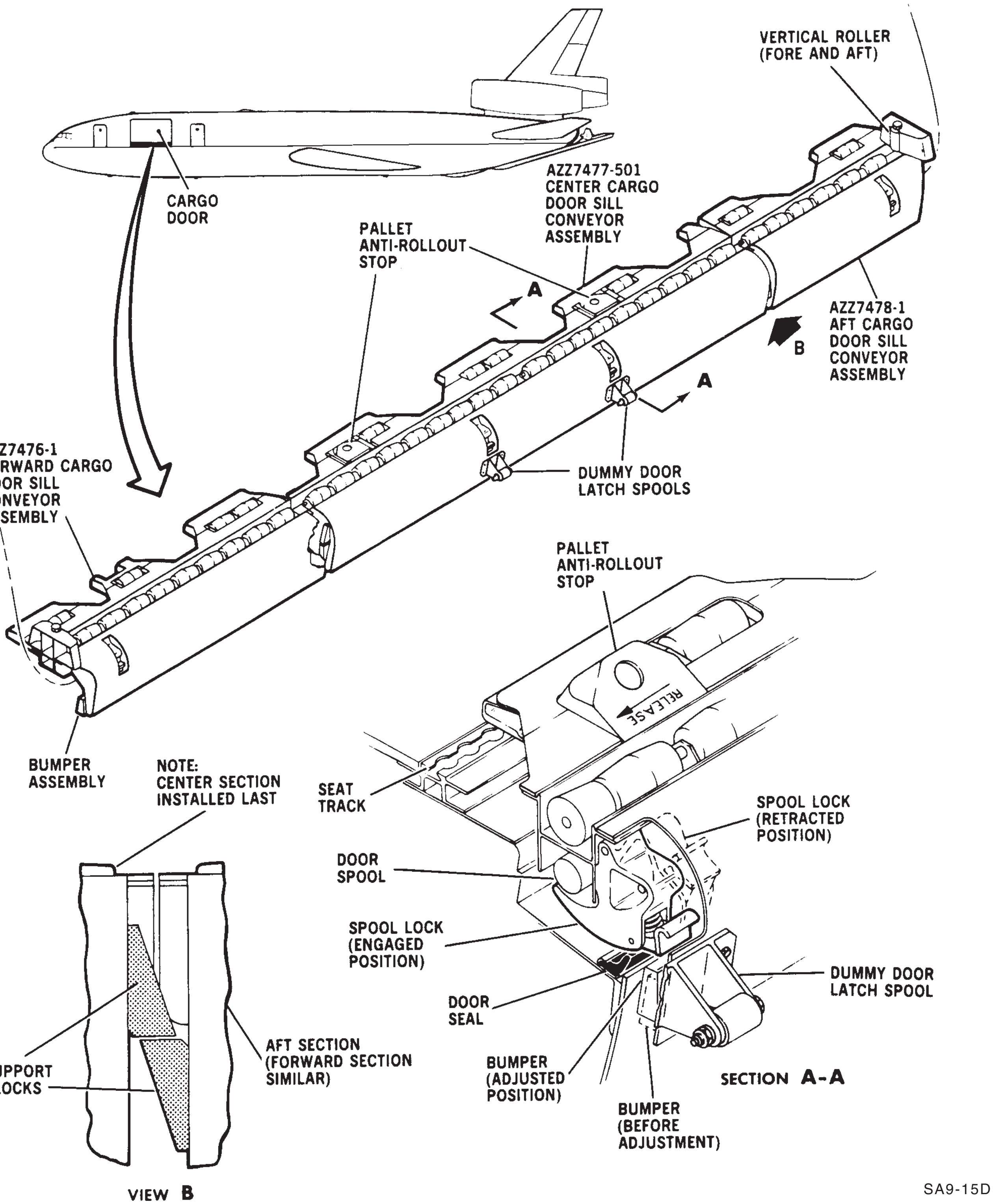


Figure 3-4. Cargo Door Sill Conveyor Installation

NOTE

- When cargo compartment pallet positions 2L(BB) and 3L(CC) are occupied, the cargo door sill conveyor must be installed and removed from outside of the aircraft.
- Forward and aft assemblies must be installed first for proper alignment of support blocks between the center and end assemblies.

Installation (Figure 3-4)

1. Retract spool locks on forward and aft conveyor assemblies.

2. Place forward and aft conveyor assemblies in position on cargo door sill.

3. Rotate spool locks to engage door spools beneath door sill. Verify forward and aft conveyor assemblies are locked in place.

4. Retract spool locks on center conveyor assembly.

5. Place center conveyor assembly in position on cargo door sill, between forward and aft conveyor assemblies.

6. Rotate spool locks to engage door spools beneath door sill. Verify center conveyor assembly is locked in place.

7. Check support blocks between conveyor assemblies for proper contact and alignment.

8. Verify conveyor bumpers fit firmly against outside edge of cargo door sill.

Removal (Figure 3-4)

1. Retract spool locks on center conveyor assembly.

2. Remove center conveyor assembly.

3. Retract spool locks on forward and aft conveyor assemblies.

4. Remove forward and aft conveyor assemblies.

POWERED ROLLERS SYSTEM

The powered rollers system consists of eight electrically-powered roller assemblies, a handheld pendant, and a control console. Electrical power is not available to the system until the cargo door is opened.

Each roller assembly is mounted directly in pans in the cargo floor through cutouts in the omnidirectional panels. The control console is located on the left side of the fuselage, just forward of the cargo door (figure 3-6).

Each roller assembly is an integrated unit consisting of a cast frame with mounting supports, a reversible electric motor, a gear box, and a treaded roller. The motors operate from the aircraft’s 115/200 VAC, 400 Hz, 3-phase electrical power system. Each motor is provided with a thermal protection device that disconnects power to the motor in the event of a high operating temperature buildup. The protective device resets automatically after the temperature drops to a safe level.

The control console consists of a CARGO LOADING SYSTEM control panel and a stowage location for the hand-held pendant. The guarded POWER switch in the control panel provides electrical power to the rollers. Green POWER indicator lights, on the control panel and pendant, come on when the POWER switch is placed in the ON position. The RIGHT CHANNEL ROLLERS switch controls power through the pendant to the three right-hand (fore and aft) channel roller assemblies. When placed in the OFF position, the right-hand channel rollers cannot be energized.

The pendant contains three toggle switches and an on/off dead-man type pushbutton power switch, (figure 3-6). The toggle switches control the direction of rotation for the three rows of rollers. The three switches (placarded FWD, MID, and AFT) provide electrical power to the laterally-positioned three forward, three mid, and two aft roller assemblies. Power is not applied to the rollers until the ROLLERS CONTROL switch is pressed. The pendant has a 24-foot long cord, which provides the operator freedom of observation during loading/off loading operations.

Each ROLLERS SELECT switch has the three following positions: IN, OFF and OUT. When any switch is placed in the IN position, the corresponding rollers will rotate inward (away from the cargo door) as the ROLLERS CONTROL switch is pressed, and pallets will be moved into the cargo compartment. In the OUT position, the rollers rotate outward (toward the door) as the ROLLERS CONTROL switch is pressed, and pallets will be moved out of the cargo compartment. The right channel rollers will not rotate if the RIGHT CHANNEL ROLLERS switch, on the control panel, is in the OFF position.

When the rollers are energized to rotate in either direction, they elevate as much as 3/8 of an inch above the adjacent omnidirectional rollers, and move the pallets at a rate of approximately 45 feet per minute. When the ROLLERS CONTROL switch is released, the rollers stop rotating and automatically retract 3/8-inch below the top surface of the omnidirectional rollers. The cargo pallet can then be moved fore and aft manually or by the cargo winch. Through the ROLLERS SELECT switches, the forward, mid, or aft rollers can be energized to rotate in opposite directions. This capability, used in conjunction with the removable pivot fitting, makes it possible to rotate pallets, in a controlled manner, about a fixed point of rotation.

POWERED ROLLERS SYSTEM LOGIC

Figure 3-5 shows a plan view of the forward section of the aircraft, which depicts the relationship between the powered rollers system, pallet locations (25-pallet, all-cargo configuration), and the cargo door opening.

The basic logic of the powered rollers system is: the forward row of rollers can be operated independently, driving away from or toward the cargo door opening, as needed. Simultaneously, the mid and/or aft rows can be operated independently, driving in either direction. With this flexibility, a differential action (any row driving opposite to the other, or any row not in use) can be used to rotate and align single or coupled pallets.

Any powered roller not necessary to move pallets should be turned off.

POWERED ROLLERS SYSTEM FUNCTIONAL TEST

The powered rollers are operated by electrical control switches on the cargo loading switch control panel and pendant (figure 3-6). The test procedures (figure 3-7) verify correct operational function of the powered rollers system.

NOTE

> Accomplish functional check of powered rollers prior to loading/downloading of cargo.

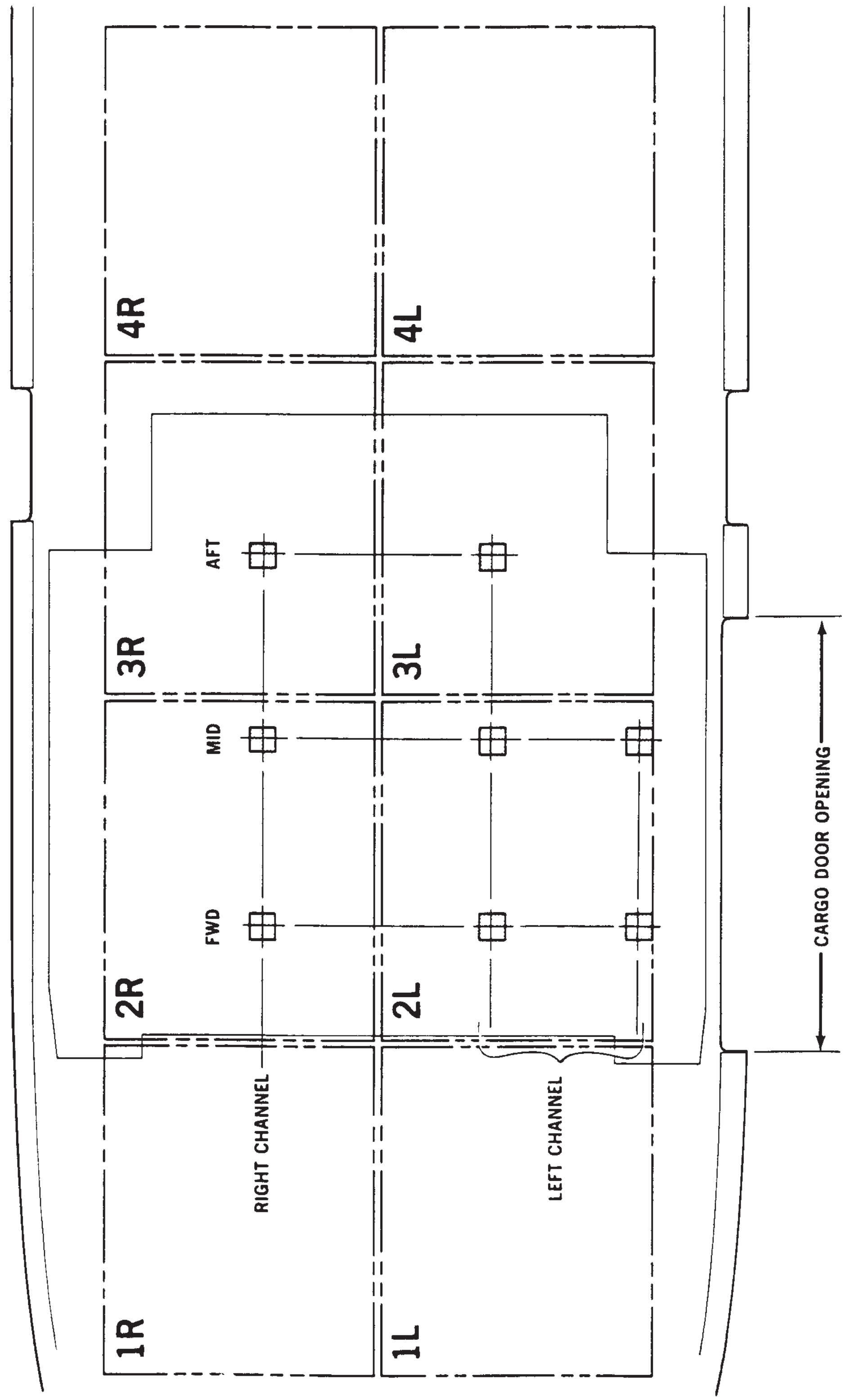


Figure 3-5. Powered Rollers Locations

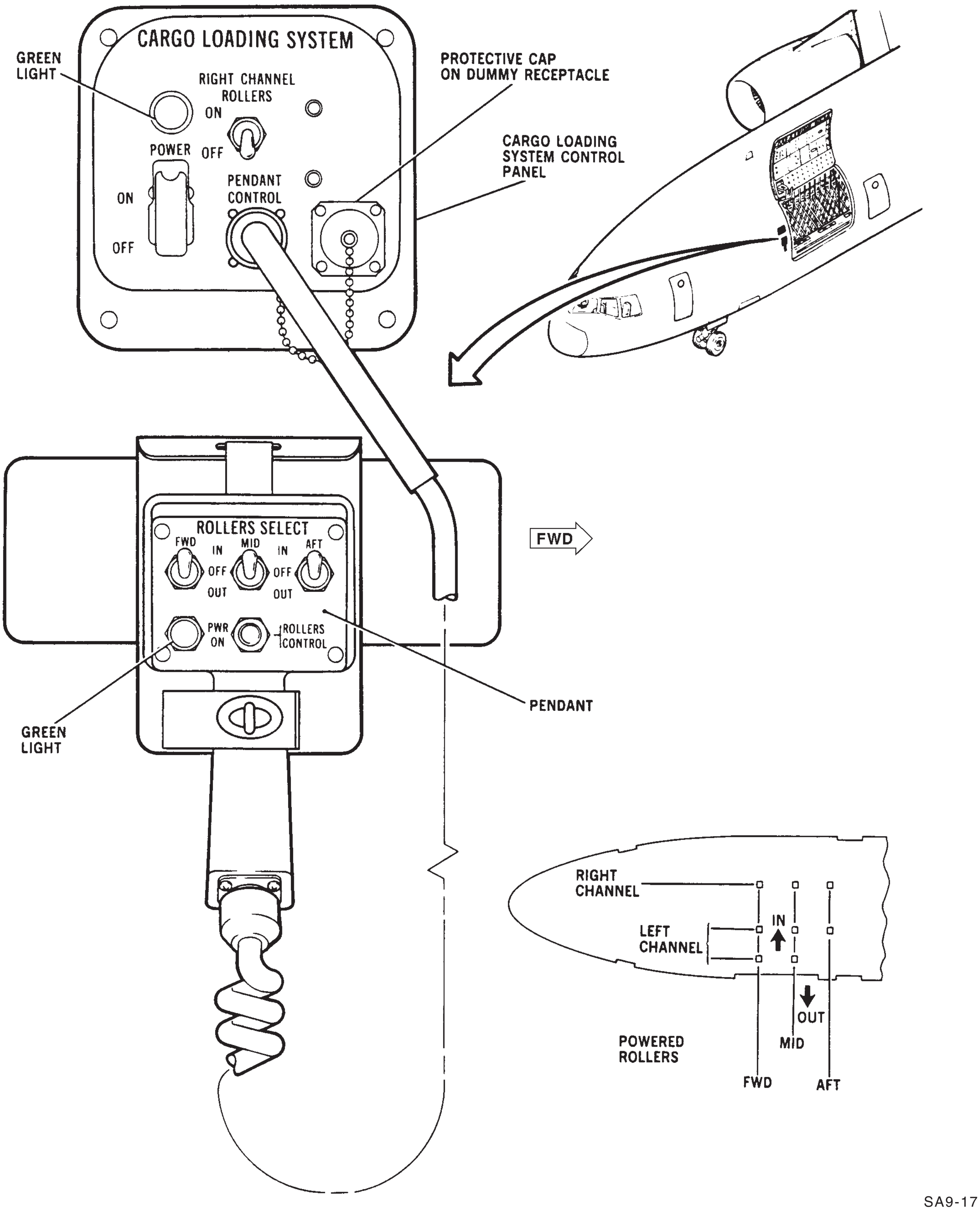


Figure 3-6. Powered Rollers System Controls

Preliminary Requirements

Verify all control switches are in the OFF position.

Remove protective cap from PENDANT CONTROL receptacle on control panel and place on dummy receptacle.

Connect pendant extension cord to PENDANT CONTROL receptacle.

Check roller assembly attachment points and electrical connection for security.

Location	Operation	Required Results

NOTE

If a malfunction occurs during this test, check circuit breaker(s) on left overhead equipment service panel. Reset applicable circuit breaker(s) if necessary. If resetting circuit breaker(s) does not correct problem, call maintenance.

Location	Operation	Required Results
Control Panel	Raise POWER switch guard and place POWER switch ON.	Green POWER indicator lights on control panel and pendant come on.
	Place RIGHT CHANNEL ROLLERS switch ON.	
Pendant	Momentarily press ROLLERS CONTROL switch.	No activation of powered rollers.
	Place three ROLLERS SELECT switches in IN position.	
	Press ROLLERS CONTROL switch.	All rollers raise, and revolve in the in direction.
	Release ROLLERS CONTROL switch.	All rollers retract and stop.
	Place three ROLLERS SELECT switches in OUT position.	

Figure 3-7. Powered Rollers System Functional Test (Sheet 1)

Location	Operation	Required Results
	Press ROLLERS CONTROL switch.	All rollers raise, and revolve in the out direction.
	Release ROLLERS CONTROL switch.	All rollers retract and stop.
Control Panel	Place RIGHT CHANNEL ROLLERS switch in OFF position.	
Pendant	Press ROLLERS CONTROL switch.	Left channel rollers (5 rollers) raise, and revolve in the out direction. Right channel rollers remain inactive.
	Release ROLLERS CONTROL switch.	Left channel rollers re-tract and stop.
	Place three ROLLERS SELECT switches in IN position.	
	Press ROLLERS CONTROL switch.	Left channel rollers (5 rollers) raise, and revolve in the in direction. Right channel rollers remain inactive.
	Release ROLLERS CONTROL switch.	Left channel rollers re-tract and stop.
	Place three ROLLERS SELECT switches in OFF position.	
Control Panel	Place POWER switch guard in down position. (This automatically moves POWER switch to OFF position.)	Green POWER indicator lights on control panel and pendant go off.

Figure 3-7. Powered Rollers System Functional Test (Sheet 2)

POWERED ROLLERS SYSTEM PROCEDURES

Listed below are the procedures which must be followed when using the powered rollers system:

WARNING

- When using the powered roller system, ensure no personnel are standing on a powered roller or in the line of travel of a moving pallet.
- Pallets continue to travel after release of the power switch on the pendant. Care must be taken not to cause injury to personnel or damage to aircraft.

CAUTION

Verify the cargo handling system components are properly configured for loading or offloading operations.

Loading HCU-6/E Pallets (No Rotation)

1. Control Panel:

a. POWER switch - ON.

b. RIGHT CHANNEL ROLLERS switch - ON, if required.

2. Pendant:

a. ROLLERS SELECT switches - IN for all pallets.

b. POWER switch - as required.

Pallet Alignment

1. Control Panel:

a. POWER switch - ON.

b. RIGHT CHANNEL ROLLERS switch - ON, if required.

2. Pendant:

a. ROLLERS SELECT switches - as required to correct alignment. Options include IN, OFF or OUT, to produce the desired alignment movement.

b. POWER switch - as required.

Offloading HCU-6/E Pallets (No Rotation)

1. Control Panel:

a. POWER switch - ON.

b. RIGHT CHANNEL ROLLERS switch - ON, if required.

2. Pendant:

a. ROLLERS SELECT switches - OUT for all pallets.

b. POWER switch - as required.

Rotation of Single or Coupled Pallets

1. Control Panel:

a. POWER switch - ON.

b. RIGHT CHANNEL ROLLERS switch - ON.

2. Pendant:

a. ROLLERS SELECT switch - as required to rotate pallet(s). Options include IN, OFF or OUT, to produce the desired rotational effect.

b. POWER switch - as required.

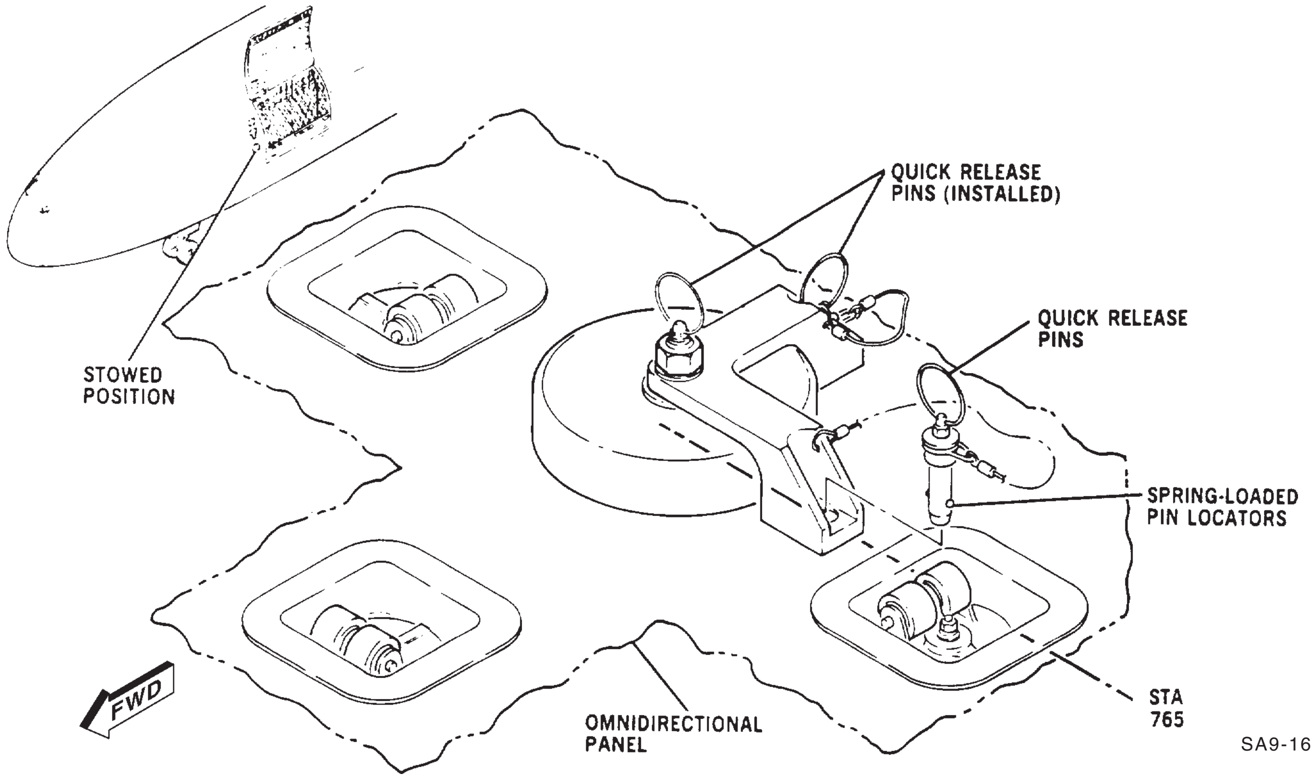


Figure 3-8. Pivot Fitting Installation

PIVOT FITTING

The fitting consists of a seven-inch horizontal roller installed in an L-shaped frame. It is attached to the left-hand aft omnidirectional conveyor panel with three quick-release pins. The forward surface of the roller is aligned with the vertical roller on the cargo door sill conveyor aft assembly. The inboard surface of the roller is in line with the left-hand longitudinal side restraint rail installed at X = +88.69.

PIVOT FITTING INSTALLATION AND REMOVAL

The pivot fitting (figure 3-8) is stowed just forward of the cargo door, directly under the powered rollers control console. To remove, support the fitting with one hand and pull the three quick-release pins out by the pin rings.

NOTE

> When installing or stowing the pivot fitting, verify the quick-release pins are fully inserted in holes, and spring-loaded locators are engaged.

When required, install the pivot fitting at station 765, directly on the omnidirectional conveyor panel, by inserting the three quick-release pins in the holes provided. Prior to installing the fitting, check the panel area and pin holes for cleanliness to ensure a secure fit.

CARGO WINCH

The winch is rated at 900-pounds cable pull, at 40 feet per minute, on a single-purchase line, under normal reel-in and reel-out conditions. The normal duty cycle for the winch is 4 continuous operating cycles (1 cycle = deployment of cable at no load and retrieval of cable at rated load of 900 pounds) then, 30 minutes off before the next series of 4 cycles.

The winch provides a 75-foot usable length of 7/32-inch diameter stainless steel cable with a swivel cargo hook (with keeper). A level wind mechanism prevents spooling and excessive slack in the wound cable, when the cable is being reeled in or out under a no-load condition. The level wind mechanism can be operated with the cable off center ±14°. The winch maintains approximately 10 pounds force under no-load conditions.

The winch is installed in an adapter assembly, which is mounted on the cargo floor seat tracks or at station 698 on the right forward omnidirectional conveyor panel. This panel contains a laterally-installed section of seat track to provide a mounting point for the adapter assembly. Whenever the winch is installed in the omnidirectional panel, the maximum pulling load must not exceed 900 pounds in order to prevent damage to the cargo handling system. The winch and adapter assembly weigh approximately 90 pounds.

Four electrical outlets in the cargo compartment provide a source of 115/200 VAC, 400 Hz, 3-phase power for the operation of the winch. These outlets are installed along the right-hand cargo compartment wall, approximately 10 inches above the floor, aft of the cabin doors (including the deactivated overwing door). A 30-foot power cord enables the winch to be installed wherever required and still be within reach of an outlet. The winch is controlled by an integral switch mounted on the winch housing or by a pendant on a 15-foot cord.

A circuit breaker for the aft outlet is located on the left-hand side of the ARO overhead panel. The circuit breakers for the forward and two mid outlets are located on the left-hand forward cabin overhead circuit breaker panel.

CARGO WINCH INSTALLATION AND REMOVAL

For longitudinal winching, the cargo winch is normally installed on the seat tracks located 8.5 or 47.5 inches either side of the aircraft centerline. For winching into the cargo compartment through the cargo door, the winch is installed on the section of seat track located laterally on the right forward omnidirectional conveyor panel at station 698 (figure 3-11, view A). Stowage position for the winch is on the seat track adjacent to the inboard side of the ARO compartment hatch (figure 3-11, view B).

The winch is mounted on an adapter assembly which is equipped with two restraint fittings located on the assembly centerline. These two fittings secure the winch to the seat track.

Installation (Figure 3-11)

1. Raise locking levers and rotate 90° (figure 3-11, view C).

2. Position winch over seat track at desired location, then carefully lower assembly so that locating studs fit into holes in seat track.

3. Rotate locking levers 90° (parallel to restraint fitting sides) to lock winch in place, then lower the levers horizontally to prevent accidental turning.

4. Connect winch electrical connector to nearest sidewall receptacle.

Removal (Figure 3-11)

1. Disconnect winch electrical connector from sidewall receptacle.

2. Secure loose equipment, such as electrical connector, cargo hook and cable, to winch housing.

3. Raise locking levers and rotate 90° to release locking studs.

4. Lift winch clear of seat tracks.

CARGO WINCH FUNCTIONAL TEST

The following test procedures verify correct operational function of the cargo winch.

Conditions Prior To Test

1. Verify control switches on winch control housing and control pendant are centered in the OFF position. (Both switches are spring-loaded for momentary operation in the OUT or IN positions.

Test (Figure 3-11)

1. Have assistant hold and maintain light tension on cable.

2. Move control pendant switch to OUT position. Observe winch operation. Check lateral movement of cable to ensure level wind mechanism is functioning.

3. Release control pendant switch.

4. Move control pendant switch to IN position. Observe winch operation. Verify level wind mechanism is winding cable smoothly on drum.

CAUTION

> Assistant shall prevent cable from catching on any protrusions such as restraint rail, conveyor assembly component, etc.

5. Maintain pressure on control pendant switch until winch shuts off automatically. (Cable travel limiting device prevents winch from reeling in cable beyond provisional limits.)

6. Release pendant control switch.

7. Repeat steps 2 through 6 using control switch on winch control housing.

WINCHING PROCEDURES

Winching is required when a cargo item is too heavy to be conveniently loaded or offloaded by other means. It is an effective method of loading or offloading coupled pallets that require rotation through the cargo door. Winching methods include only internal winching with a portable cargo winch.

WARNING

The cargo winch will not be used for loading/offloading single or coupled pallets unless it can be positively determined that the weight of the pallet(s) is the only factor preventing its movement within the rail system. Failure to comply can result in injury to personnel and/or damage to aircraft equipment.

CAUTION

- Vehicle-mounted winching is not allowed.
- When winching through cargo doorway, make sure that the loader/elevator powered drive wheels are disengaged.
- Observe path of cable to be sure cable/hook does not catch on any protrusions such as restraint rails, conveyor assemblies, etc.
- Ensure open end of cargo winch hook faces up to prevent damage to aircraft floor.

Before winch-loading cargo, the aircraft should be prepared for the loading operation. Verify all restraint latches and guide rails are positioned properly. The winch should be located so that the winch cable from the winch to the load does not contact and damage cargo, the cargo-handling system, or unprotected aircraft structure. Winch cable clearance can be checked by taking up slack.

All cargo winching shall be coordinated by a loading crew consisting of a winch operator (boom operator), and sufficient guides to monitor clearances. The boom operator shall be responsible for the winching operation and shall ensure proper prearranged signals between the loading crew are understood. Guides shall be stationed at strategic points, and in visual contact with the boom operator. During winching operations, the guides shall also check clearances between the cable and the cargo, and prevent fouling or snagging of the cables.

WINCHING OPERATION

The portable cargo winch is mounted in a winch frame (see figure 3-11), and the frame is installed on the seat tracks or on the omnidirectional roller panel located directly across from the cargo door. The winch is used only in a single-line configuration. Winching arrangements are shown in figure 3-9.

CAUTION

Verify seat track restraint fittings on winch are properly inserted in seat track and locked, prior to winching operations.

CAUTION

Pawls on restraint assemblies that are in line with the winch cable should be in the down position to prevent cable from binding in the pawls.

If a requirement exists to winch pallets into the aircraft off the loader/elevator or to winch the pallets longitudinally in the cargo compartment, a single point-of-pull can be used.

CAUTION

Attach winch cable at or near the centerline of the pallets to prevent binding in restraint rails.

FRICTIONAL EFFECTS ON WINCHING

When winching a cargo unit into the aircraft, friction may be responsible for part of the cable load.

AVERAGE COEFFICIENT OF FRICTION

The following average coefficients of friction have been selected for use when the cargo-handling system is installed (see Section V for coefficient of friction values when loading cargo units directly on the cargo floor):

LOADING METHOD	FRICTION COEFFICIENT
HCU-6/E pallets on cylindrical rollers	0.005
HCU-6/E pallets on omnidirectional rollers	0.026

WINCHING UP A SLOPED AIRCRAFT FLOOR

When winching cargo up a sloped aircraft floor, the load on the winch cable is resisted by two forces: the gravitational pull down the sloped floor and the force of friction. Both of these forces act against the force exerted by the winch cable. Both of these forces vary as the angle of the sloped floor varies.

Under normal loading conditions, with the aircraft on a flat surface, the maximum floor slope is less than 0.4°. This, combined with a sloped airport parking apron, could create a floor slope of over 3°. (The maximum slope allowed is a 5% grade or 2.86° in accordance with applicable USAF directives.)

Figure 3-10 shows the maximum pallet(s) weight that can be accommodated by the cargo winch for various aircraft floor slope angles. The curves include both the gravitational force and the frictional force of the rollers.

Figure 3-10 shows that the maximum slope for a single HCU-6/E pallet weighing 10,000 lbs is 3.6° on the omnidirectional rollers, and 4.9° on the cylindrical rollers. For coupled pallets weighing 24,500 lbs, the maximum slope is 0.6° on the omnidirectional rollers and 1.8° on the cylindrical rollers.

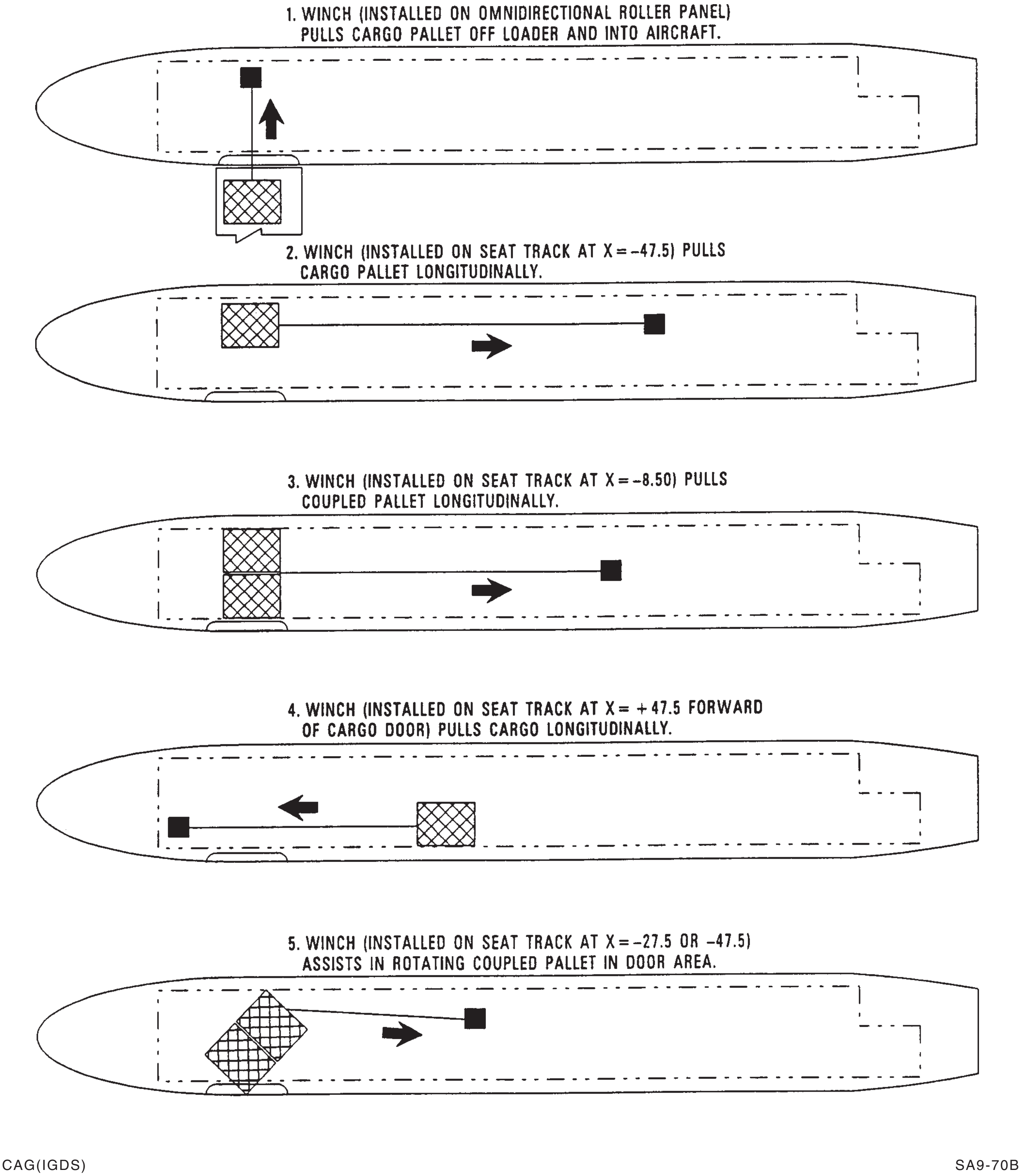


Figure 3-9. Winching Arrangements

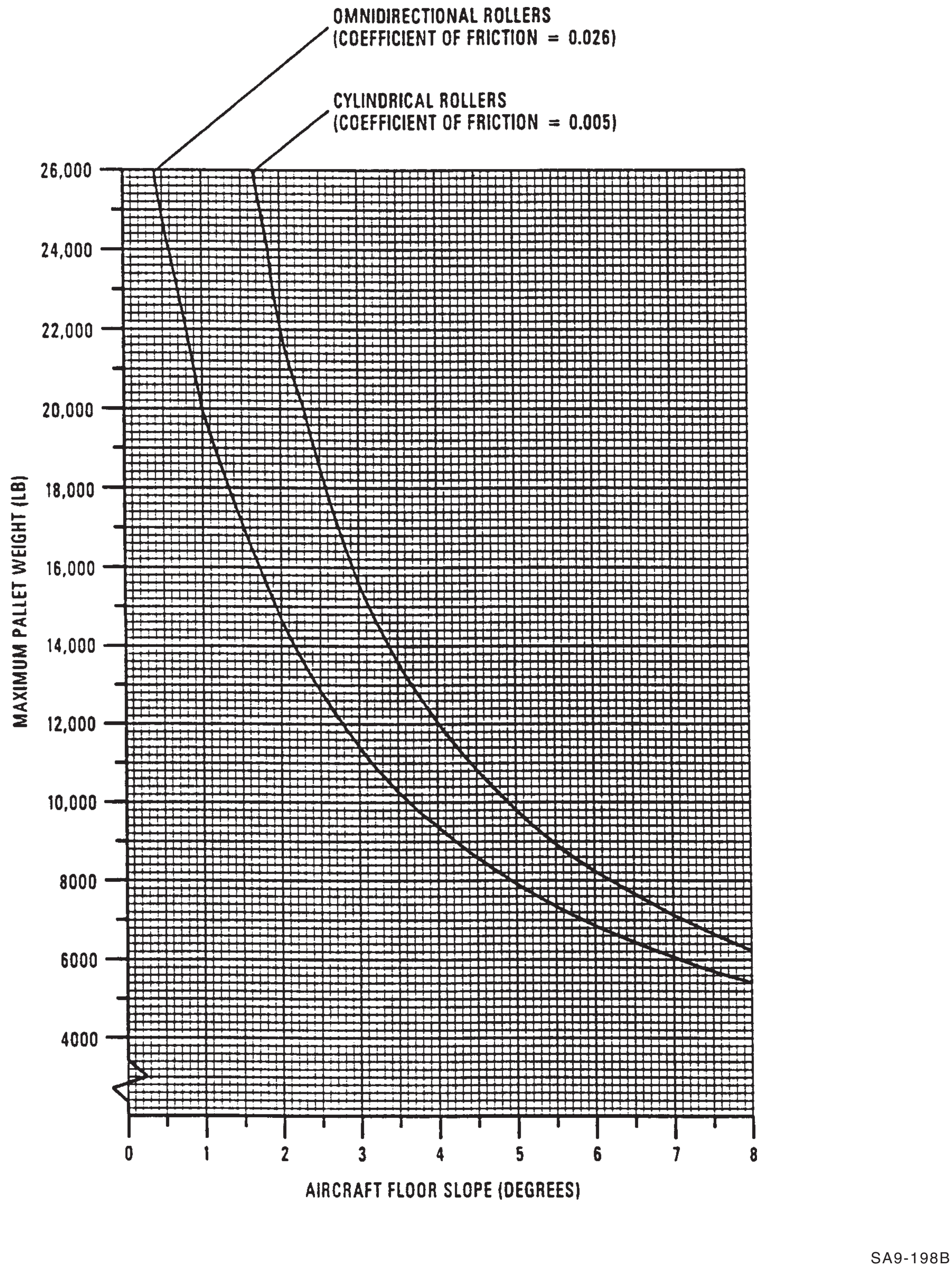


Figure 3-10. Maximum Capability of Cargo Winch on Sloped Aircraft Floor

PALLET COUPLERS

The pallet coupler, normally employed on the KC-10A, separates the HCU-6/E pallets by one inch and is provided in the government inventory. This coupler is an assembly consisting of a machined aluminum body and a hinged latch with a locking spring-loaded plunger.

WARNING

The use of wooden pallet spacers and/or wooden pallets couplers is prohibited on KC-10A aircraft. Wooden spacers and couplers may sustain hidden damage during pallet buildup and loading. This damage may allow the pallets to move out from under the restraint assemblies and become unsecured during flight.

This 1-inch coupler allows 2-pallet trains to be loaded laterally or longitudinally within the cargo handling system.

PALLET COUPLERS INSTALLATION AND REMOVAL

Two 1-inch couplers are used for each set of two coupled pallets. The pallets are coupled (on the 88- or 108-inch dimension) by installing the couplers on the second tiedown ring from the corners of the mating sides.

WARNING

Use extreme care when installing/removing pallet couplers. Personal injury may result if pallets are moved during installation and removal.

Installation (Figure 3-12)

1. Line up two pallets with mating tiedown rings opposite each other.

2. Lift two pallet rings to be coupled to the up position.

3. Position bottom of coupler body into two mating pallet lip detents.

4. Using bottom of coupler body for a gauge, align two pallets approximately one inch apart.

5. Pull spring-loaded plunger ring and lift coupler latch up to the open position. Release plunger ring.

6. Lower two mating pallet rings over posts on coupler.

7. Pull spring-loaded plunger ring and lower coupler latch to the closed position. Release plunger ring.

Removal (Figure 3-12)

1. Pull spring-loaded plunger ring and lift coupler latch up to the open position. Release plunger ring.

2. Lift two coupled pallet rings to the up position.

3. Pull spring-loaded plunger ring and lower coupler latch to the closed position. Release plunger ring.

4. Remove pallet coupler.

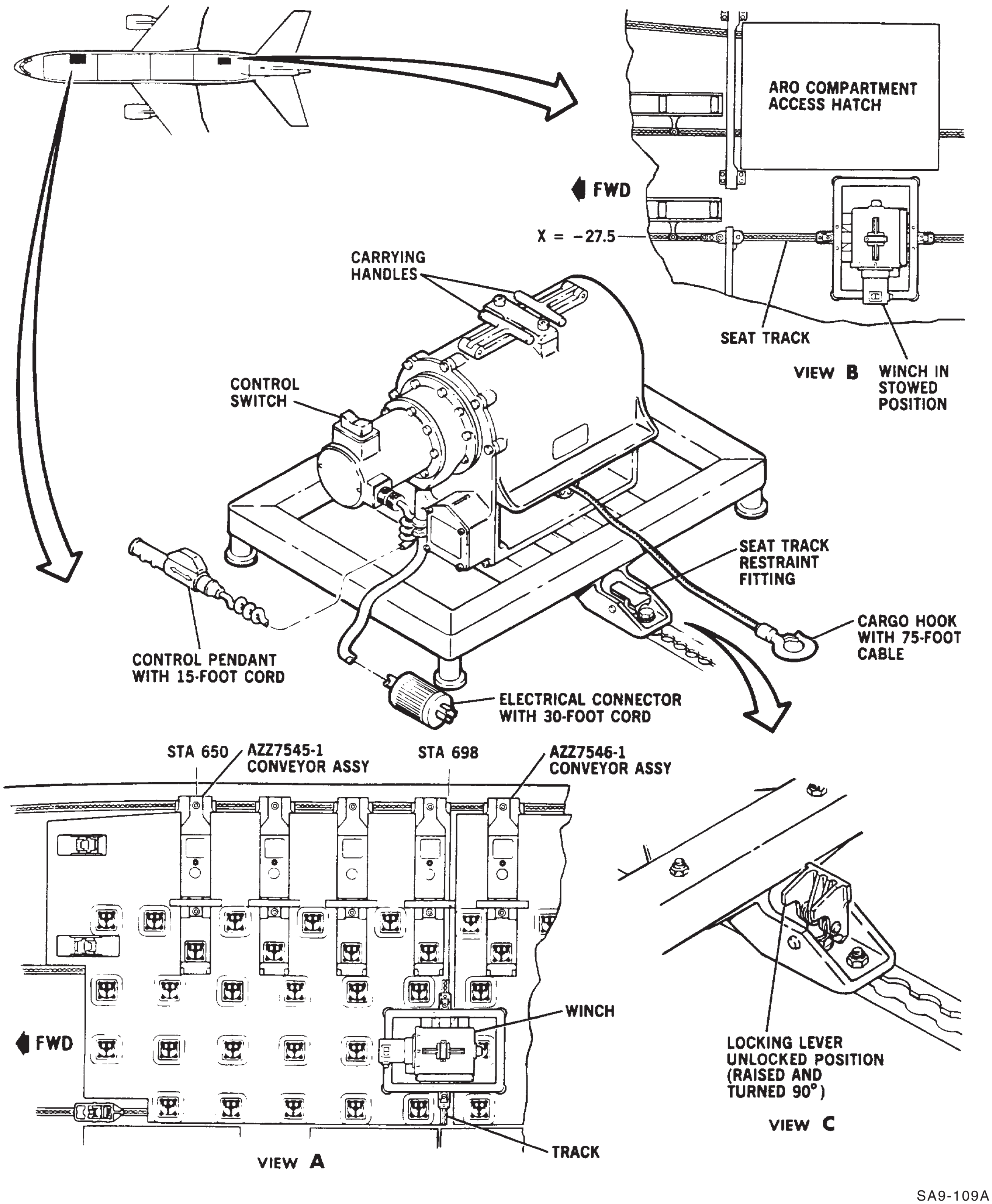


Figure 3-11. Cargo Winch Installation

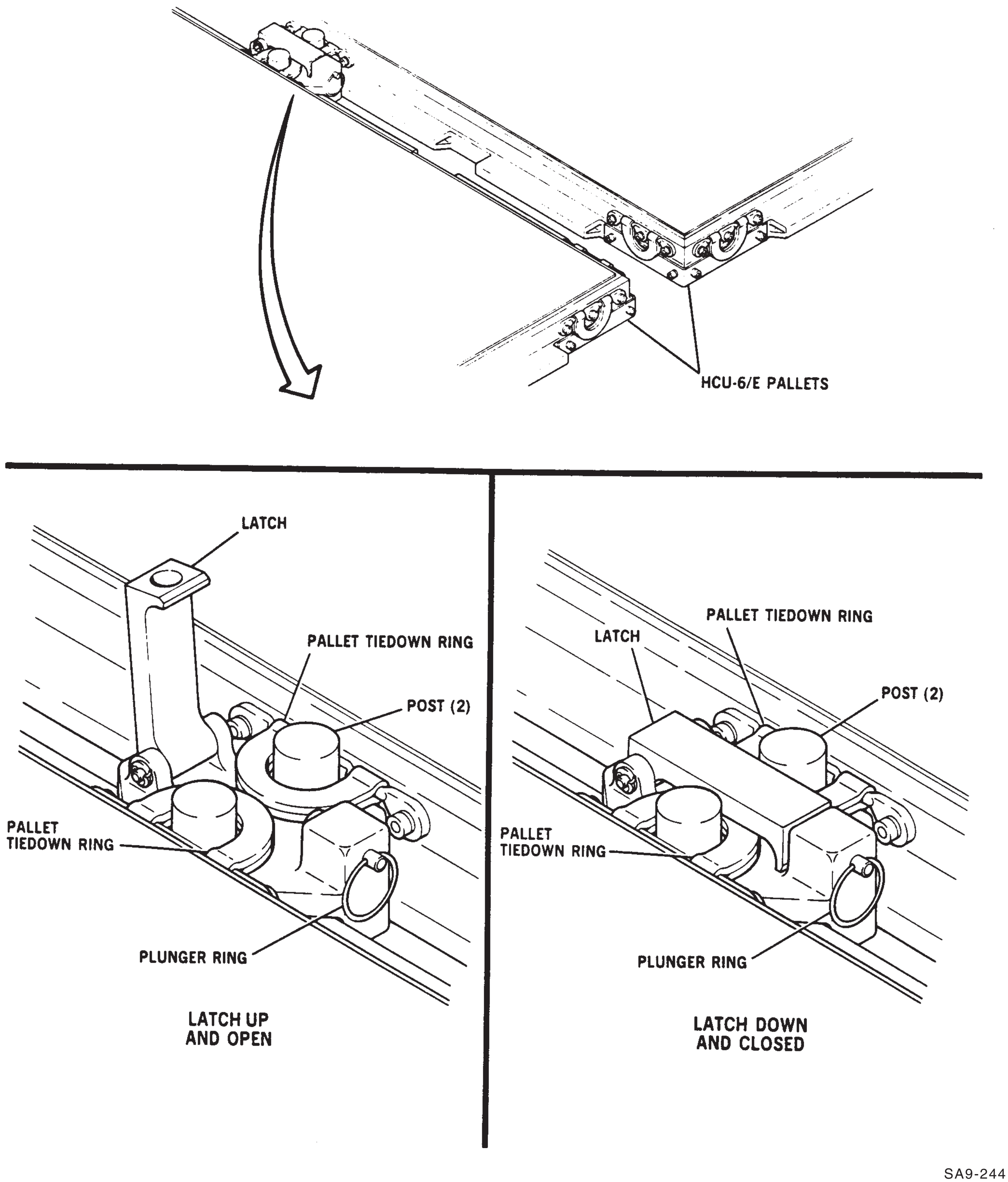


Figure 3-12. Pallet Coupler Installation

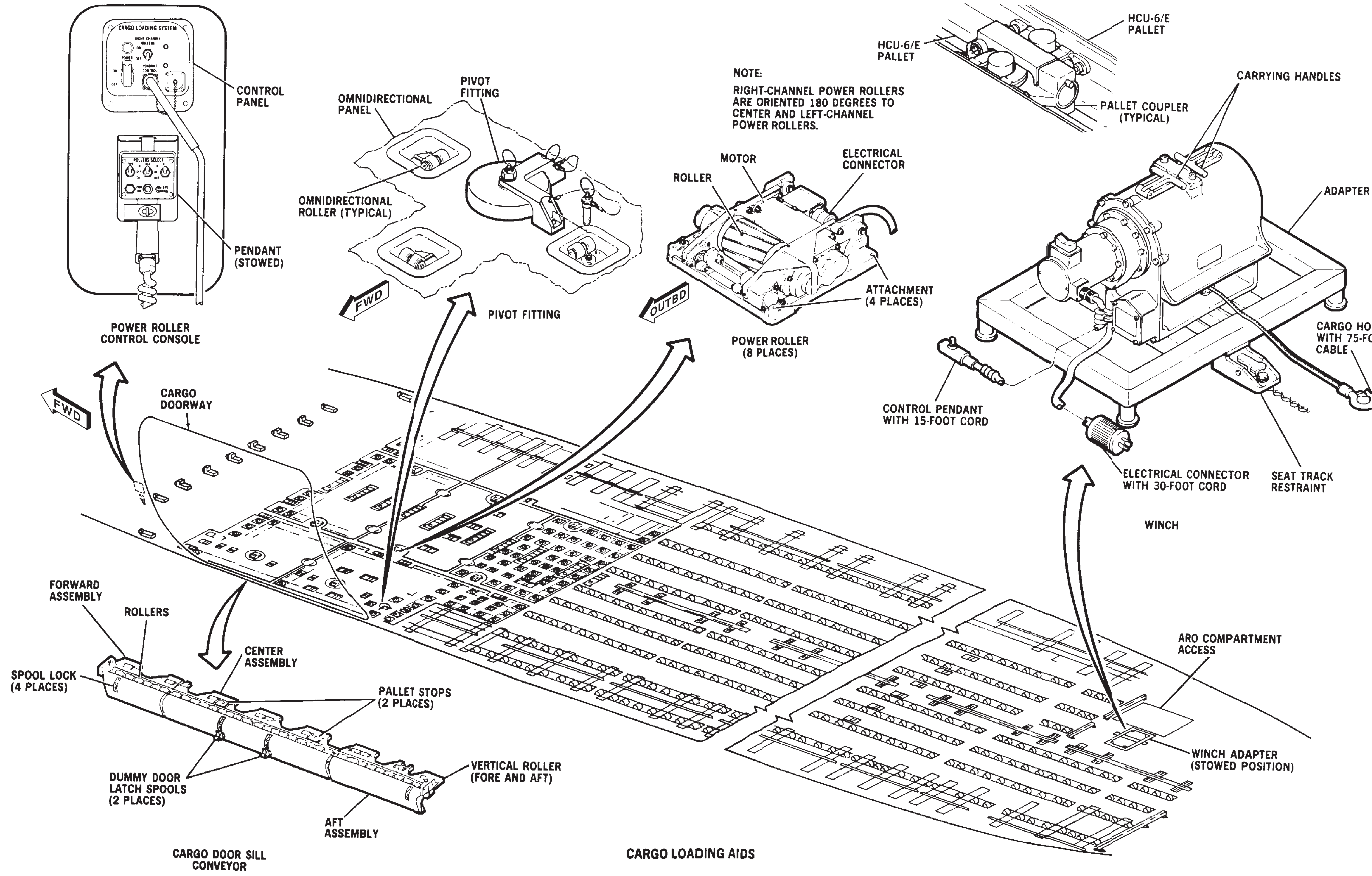


Figure 3-13. Cargo Loading Aids

OXYGEN SYSTEM CIRCUIT TEST

After emergency oxygen circuits are connected to seat pallets (and all emergency oxygen units are installed), conduct the following oxygen system circuit test. The test panel is located on the aft wall of the right-hand stowage compartment, just forward of the seat pallets (figure 3-14).

Test (Figure 3-14)

1. Turn OXY SYS TEST switch to TEST position.

   a. Five green OXY SYS VALID lights should come on, indicating all circuits to four seat pallets and overhead cabin oxygen units are good.

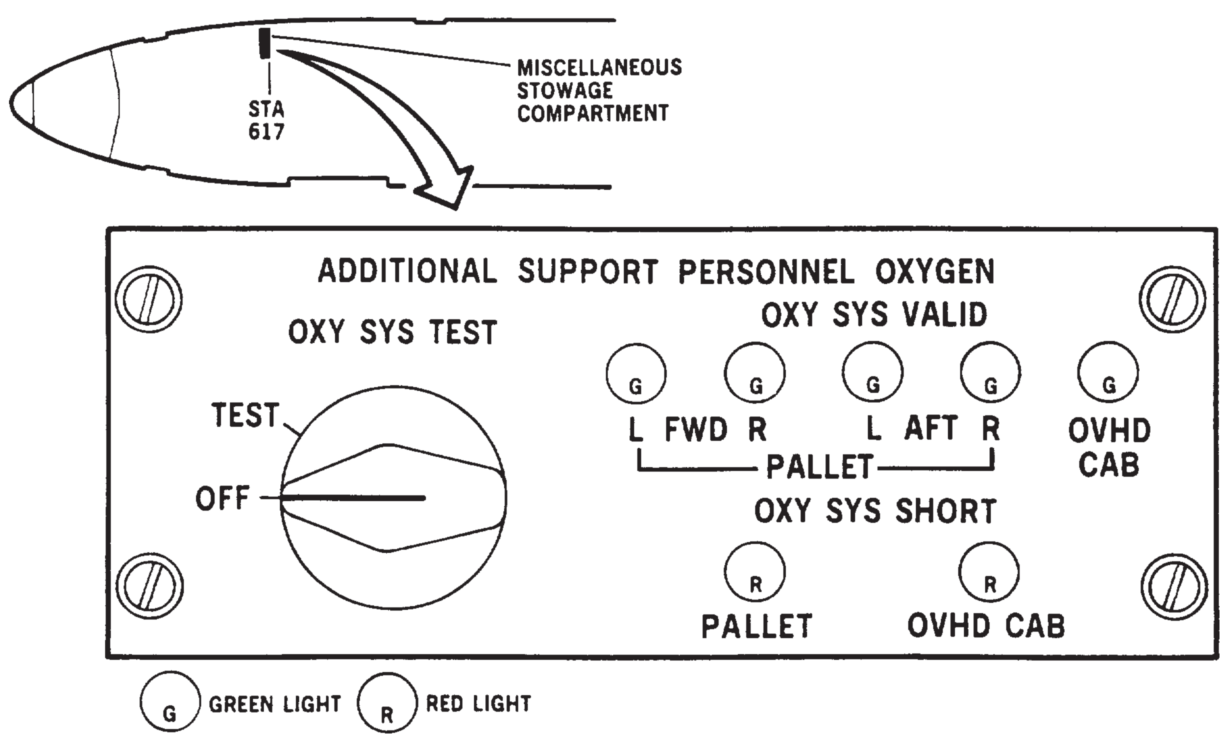
   b. If any green OXY SYS VALID lights do not come on, determine cause of open circuit and correct, if possible.

   c. If any red OXY SYS SHORT lights come on, determine cause of short and correct, if possible.

WARNING

If an oxygen system circuit malfunction cannot be corrected, personnel shall not occupy the affected seats during flight.

2. Return OXY SYS TEST switch to OFF position. Five green OXY SYS VALID lights should go out.



SA9-309

Figure 3-14. Oxygen System Circuit Test Panel

GENERAL PROCEDURES (OPERATIONS)

TABLE OF CONTENTS

KC-10A CARGO LOADING MANUAL

INTRODUCTION

This section contains general instructions relative to load planning, loading procedures, and offloading procedures for the KC-10A aircraft with the cargo handling system installed. Procedures for loading/offloading cargo directly on the cargo floor are covered in Section V. This section also contains a checklist to cover each phase of cargo loading/offloading procedures. The data and information in this section pertain to cargo which does not present any problems requiring special loading procedures.

LOAD PLANNING

The load planning phase for loading and transport operations encompasses many factors that must be taken into consideration prior to any physical loading preparation. Load planning enables loading personnel to be aware of exactly where each item of cargo should be positioned, how it should be tied down and how to determine weight and balance factors. Planning the placement and tentative tiedown of cargo will avoid trial-and-error shifting of heavy and large cargo units. Proper load planning reduces ground time. Basic factors that must be considered in planning any cargo load are as follows:

1. The location of the cargo center of gravity must be such that the center of gravity of the loaded aircraft will be within all operating limits.

2. Determine ACL if required. The total weight of the loaded aircraft must not exceed the maximum allowable gross weight.

3. If part of the cargo is to be removed at an intermediate stop, the load should be arranged so that handling of remaining cargo is kept to a minimum.

4. The load should be arranged to permit rapid and secure tiedown of all cargo items.

WARNING

> The agency offering cargo for air shipment is responsible for marking each item of cargo and all vehicle type cargo with correct gross weight and a center of balance point as follows: any item measuring 10 feet or longer, any item having a balance point at other than its center and, in addition, vehicle-type cargo having a load-carrying capability, will be marked indicating an empty or loaded CG as appropriate. Items not marked as outlined above will not be accepted for airlift, as unknown weight/CG presents an unsafe condition relative to aircraft weight and balance. If more than one pallet is required to load any item, the weight should be presented in terms of weight per pallet.

Load planning procedures are as follows:

1. Assemble cargo to be transported.

NOTE

> Only compressible cargo is recommended to be loaded in the first position occupied aft of the cargo barrier net.

2. For any cargo item having critical loading clearances, use figures 4-3 and 4-4 to determine if the item can be loaded.

3. Verify the cargo is prepared for air shipment in accordance with appropriate directives.

4. Cargo inspection - contaminated/leaking items, general conditions, hazardous material.

5. Compute compartment loads and check compartment load limitations.

6. Select the desired cargo center of gravity location limitations as described in applicable technical manual weight and balance data.

7. Position cargo units around desired center of gravity location.

8. Compute total cargo load center of gravity location.

9. Compare total cargo load center of gravity with desired aircraft center of gravity. If center of gravity differs appreciably, shift cargo to reduce differences.

10. Compare contact-area pressures with contact-area pressure limitations.

PLANNING FOR LOADING AND PLACEMENT OF HAZARDOUS CARGO

WARNING

> The KC-10A aircraft does not have in-flight cargo jettison capability.

In addition to all the factors involved in load planning, hazardous cargo requires special consideration: It must be suitable for air shipment, compatibility with other hazardous materials must be determined, and it must be certified in accordance with applicable directives.

Depending on the amount, size, and weight of hazardous cargo, placement aboard the aircraft should be planned to allow for rapid jettison during loading/offloading operations in the event of a cargo fire. Hazardous cargo should never be loaded in such a manner that it would make rapid removal impossible. Ensure that all hazardous material is readily accessible in flight and all containers are unlocked or key/combination are readily available.

CONCENTRATED LOAD PLANNING AND WEIGHT AND BALANCE FORMULAS

The following formulas are used in computing contact pressure and aircraft/cargo weight and balance:

PSI/PSF FORMULAS

1. SQUARE AND RECTANGULAR-SHAPED BOXES:

$$\frac{\text{BOX WEIGHT}}{\text{LENGTH x WIDTH}} = \text{PSI/PSF}$$

2. SKIDDED BOXES:

$$\frac{\text{BOX WEIGHT}}{\text{(SKID LENGTH x SKID WIDTH x NO. OF SKIDS)}} = \text{PSI/PSF}$$

3. TRIANGULAR-SHAPED BOXES:

$$\frac{\text{BOX WEIGHT}}{\text{(1/2 BASE LENGTH x HEIGHT)}} = \text{PSI/PSF}$$

PLF FORMULA

$$\frac{\text{UNIT NET WEIGHT}}{\text{CONTACT LENGTH (FT)}} = \text{PLF}$$

1. PNEUMATIC TIRES:

$$\frac{\text{WHEEL LOAD}}{\text{PAD AREA}} = \text{PSI}$$

(Pad Area, the elliptical footprint of the tire = PAD LENGTH x PAD WIDTH x 0.785)

VEHICLE CG FORMULA

$$\frac{\text{REAR AXLE WEIGHT x WHEEL BASE}}{\text{VEHICLE GROSS WEIGHT}} =$$

VEHICLE CG IN INCHES AFT OF FRONT AXLE

WEIGHT AND BALANCE FORMULAS

1. ARM x WEIGHT = MOMENT
2. MOMENT ÷ ARM = WEIGHT
3. MOMENT ÷ WEIGHT = ARM
4. GROSS MOMENT ÷ GROSS WEIGHT =

   AIRCRAFT CG STATION

5. MOMENTS TO INDEX:

   a. Determine ARM:

   $$\text{ARM} = \frac{\text{MOMENT}}{\text{WEIGHT}}$$

   b. Determine INDEX:

   $$\text{INDEX} = \frac{\text{WEIGHT (ARM - 1375)}}{1{,}000{,}000} + 50$$

6. INDEX TO MOMENTS:

   a. Determine ARM:

   $$\text{ARM} = \frac{\text{(INDEX - 50) x 1,000,000}}{\text{WEIGHT}} + 1375$$

   b. Determine MOMENT:

   MOMENT = ARM x WEIGHT

7. 100% MAC = 1,607.733
8. LEMAC = 1,311.955
9. LENGTH OF MAC = 295.778
10. (LENGTH OF MAC x DESIRED % OF MAC) + DISTANCE OF LEMAC =

    DESIRED AIRCRAFT CG STA

11. $$\frac{\text{AIRCRAFT CG STA - LEMAC}}{\text{LENGTH OF MAC}} \text{ x } 100 =$$

    % OF MAC

ACL FORMULA

MAXIMUM ALLOWABLE T.O. WEIGHT - T.O. FUEL - OPERATING WEIGHT = ACL

CARGO SIZE LIMITATIONS

The internal cargo compartment dimensions must be considered when loading long items of cargo such as trucks, trailers, and aircraft engines on transportation trailers. The cargo door, the curvature of the fuselage, and the combination of cargo length, width and height are critical factors that must be observed carefully during loading operations. If the cargo is extremely high at one or both ends, care must be taken to prevent contact with the upper door mechanism and compartment sidewalls during loading/offloading operations. As a general guide to observing safe loading limits, load all general cargo on HCU-6/E pallets for positioning on the cargo handling system, and load all vehicles on HCU-6/E pallets or on a pallet subfloor.

CAUTION

Do not allow pallets or cargo to contact the door jamb, compartment sidewalls, or door opening mechanism during loading/offloading operations.

LOADING AREA CLEARANCE LIMITS

The main cargo door (140 inches wide by 102 inches high), is the primary size-limiting factor for loading cargo. When equipment/cargo is loaded on HCU-6/E pallets, the usable height of the cargo door is 96 inches from the top of the pallet. This allows for a two-inch clearance. The cargo door is shown in figure 4-1.

PALLETIZED CARGO LOADING LIMITATIONS

Transporting palletized cargo is considered to be the most frequent type of cargo operation. Figure 4-2 shows the pallet contours for the different locations in the aircraft. All cargo loaded on HCU-6/E pallets should be planned to be within the dimensions given to ensure minimum clearances from aircraft structure are maintained. For actual loading, the given contours may be exceeded provided the six-inch clearance from the aircraft structure is not reduced, and that a clear walkway is maintained for Class B and E Compartments.

OVERSIZE CARGO

Cargo or equipment, whose length prohibits loading laterally, must be rotated 90° and loaded lengthwise in the cargo compartment. The maximum size cargo that can be rotated is listed in figures 4-3 and 4-4. Figure 4-3 lists the maximum size that can be loaded aft of the cargo door. Figure 4-4 lists the maximum size that can be loaded forward of the cargo door. The data in these figures was derived with the cargo handling system installed. When an item of cargo is loaded on a HCU-6/E pallet, the thickness of the pallet must be included with the height dimension.

CAUTION

Approximately two inches of clearance is provided by the data in figures 4-3 and 4-4. Extreme caution must be taken during loading/offloading operations when the dimensions of the cargo approach the maximums listed in the data.

NOTE

When oversize cargo is loaded on coupled pallets, increasing area for rotation of pallets can be accomplished by removing the center guide rail at pallet position 4L/R(D).

SAMPLE PROBLEM:

Determine the maximum length of cargo that can be loaded if the width is 36 inches and the height is 72 inches.

SOLUTION:

1. Loading Aft of Cargo Door (figure 4-3): Reading 36 inches at the top of the chart, and 72 inches at the left side of the chart, reveals that the maximum loadable length is 490 inches.

2. Loading Forward of Cargo Door: The maximum length of 303 inches is possible with the width of 36 inches and height of 72 inches (figure 4-4).

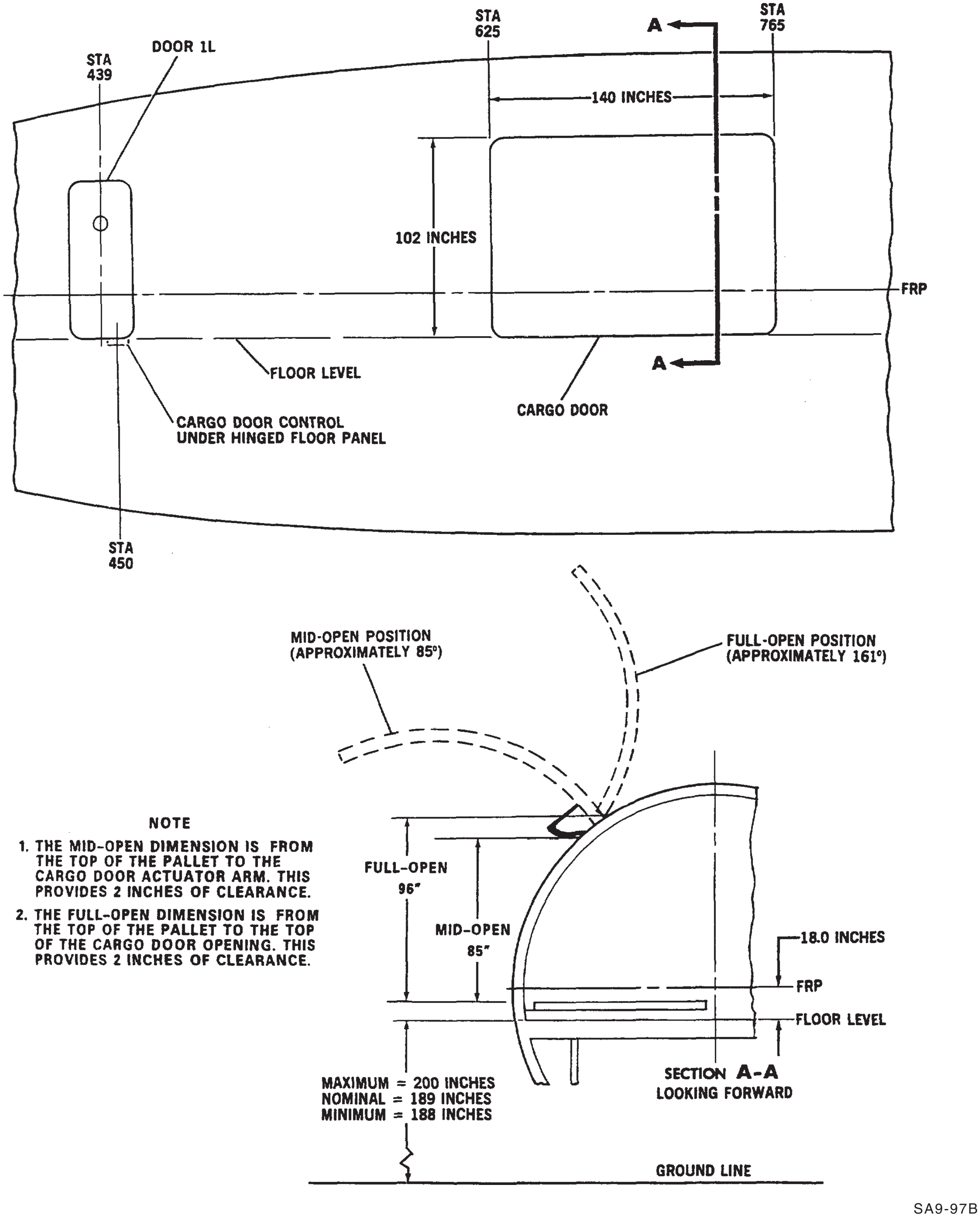
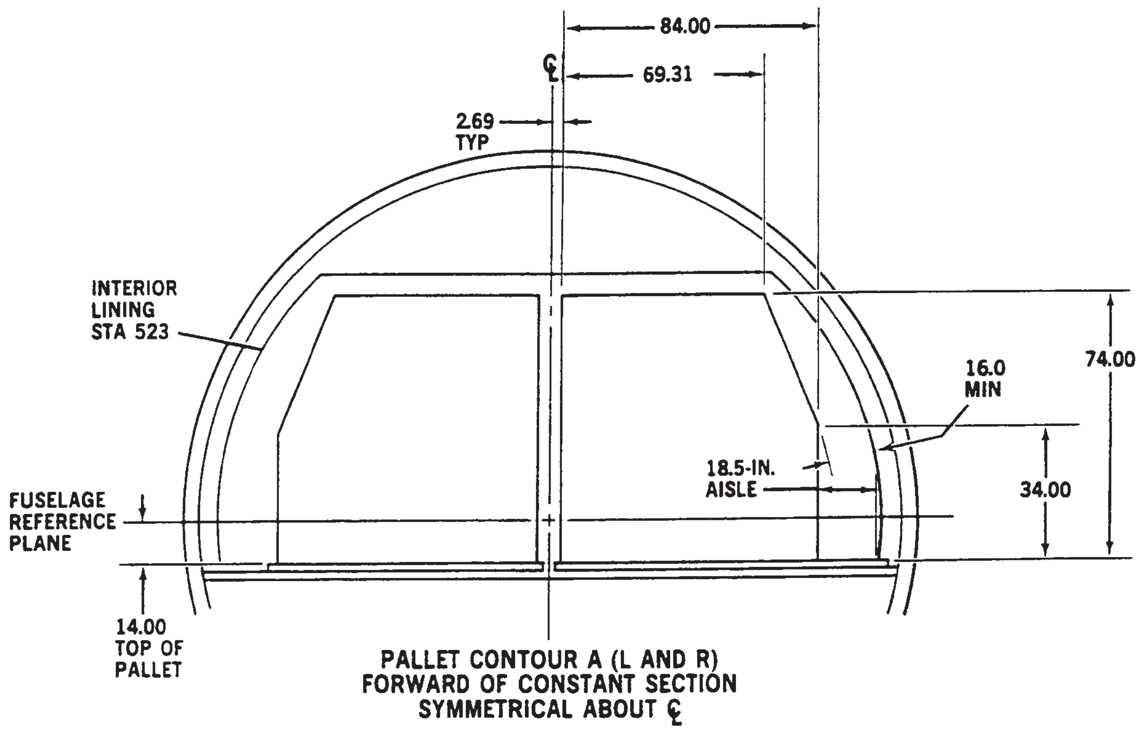


Figure 4-1. Cargo Door



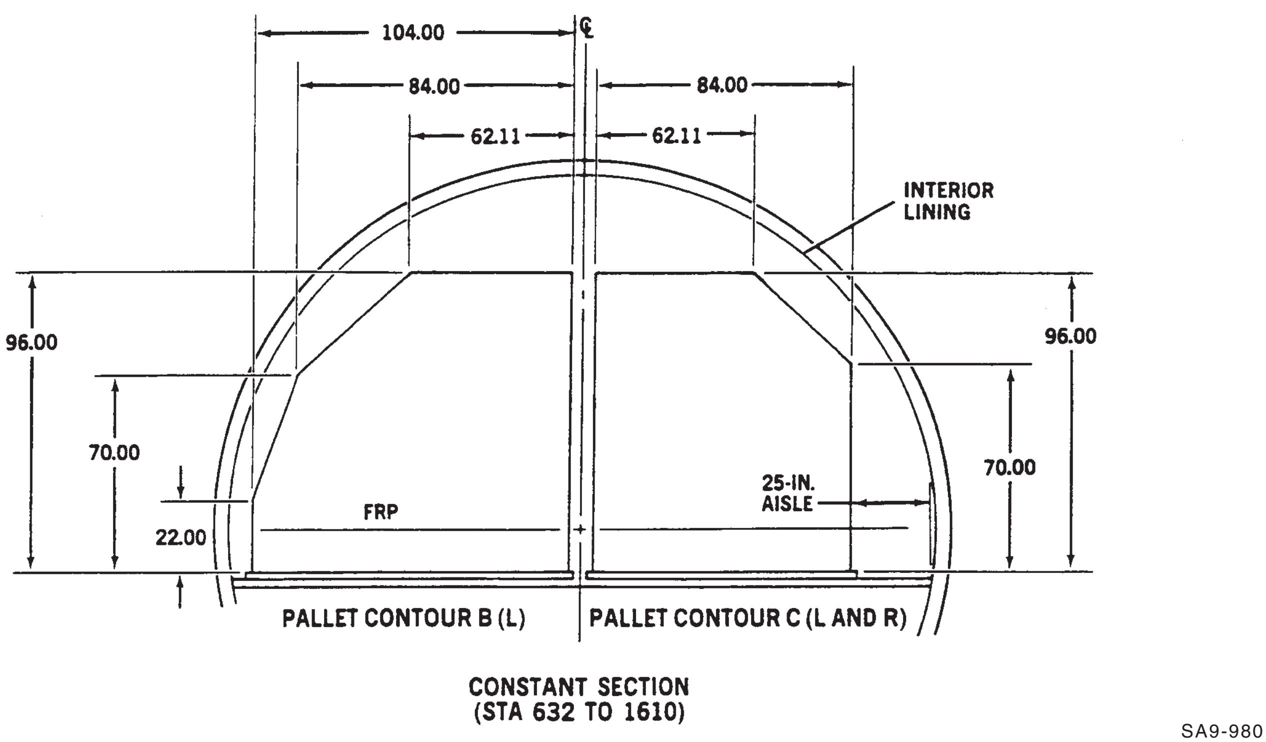
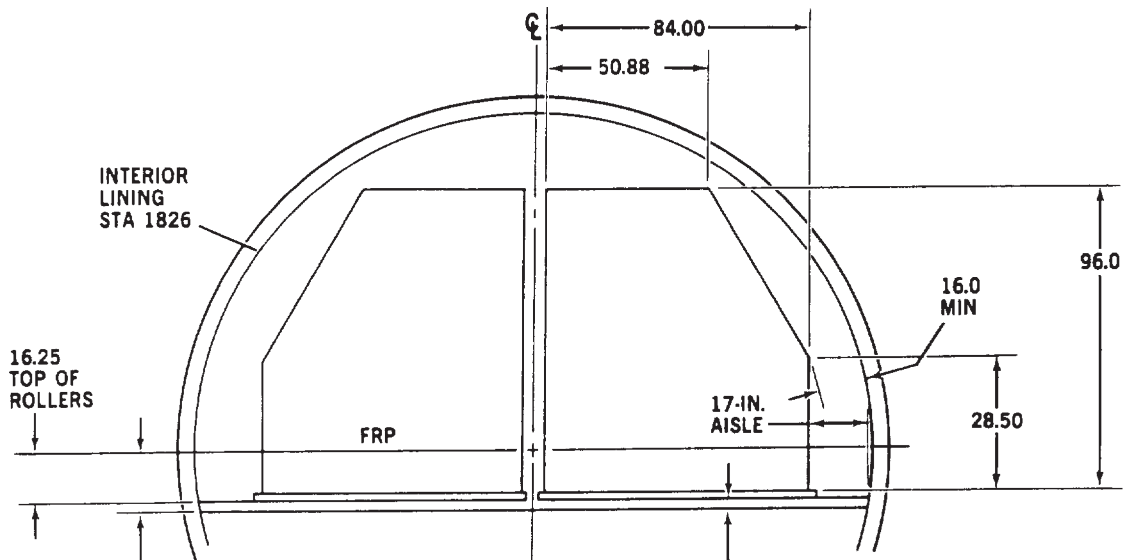
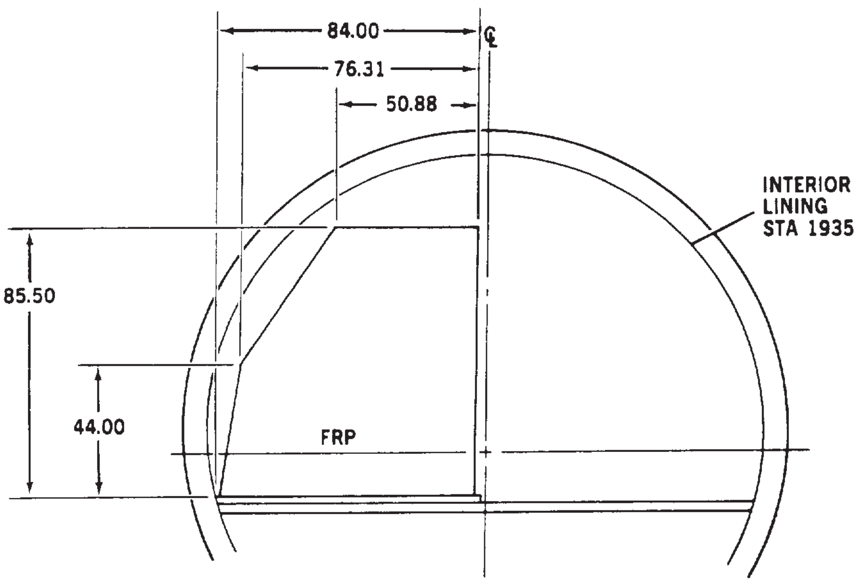


Figure 4-2. Pallet Contours and Aisle Configurations (Sheet 1)



PALLET CONTOUR D (L AND R)
AFT OF CONSTANT SECTION
SYMMETRICAL ABOUT ℄



PALLET CONTOUR E (L)
AFT PALLET

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Figure 4-2. Pallet Contours and Aisle Configurations (Sheet 2)

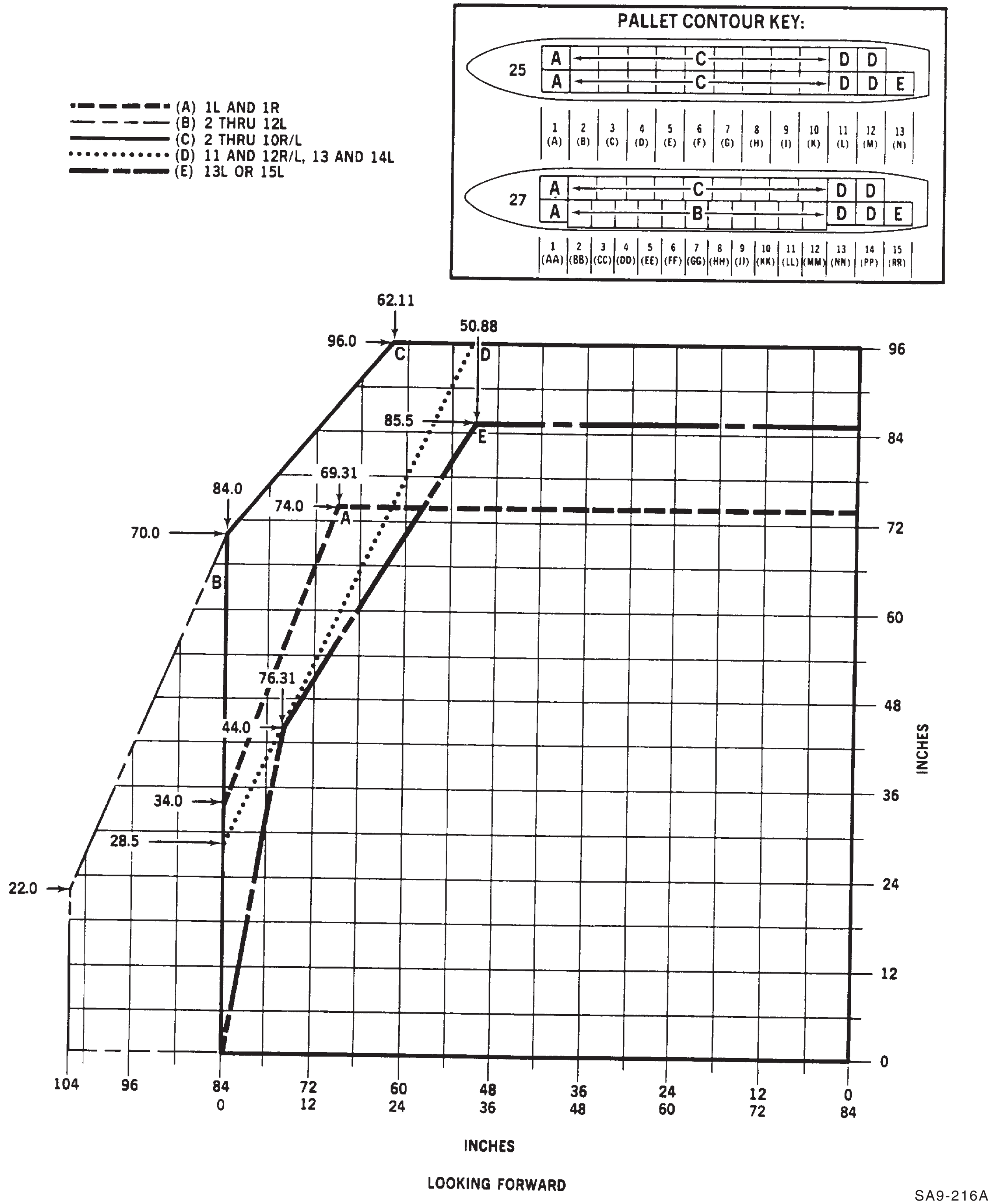

Figure 4-2. Pallet Contours and Aisle Configurations (Sheet 3)

AFT OF CARGO DOOR
MAXIMUM PACKAGE LENGTH (INCHES) FOR HEIGHT AND WIDTH SHOWN

PACKAGE HEIGHT (INCHES) \ PACKAGE WIDTH (INCHES)	12	24	36	48	60	72	84	96	108	120	132
UP TO 36	1323	982	660	520	440	380	330	295	265	240	205
48	1266	900	620	500	430	370	330	290	260	230	200
60	1016	680	550	470	390	350	310	275	250	220	195
72	740	600	490	410	360	320	280	255	230	205	180
84	590	490	420	370	325	285	255	230	210	185	160
96	490	420	370	325	285	260	235	210	185	170	145

NOTES:

1. LENGTHS ARE DETERMINED FOR PACKAGES IN CONTACT WITH TOP OF ROLLERS IN CARGO LOADING SYSTEM, ALLOWING 2-INCH CLEARANCE FROM AIRCRAFT INTERIORS.
2. THE THICKNESS OF THE PALLET MUST BE INCLUDED WITH THE HEIGHT DIMENSION.

SA9-83A

Figure 4-3. Package Size Chart - Loaded Aft of Cargo Door

FORWARD OF CARGO DOOR
MAXIMUM PACKAGE LENGTH (INCHES) FOR HEIGHT AND WIDTH SHOWN

PACKAGE WIDTH (INCHES)

PACKAGE HEIGHT (INCHES)	12	24	36	48	60	72	84	96	108	120	132
UP TO 36	330	325	320	312	305	290	270	250	235	225	215
48	325	320	315	310	305	290	270	250	235	220	213
60	320	315	310	305	300	280	265	240	225	215	205
72	315	310	303	295	290	275	255	230	215	200	190

NOTES:
1. LENGTHS ARE DETERMINED FOR PACKAGES IN CONTACT WITH TOP OF ROLLERS IN CARGO LOADING SYSTEM, ALLOWING 2-INCH CLEARANCE FROM AIRCRAFT INTERIORS.
2. THE THICKNESS OF THE PALLET MUST BE INCLUDED WITH THE HEIGHT DIMENSION.

SA9-84B

Figure 4-4. Package Size Chart - Loaded Forward of Cargo Door

CARGO WEIGHT LIMITATIONS

The aircraft has the capability to accommodate approximately 170,000 pounds of cargo on an all-cargo mission. The load planning phase involving weight distribution encompasses numerous factors which must be observed prior to any actual loading operation:

1. The total weight of the aircraft must not exceed the maximum allowable gross weight.

2. Weight limitations that must not be exceeded are expressed in terms of:

   a. Zone load limitations

   b. Compartment load limitations

   c. Personnel seating arrangement, if applicable.

3. The location of the cargo center of gravity must be such that the center of gravity of the loaded aircraft will be within the operating limits.

4. Individual items of cargo must be arranged to permit adequate, rapid and secure tiedown of all cargo items.

ZONE LOAD LIMITATIONS

Zone load limitations apply for flight operation only. The zone load limitations for cargo and various body tank weight conditions are shown in figure 4-5. The station numbers indicated along the top of the figure are pallet compartment forward (or aft) physical limits with corresponding allowable cargo load limitations under the stations. The forward fuel weight increments are for fuel loaded in the forward body tank and the aft fuel weight increments are for fuel loaded in the aft body tank.

<u>SAMPLE PROBLEM NO. 1 - ZONE LOAD LIMITATIONS</u>

PROBLEM:

Determine the maximum cargo weight that can be loaded forward of fuselage station 1175 when 26,000 pounds of fuel has been loaded in the forward body tank.

SOLUTION:

Find fuselage station 1175 on figure 4-5, Zone Load Limitations. Locate the intersection of station 1175 column and the 26,000 pound forward body tank line. Read the maximum weight allowed, which is 72,000 pounds of cargo.

SAMPLE PROBLEM NO. 2 - ZONE LOAD LIMITATIONS

PROBLEM:

Determine the maximum cargo weight that can be loaded forward of fuselage station 988 when 40,000 pounds of fuel has been loaded in the forward body tank.

NOTE

> The fuselage stations for the 27 pallet configuration are not contained on figure 4-5. When using this configuration to obtain the maximum allowable cargo weight, the following applies: Forward of station 1284, move forward to the nearest station in figure 4-5. Aft of station 1284, move aft to the nearest station in figure 4-5. The maximum cargo load can then be determined.

SOLUTION:

Find fuselage station 957 on figure 4-5. Locate the intersection of station 957 column and the 40,000 pound forward body tank line. Read the maximum weight that can be loaded which is 38, 000 pounds of cargo. This maximum cargo weight also applies to fuselage stations forward of station 957.

SAMPLE PROBLEM NO. 3 -MAXIMUM ALLOWABLE FUEL

PROBLEM:

Determine the maximum amount of fuel the flight engineer can transfer to the aft body tank with 23,000 pounds of cargo aft of fuselage station 1611.

SOLUTION:

Find fuselage station 1611 on figure 4-5. Locate the 23,000 pound cargo line under station 1611. Move over to fuel in aft body tank column. Maximum allowable fuel is 42,000 pounds.

NOTE

- The most restrictive fuselage station will be used.
- Maximum allowable fuel for forward body tank is computed in the same manner using forward fuselage stations.
- Structural load limitations and compartment load limitations must also be met, before any items of cargo can be loaded.

COMPARTMENT LOAD LIMITATIONS

Figure 4-7 identifies the compartments by number, station number, and maximum total compartment load for flight conditions. These compartments are identical to the HCU-6/E pallet locations within the cargo compartment.

ALLOWABLE CARGO LOAD
VERSUS FUEL IN BODY TANKS
(25 AND 27 PALLET CONFIGURATIONS)

	ALLOWABLE CARGO LOAD LB fwd of stations noted							ALLOWABLE CARGO LOAD LB aft of stations noted							
FWD TANK	STA 521	STA 630	STA 739	STA 848	STA 957	STA 1066	STA 1175	STA 1284	STA 1393	STA 1502	STA 1611	STA 1720	STA 1829	STA 1937	AFT TANK
0	2500	16000	30000	46000	62000	80000	99000	116000	88000	67000	49000	35000	17000	2500	0
2000					61000	78000	97000	116000	86000	65000	48000	34000			2000
4000					60000	76000	95000	114000	84000	63000	47000	33500			4000
6000					59000	74000	93000	110000	82000	61000	46000	33000			6000
8000					58000	72000	91000	108000	80000	59000	45000	33000			8000
10000					57000	70000	89000	107000	78000	57000	44000	32500			10000
12000					56000	68000	87000	106000	76000	55000	42000	32500			12000
14000					55000	66000	85000	104000	74000	53000	41000	32000			14000
16000					54000	64000	83000	100000	72000	51000	40000	32000			16000
18000					53000	62000	81000	98000	70000	49000	39000	31500			18000
20000					52000	60000	79000	96000	68000	47000	38000	30000			20000
22000					51000	58000	76000	95000	66000	45000	37000	30000			22000
24000					50000	56000	74000	92000	64000	43000	36000	29500			24000
26000					49000	54000	72000	90000	62000	41000	35000	29500			26000
28000					48000	52000	70000	88000	60000	39000	33000	28500			28000
30000					47000	50000	68000	86000	58000	37000	32000	28000			30000
32000				46000	46000	48000	66000	84000	57000	35000	30000	27500			32000
34000				43000	43000	46000	64000	82000	55000	33000	29000	27000			34000
36000				41000	41000	44000	62000	80000	53000	31000	28000	26500			36000
38000				40000	40000	42000	60000	78000	51000	29000	27000	26000			38000
40000				38000	38000	40000	58000	76000	49000	27000	26000	25000			40000
42000				36000	36000	38000	56000	74000	48000	25000	23000	23000			42000
44000				33000	34000	36000	54000	72000	45000	23000	21000	21000			44000
46000				32000	32000	34000	52000	70000	43000	21000	19000	19000			46000
48000			30000	30000	30000	32000	50000	68000	41000	19000	17000	17000	17000		48000
50000			28000	28000	28000	30000	48000	66000	39000	17000	15000	15000	15000		50000
52000			26000	26000	26000	28000	47000	64000	37000	15000	13000	13000	13000		52000
54000			24000	24000	24000	26000	45000	62000	35000	13000	11000	11000	11000		54000
56000			22000	22000	22000	24000	43000	60000	33000	11000	9000	9000	9000		56000
58000			20000	20000	20000	22000	41000	58000	31000	9000	7000	7000	7000		58000
60000	2500	16000	18000	18000	18000	20000	39000	57000	29000	7000	5000	5000	5000		60000
								54000	27000	6000	3000	3000	3000	2500	62000
								52000	25000	5000	1000	1000	1000	1000	64000
								49000	23000	4000	1000	1000	1000	1000	66000
								46000	21000	3000	1000	1000	1000	1000	68000
								43000	19000	2000	1000	1000	1000	1000	70000

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Figure 4-5. Zone Load Limitations

PERSONNEL SEATING ARRANGEMENT

The number of additional seats is a function of the cargo load. The following seat quantities versus the cargo loads must be strictly adhered to (figure 2-12):

1. With the 20 seats installed (6 additional crew and 14 support personnel, configuration code C), the cargo load is limited to 2,100 pounds per pallet, with the CG of each pallet not over 60 inches above the pallet surface.

WARNING

In configuration code C, or with an unserviceable cargo barrier net, the cargo will be restrained to the pallet to withstand 9g forward force.

NOTE

- See restraint criteria in this section for instructions on obtaining 9g restraint.
- For 20 seat configuration code G, the 2,100 pound per pallet limitation does not apply. Cargo load limitations are the same as configuration code D.
- For all other configurations, whenever the weight of any pallet exceeds 2,100 pounds, the cargo barrier net must be fully installed.

2. For cargo loads exceeding the 20 personnel restrictions, (1) above, but less than 100,000 pounds, the left and right double seats, immediately forward of the cargo barrier net, must be removed (16 seats, configuration code B) to allow space for net stretch under a 9g forward acceleration.

3. For cargo loads in excess of 100,000 pounds, the left and right double seats may be repositioned forward to the second row, where the left and right triple seats have been removed (14 seats, configuration code A).

LOAD SUMMARY CHARTS

All factors regarding load limitations must be met before any item of cargo can be loaded, including maximum floor loading (pounds per linear foot in terms of net weight), maximum axle load, maximum pallet weight, maximum compartment load and maximum zone loads.

Figure 4-7 is the summary of loading data for the 25-pallet, all-cargo configuration. This loading data also applies to the 23-pallet, mixed cargo/personnel configuration and the 17-pallet, mixed cargo/personnel configuration.

Figure 4-8 is the summary of loading data for pallets which are oriented laterally (lateral dimension is 108 inches) on the left side of the aircraft as in the 27-pallet, all-cargo configuration or the 25-pallet, mixed cargo/personnel configuration.

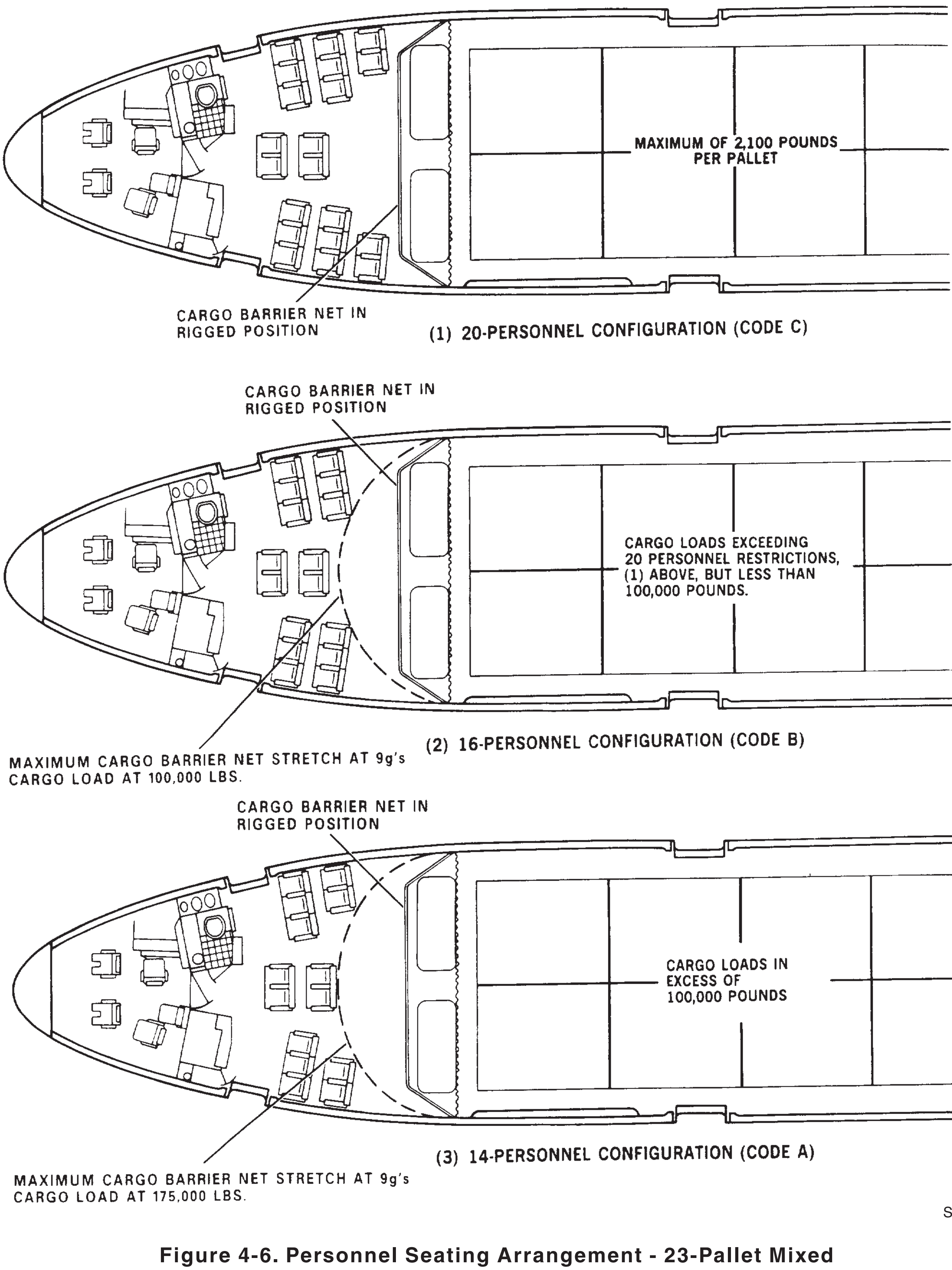

Figure 4-6. Personnel Seating Arrangement - 23-Pallet Mixed Cargo/Personnel Configuration

PALLET POSITIONS (FLOOR MARKINGS) LEFT OR RIGHT	REFERENCE DATA				(3) COMPARTMENT LOAD LIMITATIONS		(2) (3) MAXIMUM AXLE AND WHEEL WEIGHTS FOR VEHICLES, PNEUMATIC TIRES (LBS)		PALLET POSITIONS (FLOOR MARKINGS) LEFT OR RIGHT
					MAXIMUM FLOOR LOADING (LBS/LINEAR FOOT)	MAXIMUM TOTAL COMPARTMENT LOAD (LBS) LEFT OR RIGHT	(4) FLIGHT		
	CENTROID	VOLUME CUBIC FEET)	FORWARD LIMIT STATION	AFT LIMIT STATION	FLIGHT	FLIGHT (5)	MAXIMUM TIRE	MAXIMUM AXLE (7)	
1	575	356	521	630	738	6,500	-	-	1
2	684	468	630	739	738	6,500	2,250	4,500	2
3	793	468	739	848	738	6,500	2,250	4,500	3
4	902	468	848	957	738	6,500	2,250	4,500	4
5	1,011	468	957	1,066	738	6,500	2,250	4,500	5
6	1,120	468	1,066	1,175	888	6,500	2,400	4,800	6
7	1,229	468	1,175	1,284	1,452	10,000	1,600	3,200	7
8	1,338	468	1,284	1,393	1,452	10,000	1,600	3,200	8
9	1,447	468	1,393	1,502	1,452	10,000	1,600	3,200	9
10	1,556	468	1,502	1,611	1,368	10,000	2,000	4,000	10
11	1,665	395	1,611	1,720	1,110	10,000	2,000	4,000	11
12	1,774	395	1,720	1,829	738	6,500	2,000	4,000	12
(1) 13	1,883	371	1,829	1,937	738	6,500	2,000	4,000	13

NOTES:

(1) COMPARTMENT 13 PERTAINS TO LEFT SIDE ONLY.

(2) WHEELS MUST BE 48 INCHES APART. THESE ALLOWABLES ARE FOR ANY LOCATION ON THE PALLET. SEE FIGURE 4-21 FOR OTHER CONDITIONS. TREAT DUAL WHEELS AS ONE WHEEL.

(3) THE MAXIMUM WEIGHT FOR LOADING/OFF-LOADING FOR ALL PALLET POSITIONS IS; 1452 POUNDS PER LINEAR FOOT; 10,000 POUNDS TOTAL WEIGHT PER COMPARTMENT; 3,000 POUND WHEEL LOAD; 6,000 POUND AXLE LOAD.

(4) SPECIFIC VEHICLES WITH LARGER AXLE LOADS MAY BE TRANSPORTED IN SPECIAL LOCATIONS (SEE SECTION V).

(5) WHEN PALLET POSITION 10L OR R CONTAINS CONCENTRATED LOADS, THE MAXIMUM COMPARTMENT GROSS WEIGHT IS 7,000 LBS. WHEN LOADED EXCLUSIVELY WITH A UNIFORM LOAD, PALLET POSITIONS 10L OR R MAY BE LOADED TO THE PLF LIMITATION NOT TO EXCEED THE MAXIMUM COMPARTMENT GROSS WEIGHT OF 10,000 POUNDS.

(6) WHEN PALLET POSITION 11L OR R CONTAINS CONCENTRATED LOADS, THE MAXIMUM COMPARTMENT GROSS WEIGHT IS 7,500 LBS. WHEN LOADED EXCLUSIVELY WITH A UNIFORM LOAD, PALLET POSITIONS 11L OR R MAY BE LOADED TO THE PLF LIMITATION NOT TO EXCEED THE MAXIMUM COMPARTMENT GROSS WEIGHT OF 10,000 POUNDS.

(7) WHEN LOADED EXCLUSIVELY WITH AXLE LOADS THE MAXIMUM COMPARTMENT GROSS WEIGHT FOR PALLET POSITIONS 10L OR R AND 11L OR R IS 8,000 POUNDS PROVIDED THE AXLES ARE SEPARATED BY 48 INCHES OR MORE. HOWEVER, BECAUSE THE AXLE LIMIT COULD BE LESS, REFER TO FIGURE 4-21.

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Figure 4-7. Loading Data - 25 Pallet All-Cargo Configuration

PALLET POSITIONS (FLOOR MARKINGS) 1	REFERENCE DATA				COMPARTMENT LOAD LIMITATIONS 3		MAXIMUM AXLE AND WHEEL WEIGHTS FOR VEHICLES, PNEUMATIC TIRES (LBS) 2 3		PALLET POSITIONS (FLOOR MARKINGS) 1
					MAXIMUM FLOOR LOADING (LBS/LINEAR FOOT)	MAXIMUM TOTAL COMPARTMENT LOAD (LBS)	4 FLIGHT		
	CENTROID	VOLUME CUBIC FEET)	FORWARD LIMIT STATION	AFT LIMIT STATION	FLIGHT	FLIGHT 5	MAXIMUM TIRE	MAXIMUM AXLE 7	
1L	577	356	523	632	738	6,500	-	-	1L
2L	676	423	632	721	738	5,400	2,250	4,500	2L
3L	765	423	721	810	738	5,400	2,250	4,500	3L
4L	854	423	810	899	738	5,400	2,250	4,500	4L
5L	943	423	899	988	738	5,400	2,250	4,500	5L
6L	1,032	423	988	1,077	738	5,400	2,250	4,500	6L
7L	1,121	423	1,077	1,166	888	6,500	2,400	4,800	7L
8L	1,210	423	1,166	1,255	1,452	10,000	1,600	3,200	8L
9L	1,299	423	1,255	1,344	1,452	10,000	1,600	3,200	9L
10L	1,388	423	1,344	1,433	1,452	10,000	1,600	3,200	10L
11L	1,477	423	1,433	1,522	1,452	10,000	1,600	3,200	11L
12L	1,566	423	1,522	1,611	1,368	10,000	2,000	4,000	12L
13L	1,665	395	1,611	1,720	1,110	10,000	2,000	4,000	13L
14L	1,774	395	1,720	1,829	738	6,500	2,000	4,000	14L
15L	1,883	371	1,829	1,937	738	6,500	2,000	4,000	15L

NOTES:

1. THIS FIGURE INCLUDES DATA FOR THE LEFT SIDE OF THE AIRCRAFT ONLY. REFER TO FIGURE 4-7 FOR THE RIGHT SIDE.
2. WHEELS MUST BE 48 INCHES APART. THESE ALLOWABLES ARE FOR ANY LOCATION ON THE PALLET. SEE FIGURE 4-21 FOR OTHER CONDITIONS TREAT DUAL WHEELS AS ONE WHEEL.
3. THE MAXIMUM WEIGHT FOR LOADING/OFF-LOADING FOR ALL PALLET POSITIONS IS; 1452 POUNDS PER LINEAR FOOT; 10,000 POUNDS TOTAL WEIGHT PER COMPARTMENT; 3,000 POUND WHEEL LOAD; 6,000 POUND AXLE LOAD.
4. SPECIFIC VEHICLES WITH LARGER AXLE LOADS MAY BE TRANSPORTED IN SPECIAL LOCATIONS (SEE SECTION V).
5. WHEN PALLET POSITION 11L OR 12L CONTAINS CONCENTRATED LOADS, THE MAXIMUM COMPARTMENT GROSS WEIGHT IS 7,000 LBS. WHEN LOADED EXCLUSIVELY WITH A UNIFORM LOAD, PALLET POSITIONS 11L OR 12L MAY BE LOADED TO THE PLF LIMITATION NOT TO EXCEED THE MAXIMUM COMPARTMENT GROSS WEIGHT OF 10,000 POUNDS.
6. WHEN PALLET POSITION 13L CONTAINS CONCENTRATED LOADS, THE MAXIMUM COMPARTMENT GROSS WEIGHT IS 7,500 LBS. WHEN LOADED EXCLUSIVELY WITH A UNIFORM LOAD, PALLET POSITION 13L MAY BE LOADED TO THE PLF LIMITATION NOT TO EXCEED THE MAXIMUM COMPARTMENT GROSS WEIGHT OF 10,000 POUNDS.
7. WHEN LOADED EXCLUSIVELY WITH AXLE LOADS THE MAXIMUM COMPARTMENT GROSS WEIGHT FOR PALLET POSITIONS 11L, 12L AND 13L IS 8,000 POUNDS PROVIDED THE AXLES ARE SEPARATED BY 48 INCHES OR MORE. HOWEVER, BECAUSE THE AXLE LIMIT COULD BE LESS, REFER TO FIGURE 4-21.

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Figure 4-8. Loading Data - Lateral Loading (Left Side of Aircraft)

WEIGHT AND BALANCE

The maximum weight that can be carried on any specific mission is limited by the maximum allowable gross weight, and is dependent upon the aircraft's basic weight, number of personnel aboard, weight of the cargo carried, and the amount of fuel/oil aboard the aircraft. The center of gravity (CG) of the aircraft is the point around which the aircraft will balance. The flight performance of the aircraft depends on the location of this point. If the CG is outside of the limits, the aircraft shall not be flown. The aircraft must be operated only when the CG is within the limits prescribed in TO 1C-10(K)A-1. Further information may be found in TO 1C-10(K)A-5.

CENTER OF GRAVITY COMPUTATIONS

The center of gravity location of each cargo item must be determined in order to accurately compute the weight and balance condition of the loaded aircraft. Cargo shipped by air will have the center of gravity marked. If the center of gravity is not marked, and the weight is unknown, they may be readily determined by proven methods.

DETERMINING CARGO UNIT WEIGHT AND CENTER OF GRAVITY LOCATION

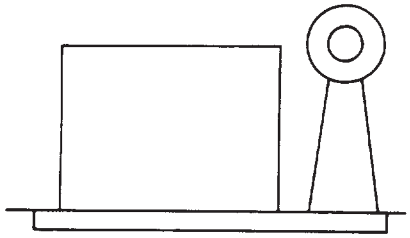
Methods of determining cargo unit weight and center of gravity locations for general cargo, and large or skid-mounted cargo, are shown in figure 4-9.

DETERMINING VEHICLE CENTER OF GRAVITY

An item of cargo such as a vehicle also has a center of gravity; that is, a point around which the vehicle will balance. Location of the center of gravity of each item of cargo is very important in loading the aircraft. To compute the center of gravity location of a vehicle, multiply the rear axle load by the wheelbase length (in inches) and divide by the gross weight of the vehicle. Vehicle center of gravity is measured in inches, aft from the centerline of the front axle (figure 4-10).

A. TO DETERMINE WEIGHT

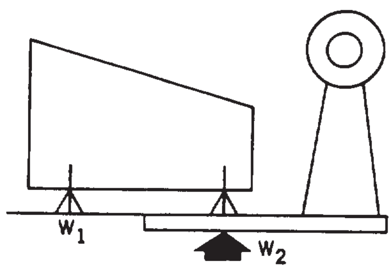
1. GENERAL CARGO

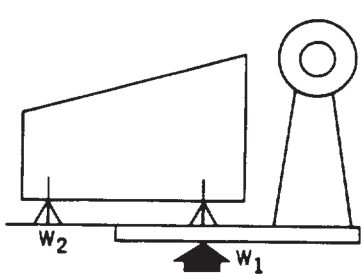


WEIGH UNIT ON SCALES

2. LARGE OR SKID-MOUNTED CARGO

A. IF SCALES CANNOT ACCOMMODATE ENTIRE UNIT, DETERMINE WEIGHT OF EACH END, USING ANGLE IRONS AS FULCRUMS.





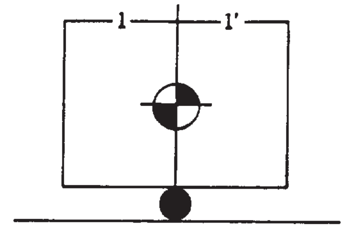
NOTE

MARK FULCRUM LOCATIONS ON BOTH SIDES OF UNIT WHEN WEIGHING ONE END. LINE UP FULCRUMS WITH MARKS WHEN WEIGHING OPPOSITE END.

B. DETERMINE UNIT WEIGHT BY ADDING END WEIGHTS.

B. TO DETERMINE C G

1. GENERAL CARGO

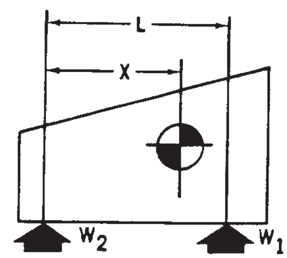


POSITION UNIT ON PIPE UNTIL IT BALANCES

NOTE

CARGO MUST BE LEVEL FOR DETERMINING CG

2. LARGE OR SKID-MOUNTED CARGO



$$X = \frac{L\,W_1}{W}$$

WHERE

X = DISTANCE FROM FULCRUM POINT TO C G

L = DISTANCE BETWEEN FULCRUM POINTS

W_1 = WEIGHT OF ONE END OF UNIT

W_2 = WEIGHT OF OTHER END OF UNIT

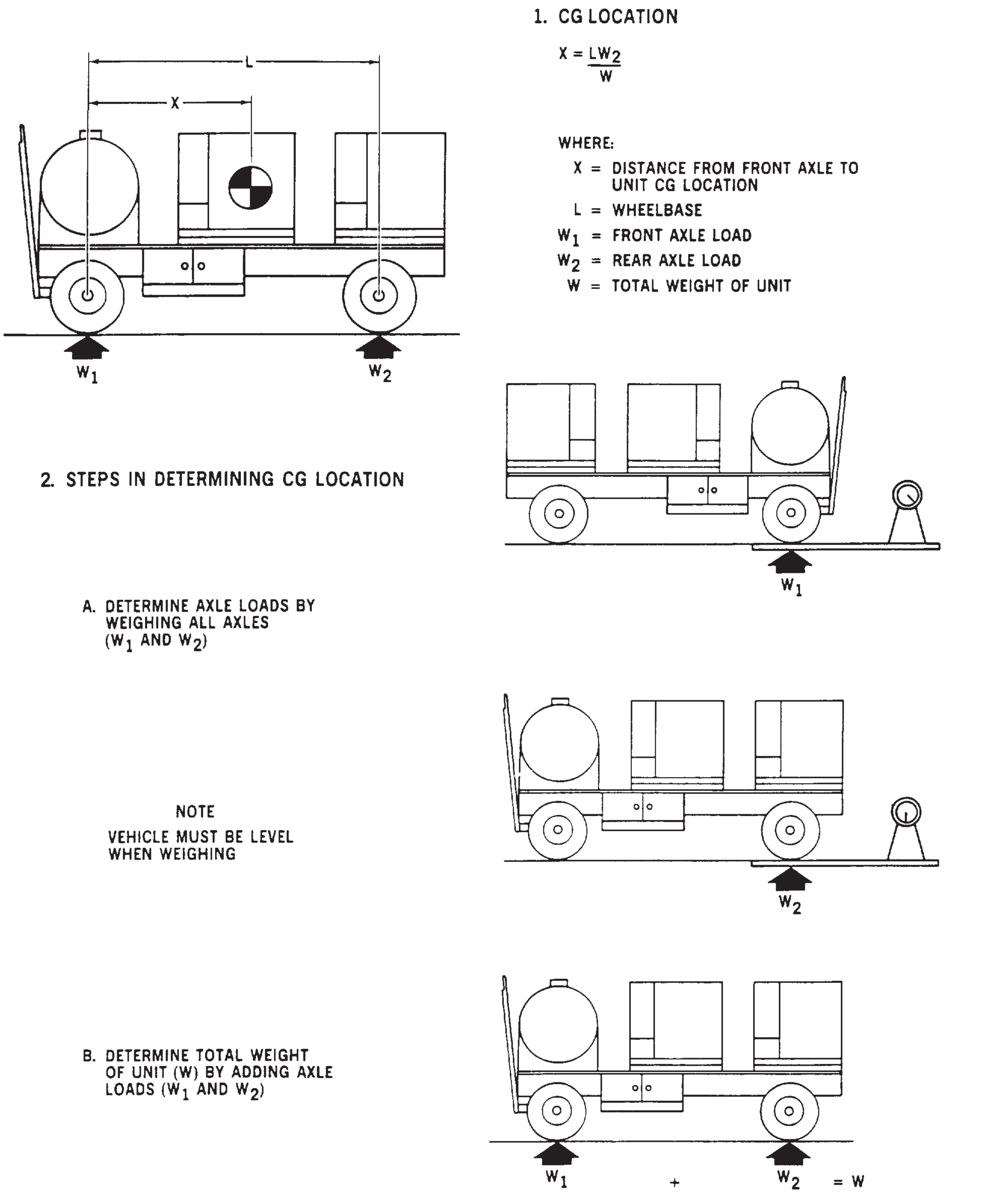
W = TOTAL UNIT WEIGHT ($W_1 + W_2$)

A. DETERMINE MOMENT AT FULCRUM POINT W_2 BY MULTIPLYING DISTANCE BETWEEN FULCRUM POINTS (L) BY UNIT WEIGHT AT FULCRUM POINT W_1.

B. DETERMINE X, THE C G DISTANCE FROM FULCRUM POINT W_2 BY DIVIDING MOMENT AT FULCRUM POINT W_2 (FROM STEP 1) BY TOTAL UNIT WEIGHT (W).

SA9-69

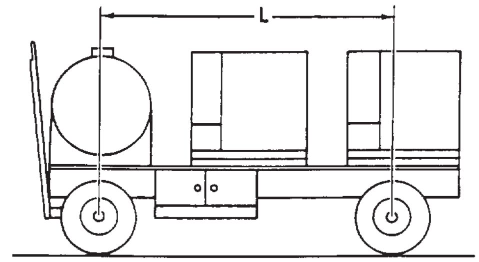
Figure 4-9. Center of Gravity Location - General Cargo



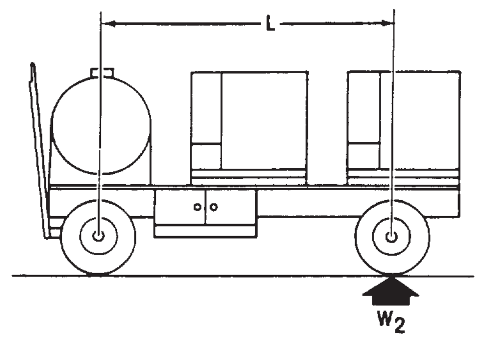
SA9-80

Figure 4-10. Center of Gravity Location - Vehicle (Sheet 1)

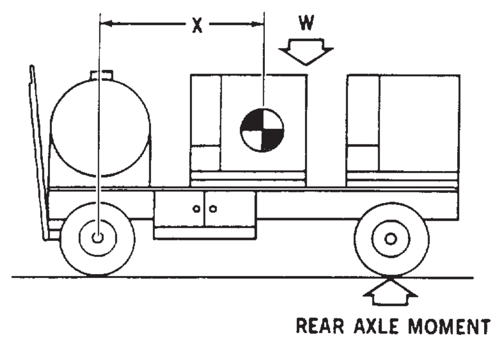
C. DETERMINE WHEELBASE (L)



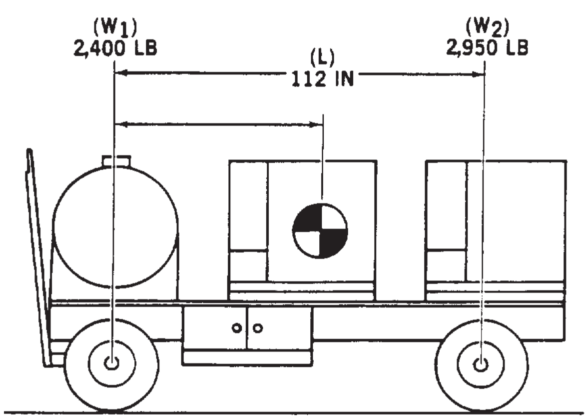
D. DETERMINE REAR AXLE MOMENT ABOUT FRONT AXLE BY MULTIPLYING REAR AXLE LOAD (W_2) BY WHEELBASE (L).



E. DETERMINE CG DISTANCE FROM FRONT AXLE (X) BY DIVIDING REAR AXLE MOMENT BY TOTAL WEIGHT (W).



3. SAMPLE PROBLEM



DETERMINE CG OF A VEHICLE WHOSE WEIGHT AND DIMENSIONS ARE AS SHOWN.

SOLUTION

USING THE FORMULA $X = \frac{LW_2}{W}$

$$X = \frac{112 \text{ IN} \times 2{,}950 \text{ LB}}{5{,}350 \text{ LB}}$$

$X = 61.8$ IN

SA9-81

Figure 4-10. Center of Gravity Location - Vehicle (Sheet 2)

TOTAL CARGO LOAD CENTER OF GRAVITY

The cargo center of gravity may be determined by either of two methods. One method uses aircraft fuselage stations, and the other method uses the centroid of the pallet compartments. Each method is explained in the following paragraphs.

CARGO CENTER OF GRAVITY BY FUSELAGE STATIONS

The center of gravity of each cargo item, as loaded in the aircraft, will coincide with an aircraft fuselage station number. Station numbers will be used as a moment arm to compute the total cargo center of gravity and the total cargo moment. Use the following procedure to locate the total load center of gravity by fuselage stations (See figure 4-11 for sample problem):

1. Locate each cargo item in the cargo compartment so that the load limitations shown on figures 4-7 and 4-8 are not exceeded.

2. Record the fuselage station location of the center of gravity of each cargo item.

3. Record weight of each cargo item.

4. Compute moment of each item by multiplying the weight by the fuselage station center of gravity, then divide the result by 10,000. The result is moment (inch-pounds/ 10,000).

$$\text{MOMENT } \left(\frac{\text{IN. -LBS}}{10{,}000}\right) = \frac{\text{FS NO. x WEIGHT OF ITEM}}{10{,}000}$$

5. Repeat steps 2 through 4 for all cargo items.

6. Add all moments as computed in step 4.

7. Add separately all the cargo item weights as recorded in step 3.

8. Compute total cargo center of gravity fuselage station location by dividing the sum of all moments by the sum of all weights.

TOTAL CARGO LOAD CG =

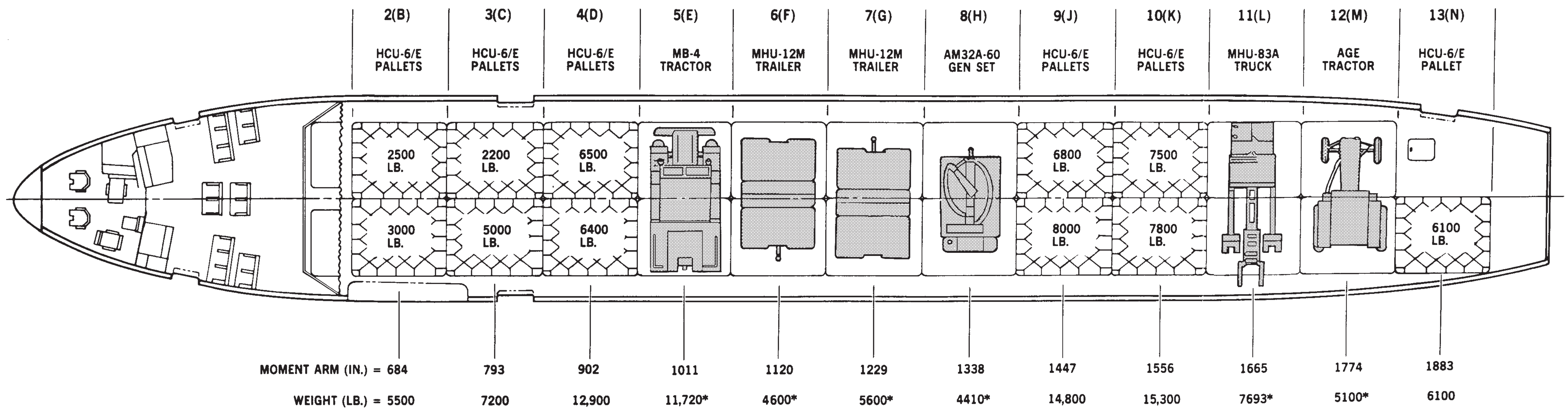
$$\frac{\text{TOTAL MOMENT } \left(\frac{\text{IN. -LBS}}{10{,}000}\right)}{\text{TOTAL WEIGHT (LBS)}} \text{ x } 10{,}000$$

9. The result of step 8 is the fuselage location of the CG for the total cargo load.

NOTE

> These calculations include the weight of cargo which may be carried on or in the vehicles.

10. Using the total cargo load center of gravity (the result of step 8, and the aircraft center of gravity, convert to percent Mean Aerodynamic Chord (% MAC) by using TO 1-1B-40 and Chart E of TO 1C-10(K)A-5. If the percent MAC is within limits, the planned load is acceptable, and will not cause the center of gravity to fall outside limits when the Weight and Balance Clearance Form (Form F) is completed prior to flight. If the center of gravity falls outside the limits, it may be necessary to relocate vehicles or other cargo to obtain a satisfactory percent MAC.



* = WEIGHT INCLUDES 600 LB. TARE (PALLETS, COUPLERS, AND STRAPS)

SA9-194D

Figure 4-11. Total Load CG - Sample Problem (Sheet 1)

PALLET POSITION	ITEM	ARM (STATION NO.)	WEIGHT (LB)	MOMENT $\left(\frac{\text{ARM X WEIGHT}}{10{,}000}\right)$
13L (N)	HCU-6/E PALLET	1883.0	6,100	1,148.63
12L & 12R (M-M)	AGE TRACTOR	1774.0	5,100	904.74
11L & 11R (L-L)	MHU-83A/E TRUCK	1665.0	7,693	1,280.88
10L & 10R (K-K)	TWO HCU-6/E PALLETS (7,800 & 7,500 LBS)	1556.0	15,300	2,380.69
9L & 9R (J-J)	TWO HCU-6/E PALLETS (8,000 & 6,800 LBS)	1447.0	14,800	2,141.56
8L & 8R (H-H)	AM32A-60 GEN SET	1338.0	4,410	590.06
7L & 7R (G-G)	MHU-12M TRAILER	1229.0	5,600	688.24
6L & 6R (F-F)	MHU-12M TRAILER	1120.0	4,600	515.20
5L & 5R (E-E)	MB-4 TRACTOR	1011.0	11,720	1,184.89
4L & 4R (D-D)	TWO HCU-6/E PALLETS (6,400 & 6,500 LBS)	902.0	12,900	1,163.58
3L & 3R(C-C)	TWO HCU-6/E PALLETS (5,000 & 2,200 LBS)	793.0	7,200	570.9
2L & 2R (B-B)	TWO HCU-6/E PALLETS (3,000 & 2,500 LBS)	684.0	5,500	376.20
		TOTALS	100,923	12,945.62

NOTES:

1. THIS TABLE IS USED FOR CALCULATING THE C.G. OF THE CARGO LOAD AND NOT FOR SEQUENCE OF ACTUAL LOADING OPERATIONS.
2. TOTAL LOAD C.G. = $\frac{\text{MOMENT}}{\text{WEIGHT}} = \frac{12{,}945.62}{100{,}923} \times 10{,}000 = 1282.7$

SA9-195A

Figure 4-11. Total Load CG - Sample Problem (Sheet 2)

CARGO CENTER OF GRAVITY BY PALLET COMPARTMENTS

A more rapid method of computing the total cargo center of gravity is by the pallet compartment method. When using this method, all cargo in a compartment is assumed to have a center of gravity at the centroid or center of the compartment. If a cargo item is located in two compartments, the weight is distributed between the compartments. If the item has an uneven weight distribution, the weight is distributed proportionally. The center of gravity of the total load is determined as follows:

1. Locate the cargo items in the pallet compartment so that the load limitations contained in figures 4-7 and 4-8 are not exceeded.

2. Record weight of cargo in each compartment.

3. Obtain pallet compartment moment from TO 1C-10(K)A-5, Basic Weight Checklist and Loading Data Manual.

4. Add compartment moments.

5. Add cargo weights.

6. Compute total cargo center of gravity location by dividing the sum of moments by the sum of weights.

CARGO CG STATION LOCATION =

$$\frac{\text{SUM OF COMPARTMENT MOMENTS}}{\text{SUM OF CARGO WEIGHTS}}$$

7. Compare the total load center of gravity station with the allowables listed in TO 1C-10(K)A-5.

LATERAL UNBALANCE CALCULATIONS

In addition to computing the longitudinal center of gravity, lateral unbalance must also be considered. Lateral unbalance results from loading different amounts of fuel in the wing tanks of the aircraft or by loading more weight on one side of the cargo compartment than the other. This section contains only that information needed to compute the lateral unbalance caused by cargo loaded in the cargo compartment.

NOTE

> The maximum lateral unbalance for cargo is also expressed as a moment, and cannot exceed 1,500,000 inch-pounds (150 simplified moments).

Lateral moments for each cargo item must be calculated to determine the lateral unbalance of the total cargo load. To determine the lateral unbalance of the total cargo load, the summation of the lateral moments on each side of the cargo compartment (left and right of the aircraft centerline) must be compared. The difference between these moments is the lateral unbalance. Lateral moments for different types of cargo are computed by the following methods:

HCU-6/E PALLETS

Lateral moments for HCU-6/E pallets may be determined by the lateral centroid of the pallet compartment. All cargo in a compartment is assumed to have its lateral center of gravity at the lateral centroid (or lateral center) of the pallet compartment. When a HCU-6/E pallet is loaded with its 108-inch dimension longitudinally (long.) in the cargo compartment, the ARM is 44.4 inches long. When the pallet's 88-inch dimension is loaded longitudinally (long.) the ARM is 54.4 inches long (figure 4-12, view A). The lateral moment is calculated by multiplying the pallet weight by the ARM.

PALLET MOMENT (108 IN. LONG.) =

> 44.4 IN. x PALLET WEIGHT (LBS) ÷ 10,000

PALLET MOMENT (88 IN. LONG.) =

> 54.4 IN. x PALLET WEIGHT (LBS) ÷ 10,000

VEHICLES LOADED LATERALLY

When vehicles are loaded laterally, the lateral moments are determined by multiplying the distance between the axle and the aircraft centerline by the axle weight (figure 4 -12, view B). Moments must be calculated for each axle.

VEHICLE MOMENT (LATERALLY LOADED) =

> DISTANCE BETWEEN AXLE AND AIRCRAFT CENTERLINE (IN.) x AXLE WEIGHT (LBS)

VEHICLES LOADED LONGITUDINALLY

When vehicles are loaded longitudinally in the cargo compartment, the lateral moment is determined by multiplying the distance between the vehicle centerline and the aircraft centerline by the vehicle weight (figure 4-12, view C).

VEHICLE MOMENT (LONG. LOADED) =

> DISTANCE BETWEEN VEHICLE CENTERLINE AND AIRCRAFT CENTERLINE (IN.) x VEHICLE WEIGHT (LBS)

Figure 4-13 is a sample problem to determine the lateral unbalance of the total cargo load. See figure 4-11 for composition of the load.

The lateral unbalance is then checked against the maximum allowable (150 moments). If the lateral unbalance is greater than the maximum allowed, palletized cargo or vehicles must be relocated to obtain a satisfactory value.

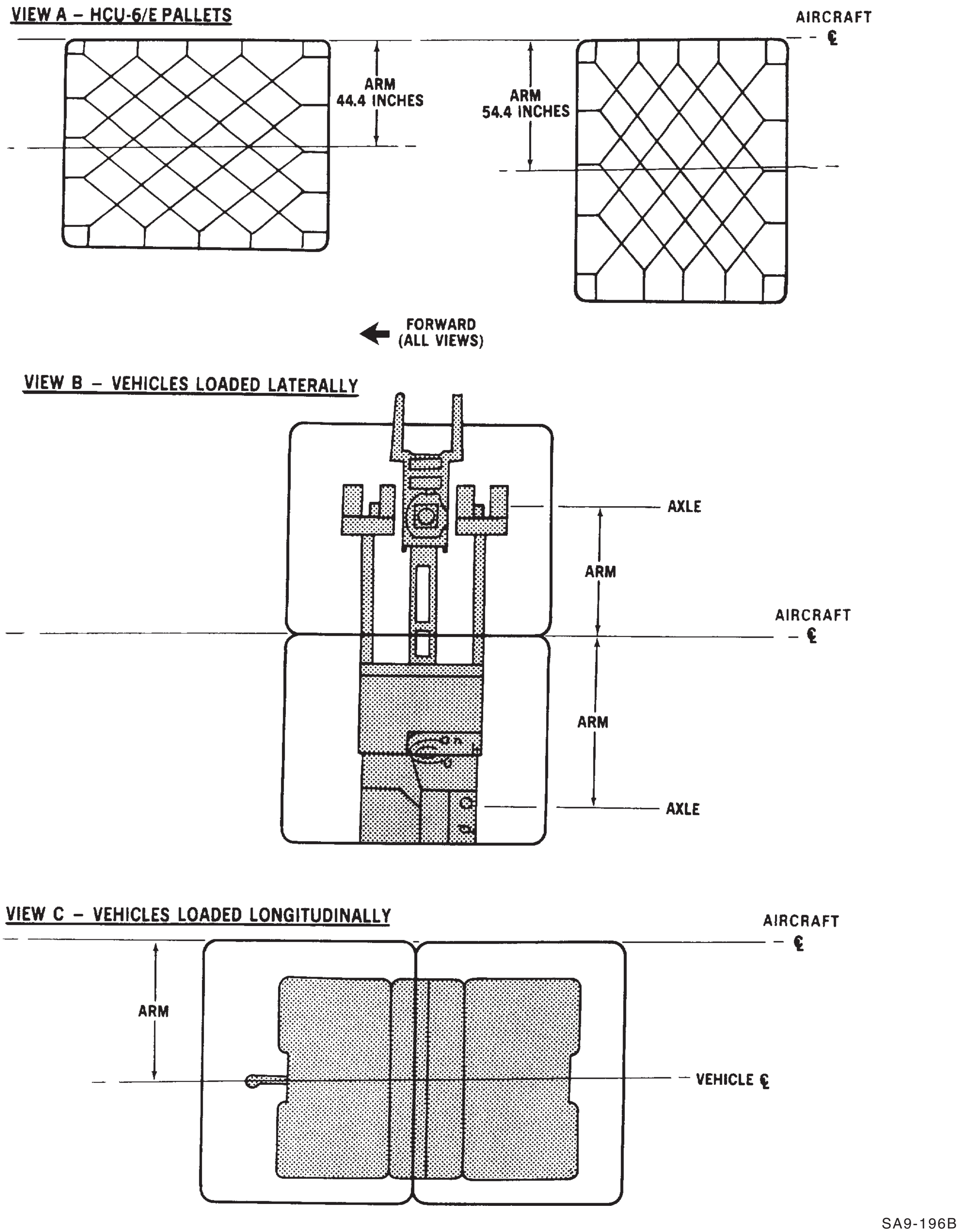


Figure 4-12. Lateral Moment Arm Determination

LEFT SIDE					RIGHT SIDE				
PALLET NUMBER	ITEM	WEIGHT (LB.)	ARM (IN.)	LATERAL MOMENT (IN-LB / 10,000)	PALLET NUMBER	ITEM	WEIGHT (LB.)	ARM (IN.)	LATERAL MOMENT (IN-LB / 10,000)
13L (N)	PALLET	6100	44.4	27.08					
12L (M)	AGE TRACTOR, REAR AXLE	4080	35.0	14.28	12R (M)	AGE TRACTOR, FRONT AXLE	1020	55.0	5.61
11L (L)	MHU-83A, FRONT AXLE	2879	49.0	14.11	11R (L)	MHU-83A, REAR AXLE	4814	42.0	20.22
10L (K)	PALLET	7800	44.4	34.63	10R (K)	PALLET	7500	44.4	33.30
9L (J)	PALLET	8000	44.4	35.52	9R (J)	PALLET	6800	44.4	30.19
8L (H)	AM32A-60, REAR AXLE	2650	30.0	7.95	8R (H)	AM32A-60, FRONT AXLE	1760	30.0	5.28
7L (G)	MHU-12M, REAR AXLE	3360	44.5	14.95	7R (G)	MHU-12M, FRONT AXLE	2240	44.5	9.97
6L (F)	MHU-12M, FRONT AXLE	2070	44.5	9.21	6R (F)	MHU-12M, REAR AXLE	2530	44.5	11.26
5L (E)	MB-4, REAR AXLE	5855	45.0	26.35	5R (E)	MB-4 FRONT AXLE	5865	45.0	26.39
4L (D)	PALLET	6400	44.4	28.42	4R (D)	PALLET	6500	44.4	28.86
3L (C)	PALLET	5000	44.4	22.20	3R (C)	PALLET	2200	44.4	9.77
2L (B)	PALLET	3000	44.4	13.32	2R (B)	PALLET	2500	44.4	11.10
TOTAL LATERAL MOMENT – LEFT SIDE (INCH-POUNDS/10,000)				248.02	TOTAL LATERAL MOMENT – RIGHT SIDE (INCH-POUNDS/10,000)				191.95
THE LATERAL UNBALANCE = 248.02 - 191.95 = 56.1 MOMENTS (ACCEPTABLE)									

NOTES:

1. USE FIGURE 4-13 FOR LOAD COMPOSITION.
2. AXLE WEIGHTS AND ARMS (FOR AXLES) WERE ESTIMATED (AXLE WEIGHTS INCLUDES TARE WEIGHT).
3. ALTHOUGH THE LATERAL UNBALANCE VALUE IS ACCEPTABLE, A LESSER LATERAL UNBALANCE COULD BE OBTAINED BY EXCHANGING PALLETS LEFT TO RIGHT OR RIGHT TO LEFT AS REQUIRED AND/OR BY TURNING THE VEHICLES 180 DEGREES.

SA9-197B

Figure 4-13. Lateral Unbalance - Sample Problem

CARGO LOADING METHODS

The primary method of loading HCU-6/E pallets on board the aircraft may be accomplished by using types of loader/elevators having an adjustable bed height of 17 feet or more.

NOTE

Approval of HQ AMC/A3VK must be obtained prior to loading/offloading with a high-lift forklift or 9-ton high-lift truck.

A secondary method of loading single HCU-6/E pallets on board the aircraft may be accomplished by using a high-lift forklift equipped with a rollerized slave dolly.

WARNING

Only forklifts with a rollerized slave dolly shall be used. The forklift shall be capable of a 17-foot lift height. The lift capacity must be equal to or greater than the pallet weight to be loaded/offloaded. An overload could cause the forklift to fail. Tines shall have a minimum length of 72 inches.

CAUTION

- Bare-tine forklift loading/offloading of cargo shall not be employed under any circumstances.
- Forklift operation inside the cargo compartment for loading/offloading cargo is strictly prohibited.
- The cargo door sill conveyor assembly shall be installed whenever cargo is being loaded or offloaded.

The loading method used for a specific item of cargo normally depends upon its size, weight, and physical characteristics, and by the configuration of the interior of the aircraft.

NOTE

- All cargo carried in the aircraft, except baggage, should be loaded on pallets and loaded/offloaded through the cargo door.
- Passenger baggage may be hand-loaded on the aircraft but must be restrained on pallets.

Palletized cargo shall be loaded through the cargo door manually, using the powered rollers, or the portable electric winch. The portable cargo winch also provides powered longitudinal movement for the palletized cargo.

GENERAL LOADING PROCEDURES

The following portion of this section contains general instructions for loading procedures. In addition, an amplified loading/offloading checklist is included. Generally, loading of personnel and cargo will be performed in accordance with instructions contained in this section. Section V provides specific instructions for certain particular items of cargo.

WARNING

- If the requirement exists for concurrent cargo loading and aircraft refueling the Boom Operator and the load team will be briefed by the Concurrent Servicing Supervisor (CSS) IAW TO 00-25-172 and 1C-10(K)A-2-12.
- The aircraft will tip over when its center of gravity is allowed to move aft of the main gear. Positive ramp and cargo floor angles and horizontal tail loads, induced by ground winds and/or snow, can cause tipover at center of gravity locations forward of the main gear. To provide a margin for these contingencies, it is recommended that the aircraft center of gravity be maintained forward of fuselage station 1430 (40% MAC) .

CAUTION

Do not load or offload cargo with the aircraft on jacks.

GENERAL LOADING PRECAUTIONS

Observe the following precautions when loading cargo:

WARNING

Pallets/nets with missing rings, exposed/deteriorated balsa core, extreme delamination or with evidence of fungus stain/dampness, shall not be loaded prior to corrective maintenance. A damaged pallet or net has lost some of its structural integrity and, as such, can jeopardize safety of flight.

CAUTION

- Care shall be taken to prevent loader/elevator from striking aircraft.
- Boom operator and loader/elevator operator must maintain loading coordination during all loading/offloading operations. Loader/elevator operator shall ensure platform drive wheels are in operation as the pallet approaches the loader/elevator. Boom operator shall release the powered roller control switch as the loader/elevator platform drive wheels engage the pallet surface. The loader/elevator platform drive wheels shall be utilized during all loading/offloading operations with palletized cargo. Exception - if the platform drive system is not operating, free-wheeling mode should be used.

CAUTION

- The two pallet stops on the center section of the cargo door sill conveyor should be raised to prevent accidental rollout of loaded pallets.

- When positioning pallets in the aircraft, avoid excessive speed to prevent damage to restraint assemblies and rails.

NOTE

- Position loader/elevator at forward edge of cargo door to allow the installation of pallet 2L (B) into the cargo handling system.

- When loading oversize cargo on coupled pallets, consideration should be given to positioning the loader/elevator towards the aft-edge of the cargo door to maximize loading clearances.

1. Before loading, all pallets shall be thoroughly cleaned of all mud, dirt, oil and stains. Pallets shall be inspected for missing rings, exposed/deteriorated balsa core, and/or extreme delamination. Pallets with this damage shall not be loaded.

2. Ensure all personnel not directly involved with the loading operation are clear of the immediate area.

3. Brief the loading crew on hand signals to be used during loading.

4. Position a loading crewmember on each side of the cargo door. These crewmembers will be responsible for monitoring the load clearances at the cargo door and assisting the boom operator as the cargo is being loaded.

PERSONNEL LOADING PROCEDURES

On missions involving mixed cargo/personnel, personnel should be loaded/offloaded through door 1L or 1R. Personnel shall board the aircraft after the cargo is loaded, and shall deplane before cargo offloading operations begin.

PALLETIZED LOADING PROCEDURES

Up to twenty-seven HCU-6/E pallets can be accommodated (figure 4-14). Eleven pallets, each capable of carrying up to 10,000 pounds of cargo, can be loaded in pallet positions 7R, 8L/R, 9L/R, 10L/R, 11L/R, 12L, and 13L. An additional eleven pallets can be loaded to 6,500 pounds each, and the remaining five pallets can be loaded to 5,400 pounds each. Procedures to be used for palletized loading are as follows:

NOTE

All stacked heights are measured from the surface of the pallets. The maximum height of netted cargo on single pallets shall not exceed 96 inches. During loading through the cargo door, only two inches of clearance exist between the cargo and the upper door jamb. All pallets must be contoured when approaching the maximum allowable heights. See figure 4-2 for contour requirements.

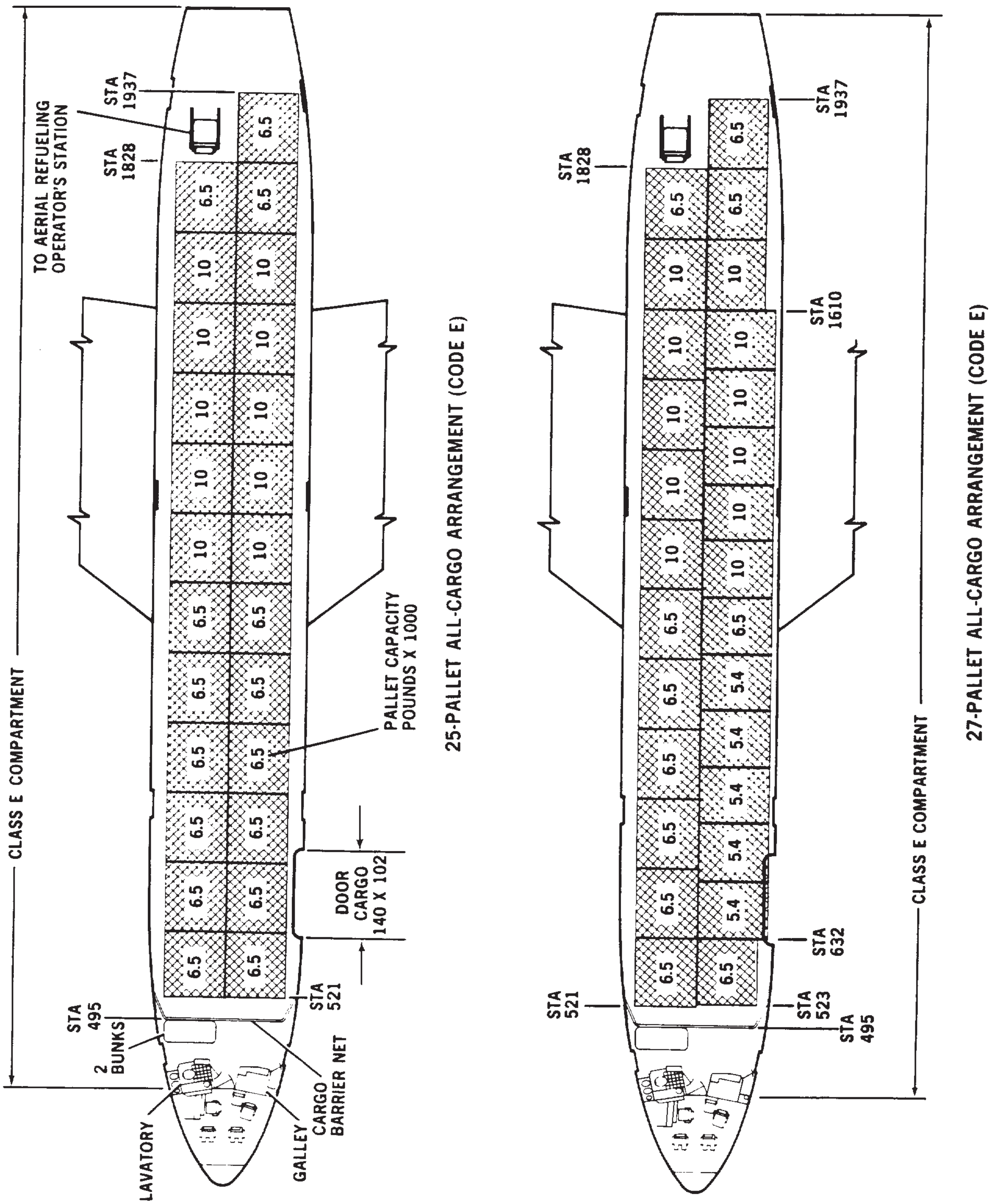
1. The maximum height of cargo on the pallets positioned forward of the cargo door, at pallet positions 1L/R(A) , shall not exceed 74 inches.

2. The maximum height of cargo on pallet positions 11L/R (L) and 12L/R (M) shall not exceed 96.0 inches. Ensure a 6-inch clearance is maintained from aircraft structures, lining, and equipment.

3. The maximum height of cargo on the aft pallet position, at 15L (RR) or 13 L(N), shall not exceed 85.5 inches.

4. The maximum single pallet weight for cargo secured with nets shall not exceed 10,000 pounds.

5. Acceptable locations for coupled pallets are shown in figure 4-15.



SA9-103A

Figure 4-14. Pallet Load Limitations

STANDARD HCU-6/E PALLET

The HCU-6/E pallet is built in accordance with MIL-P-27443. The HCU-6/E pallet illustrated in figure 4-16 is shown with miscellaneous cargo loaded on it. The cargo is restrained by a top (HCU-15/C) and two side (HCU-7/E) cargo nets. The pallet is constructed of a corrosion-resistant aluminum surface with a balsa wood core.

A lip, forming the pallet perimeter, provides 22 tiedown rings for securing the cargo nets or attaching tiedown devices for the restraint of vehicles/wheeled equipment. The tiedown rings are capable of 240° of free movement in a vertical plane that intersects the pallet edge at a right angle.

The pallet ring allowable is 7,500 pounds per ring in any direction on other aircraft (reference Pallet Specification MIL-P-27443E). The pallet ring allowable for the KC-10A aircraft is 7,500 pounds per ring except for the vertical allowable. The pallet ring vertical allowables are limited by the strength of the cargo-handling system components and the floor structure. The ring vertical allowables are 2,500 pounds maximum per ring.

Pallet dimensions are 88 inches by 108 inches, by 2.25 inches thick and the pallet weight is approximately 290 pounds. Maximum load capacity of the pallet is 10,000 pounds. The pallet has a usable area of 104 inches by 84 inches, and a loadable height of 96 inches (figure 4-2). The maximum allowable puncture load for the pallet is 250 psi up to the 10,000-pound maximum capacity. Loads that exceed the 250 psi limit must be shored to reduce the psi value to the allowable limit.

Loads must be positioned symmetrically so that the center of gravity of the load falls within 8 inches of the lateral centerline, and 10 inches of longitudinal centerline, of the pallet. If a load is concentrated on one side of the pallet, an equal weight must be placed on the opposite side to permit the common center of gravity of both loads to fall within the 16 x 20-inch rectangle of the pallet center.

The pad area of all wheeled items must be measured to ensure marginal wheel loads do not exceed the 250 psi limit. Shoring may be used to increase bearing surface and, thereby, reduce wheel pressure. The pallet itself should never be used as shoring. Internal construction of the pallet does not permit load spread. Caution must be exercised for steel/hard-rubber wheeled vehicles. Due to the thin, ribbon-line contact point of steel wheels, it is recommended that protective shoring be used for all steel/hard-rubber wheeled loads. The maximum contact area of a single, bare steel/hard-rubber wheel on the pallet will not normally exceed one square inch, and direct application may damage the pallet in flight.

PALLET NETS

Use two HCU-7/E cargo nets around the sides of the pallet, and an HCU-15/C net across the top, to secure miscellaneous loads to the pallet. When properly secured, these three nets provide all necessary restraint for palletized loads up to 10,000 pounds. One HCU-7/E side net weighs 22 pounds and one HCU-15/C top net weighs 21 pounds. A full set (two side nets and one top net) weighs 65 pounds.

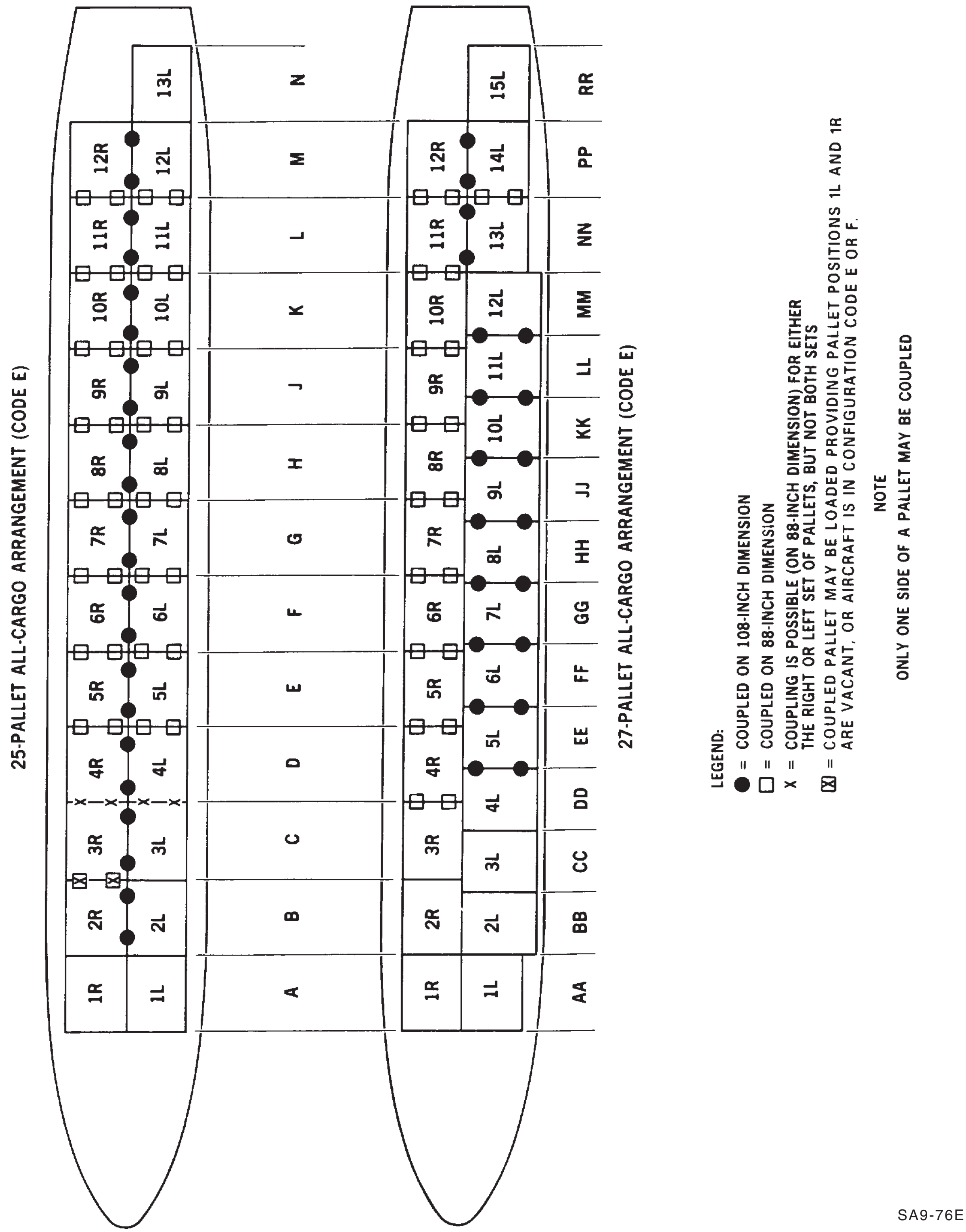


Figure 4-15. Acceptable Coupled Pallet Locations (One-Inch Couplers)

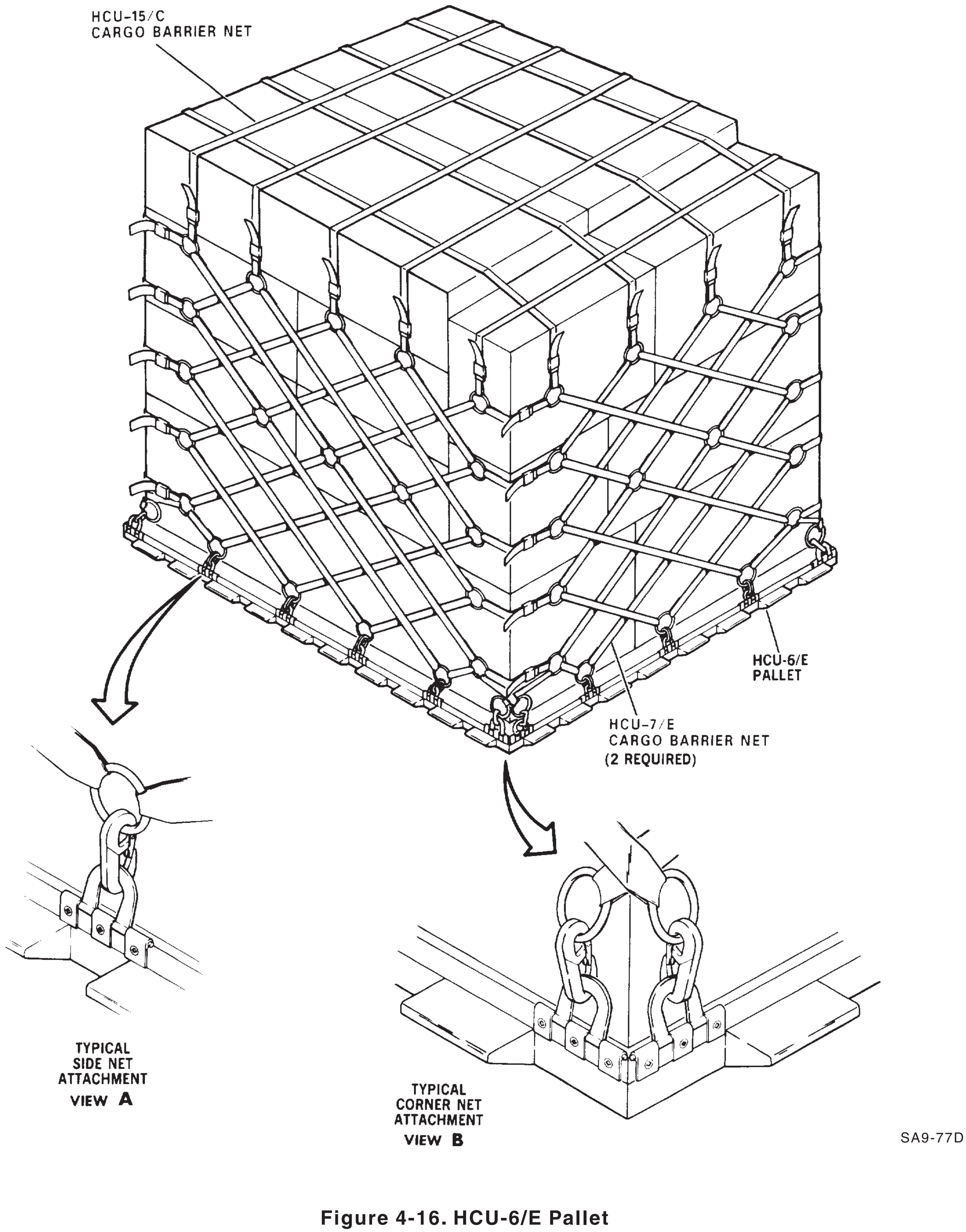


Figure 4-16. HCU-6/E Pallet

Procedures for attaching the nets to HCU-6/E pallets are as follows:

1. Start with HCU-7/E side net piece. Beginning at any corner, fasten net attaching hooks to pallet rings around the pallet periphery (figure 4 -16, view A), to the corner diagonally opposite from the beginning corner. Using the other HCU-7/E side net piece, continue fastening net attaching hooks to rings around the pallet to the beginning corner. Cross hook assemblies at all corners as shown in figure 4-16, view B.

2. Fasten net side pieces together using fastening devices at each end of net side pieces.

WARNING

> Improperly rigged nets will not provide required restraint and are a matter of safety of flight.

3. Throw HCU-15/C top net over cargo load, and fasten to side net pieces using fastening devices provided on top and side nets. Top net fastening devices (hooks) shall not be connected to the side net webbing, the pallet tiedown rings, or the bottom row of side net rings.

NOTE

> Netted cargo shall not be loaded into the aircraft until the fastening devices are properly connected.

4. Lock all fastening devices securely.

LOW-PROFILE CARGO PALLETIZING PROCEDURES

Top Net

When low-profile cargo is loaded on a pallet and does not permit the use of the side nets, the top net may be used for restraint, provided that the following procedures are adhered to:

1. The top net shall be thrown over the cargo and cinched to the pallet using the fastening devices provided on the net and the pallet tiedown rings.

2. The top net will provide all required restraint provided the net weight of the pallet does not exceed 2500 pounds and the pallet height is 45 inches or less as measured from the pallet surface. However, if the pallet net weight exceeds 2500 pounds, or the pallet height is greater than 45 inches, the top net will only provide vertical restraint and supplemental straps must be added to provide longitudinal and lateral restraint.

CAUTION

> Straps shall never be laced or woven through the net in such a manner as to prevent the tie from leading off in a straight line in the direction of pull.

Side Nets

An alternate method of restraining high-density, low-profile cargo on pallets (such as ammunition) is the HCU-7/E side nets in conjunction with 5,000-pound CGU-1/B straps, provided that the following procedures are adhered to:

1. HCU-7/E side nets shall be attached to each other.

2. Side nets shall be pulled tight over the top of cargo and secured with CGU-1/B tiedown straps. Straps shall be connected to the highest level of side-net rings, near the top of the cargo. A minimum of seven straps (four on the 108-inch side and three on the 88-inch side) shall be used for this purpose.

PRECAUTIONS FOR PALLETIZED LOADS

1. Dense cargo and crated/boxed cargo shall be loaded on the pallet first. Crushable cargo, and light-density cargo, shall be stacked on top of the load. Small-wheeled items or skidded cargo should be restrained separately to the pallet, in addition to the use of the net. All cargo shall be stacked within the vertical stacking lines of the pallet boundaries.

2. Cargo that is oversize to a single pallet, or that is placed on two pallets, shall be restrained by using the necessary number of straps attached to the pallet rings.

SHORING ON HCU-6/E PALLETS

The use of shoring, when the cargo handling system is installed and HCU-6/E pallets are used, is limited to spreading (increasing surface area) of loads to within the limits of the aircraft, protecting the top surface of the pallet, and the bridging of loads to adjoining pallet surfaces.

Suitable shoring material is 3/4-inch plywood or 2 x 12-inch planks. Plywood weighs approximately 71 pounds per full sheet (4 x 8 feet) or 2.225 pounds per square foot, and a 2 x 12-inch plank weighs approximately 6.5 pounds per square foot.

When loading items such as two-wheeled trailers, shoring may be required under the landing gear or tongue, to prevent damage to the top surface of the HCU-6/E pallet. Other cargo items with steel/hard-rubber wheels or similar concentrated loads may also require shoring.

When loading wheeled vehicles on a pallet subfloor of HCU-6/E pallets, shoring may be needed to distribute loads to adjoining pallets if a wheel is located at an edge of a pallet. Care must be taken not to cover up any tiedown rings required for restraint.

Shoring will only increase the area over which a load is distributed to whatever area is obtained by extending a plane drawn downward and outload, at an angle of 45°, until it intersects the surface on which shoring rests. The effect of this geometric estimation is illustrated in figure 5A-2.

SHORING FOR CONCENTRATED LOADS

Shoring used for concentrated loads consists of protection to the surface of the pallet and, when loading on a pallet subfloor, bridging of loads to adjoining pallets if a wheel is located at an edge of a pallet.

SLEEPER SHORING

Sleeper shoring is used to prevent movement of a vehicle due to gust load conditions, where tires or suspension system cannot withstand G loads without failure or depression producing slack in tiedown devices. This can cause a whipping action on tiedown device with potential failure. A tire failure could result in wheel rim contacting the aircraft and causing damage to the aircraft. This type of shoring is placed between the aircraft and a structural part of vehicle such as the frame or axles. It can also be used between various parts of equipment that are spring mounted to prevent their movement during flight.

SHORING FOR UNIFORM LOADS

Shoring for uniform loads consists of spreading loads to within the limits of the aircraft (PLF) .

SHORING DETERMINATION

Determine if shoring is needed by comparing allowable PLF with applied PLF for each item of cargo. If the allowable PLF is equal to or greater than the applied PLF, no shoring is required. If the allowable PLF is less than the applied PLF, shoring is required.

SHORING CALCULATION

1. Determine required length of shoring (LS) by dividing the applied load (gross weight) by the allowable PLF.

$$\text{LS (FT)} = \frac{\text{APPLIED LOAD (LB)}}{\text{ALLOWABLE PLF (LB/LIN FT)}}$$

2. Determine the required thickness of shoring (TS) as follows

$$\text{TS} = \frac{\text{LS (FT)} - \text{a (FT)}}{2}$$

Where: LS = length of shoring

a = longitudinal length of the item of cargo

NOTE

The width of shoring shall be at least as wide as the item of cargo or contact point.

RULES FOR DETERMINING TRANSPORTABILITY OF PALLETIZED GENERAL CARGO

Rules for consideration in determining transportability of general cargo on HCU-6/E pallets are:

1. Control of pounds per linear foot (PLF) and maximum weight per compartment for uniformly loaded cargo to avoid bending of the fuselage (figures 4-7 and 4-8).

2. The weight of the unit of cargo and the type and number of supports necessary to avoid damage to the cargo handling system and aircraft structure.

3. The pounds per square inch (PSI) weight distribution to prevent damage to the pallet surface.

TYPES OF GENERAL CARGO

General cargo can be classified into two types, uniformly loaded general cargo with flat bottoms and cargo with skids or other supports which create concentrated loads (figure 4-17).

Uniform Load

Cargo such as cartons/boxes/drums where the weight is evenly distributed over the entire bottom of the item of cargo.

Concentrated Load

A load which is supported by a small area compared to the size and weight of the total package. Cargo with concentrated loads usually is cargo which is too heavy or too large to be easily handled by two people and is mounted to supports to allow handling by a forklift. These supports are usually hard rubber/steel wheels or small blocks (wooden, fiberboard or metal) called contact points or skids:

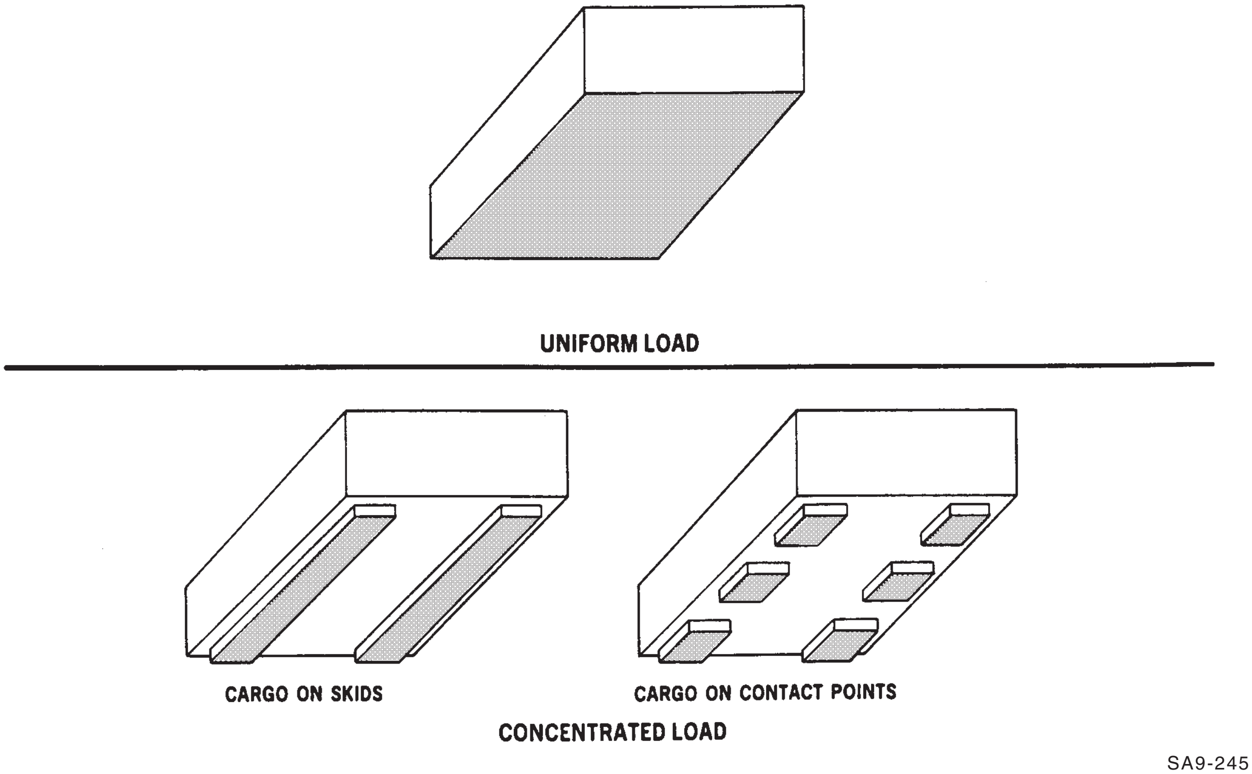


Figure 4-17. Types of General Cargo

Contact Point - A contact point is the footprint area which would be created by any piece of cargo placed on a pallet, if both the width and the length of the contact point are less than 20 inches.

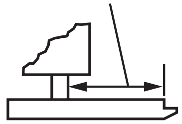
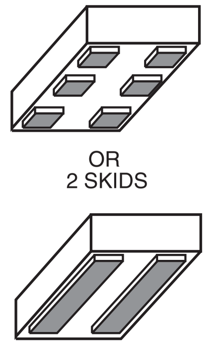
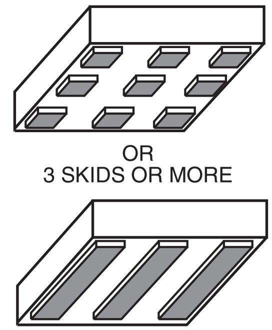
Skid - A skid is a supporting base upon which equipment is mounted for stability, damage protection and ease of handling. Skid sizes vary greatly depending upon the size of the package. Skids with lengths less than 20 inches must be considered contact points.

UNIFORM LOAD LIMITATIONS

Uniformly loaded general cargo can be loaded in all compartments up to the maximum pounds per linear feet (PLF) and the maximum weight per compartment (figure 4-7 or 4-8).

CONCENTRATED LOAD LIMITATIONS

Figure 4-18 lists the maximum general cargo concentrated load limitations for all pallet positions /compartments for the 25-pallet all-cargo configuration. Figure 4-19 lists the maximum general cargo concentrated load limitations for pallets which are oriented laterally, on the left side of the aircraft, as in the 27-pallet all-cargo configuration. These maximums, in both charts, are expressed in weight per items of cargo. These values are for items of cargo which are equal to or greater than 20 inches in length and 20 inches wide.

PALLET POSITION L OR R	SET BACK REQUIREMENT	NET WEIGHT LIMIT PER ITEM			PALLET MAXIMUM WEIGHT	PALLET POSITION L OR R
	EDGE  HCU-6/E PALLET FWD AND AFT	ANY CONFIGURATION OF CONTACT POINTS OR SKIDS	6 CONTACT POINTS  OR 2 SKIDS	9 CONTACT POINTS OR MORE  OR 3 SKIDS OR MORE		
		1	2	3		
1	NONE	1,600	1,700	2,200	6500	1
2, 3	NONE	3,800	3,800	5,700	6500	2, 3
4	NONE	5,200	6,100	6,100	6500	4
5	NONE	3,800	5,800	6,100	6500	5
6	< 10 INCHES	2,500	3,600	4,000	6500	6
	≥ 10 INCHES	4,000	5,800	6,100	6500	
7, 8	< 10 INCHES	1,800	3,700	4,400	10000	7, 8
	≥ 10 INCHES	2,500	5,000	5,900	10000	
9	NONE	2,500	5,000	5,900	10000	9
10	NONE	4,700	6,600	6,600	7000	10
11	NONE	4,000	6,100	6,100	7500	11
12	NONE	4,300	6,100	6,100	6500	12
13	NONE	6,100	6,100	6,100	6500	13

NOTES

1. IF TYPE AND NUMBER OF SUPPORTS CANNOT BE DETERMINED, USE COLUMN 1.
2. IF THE ITEM OF CARGO IS LESS THAN 20 INCHES WIDE, USE ONE-HALF OF THE ABOVE LISTED LOADS.
3. WHEN PALLET POSITION 10L OR R CONTAINS CONCENTRATED LOADS, THE MAXIMUM COMPARTMENT GROSS WEIGHT IS 7,000 LBS. WHEN LOADED EXCLUSIVELY WITH A UNIFORM LOAD, PALLET POSITIONS 10L OR R MAY BE LOADED TO THE PLF LIMITATION NOT TO EXCEED THE MAXIMUM COMPARTMENT GROSS WEIGHT OF 10,000 POUNDS.
4. WHEN PALLET POSITION 11L OR R CONTAINS CONCENTRATED LOADS, THE MAXIMUM COMPARTMENT GROSS WEIGHT IS 7,500 LBS. WHEN LOADED EXCLUSIVELY WITH A UNIFORM LOAD, PALLET POSITIONS 11L OR R MAY BE LOADED TO THE PLF LIMITATION NOT TO EXCEED THE MAXIMUM COMPARTMENT GROSS WEIGHT OF 10,000 POUNDS.
5. WHEN LOADED WITH AXLE LOADS THE MAXIMUM COMPARTMENT GROSS WEIGHT FOR PALLET POSITIONS 10L OR R AND 11L OR R IS 8,000 POUNDS PROVIDED THE AXLES ARE SEPARATED BY 48 INCHES OR MORE. HOWEVER, BECAUSE THE AXLE LIMIT COULD BE LESS, REFER TO FIGURE 4-21

Figure 4-18. Concentrated Load Limitations - 25-Pallet All-Cargo Configuration

PALLET POSITION	SET BACK REQUIREMENT (EDGE; HCU-6/E PALLET; FWD AND AFT)	NET WEIGHT LIMIT PER ITEM: ANY CONFIGURATION OF CONTACT POINTS OR SKIDS	6 CONTACT POINTS OR 2 SKIDS	9 CONTACT POINTS OR MORE OR 3 SKIDS OR MORE	PALLET MAXIMUM WEIGHT	PALLET POSITION
		1	2	3		
1L	NONE	1,600	1,700	2,200	6,500	1L
2L, 3L,4L	NONE	3,800	3,800	5,000	5,400	2L, 3L, 4L
5L	NONE	3,800	5,000	5,000	5,400	5L
6L, 7L	< 10 INCHES	2,500	3,600	4,000	5,400 (6L)	6L, 7L
	≥ 10 INCHES	4,000	5,000	5,000	6,500 (7L)	
8L, 9L, 10L	< 10 INCHES	1,800	3,700	4,400	10000	8L, 9, 10L
	≥ 10 INCHES	2,500	5,000	5,900		
11L	NONE	2,500	5,000	5,900	7,000	11L
12L	NONE	4,700	6,600	6,600	7,000	12L
13L	NONE	4,000	6,100	6,100	7,500	13L
14L	NONE	4,300	6,100	6,100	6,500	14L
15L	NONE	6,100	6,100	6,100	6,500	15L

NOTES

1. IF TYPE AND NUMBER OF SUPPORTS CANNOT BE DETERMINED, USE COLUMN 1.
2. IF THE ITEM OF CARGO IS LESS THAN 20 INCHES WIDE, USE ONE-HALF OF THE ABOVE LISTED LOADS.
3. WHEN PALLET POSITION 10L OR R CONTAINS CONCENTRATED LOADS, THE MAXIMUM COMPARTMENT GROSS WEIGHT IS 7,000 LBS. WHEN LOADED EXCLUSIVELY WITH A UNIFORM LOAD, PALLET POSITIONS 10L OR R MAY BE LOADED TO THE PLF LIMITATION NOT TO EXCEED THE MAXIMUM COMPARTMENT GROSS WEIGHT OF 10,000 POUNDS.
4. WHEN PALLET POSITION 11L OR R CONTAINS CONCENTRATED LOADS, THE MAXIMUM COMPARTMENT GROSS WEIGHT IS 7,500 LBS. WHEN LOADED EXCLUSIVELY WITH A UNIFORM LOAD, PALLET POSITIONS 11L OR R MAY BE LOADED TO THE PLF LIMITATION NOT TO EXCEED THE MAXIMUM COMPARTMENT GROSS WEIGHT OF 10,000 POUNDS.
5. WHEN LOADED WITH AXLE LOADS THE MAXIMUM COMPARTMENT GROSS WEIGHT FOR PALLET POSITIONS 10L OR R AND 11L OR R IS 8,000 POUNDS PROVIDED THE AXLES ARE SEPARATED BY 48 INCHES OR MORE. HOWEVER, BECAUSE THE AXLE LIMIT COULD BE LESS, REFER TO FIGURE 4-21

Figure 4-19. Concentrated Load Limitations - Lateral Loading (Left Side of Aircraft)

If the item of cargo is less than 20 inches long and 20 inches wide, use one-half of the value listed in figure 4-18 or 4-19.

Column 1 of figures 4-18 and 4-19 lists the maximum weight for items of cargo having any configuration of contact points or skids, provided the cargo is equal to or greater than 20 inches by 20 inches in size. The maximum weight limitation range is from 1,600 pounds to 6,100 pounds. The maximum allowable weight per item of cargo for pallet positions 6L/R (F), 7L/R (G) and 8L/R (H) of the 25-pallet all-cargo configuration and 6L (FF), 7L (GG), 8L (HH), 9L (JJ) and 10L (KK) of the 27-pallet all-cargo configuration, can be increased if the item of cargo is set back a minimum of 10 inches from the forward and aft edge of the pallet. No lateral (left or right) set back is required for any condition listed in figures 4-19 and 4-20.

NOTE

The allowables listed in figures 4-18 and 4-19 are for individual HCU-6/E pallets. Each position may be loaded up to its maximum limitation without restrictions from adjacent pallets.

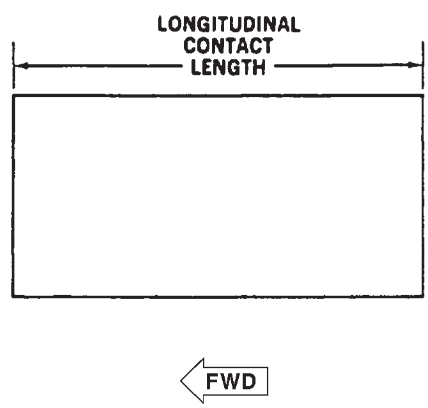
Additional weight capability is allowed in most of the compartments, provided the type and number of supports are known. Column 2 of figures 4-18 and 4-19 lists the maximum weight per item of cargo having six contact points or two skids. Column 3 lists the maximum weight per item of cargo having nine (or more) contact points or three (or more) skids.

NOTE

- If type and number of supports cannot be determined, use column 1 of figures 4-18 or 4-19.
- The no set-back values in column 1 (figures 4-18 and 4-19) can be used as a preliminary GO/NO-GO check for cargo which is supported by any configuration of contact points or skids.

All pallet positions except 10L/R (K), 11L/R (L), 12L (MM) and 13L (NN) may be loaded to its maximum compartment weight, with any combination of concentrated loads from columns 1, 2 or 3 of figures 4-18 or 4-19. Maximum weight for pallet positions 10L/R (K) and 12L (MM) are 7,000 pounds and 7,500 pounds for pallet positions 11L/R (L) and 13L (NN) when loaded with concentrated loads.

UNIFORM LOADS ON HCU-6/E PALLETS



SA9-247

1. Determine the cargo compartment pallet configuration and orientation of the pallets.

2. Determine the net weight of the unit.

3. Determine the longitudinal contact length in linear feet.

4. Mathematically divide the length (linear feet) into the unit net weight to determine PLF created by the unit:

$$\frac{\text{Unit Net Weight}}{\text{Linear Feet}} = \text{PLF}$$

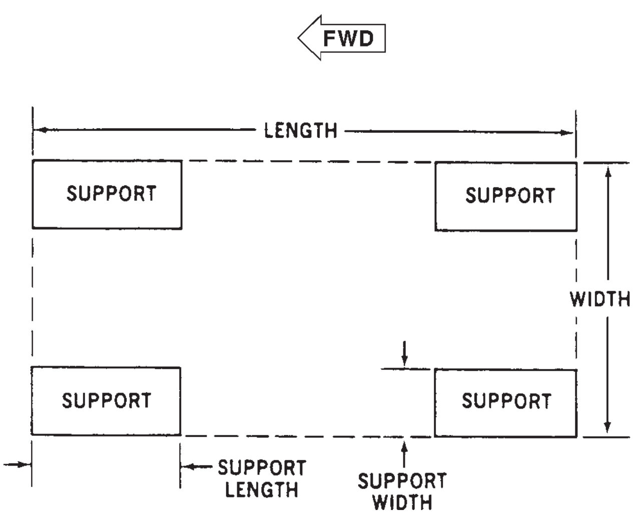
5. Compare the result with the PLF allowables in figure 4-7 or 4-8. If PLF limits are exceeded, shoring must be used.

6. Results: Pallet positions within the cargo compartment where this item may be loaded for flight.

NOTE

PSI is not required to be computed when loading uniform load cargo.

CONCENTRATED LOADS ON HCU-6/E PALLETS



SA9-248

1. Determine the cargo compartment configuration and orientation of the pallets.

2. Determine the gross weight of the unit.

3. Determine the type (length) and number of supports.

NOTE

If both the length and width of the support are less than 20 inches, the support must be considered a contact point. Do not exceed the 250 PSI limit of the pallet.

4. Determine the overall length and width of the unit of cargo.

5. Compare the type and number of supports and the gross weight with the allowables listed in figure 4-18 or 4-19.

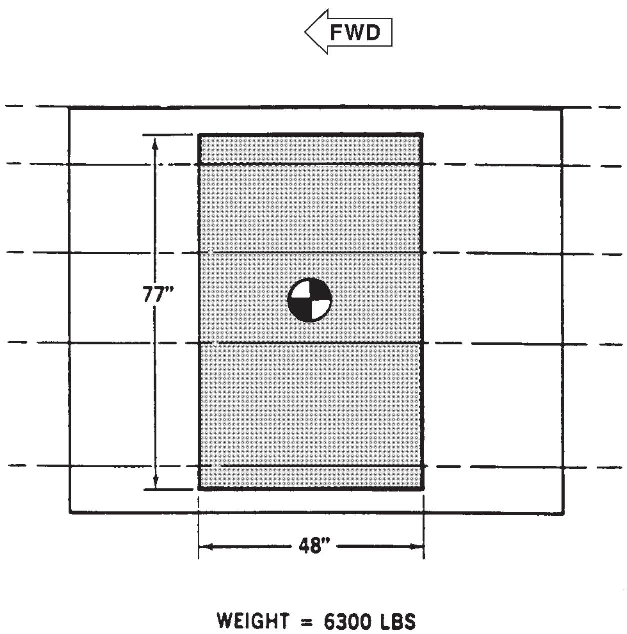
NOTE

If the overall length and width of the unit of cargo are less than 20 inches, use one-half of the values listed in figure 4-18 or 4-19.

6. Results: Pallet positions within the cargo compartment where this item may be loaded for flight.

SAMPLE PROBLEM NO. 1 - UNIFORM LOADS (LONGITUDINALLY- LOADED PALLETS)

A box of cargo, as shown below, is to be loaded on a HCU-6/E pallet, and will be located in pallet position 9R (J).



SA9-192

1. Weight = 6,300 pounds.

2. CG Location - Center of box.

3. Longitudinal length of contact = 48 inches = 4.0 feet.

4. Applied load = 6,300 pounds.

5. Applied PLF - Determine the applied PLF of the item of cargo by dividing the length into the applied load.

$$\frac{6{,}300 \text{ LBS}}{4.0 \text{ Ft}} = 1{,}575 \text{ PLF}$$

6. Allowable PLF - The allowable PLF for pallet position 9R (J) is 1,452 PLF (figure 4-7).

7. Compare allowable PLF with applied PLF. The allowable PLF is less than the applied PLF; therefore, shoring is required.

8. Shoring:

a. Required length (LS):

$$LS = \frac{\text{APPLIED LOAD}}{\text{ALLOWABLE PLF}}$$

$$= \frac{6{,}300 \text{ LBS}}{1{,}452 \text{ LB/LIN FT}}$$

$$= 4.34 \text{ FEET}$$

$$= 52.1 \text{ INCHES}$$

b. Required thickness (TS):

$$TS = \frac{LS\ (FT) - a\ (FT)}{2}$$

Where: LS = length of shoring
a = longitudinal length of the item of cargo

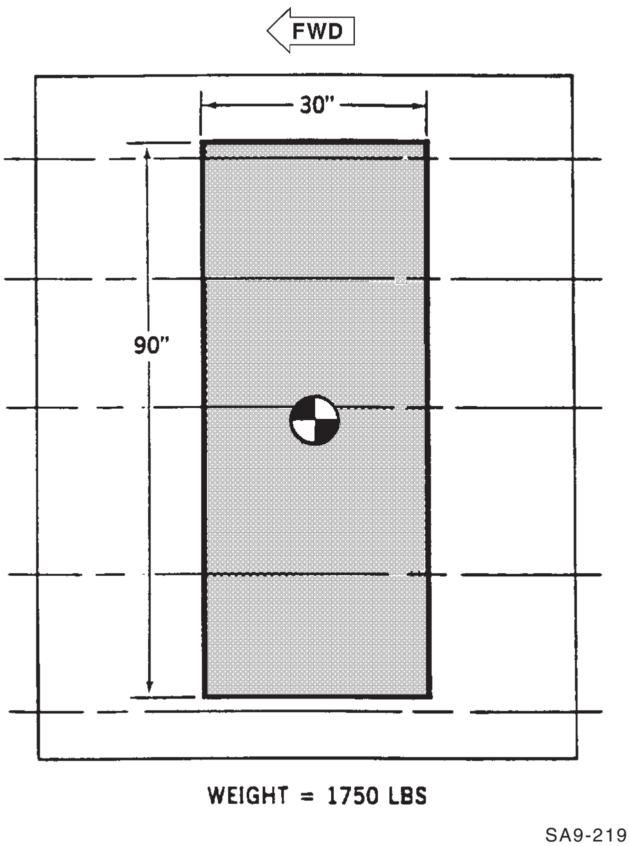
$$TS = \frac{(4.34 \text{ FT}) - (4.0 \text{ FT})}{2}$$

$$= 0.17 \text{ FEET}$$

$$= 2.04 \text{ INCHES}$$

SAMPLE PROBLEM NO. 2 - UNIFORM LOADS (LATERALLY -LOADED PALLETS)

A box of cargo, as shown below, is to be loaded on a HCU-6/E pallet, and will be located in pallet position 6L (FF).



1. Weight = 1,750 pounds.

2. CG location - Center of box.

3. Longitudinal length of contact = 30 inches = 2.5 feet.

4. Applied load = 1,750 pounds.

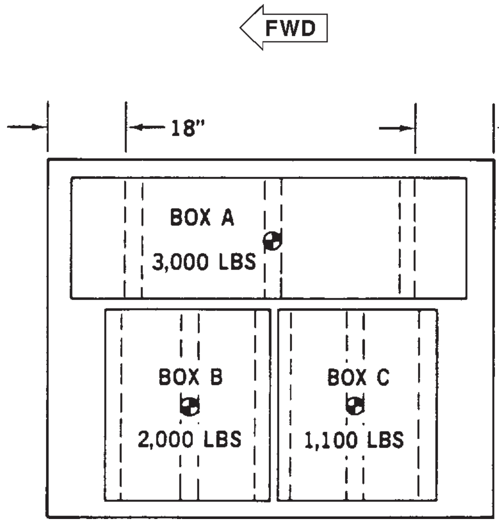
5. Applied PLF - Determine the applied PLF of the item of cargo by dividing the length into the applied load.

$$\frac{1,750 \text{ LBS}}{2.5 \text{ FT}} = 700 \text{ PLF}$$

6. Allowable PLF - The allowable PLF for pallet position 6L (FF) is 738 PLF (figure 4-8).

7. Compare allowable PLF with applied PLF. The allowable PLF is greater than the applied PLF; therefore, shoring is not required.

SAMPLE PROBLEM NO. 3 -CONCENTRATED LOADS



SA9-249

Three boxes of cargo (A, B, and C), each mounted on skids, are to be loaded on a HCU-6/E pallet. Determine the pallet positions this pallet can be loaded. Cargo compartment is configured to the 25-pallet all-cargo configuration.

1. Weight and Size:

Box A = 3,000 pounds,
95 x 30 inches

Box B = 2,000 pounds,
40 x 48 inches

Box C = 1,100 pounds,
40 x 48 inches

2. CG Locations: Center of all boxes.

3. Configuration of Contact Points or Skids:

Box A = 3 skids - 30 inches long

Box B = 3 skids - 48 inches long

Box C = 3 skids - 48 inches long

4. Pallet Gross Weight:

Pallet and Nets	=	354 pounds
Cargo (Boxes A, B & C)	=	6,100 pounds
Gross Weight	=	6,454 pounds

5. Allowable Loads:

a. Compartment Load Limitations:

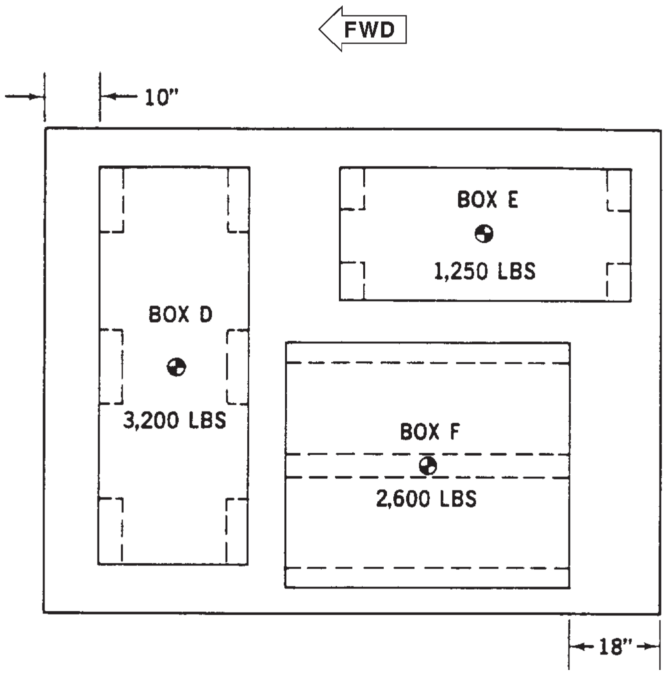
The gross weight of the pallet is 6,454 pounds. Figure 4-7 indicates this pallet may be loaded in any compartment/pallet position (left or right) provided the maximum concentrated load allowables are not exceeded.

b. Concentrated Load Limitations:

Since the length and width of all three boxes are equal to or greater than 20 inches, the full value of figure 4-19 can be used and indicates the lowest maximum weight per item of cargo, with three skids, is 2,200 pounds for pallet position 1L/R and 4,000 pounds for the remaining pallet positions without a set back requirement. One box (Box A) exceeds the 2,200 pounds. There is no increase in concentrated load allowable for pallet position 1L/R. therefore, this pallet cannot be loaded in these pallet positions. For the remaining pallet positions, the lowest maximum weight per item of cargo with three skids is 4,000 pounds.

6. Compare allowable loads to applied loads, except for pallet positions 1L/R (A), the allowable loads are larger than the applied loads. Therefore, this pallet can be loaded in pallet positions 2L/R (B) through 13L (N).

SAMPLE PROBLEM NO. 4 - CONCENTRATED LOADS



SA9-250

Three boxes of cargo (D, E and F) each mounted on skids or contact points, are to be loaded on a HCU-6/E pallet. Determine the pallet positions this pallet can be loaded. The cargo compartment is configured to the 25-pallet all-cargo configuration.

1. Weight and Size:

   Box D = 3,200 pounds,
   70 x 26 inches

   Box E = 1,250 pounds,
   52 x 24 inches

   Box F = 2,600 pounds,
   48 x 40 inches

2. CG Locations: Center of all boxes.

3. Configuration of Contact Points or Skids:

   Box D = 6 contact points -
   12 inches long

   Box E = 4 contact points -
   8 inches long

   Box F = 3 skids -
   48 inches long

4. Pallet Gross Weight:

Pallet and Nets	=	354 pounds
Cargo (Boxes D, E & F)	=	7,050 pounds
Gross Weight	=	7,404 pounds

5. Allowable Loads:

   a. Compartment Load Limitations:

   The gross weight of the pallet is 7,404 pounds. Figure 4-7 indicates this pallet can only be loaded in pallet positions 7, 8, 9, 10 and 11 (left or right) provided the maximum concentrated load allowables are not exceeded. However, the pallet cannot be loaded in pallet position 10L/R because the maximum weight of combined concentrated loads in these pallet positions is 7,000 pounds.

   b. Concentrated Load Limitations:

   Since the length and width of all three boxes are equal to or greater than 20 inches, the full values of figure 4-18 can be used.

Box D - Column 2 of figure 4-18 indicates that for positions 7 and 8, the maximum weight per item of cargo with six contact points is 3,700 pounds with no set back requirement and 5,000 pounds with a set back of 10 inches or more. Pallet position 9 maximum weight per item of cargo is 5,000 pounds.

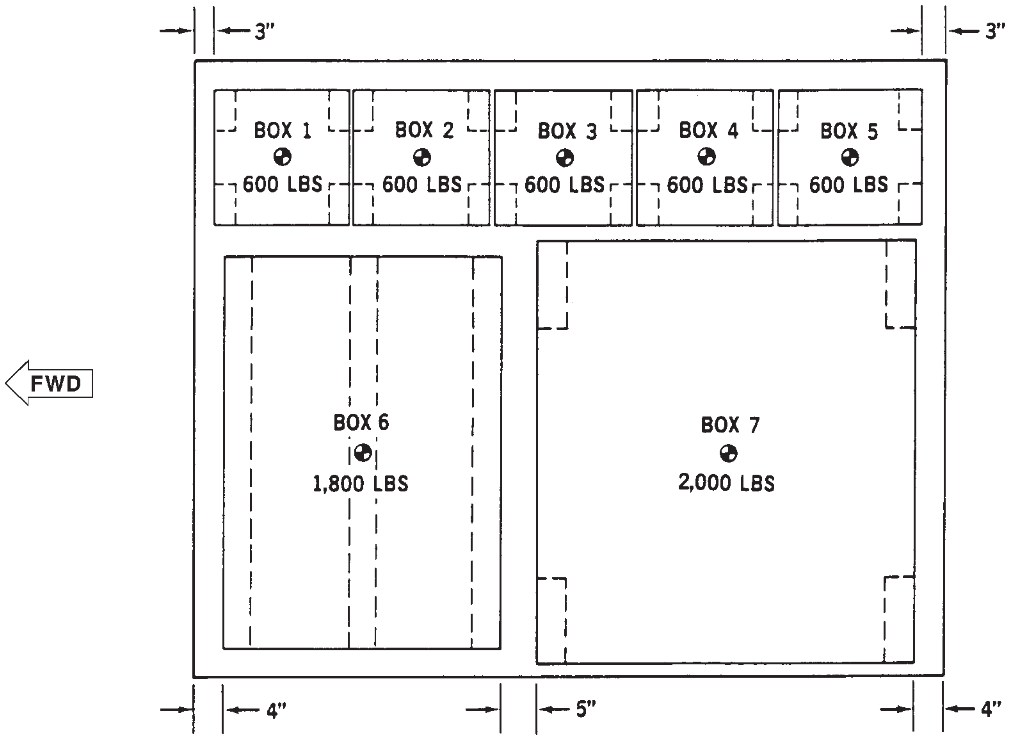
Box E - An item of cargo with four contact points is not illustrated in figure 4-18. Therefore, column 1 must be used to determine the maximum allowable weight per item of cargo. A maximum weight of 1,800 pounds (without a set back requirement) is allowed for pallet positions 7 and 8; and 2,500 pounds for pallet position 9.

Box F - Column 3 of figure 4-18 indicates that a maximum weight per item of cargo with three skids is 4,400 pounds, without a set back requirement for pallet positions 7 and 8, and 5,900 pounds with a set back of 10 inches or more. Maximum weight per item of cargo (with three skids) for pallet position 9 is 5,900 pounds.

6. Compare Allowable Loads to Applied Loads:

Since Box D and Box F are set back 10 inches or more, the allowable loads are larger than the applied loads, the pallet can be loaded in pallet positions 7, 8, 9 or 11.

SAMPLE PROBLEM NO. 5 - CONCENTRATED LOADS



SA9-251

Seven boxes of cargo (Boxes 1, 2, 3, 4, 5, 6 and 7), each mounted on skids or contact points, are to be loaded on a HCU-6/E pallet. Determine the pallet positions this pallet can be loaded. Cargo compartment is configured to the 25-pallet all-cargo configuration.

1. Weight and Size:

Boxes 1 thru 5	=	600 pounds each, 18 x 18 inches
Box 6	=	1,800 pounds, 56 x 40 inches
Box 7	=	2,000 pounds, 54 x 61 inches

2. CG Locations: Center of all boxes.

3. Configuration of Contact Points or Skids:

Boxes 1 thru 5	=	4 contact points - 6 inches long
Box 6	=	3 skids - 56 inches long
Box 7	=	4 contact points - 12 inches long

4. Pallet Gross Weight:

Pallet and Nets	=	354 pounds
Cargo (Boxes 1 thru 7)	=	6,800 pounds
Gross Weight	=	7,154 pounds

5. Allowable Loads:

a. Compartment Load Limitations:

The gross weight of the pallet is 7,154 pounds.

Figure 4-7 indicates this pallet can only be loaded in pallet positions 7, 8, 9, 10 and 11 (left or right) provided the maximum concentrated load allowables are not exceeded. However, the pallet cannot be loaded in pallet position 10 because the pallet gross weight exceeds the combined weight limitations.

b. Concentrated Load Limitations:

Boxes 1, 2, 3, 4 and 5 - Column 1 must be used to determine the maximum allowable weight per item of cargo for pallet positions 7, 8, 9 and 11. The length and width of these five boxes is less than the 20-inch requirement. Therefore, only one-half of the values can be used. The most restrictive allowable weight in these pallet positions is 900 pounds (1,800 ÷ 2) without a set back requirement.

Box 6 - Column 3 of figure 4-18 indicates the most restrictive weight for an item of cargo with three skids is 4,400 pounds without a set back requirement for pallet positions 7, 8, 9 and 11.

Box 7 - Column 1 must be used again to determine the maximum allowable weight per item of cargo. A maximum weight of 1,800 pounds (without a set back requirement) is allowed for pallet positions 7 and 8; 2,500 pounds for pallet position 9 and 4,000 pounds for pallet position 11.

6. Compare Allowable Loads to Applied Loads:

The allowable loads are larger than the applied loads except for Box 7 in pallet positions 7 and 8. The pallet may be loaded in pallet position 9 or 11. To load this pallet in pallet positions 7 or 8, do one of the following tasks:

a. Rearrange the boxes on the pallet to provide a minimum of a 10-inch set back for Box 7.

b. Place two skids under Box 7, so the values of column 2 can be used (3,700 pounds).

VEHICLE LOADING PROCEDURES

Automobiles, small trucks, small trailers, aircraft engines on transportation trailers, support equipment, and various other types of wheeled vehicles may be carried separately, or in combinations that will not exceed the size, weight limits, and payload capacity of the aircraft.

These vehicles are loaded on HCU-6/E pallets, which are then loaded into the cargo handling system. Vehicles may be loaded aboard the aircraft by one of two methods:

1. The first method consists of prepalletizing and restraining the vehicles on single or coupled pallets prior to loading aboard the aircraft. This method requires the least amount of time for loading operations.

2. The second method involves the installation of a partial-pallet subfloor, where all pallet positions in the doorway area, and forward, remain open. A coupled pallet is installed on a loader/ elevator, and is used as a conveyable transfer platform for rotating large cargo items in the doorway area. The cargo items are driven or pushed onto the transfer platform, the platform is rotated 90°, then butted and secured against the end of the installed pallet subfloor at the required position in the aircraft. The restraint devices are attached after the cargo unit is in position.

NOTE

- The actual method used to load vehicles is dependent on the allowable loading time and the availability of material handling equipment.
- Certain large cargo units which have very little loading clearances should be loaded by the prepalletized method (method 1).
- When loading trailers, restrain the tongue in the up position by a restraint device, by the tongue self-locking pin, or remove the tongue.

PREPARATION OF VEHICLES FOR LOADING

Check dimensions of the vehicle before loading it into the aircraft. Some large vehicles allow very little clearance. Some vehicles may be reduced in height by removal of such components as exhaust stacks, antennas, etc. Vehicle length may be reduced by removing the drawbar assembly. Width may be reduced by folding/removing mirrors.

CAUTION

Tires shall not be deflated to increase vertical clearance. Tire deflation may cause the tire sealing to break, allowing air pressure to escape and permitting the wheel rim to contact the HCU-6/E pallet during flight through turbulence.

NOTE

Items loaded in vehicles must be within the pallet contours shown in figure 4-2.

The shipping agency shall determine the weights on the wheels and axles by actually weighing the vehicle.

NOTE

Book weights shall not be used.

If the vehicle is to carry a load when it is in the aircraft, load the vehicle before weighing it, or make proper allowance for the load and vehicle shall be determined. Wheel and axle weights shall be within allowable limits of the cargo compartments.

Transportation of vehicles by air requires tying down the vehicle in the aircraft and lashing down all cargo (or other items of loose equipment) on the vehicle. Each vehicle loaded into the aircraft should be checked carefully to ensure all loose items are tied down. The following is a list of items to be checked:

1. All cargo in vehicles.

2. Spare wheels.

3. Tools and tool box covers.

4. Chocks or similar items.

5. Cables, supply hoses on support equipment.

6. Fuel in tanks, and extra fuel tanks (refer to applicable directives for amount permitted).

CAUTION

The A/M 32A-86 Hobart Generator must be loaded with the fuel filler neck forward in the aircraft. Fuel may leak during climb-out if the filler neck is loaded facing aft.

PREPARATION OF AIRCRAFT FOR LOADING VEHICLES

Prepare the aircraft for loading vehicles as follows:

1. If loading vehicles on a partial-pallet subfloor, install empty pallets into the cargo handling system.

NOTE

- Before loading empty pallets in the aircraft, verify the pallet rings are in the up position. This is required for attaching restraint devices.
- In the partial-pallet subfloor method, all pallet positions in the doorway area and forward remain open. The vehicles shall be loaded onto a conveyable transfer platform (coupled HCU-6/E pallets) for rotation in the doorway area, moved aft, then butted and secured against the end of the pallet subfloor.

2. Prior to loading vehicles, attach restraint devices to provide two forward and two aft lines of restraint. A single device on each end arranged in a dual line configuration is satisfactory.

3. When loading on a partial-pallet subfloor, move the vehicle on the coupled pallets into the aircraft and rotate 90°.

CAUTION

Assign personnel to monitor loading clearances.

NOTE

The preferred method of rotating vehicles is manually. However, the cargo winch or powered roller system can be used to rotate vehicles.

NOTE

During loading/off loading of pallets, the restraint assemblies at fuselage station 629.5 may be used as pallet guides.

4. Manually move or winch the vehicle longitudinally to the pallet subfloor.

5. When using 88-inch dimension transfer platform, with one-inch pallet couplers, use a minimum of two dual pawl end restraint assemblies at the forward end to preclude the platform from moving forward during transfer.

6. When using 108-inch dimension transfer platform, use two tiedown chains to secure the transfer platform to the pallets installed in the cargo handling system to preclude the platform from moving forward during transfer.

7. Manually move or drive the vehicle onto the partial-pallet subfloor into the prearranged load position.

8. Tie down the vehicle in accordance with procedures as outlined in this section.

VEHICLE LOADING PRECAUTIONS

WARNING

- Proper ventilation of the aircraft shall be provided when loading/offloading self-propelled vehicles. Prolonged exposure to carbon monoxide fumes will produce adverse effects that may prove fatal.
- Brakes and/or air pressure on all vehicles shall be checked for proper functioning prior to driving vehicle within the aircraft.
- When driving a vehicle within the aircraft, use the lowest gear with the transfer case, if applicable, in low range.

CAUTION

Ensure vehicle operator is in vehicle with brakes applied prior to releasing restraint devices.

NOTE

- If vehicle has automatic transmission, place the transmission shift lever in park.
- If vehicle is gasoline engine driven with a standard transmission, place the transmission in the lowest gear.
- Diesel powered vehicles shall be parked with the transmission in neutral, or if equipped with automatic transmission, in park.
- Provide ventilation by opening doors as required. Aircraft air conditioning system should be used.

1. During the rotation of coupled pallets, the center guide restraint rail at pallet position 4L/R (D) may be removed. Reinstallation of the rail may be required prior to longitudinal movement.

2. If the cargo handling system is configured in the 23-pallet mixed cargo/personnel configuration, the bunks may be removed and the environmental curtain rolled up to allow rotation of large vehicles.

3. If the cargo handling system is configured in the 17-pallet mixed cargo/personnel configuration, the palletized lavatory Z may be removed to allow rotation of large vehicles.

4. If it is necessary to transit the center guide rails when maneuvering steel/hard-rubber wheeled equipment within the aircraft, shoring is required to prevent damage to the rails.

NOTE

If vehicles have pneumatic tires narrow enough to penetrate between the pallets and contact the center guide rail, shoring is required.

5. When vehicle is in position, the driver shall remain in the vehicle guarding the brake until at least one forward and one aft tie-down device is attached.

VEHICLE AXLE WEIGHT LIMITATIONS

Figures 4-7 and 4-8 list maximum axle (pneumatic -tired vehicles) for all compartments. A maximum single axle weight of 4,800 pounds (flight conditions) is allowed to be loaded on HCU-6/E pallets in one compartment. Axle load limitations in the remaining compartments range from 3,200 to 4500 pounds. These maximums are for vehicle wheelbase or tread (whichever is less) of 48 inches or more. For pneumatic-tired vehicles that have less than a 48-inch tread or wheelbase, see figure 4-20 for these allowable axle loads. For heavier axles refer to Section V.

SINGLE WHEEL LIMITATIONS

Figures 4-7 and 4-8 list maximum individual wheel loads for all compartments. A maximum single wheel load of 2,400 pounds is allowed in one compartment for flight condition. Single wheel load limitations in the remaining compartments range from 1,600 to 2,250 pounds. These maximums are for single wheel loads which are 48 inches or more apart. For single wheel loads that are less than 48 inches apart, use one-half of the values listed in figure 4-20.

ADJACENT WHEEL AND AXLE LIMITATIONS

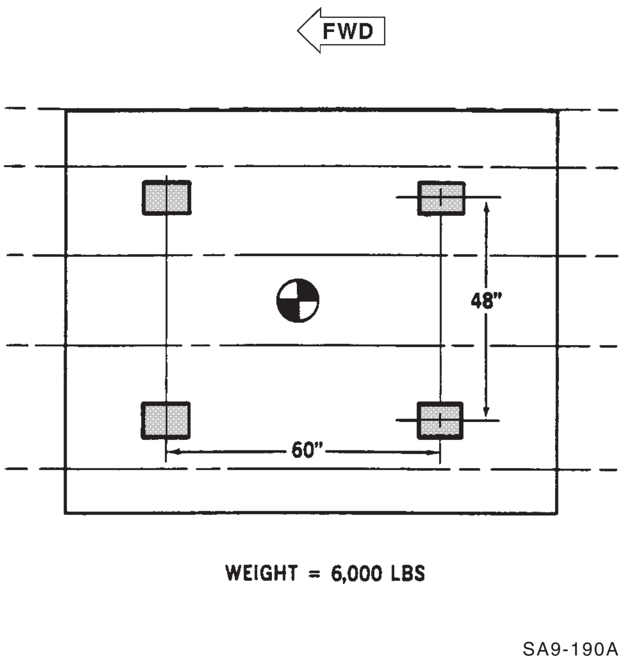
The allowable axle loads and single wheel load limitations listed in figures 4-7, 4-8 and 4-20, apply to adjacent axles and wheels.

ADJACENT AXLE AND WHEEL LOADS WITH SECTION V VEHICLES

Except as noted in Section V, the axle load(s) of the vehicles contained in Section V exceed the maximum allowable axle weights listed in figures 4-7 and 4-8. To determine the maximum allowable axle/wheel load(s) in pallet positions adjacent to a Section V vehicle, measure the distance from Section V vehicle axle/wheel(s) and use figure 4-20. The Section V vehicle weight is not considered.

SAMPLE PROBLEM NO. 1 - AXLE LOADS

A four-wheeled trailer, as shown below, is to be loaded in pallet position 7L (G). Calculate the load limits.



1. Weight = 6,000 pounds.

2. CG Location - Center of trailer.

3. Applied Load - Since the CG is at the center of the trailer, each axle has an equal load.

LOAD (PER AXLE) =

$$\frac{\text{WEIGHT}}{\text{NUMBER OF AXLES}} =$$

$$\frac{6{,}000\ \text{(LBS)}}{2} = 3{,}000\ \text{POUNDS}$$

4. Distance between axle loads:

Wheel base = 60 inches

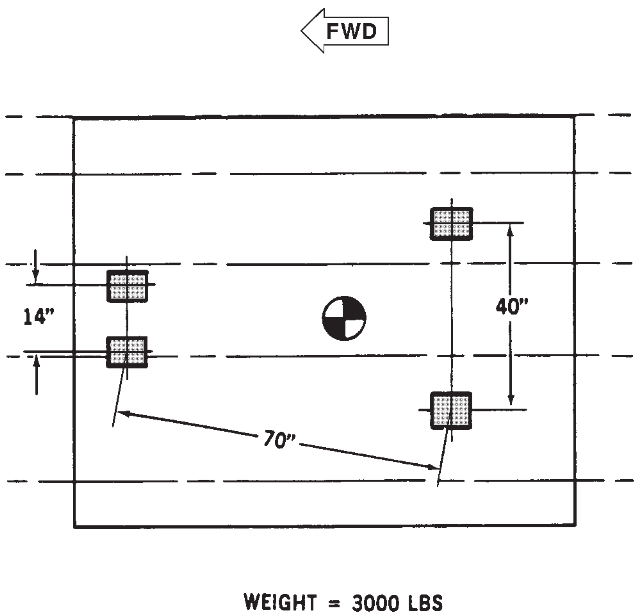
Tread = 48 inches

5. Allowable Load - Figure 4-7 indicates that the maximum axle load for pallet position 7L (G) is 3,200 pounds for axles that are at least 48 inches apart.

6. Compare allowable load with the applied load. The allowable axle load of 3,200 pounds is greater than the applied axle load of 3,000 pounds; therefore, the trailer can be loaded in pallet position 7L (G).

SAMPLE PROBLEM NO. 2 - AXLE LOADS

A generator set as shown below, is to be loaded in pallet position 8L (H). Calculate the load values.



SA9-191A

1. Weight = 3,000 pounds.

2. CG Location 23.3 inches from the rear axle.

3. Applied Load - The axle loads are as follows:

Front Axle = 1,000 pounds.

Rear Axle = 2,000 pounds.

4. Distance between axle loads:

Wheelbase = 70 inches (diagonal measurement).

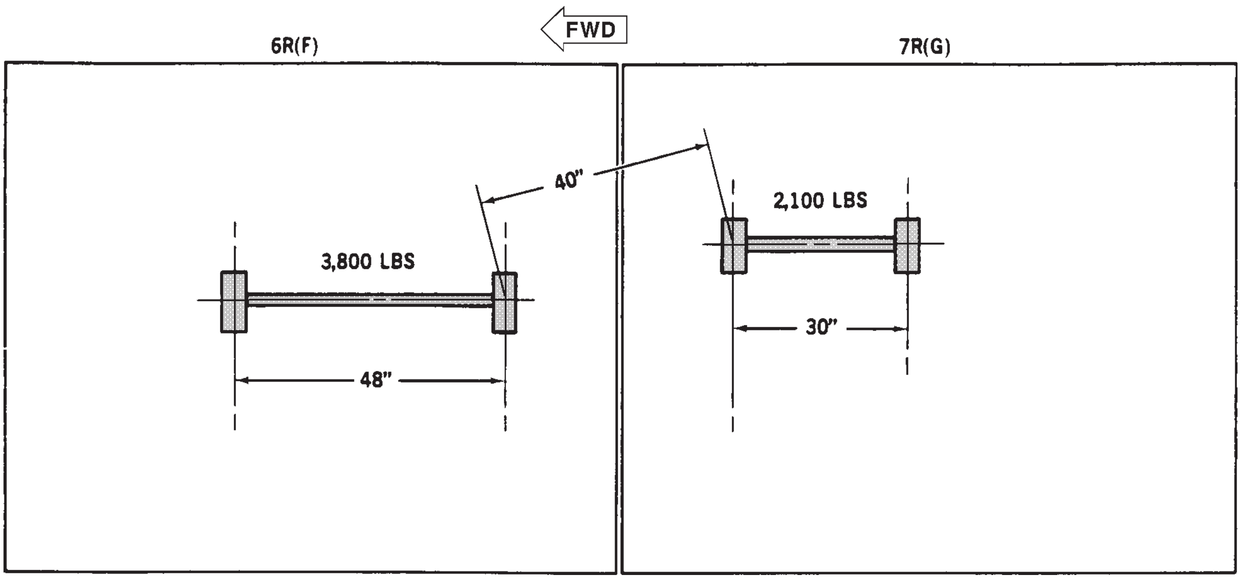
Front Tread = 14 inches.

Rear Tread = 40 inches.

5. Allowable Load - Figure 4-7 shows that values for axle loads are for loads which are 48 inches or more, and therefore cannot be used. Note 2 refers to figure 4-20 for other conditions. Figure 4-20 is a list of axle loads for pallet position 8L (H) and other adjacent positions. The front and rear treads (14 and 40 inches) are less than the wheelbase (70 inches); therefore, the distance between the axles (wheelbase) is not the controlling factor. The tread of the front axle is 14 inches, and the maximum load for a 14-inch distance is 1,840 pounds. The tread on the rear axle is 40 inches, and the figure shows that 2,880 pounds can be loaded.

6. Compare allowable load with the applied loads. The allowable load for a 14-inch tread is 1,840 pounds, which is larger than the 1,000-pound applied load, and the allowable load for a 40-inch tread is 2,880 pounds, which is larger than the 2,000-pound applied load; therefore, the generator set can be loaded in pallet position 8L (H).

SAMPLE PROBLEM NO. 3 - AXLE LOADS



SA9-208B

Two axles, as shown above, are to be loaded on HCU-6/E pallets and will be located in pallet positions 6R (F) and 7R (G).

1. Pallet Position 6R (F):

   a. Axle Weight = 3,800 pounds.

   b. Tread = 48 inches.

   c. Allowable Load - Since the tread of the axle is 48 inches, figure 4-7 indicates a maximum axle weight of 4,800 pounds for pallet position 6R (F). Since the axle weight is less than 4,800 pounds, the axle can be loaded.

2. Pallet Position 7R (G):

   a. Axle Weight = 2,100 pounds.

   b. Tread = 30 inches.

   c. Allowable Load - Since the tread is less than 48 inches, figure 4-7 cannot be used. Note 2 refers to figure 4-20 for other conditions. Figure 4-20 is a list of axle loads for pallet positions 7R (G) and other adjacent positions. The figure shows that for a tread of 30 inches, a maximum axle load of 2,480 pounds is allowed. Since the axle weight is less than 2,480 pounds, the axle can be loaded in pallet position 7R (G).

3. Adjacent Axle Loads

The illustration of the axle loads shows that the two axles are loaded longitudinally in the cargo compartment. The most critical concentrated loads are the aft wheel of the axle loaded in pallet position 6R (F) and the forward wheel of the axle loaded in pallet position 7R (G). To determine if these axles are loadable, the weights of each wheel must be checked against the distance from each other.

a. Wheel Weights (Applied Loads):

(1) Pallet position 6R (F) =

$$\frac{3{,}800 \text{ lbs.}}{2} = 1{,}900 \text{ lbs.}$$

(2) Pallet position 7R (G) =

$$\frac{2{,}100 \text{ lbs.}}{2} = 1{,}050 \text{ lbs.}$$

b. Distance = 40 inches (diagonal measurement).

c. Allowable Load:

NOTE

For single wheel loads, use one-half of the values listed in figure 4-20.

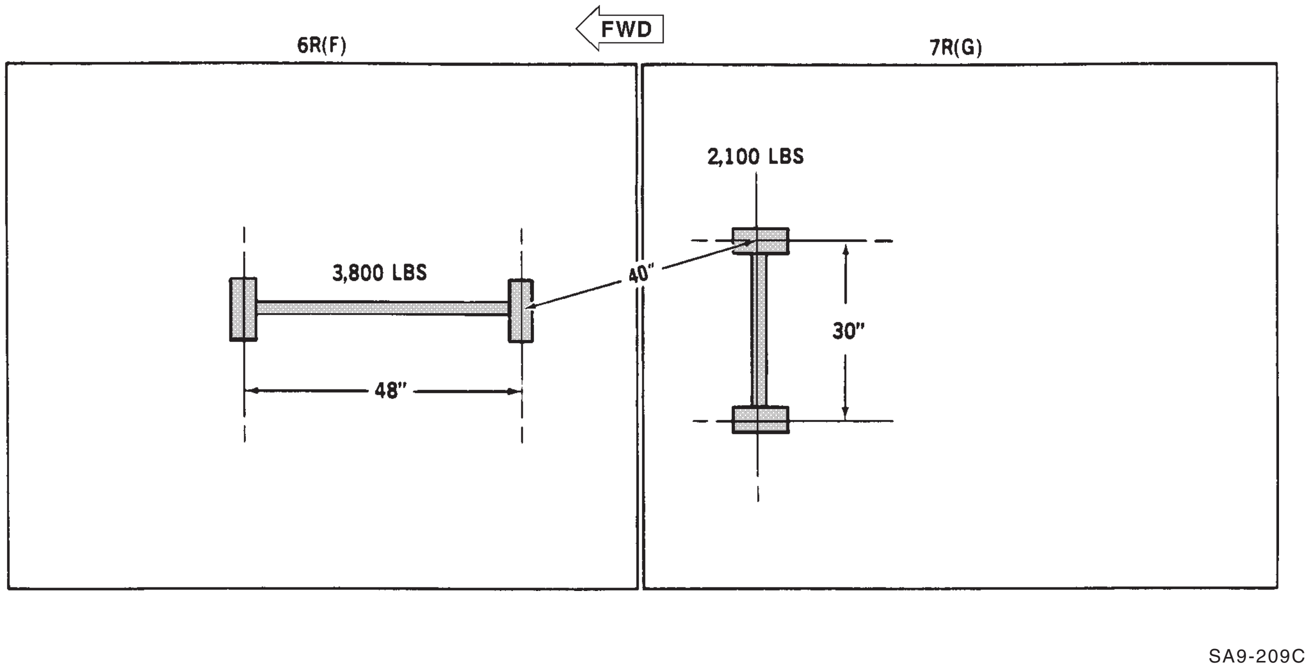
(1) Pallet position 6R (F) figure 4-20, indicates that for loads that are 40 inches apart, the maximum weight for each single wheel load in pallet position 6R (F) is 2,160 pounds (4,320 ÷ 2).

(2) Pallet position 7R (G) - figure 4-20 indicates that for loads that are 40 inches apart, the maximum weight for each single wheel load in pallet position 7R (G) is 1,440 pounds (2,880 ÷ 2).

d. Compare Allowable Loads with Applied Loads (Wheel Weights):

The allowable loads in each pallet position were more than the applied loads. Therefore, the axles are allowed to be loaded.

SAMPLE PROBLEM NO. 4 - AXLE LOADS



This sample problem is identical to problem No. 3 except that the axle in pallet position 7R (G) is loaded laterally in the cargo compartment. In sample problem No. 3, it was determined that the axles could be loaded.

1. Adjacent Axle Loads:

   a. Applied Loads:

      (1) Pallet position 6R (F) = 1,900 pound/wheel.

      (2) Pallet position 7R (G) = 2,100 pound/axle.

   b. Distance = 40 inches.

   c. Allowable Load:

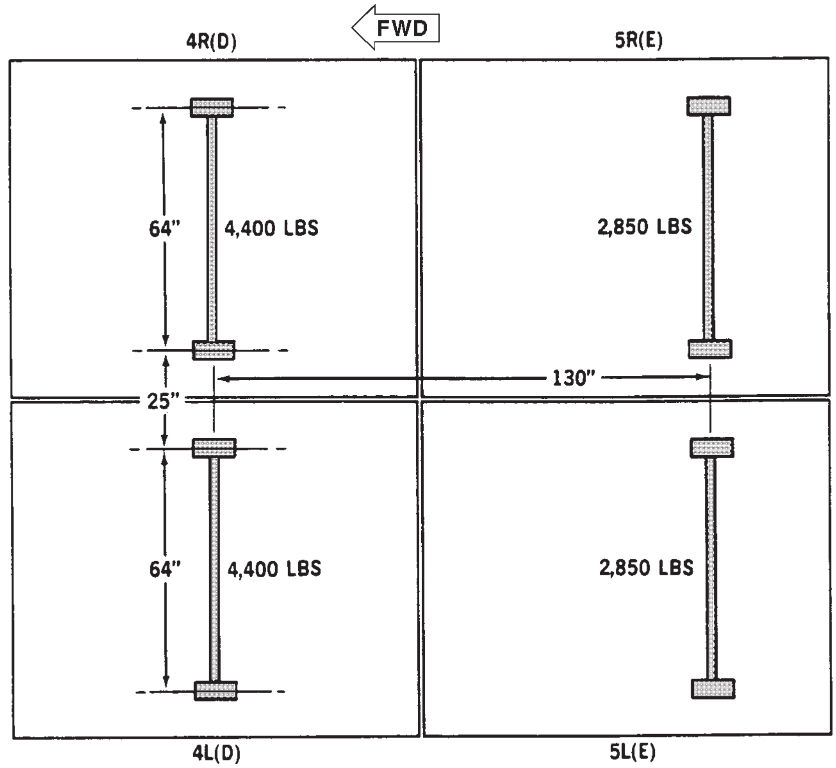
      (1) Pallet position 6R (F) = figure 4-20 indicates that for loads that are 40 inches apart, the maximum weight for each single wheel load is 2,160 pounds (4,320 ÷ 2).

      (2) Pallet position 7R (G) - figure 4-21 indicates that for loads that are 40 inches apart, the maximum axle weight in pallet position 7R (G) is 2,880 pounds.

   d. Compare Allowable Loads with Applied Loads:

      The allowable loads in each pallet position were more than the applied loads. Therefore, these axles are allowed to be loaded.

SAMPLE PROBLEM NO. 5 - AXLE LOADS



SA9-280

Two vehicles, as shown above, are to be loaded on pallets located in pallet positions 4L/R (D) and 5L/R (E).

1. Pallet positions 4L/5L (D/E):

   a. Front Axle Weight = 2,850 pounds.

      Rear Axle Weight = 4,400 pounds.

   b. Wheel Base = 130 inches.

      Wheel Tread = 64 inches.

   c. Allowable Load - Since the wheel base and tread are both over 48 inches, figure 4-7 allows a maximum axle weight of 4,500 pounds for pallet positions 4L/5L (D/E). Since the axle weights are less than 4,500 pounds, the axles can be loaded.

2. Pallet Positions 4R/5R (D/E):

   a. Front Axle Weight = 2,850 pounds.

      Rear Axle Weight = 4,400 pounds.

   b. Wheel Base = 130 inches.

      Wheel Tread = 64 inches.

   c. Allowable Load - Since these vehicle allowable loads for 4R/5R (D/E) are not exceeded, the adjacent wheel load limits must now be considered.

3. Adjacent Wheel Loads:

   a. Applied Loads:

      (1) Pallet positions 4L/R (D) = 2,200 pounds/wheel.

      (2) Pallet positions 5L/R (E) = 1,425 pounds/wheel.

b. Distance = 25 inches.

c. Allowable Load:

Pallet positions 4L/5L (D/E) and 4R/5R (D/E) - Figure 4-20 indicates that for loads 25 inches apart, the maximum weight for each single wheel load is 1,603 pounds (3,206 ÷ 2).

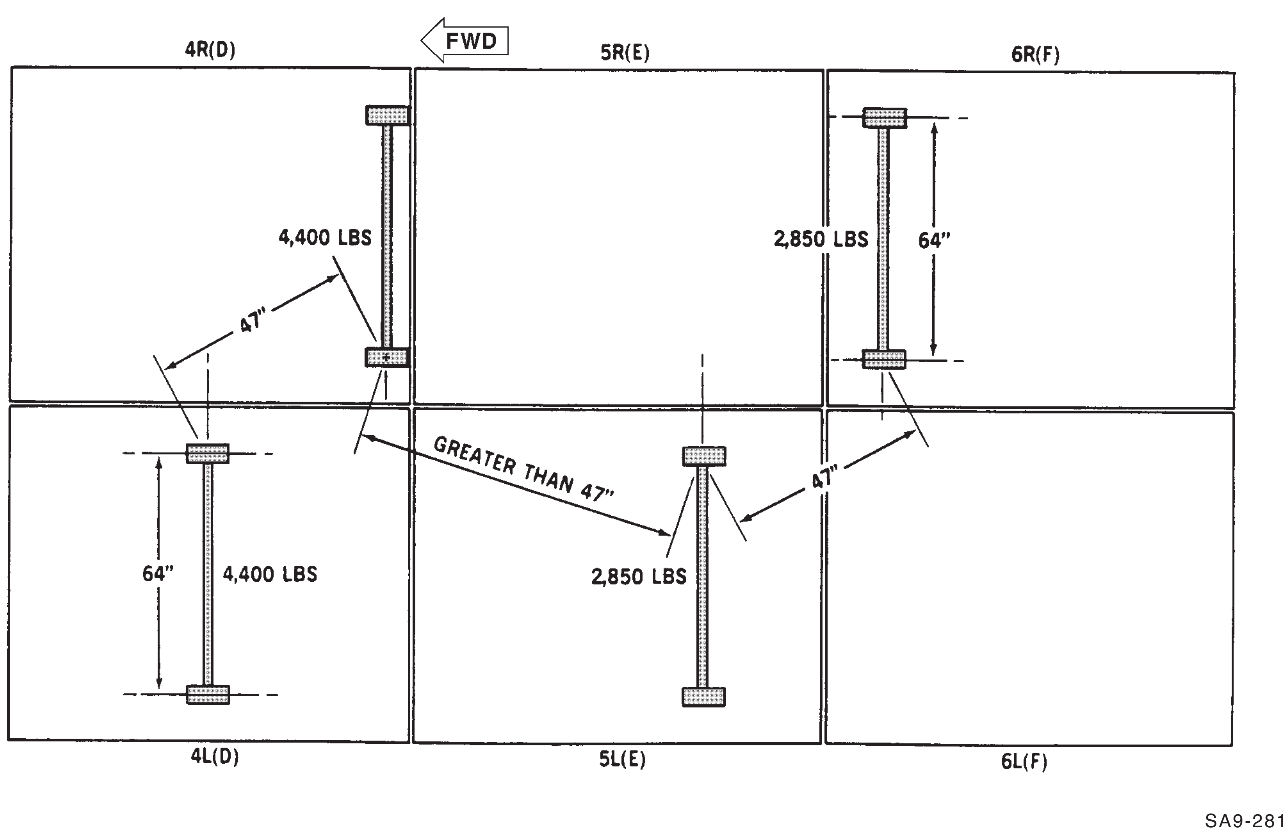
d. Compare Allowable Loads with Applied Loads:

The allowable loads in pallet positions 4L/5L (D/E) are less than the applied loads. Therefore, additional spacing is required in order to load these vehicles on adjacent pallets. Since additional spacing cannot be obtained by moving the vehicles apart laterally, the vehicles should be offset longitudinally as illustrated below. Figure 4-20 indicates that a minimum spacing of 47 inches between the wheels is required to support a wheel load of 2,200 pounds. If the vehicle on the right side is moved aft, so that the diagonal measurement between wheels is 47 inches, the allowable loads can be computed as follows:

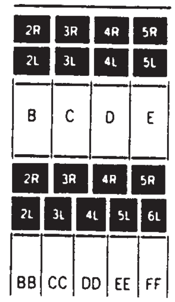
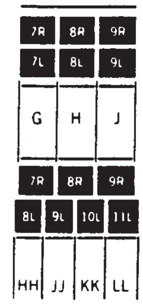
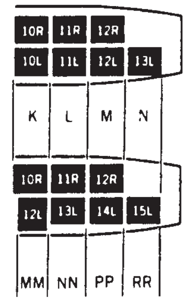
(1) Pallet positions 4L/R (D) and 5L/R (E) - Figure 4-20 indicates that for loads 47 inches apart, the maximum weight for each single wheel load is 2,222 pounds (4,444 ÷ 2).

(2) Pallet position 6R (F) - Figure 4-21 indicates that for loads 47 inches apart, the maximum weight for each single wheel load is 2,370 pounds (4,740 ÷ 2).

(3) The applied loads are now less than the allowable loads, therefore, the vehicles can be loaded.



ALLOWABLE AXLE WEIGHT ON HCU-6/E PALLETS

DISTANCE BETWEEN WHEELS (INCHES)	PALLET POSITIONS/COMPARTMENT ALLOWABLE WEIGHT (POUNDS)			
				
8	2,250	2,400	1,600	2,000
9	2,306	2,460	1,640	2.050
10	2,362	2,520	1,680	2,100
11	2,419	2,580	1,720	2.150
12	2,475	2,640	1,760	2,200
13	2,531	2,700	1,800	2,250
14	2,587	2,760	1,840	2,300
15	2,644	2,820	1.880	2,350
16	2,700	2,880	1.920	2,400
17	2,756	2,940	1.960	2,450
18	2,812	3,000	2,000	2,500
19	2,869	3,060	2,040	2,550
20	2,925	3,120	2,080	2,600
21	2,981	3,180	2,120	2,650
22	3,037	3,240	2.160	2,700
23	3,094	3,300	2,200	2,750
24	3,150	3,360	2,240	2,800
25	3,206	3,420	2,280	2,850
26	3,262	3,480	2,320	2,900
27	3,319	3,540	2,360	2,950
28	3,375	3,600	2,400	3,000
29	3,431	3,660	2.440	3,050
30	3.487	3,720	2,480	3,100
31	3,544	3,780	2,520	3,150
32	3,600	3,840	2,560	3,200
33	3,656	3,900	2,600	3,250
34	3,712	3,960	2.640	3,300
35	3,769	4,020	2.680	3,350
36	3,825	4,080	2,720	3,400
37	3,881	4,140	2,760	3.450
38	3,938	4,200	2,800	3,500
39	3,994	4,260	2,840	3,550
40	4,050	4,320	2,880	3,600
41	4,106	4,380	2,920	3,650
42	4,162	4,440	2,960	3.700
43	4,219	4,500	3,000	3,750
44	4,275	4,560	3,040	3.800
45	4.331	4,620	3,080	3,850
46	4,387	4,680	3,120	3,900
47	4,444	4,740	3,160	3.950
48	4,500	4,800	3,200	4,000

<u>AXLE LOADS</u>

1. USE LESSER OF TREAD OR WHEELBASE.
2. CHECK BOTH AXLES TO DETERMINE ACCURATE TREAD DIMENSION.
3. TREAT DUAL WHEELS AS ONE WHEEL.
4. ZONE LOAD LIMITATIONS AND COMPARTMENT LOAD LIMITATIONS MUST ALSO BE COMPLIED WITH.
5. FOR SINGLE WHEELS USE ONE-HALF OF VALUES LISTED ABOVE. USE 8-INCH LINE WHEN WHEELS ARE LESS THAN 8 INCHES APART (LATERALLY OR LONGITUDINALLY).
6. WHEEL TREAD MEASUREMENTS WILL BE TAKEN FROM THE MIDDLE OF THE TIRE, DUAL WHEELS WILL BE MEASURED FROM THE MIDDLE OF THE TWO TIRES.
7. REFER TO SECTION 5F FOR CENTERLINE LOADED VEHICLES.

SA9-213C

Figure 4-20. Vehicle Axle Weight Limitations

GUIDES

Guides must be stationed at strategic points outside and within the aircraft to observe clearances. Guidance will be given by prearranged signals. Drivers are obligated to adhere to the guides' instructions and not attempt to judge clearance for themselves.

HAND SIGNALS

CAUTION

> Since the guide is facing the driver, the guide shall exercise care not to become confused in rendering hand signals. Whether the vehicle is backing or moving forward, the driver must always turn his wheels in the direction of the guide's extended hand or light.

When loading self-propelled vehicles, guidance by hand signals or light signals is given by assistants placed at vantage points. Turns are to be made in the direction of the extended hand or light. It is the responsibility of the guide to signify, by extended arm or light, the direction the vehicle driver is to turn. It is the responsibility of the driver to follow the guide's commands.

SECURING VEHICLES AFTER LOADING

Based on knowledge of the gross weights and axle loads of the vehicles to be loaded, the boom operator shall inform the guides where the vehicles will be driven so as not to exceed allowable loads, and where the vehicles will be positioned to achieve the optimum load center of gravity. After each vehicle has been positioned, the standard transmission of vehicles powered by gasoline engines shall be placed in the lowest gear, and vehicles powered by diesel engines shall be placed in neutral. If either type of powered vehicle is equipped with an automatic transmission, it shall be placed in park. The brakes shall be set, and the ignition shall be turned OFF.

AIRCRAFT TIPOVER PROBLEM

Certain cargo and fuel/cargo loading conditions can create a tail-heavy condition which can cause the aircraft to tip on its tail.

WARNING

- A tipover condition must be avoided to prevent injury to personnel or damage to the aircraft.

- The aircraft will tipover when its center of gravity is allowed to move aft of the main gear. Positive ramp and cargo floor angles and horizontal tail loads, induced by ground winds and/or snow, can cause tipover at center of gravity locations forward of the main gear. To provide a margin for these contingencies, it is recommended that the aircraft center of gravity be maintained forward of fuselage station 1430 (40% MAC).

Contingencies considered in the above recommendation include: a positive aircraft attitude of 3.26° (a floor slope of 0.4° combined with the maximum AFM86-3 apron slope of 2.86° or 5% grade) and maximum ground winds for cargo door operation. Effect of the ground winds were calculated assuming that the horizontal stabilizer is positioned in a 2° nose up attitude, reference TO 1C-10(K)A-1, After Landing and Parking Procedures.

If snow has been allowed to buildup on the horizontal stabilizer, it must be either removed or considered in the tipover analysis. The recommended center of gravity tipover location should be moved forward three inches for each inch of snow on the horizontal stabilizer.

Proper cargo loading sequence must be maintained at the aircraft's center of gravity forward of the tipping axis (fuselage station 1442, 44% MAC).

In addition to proper cargo loading sequence, proper coordination is necessary prior to fuel load/transfer and cargo onload/offload.

The static stability of the aircraft should also be confirmed prior to certain maintenance operations, such as engine removal and jacking the nose landing gear.

Detailed load planning is required prior to initiating any loading or offloading operations.

Instructions for completing the tipping load analysis worksheet are listed below. When doing this analysis for onloading or offloading, consider the arm computed from only basic aircraft, operational items, and appropriate fuel load to determine if the CG is at or forward of 21%.

1. Enter the basic aircraft weight and moment.

NOTE

Basic aircraft weight and moment are obtainable from DD Form 365-3 (Chart C).

2. Enter operational items, weights, and moments. Refer to TO 1C-10(K)A-5.

NOTE

- Operational items include potable water, emergency equipment, extra equipment, configuration changes, and load crew.

- After the most aft cargo item is loaded, the weight associated with the loading personnel must not be entered again. However, if additional personnel are required during loading operations, the additional weight must be included at that time.

3. ONLOAD TIPPING ANALYSIS

a. Enter actual fuel onboard and moments.

b. Sum the actual fuel and moment with items 1 and 2, subtract weight and moment of IAU (if applicable), and compute the center of gravity for aircraft, operational items and actual fuel.

NOTE

During onloading operations, when aircraft CG (not including cargo or passengers) is 21% (1374 arm) or less and cargo does not exceed the compartment flight limitations, further tipping analysis is not required.

c. Enter the weight and arm of cargo item to be onloaded in the most aft location in the cargo compartment. Compute the moment.

d. Sum the weights and moments, and compute the new ARM for the aircraft, operational items, fuel and cargo items. The ARM must be forward of fuselage station 1430 (40% MAC) to prevent a tipover condition (see step 5)

NOTE

During onloading operations, it is only necessary to compute tipover analysis for cargo items loaded aft of fuselage station 1430 (40% MAC). This includes all pallet positions aft of 8.

e. Repeat steps 3c and 3d for all necessary cargo items. (Aft of pallet position 8)

4. OFFLOAD TIPPING ANALYSIS.

a. Enter parking fuel and moments.

b. Sum the parking fuel and moment with items 1 and 2, subtract weight and moment of IAU (if applicable), and compute the center of gravity for aircraft, operational items and parking fuel.

NOTE

During offloading operations, when aircraft CG (not including cargo or passengers) is 21% (1374 arm) or less and cargo does not exceed the compartment flight limitations, further tipping analysis is not required.

c. Sum the total cargo weight and moment with step 4b.

d. Enter the weight and arm of cargo item to be offloaded in the most forward location in the cargo compartment. Compute the moment.

e. Subtract the weights and moments, and compute the new ARM for the aircraft, operational items, fuel and remaining cargo items. The ARM must be forward of fuselage station 1430 (40% MAC) to prevent a tipover condition (see step 5).

NOTE

During offloading operations, it is only necessary to compute tipover analysis for cargo items loaded forward of fuselage station 1430 (40% MAC).

f. Repeat steps 4d and 4e for all necessary cargo items to be offloaded.

5. During onloading/offloading analysis, if the ARM is greater than fuselage station 1430 (40% MAC), steps must be taken to adjust the load to correct this condition.

a. Rearrange the cargo items as required.

b. If applicable, load palletized cargo items in position 1L/R (A).

c. If the aircraft configuration prevents installation of palletized cargo in positions 1L/R (A), it may be necessary to maintain palletized cargo at or near the cargo door while other cargo is being moved fore and aft in the aircraft.

d. Add fuel or transfer fuel to the forward body tank.

TIPOVER ANALYSIS USING PALLET COMPARTMENT METHOD

Another method to compute the tipover analysis is to use the pallet compartment method (see cargo center of gravity by pallet compartment, discussed previously in this section of the manual) . When using this method, all cargo in a pallet compartment is assumed to have a center of gravity at the centroid or center of the compartment. Again, if cargo items are in two pallet compartments, the weight is distributed between the compartments. The tipping load analysis worksheet will also be used for this method. Instructions are as follows:

1. Enter the basic aircraft empty weight or operational empty weight, and corresponding moment.

NOTE

Basic aircraft empty weight and moment are obtainable from DD Form 365-3 (Chart C) .

2. Enter operational items, weights and moments (if applicable) . Refer to TO 1C-10(K)A-5.

NOTE

The various cargo and/or personnel configurations will change the amount of operational items aboard the aircraft.

3. Enter fuel onboard and moments.

4. Sum the weights and moments for items 1 through 3, and compute the center of gravity for the aircraft, operational items and fuel:

CG FUSELAGE STATION =

$$\frac{\text{SUM OF MOMENTS } \left(\frac{\text{IN.-LBS}}{10{,}000}\right)}{\text{SUM OF WEIGHTS (POUNDS)}} \times 10{,}000$$

5. Enter the weight of cargo loaded in the most aft pallet compartment. Include the weight of the loading personnel as before. Obtain the pallet compartment moment from TO 1C-10(K)A-5.

6. Sum the weights and moments, and compute the new center of gravity location for the aircraft, operational items, fuel and cargo items. The center of gravity location must be forward of fuselage station 1430 (40% MAC) to prevent a tipover condition.

7. Repeat steps 5 and 6 for all pallet compartments.

AIRCRAFT DEFLECTION DURING LOADING OPERATIONS

When a cargo item is loaded into the cargo compartment, the landing gear struts will compress. The nose landing gear (NLG) is located just forward of the cargo door, and will support more of the weight of the cargo item than the main landing gear group. The amount of compression of the NLG strut depends upon the aircraft gross weight, aircraft CG location, and the weight of the cargo item that is to be loaded.

For a given cargo item weight, the greatest NLG strut compression occurs when the aircraft center of gravity is between fuselage station numbers 1400 (30% MAC) and 1430 (40% MAC), and the aircraft gross weight is less than 400,000 pounds.

The greater the cargo item weight, the greater the compression of the NLG strut. If the cargo item is large (height) and heavy, interference between the cargo item and the cargo door hinge could occur if the loading equipment remained stationary.

CAUTION

Damage could occur to the aircraft cargo door if a large/heavy cargo item is loaded into the cargo compartment, the aircraft gross weight is less than 400,000 pounds, and the CG location is between fuselage station numbers 1400 (30% MAC) and 1430 (40% MAC).

Figure 4-21 shows the amount of deflection of the aircraft cargo floor (top of rollers) for various weights of cargo to be loaded when the aircraft gross weight and center of gravity is known.

SAMPLE PROBLEM:

Determine how much floor deflection would occur at the cargo door when loading a 97-inch high pallet (including the thickness of the pallet), weighing 6, 000 pounds, into the aircraft when the aircraft gross weight is 380,000 pounds and the CG location is at fuselage station 1406. Also determine the clearance, if any, between the top of the pallet and the cargo door hinge.

SOLUTION:

Find fuselage station number 1406 (figure 4-21). Project a line up, until it intersects the proper aircraft gross weight curve. From that intersection, project a line parallel (to the base of the curve) until it intersects the weight of the cargo item to be loaded. From that intersection, drop a line down and read off the amount of deflection of the aircraft floor. Loading a 6,000-pound pallet when the aircraft gross weight is 380,000 pounds, and the CG is at fuselage station 1406, would cause the floor to deflect approximately 1.9 inches.

To determine the clearance between the cargo item and the cargo door hinge, subtract the height of the cargo item from the door height (include the height of the rollers) to obtain the static clearance, then subtract the amount of deflection from the static clearance. This result is the actual clearance between the cargo and the cargo door hinge, assuming that the loading equipment platform remains stationary during the loading operation.

STATIC CLEARANCE =

CARGO DOOR HEIGHT –
HEIGHT OF ROLLERS –
HEIGHT OF CARGO ITEM =

102 IN. - 1.75 IN. - 97 IN. =

3.25 INCHES

ACTUAL CLEARANCE =

STATIC CLEARANCE –
AMOUNT OF DEFLECTION =

3.25 IN. - 1.90 IN. =

1.35 INCHES

If the actual clearance is near zero or a negative number, and the item will fit through the cargo door, steps must be taken to allow the cargo item to be loaded.

1. Rearrange the cargo items (or palletized cargo) as required to move the center of gravity forward.

2. Add fuel or transfer fuel to the forward body tank.

3. If applicable, load palletized cargo in pallet position 1L/R (A).

4. Lower the platform of the loading equipment as the cargo item enters the cargo compartment.

5. Reduce the height of the cargo item by disassembly or, in case of pallets, by restacking.

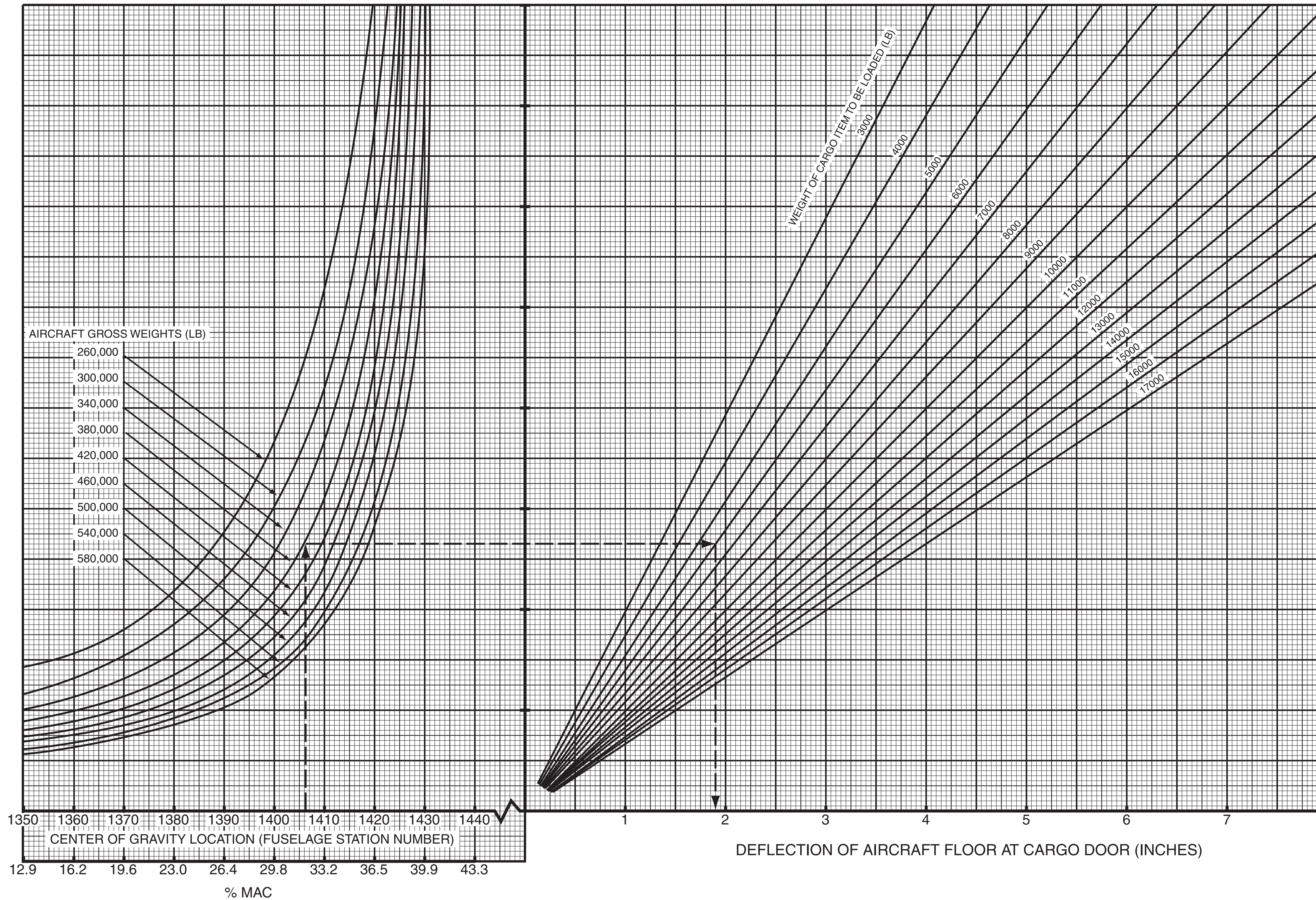


Figure 4-21. Aircraft Deflection During Loading Operations

RESTRAINT CRITERIA

All cargo in the aircraft shall be restrained so it will not shift during any flight conditions normally experienced by the aircraft. Forces caused by various flight conditions tend to move the cargo in a forward, aft, side, or vertical direction, or in certain combinations of these directions. These forces are directly proportional to the cargo's weight. The ratio between the cargo's weight and the maximum force that will act in each direction is called the load factor.

CARGO RESTRAINT LOAD FACTORS

Cargo must be restrained so it will not shift because of loads resulting from dynamic forces encountered during takeoff, flight and landing. The restraint must be adequate for the greatest load that may result. These loads are expressed in terms of cargo weight times the applicable load factor. If a cargo unit is subjected to a load equal to 1.5 times its weight, it must be restrained for a load factor of 1.5 to prevent it from shifting. Counter-forces applied to the cargo to prevent movement are identified by the direction in which the cargo would move if it were unrestrained. Forward restraint keeps the cargo from moving forward, aft restraint prevents the cargo from moving rearward, lateral restraint prevents side-to-side movement, and vertical restraint prevents the cargo from moving upward.

MINIMUM RESTRAINT FORCES

Minimum restraints used to prevent cargo movement in any direction are called the restraint criteria. Expressed in units of the force of gravity, or load factor, minimum restraint criteria are as follows:

DIRECTION	RESTRAINT CRITERIA
Forward (with cargo barrier net)	1.5 g's
Forward (without cargo barrier net)	9.0 g's
Aft	1.5 g's
Lateral	1.5 g's
Vertical	2.0 g's

CARGO RESTRAINT

The cargo handling system rails, end restraint fittings and cargo barrier net, provide all restraint necessary for cargo loaded on standard HCU-6/E pallets, provided the cargo is attached to the pallets to meet the minimum restraint criteria established for the aircraft. When properly secured, the HCU-7/E side nets and the HCU-15/C top net provide all necessary restraint including longitudinal and lateral restraint of 1.5 g's, and vertical restraint of 2.0 g's, for palletized loads up to 10,000 pounds.

When loading wheeled vehicles and equipment on HCU-6/E pallets, the necessary restraint is provided by attaching tiedown devices to the rings of the pallets. This method of restraint must not exceed the maximum values established for the aircraft.

9 G RESTRAINT REQUIREMENTS

In situations where 9 g restraint load factor is required, it can be obtained by one of the following methods:

WARNING

Cargo weight must not exceed 2,100 pounds gross weight per pallet.

1. High profile cargo can be restrained using two HCU-7E side nets and the HCU-15/E top net. The CG of the pallet must not be over 60 inches above the pallet surface.

2. Low profile cargo can be restrained using the HCU-15/E top net.

3. Cargo that cannot be restrained by nets will be restrained using sufficient chains or straps.

NOTE

If all of the above conditions are met and the cargo is installed in the cargo handling system, the cargo and pallet are restrained for 9 g forward restraint and the cargo barrier net is not required.

FUNDAMENTAL PRINCIPLES OF CARGO RESTRAINT

Certain fundamental principles must be observed when tying down cargo. Although the details of tying down each unit of cargo vary with its bulk, weight, configuration and location in the aircraft, these fundamental principles of restraint are always applicable. If the fundamental principles are observed, satisfactory restraint of cargo movement can be achieved.

Neglecting friction, the tiedown cannot begin to restrain the load until it has shifted so that the tiedowns begin to go in the same direction as the force. When a tiedown strap or chain is placed around a cargo unit, and the tiedown attachment points are to two opposite pallet rings, the value of the strap or chain is doubled, provided the pallet ring allowables are not exceeded (figures 4-22 and 4-26). For restraint computations, refer to the **METHODS TO COMPUTE TIEDOWN RESTRAINT VALUES** paragraph within this section.

Ties made solely for one load direction cannot be expected to restrain cargo against a load applied simultaneously from another direction. This applies to tiedowns that are passed around or over the top of the cargo and not directly attached to it (figure 4-23).

When a tiedown device is attached directly to a cargo unit and not merely passed over or around it, restraint can be applied for more than one load direction, depending on the strength of the device and the angle of pulloff from the tiedown fitting. By varying the angle of attachment, a tiedown device can be attached to the cargo so that restraint is available simultaneously in three directions (figure 4-24).

When tiedown devices are attached to cargo, the lines of action of the tiedown devices should, if possible, intersect above the cargo vertical center of gravity as shown in figure 4-24. Such a tiedown reduces the tendency of cargo to overturn when subjected to combined upward and side loads.

The point of attachment of a tiedown device to a cargo unit must be substantial enough to withstand the loads for which the cargo unit is being restrained. A tiedown device must not be attached to any convenient protrusion on a cargo unit without due consideration of the protrusion’s strength.

Unsymmetrical tiedowns permit load distribution which may ultimately result in tiedown device failure. This failure would result from the different load-deflection rates of

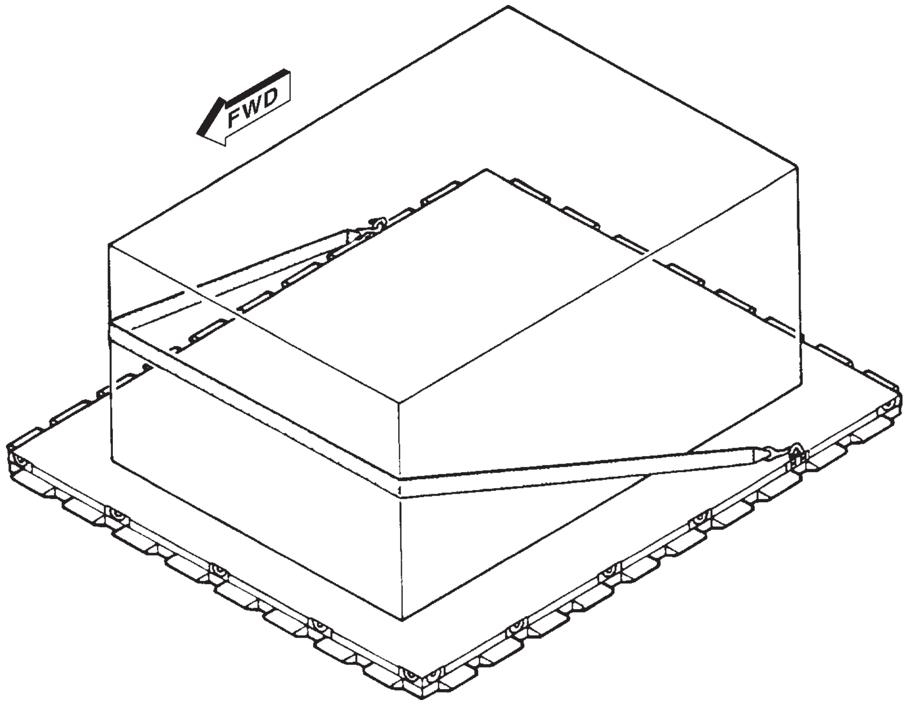


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Figure 4-22. Forward Restraint Example

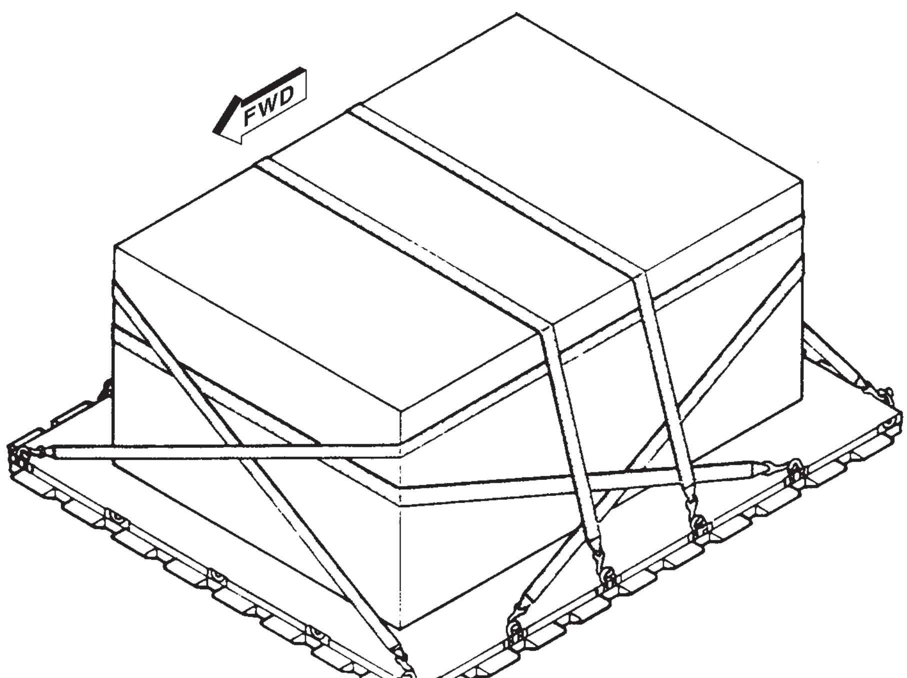

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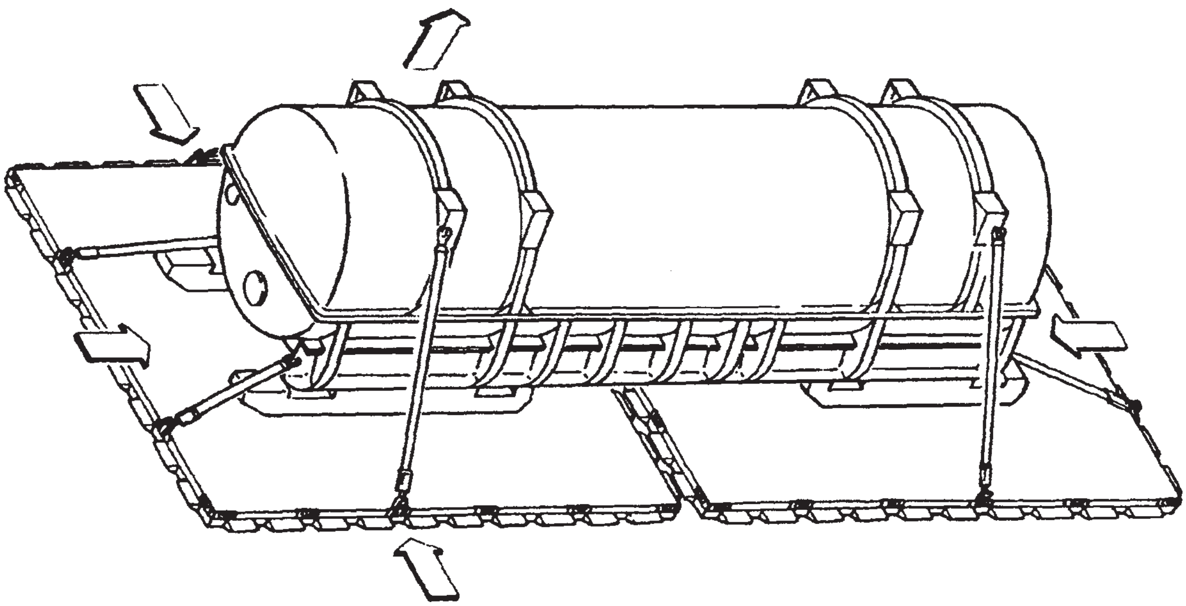
Figure 4-23. Cargo Restrained For All Load Directions



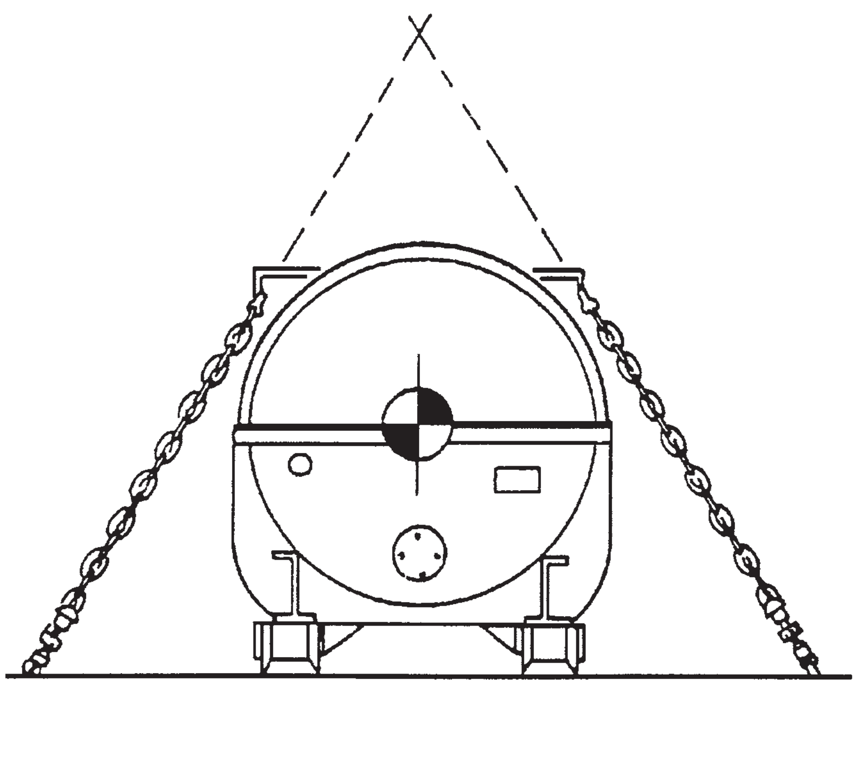


Figure 4-24. Tiedown Basic Principles

dissimilar materials or identical materials of different length. Any material subjected to a tension load will stretch a given percentage of its length. Therefore, the greater the length, the greater the potential amount of stretch. If two tiedown devices of the same type and capacity are used to restrain a load in a given direction, and one tiedown is longer than the other, the longer tiedown, with its greater stretch potential, will permit the shorter tiedown to assume the majority of any load which may develop. If, as a result, the shorter tiedown should be overstressed and fail, the longer tiedown would be subjected to the full load, and it would probably fail also.

Although all materials stretch in direct proportion to the applied load, different materials have different rates of stretch. Nylon devices stretch more readily than steel and, under tension, almost immediately permit the steel device to assume the majority of the load. Therefore, when two or more tiedown devices are required to restrain a unit of cargo for a given load direction, the devices must be of the same type, and the tiedowns must be approximately the same length.

When a tiedown device is improperly configured its actual capacity is less than its rated capacity. See Figure 4-25 for correct tiedown device configuration.

DETERMINING TYPE AND QUANTITY OF TIEDOWN DEVICES REQUIRED

Determination of the types and quantities of tiedown devices to be used in restraining cargo should be based on the following considerations:

1. Appropriate strength rating to afford adequate restraint with the minimum number of devices.

2. Wheeled vehicles and cargo items having fixed tiedown points should be secured using appropriately rated tiedown devices.

3. Tiedown devices must be appropriate for the cargo to be restrained so neither cargo nor tiedown device will be damaged.

4. Like types and lengths of tiedown devices will be used for a given direction of restraint.

5. Tiedowns should be attached in a symmetrical pattern by using corresponding fittings on each side of the cargo pallet.

6. Tiedown devices must be securely attached to the cargo and all slack removed so that any tendency toward motion is immediately restrained.

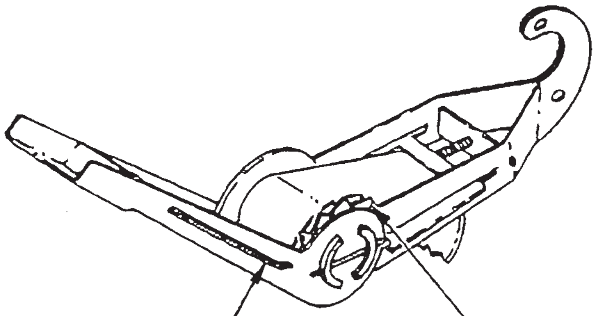
7. Do not use nylon devices over sharp edges.

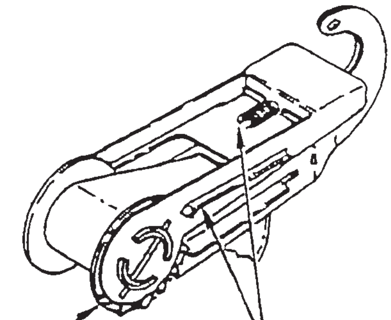
EFFECT OF APPLYING RESTRAINT AT ANGLES

Every tiedown device is rated to withstand a force exerted parallel to the tiedown device (figure 4-26, view 1). When one end of a device is secured to a pallet ring fitting or a fitting on the cargo floor, the longitudinal force will not be exerted parallel to the length of the device unless the device is attached to the cargo, as shown in view 2. If so attached, all the rated strength will be available to prevent the cargo from moving in the direction of the longitudinal arrow.

Because it is seldom practical to fasten a tiedown device as illustrated in views 1 and 2, they are usually attached at some point

CGU-1/B TIEDOWN DEVICE, 5,000 POUND STRAP.





TYPE CGU - 1/B/5,000 POUND CAPACITY TIEDOWN DEVICE

INSPECTION

INSPECT TIEDOWN DEVICE FOR SERVICEABILITY, WORN OR MISASSEMBLED PARTS, SPRINGS THAT DO NOT ENGAGE FINGERS PROPERLY, AND BENT FINGERS ON PART THAT ROTATES SPINDLE.

NOTE

DO NOT USE TIEDOWN DEVICE WITH DEFECTIVE PARTS.

OPERATION

1. HOOK TIEDOWN DEVICE TO TIEDOWN FITTINGS.
2. TO SECURE CARGO AFTER BOTH HOOKS ARE ATTACHED, PULL STRAP WEBBING THROUGH THE TIGHTENING DEVICE UNTIL APPROXIMATELY 4 INCHES OF SLACK REMAINS BETWEEN THE HOOKS.

NOTE

DO NOT USE ANY TYPE OF LEVER OR MECHANICAL MEANS TO ASSIST HAND RATCHETING.

3. HOLD THE MAIN WEB AND THE LOOSE END OF WEB WITH ONE HAND AND RATCHET THE TIGHTENING DEVICE WITH THE OTHER HAND. THIS PROCEDURE WILL PERMIT THE WEBBING TO WRAP AT LEAST ONE AND ONE-HALF TURNS AROUND THE SPINDLE OF THE TIGHTENING DEVICE. THIS PROCEDURE SHOULD PROVIDE SUFFICIENT FRICTION TO PREVENT SLIPPING.
4. IF SLIPPING STILL OCCURS. DISCONTINUE USE OF THE TIEDOWN DEVICE.

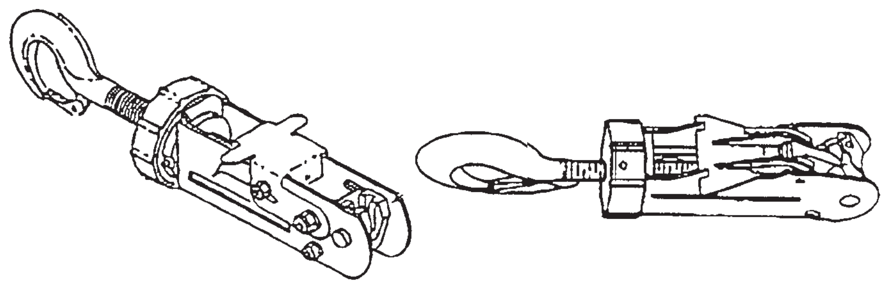
Figure 4-25. Tiedown Devices (Sheet 1 of 3)

NOTE

- DEVICES ARE STILL SERVICEABLE WHEN SPRING CLIPS ARE MISSING.
- MB-1 DEVICES HAVE 10,000-POUND CAPACITY.

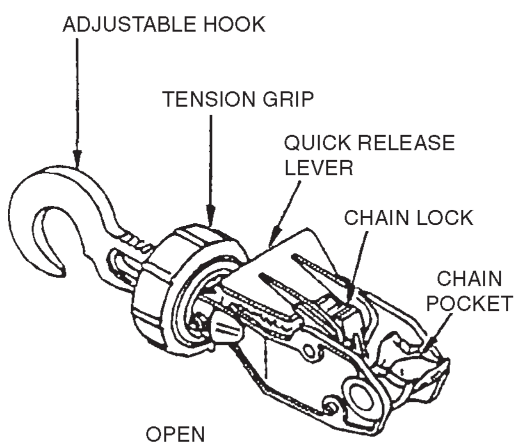
WARNING

USE THE TURNBUCKLE TO EASE TENSION PRIOR TO PULLING QUICK-RELEASE LEVER. IF TURNBUCKLE CANNOT BE TURNED TO EASE TENSION, RESTRAIN THE CHAIN USING A GLOVE-PROTECTED HAND PRIOR TO PULLING THE QUICK-RELEASE LEVER.

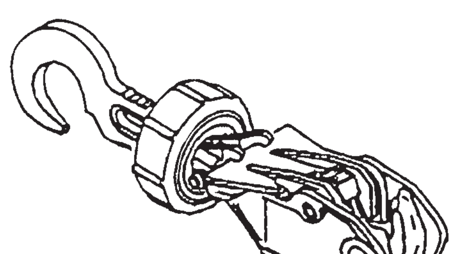


MB-1 MB-1

MB-1/CGU-4/E OPERATING INSTRUCTIIONS



OPEN



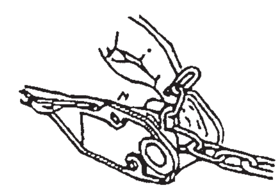
CLOSED

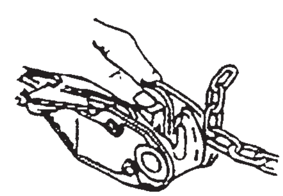
1. FULLY EXTEND ADJUSTABLE HOOK BY ROTATING TENSION GRIP.
2. CLOSE CHAIN POCKET AND LOCK QUICK-RELEASE LEVER.
3. INSERT CHAIN IN CHAIN POCKET.
4. PUSH CHAIN DOWN UNTIL ITS BOTTOM END IS SECURED BY THE CHAIN LOCK.
5. ROTATE TENSION GRIP UNTIL CHAIN IS TIGHT.

NOTE

IF CHAIN IS TOO LOOSE, RELEASE BY DEPRESSING THE CHAIN LOCK, AND READJUST THE CHAIN TO PROPER LENGTH.

6. TO RELEASE DEVICE UNDER LOAD, PULL UP ON QUICK-RELEASE LEVER.





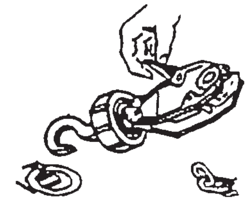


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Figure 4-25. Tiedown Devices (Sheet 2 of 3)

CAUTION

THE MB-1/CGU-4/E TIEDOWN DEVICE WHEN RIGGED IN A CERTAIN CONFIGURATION HAS A CAPACITY DRASTICALLY BELOW THE TIEDOWN'S 10,000-POUND CAPACITY RATING. THIS CONFIGURATION EXISTS WHEN THE LOAD CARRYING PORTION OF THE CHAIN IS ROUTED UP AND THEN DOWN INTO THE TIEDOWN.

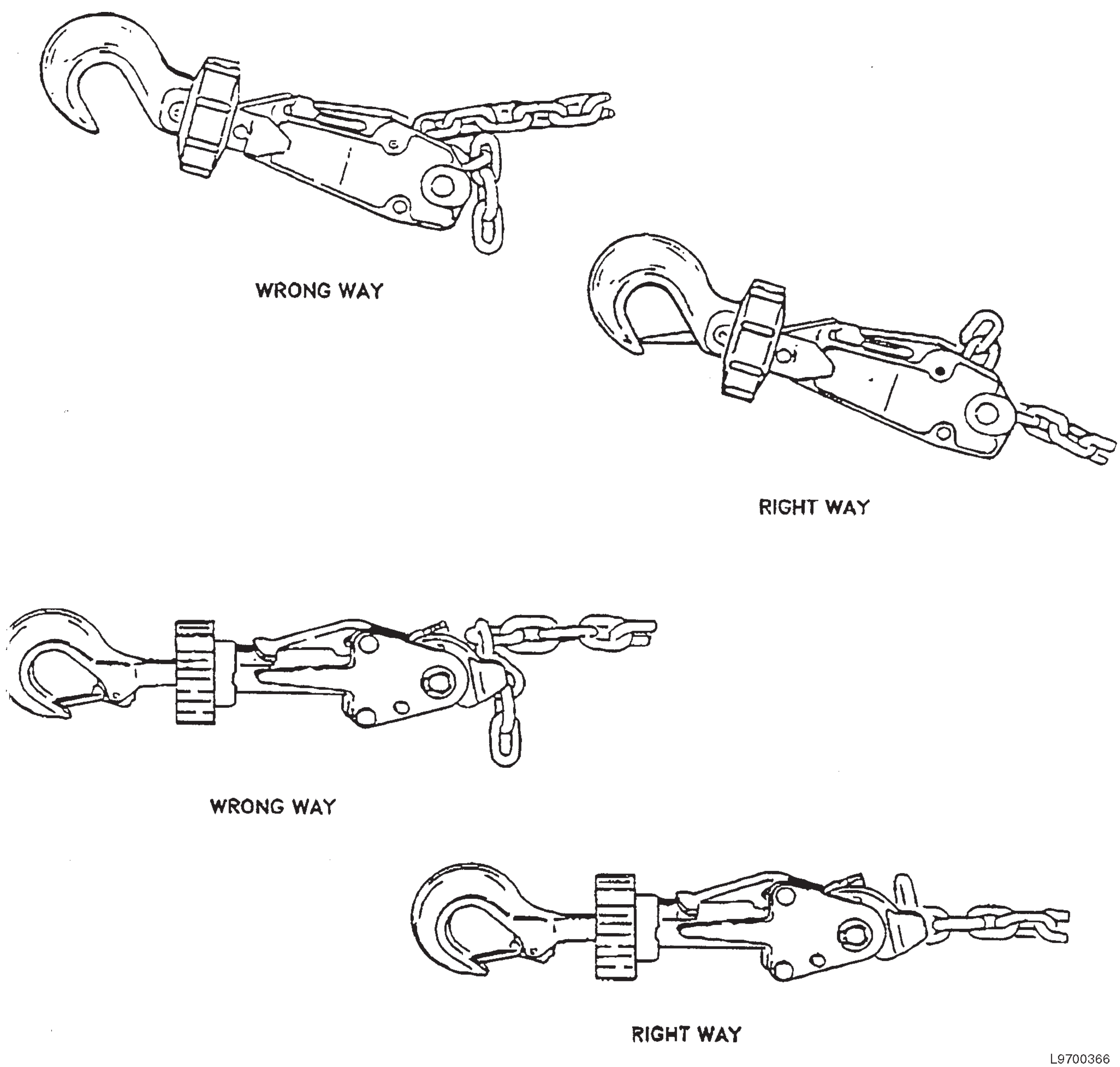


Figure 4-25. Tiedown Devices (Sheet 3 of 3)

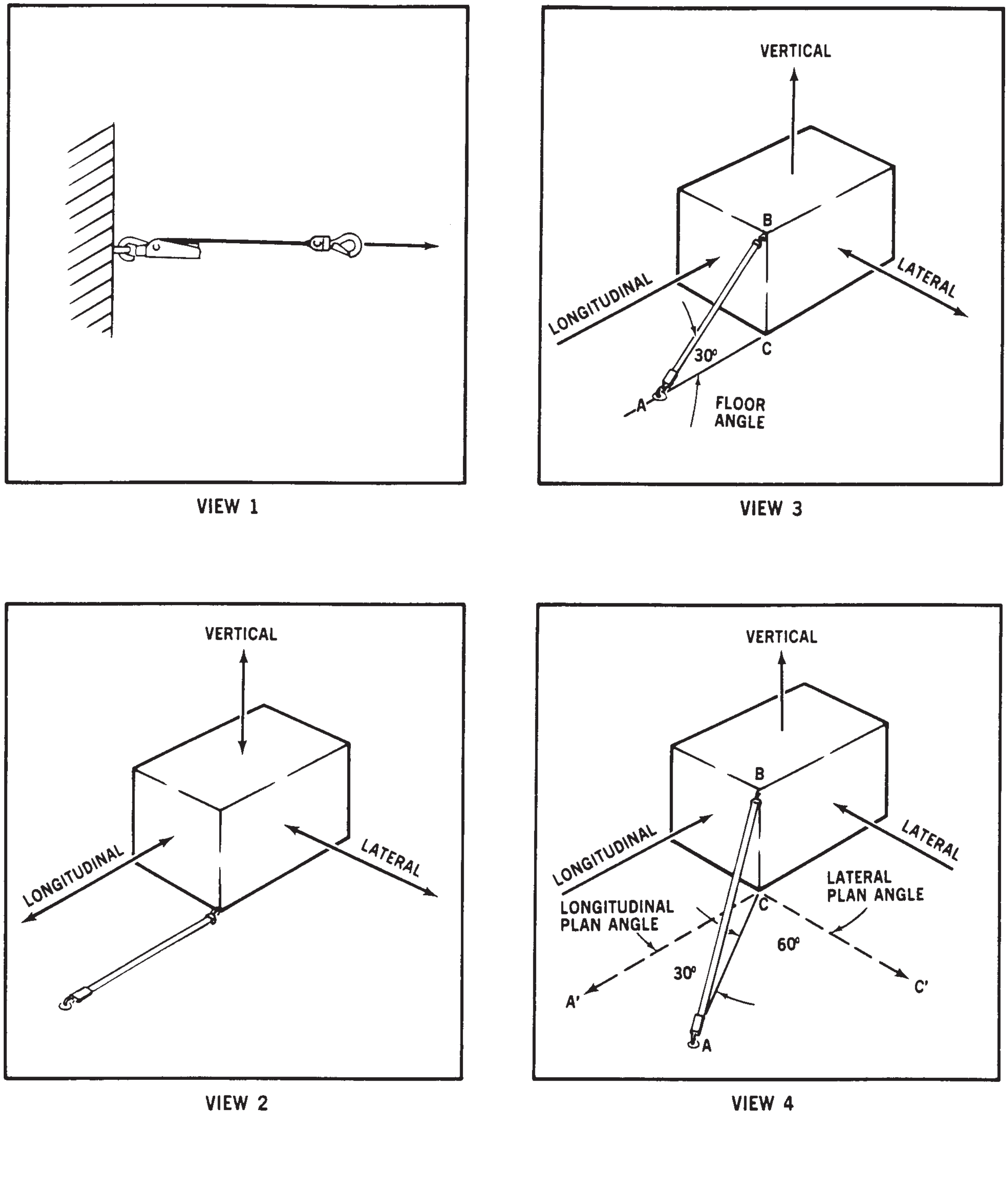


Figure 4-26. Cargo Restraint Angles

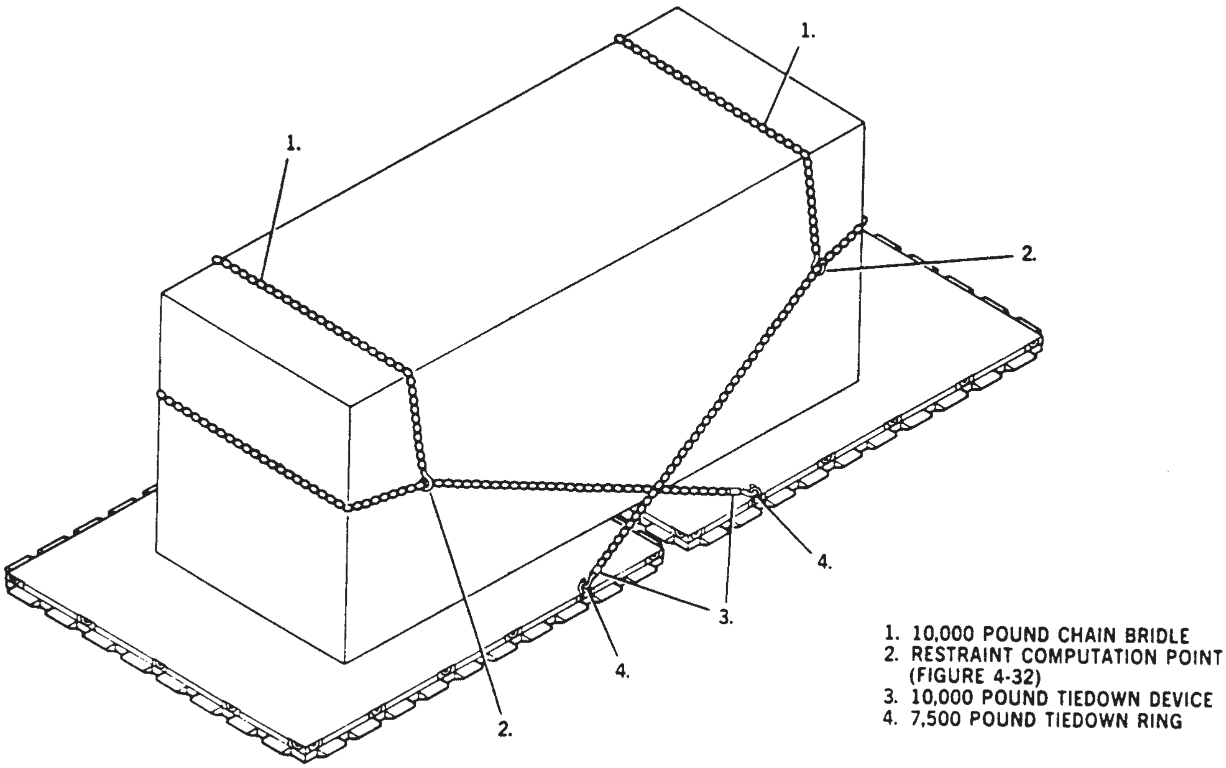


Figure 4-27. Chain Bridle Restraint of Cargo

above the pallet or floor, as shown in view 3. When so attached, only part of the device will be available to prevent cargo longitudinal movement. Vertical restraint will be provided, but no lateral restraint will be provided. A compromise position, as shown in view 4, generally provides restraint simultaneously in three directions: forward, vertical, and lateral. Aft restraint is obtained by attaching tiedowns symmetrically in pairs to the front of the cargo.

CHAIN BRIDLES

WARNING

When using chain bridles, ensure no restraint values are counted for tiedown straps going in the same direction.

Chain bridles can be used to restrain large crates or stacks of cargo (figure 4-27). Attach the chain bridles using the following procedures:

1. The chain bridle should be made up using 10,000 pound tiedown chains. The number of chains depends on the physical size of the cargo.

2. Chain bridles properly installed on coupled pallets are an acceptable method of obtaining lateral restraint in addition to the other directions (forward, aft and vertical).

NOTE

It may be necessary to install additional tiedowns to provide adequate restraint.

3. A chain bridle may be used in conjunction with tiedown straps; however, this feature has been omitted from figure 4-27 for the sake of clarity.

4. Restraint calculations shall be made from the point where the angle of the chain changes direction.

HIGH-MOBILITY MULTI-WHEELED VEHICLES

1. Some High-Mobility Multi-Wheeled Vehicles (HMMWV's) have been damaged by using the radius rods for tiedown. Using other suspension components for tiedown may cause alignment problems or damage to that component. In order to preclude further damage, all HMMWV's shall be secured in accordance with Section IV or V of TO 1C-10(K)A-9 and the following data:

2. TMM55-2320-280-214 depicts the tiedown rings located on the front and rear bumpers as the primary tiedown points for air shipment of HMMWV's. These tiedown rings will not provide sufficient tiedown for all variants. Several tiedown points certified for airdrop tiedown must be used to provide additional restraint. The radius rods shall not be used for restraint/tiedown points.

3. All basic variants of the HMMWV may be restrained at weights up to 8,200 pounds not to exceed -9 Section IV and V criteria, using only tiedown rings on the bumpers. When permitted weight exceeds 8,200 pounds, apply an additional 9,600 pounds of lateral restraint to the rings on the frame just aft of the front bumper and the rings on the frame just aft of the rear coil springs.

4. The pintle hook provides 30,000 pounds of forward/aft restraint and may be used to provide additional restraint.

GENERAL RULES FOR APPLYING TIEDOWNS

The following general conditions should be satisfied when restraining cargo (figure 4-30):

1. Always compute the number of tiedown devices required. Apply aft restraint (tiedowns 1, 2, 5 and 6) in the opposite direction, but at the same angle as forward restraint (tiedowns 3, 4, 7 and 8). Use the same attachment point (points A, B, C or D) on the cargo for attaching a forward and an aft restraint strap, if possible.

2. Always attach an even number of tiedowns (4 devices, or 6 devices, or 8 devices, etc.) in pairs (1 and 2, 3 and 4, 5 and 6, 7 and 8), for forward or aft restraint. Tiedown devices should be attached in the symmetrical pattern by connecting to opposite fittings (A opposite B, C opposite D, E opposite F) across the cargo pallet(s).

3. If the center of gravity is remote from the geometric center of the load, as in figure 4-30, add an additional tiedown (tiedowns 9 and 10) on each side of the load so the center of gravity will be between two pairs of tiedowns.

4. Spring-mounted vehicles, such as automobiles or small and medium trucks, must be tied down by using points on the frame of the vehicle. Use sufficient devices to restrain the total weight of the vehicle. Do not apply more than half of the total restraint required in any given direction to the axles of spring-mounted vehicles ie. trucks, automobiles, and similar type equipment.

CAUTION

- Inspect the back side of the axles and structures for the presence of hydraulic lines or electrical cables before attaching the tiedown devices around these hidden areas.
- When transporting aircraft engines, attach as many tiedown devices as possible to the adapters to prevent separation of engine from transportation trailer.
- When applying restraint to HMMWV utilize tiedown points on the vehicle bumpers and frame. This will prevent damage to the vehicle suspension components. The lower suspension control arms can be used ONLY when sufficient restraint cannot be applied using these tiedown points.

RESTRAINT USING THE A-7000 TYPE TIE DOWN DEVICE

Restraint can also be applied by using the A-7000 type tiedown device. The tiedown devices are attached directly on the cargo floor by installing double swivel-type fittings (A-7000 or equivalent) in the seat tracks (figure 4-28). A general tiedown capacity of 1,600 pounds, in any direction, is allowed anywhere on the seat track.

NOTE

> A-7000 devices should be placed a minimum 20 inches apart when used in the same seat track.

Restraint Method 2 can be used to determine restraint from tiedown devices attached directly to the cargo floor. In certain areas, a maximum of 1,600 or 3,000 pounds vertical restraint is allowed (figure 4-29).

CAUTION

> When using seat tracks as tiedown points, extreme care should be exercised when selecting low tiedown angles to prevent damaging the cargo floor with tiedown devices.

NOTE

> An A-7000 tiedown fitting can provide up to 10,000 pounds of restraint, but the overall restraint received is determined by two factors: vertical tiedown allowables and the type of tiedown device used.

TIEDOWN CRITERIA FOR VEHICLES/ EQUIPMENT ON HCU-6/E PALLETS

Loading wheeled vehicles/equipment on HCU-6/E pallets requires attaching the restraint devices to the pallet rings. The pallet ring allowable is 7,500 pounds per ring in any direction on other aircraft (Reference: Pallet Specification MIL-P-27443E) .

However, the pallet ring vertical allowables are limited by the strength of the cargo handling system components and the floor structure. The ring vertical allowable is 2,500 pounds maximum per ring (figure 4-31).

When two HCU-6/E pallets are coupled together (88 or 108 inch side), the cargo system latches (between the coupled pallets) cannot be used. Without these latches, restraint devices will not be applied along the coupled edges. Therefore, when coupled pallets are used, only the rings around the edges of the pallets are available for restraint (figure 4-31). The vertical allowable for single pallets also apply to coupled pallets.

When pallets are coupled on the 108 inch side, the 1 inch couplers may be removed once the pallets enter the conveyor system. The center guide rails will remain in place and the loaded pallets will become a moveable subfloor. Vertical, lateral, and longitudinal restraints allowables will apply using available tiedown rings.

NOTE

> Use 1 inch couplers to recouple pallets (108 inch side) prior to offloading.

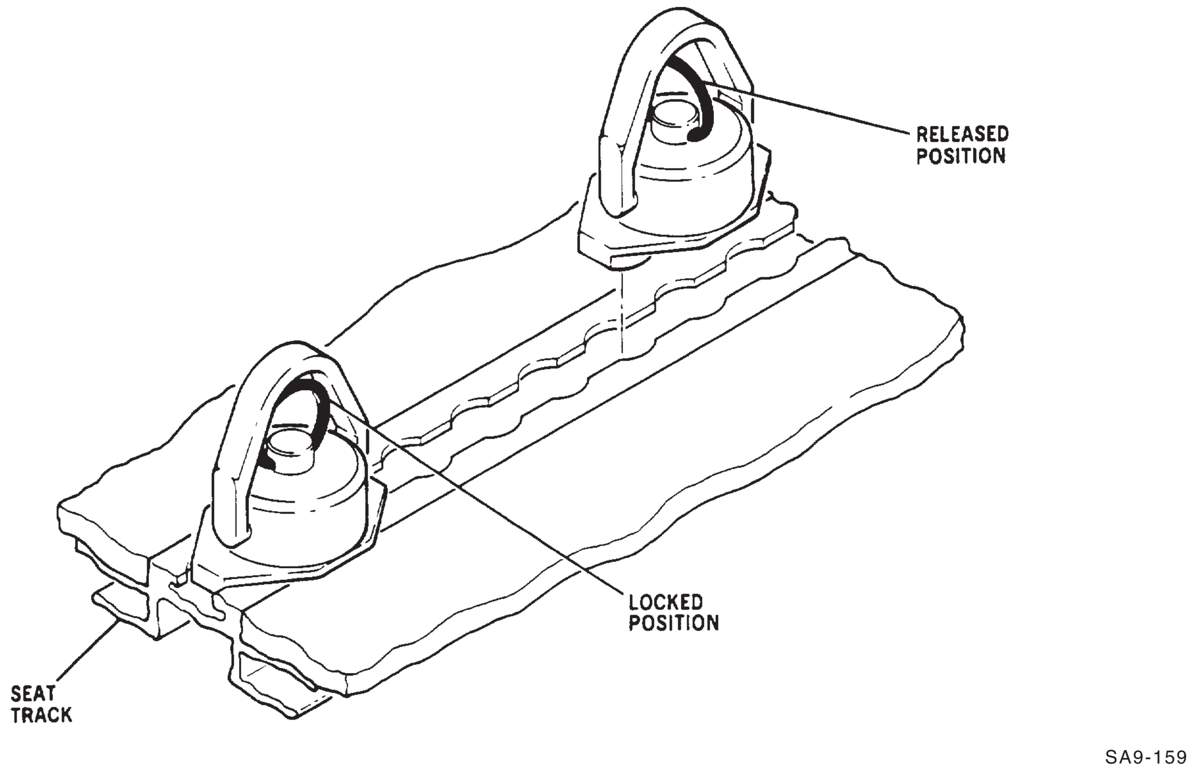


Figure 4-28. A-7000 Tiedown Fitting

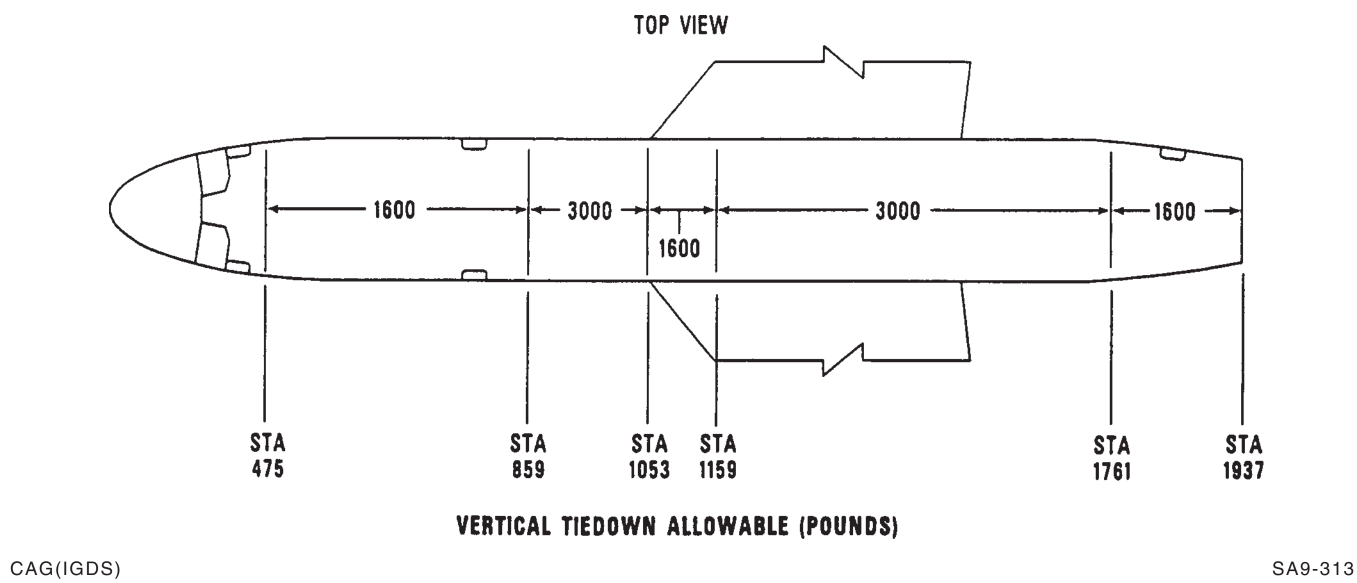


Figure 4-29. A-7000 Vertical Tiedown Allowables

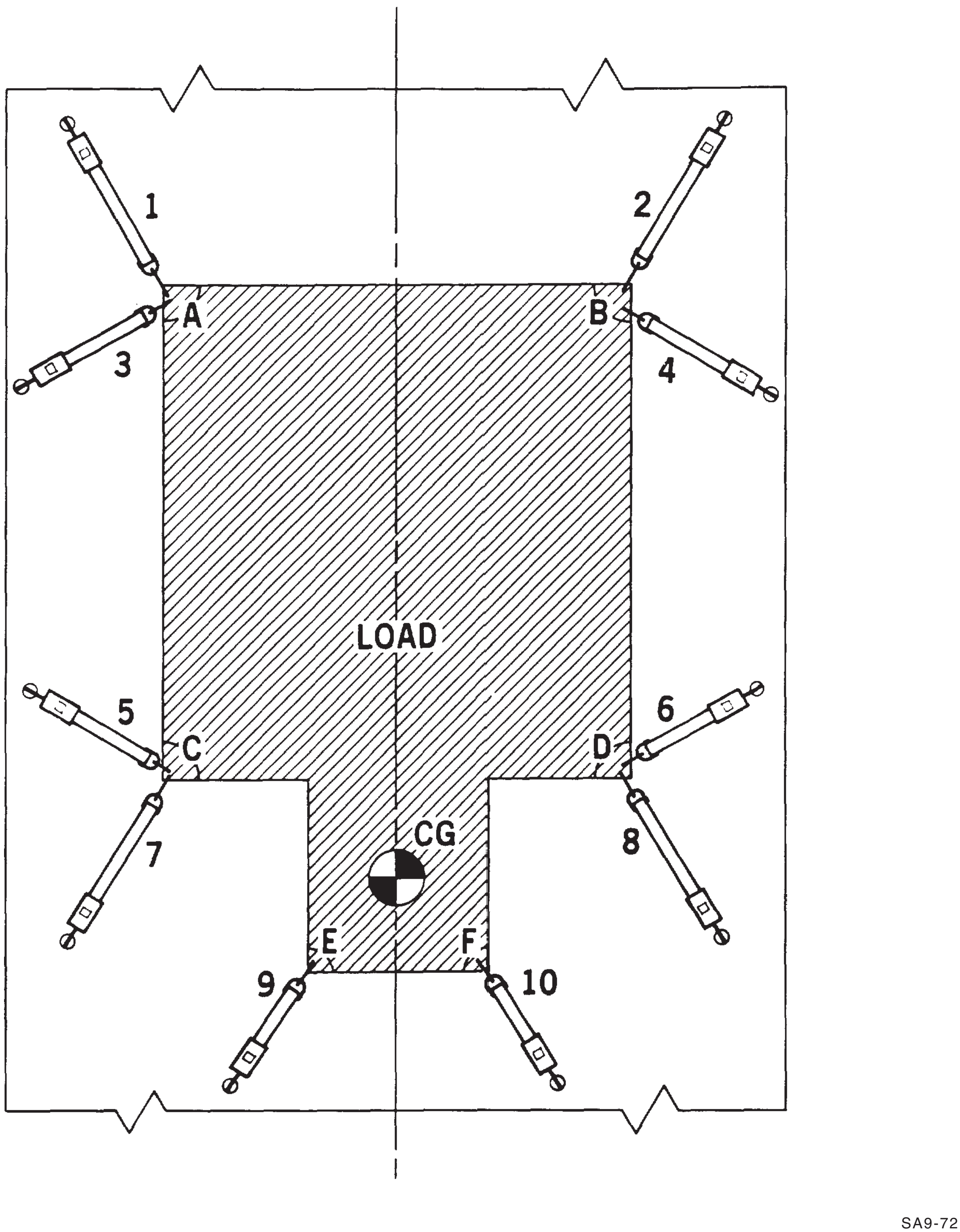
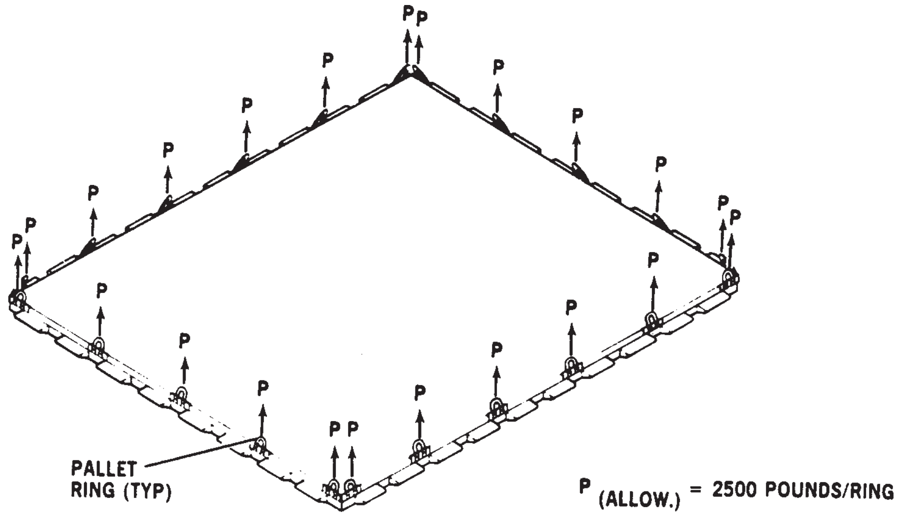
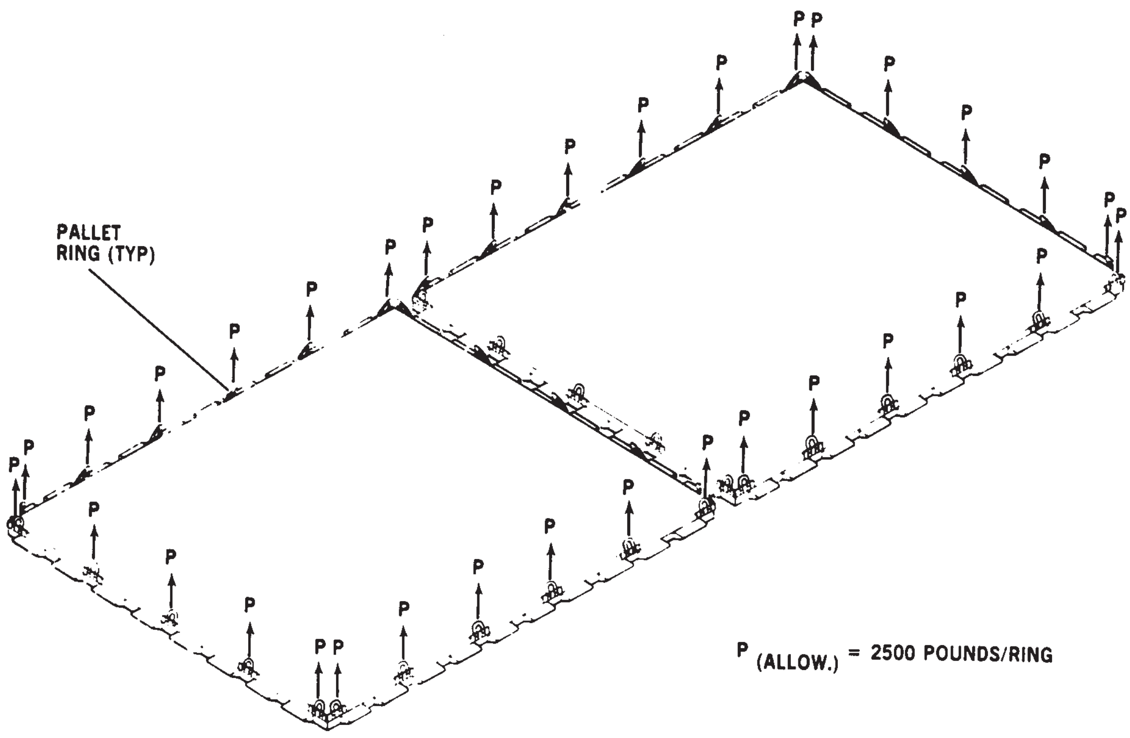


Figure 4-30. Typical Tiedown Restraint Pattern



SINGLE HCU-6/E PALLETS



COUPLED HCU-6/E PALLETS

SA9-47A

Figure 4-31. HCU-6/E Pallet Ring Vertical Allowables

METHODS TO COMPUTE TIEDOWN RESTRAINT VALUES

The following methods can be used to determine restraint received from tiedown devices. The restraint values are determined by measuring the strap or chain length; the effective vertical, forward or aft, and lateral lengths and applying them to certain (tiedown ratio) formulas. Figure 4-32 shows the required measurements used to determine restraint values.

Ratio Method 1 is used when the allowable pallet ring vertical restriction of 2,500 pounds is not exceeded. Ratio Method 2 is used to limit the vertical restraint to 2,500 pounds, and to provide the resultant values for the forward or aft and the lateral restraints.

Throughout the following formulas and sample problems, the numbered brackets ( ) are used to identify the following corresponding notes:

(1) The maximum rated restraint when using a 10,000 pound chain attached to a HCU-6/E pallet ring is 7,500 pounds. When using 5,000 pound straps, the maximum rated restraint value is 5,000 pounds.

(2) A maximum of 2,500 pounds vertical restraint per ring is allowed.

(3) If vertical restraint is less than 2,500 pounds, use actual value and continue using Ratio Method 1. If vertical restraint is equal to or greater than 2,500 pounds, limit the vertical restraint to 2,500 pounds and calculate the longitudinal and lateral restraints using Ratio Method 2.

(4) The calculated restraint received from a particular tiedown device cannot be higher than the rated restraint of a particular strap, chain, fitting or ring.

RATIO METHOD 1

1. To calculate vertical restraint:

$$\frac{\text{VERTICAL EFFECTIVE LENGTH (B)}}{\text{STRAP/CHAIN LENGTH (A)}} \text{ X } 5{,}000 \text{ LBS}^{(1)} =$$

NOTE

If vertical restraint is less than 2,500 pounds, use the actual value and continue on with steps 2 and 3 of this ratio method. If vertical restraint is equal to or greater than 2,500 pounds, limit the vertical restraint to 2,500 pounds and calculate the longitudinal and lateral restraints using Ratio Method 2.

2. To calculate longitudinal restraint:

$$\frac{\text{FORWARD OR AFT EFFECTIVE LENGTH (D)}}{\text{STRAP/CHAIN LENGTH (A)}} \text{ X}$$

5,000 LBS(1) =

3. To calculate lateral restraint:

$$\frac{\text{LATERAL EFFECTIVE LENGTH (E)}}{\text{STRAP/CHAIN LENGTH (A)}} \text{ X}$$

5,000 LBS(1) =

RATIO METHOD 2

1. Vertical restraint is the 2,500 pounds obtained from the vertical restraint calculation in step 1 of Ratio Method 1.

2. To calculate longitudinal restraint:

$$\frac{\text{FORWARD OR AFT EFFECTIVE LENGTH (D)}}{\text{VERTICAL EFFECTIVE LENGTH (B)}} \text{ X}$$

2,500 LBS(2) =

3. To calculate lateral restraint:

$$\frac{\text{LATERAL EFFECTIVE LENGTH (E)}}{\text{VERTICAL EFFECTIVE LENGTH (B)}} \text{ X}$$

2,500 LBS(2) =

<u>SAMPLE PROBLEM 1 (Figure 4-32, View A)</u>

This sample problem assumes that 10,000 pound chains are used.

1. Calculate vertical restraint:

$$\frac{\text{VERTICAL EFFECTIVE LENGTH (B)}}{\text{CHAIN LENGTH (A)}} \text{ X}$$

7,500 LBS(1) =

a. To obtain vertical effective length (B), measure from attachment point on cargo to a point directly beneath it on the pallet (25 inches).

b. To obtain length of tiedown chain (A), measure from pallet tiedown ring to attachment point on cargo (50 inches).

c. Divide tiedown chain length (A) (50 inches) into vertical effective length (B) (25 inches) to determine ratio:

```
        .5 Ratio
  50/25.0
     250
       0
```

d. Multiply this ratio (.5) times rated restraint of tiedown (7,500 lbs) (1):

```
   7,500 Chain strength
      .5 Ratio
 3,750.0 Restraint received from
         tiedown for vertical(3)
```

NOTE

Since the vertical restraint is greater than 2,500 pounds, Ratio Method 2 will be used to calculate the longitudinal and lateral restraint values.

2,500 Actual restraint used for vertical(3)

2. Calculate longitudinal restraint:

$$\frac{\text{FORWARD OR AFT EFFECTIVE LENGTH (D)}}{\text{VERTICAL EFFECTIVE LENGTH (B)}} \text{ X}$$

2,500 LBS(2) =

a. To obtain forward or aft effective length (D), measure from a point directly beneath attachment point on cargo, along a longitudinal axis, to a point lateral to the pallet tiedown ring being used (37 inches).

b. Divide vertical effective length (B) (25 inches) into forward or aft effective length (D) (37 inches) to determine ratio:

```
     1.48 Ratio
25/37.00
   25
   120
   100
    200
    200
      0
```

c. Multiply this ratio (1.48) times rated restraint of tiedown (2,500 lbs)[2]:

```
   2,500  Ring allowable
    1.48  Ratio
   20000
  10000
  2500
3,700.00  Restraint received from
          tiedown for forward or aft
```

3. Calculate lateral restraint:

$$\frac{\text{LATERAL EFFECTIVE LENGTH (E)}}{\text{VERTICAL EFFECTIVE LENGTH (B)}} \times$$

2,500 LBS[2] =

a. To obtain lateral effective length (E), measure from a point directly beneath attachment point on cargo to the row of pallet tiedown rings being used (22 inches).

b. Divide vertical effective length (B) (25 inches) into lateral effective length (E) (22 inches) to determine ratio:

```
      .88 Ratio
25/22.00
   200
    200
    200
      0
```

c. Multiply this ratio (.88) times rated restraint of tiedown (2,500 lbs)[2]:

```
   2,500  Ring allowable
     .88  Ratio
   20000
  20000
2,200.00  Restraint received from
          tiedown for lateral
```

4. Summary of calculations [4]:

Vertical	= 2,500 lbs
Longitudinal	= 3,700 lbs
Lateral	= 2,200 lbs

<u>SAMPLE PROBLEM 2 (Figure 4-32, View B)</u>

This sample problem assumes that 5,000 pound straps are used.

1. Calculate vertical restraint:

$$\frac{\text{VERTICAL EFFECTIVE LENGTH (B)}}{\text{STRAP LENGTH (A)}} \times$$

5,000 LBS[1] =

a. To obtain vertical effective length (B), measure from attachment point on cargo to a point directly beneath it on the pallet (15 inches).

b. To obtain length of tiedown strap (A), measure from pallet tiedown ring to the attachment point on cargo (60 inches).

c. Divide tiedown strap length (A) (60 inches) into vertical effective length (B) (15 inches) to determine ratio:

```
      .25 Ratio
60/15.00
   120
    300
    300
      0
```

d. Multiply this ratio (.25) times rated restraint of tiedown (5, 000 lbs) [1] :

5,000	Strap strength
.25	Ratio
25000	
10000	
1,250.00	Restraint receiver from tiedown for vertical [3]

NOTE

Since the vertical restraint is less than 2,500 pounds, Ratio Method 1 will be used to calculate the longitudinal and lateral restraint values.

2. Calculate longitudinal restraint:

$$\frac{\text{FORWARD OR AFT EFFECTIVE LENGTH (D)}}{\text{STRAP LENGTH (A)}}$$

5,000 LBS[1] =

a. To obtain forward or aft effective length (D), measure from a point directly beneath attachment point on cargo, along a longitudinal axis, to a point lateral to the pallet tiedown ring being used (51 inches).

b. Divide tiedown strap/length (A) (60 inches) into forward or aft effective length (D) (51 inches) to determine ratio:

```
     .85 Ratio
 60/51.00
    480
     300
     300
       0
```

c. Multiply this ratio (.85) times rated restraint of tiedown (5, 000 lbs) [1]:

5,000	Strap strength
.85	Ratio
25000	
40000	
4,250.00	Restraint received from tiedown for forward or aft

3. Calculate lateral restraint:

$$\frac{\text{LATERAL EFFECTIVE LENGTH (E)}}{\text{STRAP LENGTH (A)}} \text{ X}$$

5,000 LBS[1] =

a. To obtain lateral effective length (E), measure from a point directly beneath attachment point on cargo to the row of pallet tiedown rings being used (30 inches).

b. Divide tiedown strap length (A) (60 inches) into lateral effective length (E) (30 inches) to determine ratio:

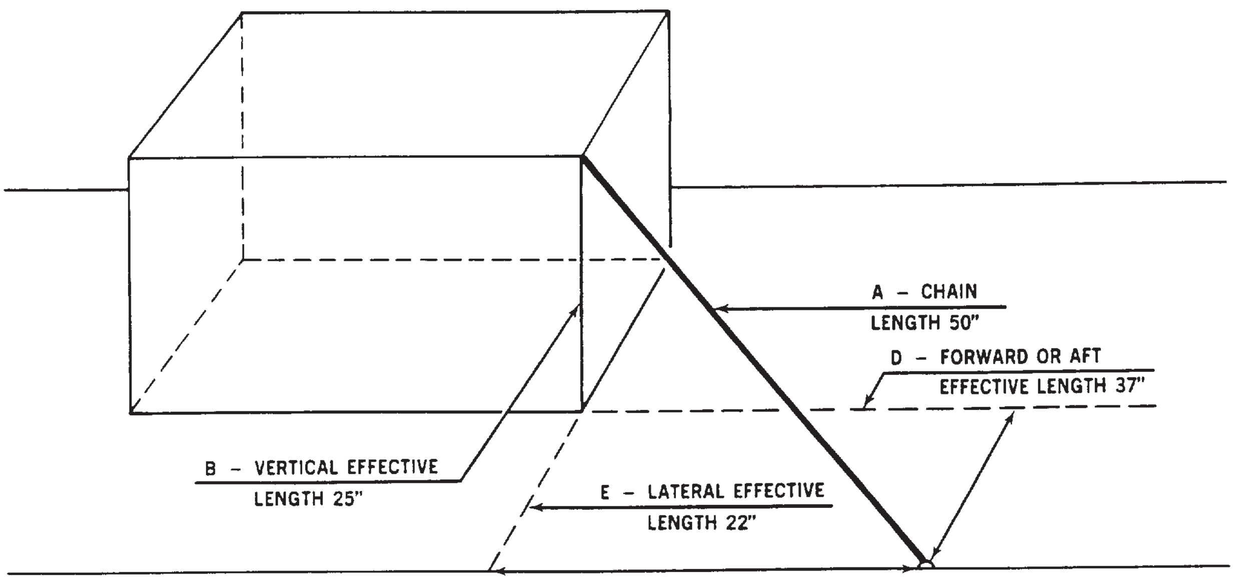
```
     .5 Ratio
 60/30.00
    300
      0
```

c. Multiply this ratio (.5) times rated restraint of tiedown (5,000 lbs) [1]:

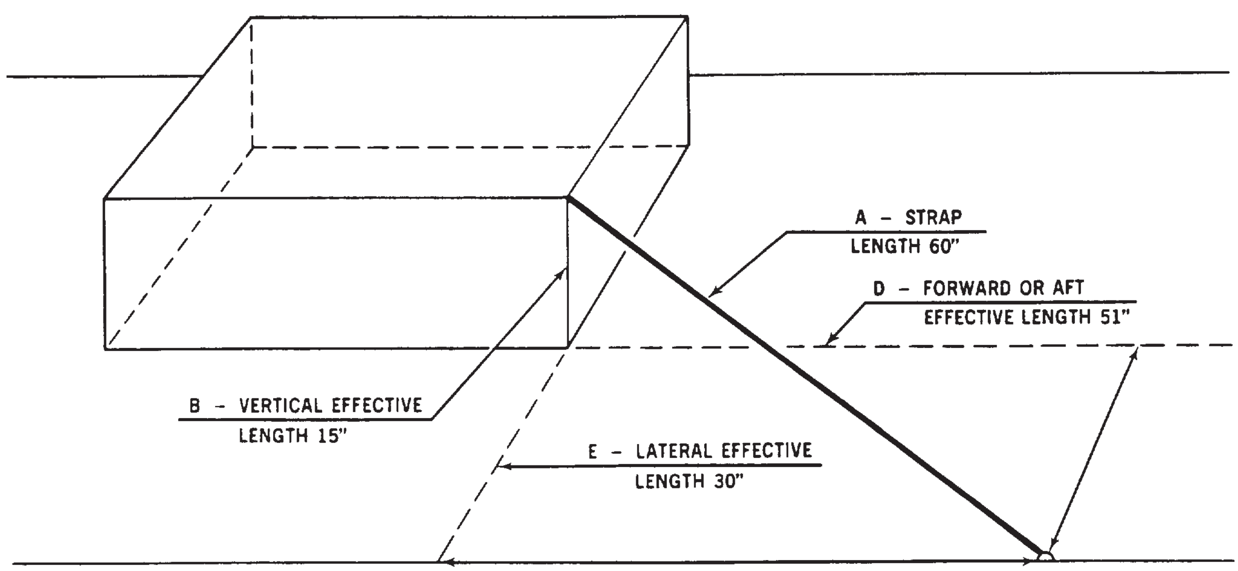
5,000	Strap strength
.5	Ratio
2,500.00	Restraint received from tiedown for lateral

4. Summary of calculations [4]:

Vertical	= 2,500 lbs
Longitudinal	= 3,700 lbs
Lateral	= 2,200 lbs



VIEW A – SAMPLE PROBLEM 1



VIEW B – SAMPLE PROBLEM 2

SA9-223

Figure 4-32. Tiedown Restraint Measurements

AMPLIFIED LOADING/OFFLOADING CHECKLIST

The amplified checklist summarizes information presented in preceding sections of this manual in such a manner that it can be used for quick reference during loading and off-loading operations. It is incomplete without the boom operator's checklists contained in TO 1C-10(K)A-1 and TO 1C-10(K)A-lCL-3-1.

MISSION PLANNING

TYPE LOAD

1. Weight & Number of Pallets .... DETERMINE

2. Weight & Size of Large Cargo Items .... DETERMINE

   Determine weight and size of cargo items that are too large to be palletized prior to loading. Check package size charts or cargo profiles in this section.

3. CG Location of Large Cargo Units .... DETERMINE

   Determine center of gravity locations of all cargo units.

4. Hazardous Materials/Special Handling .... CHECK (IF REQUIRED)

   Verify materials are certified as properly prepared for air shipment. Determine their compatibility for air shipment with other hazardous materials in accordance with applicable directives. Ensure all hazardous material is readily accessible in flight and all containers are unlocked or keys/combination are readily available.

5. Motorized Vehicles/Equipment .... CHECK (IF REQUIRED)

   If motorized vehicles, trailers, and/or equipment are to be carried, verify they are certified as properly prepared for air shipment.

   Verify all cargo, loose accessories, and equipment are secure on or in vehicles for the required restraint.

6. Pallet Condition .... CHECK

   Check cargo for soil contamination, pest infestation and pallets/ nets for damage/missing components.

7. Mounted Cargo .... CHECK (IF REQUIRED)

   Verify all mounted cargo is properly secured to carrier(s).

8. Number of Passengers .... CHECK

LOADING COORDINATION

1. Coordinate Actual Loading Time, ACL, Special Equipment Requirements & Aircraft Configuration .... ACCOMPLISH

NOTE

- Aircraft configuration is determined by the number of cargo pallets/personnel to be loaded.
- When the aircraft is in the Code A, B, or C configuration, the number of seats varies with the amount of the cargo load. Verify the unusable seats are removed when the 14 or 16 seating arrangement is required.

LOAD COMPUTATIONS

1. Passenger Load Position .... DETERMINE

   Utilizing TO 1C-10(K)A-5 and this manual, determine passenger load position.

2. Cargo Load Position .... DETERMINE

   Using procedures outlined in this manual and TO 1C-10(K)A-5, position cargo so that the following is complied with: Contact Pressure Limitations; PLF; PSI; Axle/Concentrated Loads; Lateral Unbalance Conditions; Compartment Limitations; Zone Loads; Maximum Fuel Allowables; Tipping Analysis; Aircraft CG Limits.

3. Restraint Requirements .... COMPUTE

   Compute restraint of cargo utilizing load factors in this section for longitudinal, lateral, and vertical loads.

4. Cargo/Passenger Load Data .... COORDINATE

   Sufficient data will be provided to the Primary Boom Operator to complete the DD Form 365-4. The Cargo Loading Boom Operator will inform the Flight Engineer of the maximum amount of fuel that can be transferred to FWD or AFT body tanks to comply with Zone Load Limitations.

AIRCRAFT LOADING

EXTERIOR INSPECTION

1. Cargo Loading Area . . . . CLEAR

   Check area is clear of obstructions.

2. Wheel Chocks. . . . . POSITIONED

   Verify wheel chocks are positioned approximately two inches in front of main landing gear wheels.

3. Fire Extinguishers. . . . . AVAILABLE

   Verify ground fire extinguishers are placed for easy accessibility and are serviceable.

4. APU or External Power . . . . DETERMINE

   If APU power will be used, verify inlet and exhaust areas are clear of obstructions.

INTERIOR INSPECTION

NOTE

If in configuration "D", delay steps 4 and 7 until after seat pallets are removed.

1. AFTO Form 781 . . . . CHECK

   To ensure the aircraft is safe to receive electrical power, review the AFTO Form 781 for aircraft status prior to electrical power being applied and systems operated.

WARNING

Prior to the initial application of electrical power and after fuel servicing, ensure the center accessory compartment has been inspected for fuel leaks/fumes.

2. Electrical/Air Conditioning . . . . ESTABLISH

   If flight engineer is not available, refer to TO 1C-10(K)A-1, section IV, for detailed instructions on establishing electrical/air conditioning.

3. Emergency Light Switch . . . . ARM/TEST

   a. Emergency Lights . . . . ARM

      Observe DISARMED light goes off.

      NOTE

      The DISARMED light will be on when switch is in either ON or OFF.

   b. EMER LT TEST Button . . . . PUSH AND HOLD

      Observe EMER LT TEST light comes on.

      NOTE

      Pushing EMER LT TEST causes emergency lights to come on and test condition of integral batteries under load. EMER LT TEST light will come on when all four circuits and batteries are satisfactory. Test requires approximately 5 seconds.

   c. EMER LT TEST Button . . . . RELEASE

      Observe EMER LT TEST light goes off.

4. Pivot Fitting . . . . INSTALL (IF REQUIRED)

   Install unless the left side restraint rails are moved to the outboard position.

5. ARO Compartment Door . . . . CLOSE

6. Cargo Door . . . . OPEN

7. Cargo Handling System .... CHECK

Visually inspect and perform operational checks of the cargo handling system components to ensure the system is operational, not damaged, properly installed and configured to accept planned loading.

Perform power rollers system functional test. If a malfunction occurs during this test, check circuit breaker(s) if necessary. If resetting circuit breaker(s) does not correct problem, call maintenance.

WARNING

Proper location and condition of all cargo handling components are necessary to ensure integrity of the system. A damaged cargo handling system has lost some of its structural integrity thus reducing its restraint capability which jeopardizes safety of flight.

CAUTION

Visual inspection and operational checks of components are important to the success of the mission. Obstructed or malfunctioning mechanisms, bent or misaligned conveyors and restraint rails, or improperly installed components can be seriously damaged during loading operation.

CARGO ONLOADING

1. Loading Coordination .... COMPLETE

   Coordinate with primary boom on duties to be performed. Coordinate with ATOC and other cargo-handling agencies if not previously accomplished.

2. Loading Computation....................................... VERIFY (IF REQUIRED)

   If not previously accomplished, ensure the following is complied with: Contact Pressure Limitations; PLF; PSI; Axle/Concentrated Loads; Lateral Unbalance Conditions; Compartment Limitations; Zone Loads; Maximum Fuel Allowables; Tipping Analysis; Aircraft CG Limits.

3. Loading Team.. BRIEF

   Brief loading team members on assigned duties, hand signals, egress, and emergency procedures to be used. Caution loading crew not to use restraint assemblies and rails as pallets stops, and not to use excessive speed when rolling pallets into aircraft.

   Assign guides at cargo door to check clearances.

4. Loader/Elevator... POSITION

   Direct vehicle into position. Adjust level of loader/elevator rollers to same level of rollers of aircraft.

5. Cargo Door Sill Conveyor.. INSTALL

   This step may be delayed until the first IAU pallet is offloaded.

   CAUTION

   When the cargo door sill conveyor is not installed, caution must be used to prevent damage to the door jamb.

6. Cargo .... LOAD

   Verify only planned cargo is loaded.

   Position cargo as determined during the load planning.

   Ensure hazardous cargo is properly marked/labeled, documented, and is not leaking.

   CAUTION

   Ensure all lateral, single and dual pawl assemblies are in the up and locked position for all onloaded pallets.

Palletized Cargo

Move pallets from loader/elevator into aircraft.

NOTE

- When loading/offloading pallets, the restraint assemblies at fuselage station 629.5 may be used as pallet guides.
- If required, load pallets into position 1R and 1L for ballast.
- If loaded pallets cannot be moved manually, use the cargo winch.

Vehicles

After vehicle is driven into predetermined loading position, verify ignition switch is off, engine is completely stopped, that parking brake is set, transmission is in the lowest gear or park, and forward and aft safety restraint devices are installed before driver leaves vehicle.

NOTE

Diesel powered vehicles shall be parked with transmission in neutral, or if equipped with automatic transmission, in park.

7. Manifest .... CHECK

   Verify only cargo manifested is being shipped.

8. Pivot Fitting .... REMOVE (IF REQUIRED)

9. Cargo Door Sill Conveyor .... REMOVE

   The cargo door sill conveyor may be removed prior to loading the last IAU pallet.

CAUTION

When the cargo door sill conveyor is not installed, caution must be used to prevent damage to the door jamb.

10. Loader/Elevator .... RELEASE

11. Cargo Door .... CLOSE

    Refer to TO 1C-10(K)A-1 Boom Operators Final Preparation Checklist and complete dagger (†) items on remaining checklist.

    If APU/external power shutdown is required and flight engineer is not available, refer to TO 1C-10(K)A-1 Boom Operators After Landing/Parking Checklist.

AIRCRAFT OFFLOADING

1. Exterior Inspection .... ACCOMPLISH

   Refer to Exterior Inspection Checklist under Aircraft Loading.

2. AFTO FORM 781 .... CHECKED (IF REQUIRED)

   To ensure the aircraft is safe to receive electrical power, review the AFTO Form 781 for aircraft status prior to electrical power being applied and systems operated.

WARNING

> Prior to initial application of electrical power and after fuel servicing, ensure the center accessory compartment has been inspected for fuel leaks/fumes.

3. ELECTRICAL/AIR CONDITIONING .... ESTABLISH (IF REQUIRED)

   If flight engineer is not available, refer to TO 1C-10(K)A-1, section IV, for detailed instructions on establishing electrical/air conditioning.

4. EMERGENCY LIGHT SWITCH .... ARM/TEST

   a. Emergency Lights .... ARM

      Observe DISARMED light goes off.

NOTE

> The DISARMED light will be on when the switch is in either ON or OFF.

b. EMER LT TEST Button . . . . PUSH AND HOLD

Observe EMER LT TEST light comes on.

NOTE

Pushing EMER LT TEST causes emergency lights to come on and test condition of integral batteries under load. EMER LT TEST light will come on when all four circuits and batteries are satisfactory. Test requires approximately 5 seconds.

c. EMER LT TEST Button . . . . RELEASE

Observe EMER LT TEST light goes off.

5. Offload Tipping Analysis . . . . COMPLETE

6. Cargo Door . . . . OPEN

7. Loading Team . . . . BRIEF

Brief loading team members on assigned duties, hand signals, egress, and emergency procedures to be used. Caution loading crew not to use restraint assemblies and rails as pallet stops, and not to use excessive speed when rolling loaded pallets out of aircraft.

Assign guides at cargo door to check clearances.

8. Loader/Elevator . . . . POSITION

Direct vehicle into position. Adjust level of loader/elevator to same level of rollers in aircraft.

9. Cargo Door Sill Conveyor . . . . INSTALL

This step may be delayed until the first IAU pallet is offloaded.

CAUTION

When the cargo door sill conveyor is not installed, caution must be used to prevent damage to the door jamb.

10. Pivot Fitting . . . . INSTALL (IF REQUIRED)

Install unless the left side restraint rails are moved to the outboard position.

11. Cargo .... OFFLOAD

    If intermediate stops are made, verify only scheduled cargo is offloaded.

    Check cargo against manifest.

    Offloading procedures are essentially the reverse of loading procedures.

NOTE

Retain safety restraint devices on vehicles until they are ready for offloading.

12. Pivot Fitting .... REMOVE

13. Cargo Door Sill Conveyor .... REMOVE

    The cargo door sill conveyor may be removed prior to loading the last IAU pallet.

CAUTION

When the cargo door sill conveyor is not installed, caution must be used to prevent damage to the door jamb.

14. Loader/Elevator .... RELEASE

15. Cargo Door .... CLOSE

    If thru-flight, refer to TO 1C-10(K)A-1 Boom Operators Final Preparation Checklist and accomplish dagger (†) items.

    If APU/external power shutdown is required and flight engineer is not available, refer to TO 1C-10(K)A-1 Boom Operators After Landing/Parking Checklist.

SPECIFIC PROCEDURES

TABLE OF CONTENTS

INTRODUCTION

This section contains specific procedures for those types of cargo whose physical characteristics are such that they require special loading consideration over and above the general procedures covered in Sections III and IV. These specific procedures, for each type of cargo, include instructions for preloading, loading, restraint, offloading and postloading, as appropriate.

This section is divided into subsections (VA, VB, VC, etc.). Normally, each subsection covers a particular load or type of load. Each subsection is complete in itself with regard to procedures and instructions for that particular cargo. These procedures and instructions take precedence over the general procedures in Section IV, and shall be complied with as stated.

The subsections are presented in such a way that information for various types of cargo can be added or deleted without affecting other subsections.

POSITIONING VEHICLES WITHIN CARGO COMPARTMENT

Except when otherwise directed in subsections, directional positioning of vehicles within the cargo compartment is optional, providing adequate clearances are maintained, i.e., walkways and aircraft structure. For simplicity, tiedown patterns shown in the subsections are based on forward direction depicted and do not dictate directional positioning. Vehicles shall be positioned on pallets to ensure a symmetrical tiedown pattern.

NOTE

Specific vehicles with axle/wheel weights exceeding section IV limitations must be positioned on pallets as shown in applicable subsections.

VEHICLE TIEDOWN PATTERNS

For symmetrical tiedown patterns, the preferred cargo handling system configuration is the 25-pallet all-cargo, 23-pallet mixed cargo/personnel, or 17-pallet mixed cargo/personnel configurations. Most vehicles are loaded longitudinally in the cargo compartment. However, some vehicles may be loaded laterally in the above configurations or longitudinally in the 27-pallet all-cargo configuration.

All tiedown patterns are typical within each subsystem. If vehicle configuration and/or tiedown attachment points are not identical to those shown in the figures, ensure that adequate tiedown is applied.

FLOOR-LOADED CARGO

GENERAL

This section contains instructions for loading, restraining and offloading floor-loaded cargo where the cargo handling system has been removed from the aircraft.

WARNING

When carrying floor-loaded cargo, in a Class B cargo compartment configuration, access for a crew member with fire extinguisher must be maintained down the entire cabin length. The access route need not be a straight line for the entire length.

NOTE

- Approval of HQ AMC/A3VK must be obtained prior to floor-loading cargo.
- Non-cargo items such as small amounts of crew baggage/gear and equipment, medical litters, and fleet service items, etc., are not considered floor-loaded cargo. Ensure these items will not damage the floor, are not blocking aisles or passageways, and are adequately restrained.

CARGO SIZE LIMITATIONS

The size limitations outlined in Section IV apply to the accommodation of floor-loaded cargo, except for the following condition. The package size charts, figures 4-3 and 4-4, were created using the top of the rollers to compute the maximum length and width combinations that are loadable. To use figure 4-3 and 4-4, subtract 1.75 inches (height of the rollers) from the height of the cargo items to be loaded.

CARGO WEIGHT LIMITATIONS

The load planning phase involving weight distribution encompasses more factors which must be observed, prior to the loading operation, when loading floor-loaded cargo in comparison to palletized cargo. In addition to structural, zone, and compartment load limits, contact area pressures in terms of PSI and PSF, and wheel and axle load limits must not be exceeded.

Zone load limits are shown in figure 4-5, and compartment load limits are illustrated in figure 4-6.

LOAD SUMMARY CHARTS FOR FLOOR-LOADED CARGO

All factors regarding weight limitations must be satisfied before an item of cargo can be loaded. These factors include PSI, PSF, PLF, maximum axle/wheel loads, maximum compartment loads, and maximum zone loads.

Figure 5A-1 summarizes the loading data for floor-loaded cargo. These compartments are identical to the pallet compartment location. The summary chart includes the following information:

Columns 1 through 5: Reference data - centroid, forward and aft limits, floor area, and volume.

Columns 6 and 7: Working contact area pressures (PSI) .

Columns 8 through 11: Maximum floor loading in terms of PSF and PLF.

Columns 12 and 13: Maximum total compartment load.

Columns 14 through 17, Maximum axle and wheel weight limits (vehicles with pneumatic tires).

WEIGHT AND BALANCE

The weight and balance criteria and methods for computing cargo unit center of gravity are identical to those outlined in Section IV.

CARGO LOAD PLANNING PROCEDURE

The cargo load planning procedures outlined in Section IV apply to loading floor-loaded cargo.

SHORING REQUIREMENTS

CAUTION

> A minimum of one sheet of 3/4-inch thick plywood shoring is required whenever loading floor-loaded cargo. Shoring must cover adjoining floor beams or seat tracks.

Shoring is the use of reinforcing material to distribute concentrated loads on as many floor beams and seat tracks as possible, and to protect floor panel surfaces from punctures or damage. Suitable shoring material is 3/4-inch thick plywood or 2 x 12-inch planks.

Concentrated loads should be spaced at a minimum of 20 inches apart and, where possible, shall be placed to take maximum advantage of direct support from the floor beams. If a load on the floor exceeds 150 pounds per square foot, adequate shoring must be used as a load spreader to adjacent floor areas until each square foot supports 150 pounds per square foot or less.

NOTE

> Three plywood panels, 3/4-inch thick, one placed on top of the other, are required to replace a 2 x 12-inch plank. A 4 x 8-foot plywood panel, 3/4-inch thick, weighs approximately 71 pounds. A 2 x 12-inch plank, 6 feet long, weighs about 40 pounds.

EFFECT OF SHORING

The weight of a load resting on shoring is not spread equally over the entire area of contact between the shoring and the surface on which the shoring is resting. In general, shoring will only increase the area over which a load is distributed to whatever area is obtained by extending a plane drawn downward and outward from the outside line of contact of the load, at an angle of 45°, until it intersects the surface on which the shoring rests. The effect of this geometric estimation is illustrated in figure 5A-2. Assume that the shoring is 0.75 inches thick (one sheet of plywood) and the box is 6 inches wide by 12 inches long. The area of contact between the box and plank will be 6 x 12 inches, or 72 square inches. Now extend imaginary planes downward and outward from the edges of the bottom of the box at angles of 45°. Where these imaginary planes intersect the cargo floor, the area of contact will be 7.5 x 13.5 inches, or 101.3 square inches. In this particular case, the area of contact has almost doubled, but the increase will not always be so proportionately great. What has happened in this instance is that the area over which the load has been distributed has been enlarged by the addition of a border 0.75 inches wide all around the area of contact between the box and shoring. This border is as wide as the shoring is thick.

COMPARTMENT/POSITIONS LEFT OR RIGHT		REFERENCE DATA					WORKING CONTACT AREA PRESSURES (PSI) (2)		COMPARTMENT LOAD LIMITATIONS						(5) MAXIMUM AXLE AND WHEEL WEIGHTS FOR VEHICLES PNEUMATIC TIRES			
									MAXIMUM FLOOR LOADING (PSF)		MAXIMUM FLOOR LOADING (PLF)		MAXIMUM TOTAL COMPARTMENT LOAD (LBS) LEFT OR RIGHT		LOADING OFF-LOADING		FLIGHT	
PALLET POSITIONS (FLOOR MARKINGS)	PALLET COMPARTMENTS (SIDEWALL MARKINGS)	CENTROID	FLOOR AREA (SQUARE FEET)	VOLUME (CUBIC FEET)	FORWARD LIMIT STATION	AFT LIMIT STATION	(3) LOADING OFF-LOADING	(4) FLIGHT	LOADING OFF-LOADING	FLIGHT	LOADING OFF-LOADING	FLIGHT	LOADING OFF-LOADING	FLIGHT	MAXIMUM TIRE	MAXIMUM AXLE	MAXIMUM TIRE	MAXIMUM AXLE
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
1	A	575	66	356	521	630	10	1	150	150	1452	738	10,000	6,500	920	1,840	(6) –	(6) –
2	B	684	66	468	630	739	10	1	150	150	1452	738	10,000	6,500	920	1,840	REFER TO FIGURE 5A-12	
3	C	793	66	468	739	848	10	1	150	150	1452	738	10,000	6,500	920	1,840		
4	D	902	66	468	848	957	10	1	150	150	1452	738	10,000	6,500	920	1,840		
5	E	1011	66	468	957	1066	10	1	150	150	1452	738	10,000	6,500	920	1,840		
6	F	1120	66	468	1066	1175	10	1	150	150	1452	888	10,000	6,500	920	1,840		
7	G	1229	66	468	1175	1284	10	1	150	150	1452	1452	10,000	10,000	920	1,840		
8	H	1338	66	468	1284	1393	10	1	150	150	1452	1452	10,000	10,000	920	1,840		
9	J	1447	66	468	1393	1502	10	1	150	150	1452	1452	10,000	10,000	920	1,840		
10	K	1556	66	468	1502	1611	10	1	150	150	1452	1368	10,000	10,000	920	1,840		
11	L	1665	66	395	1611	1720	10	1	150	150	1452	1110	10,000	10,000	920	1,840		
12	M	1774	66	395	1720	1829	10	1	150	125	1452	738	10,000	6,500	920	1,840		
(1) 13	N	1883	66	371	1829	1937	10	1	150	125	1452	738	10,000	6,500	920	1,840		

NOTES:

(1) COMPARTMENT 13(N) PERTAINS TO LEFT SIDE ONLY.

(2) SHORING IS REQUIRED WHEN LOADING FLOOR LOADED CARGO DIRECTLY ON THE AIRCRAFT FLOOR TO PROTECT THE FLOOR PANELS. SHORING MUST COVER ADJOINING FLOOR BEAMS OR SEAT TRACKS.

(3) FOR CARGO UNITS THAT HAVE A CONTACT AREA OF 9 SQUARE INCHES OR LESS, 50 PSI IS ALLOWED. THERE MUST BE A MINIMUM OF 20 INCHES BETWEEN CONTACT AREA CENTERS.

(4) FOR CARGO UNITS THAT HAVE A CONTACT AREA OF 9 SQUARE INCHES OR LESS, 10 PSI IS ALLOWED. THERE MUST BE A MINIMUM OF 20 INCHES BETWEEN CONTACT AREA CENTERS.

(5) WHEELS MUST BE 48 INCHES APART. SEE FIGURE 5A-12 FOR OTHER CONDITIONS. ONE SHEET OF 3/4-INCH PLYWOOD SHORING IS REQUIRED.

(6) ONLY COMPRESSIBLE CARGO IS RECOMMENDED IN COMPARTMENT 1L/R (A).

SA9-141C

Figure 5A-1. Loading Data-Floor-Loaded Cargo

The direct proportion between the width of the border and the thickness of the shoring is generally applicable to all shoring. Since the addition of area occurs only around the edge of the area of contact, the larger the object shored, the smaller the proportion of increase of contact area.

Shoring 1.5 inches thick (2 sheets of plywood), under a box 12 inches square, will increase the area of contact by 56% by adding 81 square inches to the original 144. Shoring 1.5 inches thick, under a box 60 inches square, will increase the area of contact by only about 10 percent by adding only 369 square inches to the original 3,600 square inches. The spreading effect of shoring is the same regardless of the shape of the area of contact. Under flight conditions, properly inflated pneumatic tires will deflect and increase the load bearing area. Under-inflated tires may bottom out against the rims; therefore, decreasing the load bearing area and increasing the load bearing pounds per square inch contact pressure exerted on the aircraft floor momentarily.

ROLLING SHORING

Rolling shoring is used on the floor areas over which a vehicle must roll when being loaded on the aircraft. This type of shoring is also used when loading general cargo by means of roller prybars or roller dollies.

PARKING SHORING

Parking shoring is required under vehicles or cargo aboard the aircraft in flight. Those items of cargo or vehicles that require rolling shoring also require parking shoring. Whenever possible, the shoring should be large enough to cover the adjacent floor beams or seat tracks. Figure 5A-3 shows a possible placement of 3/4-inch plywood sheets which cover up the minimum of seat tracks. This configuration allows maximum flexibility for attachment of restraint fittings, and provides a wide range of tread width for wheeled vehicles. Additional parking shoring may be required for flight load factors.

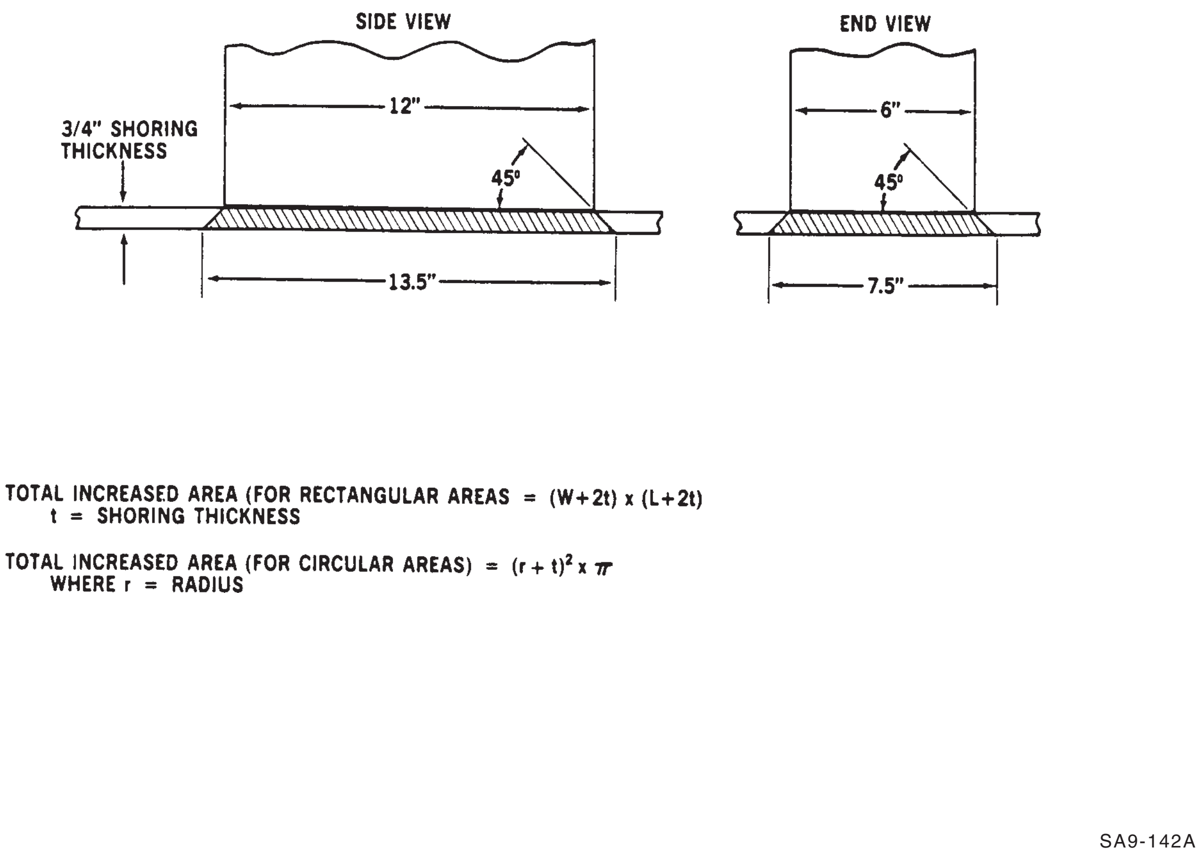
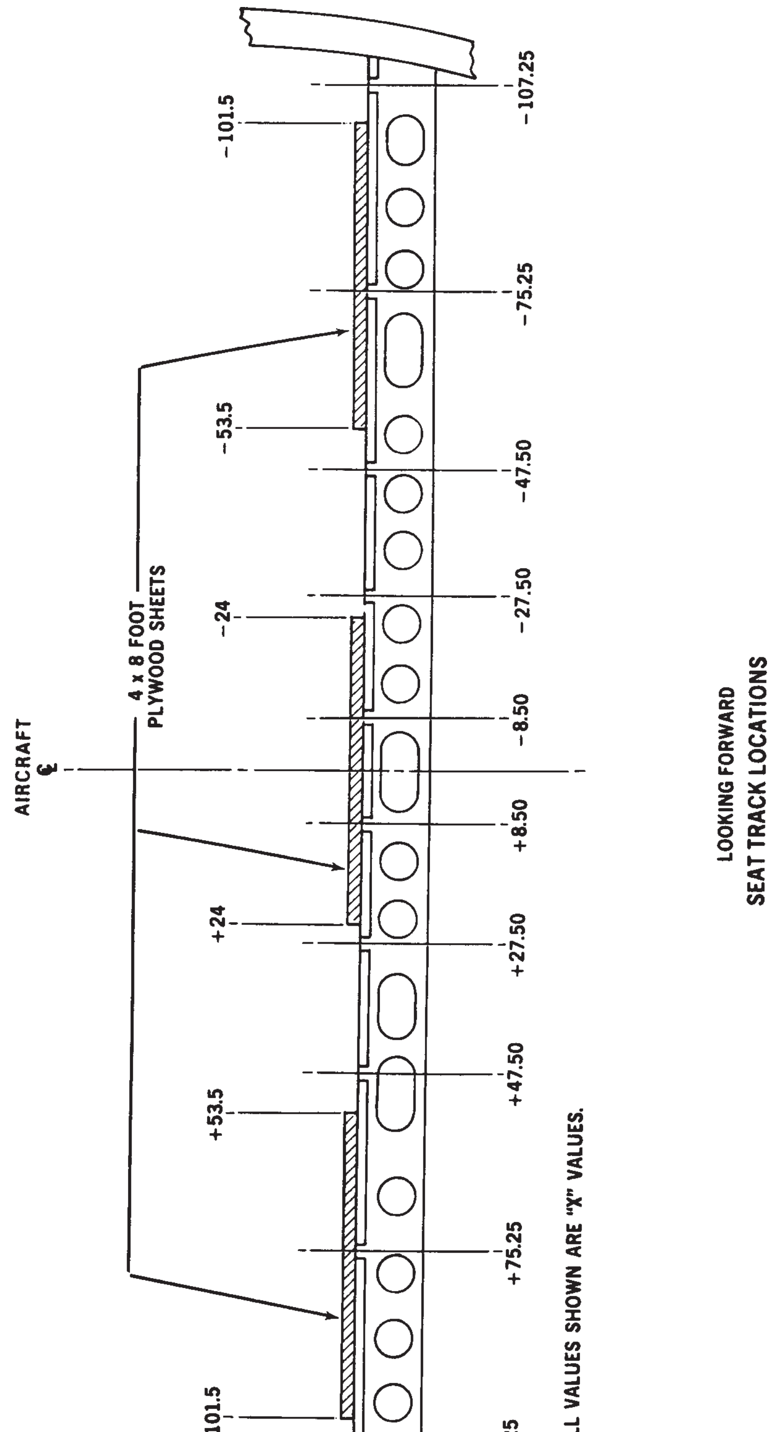


Figure 5A-2. Effect of Shoring



SA9-143A

Figure 5A-3. Symmetrical Plywood Sheet Shoring Location (Aft of Door Loading Area)

WINCHING PROCEDURES

Winching operations for floor-loaded cargo differ somewhat from the winching procedures when the cargo handling system is installed. One primary difference is that only longitudinal winching is possible in the cargo compartment. The capability to winch cargo laterally in the cargo door area has been eliminated because the omnidirectional panel, is a portion of the cargo handling system.

Before using the winch to load or offload floor-loaded cargo, the aircraft should be prepared for these operations: The shoring that is used shall be positioned to allow attachment of the winch onto the seat tracks. The winch should be located so that the winch cable, from the winch to the cargo, does not contact and damage either the cargo or the unprotected aircraft structure.

FRICTIONAL EFFECT ON WINCHING FLOOR-LOADED CARGO

When winching floor-loaded cargo in the aircraft, friction may be responsible for much of the cable load.

Friction is the resistance to relative motion between two surfaces in contact. If the surfaces are in sliding contact, as in the case when skid-mounted cargo is being winched, the resistance is called sliding friction. If the surfaces are in rolling contact, the resistance to motion is called rolling friction.

This type of friction is encountered when winching cargo on wheel or rollers.

COEFFICIENT OF FRICTION

Each material or combination of materials has its average coefficient of friction. Average is used in defining the coefficient of friction because of the many variables which tend to change the coefficient of friction.

Sliding Friction

In sliding friction, encountered when winching skid-mounted cargo, any one or a combination of the following changes could cause a change in the coefficient of friction:

1. Changes in temperature
2. Changes in humidity
3. Amount and type of lubricant

Rolling Friction

More variables appear when determining the coefficient of friction for a cargo unit mounted on wheels or rollers. Following are some of the variables encountered in determining the coefficient of friction for wheeled vehicles:

1. Wheel width
2. Wheel diameter
3. Type of tread
4. Tire pressure
5. Bearing variables

AVERAGE COEFFICIENT OF FRICTION

To simplify the problem of variable effects on the coefficient of friction, an average value under normal conditions is used for each material or combination thereof, and is called the average coefficient of friction. The following have been selected for use in this section:

LOADING METHOD	FRICTION COEFFICIENT (f)
Rolling on rails (steel wheels)	0.005
Rolling on steel/hard rubber wheels	0.018
Rolling on pneumatic tires	0.018
Rolling on tracks (tracked vehicles)	0.080
Sliding on greased shoring	0.260
Sliding on dry shoring	0.490
Sliding skids on non-skid surfaces	0.815
Sliding on non-skid surfaces	1.000

NOTE

Although the average coefficient of friction is satisfactory in most cases, certain conditions, such as wet wood, can increase the coefficient.

WINCHING FLOOR-LOADED CARGO

When winching the cargo unit along the horizontal (level) cargo floor, the load on the winch cable is equal to the weight of the cargo unit times its coefficient of friction on the cargo floor. However, when winching cargo up a sloped aircraft floor, the load on the winch cable is resisted by two forces: the gravitational pull down the sloped floor, and the force of friction. Both of these forces act against the force exerted by the winch cable. Both of these forces vary as the angle of the sloped floor varies.

Figure 5A-4 shows the maximum weight that can be accommodated by the cargo winch for various aircraft floor slope angles. The curves include both the gravitational force and the frictional force for the eight different average coefficient of friction values.

SAMPLE WINCH PROBLEM

Assume the aircraft is parked on a sloped ramp which causes the aircraft floor to be at a slope of 4°. Determine the maximum load that can be slid over dry shoring using the cargo winch.

SOLUTION:

Extend a line upward from four degrees until it intersects the 0.490 curve (coefficient of friction curve for dry shoring). From that intersection, extend a line to the left, and read off the maximum cargo weight that can be winched. For this problem, the maximum weight is 1600 pounds.

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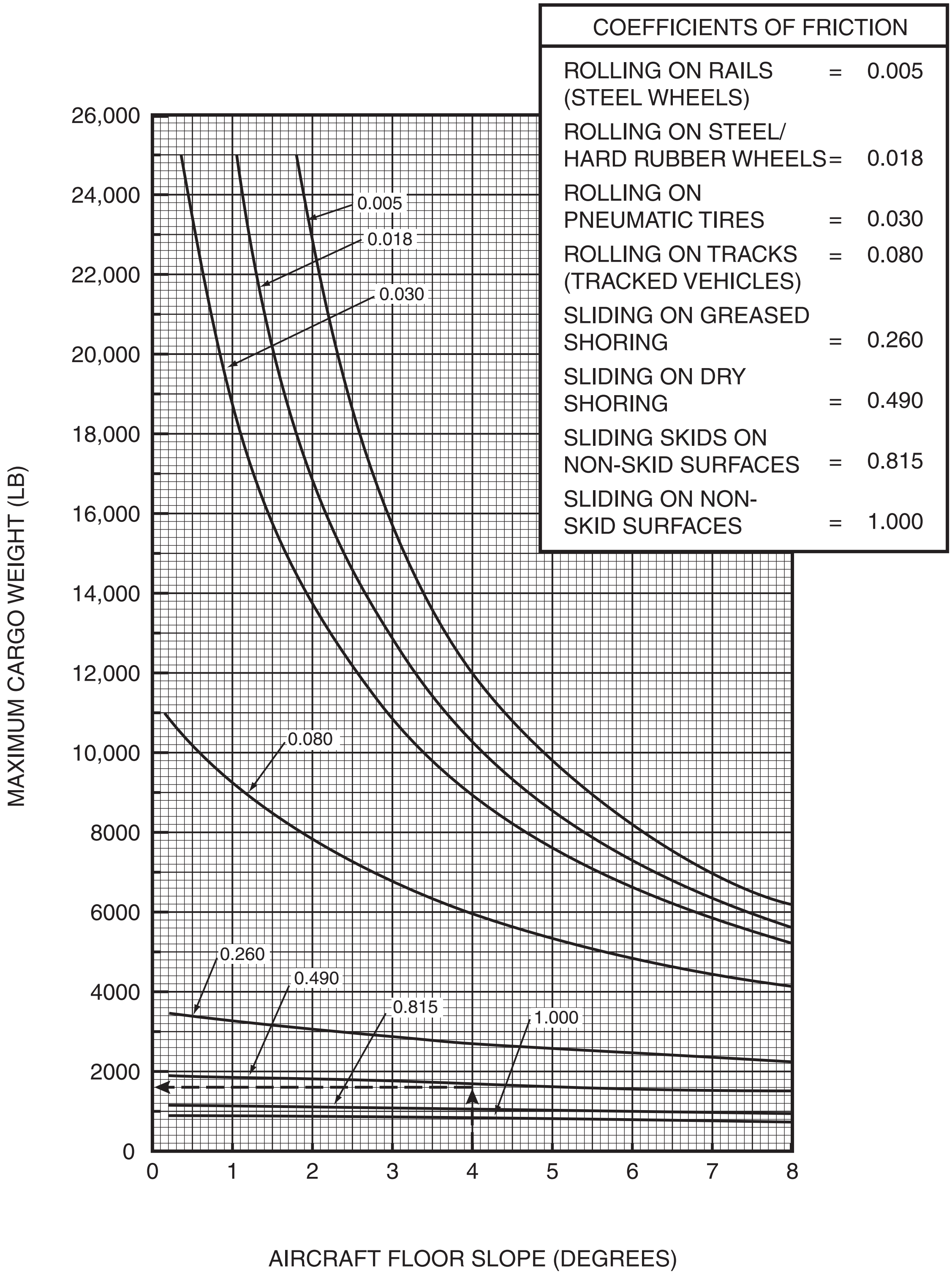


Figure 5A-4. Maximum Capability of Cargo Winch on Sloped Aircraft Floor For various Coefficient of Friction Values

GENERAL LOADING PROCEDURES FOR FLOOR-LOADED CARGO

The remainder of this section contains general instructions for loading procedures for floor-loaded cargo, including a comprehensive checklist.

Floor-loaded cargo can be placed anywhere within the cargo compartment, provided that the floor loading limitations are not exceeded, aircraft center of gravity limits are observed, and restraint criteria are met.

CARGO LOADING METHODS

CAUTION

- If the cargo door sill conveyor assembly has been removed with the cargo handling system, extreme caution must be used to prevent damage to the door jamb.
- Roller conveyors shall not be used to move floor-loaded cargo. Roller conveyors are restricted to moving pallets or platforms specifically designated for use with the roller conveyor system, unless authorized by specific procedures in Section V.

The loading method used for a specific item of cargo normally depends upon its size, weight, and physical characteristics. All cargo carried in the aircraft shall be loaded and offloaded through the cargo door.

Wheeled equipment shall be manually pulled or pushed into the aircraft. Longitudinal movement may be accomplished manually or by the cargo winch.

Boxed/crated cargo should be carried, if possible, or carefully skidded across the protective shoring into position. Winching boxed or crated cargo may be accomplished provided that shoring is placed on the cargo compartment floor and the shoring does not move during winching operation.

RULES FOR DETERMINING TRANSPORTABILITY OF FLOOR-LOADED CARGO

BOX TYPE CARGO

Observe all rules when planning loads. (See sample problem 1):

1. Determine the total weight of the cargo unit by weighing, then compute the area in square inches, and the length in linear feet (figure 5A-5, detail A).

CAUTION

- The cargo floor surface is very vulnerable to damage. It is required to use shoring at all times when loading directly on the cargo floor.
- The primary considerations are: control of pounds per linear foot to avoid bending the fuselage, square-foot weight distribution to prevent damage to the cargo floor, and the square-inch weight distribution to prevent puncture of the cargo floor surface.

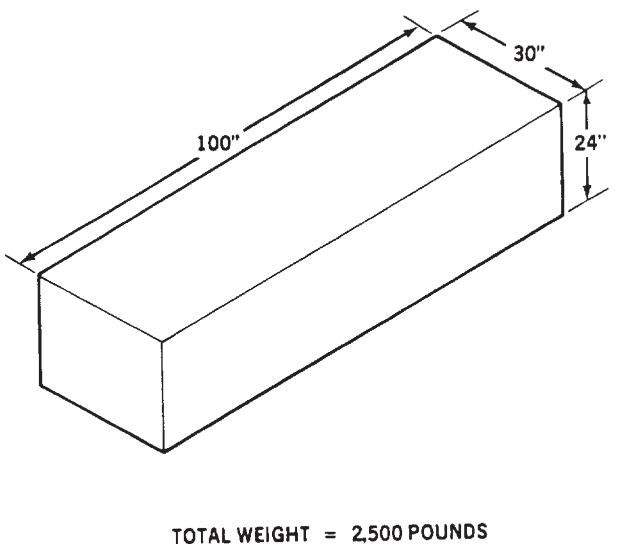
2. Determine the PSI of the unit by dividing the weight of the unit by the total area (in square inches) that contacts the floor.

This value of PSI must be within the applicable allowances as shown in columns 6 and 7 of figure 5A-l.

3. Determine the PSF of the unit by dividing the weight of the unit by the total area (in square feet) that contacts the floor. This value of PSF must be within the applicable allowances shown in columns 8 and 9 of figure 5A-1.

4. Determine the PLF by dividing the weight of the unit by the length in feet. If more than one load is to be placed across the width of the floor, determine the PLF for the entire load. The value of pounds per linear foot must be within the limits shown in columns 10 and 11 of figure 5A-1.

SAMPLE PROBLEM 1 - BOX TYPE CARGO



SA9-146

PROBLEM:

Determine if this box type cargo can be safely loaded and air transported on the cargo floor compartment 4R (D). One layer of 3/4-inch plywood sheets have been installed to protect the floor panels.

SOLUTION:

Refer to rules for determining transportability.

1. Total weight = 2,500 pounds

   Contact area in inches
   (L + 2t) x (W + 2t)

   (where t = thickness of the shoring)

   = (100 in. + 2 (.75 in.)) x
   (30 in. + 2 (.75 in.))

   = 3,197.3 sq. in.

   Contact area in feet =
   $$\frac{3{,}197.3 \text{ sq. in.}}{144 \text{ sq. in./1 sq. ft.}}$$

   = 22.2 sq. ft.

   Contact length in feet =

   $$\frac{101.5 \text{ in.}}{12 \text{ in./ft.}} = 8.5 \text{ lin. ft.}$$

2. To determine the pounds per square inch (PSI), divide the weight of the unit by the contact area expressed in square inches.

   $$\frac{2{,}500 \text{ lb.}}{3{,}197.3 \text{ sq. in.}} = 0.8 \text{ PSI}$$

   The limit is 1.0 PSI (figure 5A-1, column 7)

3. To determine the pounds per square foot (PSF), divide the weight of the unit by the contact area expressed in square feet.

$$\frac{2{,}500 \text{ lb.}}{22.2 \text{ sq. ft.}} = 112.6 \text{ PSF}$$

The limit is 150 PSF (figure 5A-1, column 9).

4. To determine the pounds per linear foot (PLF), divide the weight of the unit by the contact length in feet.

$$\frac{2{,}500 \text{ lb.}}{8.5 \text{ lin. ft.}} = 294.1 \text{ PLF}$$

The limit for compartment 4R (D) is 738 PLF (figure 5A-1, column 11)

Since none of the above values exceed the maximum limits of the aircraft, this item may be safely air transported in compartment 4R (D).

CARGO ON SUPPORTS

Observe all rules when planning loads. (See sample problem 2.)

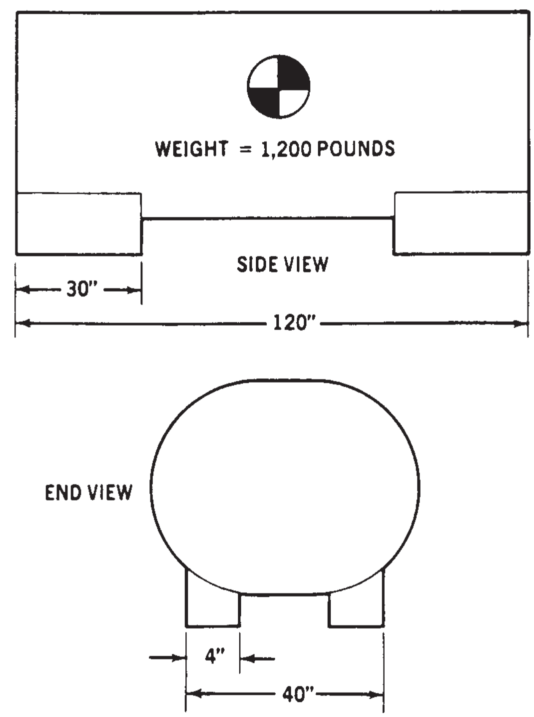
1. Determine the weight carried by each support and the single support contact area (figure 5A-5, detail B).

2. Using the weight per support and the contact area of the single support, use the following steps to check the load effect on the floor (figure 5A-1):

   a. Divide the weight on the support by the contact area of the support in square feet. This value, in pounds per square foot, must be within the allowables shown in columns 8 and 9 of figure 5A-1. Shoring may be used to increase the contact bearing area.

   b. Divide the weight on the support by the contact area in square inches. This value, in pounds per square inch, must be within the allowables shown in columns 6 and 7 of figure 5A-1.

SAMPLE PROBLEM 2 - SKID-MOUNTED CARGO



SA9-147

PROBLEM:

Determine if this skid-mounted cargo can be loaded in compartments 6L (F) and 7L (G). Plywood sheets (3/4-inch) have been placed on the floor to protect the floor panels.

SOLUTION:

Refer to rules for determining transportability.

1. Weight = 1,200 Pounds

   Weight per support = 300 pounds

   Contact area per support (sq. in.) =

   = (30 in. + 2 (.75 in.)) x
   (4 in. + 2 (.75 in.))

   = 173.3 sq. in.

2. Column 13, figure 5A-1, maximum compartment loads 6,500 pounds for compartment 6L (F) and 10,000 pounds for compartment 7L (G) are not exceeded.

3. To determine the PSI, divide the weight per support by contact area of the support.

   $$\frac{300 \text{ pounds}}{173.3 \text{ sq. in.}} = 1.7 \text{ PSI}$$

   This value exceeds the maximum allowable of 1.0 PSI. Additional shoring is required before this item can be safely air transported.

4. To determine the total shoring requirement, use the formula for rectangular areas shown in figure 5A-2.

   Area = (W + 2t) x (L + 2t)

   where t = thickness of shoring First, the minimum required area must be determined to satisfy the floor loading. Divide the weight per support by the maximum PSI allowable.

   $$\frac{300 \text{ pounds}}{1.0 \text{ PSI}} = \begin{matrix}300 \text{ sq. in.} \\ \text{(minimum)}\end{matrix}$$

   Next, solve for the total shoring thickness by applying 300 sq. in. into the formula.

   Width of support 4 inches

   Length of support 30 inches

   300 sq. in. =
   (4 + 2t) x (30 + 2t)

   t = 2.4 inches

   The unit of cargo was loaded on 3/4-inch plywood sheets; therefore, an additional 1.65 inches of shoring is required under the supports.

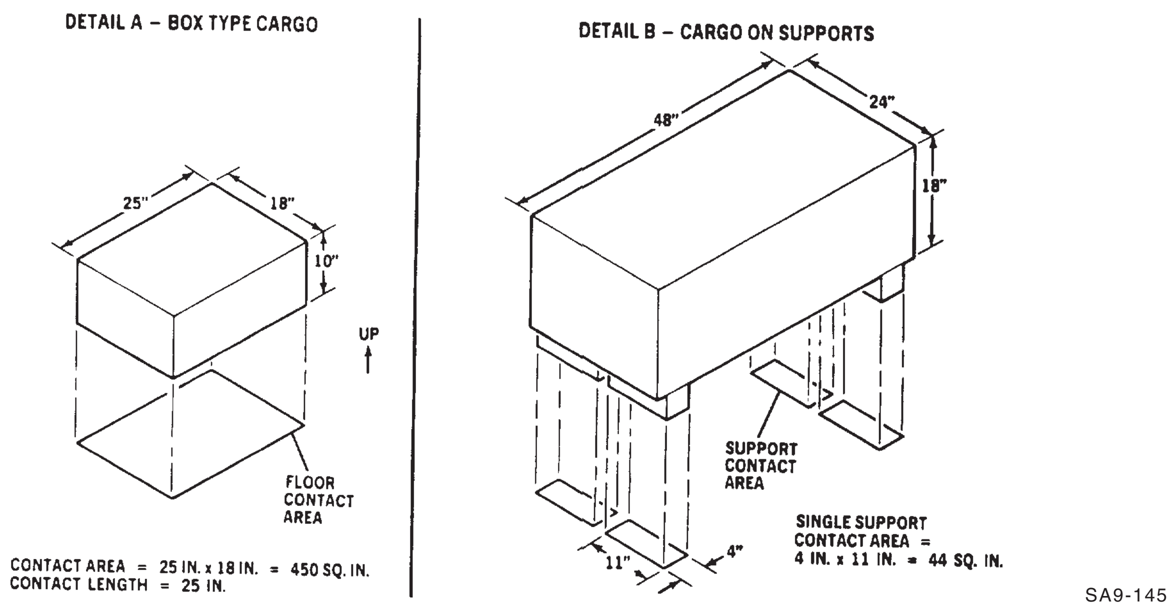


Figure 5A-5. Computing Floor Areas

DRUMS

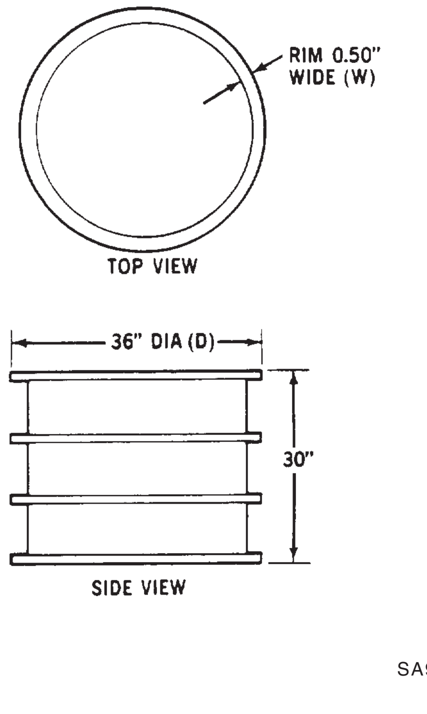
Observe all rules when planning loads. (See sample problems 3 and 4).

1. Determine the total weight of the cargo unit by weighing, then compute contact length in linear feet.

2. Determine the PLF by dividing the weight of the unit by the length in feet. If more than one drum is to be placed across the width of the floor, determine the PLF for the entire load. This value must be within the limits shown in columns 10 and 11 of figure 5A-1. Use figures 5A-6, 5A-7, 5A-8, 5A-9 and 5A-10 to control PSI within limits shown in columns 6 and 7 of figure 5A-1.

<u>SAMPLE PROBLEM 3 - DRUMS WITH RIMS</u>

(USE FIGURES 5A-6, 5A-7, 5A-8 AND 5A-9)



SA9-153

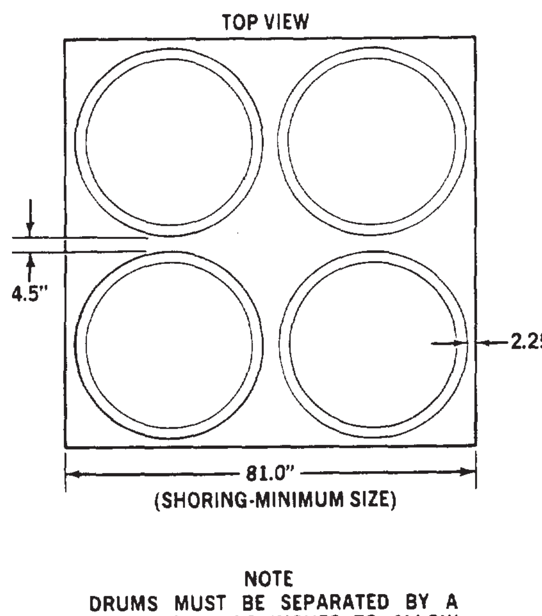
PROBLEM:

Four 50 gallon drums are to be loaded and transported in compartment 5R (E). The gross weight of each drum is 450 pounds, the base flange width (W) is 0.50 inch, and the diameter of each drum is 36 inches as shown above.

SOLUTION:

1. Figure 5A-7 indicates that a total of 3 layers of 3/4 inch plywood shoring is required for flight conditions. One sheet of plywood is required for loading/offloading operations.

2. Determine the PLF loading for the four drums arranged as shown in the following illustration.



NOTE
DRUMS MUST BE SEPARATED BY A MINIMUM OF 4.5 INCHES TO ALLOW FOR THE EFFECT OF THE SHORING DISTRIBUTING THE WEIGHT TO THE CARGO FLOOR.

SA9-154

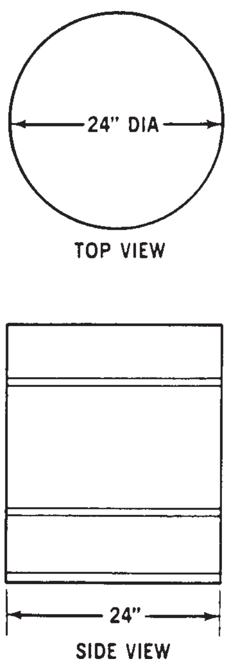
$$\text{Length (ft.)} = \frac{81.0 \text{ inches}}{12 \text{ in./ft.}} = 6.8 \text{ lin. ft.}$$

$$= \frac{(450 \text{ lbs/drum}) \times 4 \text{ drums}}{6.8 \text{ lin. ft.}}$$

$$= 264.7 \text{ PLF}$$

This is within the allowable PLF loading of 738 PLF for compartment 5R (E) shown in column 11, figure 5A-1

<u>SAMPLE PROBLEM 4 - DRUMS WITHOUT RIMS</u>



SA9-155

PROBLEM:

Determine contact pressure and shoring requirements for a 24-inch diameter flat bottom drum which weighs 575 pounds, to be loaded in compartment 2L (BB).

SOLUTION:

Figure 5A-10 indicates that 2 layers of 3/4-inch plywood sheets are required for flight conditions. One sheet is required for loading/offloading operations.

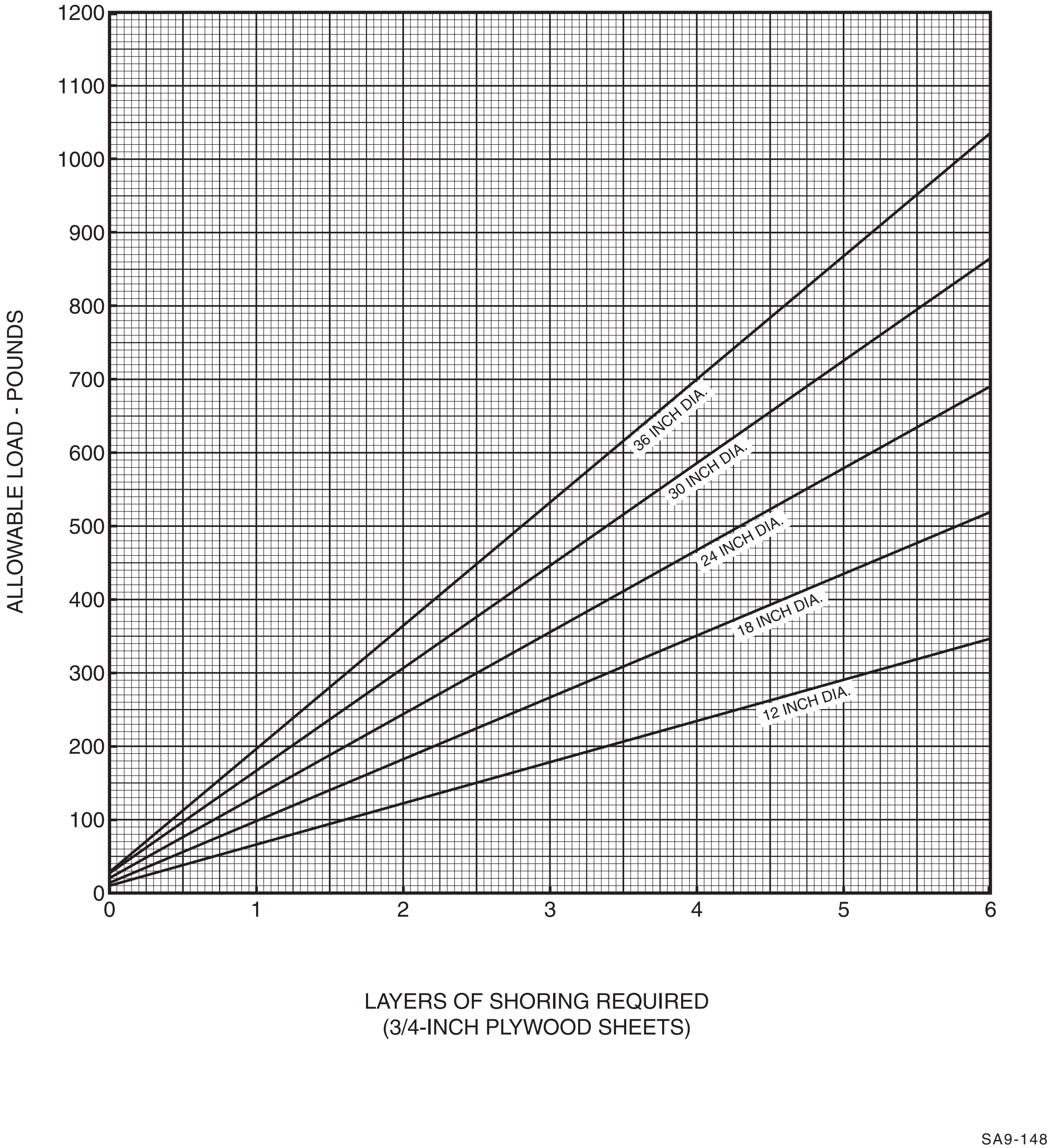


Figure 5A-6. Drums With 0.25-Inch Rims

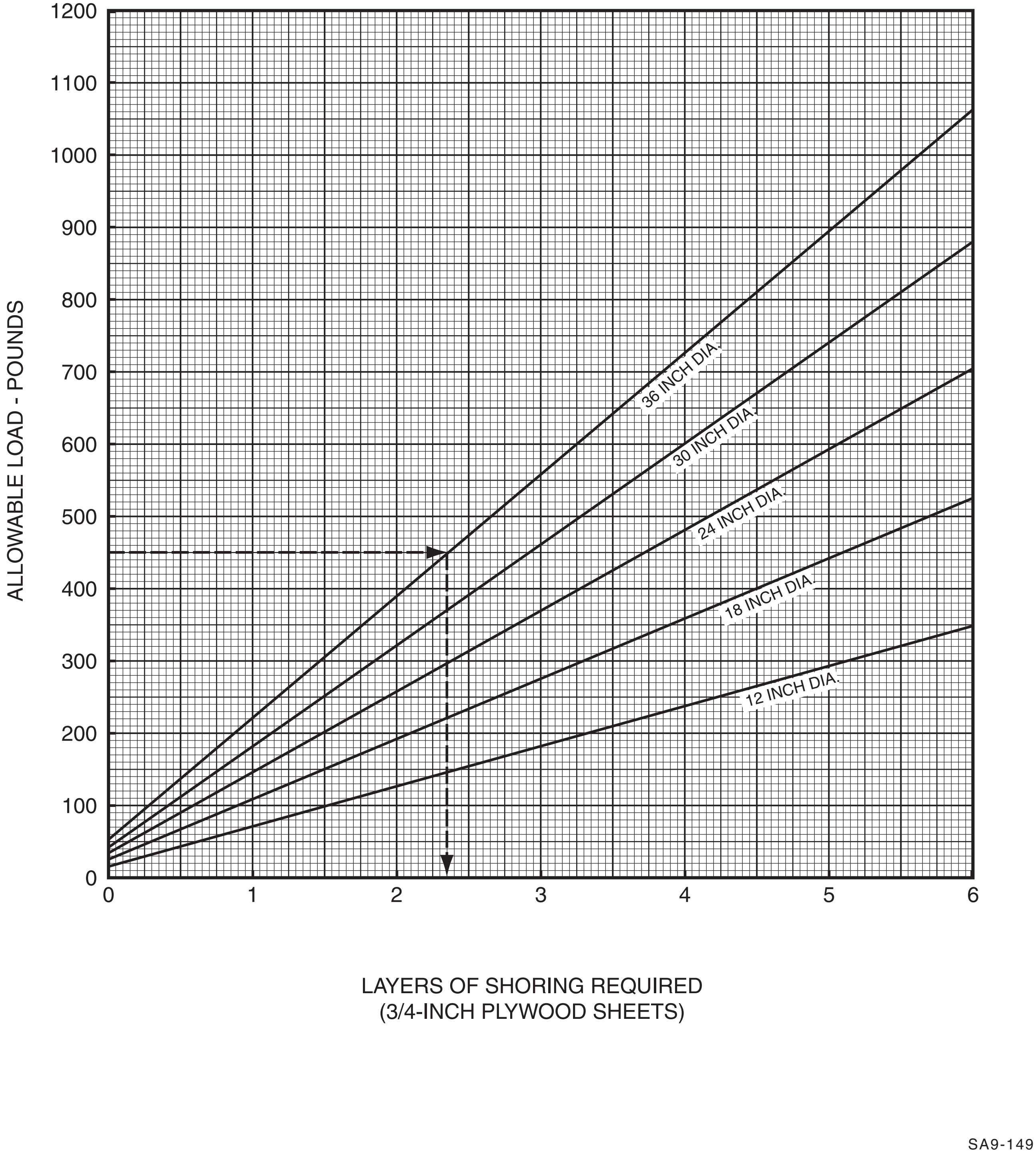


Figure 5A-7. Drums With 0.50-Inch Rims

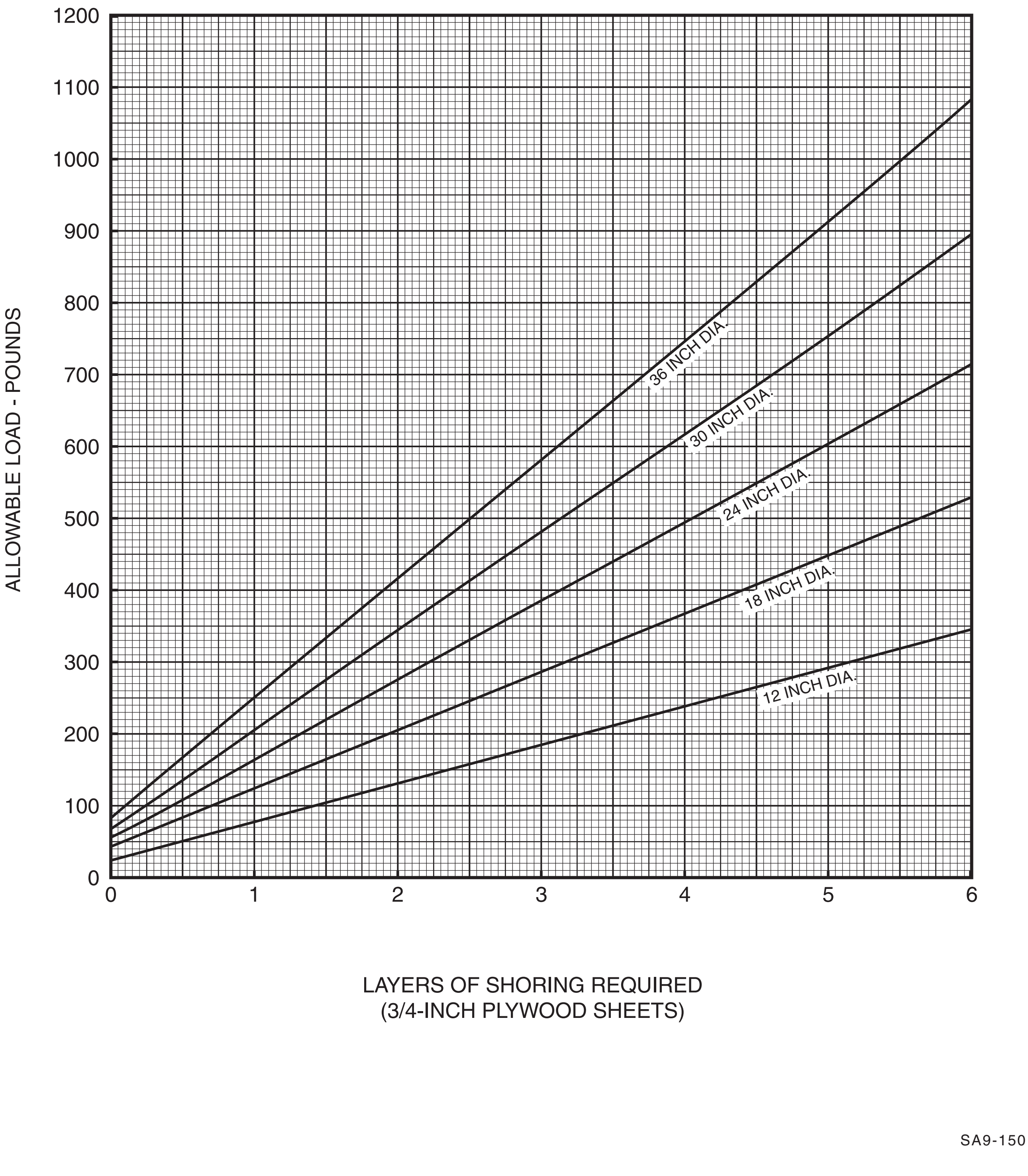


Figure 5A-8. Drums With 0.75-Inch Rims

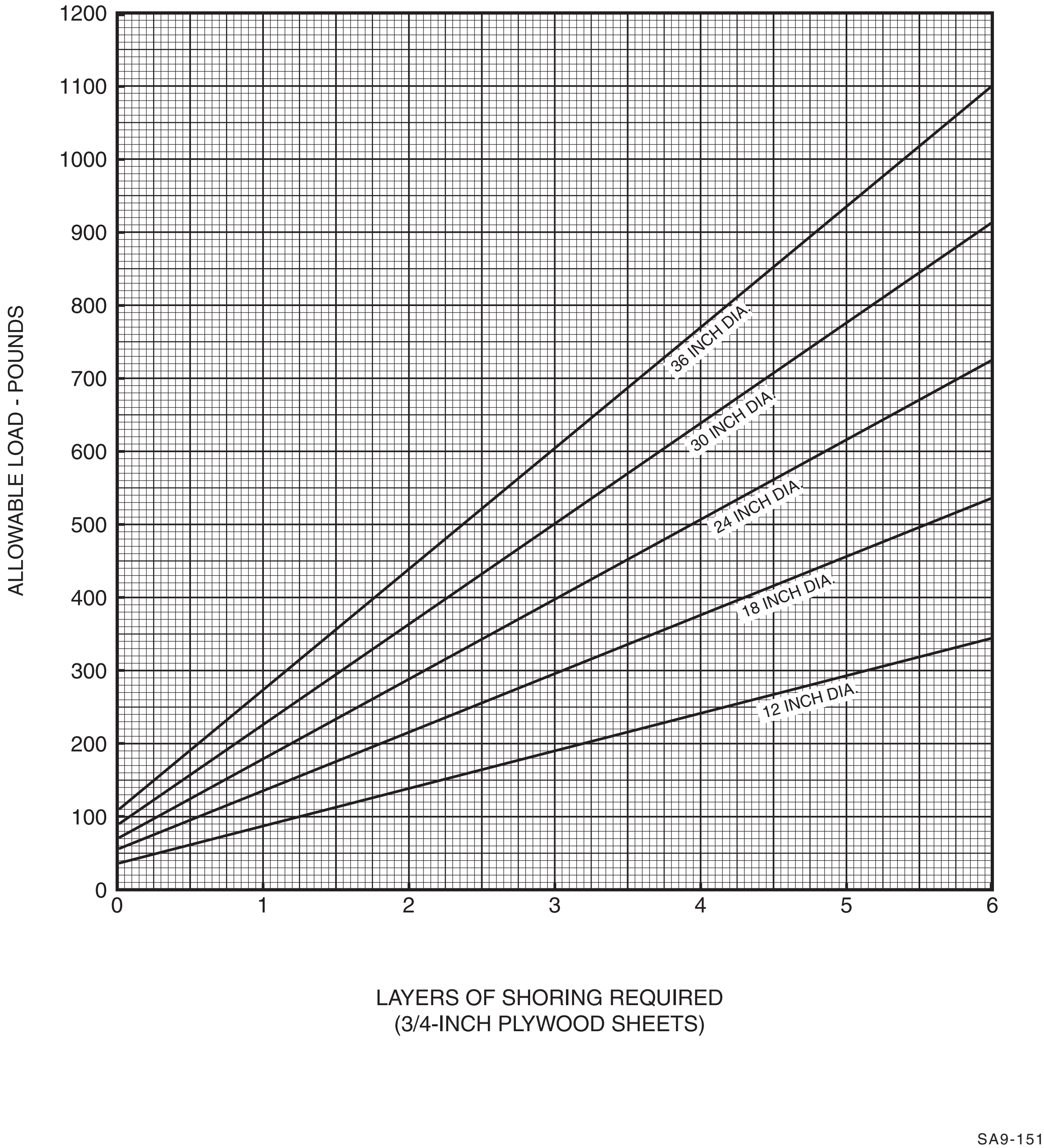


Figure 5A-9. Drums With 1.00-Inch Rims

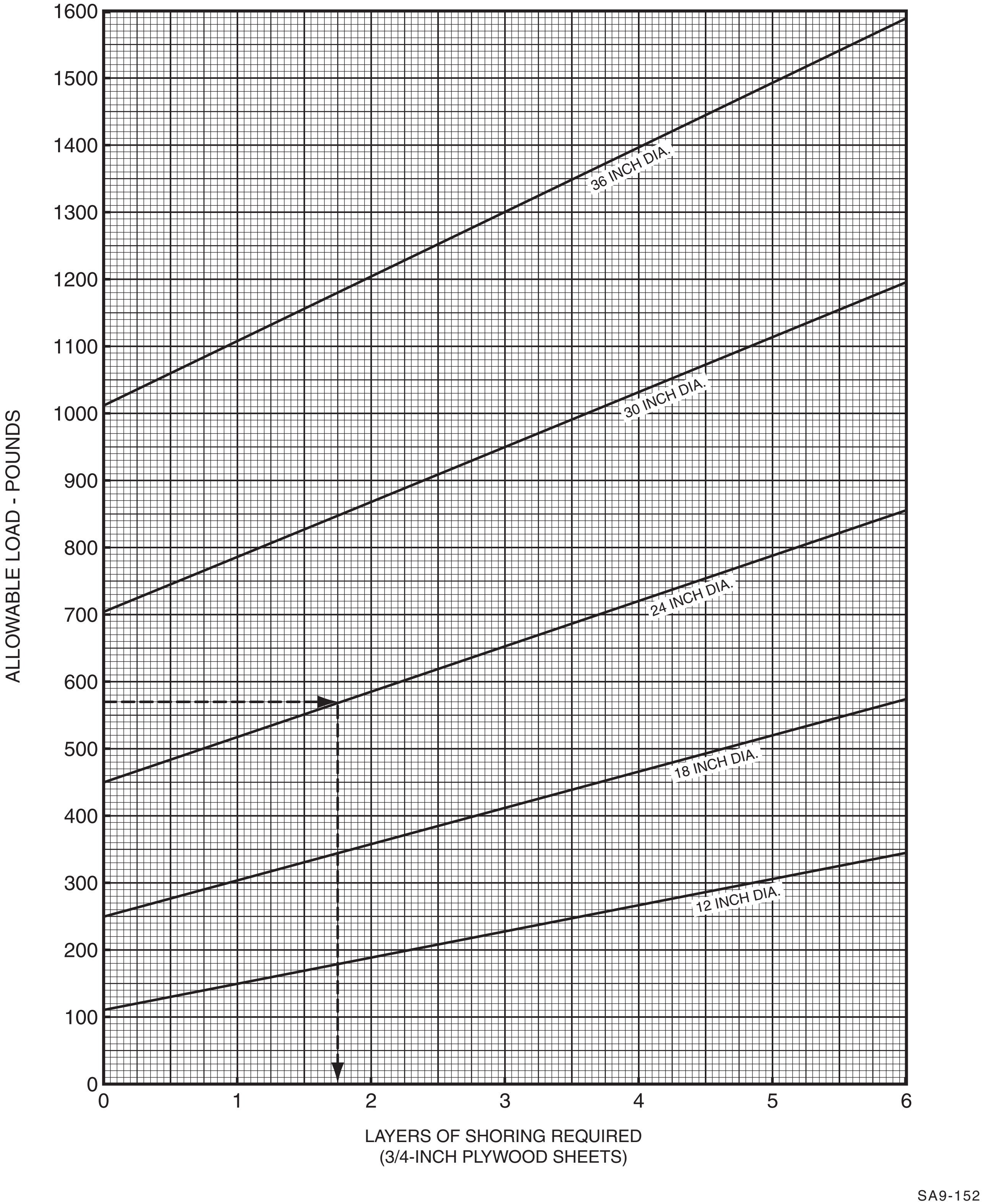


Figure 5A-10. Drums Without Rims

STEEL AND HARD RUBBER TIRE WHEEL ALLOWABLES

Observe all rules when planning loads (figure 5A-11).

1. Determine the total weight of the cargo unit, and the weight per wheel, by weighing.

2. Determine the width of the wheel by measurement.

3. Use figure 5A-11 to determine the maximum wheel load and shoring requirements for loading/offloading and flight conditions.

4. If more than one unit of cargo is loaded in the cargo compartment, ensure the combined weights do not exceed the limits shown in columns 12 and 13 of figure 5A-1.

CAUTION

The loading/offloading values of figure 5A-11 can be used for roller prybars; however, the maximum load per roller prybar, with one layer of shoring, is 700 pounds.

EQUIPMENT ON PNEUMATIC TIRES

Observe all rules when planning loads. (See sample problem 5.)

1. Determine the total weight of the equipment, each axle load, and each wheel load, by actual weighing.

2. Determine the wheel base and wheel tread, by measurement.

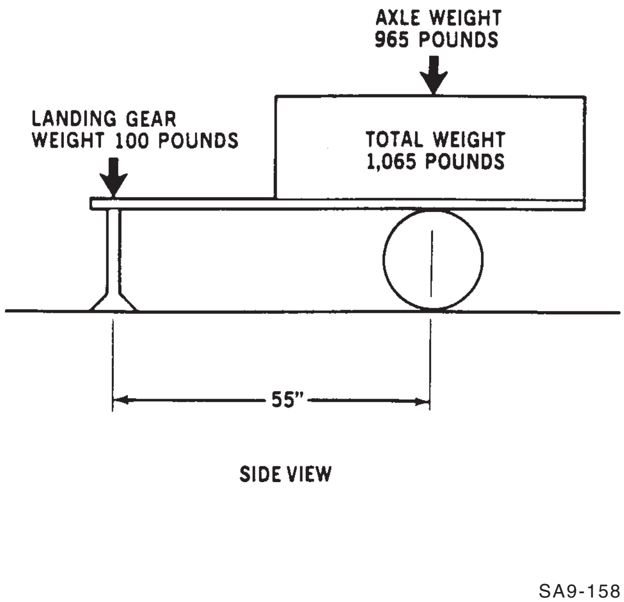
3. The values of pounds per axle and pounds per wheel must be within the allowable limits shown in columns 14 and 15 for loading/offloading and within the values shown in figure 5A-012 for flight conditions.

4. If the equipment is equipped with both steel and pneumatic tires (i.e., U.S. Army Trailer), use figure 5A-11 for the steel wheel, and use figure 5A-12 for the pneumatic wheel.

5. If more than one item of cargo is loaded in the cargo compartment, determine the total weight loaded in the compartment to verify they do not exceed the limit as shown in columns 12 and 13 of figure 5A-1.

6. If more than one item with pneumatic tires is loaded in a compartment, verify the minimum spacing between axles, given in figure 5A-12, is maintained.

SAMPLE PROBLEM 5 - EQUIPMENT WITH PNEUMATIC TIRES.



PROBLEM:

Determine if this trailer can be safely loaded in the cargo compartment. One layer of 3/4-inch plywood sheets has been installed to protect the floor panels.

SOLUTION:

1. TOTAL WEIGHT = 1065 pounds

   Axle weight = 965 pounds

   Landing Gear = 100 pounds

   Tread = 53 inches

   Wheelbase = 55 inches

Figure 5A-12 indicates that two sheets of 3/4-inch plywood are required under the axle. The landing gear, 5 inches long and 1.5 inches wide, has an area of 7.5 square inches. Figure 5A-1, note 4, indicates that, for a contact area of 9 square inches or less, 10 PSI is allowed.

To determine the PSI of the landing gear, divide the weight by the area.

$$\text{PSI} = \frac{\text{100 pounds}}{\text{7.5 sq. in.}} = 13.3 \text{ PSI}$$

Since the PSI of the landing gear is greater than the 10 PSI allowed, shoring is required. The one layer of shoring that was installed to protect the floor panels also distributes the load over a larger area. This larger area is 19.5 square inches.

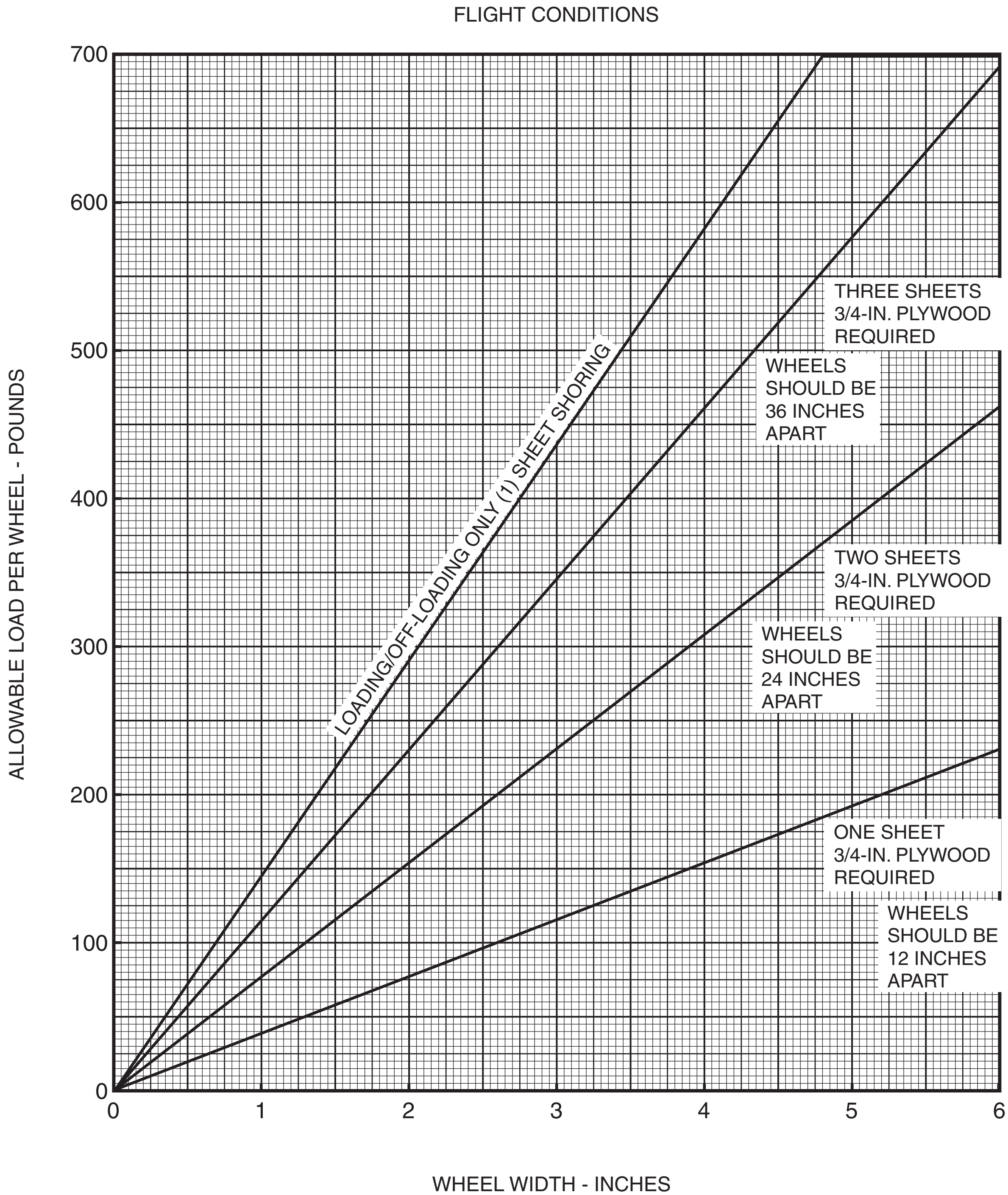
Area = (L + 2t) x (W + 2t)

Where t = thickness of shoring

To determine the revised PSI, divide the weight by the larger area.

$$\text{PSI} = \frac{\text{100 pounds}}{\text{19.5 sq. in.}} = 5.1 \text{ PSI}$$

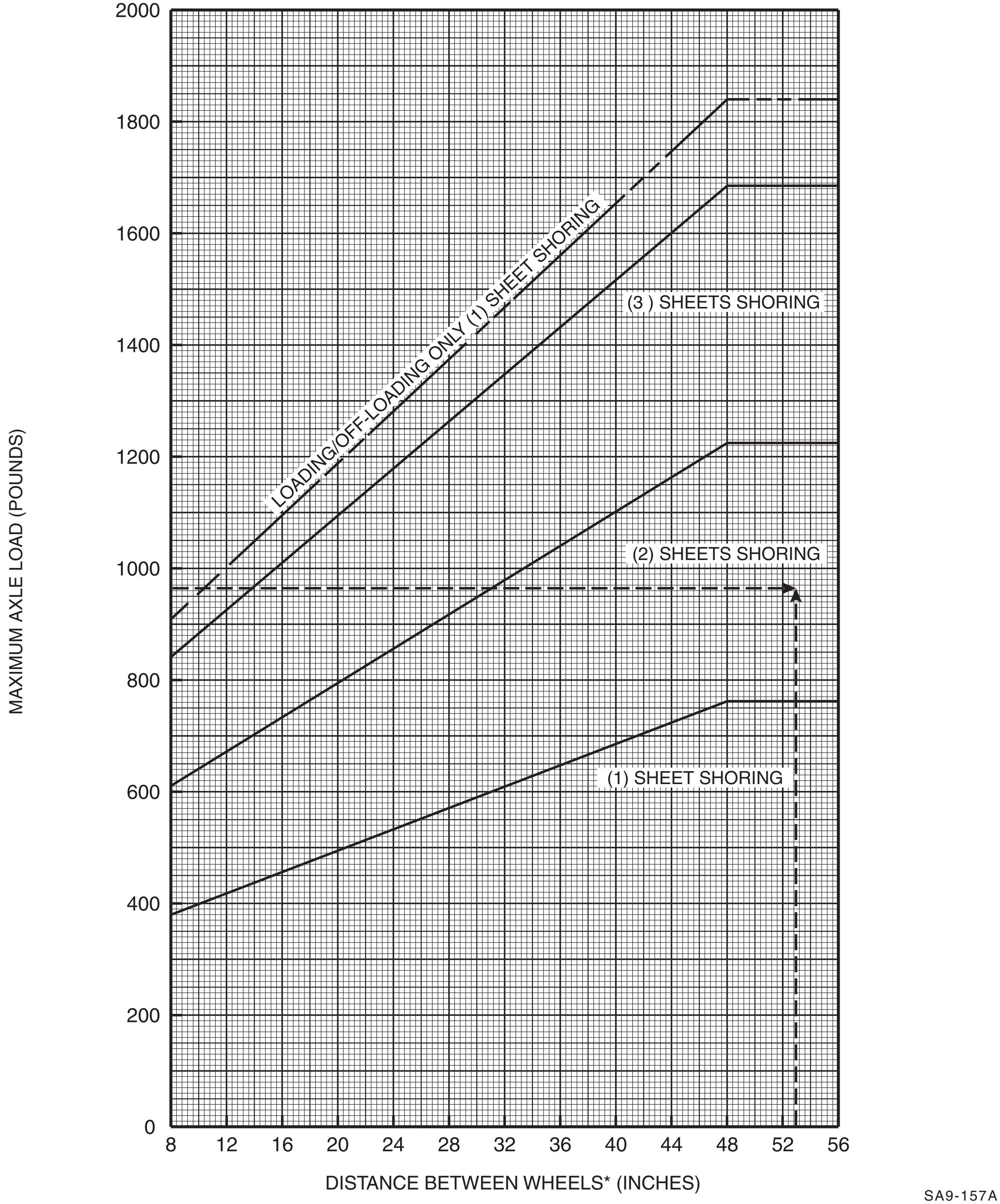
Since this PSI is less than the allowed, the landing gear can be loaded with a single sheet of shoring.



CAUTION: RUBBER OR STEEL WHEELS WITH LOADS GREATER THAN 700 POUNDS WILL NOT BE LOADED.

SA9-156A

Figure 5A-11. Allowable Loads For Hard Rubber Or Steel Wheels



*LESSER OF WHEEL BASE OR TREAD OR ADJACENT WHEEL

Figure 5A-12. Allowable Axle Load Pneumatic Tires

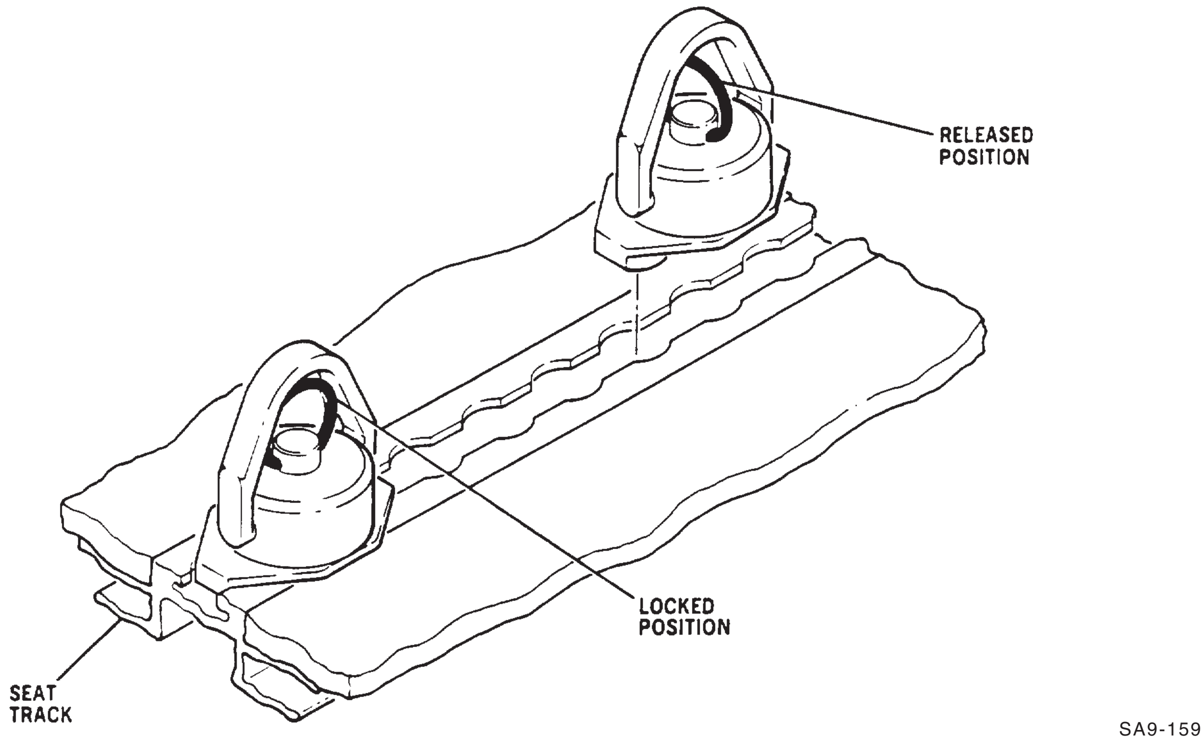


Figure 5A-13. A-7000 Tiedown Fitting

RESTRAINT FOR FLOOR-LOADED CARGO

The restraint criteria and the minimum restraint forces outlined in Section IV apply to loading floor-loaded cargo. The difference in restraint of floor-loaded cargo, and cargo that has been palletized, is the attachment of the tiedown devices. The tiedown devices are attached directly on the cargo floor by installing double swivel-type fittings (A-7000 or equivalent) in the seat tracks, as shown in figure 5A-13. The fittings should be installed at 20-inch intervals within a given seat track. This results in a hypothetical 20-inch grid pattern for tiedown, as the seat tracks are separated by approximately 20 inches. A general tiedown capacity of 1,600 pounds, in any direction, is allowed anywhere on the seat track.

Ratio Method 2, presented in Section IV, can be used to determine restraint from tiedown devices attached directly to the cargo floor. In certain areas, a maximum of 1,600 or 3,000 pounds vertical restraint is allowed as shown in figure 5A-14.

NOTE

An A-7000 tiedown fitting can provide up to 10,000 pounds of restraint, but the overall restraint received is determined by two factors: vertical tiedown allowables and the type of tiedown device used.

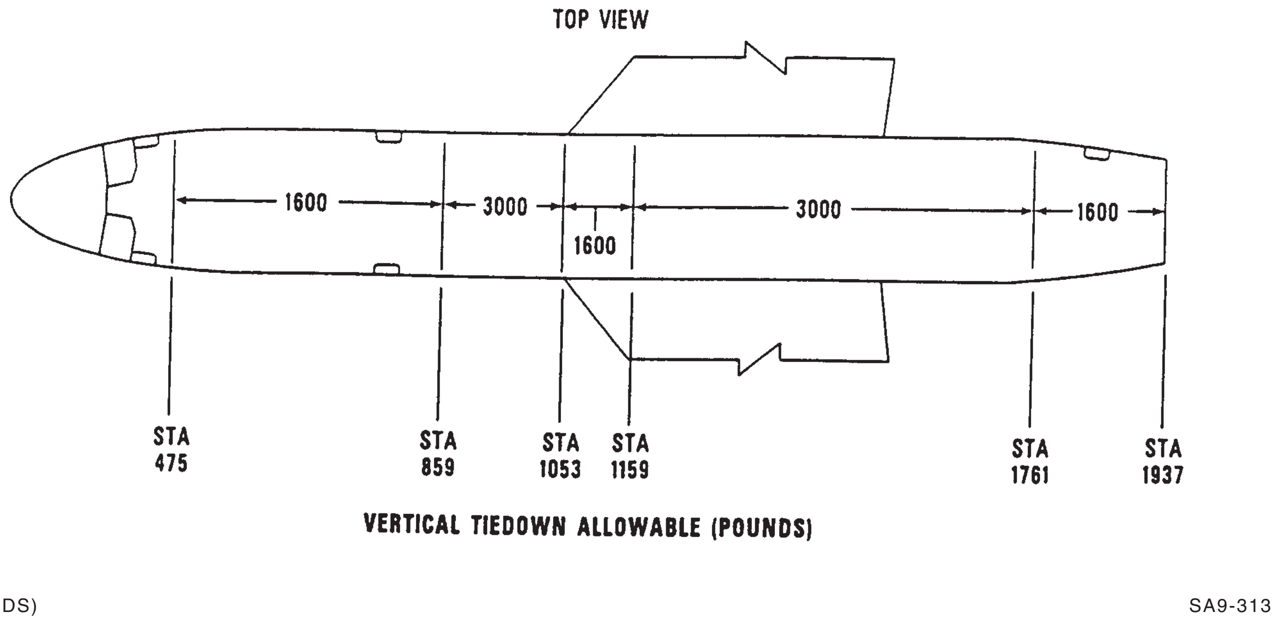


Figure 5A-14. Floor-Loaded Vertical Tiedown Allowables

CHECKLIST - FLOOR-LOADED CARGO

(NOTE: SECTION IV CHECKLISTS APPLY FOR OTHER LOADING/OFFLOADING TASKS)

1. Loading Crew . . . . BRIEFED

   Brief loading crew members on duties to be accomplished and hand signals to be used.

2. Cargo Compartment Floor . . . . CHECKED

   Only method of loading floor-loaded cargo is without cargo handling system installed in aircraft.

3. Contact Area Pressure . . . . COMPUTED

   Determine the contact are pressures of cargo units.

4. Shoring Requirements . . . . DETERMINED

   Determine Shoring Requirements.

5. Dimension, Weights, and CG Locations of Cargo Units . . . . MARKED

   Verify all applicable cargo is properly marked for air shipment.

6. Guides . . . . ASSIGNED

   Assign guides to observe critical clearances.

7. Loader/Elevator Driver . . . . BRIEFED

   Caution driver to follow signals of guides and not attempt to judge clearances by himself. Brief driver on procedures to be followed during loading/offloading of cargo, such as tilting, vertical, and horizontal positions.

8. Wheel Chock(s) . . . . POSITIONED

   Position chock(s) to prevent loader from striking aircraft. Position additional chock(s) if more than one loader/elevator is used.

9. Loader/Elevator . . . . POSITION/ADJUSTED

   Direct loader/elevator driver into position. Adjust level of loader/elevator to the same level as the aircraft cargo floor.

10. Cargo Door Sill Conveyor . . . . INSTALL (IF AVAILABLE)

11. Load Cargo .... COMPLETED

    Position cargo as required.

12. Types and Number of Tiedown Devices Required.......................... COMPUTED

    Determine types and number of tiedown devices required to meet restraint criteria.

13. Installation of Tiedown Devices .... SUPERVISED

    Supervise the installation of tiedown fittings and devices.

14. Tiedown Device Installation... CHECKED

    Check tiedown device installation and tighten.

15. Cargo Door Sill Conveyor.. STOWED

    Remove door sill conveyor assembly and stow.

B-1B ENGINE/3000E TRAILER

GENERAL

This section contains instructions for preloading, loading, restraining and offloading the B-1B Engine/3000E Trailer combination. The most critical part of loading this item is the engine to cargo door clearance; specifially the distance from the top of the engine to the top of the cargo door opening distance.

PREPARATION OF AIRCRAFT FOR LOADING

Prepare the aircraft for loading the B-1B Engine/3000E Trailer as outlined in Section IV of this manual and as follows:

The engine/trailer can be loaded longitudinally on either side of the aircraft. The engine/trailer will fit the aircraft contour from pallet positions 2 L/R into pallet positions 10 L/R when centered on the 463L pallet (coupled on the 88-inch side). Boom Operators will check aircraft CG/gross weight and the TO 1C-10(K)A-9 Deflection Chart to determine if deflection is an issue for loading/offloading. The cargo door will be in the full-open position for all on/offloading procedures and the cargo barrier net will be raised to its highest possible position. All restraint and axle load limitations will be in accordance with Section IV of this manual.

CAUTION

- Due to the height and weight of the B-1B Engine/3000E Trailer, it is critical for the boom operator to check for any deflection issues during loading. The B-1B Engine/3000E Trailer provides 1/2 inch to 1 inch of clearance between the highest point of the B-1B Engine and the top of the cargo door opening; use extreme caution while loading/offloading.
- Due to the height and weight of the B-1B Engine/3000E Trailer, it is critical for the boom operator to maintain positive control of the item once it enters the aircraft. The preferred method for rotating this item is manually; however, the boom operator should not hesitate to use the powered rollers to assist in this task; loss of control of this item once it enters the aircraft could cause damage to the aircraft and/or injury to personnel.

PREPARATION OF THE B-1B/3000E TRAILER FOR LOADING

Prepare the B-1B Engine/3000E Trailer for loading on a pallet coupled on the 88-inch side in accordance with the procedures outlined for vehicle/equipment preparation in Section IV of this manual, and as follows:

The Boom Operator and Load Team Supervisor will ensure that the placard height is 99 inches or less; the item will be measured by the boom operator prior to the cargo entering the aircraft. They will also ensure that trailer tire pressures are no greater than 32 PSI and no less than 30 PSI and the engine/trailer are securely mated together and fully restrained prior to entering the aircraft to prevent movement/shifting.

LOADING PRECAUTIONS

Observe all loading precautions as outlined for vehicle/equipment loading in Section IV, and as follows:

1. Close coordination between the Boom Operator and Loader Operator is critical. Maintain positive visual and verbal contact with the loader operator at all times and thoroughly brief all hand signals and loading procedures prior to upload/offload.

2. The Boom Operator will ensure that the loader elevator rollers are level with the aircraft rollers; if the loader elevator is higher than the aircraft floor, the B1-B Engine/ 3000E Trailer combination will strike the cargo door/fuselage causing damage to both.

3. The engine/trailer combination must be brought into the aircraft as slow as possible so that cargo clearance and deflection can be monitored. The highest point on the cargo is about one-third of the way down from the aft-end of the engine (raised metal ring around engine) at a height of 99 inches. This part of the engine will provide about one-half inch of clearance to the rubber insulation covering the cargo door frame. Adjust the loader elevator height to ensure loader surface is level with the omni panel and that the top of the engine doesn't contact the upper cargo door frame.

4. When the aircraft powered rollers are energized, the engine/trailer combination will raise up slightly. Allow the load elevator drive wheel to move the pallet train into the aircraft as far as possible before using the aircraft powered rollers. This will alleviate the possibility of the pallet rising and striking the top of the cargo door opening. Use caution when using the powered rollers during wet conditions.

5. The Boom Operator and Load Team will use caution when rolling the engine/trailer combination under the barrier net and aircraft fixture/structures (exit signs, etc.). Cabin doors 2 L/R will be fully closed and armed prior to on/offloading this item.

LOADING PROCEDURES

Follow procedures for loading vehicles on HCU-6/E pallets into the cargo compartment as outlined in Section IV, and as follows:

1. Center the loader elevator with the cargo door opening to allow for max clearance of the cargo door actuating mechanism during on/offloading.

2. The Boom Operator will assign and brief spotters to monitor all four corners of the item as it's on/offloaded.

3. A spotter will be positioned opposite of the boom operator to monitor cargo door/ engine trailer clearance; this is a critical responibility and must be thoroughly briefed prior to on/offload.

4. The Boom Operator will ensure that the engine enters the aircraft aft-end first (the after-burner or exhaust section is considered the aft-end).

5. The Boom Operator and Load Team will monitor height/clearances and speed of the engine/trailer combination at all times during on/offloading.

6. The Boom Operator will maintain control of the engine/trailer combination once it enters the aircraft. The preferred method of rotating this item is manually; however, the boom operator should not hesitate to use the powered rollers to assist in this task; loss of control of this item once it enters the aircraft could cause damage to the aircraft and/or injury to personnel.

7. The Boom Operator will use TO 1C-10(K)A-9, section IV criteria for weight, axle, and restraint requirements and restrictions.

PREPARATION OF AIRCRAFT FOR OFFLOADING

Prepare the aircraft for offloading the B-1B Engine/3000E Trailer combination in the same manner as for loading.

OFFLOADING PRECAUTIONS

Offloading precautions are the same for loading.

OFFLOADING PROCEDURES

Offloading procedures are essentially the reverse of loading procedures.

MHU-83 SERIES MUNITIONS LOADING TRUCKS

GENERAL

This section contains instructions for preloading, loading, restraining and offloading the MHU-83 Series Munitions Loading Trucks (figure 5C-1). This munitions loading truck is also known as the MJ-4 truck. These instructions are only for driving the trucks onto a conveyable transfer platform and to be loaded on a partial-pallet subfloor. The MHU-83 series trucks can also be loaded/offloaded by the prepalletized method. Instructions for the MB-4 tractor (Section VB) can be used for loading the MHU-83 series trucks by the prepalletized method.

PREPARATION OF AIRCRAFT FOR LOADING

Prepare the aircraft for loading the MHU-83 series trucks as outlined in Section IV of this manual, and as follows:

1. The trucks can be loaded laterally or longitudinally in the aircraft as shown in figure 5C-2. If the trucks are loaded longitudinally, on pallets coupled on the 108 inch dimension, special pallet configurations forward and aft of the truck loaded position must be provided, as the truck extends over each end of the coupled pallets.

CAUTION

When loading MHU-83 series trucks in adjacent pallet positions, place the drive wheels (heaviest axle weight) on alternate pallets to prevent possible structural damage to floor.

NOTE

The tines of the MHU-83 series trucks may be rotated 90°, removed, or raised and pinned in the vertical position to allow proper clearance for walkways or adjacent pallet positions. With the tines in the normal position they may contact the aircraft sidewall.

2. If loaded laterally, the AZZ7351-527 or -529 center guide rail assemblies must be temporarily removed to allow the loaded coupled pallets to move longitudinally in the aircraft. The center-guide rails located at the positions where the truck is loaded are not required.

PREPARATION OF MHU-83 SERIES TRUCKS FOR LOADING

Prepare the truck for loading on a pallet subfloor by checking the vehicle in accordance with the procedures outlined for vehicle /equipment preparation in Section IV of this manual.

LOADING PRECAUTIONS

Observe all loading precautions as outlined for vehicle/equipment loading in Section IV.

LOADING PROCEDURES

Follow procedures for positioning the loader/elevator at the cargo door and for loading vehicles on HCU-6/E pallets into the cargo compartment as outlined in Section IV, and as follows:

LOADED LATERALLY

1. Move the vehicle (on conveyable transfer platform) from loader/elevator into the aircraft.

NOTE

> Use only 1-inch pallet couplers to couple the HCU-6/E pallets when loading the MHU-83 series trucks laterally in the cargo compartment.

2. Move the coupled pallets (with vehicle) into the prearranged load position (figure 5C-3).

3. Secure pallets by raising restraint assembly pawls and lock into position.

4. Tie down the truck in accordance with procedures outlined in Section IV and illustrated in figure 5C-4 and 5C-5.

LOADED LONGITUDINALLY

1. Position empty pallets in prearranged load positions.

2. Move the vehicle (on conveyable transfer platform) from loader/elevator into the aircraft.

3. Rotate the vehicle manually or by the powered roller system.

4. Move the vehicle longitudinally to the pallet subfloor.

5. When using 88-inch dimension transfer platform, with one-inch pallet couplers, use a minimum of two dual pawl end restraint assemblies at the forward end to preclude the platform from moving forward during transfer.

6. When using 108-inch dimension transfer platform, use two tiedown chains to secure the transfer platform to the pallets installed in the cargo handling system to preclude the platform from moving forward during transfer.

7. Drive or manually move the vehicle onto the pallet subfloor and into prearranged load position (figure 5C-6).

8. Tie down the truck in accordance with the procedures outlined in Section IV and illustrated in figures 5C-7 and 5C-8.

PREPARATION OF AIRCRAFT FOR OFFLOADING

Prepare the aircraft for offloading the MHU-83 series trucks in the same manner as for loading.

PREPARATION OF MHU-83 SERIES TRUCKS FOR OFFLOADING

No specific preparation of the MHU-83 series truck is required. If the truck is to be driven off the aircraft ensure the brakes are operating properly.

OFFLOADING PRECAUTIONS

Offloading precautions are the same as for loading.

OFFLOADING PROCEDURES

Offloading procedures are essentially the reverse loading procedures.

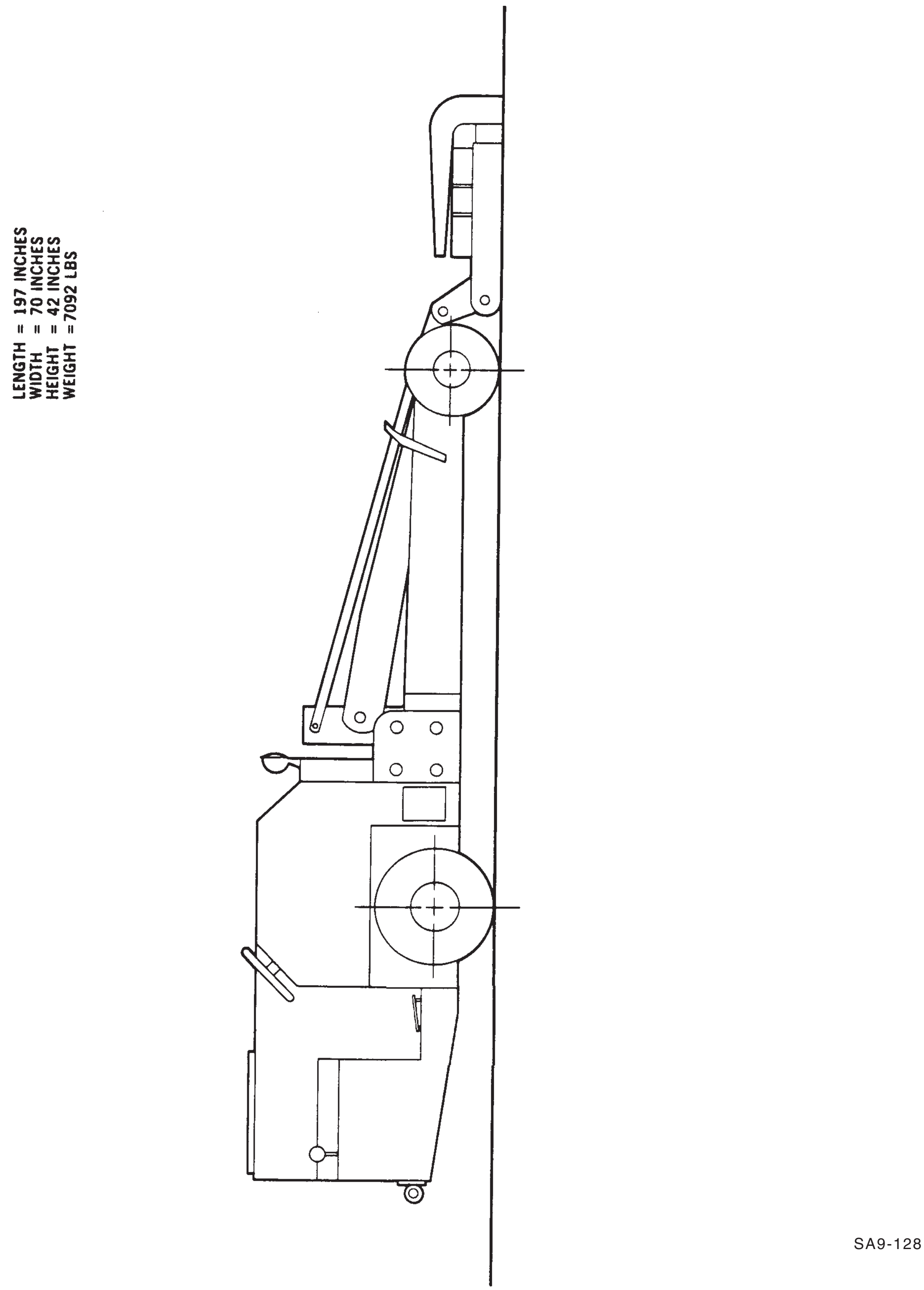


Figure 5C-1. MHU-83 Series Munitions Loading Truck

KC-10A CARGO LOADING MANUAL

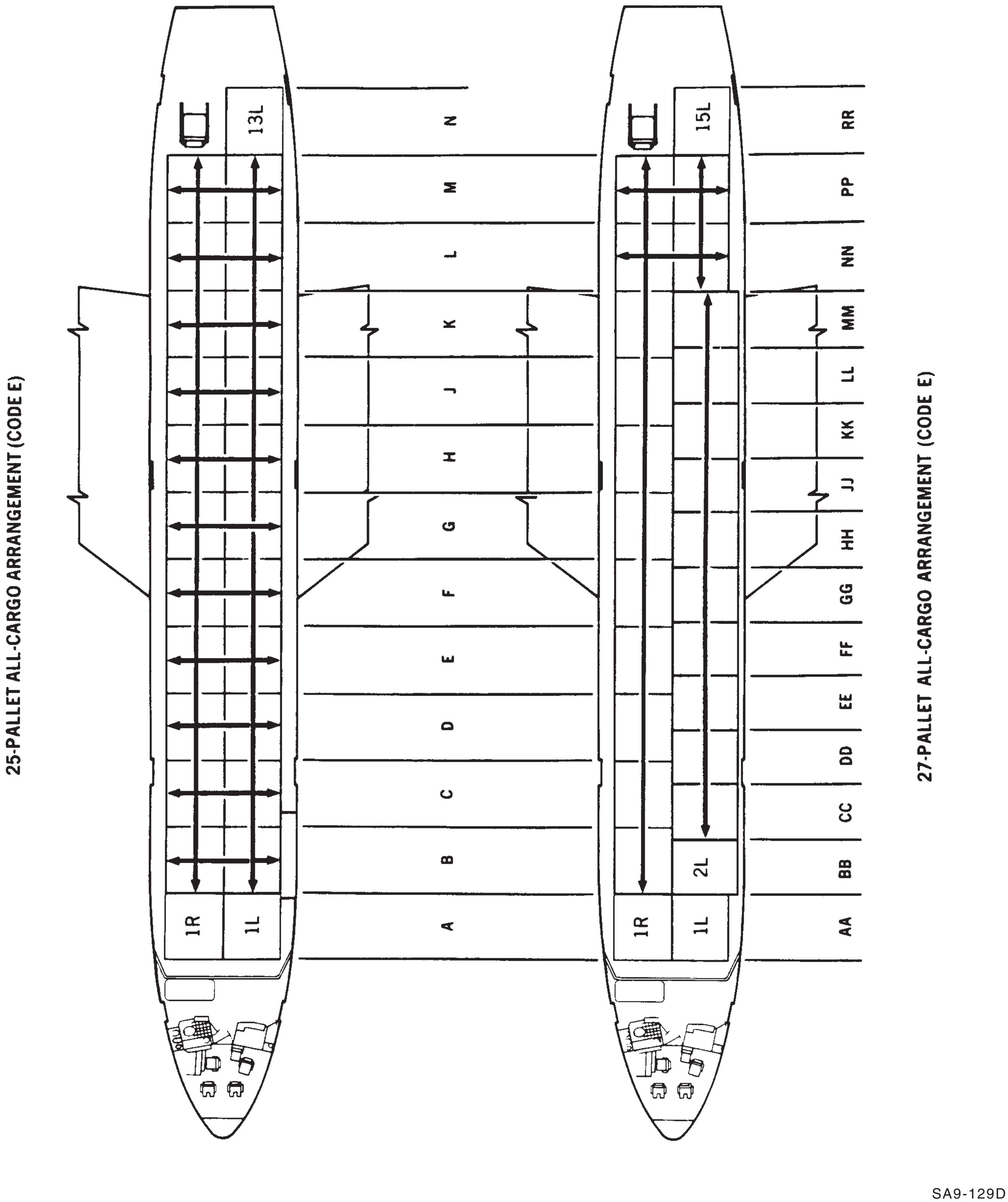


Figure 5C-2. Loadable Locations for MHU-83 Series Trucks

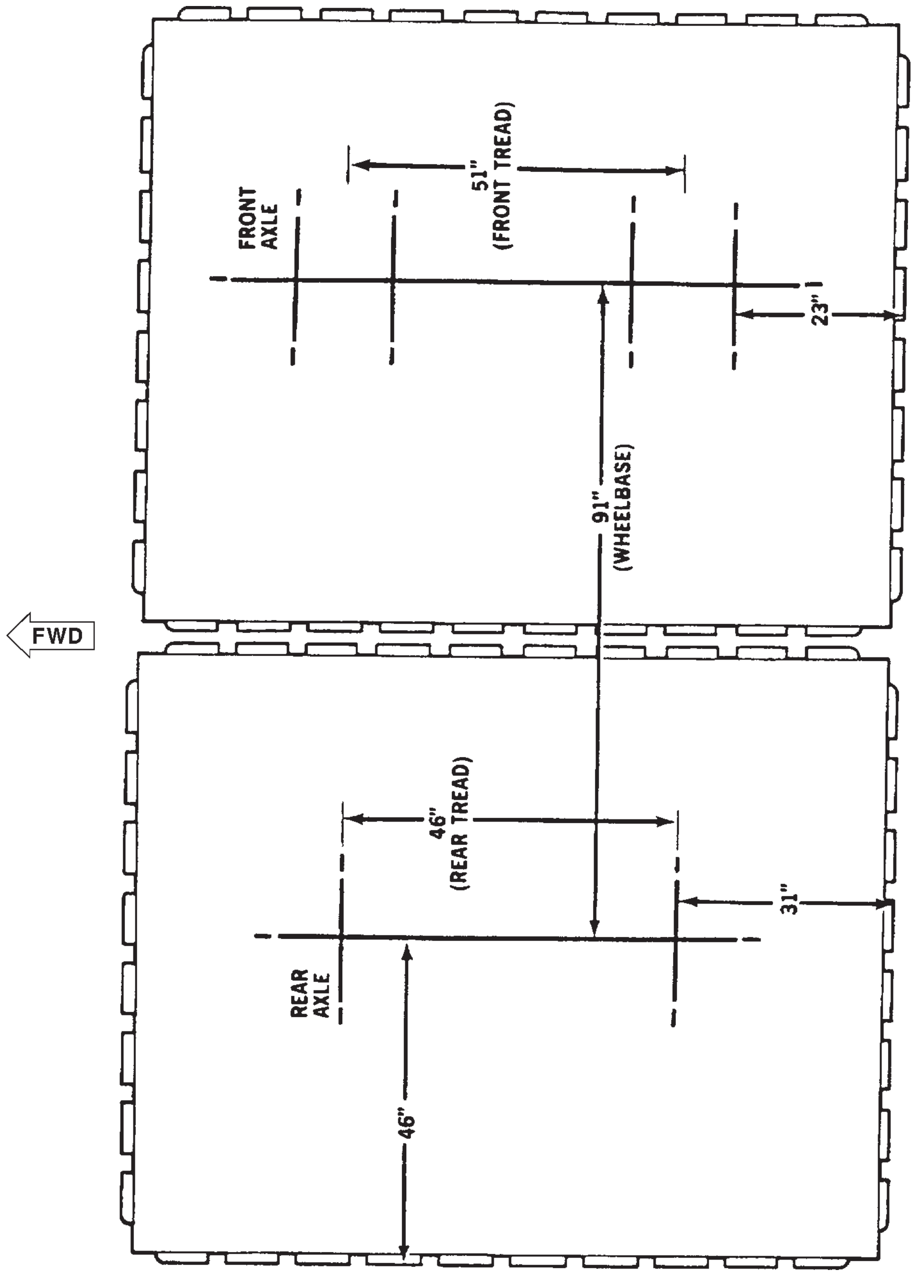


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Figure 5C-3. Position of MHU-83 Series Munitions Loading Truck on Coupled Pallets (Coupled on 108-Inch Dimension)

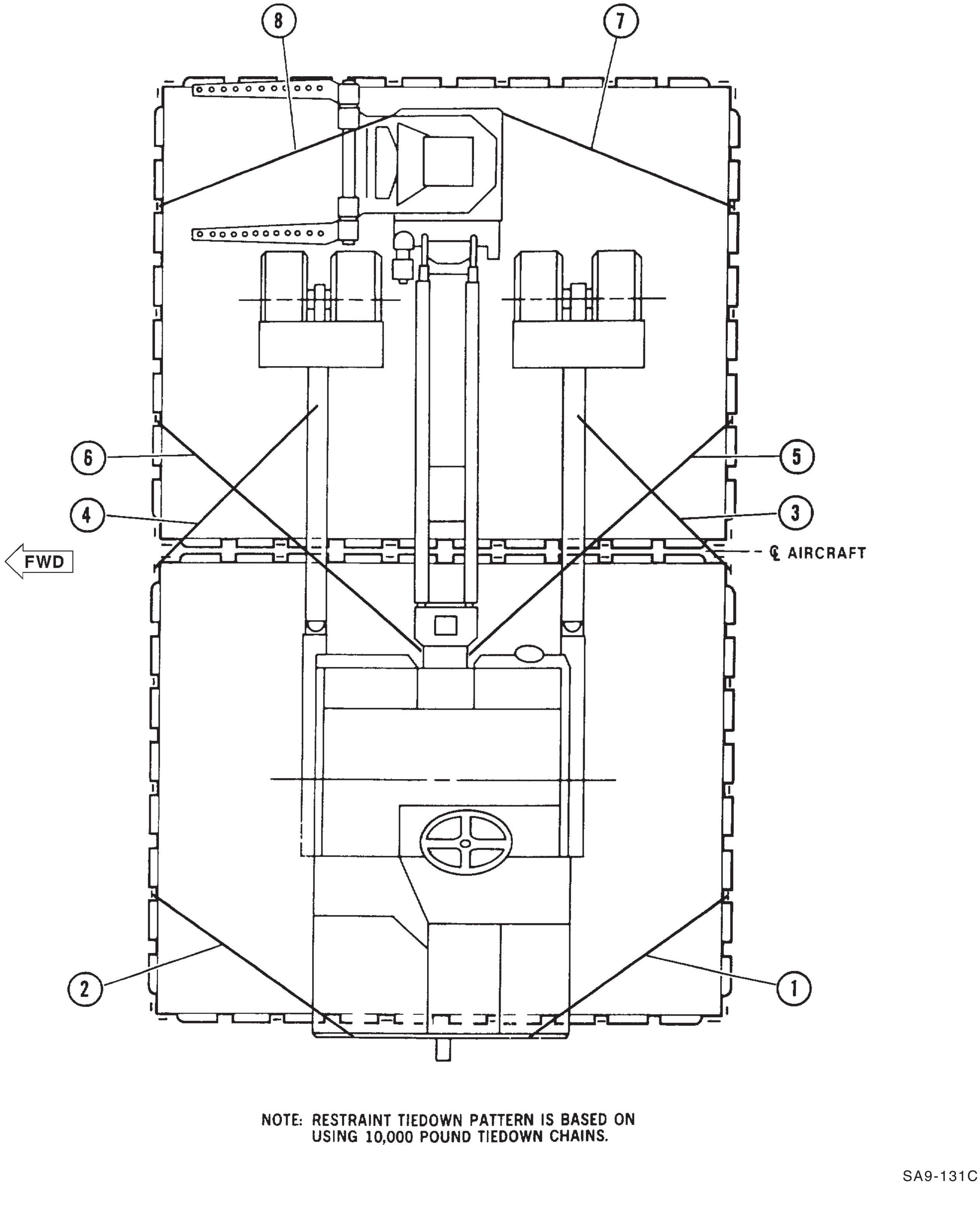


Figure 5C-4. Plan View - Tiedown Pattern for MHU-83 Series Truck (Pallets Coupled on 108-Inch Dimension)

TIE DOWN NO.	VEHICLE ATTACH POINT	PALLET RING ATTACH POINT	ACTUAL MEASUREMENTS (INCHES)				RESTRAINT VALUES (LBS)				
				EFFECTIVE LENGTHS			LONGITUDINAL		LATERAL		
			DEVICE LENGTH	VERT	LONG.	LAT	FWD	AFT	LEFT	RIGHT	VERT
1	REAR FRAME	SIDE	46	12	40	22	6521		3586		1956
2	REAR FRAME	SIDE	46	12	40	22		6521	3586		1956
3	OUTRIGGER EYE	SIDE	49	14	28	40	4285			6122	2142
4	OUTRIGGER EYE	SIDE	49	14	28	40		4285		6122	2142
5	LIFT ARM	SIDE	67	29	50	36	4310		3103		2500
6	LIFT ARM	SIDE	67	29	50	36		4310	3103		2500
7	LIFT PLATFORM	SIDE	47	13	44	7	7021			1117	2074
8	LIFT PLATFORM	SIDE	47	13	44	7		7021		1117	2074
TOTAL APPLIED RESTRAINT							22,137	22,137	13,378	14,478	17,344
TOTAL REQUIRED RESTRAINT							10,638	10,638	10,638	10,638	14,184

SA9-132D

Figure 5C-5. Restraint Values - MHU-83 Series Truck at 7,092 Pounds (Pallets Coupled on 108-Inch Dimension)

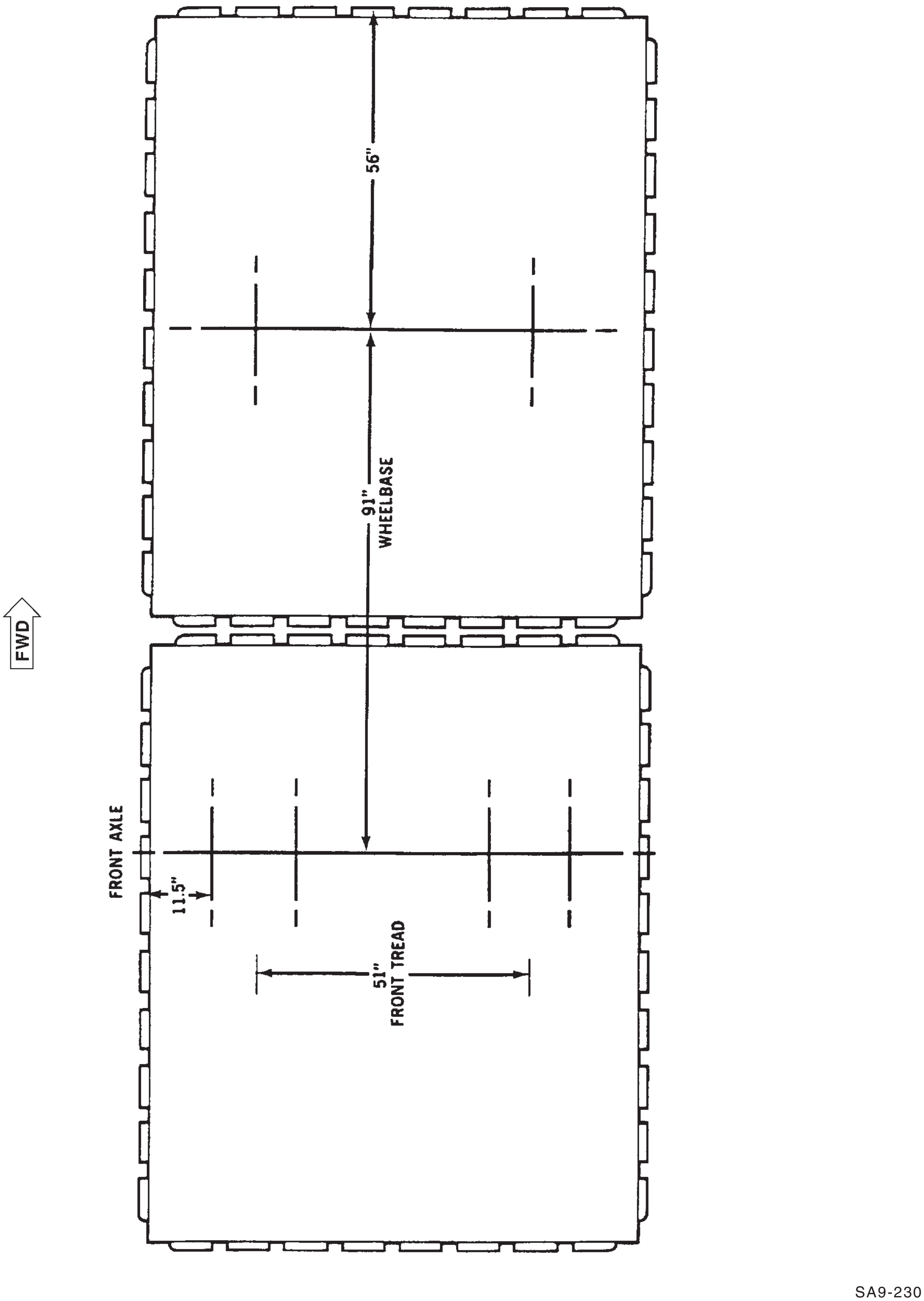
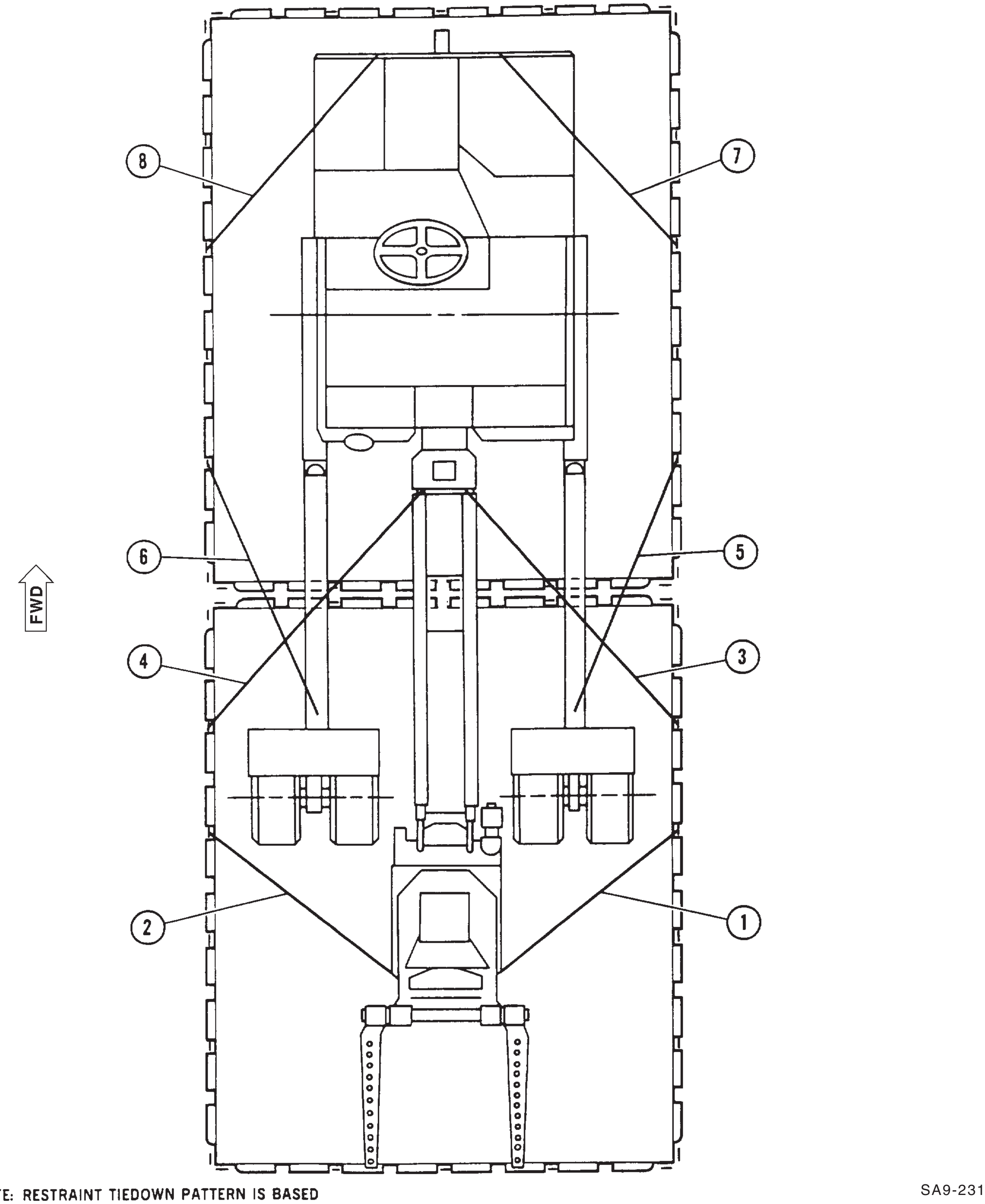


Figure 5C-6. Position of MHU-83 Series Truck on Coupled Pallets (Coupled on 88-Inch Dimension)



NOTE: RESTRAINT TIEDOWN PATTERN IS BASED
ON USING 10,000 POUND TIEDOWN CHAINS.

Figure 5C-7. Plan View - Tiedown Pattern for MHU-83 Series Truck (Pallets Coupled on 88-Inch Dimension)

TIE DOWN NO.	VEHICLE ATTACH POINT	PALLET RING ATTACH POINT	ACTUAL MEASUREMENTS (INCHES)				RESTRAINT VALUES (LBS)				
			DEVICE LENGTH	EFFECTIVE LENGTHS			LONGITUDINAL		LATERAL		VERT
				VERT	LONG.	LAT	FWD	AFT	LEFT	RIGHT	
1	LIFT PLATFORM	SIDE	47	12	25	39		3989	6223		1914
2	LIFT PLATFORM	SIDE	47	12	25	39		3989		6223	1914
3	LIFT ARM	SIDE	69	29	48	40	4137		3448		2500
4	LIFT ARM	SIDE	69	29	48	40	4137			3448	2500
5	OUTRIGGER EYE	SIDE	52	14	46	17		6634	2451		2019
6	OUTRIGGER EYE	SIDE	52	14	46	17		6634		2451	2019
7	REAR FRAME	SIDE	47	13	35	28	5585		4468		2074
8	REAR FRAME	SIDE	47	13	35	28	5585			4468	2074
TOTAL APPLIED RESTRAINT							19,444	21,246	16,590	16,590	17,014
TOTAL REQUIRED RESTRAINT							10,638	10,638	10,638	10,638	14,184

SA9-267

Figure 5C-8. Restraint Values - MHU-83 Series Truck at 7,092 Pounds (Pallets Coupled on 88-inch Dimension)

JOINT TASK FORCE/COMMAND AND CONTROL MODULE, CENTERLINE LOADED

GENERAL

This section contains instructions for loading and offloading the Joint Task Force Command and Control Module (JTF/CCM) (figure 5D-1) commonly known as The Silver Bullet. The command module is a three section trailer built by Airstream Corporation and installed in the cargo compartment using centerline loading configuration. Each section of the module is permanently attached to a 108 inch by 144 inch type 5 airdrop platform. These platforms have four skids attached to the bottom of the pallet. The floor configuration is changed and uses new cross track assemblies in conjunction with the center-guide rails to allow loading of 108 inch wide pallets on the aircraft centerline. It also places a longitudinal roller conveyor under each skid allowing smooth movement down the cargo compartment. These skids do not allow the platform to roll smoothly across the omni-directional panel.

PREPARATION OF AIRCRAFT FOR LOADING.

Ensure the aircraft is properly configured for loading IAW Chapter 25 of AFI 11-2 KC-10 Volume 3. This is necessary to ensure the module is properly restrained. This configuration includes a six pallet sub-floor installed in pallet positions 10 through 12. The pallet sub-floor is provided for baggage and hand carried special equipment to support the module, and all conveyor assemblies removed for this configuration change. This is necessary in order to be able to reconfigure the cargo floor at a forward location after the module has been offloaded. Each pallet of the sub-floor will not exceed 2,100 pounds gross weight with the CG of the pallet not over 60 inches above the pallet surface, and be restrained to 9 G's forward restraint. Top nets will be provided with this configuration for the baggage pallets. The pallet of removed aircraft floor assemblies will be restrained to 9 G's forward restraint with tie-down straps.

LOADING PRECAUTIONS

Observe all loading precautions as outlined for loading in Section IV.

LOADING PROCEDURES

Follow procedures for positioning the loader/elevator at the cargo door for loading vehicles/pallets into the cargo compartment as outlined in Section IV, and as follows:

1. Prior to loading the command module, a six pallet sub-floor will be installed in pallet positions 10 through 12. This subfloor must be installed for proper stowage of the cargo assemblies, special equipment (command module associated equipment only), and baggage.

2. Due to the module height, consideration must be given to aircraft deflection. The module is 94.06 inches high mounted on a 3.5 inch thick airdrop platform.

3. Attach four tiedown straps to the front and back rings on the platform to ensure positive control on the omni-directional panel. When bringing the module into the aircraft do not use the powered rollers. The skids on the bottom of the airdrop platform interfere with normal operation of the rollers. Ensure a sufficient number of personnel (at least five) are available to control the movement of the module on the omni-directional panel and

monitor clearances, particularly height (figure 5D-2).

CAUTION

- Do not use the powered rollers. The skids on the bottom surface of the pallet may damage the skid plates on the rollers.
- Precise positioning of the module on aircraft centerline is imperative to ensure it will enter the rail system without damaging the rails.

4. After the module is loaded, the longitudinal rollers in compartment 4 must be repositioned to their proper location to allow the IAU to be properly installed.

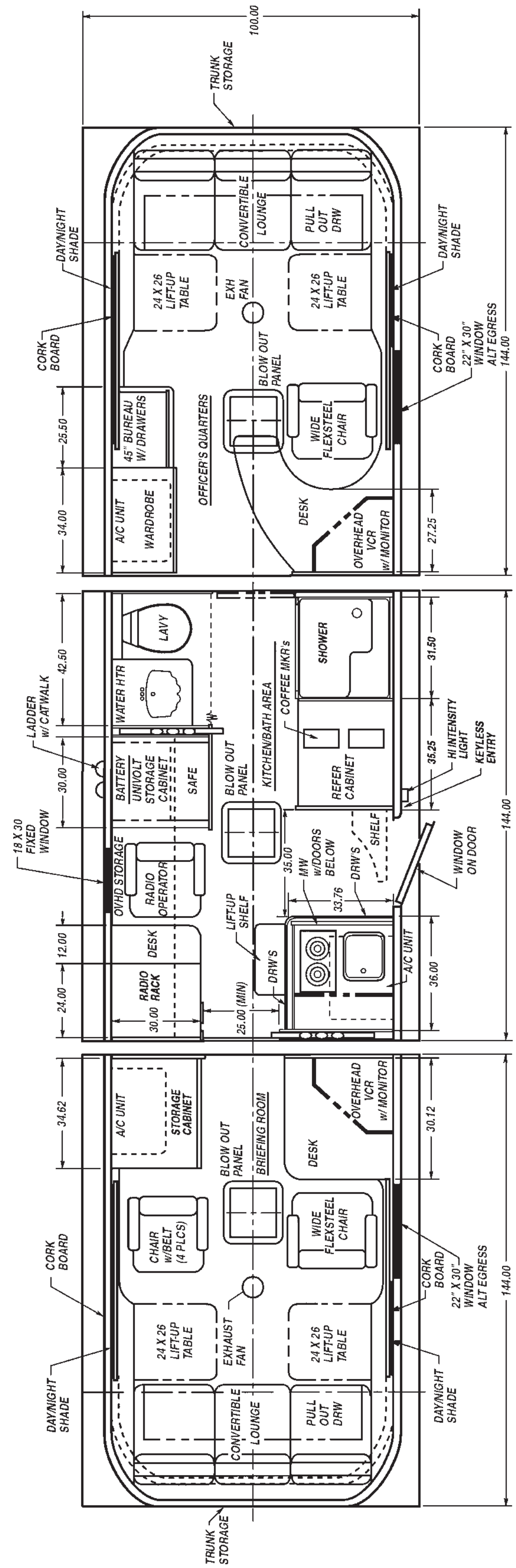


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Figure 5D-1. Joint Task Force/Command and Control Module (JTF/CCM)

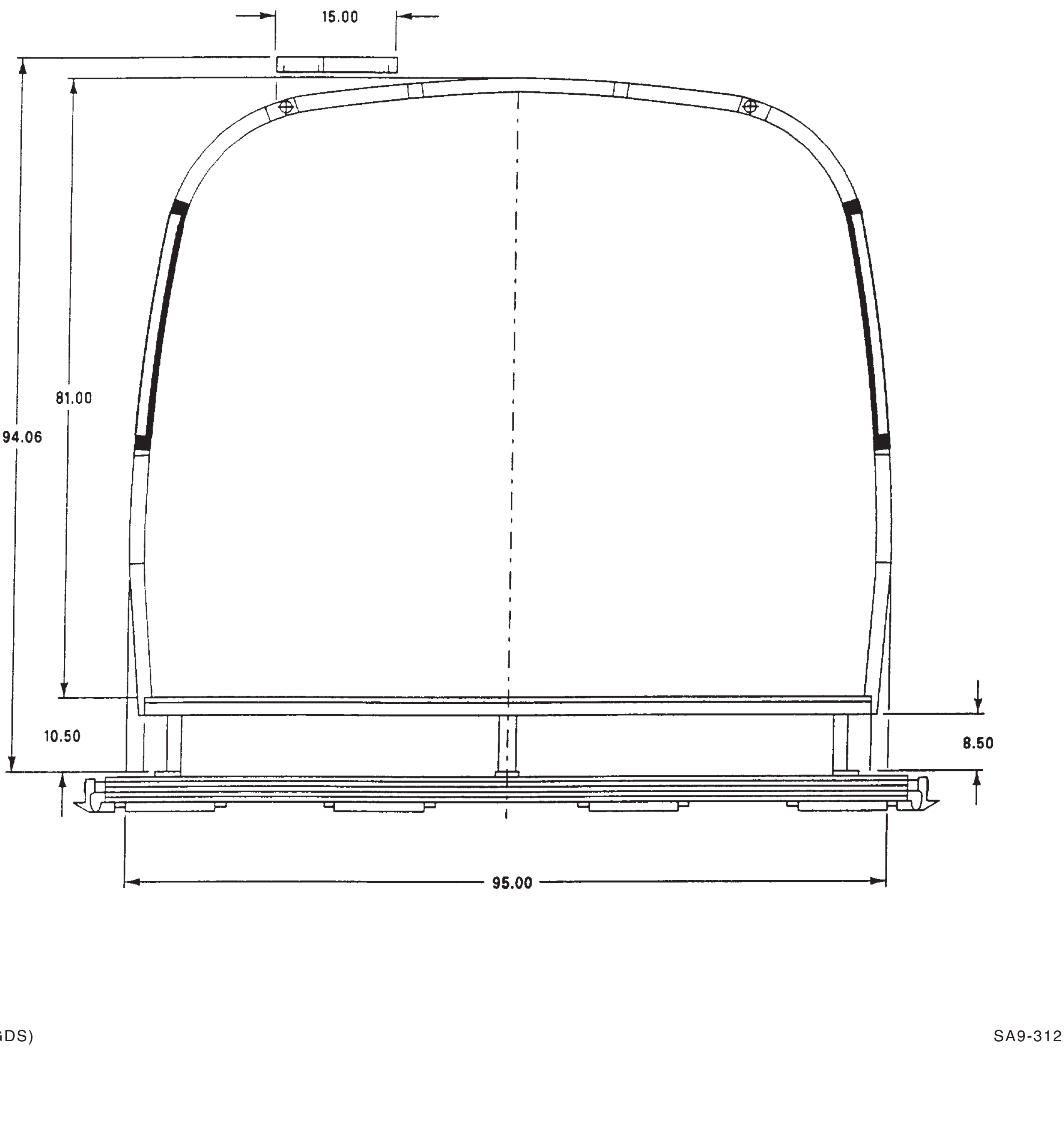
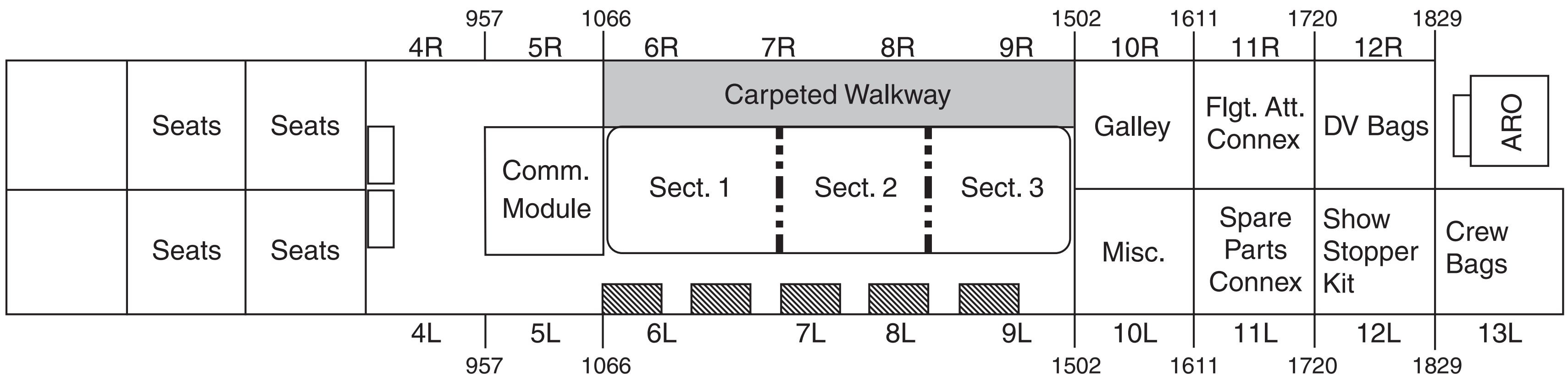


Figure 5D-2. Typical Contour Cross Section of Joint Task Force/ Command and Control Module (JTF/CCM)



Loading Notes:

1) Once the 4 pallets are placed in positions 10 & 11, loading must stop to allow for a center line configuration.

2) Items displayed in pallet positions 4 thru 11 will be provided by the Silver Bullet crew.

3) The items loaded on left side of aircraft belongs to the Silver Bullet crew (items such as test equipment, bags, additional supplies, etc.)

Pos	Arm	Standard Weight	Mom	Addition/Reason
13L	13L	1065	201	Boom Operator's Discretion
12L	12L	1400	248	Show Stopper Kit (1400 Lbs. base weight or as manifested)
12R	12R	355	63	Boom Operator's Discretion
11L	11L	1250	208	200 Lbs. Storage/Supplies/Coolers/Water
11R	11R	1900	316	Food Supplies/Coolers/Dry Ice
10L	10L	750	117	Misc. Coolers/Water/Ice
10R	10R	1250	195	350 Lbs. Water (included)
9C	1424C	4650	662	Add Weight for Left Side Bags/Equipment
8C	1284C	6960	894	Add 600 Lbs. for Walkway
6C	1142C	4650	531	Add for Left Side Bags/Equipment
5C	5C	4400	445	Add for Left Side Bags/Equipment

Figure 5D-3. KC-10 Silver Bullet Load Plan

MISCELLANEOUS CARGO LOADING DATA

GENERAL

This section contains a listing of miscellaneous cargo requiring only minor modification and/or limited procedures for loading. Section III, Aircraft Configuration and Section IV, General Procedures must be complied with, as applicable, in addition to the procedures specified in this section.

NOTE

These instructions reflect careful consideration of all operational limitations of the aircraft, and do not compromise safe operation or structural limitations. Where these procedures and limitations differ from procedures and limitations contained in Section IV, these procedures and limitations shall apply.

NOMENCLATURE	DIMENSIONS AND WEIGHT	PREPARATION FOR LOADING PROCEDURES
TRAILER, MUNITIONS MHU-12M OR MHU-12A/M TRAILER, UTILITY F-2 OR F-2A TRAILER, MUNITIONS MHU-141/M	L = 129 INCHES W = 84 INCHES H = 28 INCHES (EMPTY) TARE WT = 1,645 POUNDS GROSS WT = MHU-12M = 6,645 POUNDS MHU-12A/M = 5,645 POUNDS L = 180 INCHES W = 52 INCHES H = 51 INCHES (EMPTY) TARE WT = 900 POUNDS GROSS WT = 5,900 POUNDS L = 138 INCHES W = 84 INCHES H = 34 INCHES (EMPTY) TARE WT = 2,370 POUNDS GROSS WT = 7,870 POUNDS	MUNITION TRAILERS MAY BE DOUBLE STACKED FOR TRANSPORTABILITY. HOWEVER, THE MHU-12 TRAILERS MAY BE TRIPLE STACKED WHEN CENTERLINE LOADED. TO ALLOW FOR CLEARANCE THROUGH THE CARGO DOOR. THE TOWBAR ON SOME CONFIGURATIONS OF STACKED TRAILERS MAY HAVE TO BE REMOVED AND STOWED. ACTUAL LOADABLE LOCATIONS DEPEND ON THE AXLE LOADS (FIGURES 4-7 AND 4-8) AND CONTOURS (FIGURE 4-2). TIEDOWN DEVICES WILL BE USED TO SECURE TRAILER TO TRAILER. EACH TRAILER WILL BE RESTRAINED USING PROCEDURES OUTLINED IN SECTION IV.
TRAILER MUNITIONS MHU-110/M TRAILER MUNITIONS MHU-85/M	L = 196 INCHES W = 91 INCHES H = 30 INCHES (EMPTY) TARE WT = 3,600 POUNDS L = 204 INCHES W = 96 INCHES H = 40 INCHES (EMPTY) TARE WT = 6,900 POUNDS	THE MUNITIONS TRAILERS MAY BE LOADED LATERALLY OR LONGITUDINALLY ON THE CENTERLINE. IF THE AIRCRAFT IS IN THE 27-PALLET, ALL CARGO CONFIGURATION, THE TRAILERS MAY BE LOADED LONGITUDINALLY ON THE LEFT SIDE OF THE AIRCRAFT. ALL SECTION IV LIMITATIONS MUST BE MET. THE MHU-110 TRAILERS MAY STACKED 2-HIGH IF ALLOWABLE CONTOURS AND AXLE WEIGHT LIMITATIONS IN SECTION IV ARE MET. THE CARGO CAPACITY OF EACH TRAILER IS 15,000 POUNDS. THE MAXIMUM WEIGHT DEPENDS ON SECTION IV ALLOWABLE AXLE LOADS. ENSURE CARGO IS WITHIN SECTION IV CONTOUR RESTRICTIONS. THE TRAILERS MAY BE LOADED ONTO A PARTIAL PALLET SUBFLOOR OR PREPALLETIZED. IF PALLETIZED, FOLLOW LOADING INSTRUCTIONS FOR THE MB-4 TRACTOR COVERED IN SECTION VB. WHEN LOADED LATERALLY, THE FRONT AND REAR OF THE TRAILER EXTENDS INTO THE WALKWAY. DO NOT ALLOW THE WALKWAY TO BE OBSTRUCTED TO A POINT THAT A PERSON CANNOT PASS BY.

SA9-181F

NOMENCLATURE	DIMENSIONS AND WEIGHT	PREPARATION FOR LOADING PROCEDURES
LIGHT DUTY TRUCKS, HMMWV'S AND OTHER VEHICLES		AXLE WEIGHTS UP TO 6,200 POUNDS CAN BE CENTERLINE LOADED AT STATION 1329, 1438, OR 1547, PROVIDED THE TREAD IS BETWEEN 60 AND 70 INCHES. AXLE WEIGHTS UP TO 5,200 POUNDS CAN BE CENTERLINE LOADED AT STATION 1329, 1438, OR 1547, PROVIDED THE TREAD IS BETWEEN 70 AND 72 INCHES. REMAINING AXLES OF THESE VEHICLES MUST MEET SECTION IV LIMITS.
AIR DROP PLATFORM	L = 192 INCHES (MAXIMUM) W = 108 INCHES	IF NECESSARY REMOVE SKIDS FROM BOTTOM OF PLATFORM TO PROVIDE FLAT SURFACE FOR MOVEMENT ON THE CARGO HANDLING SYSTEM. LOAD PLATFORM LATERALLY IN CARGO COMPARTMENT. UTILIZE FORE AND AFT RETRACTABLE RESTRAINT DEVICES TO LOCATE PLATFORM. INSTALL RESTRAINT FITTINGS (A-7000 OR EQUIVALENT) IN THE SEAT TRACKS. PROVIDE RESTRAINT IN ACCORDANCE WITH PROCEDURES OUTLINED IN SECTION IV OR VA FOR FLOOR-LOADED CARGO.
BARE BASE SHELTERS 1) EXPANDABLE P/N 312010-001-101 2) PERSONNEL P/N 3080010-001-101 (TRIPLE UNIT)	L = 160 INCHES W = 96 INCHES H = 96 INCHES WT(1) = 12,720 POUNDS WT(2) = 13,125 POUNDS	LOAD SHELTER(S) ON CENTERLINE OF AIRCRAFT. THE AZZ27351-527 OR -529 CENTER GUIDE RAIL ASSEMBLIES MUST BE TEMPORARILY REMOVED TO ALLOW THE SHELTER(S) TO MOVE LONGITUDINALLY IN THE CARGO COMPARTMENT. THE CENTER GUIDE RAILS LOCATED AT THE POSITION WHERE THE SHELTER(S) IS LOADED SHALL NOT BE USED, AND SHALL BE STOWED. TIE DOWN THE SHELTER(S) IN ACCORDANCE WITH PROCEDURES OUTLINED IN SECTION VA FOR FLOOR-LOADED CARGO.

SA9-182G

COUPLED HCU-6/E PALLETS WITH TWO-INCH COUPLERS

GENERAL

A pallet coupler has been developed to create pallet trains for loading in airlift aircraft. These couplers separate the HCU-6/E pallets by 2 inches, allowing the pallet train(s) to properly engage the rail (463L) system of the above aircraft.

To accept coupled HCU-6/E pallets (which have been coupled with the 2-inch coupler) in this aircraft, several components of the cargo handling system must be repositioned.

This section contains instructions for preparing the cargo handling system to accept pallets that have been coupled together with the 2-inch coupler.

PALLET LOCATIONS FOR PALLETS COUPLED ON THE 108-INCH DIMENSION

Coupled pallets that are built up for other aircraft are coupled on the 108-inch dimension of the HCU-6/E pallets. These coupled pallets may be accepted only when the cargo handling system is in the 25-or 27-pallet (lateral) configuration. The pallet locations that could accept these pallets are shown in figure 5F-1.

PALLET LOCATIONS FOR PALLETS COUPLED ON THE 88-INCH DIMENSION

Coupled pallets may be built up for the KC-10A using 2-inch couplers on the 88-inch dimension of the HCU-6/E pallets. These coupled pallets may be accepted when the cargo handling system is in the 25-pallet (longitudinal) configuration. The pallets must be loaded only on the left side of the aircraft, because movement of the outboard longitudinal conveyor assembly on the right side interferes with the walkway installation. The pallet locations that could accept these pallets are shown in figure 5F-2.

NOTE

> These instructions apply only to one location for the coupled pallets. Other locations are possible, but are not included in this section. Mission configuration, and weight and balance requirements, could dictate other locations for the coupled pallets in the cargo compartment. These instructions are for procedures only, and do not reflect the exact instructions for each requirement.

PREPARATION OF CARGO HANDLING SYSTEM FOR LOADING

Prepare the cargo handling system for loading coupled HCU-6/E pallets with the 2-inch couplers as follows:

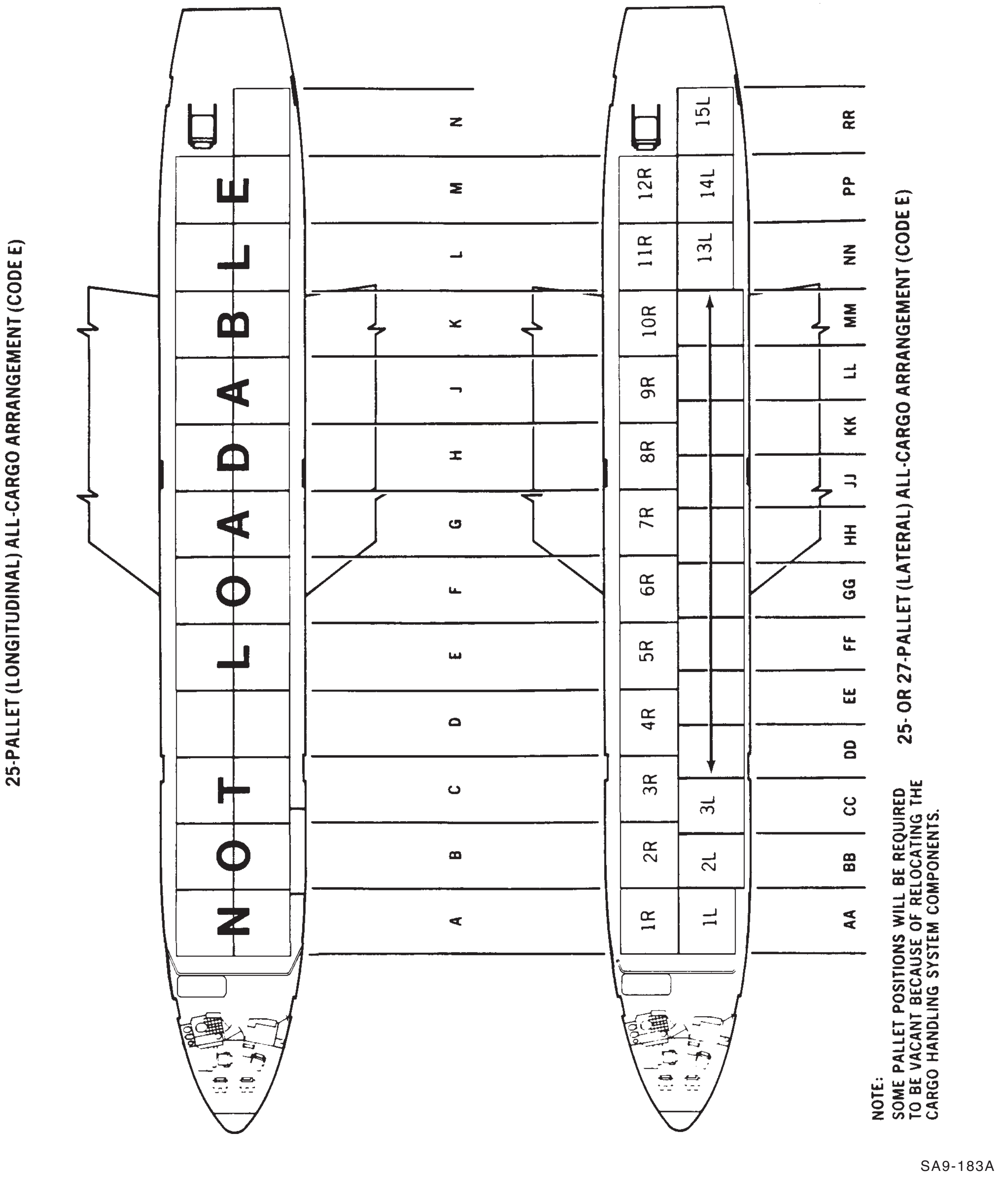
1. Actual location for coupled pallets depends on the weight and balance requirement for the mission. For this discussion, assume that coupled pallets will be loaded in pallet positions 4L-5L (DD-EE).

2. Figure 5F-3 shows the cargo handling system in the area of pallet positions 4L-5L (DD-EE).

3. Relocate the three AZZ7345-501 dual-pawl end restraint assemblies (at seat tracks: X= +8.5, +27.5, and +47.50) from station 1081.0 to 1082.0 (see figure 5F-3). This movement of 1 inch provides the additional inch required for the 2-inch coupler. The holes in the seat track are on 1-inch centers. Refer to Section III for removal and installation instructions.

4. Relocate the AZZ7551-1 outboard longitudinal conveyor assembly aft by 1 inch. This is accomplished by removing the 16 AZZ7410-1 equipment restraint assemblies, sliding the conveyor assembly aft 1 inch, and then reinstalling the 16 equipment restraint assemblies in the seat track. Figure 5F-3 shows a typical outboard longitudinal conveyor assembly, and the location of the equipment restraint assemblies in relationship to the crosstracks of the conveyor assembly. Refer to Section III for removal and installation instructions for the AZZ7410-1 equipment restraint assemblies.

5. With coupled pallets loaded in 4L-5L (DD-EE), the pallet position aft of the coupled pallets (6L (FF)) must remain empty, as there is not adequate space to load a HCU-6/E pallet.



SA9-183A

Figure 5F-1. Acceptable Area for Locating Coupled Pallets With 2-Inch Coupler (Coupled on 108-Inch Dimension)

KC-10A CARGO LOADING MANUAL

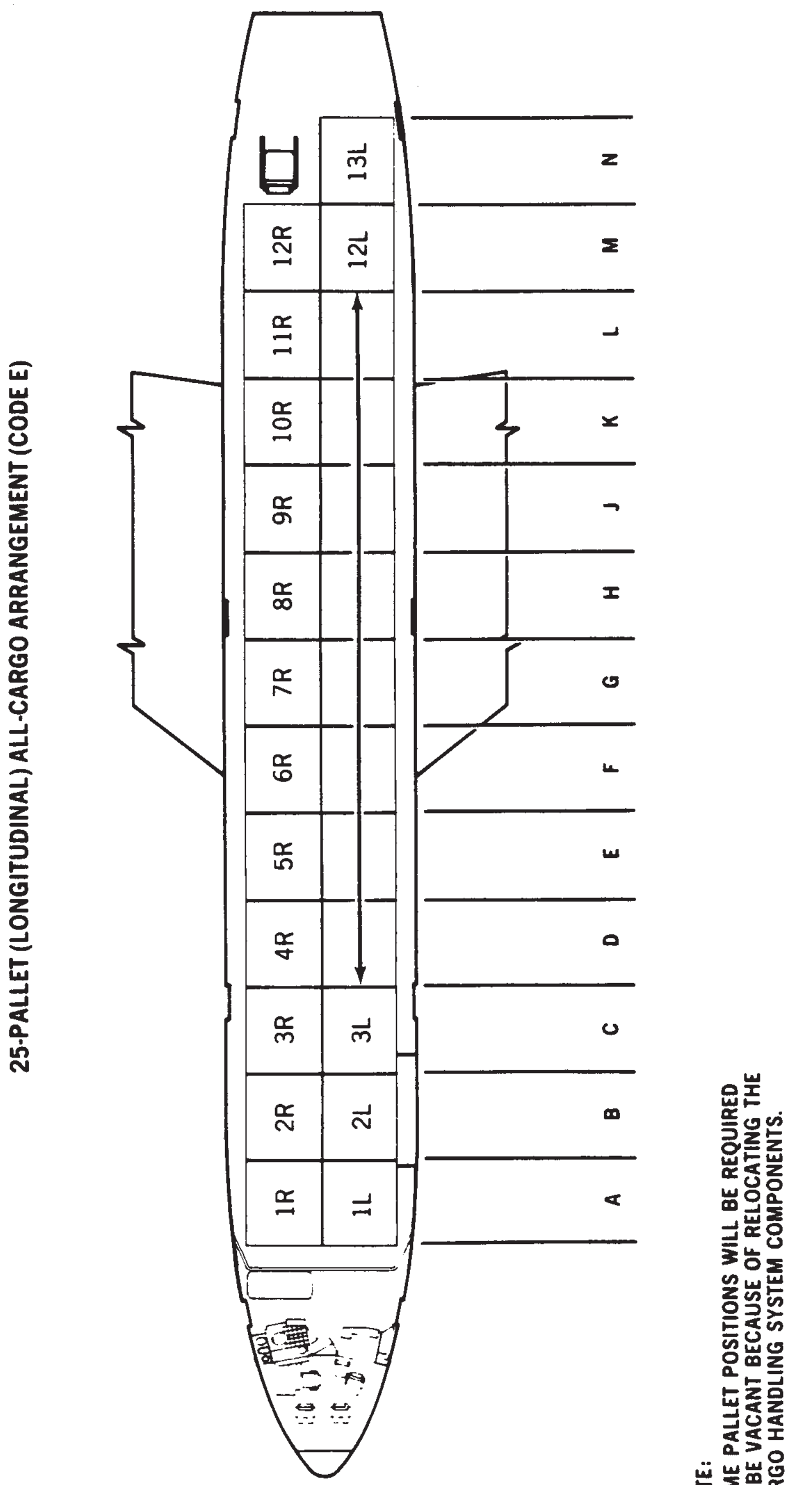


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Figure 5F-2. Acceptable Area for Locating Coupled Pallets With 2-Inch Coupler (Coupled on 88-Inch Dimension)

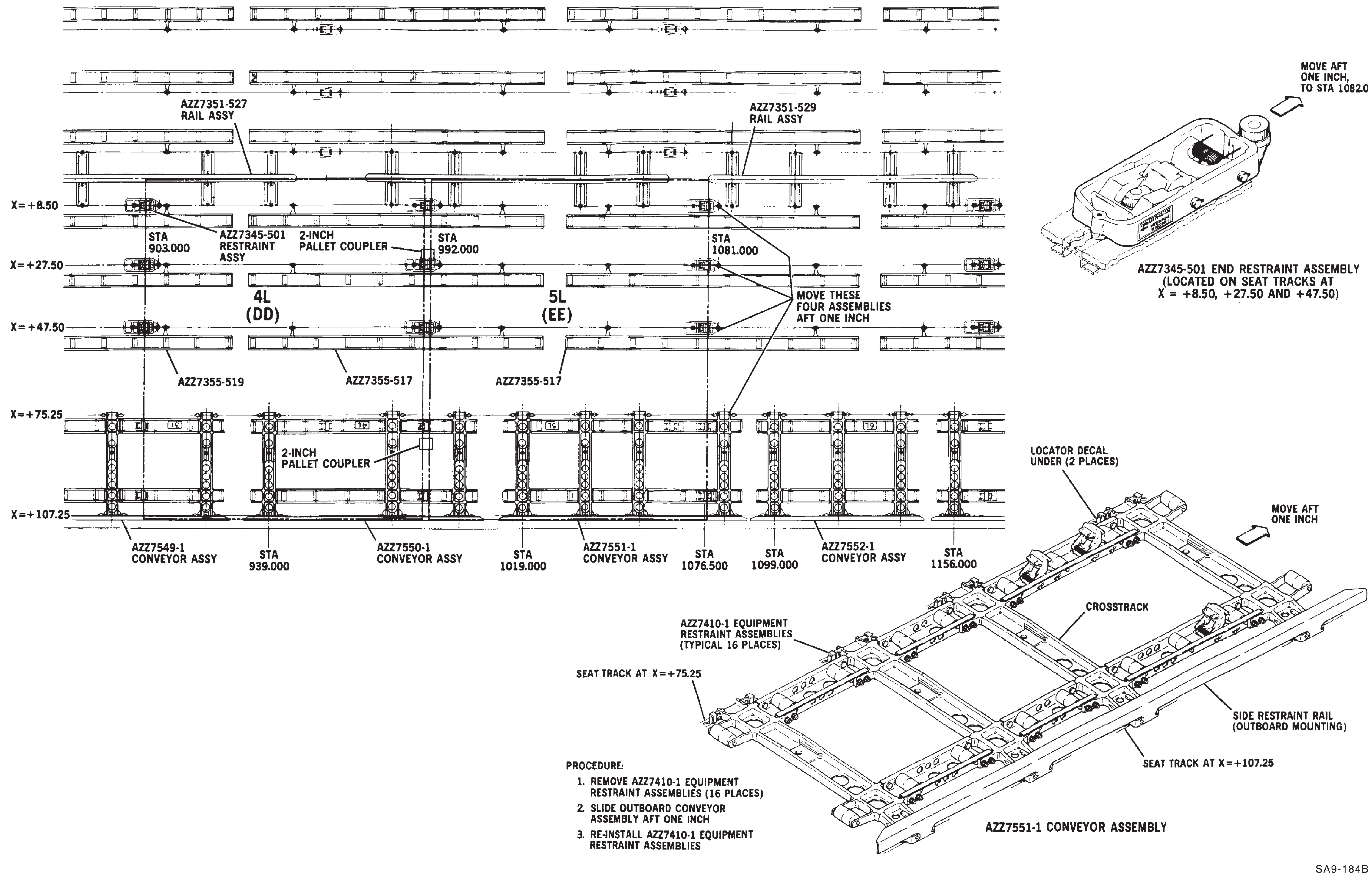


Figure 5F-3. Cargo Handling System Configuration for Coupled Pallets with 2-inch Couplers

POLYALPHAOLEFIN (PAO) AIR COOLING CART

GENERAL

This section contains instructions for preloading, loading, restraining and offloading the Polyalphaolefin (PAO) Air Cooling Cart (figure 5G-1) onto a conveyable transfer platform and to be loaded on a partial-pallet subfloor.

PREPARATION OF AIRCRAFT FOR LOADING

Prepare the aircraft for loading the PAO Air Cooling Cart as outlined in Section IV of this manual and as follows:

1. The PAO Air Cooling Carts are loaded longitudinally on the centerline of the cargo compartment as shown in figure 5G-2.

2. The PAO Air Cooling Carts can be loaded when the cargo handling system is configured in the 25-pallet all-cargo configuration, the 23-pallet mixed cargo personnel configuration or the 17-pallet mixed cargo/ personnel configuration.

PREPARATION OF PAO AIR COOLING CART FOR LOADING

Prepare the PAO Air Cooling Cart for loading on a pallet subfloor by checking the vehicle in accordance with the procedures outlined for vehicle/equipment preparation Section IV of this manual, and as follows:

LOADING PRECAUTIONS

Observe all loading precautions as outlined for vehicle/equipment loading in Section IV.

CAUTION

The PAO Air Cooling Cart must be loaded with the fuel filler neck forward in the aircraft. Fuel may leak during climb-out if the filler neck is loaded facing aft.

LOADING PROCEDURES

Follow procedures for positioning the loader/ elevator at the cargo door and for loading vehicles on HCU-6E pallets into the cargo compartment as outlined in Section IV, and as follows:

LOADED LONGITUDINALLY ON CENTERLINE

1. Position empty pallets in prearraged load positions.

2. Move the vehicle (on conveyable transfer platform) from loader/elevator into the aircraft.

3. Rotate the vehicle manually or by the powered roller system, aligning it on the aircraft centerline.

4. Move the vehicle longitudinally to the pallet subfloor.

5. When using 88-inch dimension transfer platform, with one-inch pallet couplers, use a minimum of two dual pawl end restraint assemblies at the forward end restraint assemblies at the forward end to preclude the platform from moving forward during transfer.

6. When using 108-inch dimension transfer platform use two tiedown chains to secure the transfer platform to the pallets installed in the cargo handling system to preclude the platform from moving forward during transfer.

7. Manually move the vehicle onto the pallet subfloor and into prearranged load position (figure 5G-3).

8. Tie down the PAO Air Conditioning Cart in accordance with the procedures outlined in Section IV and illustrated in figure 5G-4.

PREPARATION OF AIRCRAFT FOR OFFLOADING

Prepare the aircraft for offloading the PAO Air Cooling Cart in the same manner as for loading.

PREPARATION OF PAO AIR COOLING CART FOR OFFLOADING

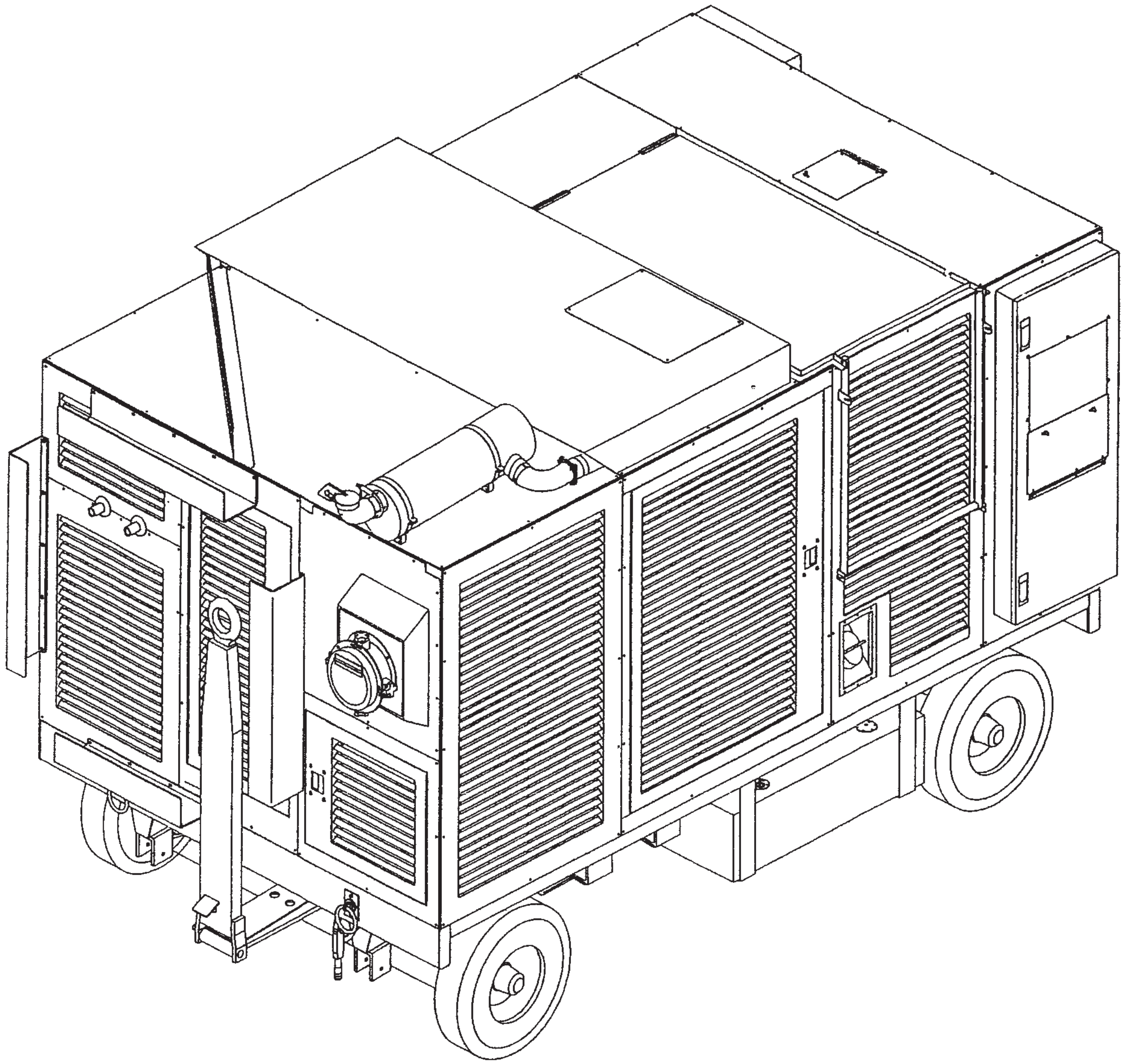
No specific preparation of the PAO Air Cooling Cart is required.

OFFLOADING PRECAUTIONS

Offloading precautions are the same as for loading.

OFFLOADING PROCEDURES

Offloading procedures are essentially the reverse of loading procedures.



PAO CART PN 12265-3
LENGTH = 143 INCHES
WIDTH = 80 INCHES
HEIGHT = 92 INCHES
WEIGHT = 10880

Figure 5G-1. PAO Air Cooling Cart

KC-10A CARGO LOADING MANUAL

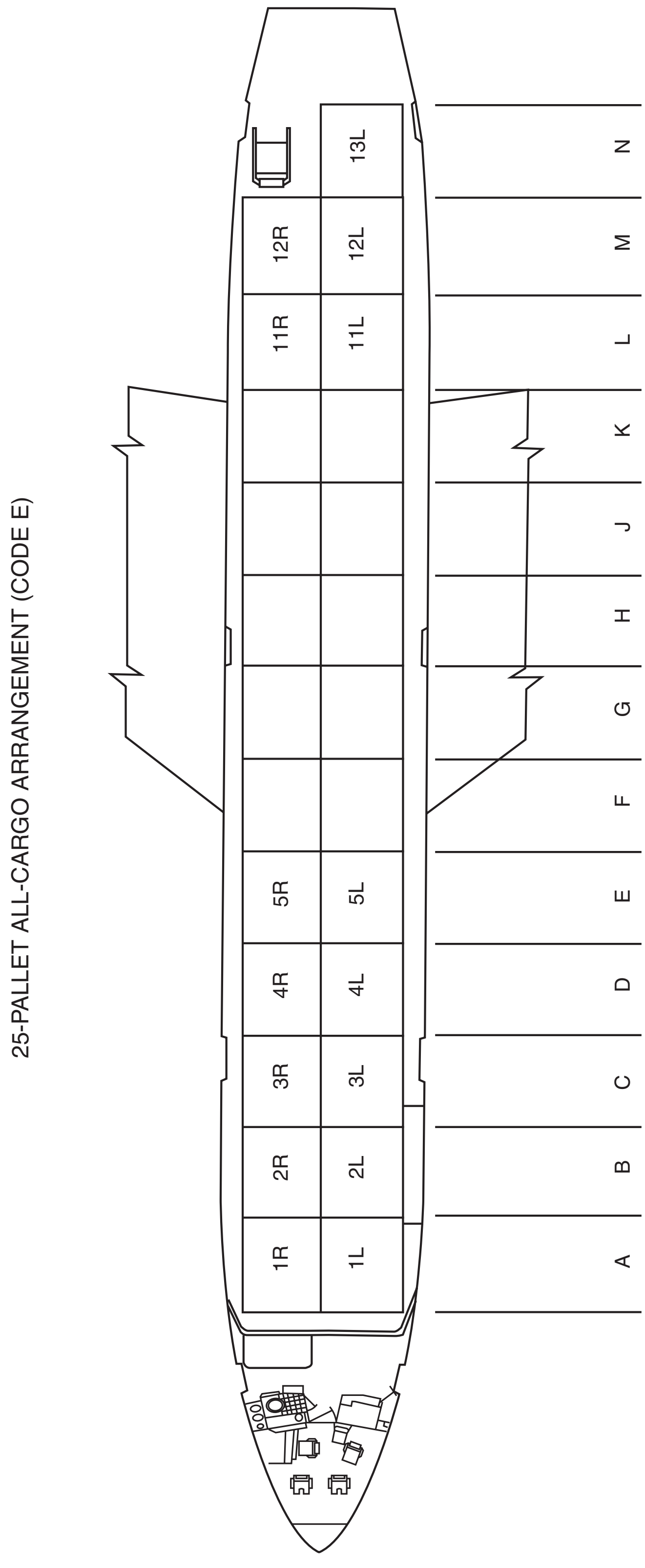


Figure 5G-2. Loadable Locations for PAO Air Cooling Cart

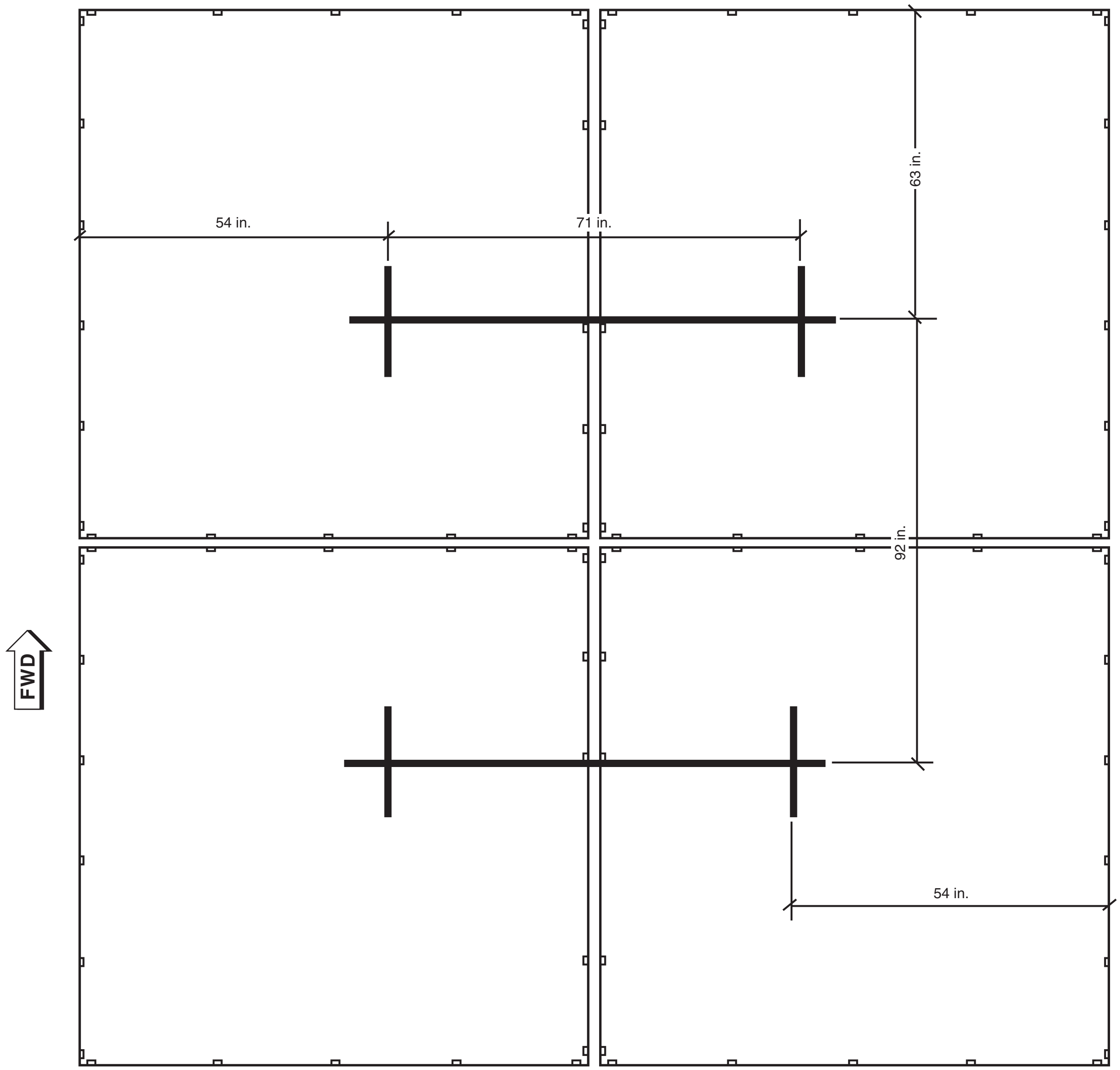


Figure 5G-3. Position of PAO Air Cooling Cart (Centerline Loaded)

KC-10A CARGO LOADING MANUAL

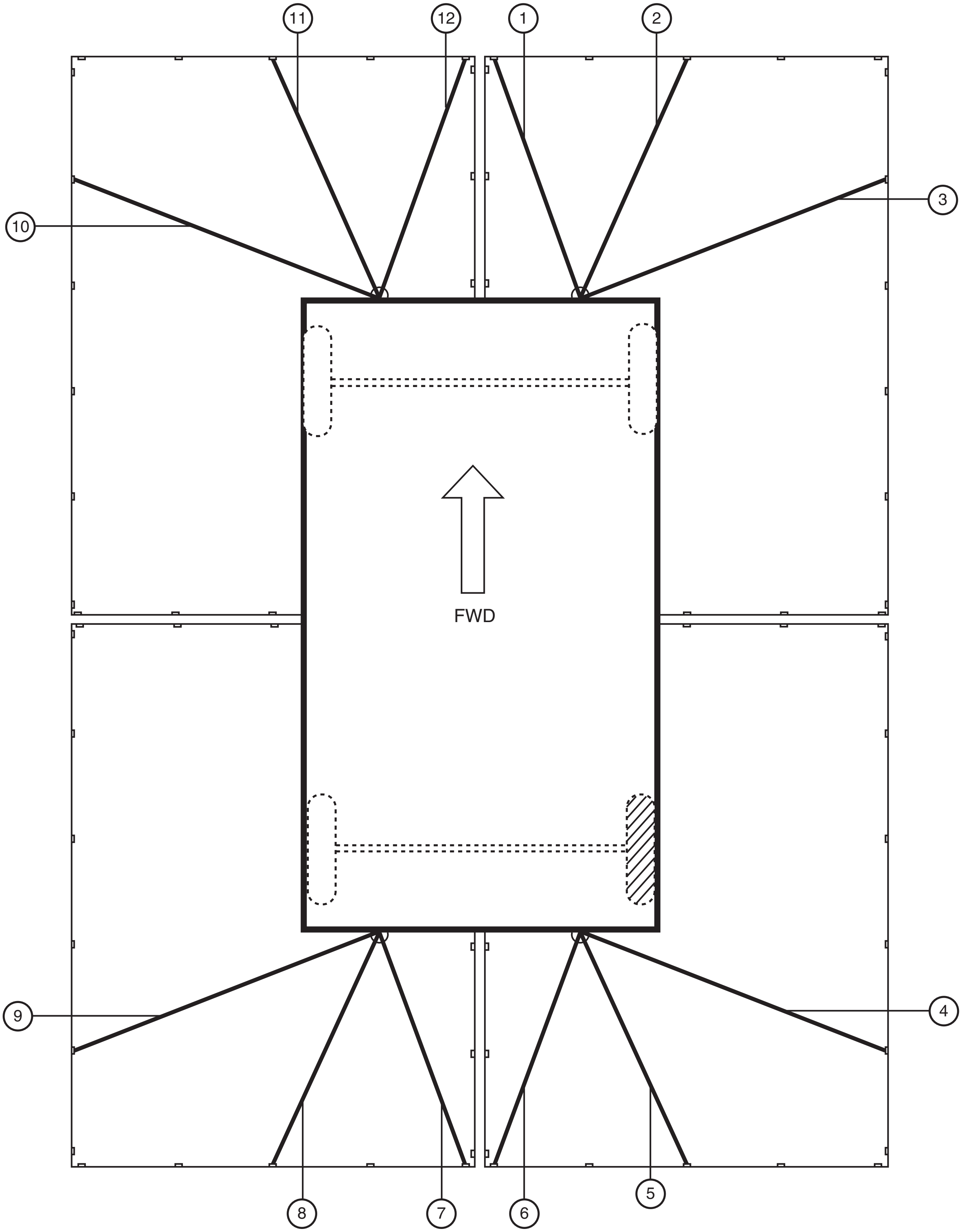


Figure 5G-4. Plan View - Tiedown Pattern for PAO Air Cooling Cart (Centerline Loaded)

TIE DOWN NO.	VEHICLE ATTACH POINT	PALLET RING ATTACH POINT	ACTUAL MEASUREMENTS (INCHES)				RESTRAINT VALUES (LBS)				
			DEVICE LENGTH	EFFECTIVE LENGTHS			LONGITUDINAL		LATERAL		VERT
				VERT	LONG.	LAT.	FWD	AFT	LEFT	RIGHT	
1	FWD RING RIGHT	CORNER	52	23	44	19		4783		2065	2500
2	FWD RING RIGHT	SIDE	54	23	44	23		4783	2500		2500
3	FWD RING RIGHT	SIDE	70	23	21	64		2283	6957		2464
4	AFT RING RIGHT	SIDE	70	23	19	64	2065		6957		2464
5	AFT RING RIGHT	SIDE	50	23	41	23	4457		2500		2500
6	AFT RING RIGHT	CORNER	48	23	41	19	4457			2065	2500
7	AFT RING LEFT	CORNER	48	23	41	19	4457		2065		2500
8	AFT RING LEFT	SIDE	50	23	41	23	4457			2500	2500
9	AFT RING LEFT	SIDE	70	23	19	64	2065			6957	2464
10	FWD RING LEFT	SIDE	70	23	21	64		2283		6957	2464
11	FWD RING LEFT	SIDE	54	23	44	23		4783		2500	2500
12	FWD RING LEFT	CORNER	52	23	44	19		4783	2065		2500
TOTAL APPLIED RESTRAINT							21,957	23,696	23,043	23,043	29,857
TOTAL REQUIRED RESTRAINT							16,320	16,320	16,320	16,320	21,760

Figure 5G-5. Restraint Values PAO Air Cooling Cart at 10,880 Pounds (Centerline Loaded)

M35A2 2-1/2-TON CARGO TRUCK (WITHOUT WINCH)

GENERAL

This section contains instructions for preloading, loading, restraining and offloading the M35A2 2-1/2-Ton Cargo Truck without a winch (figure 5H-1). These instructions are only for driving the truck onto a conveyable transfer platform and to be loaded/offloaded on a partial-pallet subfloor that is installed into the cargo handling system.

PREPARATION OF AIRCRAFT FOR LOADING

Prepare the aircraft for loading the M35A2 Cargo Trucks as outlined in Section IV of this manual, and as follows:

NOTE

- In the 23-pallet mixed cargo/personnel configuration, roll up the environmental curtain and remove the bunks to allow for clearance during rotation and positioning of the trucks.
- In the 17-pallet mixed cargo/personnel configuration, the lavatory Z may have to be removed to allow for clearance during rotation and positioning of the trucks.

1. The trucks are loaded longitudinally on the centerline of the cargo compartment as shown in figure 5H-2. The trucks can be loaded when the cargo handling system is configured in the 25-pallet all-cargo configuration, the 23-pallet mixed cargo/personnel configuration or the 17-pallet mixed cargo/personnel configuration.

2. The trucks shall be loaded onto the conveyable transfer platform for rotation and longitudinal movement within the cargo compartment.

NOTE

- The front axle of the 2-1/2-ton truck must be loaded in compartment 8, 9, or 10 and positioned as depicted in figure 5H-3.
- The HCU-6/E pallets must be coupled on the 88-inch dimensions.

PREPARATION OF M35A2 CARGO TRUCKS FOR OFFLOADING

Prepare the truck for loading on a pallet subfloor by checking the vehicle in accordance with the procedures outlined for vehicle/equipment preparation in Section IV of this manual, and as follows:

CAUTION

The maximum front axle weight is 6,200 pounds. Do not exceed this weight due to possible structural damage to floor.

1. The maximum weight for the 2-1/2-ton truck is 18,000 pounds.

2. Cargo loaded in the vehicle bed must not be higher than the side racks (metal sides of the cargo body).

LOADING PRECAUTIONS

Observe all loading precautions as outlined for vehicle/equipment loading in Section IV.

LOADING PROCEDURES

Follow procedures for positioning the loader/elevator at the cargo door and for loading vehicles on HCU-6/E pallets into the cargo compartment as outlined in Section IV, and as follows:

1. The preferred method of rotating the truck is manually. However, the cargo winch or powered roller system can be used to rotate the truck.

2. Move the truck longitudinally, on the centerline of the aircraft, to the pallet subfloor.

3. Use a minimum of two dual paw end restraint assemblies at the forward end to preclude the platform from moving forward during transfer.

4. Instruct the truck driver to start the engine and slowly drive the truck onto the pallet subfloor and into the prearranged load position (figure 5H-3).

5. Tie down the truck in accordance with procedures outlined in Section IV and shown in figures 5H-4 and 5H-5.

PREPARATION OF AIRCRAFT FOR OFFLOADING

Prepare the aircraft for offloading the M35A2 Cargo Trucks in the same manner as for loading.

PREPARATION OF M35A2 CARGO TRUCKS FOR OFFLOADING

Ensure that the brakes of the trucks are operating properly.

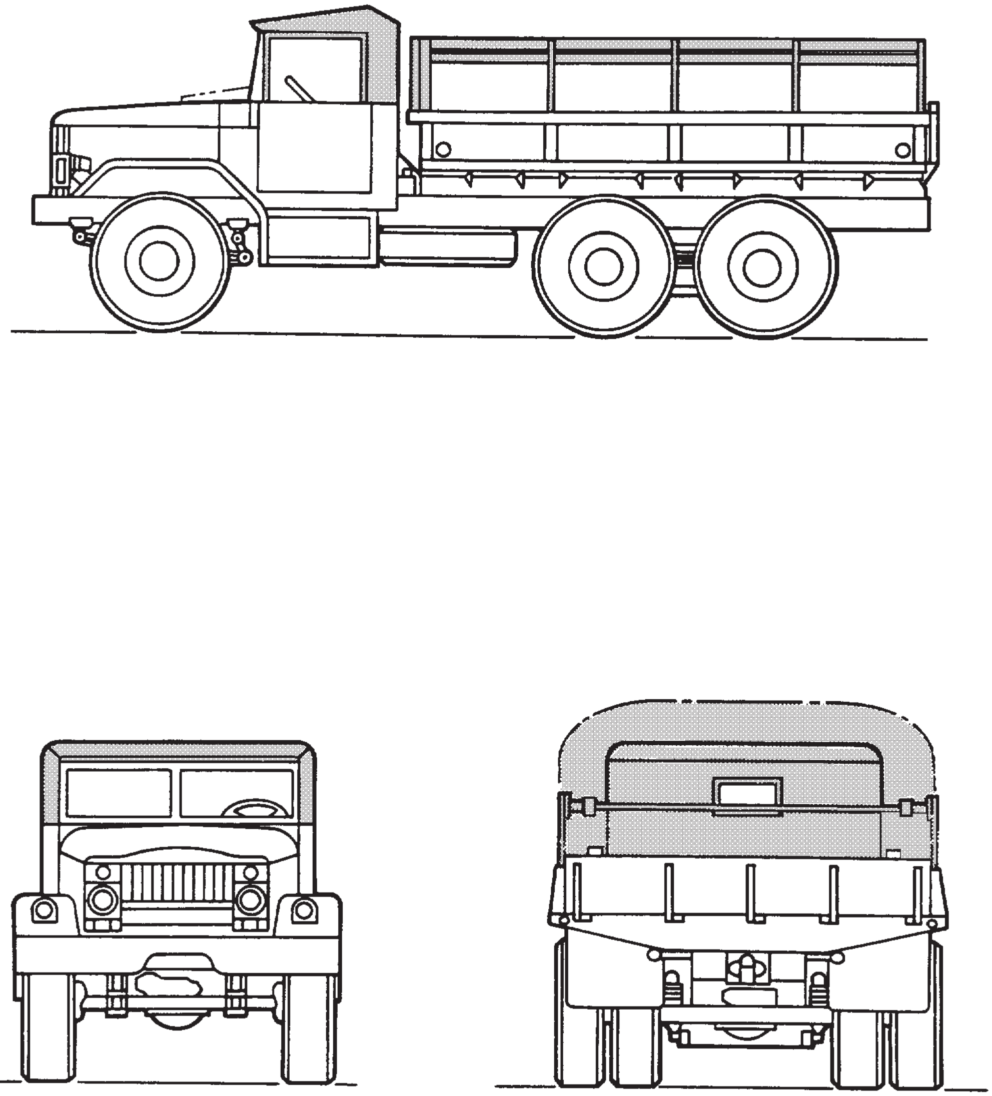
OFFLOADING PRECAUTIONS

Offloading precautions are the same as for loading.

OFFLOADING PROCEDURES

Offloading procedures are essentially the reverse of loading procedures.

LENGTH = 265 INCHES
WIDTH = 96 INCHES
HEIGHT = 81 INCHES
WEIGHT = 18,000 LBS



NOTE: SHADED AREA DEPICTS PARTS REMOVED FOR REDUCED CONFIGURATION

SA9-241A

Figure 5H-1. M35A 2-1/2-Ton Cargo Truck (Without Winch)

KC-10A CARGO LOADING MANUAL

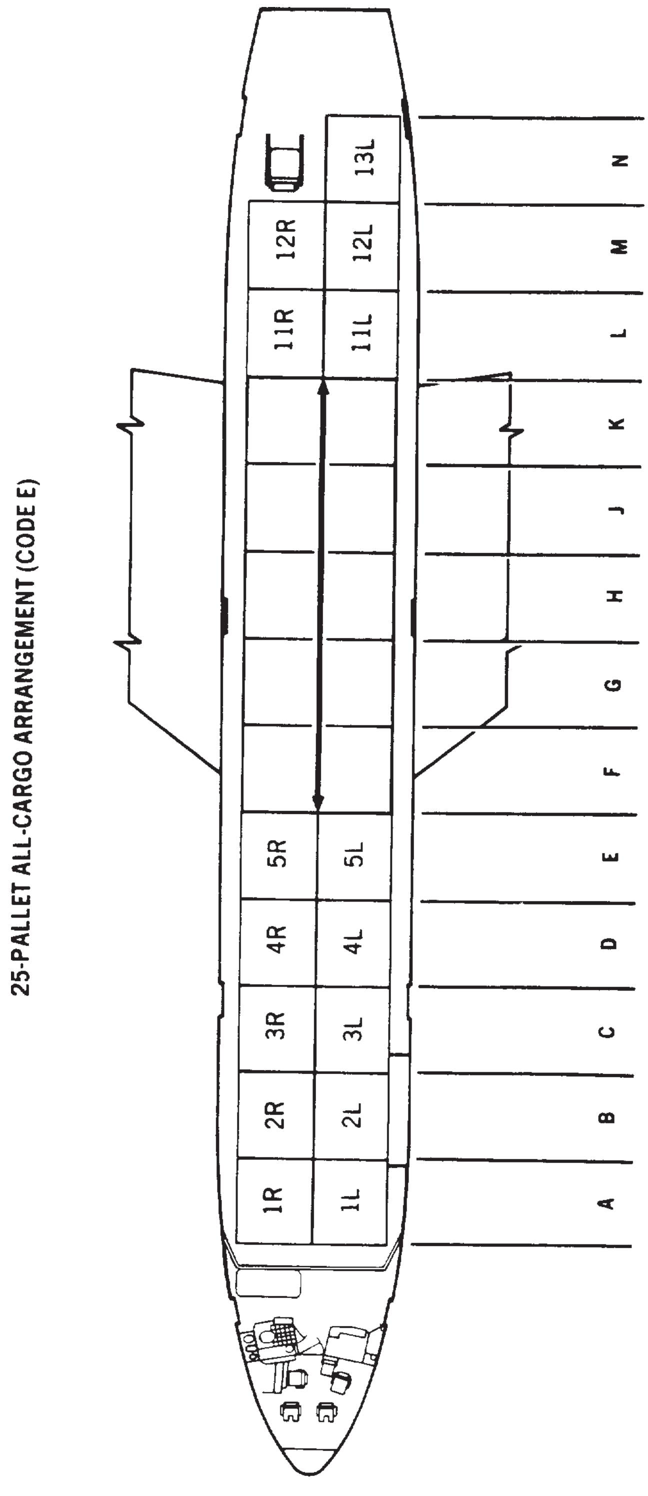


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Figure 5H-2. Loadable Locations for M35A2 Cargo Truck

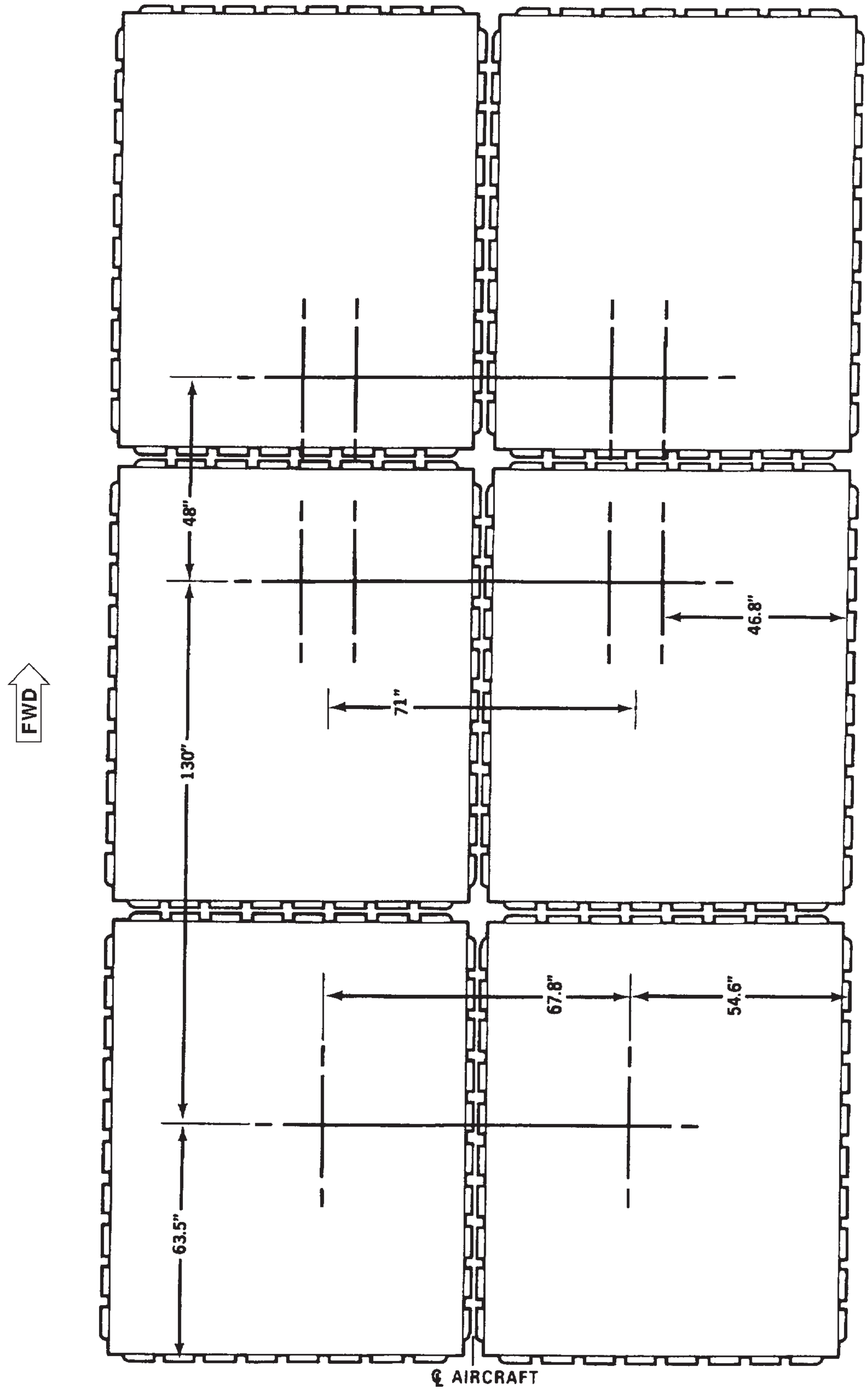

Figure 5H-3. Position of M35A2 Cargo Truck (Centerline Loaded)

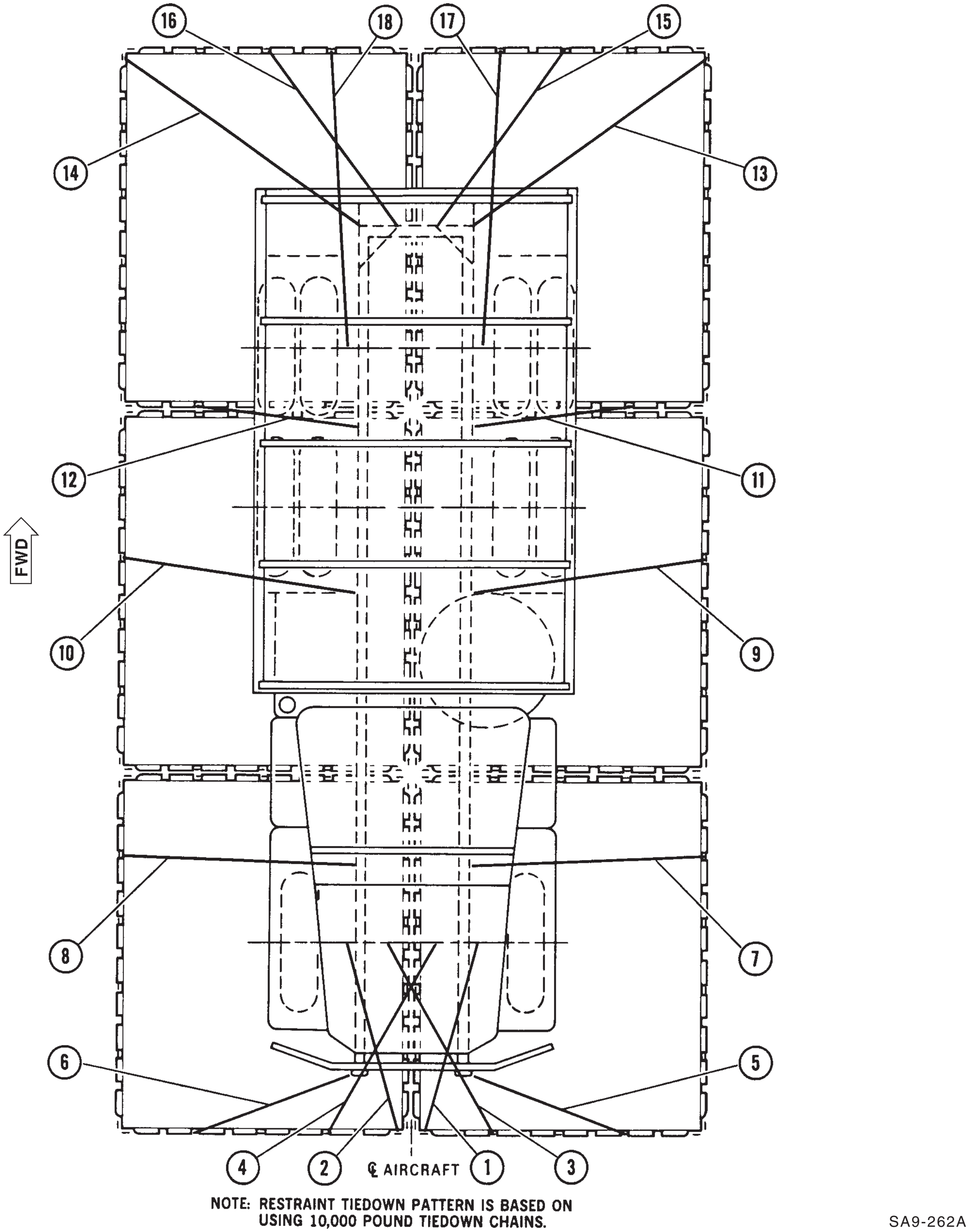

Figure 5H-4. Plan View - Tiedown Pattern for M35AC Cargo Truck (Centerline Loaded)

TIE DOWN NO.	VEHICLE ATTACH POINT	PALLET RING ATTACH POINT	ACTUAL MEASUREMENTS (INCHES)				RESTRAINT VALUES (LBS)				
			DEVICE LENGTH	EFFECTIVE LENGTHS			LONGITUDINAL		LATERAL		VERT
				VERT	LONG.	LAT.	FWD	AFT	LEFT	RIGHT	
1	FRONT AXLE	CORNER	64	21	58	13	6796			1523	2460
2	FRONT AXLE	CORNER	64	21	58	13	6796		1523		2460
3	FRONT AXLE	SIDE	71	21	60	32	6338		3380		2218
4	FRONT AXLE	SIDE	71	21	60	32	6338			3380	2218
5	FRONT BUMPER	SIDE	64	37	19	48	1283		3243		2500
6	FRONT BUMPER	SIDE	64	37	19	48	1283			3243	2500
7	SIDE FRAME	SIDE	76	34	2	69		147	5073		2500
8	SIDE FRAME	SIDE	76	34	2	69		147		5073	2500
9	SIDE FRAME	SIDE	77	35	4	68		285	4857		2500
10	SIDE FRAME	SIDE	77	35	4	68		285		4857	2500
11	SIDE FRAME	SIDE	54	31	3	44		241	3548		2500
12	SIDE FRAME	SIDE	54	31	3	44		241		3548	2500
13	REAR BUMPER	CORNER	89	36	41	69		2847	4791		2500
14	REAR BUMPER	CORNER	89	36	41	69		2847		4791	2500
15	REAR BUMPER	SIDE	72	39	46	40		2948	2564		2500
16	REAR BUMPER	SIDE	72	39	46	40		2948		2564	2500
17	REAR AXLE	SIDE	89	22	84	11		7078	926		1853
18	REAR AXLE	SIDE	89	22	84	11		7078		926	1853
TOTAL APPLIED RESTRAINT							28,834	27,092	29,905	29,905	43,062
TOTAL REQUIRED RESTRAINT							27,000	27,000	27,000	27,000	36,000

SA9-263

Figure 5H-5. Restraint Values - M35A2 Cargo Truck at 18,000 Pounds (Centerline Loaded)

AM-1325 FLYAWAY NO. 2 ENGINE CHANGE PLATFORM

GENERAL

This section contains instructions for preloading, loading, restraining and offloading the AM-1325 Flyaway No. 2 Engine Change Platform (figure 5J-1). The instructions are for aircraft handling, loading and offloading by the prepalletized method.

NOTE

The AM-1325 Flyaway No. 2 Engine Change Platform consists of one coupled pallet containing the platform stand and a single pallet containing ancillary equipment. This section contains special loading instructions for loading the coupled pallets. The single pallet requires no special loading instructions.

PREPARATION OF AIRCRAFT FOR LOADING

Prepare the aircraft for loading the AM-1325 Flyaway No. 2 Engine Change Platform as outlined in Section IV of this manual and as follows:

1. The method of loading the AM-1325 Platform in the cargo compartment is longitudinally for the all-cargo configurations as well as for all mixed cargo-personnel configurations. Figure 5J-2 shows the locations where the Platform may be loaded in the aircraft.

CAUTION

For the mixed cargo-personnel configurations the platform shall not be loaded in the first position aft of the cargo barrier net.

2. Rotation of the platform while loading is required since the palletized length is 217 inches.

NOTE

The platform set consisting of a LH and a RH stand weighs a total of 11,200 lbs. This includes the pallets, turnbuckles and all tiedown brackets, but, excludes the chains.

PREPARATION OF AM-1325 PLATFORM FOR LOADING - PALLETIZING ON COUPLED HCU-6/E PALLETS

CAUTION

Height of the AM-1325 Platform must not exceed 97 inches. This allows one inch of clearance for aircraft deflection.

NOTE

Under normal circumstances, cargo loading personnel will receive the AM-1325 Platform in the prepalletized form. If the platform is prepalletized correctly, (figure 5J-1), proceed to LOADING PRECAUTIONS. If the platform is not in the prepalletized form or if improper stacking or restraining is found, perform prepalletizing using the following procedures.

Prepare and prepalletize the AM-1325 Platform for loading in the aircraft as follows:

1. Position two empty pallets on pallet buildup stand and couple on the 88-inch sides.

NOTE

Use only 1-inch pallet couplers to couple the HCU-6/E pallets.

2. The original pallets delivered with the platform are painted with the outline for locating the platforms position. Should new pallets be used, mark or paint the surface with the pattern shown in figure 5J-3.

NOTE

The platform consists of a LH stand and a RH stand. Both should be in a collapsed and folded configuration. The LH stand is the one with turnbuckles and brackets attached and contains the generator and battery charger.

3. Palletize the AM-1325 Platform on the pallets using cargo loading procedures.

A tow truck/lifting motor is required. Position the LH platform stand first, matching the bottom of the stand with the pattern painted on the pallets (figure 5J-3).

CAUTION

If the platform is improperly positioned on the pallets, it may damage aircraft sidewalls. Caster wheel protrusion up to 4 inches outside of pallet 88-inch ends is normal.

NOTE

Ten turnbuckle clevis assemblies are required with the platform stand (figure 5J-1 and 5J-4). The turnbuckle clevis assemblies are used only for positioning the platform and are not used as load restraints.

4. Position the LH platform stand by securing the pallet hold-down loops into the turnbuckle clevis assemblies and tightening the turnbuckles.

5. Tiedown the LH platform stand in accordance with procedures outlined in Section IV and illustrated in figures 5J-1, 5J-4 and 5J-6.

6. Position the RH platform stand on top of the LH Stand, duplicating the orientation of the now secured LH Stand. Align wheel direction and all sides of the RH platform stand to match the lower stand with the four outboard casters facing the direction.

7. Tiedown the RH platform stand in accordance with procedures outlined in Section IV and illustrated in figures 5J-1, 5J-5 and 5J-6.

8. Using tiedown straps tiedown upper RH platform stand as shown in figure 5J-1.

LOADING PRECAUTIONS

Observe all loading precautions outlined for vehicle/equipment loading in Section IV.

LOADING PROCEDURES - PREPALLETIZED ON COUPLED HCU-6/E PALLETS

Follow procedures for positioning the loader/elevator at the cargo door and for loading HCU-6/E pallets into the cargo compartment as outlined in Section IV and as follows:

1. Move the coupled pallets (with platform) from loader/elevator into the aircraft.

CAUTION

- Extreme caution shall be exercised as the platform enters the cargo compartment. Overhead clearances shall be closely monitored to prevent damage to the overhead cargo door jamb.
- Damage could occur to the aircraft cargo door when the platform is loaded into the cargo compartment because of landing gear strut deflection. Refer to Section IV, Aircraft Deflection chart.

2. Manually, or by the powered roller system, rotate and move the coupled pallets longitudinally into prearranged pallet position, (figure 5J-2).

3. Secure pallets by raising the restraint assembly pawls, and lock into position.

PREPARATION OF AM-1325 PLATFORM FOR OFFLOADING

No specific preparation of the AM-1325 Platform is required. As in pallet offloading, retract floor restraints as necessary.

OFFLOADING PRECAUTIONS

Offloading precautions are the same as for loading.

OFFLOADING PROCEDURES

Offloading procedures are essentially the reverse of loading procedures.

KC-10A CARGO LOADING MANUAL

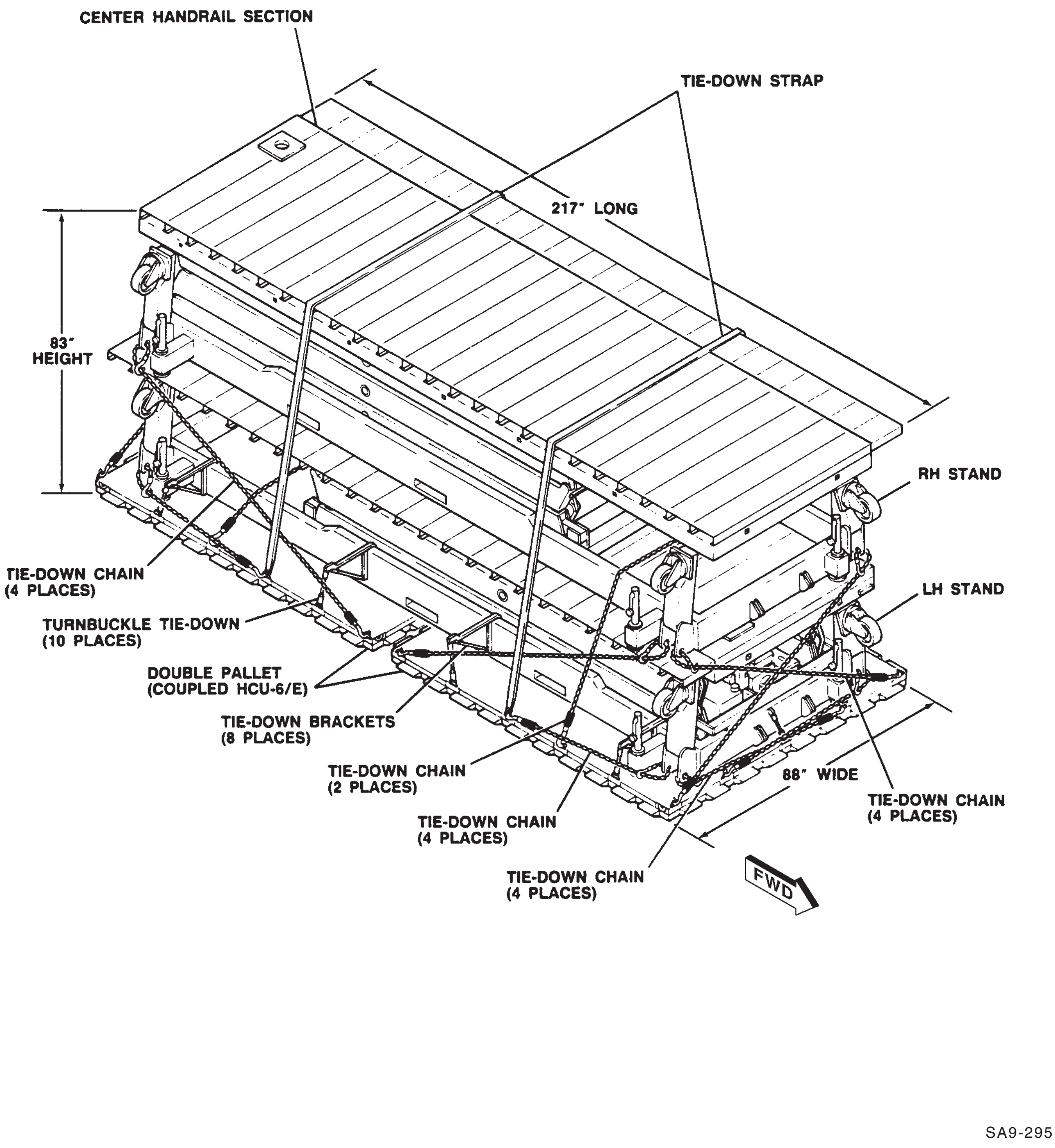

Figure 5J-1. AM-1325 Flyaway No. 2 Engine Change Platform - Prepalletized

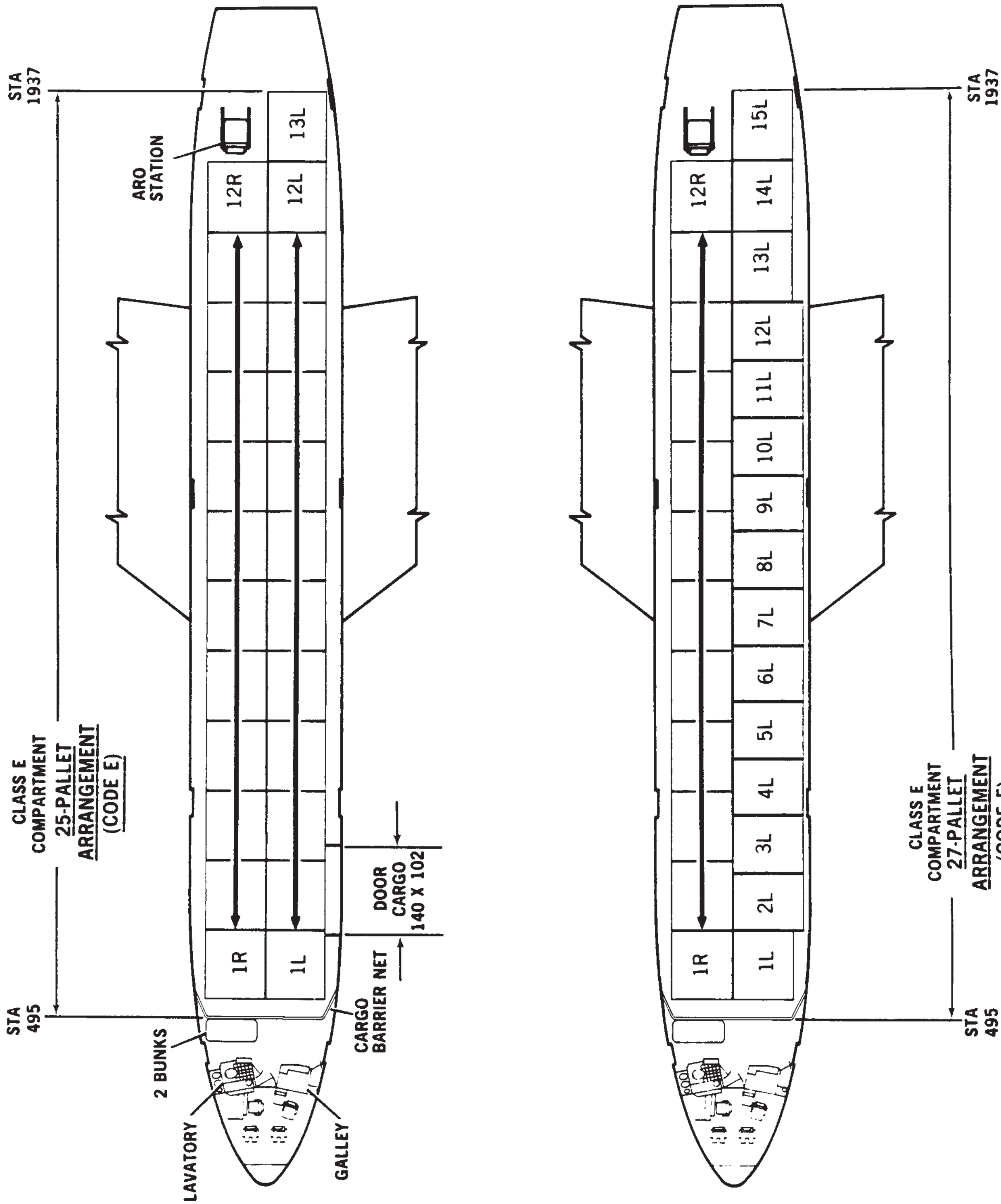

Figure 5J-2. Platform Loading Locations

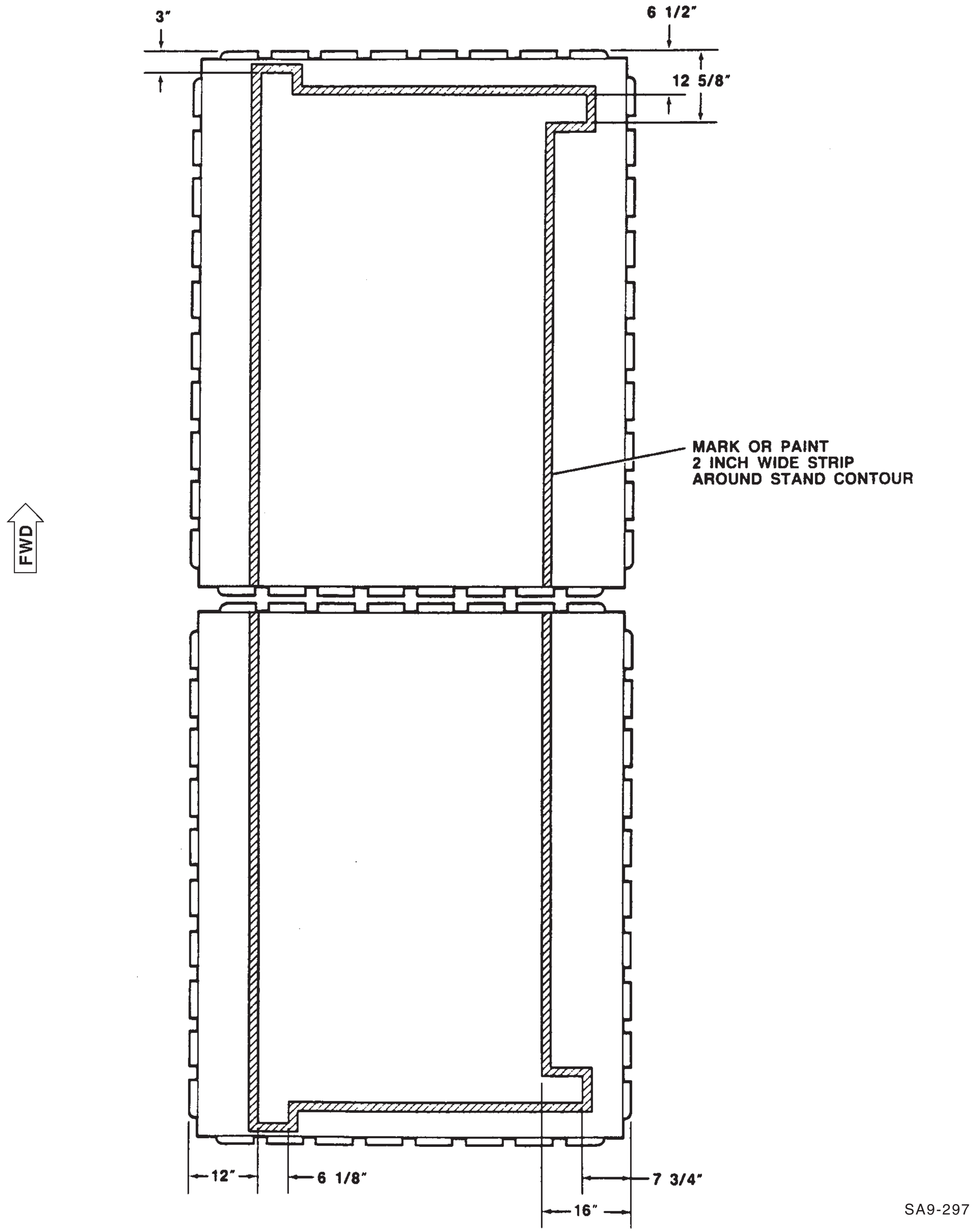

Figure 5J-3. Positions of AM-1325 Platform on Coupled Pallets (Coupled on 88-Inch Dimension)

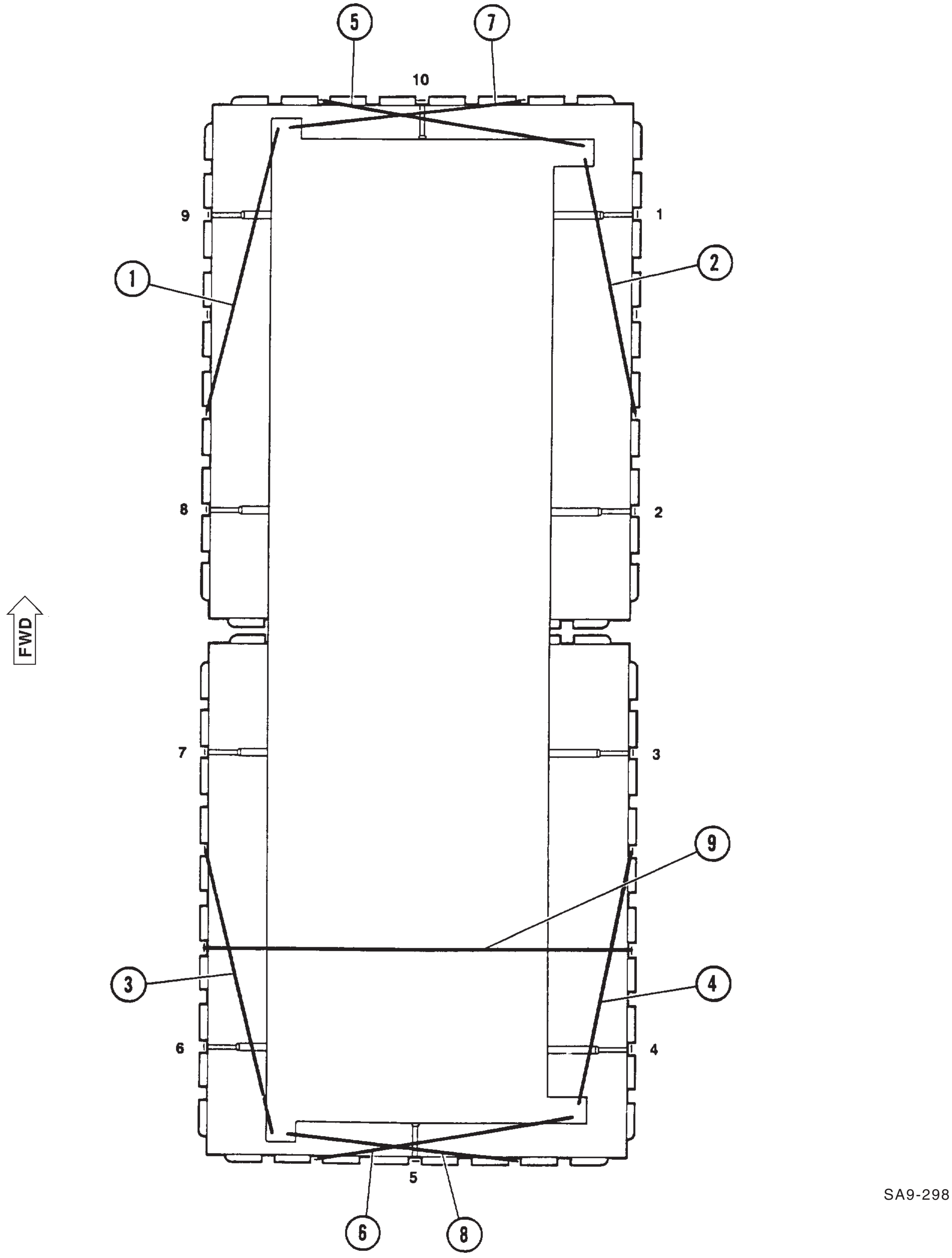

Figure 5J-4. Plan View of Chain and Turnbuckle Tiedown Locations. Lower (LH) Platform Stand

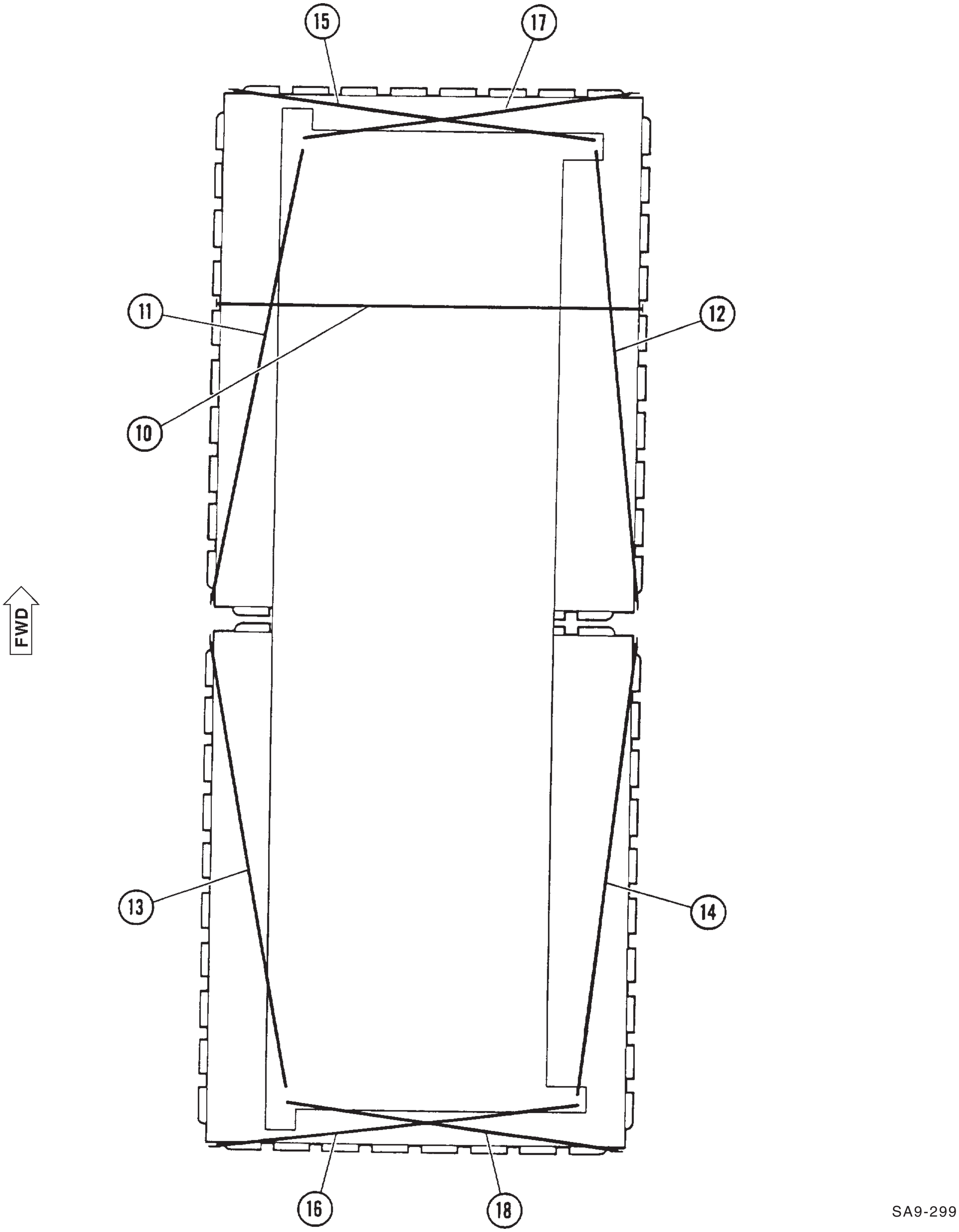

Figure 5J-5. Plan View of Chain Tiedown Locations for Upper (RH) Platform Stand

TIE DOWN NO.	VEHICLE ATTACH POINT	PALLET RING ATTACH POINT	ACTUAL MEASUREMENTS (INCHES)				RESTRAINT VALUES (LBS)				
			DEVICE LENGTH	EFFECTIVE LENGTHS			LONGITUDINAL		LATERAL		VERT
				VERT	LONG.	LAT.	FWD	AFT	LEFT	RIGHT	
1	L FWD CORNER	FWD L SIDE	61	0	60	11	7377			1352	
2	R FWD CORNER	FWD R SIDE	52	0	51	6	7355		865		
3	L AFT CORNER	AFT L SIDE	61	0	60	11		7377		1352	
4	R AFT CORNER	AFT R SIDE	52	0	51	6		7355	865		
5	R FWD CORNER	FWD EDGE L	57	0	5	56		657		7368	
6	R AFT CORNER	AFT EDGE L	57	0	5	56	657			7368	
7	L FWD CORNER	FWD EDGE R	47	0	2	46		319	7340		
8	L FWD CORNER	AFT EDGE R	47	0	2	46	319		7340		
TOTAL APPLIED RESTRAINT							15708	15708	16410	17440	
TOTAL REQUIRED RESTRAINT							9000	9000	9000	9000	

TIE DOWN NO.	VEHICLE ATTACH POINT	PALLET RING ATTACH POINT	ACTUAL MEASUREMENTS (INCHES)				RESTRAINT VALUES (LBS)				
			DEVICE LENGTH	EFFECTIVE LENGTHS			LONGITUDINAL		LATERAL		VERT
				VERT	LONG.	LAT.	FWD	AFT	LEFT	RIGHT	
11	L FWD CORNER	FWD L SIDE	109	42	100	11	5952			654	2500
12	R FWD CORNER	FWD R SIDE	100	42	91	6	5416		357		2500
13	L AFT CORNER	AFT L SIDE	109	42	100	11		5952		654	2500
14	R AFT CORNER	AFT R SIDE	100	42	91	6		5416	357		2500
15	R FWD CORNER	FWD L CORNER	87	42	5	76		297		4523	2500
16	R AFT CORNER	AFT L CORNER	87	42	5	76	297			4523	2500
17	L FWD CORNER	FWD R CORNER	78	42	2	66		119	3928		2500
18	L AFT CORNER	AFT R CORNER	78	42	2	66	119		3928		2500
TOTAL APPLIED RESTRAINT							11784	11784	8570	10354	
TOTAL REQUIRED RESTRAINT							7800	7800	7800	7800	

TIE DOWN NO.	VEHICLE ATTACH POINT	PALLET RING ATTACH POINT	ACTUAL MEASUREMENTS (INCHES)				RESTRAINT VALUES (LBS)				
			DEVICE LENGTH	EFFECTIVE LENGTHS			LONGITUDINAL		LATERAL		VERT
				VERT	LONG.	LAT.	FWD	AFT	LEFT	RIGHT	
9	STRADDLE	AFT SIDES		8/8	0	10/14					5000
10	STRADDLE	FWD SIDES		50/50	0	10/14					5000
TOTAL APPLIED RESTRAINT											30000
TOTAL REQUIRED RESTRAINT											22440

SA9-300

Figure 5J-6. Restraint Values - Upper Platform at 5200 Pounds and Lower Platform at 6000 Pounds. (Pallets Coupled on 88-Inch Dimension)

AM-1998 KC-10A ENGINE TRANSPORT DEVICE

GENERAL

This section contains instructions for preloading, loading and offloading the AM-1998 KC-10A Engine Transport Device. The instructions are for aircraft handling, loading and offloading by the prepalletized method.

The AM-1998 KC-10A Engine Transport Device, figure 5K-1, is intended to allow shipment of the CF6-50C2 engine less the inlet cowl. This is accomplished by rolling the engine on the transport device to lower the height below 100 inches. The device is positioned on two 463L pallets coupled on their 88-inch dimensions. Required restraint is provided by 26 turnbuckles between the transport device and the pallet. This device is compatible with the standard HCU-6/E palletized system.

PREPARATION OF AIRCRAFT FOR LOADING

Prepare the aircraft for loading the AM-1998 KC-10A Engine Transport Device as outlined in Section IV of this manual and as follows:

1. The method of loading the AM-1998 KC-10A Engine Transport Device is longitudinally for the all cargo configuration as well as for all mixed cargo-personnel configurations. Figures 5K-2 and 5K-3 depict the locations where the device(s) may be loaded.

NOTE

Two transport devices will normally be deployed so that one can support the new engine while the other accepts the old engine.

PREPARATION OF AM-1998 KC-10A ENGINE TRANSPORT DEVICE FOR LOADING

Cargo loading personnel shall receive the transport device (with engine) in the prepalletized form with engine/cradle in rolled position and cradle lock pins installed.

NOTE

When the transport device is airlifted without the engine, cradle shall not be in the rolled position. Verify the cradle is secured to the support base and both support arms are stowed.

LOADING PRECAUTIONS

Observe all loading precautions outlined for vehicle/equipment loading in Section IV.

Rotation of the transport device on the omni - directional panels is required due to the palletized length of 240 inches.

CAUTION

Use only the transport device structure when moving the device. Damage to engine or engine accessories may occur if used as positioning aids.

LOADING PROCEDURES - AM-1998 KC-10A ENGINE TRANSPORT DEVICE

Follow procedures for positioning the loader/elevator at the cargo door and for loading HCU-6/E coupled pallets into the cargo compartments as outlined in Section IV.

The transport device is positioned on the loader/elevator by the Step-on/Step-off method.

NOTE

The AM-1998 KC-10A Engine Transport Device shall be loaded with engine tailpipe first.

1. The loader/elevator platform must be as low as possible so as to accommodate the Step-on/Step-off feature as follows:

a. With the device sitting on caster legs, adjust all caster legs simultaneously until transport device is above loader/elevator platform. Move the transport device onto the loader/elevator platform until the aft caster legs are approximately 6 inches from the loader.

b. Actuate all four caster leg cranks to lower aft end of frame onto the loader, keeping the transport device frame level.

c. Continue to retract aft caster leg cranks only until they are no longer supporting the load. Retract casters fully, unpin, rotate to the stowed position and pin.

d. Move the transport device further onto the loader until the forward caster legs are approximately 6 inches from the loader. Retract casters fully, unpin, rotate to stowed position and pin.

2. Complete moving the transport device onto the loader/elevator.

Move the transport device from the loader/elevator into the aircraft.

CAUTION

- Extreme caution shall be exercised as the transport device enters the cargo compartment. Overhead clearance shall be closely monitored to prevent damage to overhead cargo door jamb, and lateral clearances shall be closely monitored as the transport device is moved within the cargo compartment to prevent damage to aircraft structure. Aircraft deflection shall be computed when loading and offloading the transport device when engine is mounted on the device.
- Load sequencing is critical due to lateral and aft overhang. Positioning of other pallets in the cargo compartment may be restricted.

Manually, or by the powered roller system, rotate the transport device and move it into the prearranged pallet position. Raise the restraint assembly pawls to lock pallets into position.

PREPARATION OF AM-1998 KC-10A ENGINE TRANSPORT DEVICE FOR OFFLOADING

No specific preparation of the transport device is required. As in pallet offloading, retract pawls and offload device.

OFFLOADING PRECAUTIONS

Offloading precautions are the same as for loading.

OFFLOADING PROCEDURES

Offloading procedures are essentially the reverse of loading procedures.

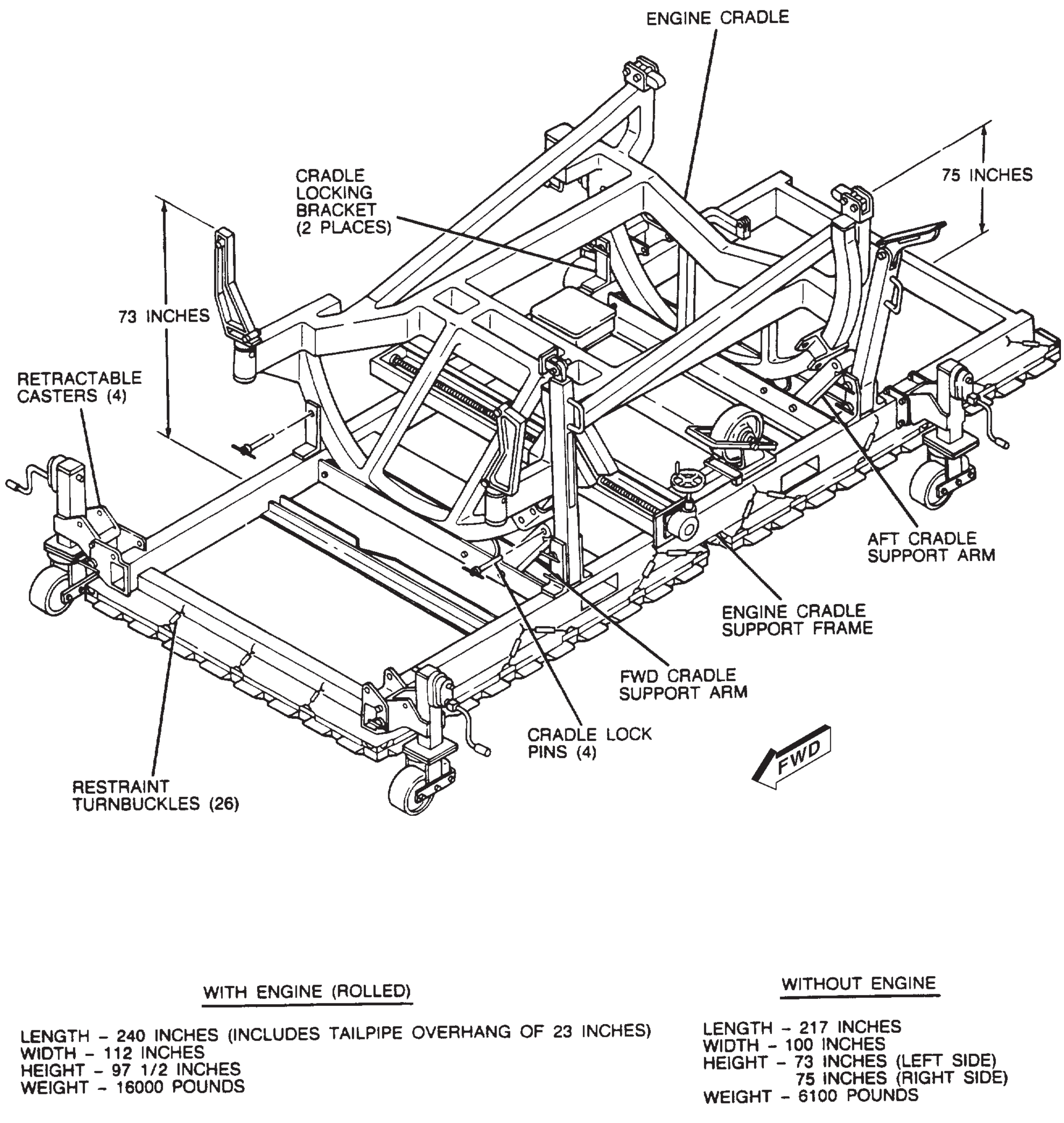

Figure 5K-1. AM-1998 KC-10A Engine Transport Device

KC-10A CARGO LOADING MANUAL

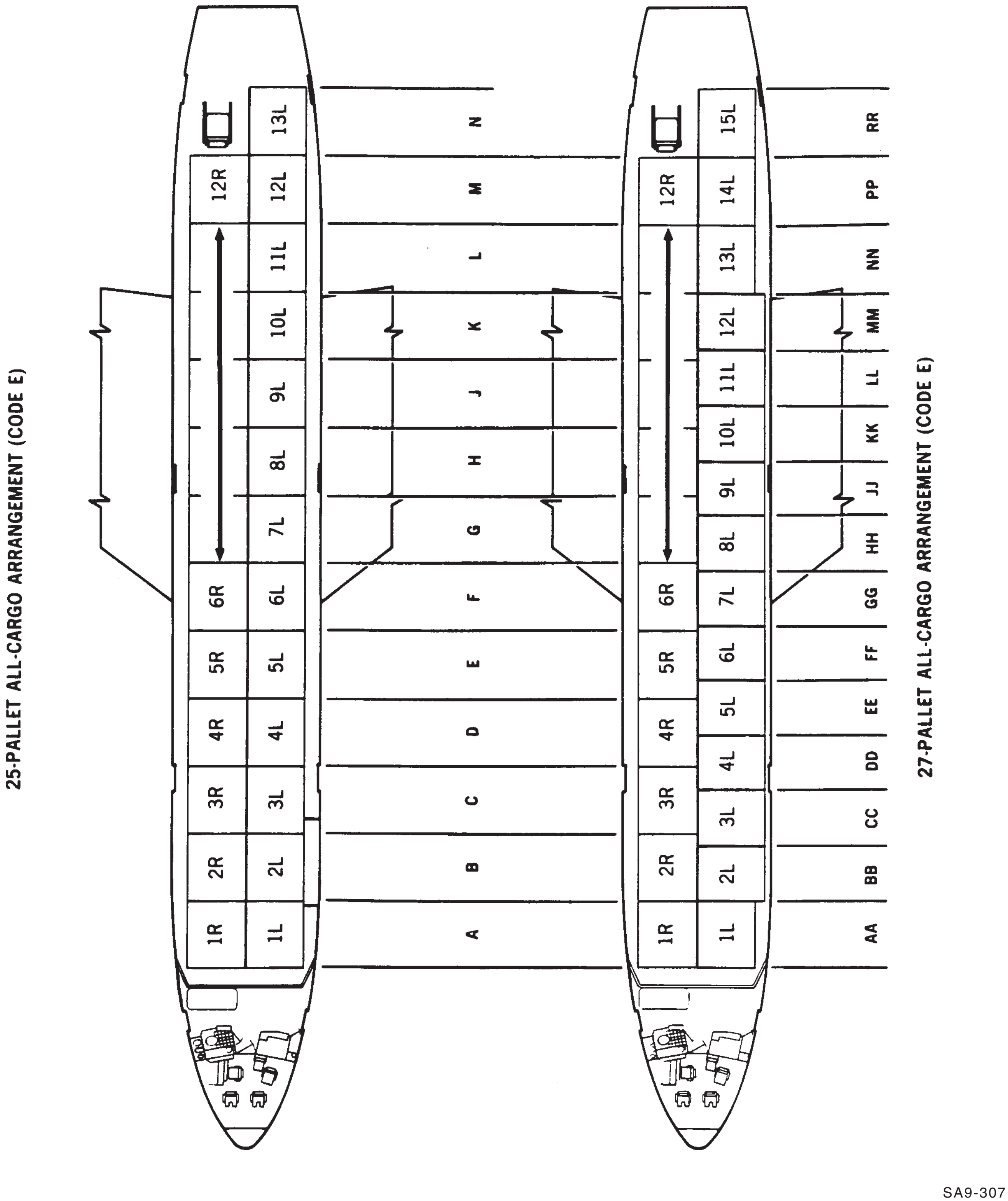

Figure 5K-2. Loadable Locations For AM-1998 KC-10A Engine Transport Device With KC-10A Engine In Rolled Position

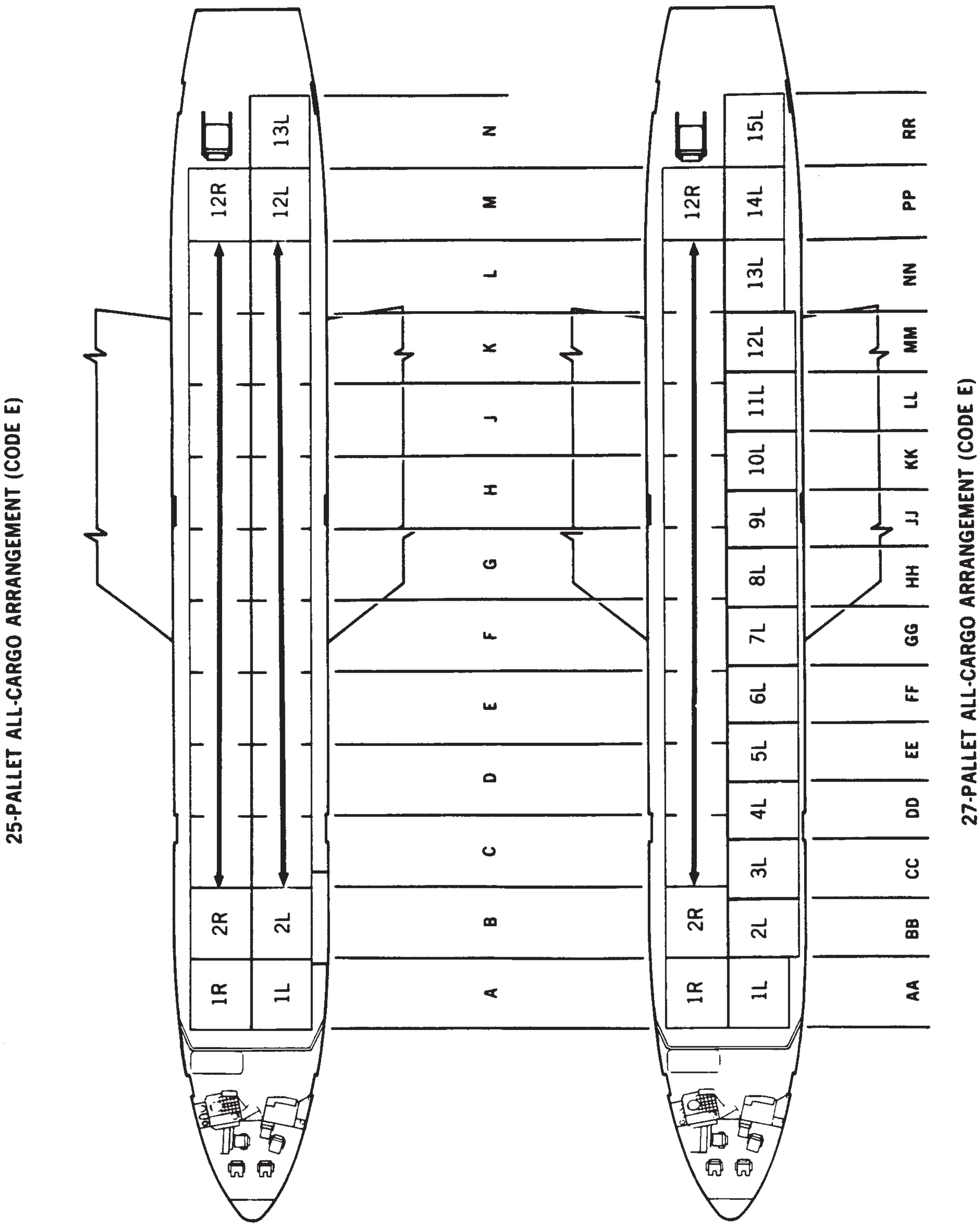

Figure 5K-3. Loadable Locations for AM-1998 Engine Transport Device Without KC-10A Engine

EMERGENCY PROCEDURES

TABLE OF CONTENTS

INTRODUCTION

This section provides instructions for emergency procedures to follow in the event of a cargo fire during loading/offloading operations.

Inflight emergency procedures, and emergency evacuation of personnel from the aircraft during ground emergencies and ditching situations are found in TO 1C-10(K)A-1.

EMERGENCY PROCEDURES DURING LOADING/OFFLOADING OPERATIONS

Should fire occur in any cargo item during the loading/offloading operation, proceed as follows:

1. Warn all personnel of the danger and direct evacuation of the aircraft.

2. Remove the burning item from the aircraft if accessible, removable, or practical.

3. Notify the fire department by best available means.

4. Attempt to extinguish fire with the onboard portable fire extinguishers or other available fire fighting equipment.

5. Shut down all operating aircraft systems.