

NAVAL SHIPS' TECHNICAL MANUAL
CHAPTER 588
AIRCRAFT ELEVATORS

THIS CHAPTER SUPERSEDES CHAPTER 588 DATED 31 JULY 1990

DISTRIBUTION STATEMENT A: APPROVED FOR PUBLIC RELEASE, DISTRIBUTION IS UNLIMITED.

PUBLISHED BY DIRECTION OF COMMANDER, NAVAL SEA SYSTEMS COMMAND.

31 OCT 1997

NAVSEA TECHNICAL MANUAL CERTIFICATION SHEET						_ 1 _ of _ 1 _	
Certification Applies to: New Manual <input type="checkbox"/>						Revision <input checked="" type="checkbox"/>	Change <input type="checkbox"/>
Applicable TMINS/Pub. No. <u>S9086-T3-STM-010/CH-588R1</u>							
Publication Date (Mo, Da, Yr) <u>October 31, 1997</u>							
Title: <u>NSTM Chapter 588, Aircraft Elevators</u>							
TMCR/TMSR/Specification No: _____							
CHANGES AND REVISIONS:							
Purpose: <u>Side bars in the outside margins indicate changes since the last revision.</u>							
<u>Changes are administrative renumbering of paragraphs, added new requirement to use pressure lubricators</u>							
<u>on wire rope to installation and added statement that poured end fittings do not require pull testing</u>							

Equipment Alteration Numbers Incorporated: _____							
TMDER/ACN Numbers Incorporated: _____							
<i>Continue on reverse side or add pages as needed.</i>							
CERTIFICATION STATEMENT							
This is to certify that responsible NAVSEA activities have reviewed the above identified document for acquisition compliance, technical coverage, and printing quality. This form is for internal NAVSEA management use only, and does not imply contractual approval or acceptance of the technical manual by the Government, nor relieve the contractor of any responsibility for delivering the technical manual in accordance with the contract requirement.							
Authority	Name	Signature	Organization	Code	Date		
Acquisition	T. W. Nodeen	<i>T. W. Nodeen</i>	NAVSEA	03W43	10/31/97		
Technical	K. D. Brayton	<i>K. D. Brayton</i>	NAVSEA	03W4	10/31/97		
Printing Release	Digital Media Publishing						

Certification Sheet

TABLE OF CONTENTS

Chapter/Paragraph	Page
588 AIRCRAFT ELEVATORS	588-1
SECTION 1. FUNCTIONAL DESCRIPTION	588-1
588-1.1 INTRODUCTION	588-1
588-1.2 STRUCTURE	588-3
588-1.2.1 GENERAL.	588-3
588-1.2.2 PLATFORMS.	588-3
588-1.2.3 GUIDE RAILS.	588-4
588-1.2.4 GUIDE ROLLERS.	588-4
588-1.3 REEVING	588-6
588-1.3.1 GENERAL.	588-6
588-1.3.2 WIRE ROPE.	588-6
588-1.3.3 SHEAVES.	588-7
588-1.4 HYDRAULIC ENGINES	588-7
588-1.4.1 GENERAL.	588-7
588-1.4.2 RAM TYPE.	588-7
588-1.4.3 PISTON TYPE.	588-7
588-1.5 HYDRAULICS	588-7
588-1.5.1 GENERAL.	588-7
588-1.5.2 MAIN PUMPS.	588-10
588-1.5.3 AIR SYSTEMS.	588-10
588-1.5.3.1 High-Pressure System.	588-10
588-1.5.3.2 Low-Pressure System.	588-10
588-1.5.4 SUMP AND SUPPLY TANKS.	588-10
588-1.5.5 SUMP PUMP AND FLUID COOLING SYSTEM.	588-10
588-1.5.6 LEVELING INTENSIFIER.	588-10
588-1.6 CONTROL SYSTEM	588-11
588-1.6.1 GENERAL.	588-11
588-1.6.2 ELEVATOR CONTROL RELAY PANEL.	588-13
588-1.6.3 CONTROL STATIONS.	588-13
588-1.6.3.1 Hangar Deck Control Station.	588-13
588-1.6.3.2 Gallery Deck Control Station.	588-13
588-1.6.3.3 Machinery Room Control Station.	588-13
588-1.6.4 SPEED CONTROL.	588-14
588-1.6.4.1 Mechanical Feedback.	588-16
588-1.6.4.2 Hydraulic Flow Control.	588-17
588-1.7 SAFETY DEVICES	588-20
588-1.7.1 GENERAL.	588-20
588-1.7.2 PLATFORM LOCKBARS.	588-20

TABLE OF CONTENTS - Continued

Chapter/Paragraph	Page
588-1.7.3 DECK STANCHIONS.	588-20
588-1.7.4 SLACK ROPE SWITCHES.	588-20
588-1.7.5 WARNING HORNS.	588-21
588-1.7.6 INTERLOCKS.	588-21
588-1.7.7 WHEEL STOPS, SAFETY NETS AND MACHINERY GUARDS.	588-21
SECTION 2. GENERAL OPERATING REQUIREMENTS	588-21
588-2.1 OPERATOR REQUIREMENTS	588-21
588-2.2 ELEVATOR OPERATION	588-21
588-2.2.1 GENERAL.	588-21
588-2.2.2 PRE-OPERATIONAL PROCEDURE.	588-21
588-2.2.2.1 Machinery Room.	588-22
588-2.2.2.2 Gallery Deck.	588-22
588-2.2.2.3 Hangar Deck.	588-22
588-2.2.3 ELECTRIC OPERATION.	588-22
588-2.2.4 MANUAL OPERATION.	588-22
588-2.2.5 EMERGENCY OPERATION.	588-22
588-2.2.6 ELEVATOR SECURE.	588-23
SECTION 3. ELEVATOR MAINTENANCE AND INSPECTION	588-23
588-3.1 GENERAL	588-23
588-3.2 DAILY INSPECTION	588-23
588-3.3 ANNUAL INSPECTION	588-23
588-3.4 WIRE ROPE	588-24
588-3.4.1 GENERAL.	588-24
588-3.4.2 LUBRICATION.	588-25
588-3.4.3 TENSIONING.	588-25
588-3.4.4 INSPECTION REQUIREMENTS.	588-26
588-3.4.5 REPLACEMENT CRITERIA.	588-27
588-3.4.6 REPLACEMENT EXCEPTIONS.	588-27
588-3.4.6.1 Extended Service.	588-28
588-3.4.6.2 Damaged Wire Rope.	588-28
588-3.4.7 WIRE ROPE INSTALLATION.	588-29
588-3.5 HYDRAULICS	588-29
588-3.6 STANCHIONS AND PLATFORM LOCKBARS	588-30
SECTION 4. ELEVATOR TESTING	588-30
588-4.1 GENERAL	588-30

TABLE OF CONTENTS - Continued

Chapter/Paragraph	Page
588-4.2 LOAD TESTING	588-30
588-4.2.1 REQUIRED LOAD TESTING.	588-31
588-4.2.2 LOAD TEST REQUIREMENTS.	588-31
588-4.3 OPERATIONAL TESTING	588-35
588-4.3.1 REQUIRED OPERATIONAL TESTING.	588-35
588-4.3.2 OPERATIONAL TEST REQUIREMENTS.	588-35
588-4.4 HYDRAULIC TESTING	588-36

LIST OF TABLES

Table	Title	Page
588-3-1.	MAXIMUM FIRE TEMPERATURE	588-26

LIST OF ILLUSTRATIONS

Figure	Title	Page
588-1-1.	Typical Inboard Elevator Arrangement	588-2
588-1-2.	Typical Deck Edge Elevator Arrangement	588-3
588-1-3.	Folding Platform	588-4
588-1-4.	Typical Guide Roller Arrangement	588-5
588-1-5.	Typical Aircraft Elevator Reeving Arrangement	588-6
588-1-6.	Simplified Hydraulic Schematic	588-9
588-1-7.	Control System Functional Block Diagram	588-12
588-1-8.	Main Flow Control Valve	588-15
588-1-9.	Mechanical Feedback Speed Control	588-17
588-1-10.	Pressure-compensated Main Flow Control Valve	588-19
588-4-1.	Test Load Positioning (Sheet 1 of 3)	588-32
588-4-1.	Test Load Positioning (Sheet 2 of 3)	588-33
588-4-1.	Test Load Positioning (Sheet 3 of 3)	588-34

CHAPTER 588

AIRCRAFT ELEVATORS

SECTION 1.

FUNCTIONAL DESCRIPTION

588-1.1 INTRODUCTION

588-1.1.1 Aircraft elevators are designed primarily to transport aircraft between the hangar deck and the flight deck. They are, however, also used to transport cargo and equipment. Aircraft elevators are found on aircraft carriers and on some amphibious assault ships such as LHA's, LPH's and LHD's. All aircraft elevators use hydraulic engines, sheaves and wire ropes to lift and lower the platform. Inboard and deck edge are the two major types of aircraft elevators. These names refer to the location of the elevator platform on the ship. Inboard elevators are located inside the hull of the ship. [Figure 588-1-1](#) illustrates one type of inboard aircraft elevator. Deck edge elevators are more common and are located just outboard of the hull. A typical deck edge elevator is illustrated in [Figure 588-1-2](#). The machinery for inboard and deck edge elevators operate under the same principles and are similar in arrangement.

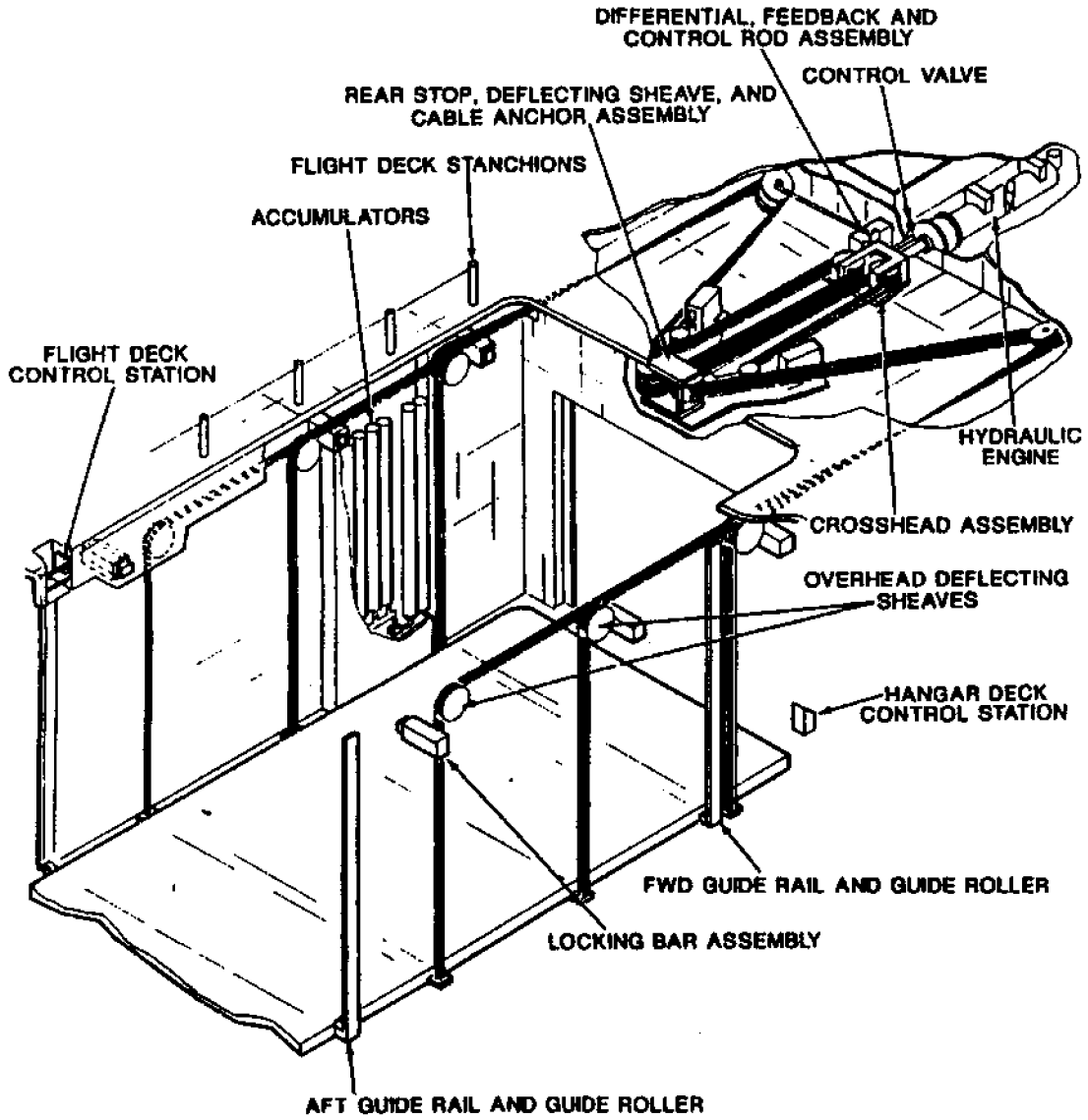


Figure 588-1-1. Typical Inboard Elevator Arrangement

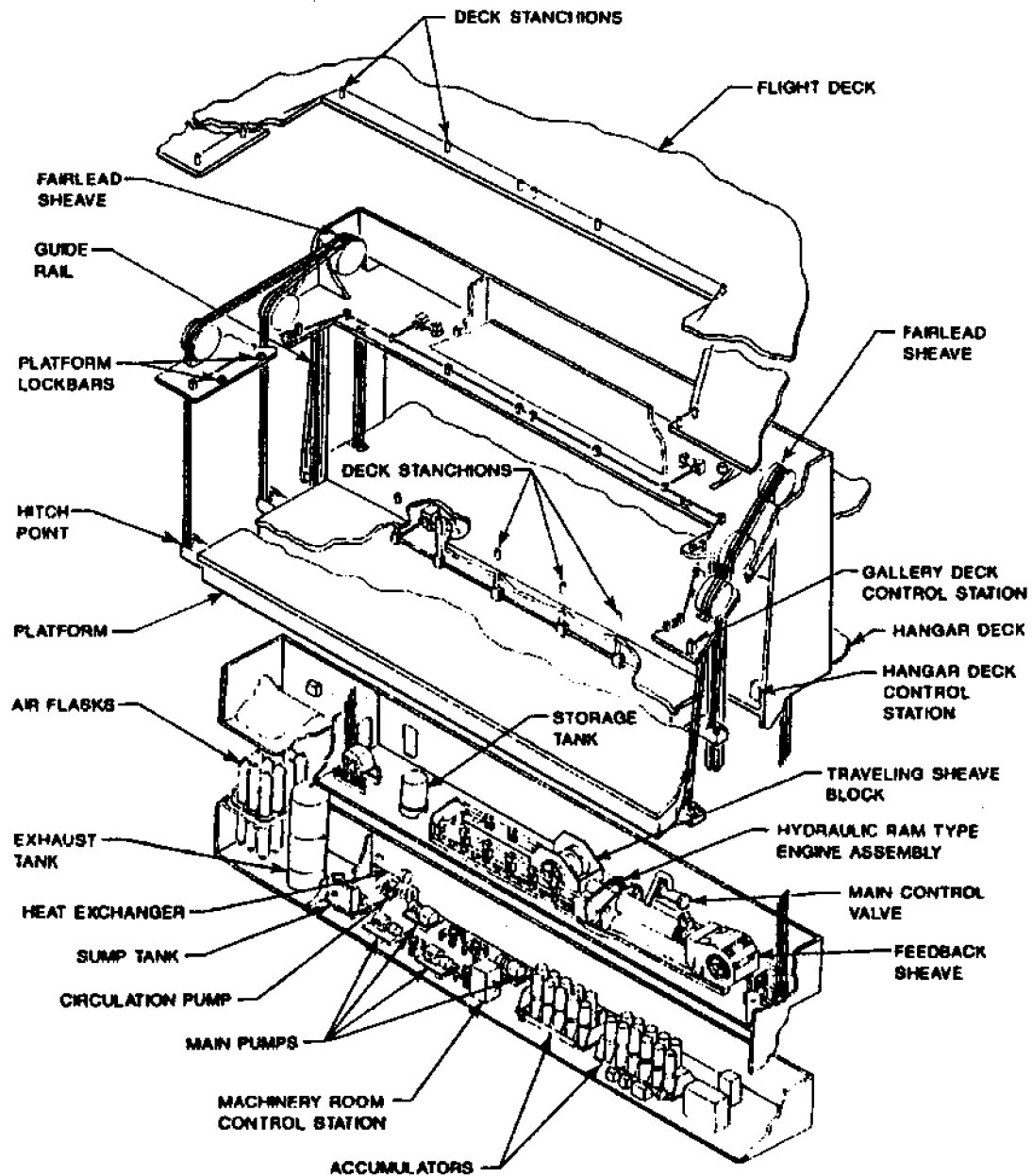


Figure 588-1-2. Typical Deck Edge Elevator Arrangement

588-1.2 STRUCTURE

588-1.2.1 GENERAL. The aircraft elevator structure is designed to withstand the weight of the platform, the rated load, wind loads, wave loads and dynamic forces from the movement of the ship and the elevator platform, and on some elevators, nuclear overblast pressures. Deck edge elevators are cantilevered off the hull of the ship. Inboard elevators use the platform as a hatch at the flight deck. Guide rails and rollers constrain the platform so it can only move in the vertical direction.

588-1.2.2 PLATFORMS. Aircraft elevator platforms are designed to be as lightweight as possible while still properly supporting the rated load. The elevator platform is sufficiently rigid to support the rated load with mini-

mal deflection, allowing platform lockbars to be inserted (to provide positive support at the flight deck) or retracted, regardless of the position of the load on the platform. Folding platforms are used on deck edge elevators for some amphibious assault ships to allow the ships sufficient clearance to pass through the Panama Canal. When necessary, the folding platform can be stowed vertically as illustrated in [Figure 588-1-3](#).

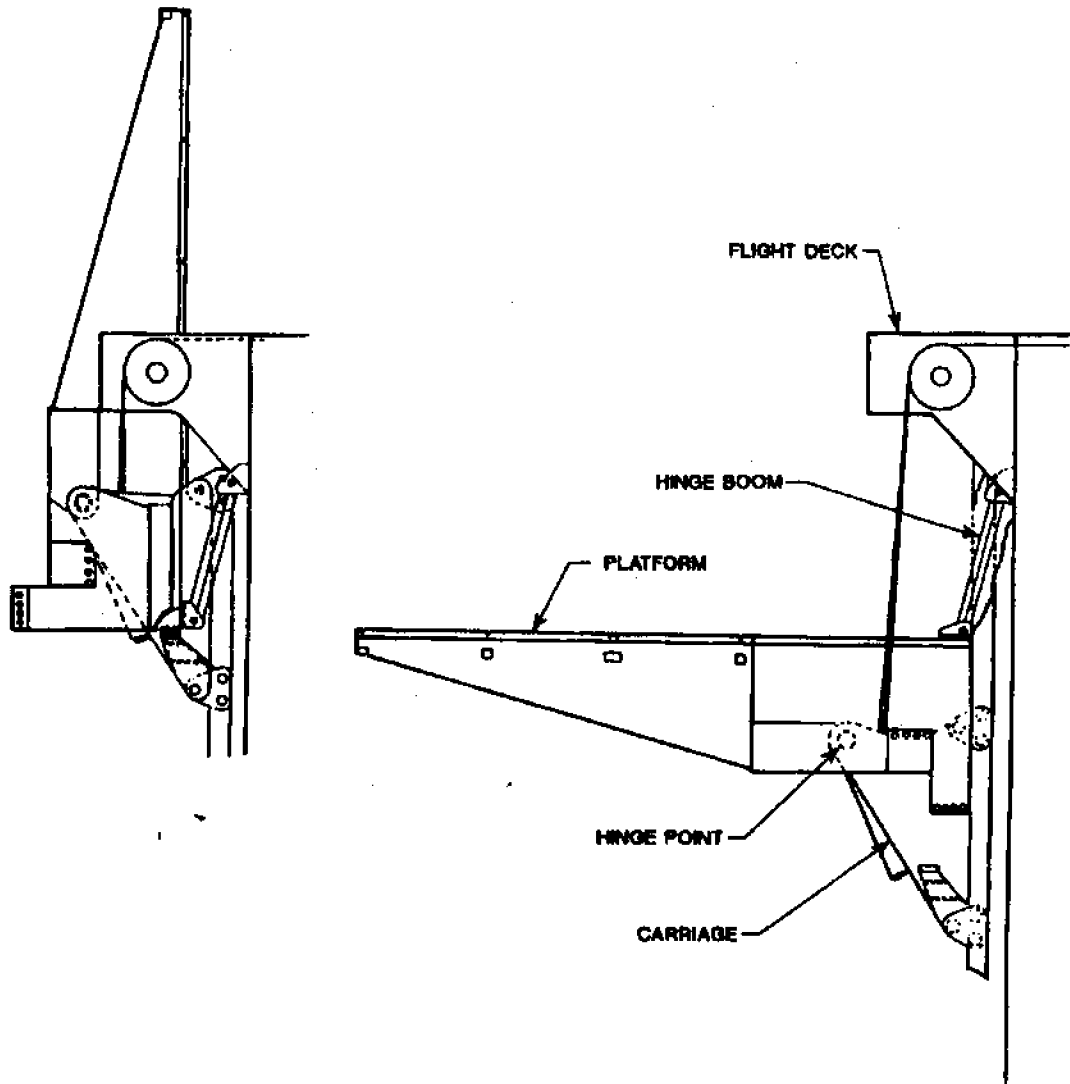


Figure 588-1-3. Folding Platform

588-1.2.3 GUIDE RAILS. The guide rails are mounted to the ship. They control the lateral motion of the elevator platform and support any of the side loads on the platform. These side loads result from ship motion and, in the case of the deck edge elevator, the lateral loads caused by the cantilevered platform. On deck edge elevators, the guide rails follow the angle of the ship's hull lines.

588-1.2.4 GUIDE ROLLERS. The guide rollers are attached to the platform and ride along the guide rails and restrict horizontal movement of the elevator platform while still allowing vertical platform movement. The guide rollers transmit all the lateral forces from the platform to the guide rails. [Figure 588-1-4](#) illustrates a typical guide roller arrangement.

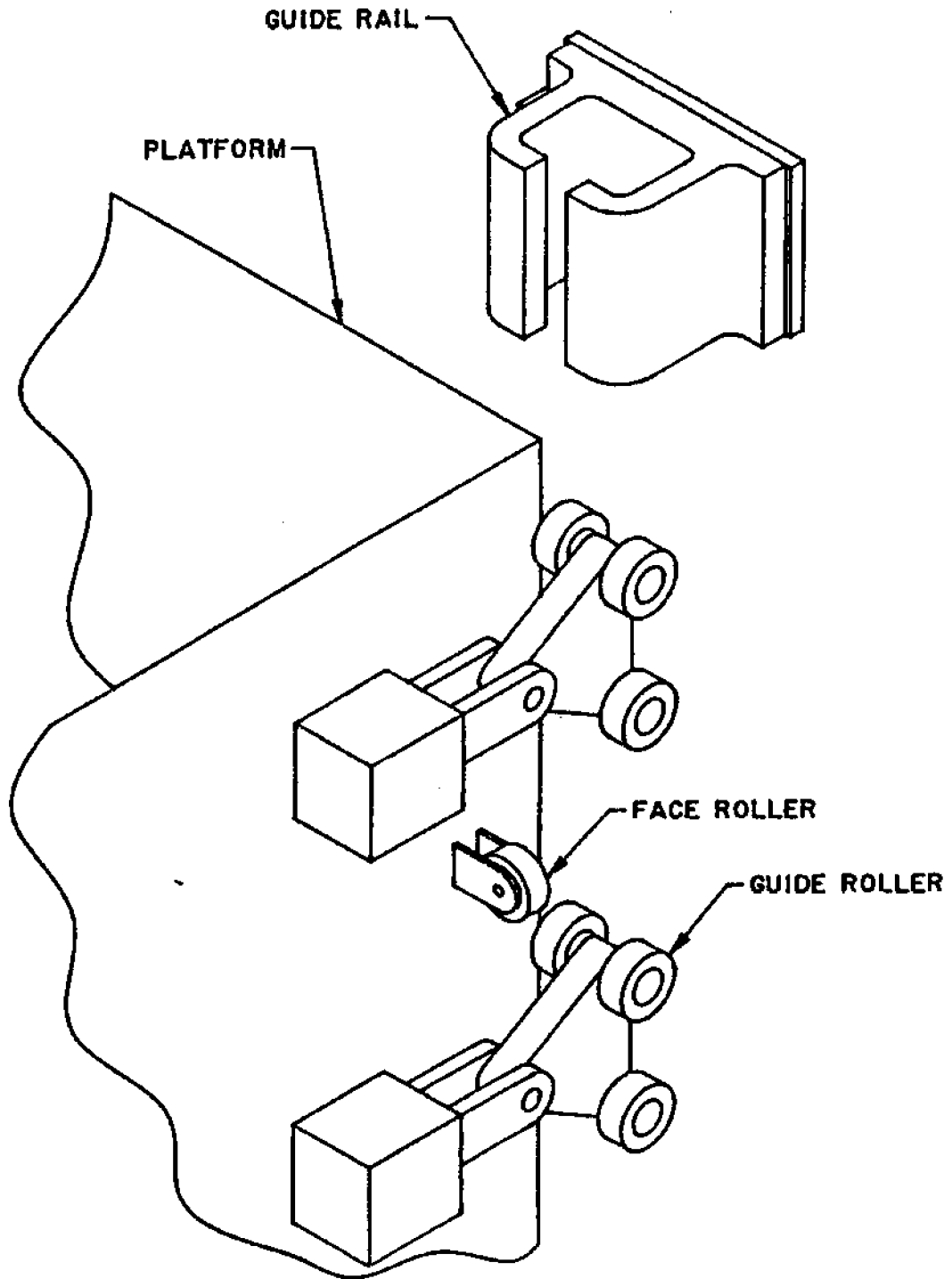


Figure 588-1-4. Typical Guide Roller Arrangement

588-1.3 REEVING

588-1.3.1 GENERAL. Reeving arrangements vary from ship to ship and often from elevator to elevator, however, there are some details that are common to all aircraft elevators. Figure 588-1-5 illustrates a typical aircraft elevator reeving arrangement. The hoist wire ropes are secured at the one end to the wire rope anchor structure on the hydraulic engine in the machinery room. The wire ropes wrap one-half turn around the traveling sheave and a quarter- or half-turn around one engine sheave. The ropes that take a half-turn around the first engine sheave are directed to a second engine sheave on the opposite end of the machinery room. These ropes and the remaining ropes on the first engine sheave move up out of the machinery room to the fairlead sheaves. The fairlead sheaves direct the wire ropes out to the spouson sheaves which turn the ropes down to the elevator platform. The ends of the wire ropes attach to the platform at two or more hitch points. This arrangement provides a 2:1 ratio of platform movement to traveling sheave movement.

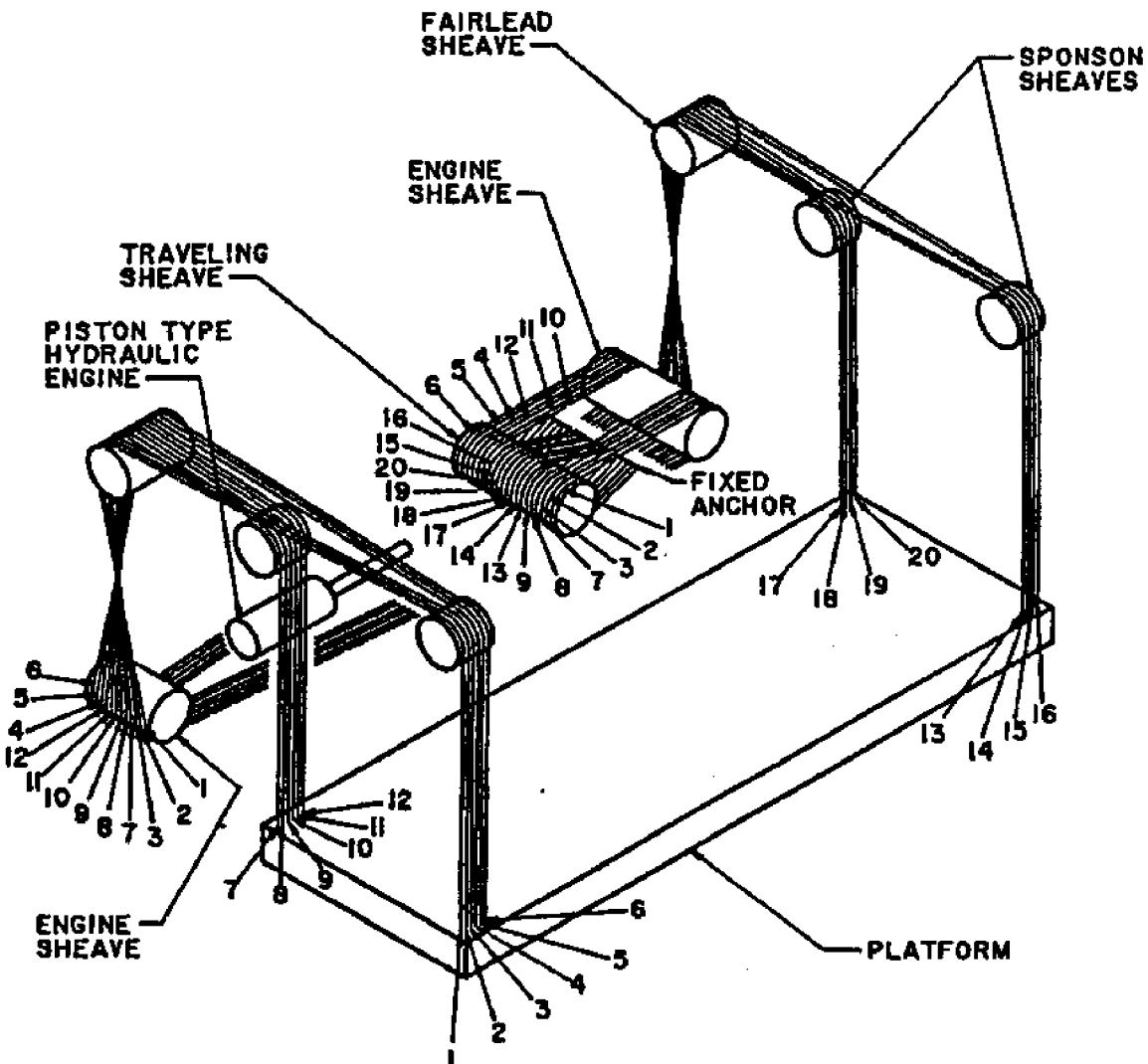


Figure 588-1-5. Typical Aircraft Elevator Reeving Arrangement

588-1.3.2 WIRE ROPE. The hoist wire ropes are type IV, class 3, flattened-strand, construction 2, 6 x 30, style G; or construction 3, 6 x 27, style H wire rope in accordance with RR-W-410. Hoist wire ropes are right-hand, lang lay of ungalvanized, extra improved plow steel (EIPS) with an independent wire rope core (IWRC). Proper

installation of the hoist wire ropes leaves enough adjustment in the attachment bolts at the wire rope anchor structure in the machinery room, for future wire rope stretch. The hoist wire ropes support all the vertical loads from the platform including: platform weight, live loads and vertical forces from the ship's motion. Hoist wire ropes are arranged and adjusted to equally share the vertical loads between the hitch groups and the individual ropes within a hitch group. Equal tension in the hoist wire ropes within each hitch group is critical to proper operation of the elevator. The proper working condition of the hoist wire rope is dependent on scheduled maintenance and is essential to reliable operation of the elevator.

588-1.3.3 SHEAVES. The traveling sheave along with one engine sheave take up the hoist wire rope as the platform is raised to the flight deck. The engine sheaves are located in the machinery room and direct the hoist wire ropes to the fairlead sheaves. The fairlead sheaves are located above the engine sheaves and direct the hoist wire ropes to the sponson sheaves. The sponson sheaves direct the hoist wire ropes down to the elevator platform. The sheaves are fitted with guards to prevent the wire rope from leaving the groove and with grease fittings for lubrication of the bearing. Installations that use mechanical feedback speed control use one engine sheave to provide speed feedback to the speed control mechanism.

588-1.4 HYDRAULIC ENGINES

588-1.4.1 GENERAL. The hydraulic engine translates hydraulic pressure into the force necessary to lift the elevator platform. Hydraulic fluid under pressure enters the hydraulic engine, forces the traveling sheave block (also called the crosshead) away from the wire rope anchor assembly, thereby taking up the wire ropes and lifting the platform. Gravity acts to lower the platform, forcing hydraulic fluid out of the hydraulic engine. The hydraulic fluid is metered by the main control valve to control the rate of lift and descent of the platform. When the platform is at the hangar deck, the traveling sheave rests against crosshead stops on the hydraulic engine frame, supporting the platform. There are two basic types of hydraulic engines: ram type and piston type.

588-1.4.2 RAM TYPE. Ram type hydraulic engines use a large ram to push the traveling sheave block away from the wire rope anchor structure. The ram has a large diameter to provide the required cross-sectional area to lift the platform and resist the buckling load. To raise the elevator platform, hydraulic pressure is applied to the engine, forcing the ram to extend and take up the wire ropes. When the ram is fully extended, the platform is at the flight deck. When the ram is fully retracted, the platform is at the hangar deck. The weight of the platform provides the force needed to retract the ram.

588-1.4.3 PISTON TYPE. Piston type hydraulic engines pull the traveling sheave block away from the wire rope anchor structure. The piston rod of this type of hydraulic engine is much smaller than the ram type because it is loaded in tension and buckling forces are eliminated. To raise the elevator platform, hydraulic pressure is applied to the rod end of the engine, forcing the rod to retract and take up the wire ropes. When the piston rod is fully retracted, the platform is at the flight deck. When the piston rod is fully extended, the platform is at the hangar deck. The weight of the platform provides the force needed to extend the piston rod.

588-1.5 HYDRAULICS

588-1.5.1 GENERAL. Hydraulics provide the motive force for the elevator platform. Aircraft elevator hydraulic fluid is a phosphate ester type in accordance with MIL-H-19457C. Some aircraft elevators use relatively low-pressure hydraulics, as low as 1000 psi. Other aircraft elevators use higher-pressure hydraulics, up to 2800 psi. Although operating pressures vary over a wide range, the basic hydraulic system is similar for all aircraft elevators. [Figure 588-1-6](#) shows a simplified, typical hydraulic schematic. The main flow control valve controls the

flow to and from the hydraulic engine. The main pumps draw from the exhaust tank or low-pressure accumulators and charge the high-pressure accumulators or high-pressure tank. On the platform lifting cycle, pressurized hydraulic fluid is directed by the main control valve from the main pumps and accumulators or high-pressure tank to the hydraulic engine. On the platform lowering cycle, fluid is directed by the main control valve from the hydraulic engine to the exhaust tank.

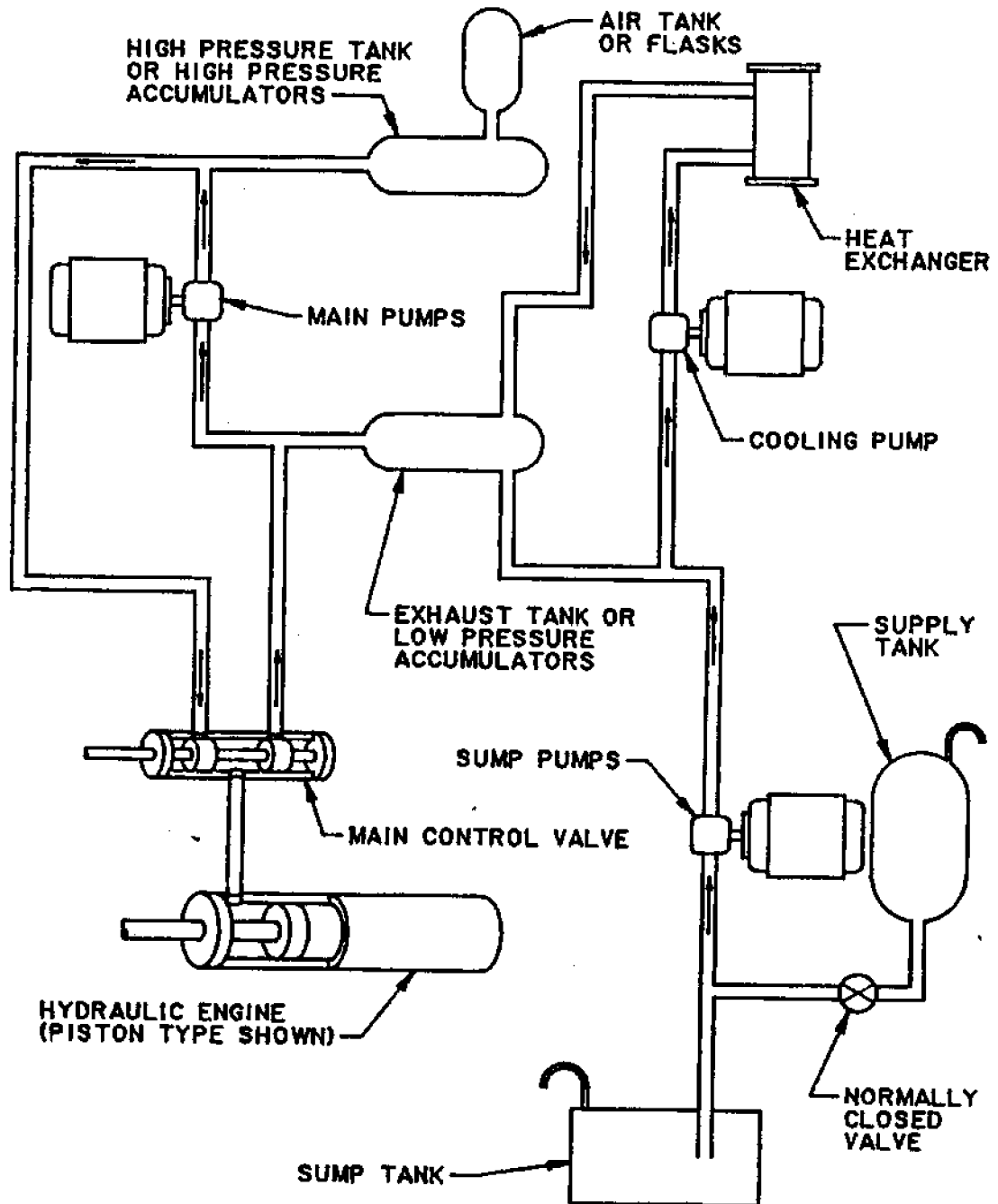


Figure 588-1-6. Simplified Hydraulic Schematic

588-1.5.2 MAIN PUMPS. Two or more pumps work in parallel to supply fluid to the accumulators or high-pressure tank. The pumps are controlled by limit or pressure switches on the high-pressure accumulators or high-pressure tank. Most aircraft elevator main pumps are variable displacement, axial piston pumps, however, some systems use fixed displacement pumps. In normal operation, the pumps work together to supply fluid. However, when necessary, the elevator may be operated with only one pump.

588-1.5.3 AIR SYSTEMS. An elevator hydraulic system consists of a high-pressure tank or accumulators, and an exhaust tank or low-pressure accumulators. These devices comprise the high- and low-pressure air systems. Air or nitrogen is used to pressurize hydraulic fluid. Unlike hydraulic fluid, gases are highly compressible. The gas is contained in a closed system. As hydraulic fluid enters the accumulators or tanks, the gas has no escape and is compressed. The gas acts as a spring to pressurize the hydraulic fluid until it is needed.

588-1.5.3.1 High-Pressure System. The accumulators are connected to the hydraulic system on one end and to gas flasks on the other. In most accumulators, a piston separates the hydraulic fluid from the compressed gas. The high-pressure and exhaust tanks work under the same principle as the accumulators except that no piston separates the hydraulic fluid from the gas. Relief valves protect the system from over-pressurization. The high-pressure accumulators and the high-pressure tank store hydraulic fluid at system pressure. This arrangement can supply a large volume of fluid in a short period of time. This allows the main pumps to be smaller sized than they would be if they supplied all the fluid to lift the platform. The fluid in the high-pressure accumulators and tank supplements the main pumps during normal operation and provides fluid to operate the elevator at normal speeds upon pump or electrical failure.

588-1.5.3.2 Low-Pressure System. The exhaust tank and low-pressure accumulators also store hydraulic fluid under pressure, but at a much lower pressure than the high-pressure tank or high-pressure accumulators. This fluid is used to supply the main pumps and is pressurized by the hydraulic engine as the platform descends.

588-1.5.4 SUMP AND SUPPLY TANKS. The sump tank receives normal system internal fluid leakage and drainage from components in the hydraulic system. The supply tank stores sufficient make-up and reserve fluid to raise the platform to the flight deck. Clean, new fluid is added to the supply tank to make up for fluid that leaks out of the system. This fluid is transferred as necessary to the sump tank. Both the sump tank and the supply tank are vented. Extreme care must be exercised in transferring fluid to the sump and storage tanks. The rate of fluid flow into the sump and storage tanks must not exceed the venting capacity of the tank vents. Excessive pressure in the storage tank can lead to rupture of the tank. Excessive pressure in the sump tank can cause rupture of the tank or the pump cases. Before transferring fluid to the sump tank or operating the elevator, ensure that electrical power is supplied to the sump pump to prevent overflowing the sump tank.

588-1.5.5 SUMP PUMP AND FLUID COOLING SYSTEM. Float switches in the sump tank activate the sump pump when a predetermined fluid level is reached. The sump pump takes fluid from the sump tank and discharges the fluid to the exhaust tank. The sump pump can be used for emergency operation of the platform. The fluid cooling system takes fluid from the exhaust tank and pushes it through a filter and a seawater cooler. The cooled and filtered fluid is returned to the exhaust tank.

588-1.5.6 LEVELING INTENSIFIER. Some elevators are fitted with a leveling intensifier. This device gives an extra boost of pressure to the hydraulic engine when the platform is at the upper positive stops, causing the wire ropes to stretch an additional amount. This allows the platform to be loaded up to its rated load at the flight deck without significant platform movement due to wire rope stretch, making it possible to retract lockbars without the platform dropping. This device usually consists of a piston accumulator and a valve, mechanically actuated by the traveling sheave block.

588-1.6 CONTROL SYSTEM

588-1.6.1 GENERAL. The elevator control system uses a combination of electrical, hydraulic and mechanical devices to operate the elevator. The control system accomplishes the following:

- a. Enables the elevator to move and accelerate to high speed in the desired direction.
- b. Automatically transfers to slow speed as the elevator platform approaches a stopping level and stops at that level whether loaded or unloaded.
- c. Incorporates all safety devices within the control system to ensure safe operation of the elevator during electric operation.

The system functional block diagram ([Figure 588-1-7](#)) illustrates the relationship of the hardware in controlling the elevator. Hardware reference is as follows:

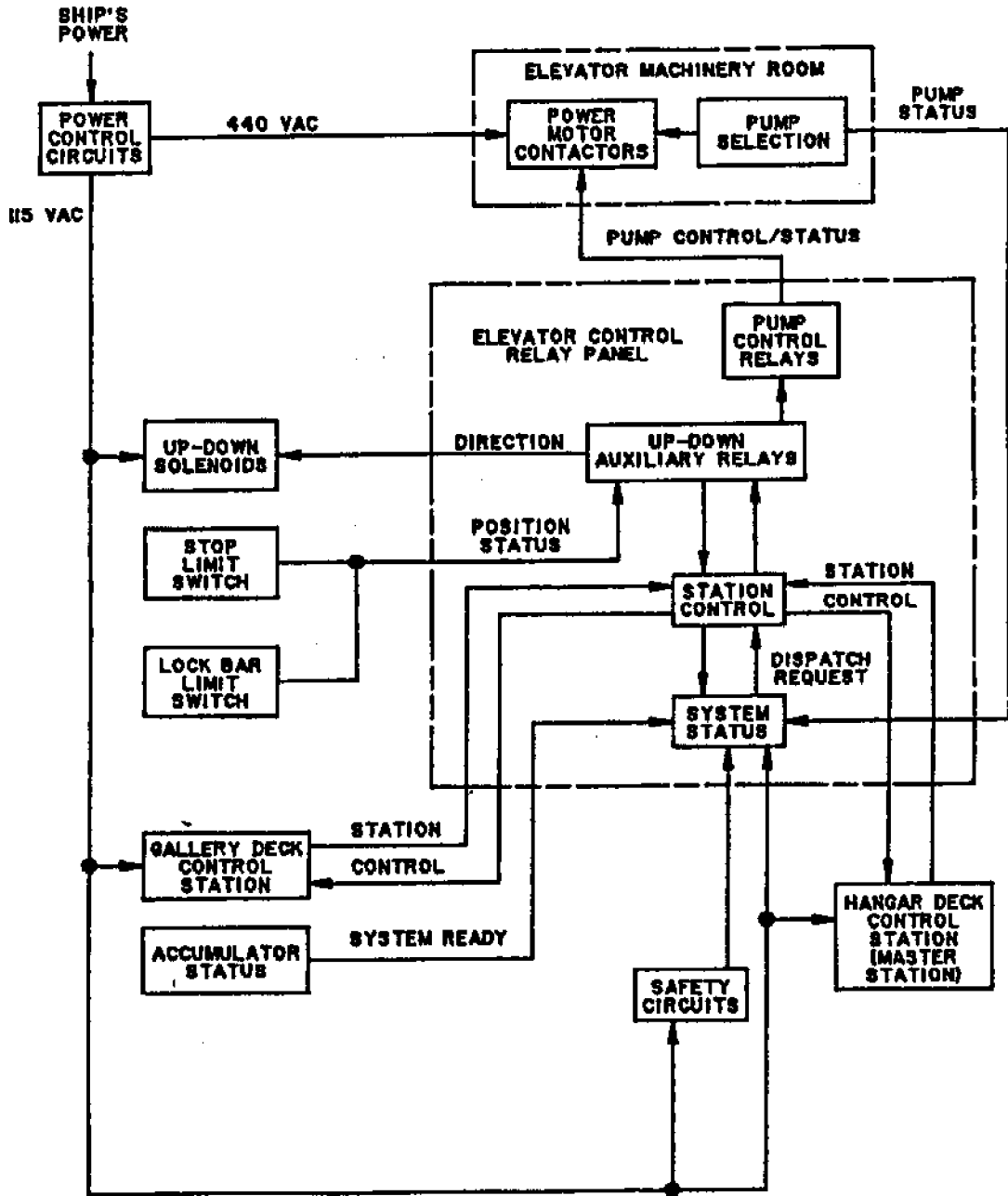


Figure 588-1-7. Control System Functional Block Diagram

- a. The up-down solenoids control the flow of the hydraulic fluid to dispatch the elevator platform in the proper direction.
- b. The up-down relays operate the solenoids to initiate direction.
- c. The lockbar limit switches prevent operation when the platform is in a stowed and locked position.
- d. The stop limit switches allow the platform to come to the correct stopping position and provide status information to the system control logic.
- e. The accumulator status indicates when the hydraulic system is charged with sufficient hydraulic fluid to allow operation.
- f. The safety circuits ensure that the elevator operates safely under all conditions. All safety circuits are independent and include the slack rope limit switches and the status of interfacing systems.

588-1.6.2 ELEVATOR CONTROL RELAY PANEL. Each elevator electrical system contains an elevator control relay panel. The elevator control relay panel is located in the elevator machinery room. The elevator control relay panel and the associated interfacing devices monitor and control the elevator electrical control circuits to ensure safe, smooth elevator operation of the aircraft elevator. Electrical power is supplied from 440 Vac, 60 Hz, 3-phase ship's power to the ac magnetic motor controller for operation of the elevator pumps. 440 Vac power is also supplied to the motor controller transformer. The motor controller transformer converts the 440 Vac to 115 Vac for operation of the hardware in the control safety circuits and the operating control panels of the elevator.

588-1.6.3 CONTROL STATIONS. Each elevator has three separate control stations that must be manned and in constant communication with each other before any elevator operation takes place. The stations are: hangar (main) deck control station, gallery deck control station and machinery room control station. These three control stations contain various controls and indicators to initiate and control all elevator movement.

588-1.6.3.1 Hangar Deck Control Station. The hangar (main) deck control station is the master control station and is located at the forward end of the hangar deck elevator opening, outboard of the elevator doors. The hangar deck control station provides a central point for operating the elevator and observing elevator operation from the hangar deck. The hangar deck control station contains controls to actuate platform movement, operate hangar deck stanchions, stop platform movement and sound warning horns. A sound-powered phone is used to communicate with the gallery deck and machinery room control stations. Indicator lights on the control panel verify the status of the system components and subsystems. The controls for manual operation of the elevator are located at the hangar deck control station.

588-1.6.3.2 Gallery Deck Control Station. The gallery deck control station is the secondary control station and along with the hangar deck control station, completes the electrical control circuits for normal elevator operation. Both control stations must be manned to initiate elevator movement during normal elevator operation. The gallery deck control station is near the forward outboard edge of the elevator at the gallery deck walkway or on the flight deck adjacent to the platform. The gallery deck control station provides a central point for operating the elevator and observing elevator operation from the gallery deck walkway or from the flight deck. The gallery deck control station contains controls to permit platform movement, stop platform movement, and operate flight deck stanchions and platform lockbars. A sound-powered phone is used to communicate with the hangar deck and machinery room control stations.

588-1.6.3.3 Machinery Room Control Station. The machinery room control station is located in the elevator machinery room. Its location provides a central point for operating and observing the operation of the machinery room equipment. Each machinery room control station consists of various indicator lights and switches, ac

motor controllers, the accumulator and elevator control panels, system gauges and valves, and various monitoring devices attached to individual components. A sound-powered phone is used to communicate with the hangar deck and gallery deck control stations.

588-1.6.4 SPEED CONTROL. The speed of the elevator platform is controlled by the main flow control valve. A typical main flow control valve is shown in [Figure 588-1-8](#). The main flow control valve is a two- or three-position, closed-centered, proportional spool valve. When the spool is centered, no hydraulic flow occurs. Shifting of the spool in either direction causes fluid flow. The more the spool is shifted away from center, the greater the flow. The main flow control valve regulates the flow of hydraulic fluid to and from the hydraulic engine. If platform speed is low, hydraulic flow is increased. If platform speed is excessive, hydraulic flow is decreased. On the platform lifting cycle, the main flow control valve directs and meters high-pressure fluid from the accumulators or high-pressure tank to the hydraulic engine. On the platform lowering cycle, the main flow control valve directs and meters the fluid from the hydraulic engine to the exhaust tank. At the limits of elevator platform travel, cams or limit switches are used to shift the main flow control valve spool and slow the elevator platform. Shifting of the main control valve spool between platform travel limits is controlled automatically by one of two methods, mechanical feedback or hydraulic flow control.

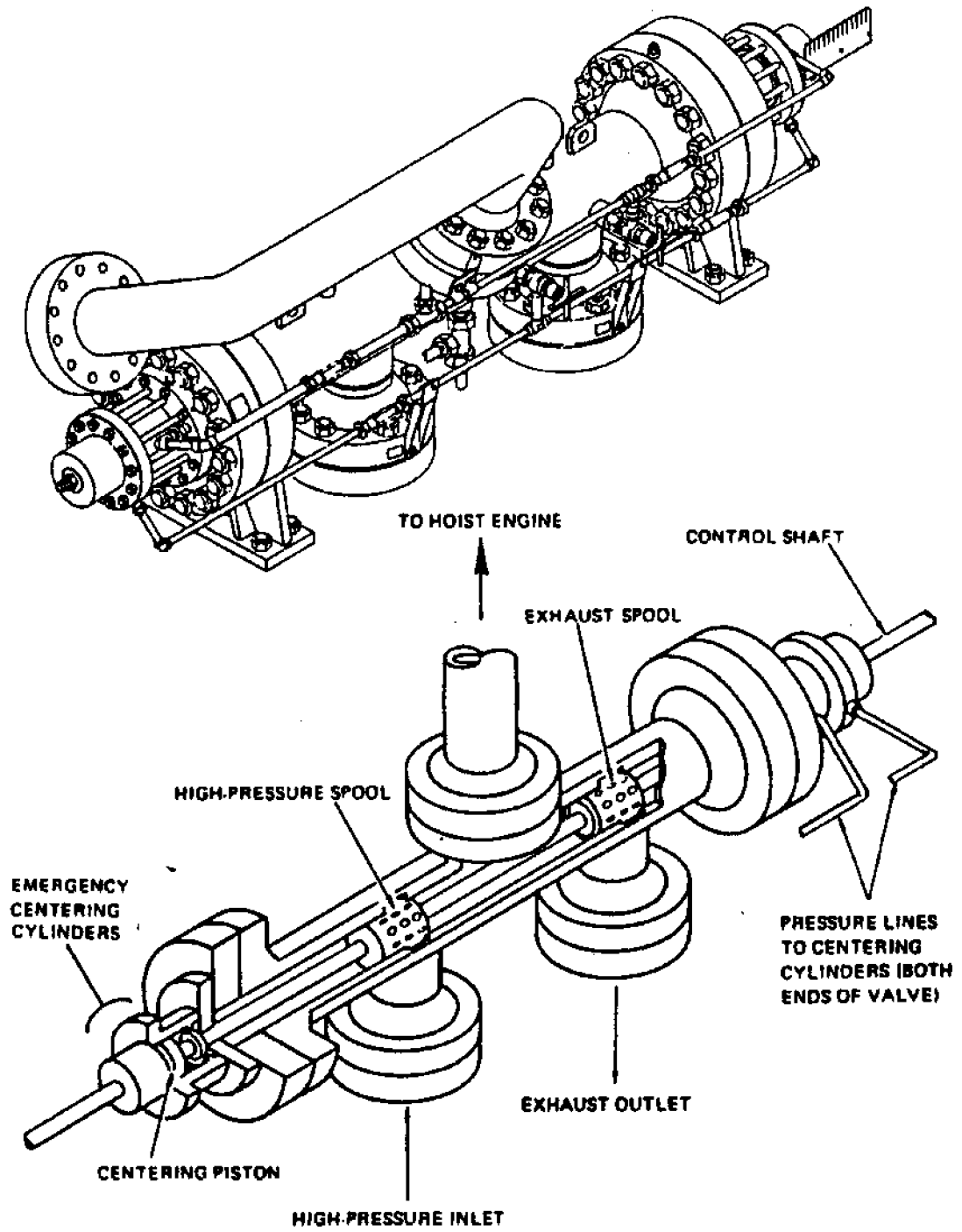
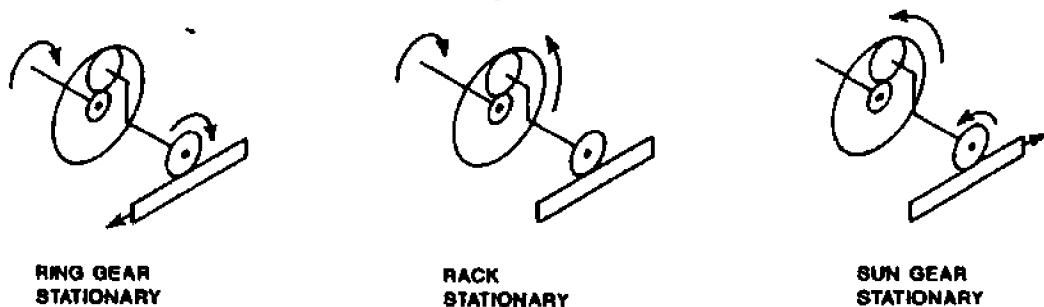
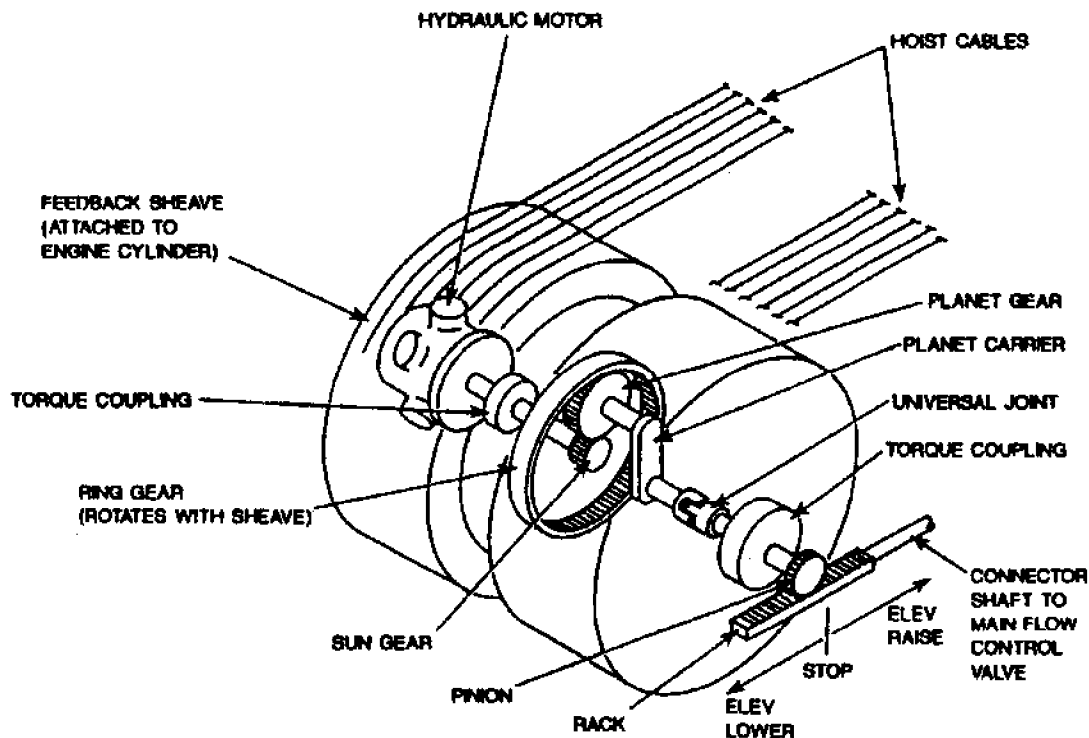


Figure 588-1-8. Main Flow Control Valve

588-1.6.4.1 Mechanical Feedback.

588-1.6.4.1.1 The majority of aircraft elevator systems use some type of mechanical feedback device to shift the main control valve spool. Generally, this assembly consists of a servocontrol manifold, a directional control valve, a fixed displacement hydraulic or electric motor, a planetary or differential gear system, and a rack and pinion gear or a worm screw.

588-1.6.4.1.2 A simplified mechanical feedback device using a planetary gear system is illustrated in [Figure 588-1-9](#). When a command is initiated at the control station to raise or lower the platform, the solenoid-operated directional control opens and hydraulic fluid is permitted to flow. This operates the hydraulic motor in the desired direction. The servocontrol manifold compensates for supply pressure variations and provides a constant flow rate to the hydraulic motor, resulting in a constant speed output from the motor. The output shaft of the motor is connected, in the case of the planetary gear system, to the sun gear. As the sun gear revolves, it drives a planet gear that rotates about a shaft on the planet carrier. Since the feedback sheave is stationary at this point, the planet carrier walks around the ring gear. As the planet carrier walks, it drives the pinion shaft and causes the rack to move, shifting the spool of the main flow control valve. When the pre-set platform speed is attained, the speed of the ring gear properly matches that of the sun gear and the rack and the pinion become stationary.



DIRECTIONS OF MOVEMENT IN FEEDBACK MECHANISM WITH ONE GEAR STATIONARY

Figure 588-1-9. Mechanical Feedback Speed Control

588-1.6.4.1.3 In elevators equipped with differential gear systems, the speed of the hydraulic motor is compared to the speed of the feedback sheave across a differential and the valve spool is similarly shifted. On some systems, a worm screw performs the function of the rack and pinion or an electric motor performs the function of the fixed displacement hydraulic motor.

588-1.6.4.2 Hydraulic Flow Control.

588-1.6.4.2.1 A few aircraft elevator systems depend on monitoring and directly controlling the flow of hydraulic fluid to or from the hydraulic engine in order to control the platform speed. This is accomplished by using a pressure-compensated main flow control valve. When actuated, the valve supplies a constant flow rate

over a wide range of supply pressures. A constant flow rate to or from the hydraulic engine results in constant platform speed. This flow control valve is shown schematically in [Figure 588-1-10](#).

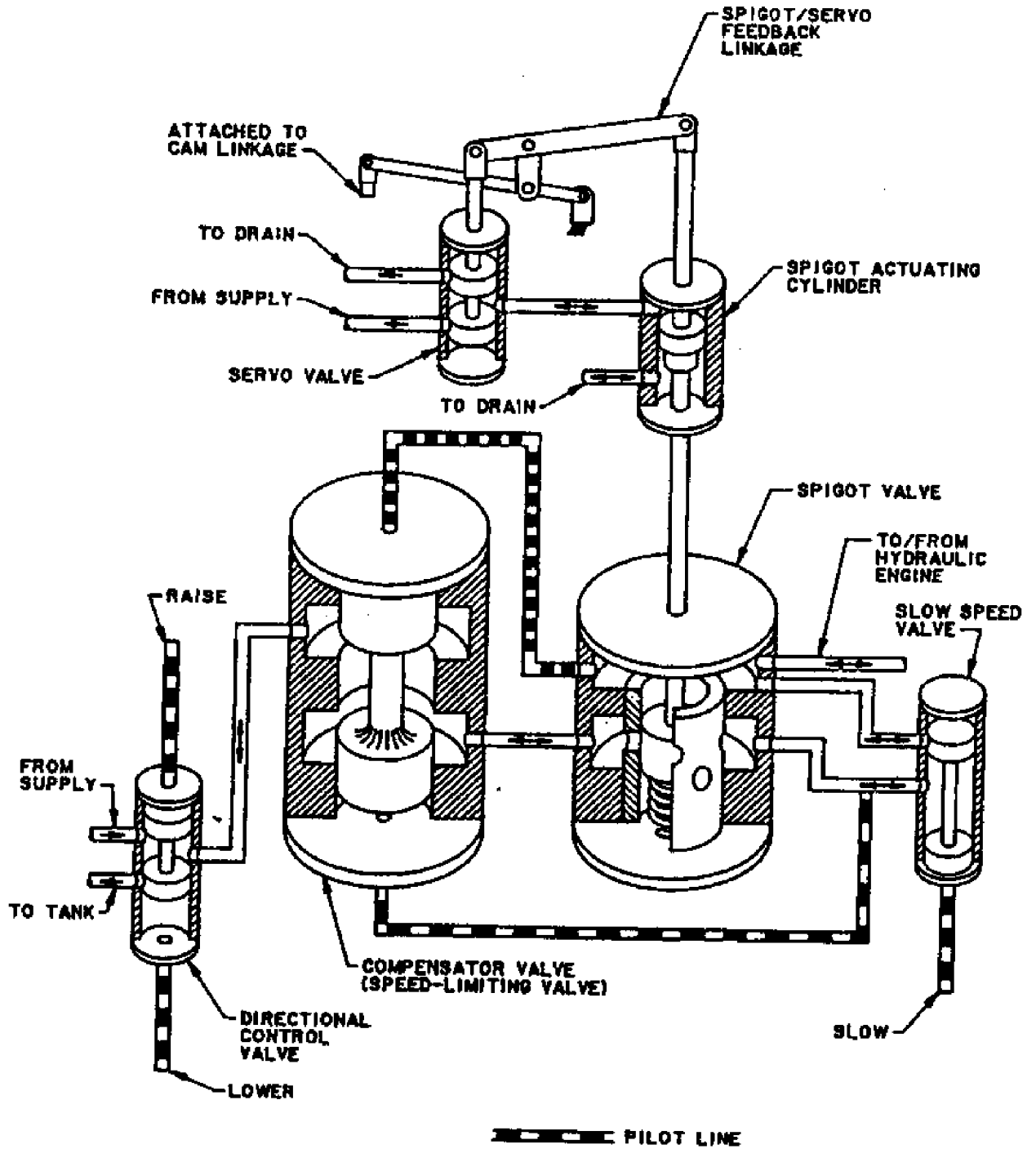


Figure 588-1-10. Pressure-compensated Main Flow Control Valve

588-1.6.4.2.2 The main components of the main flow control valve are the servo valve, spigot valve and cylinder, slow speed valve, compensator valve, and directional control valve. The directional control valve controls the direction of fluid flow through the remainder of the main control valve and ultimately, the direction of the elevator platform movement. All the other major components of the main flow control valve work together to control fluid flow rate and consequently, the speed of the elevator platform

588-1.6.4.2.3 When a high speed command is issued from the control stations, pilot pressure shifts the directional control valve to the appropriate position and opens the slow speed valve to allow fluid flow to or from the hydraulic engine. The traveling sheave block will begin to move and contact the cam linkage. Movement of the cam linkage shifts the servo valve to port pilot pressure to the spigot actuating cylinder. The actuating cylinder positions the spigot valve spool. The spigot valve has radial holes drilled along the length of a sleeve that allow more fluid flow and therefore greater elevator speed, with increased displacement of the spool. The flow rate through the spigot valve, and therefore the maximum elevator speed, is regulated by the compensator valve. The compensator valve uses pilot pressure to compare the pressure difference across the spigot valve. As the flow through the spigot valve increases, so does the pressure drop across the valve. If the flow rate increases beyond a certain value, the pilot pressure moves the compensator valve to reduce fluid flow to the spigot valve. When the platform nears the end of travel, the traveling sheave block moves the cam linkage to shift the servo valve. Pilot pressure is ported to shift the spigot actuating cylinder to begin to close the spigot valve. As the spigot valve closes, the elevator platform is slowed to a stop at the deck level.

588-1.7 SAFETY DEVICES

588-1.7.1 GENERAL. Several safety devices are present on all aircraft elevators. Each safety device has a purpose and will prevent injuries if used in conjunction with proper operating procedures. Several safety devices can be bypassed in emergency situations and special care must be taken when operating the elevator in manual mode to prevent injury to personnel or damage to equipment.

588-1.7.2 PLATFORM LOCKBARS. The purpose of the platform lockbars is to secure the platform at the flight deck. The lockbars are generally ganged together and are actuated hydraulically or pneumatically. The lockbars are capable of supporting the weight of the platform loaded to its rated capacity, plus snow and ice loads and dynamic forces caused by storm conditions. The platform lockbars must be retracted before initiating any platform movement. The mechanical interlocks prevent extension of the lockbars unless the platform is at the flight deck. Electrical interlocks prevent elevator operation when the lockbars are extended.

588-1.7.3 DECK STANCHIONS. Deck stanchions are installed at the hangar and flight deck levels. The stanchions consist of pipes with wire rope strung between consecutive stanchions. The deck stanchions are intended as personnel barriers and as a visual warning for equipment operators when the platform is not present. The stanchions should be raised by the operator before commencing platform movement and lowered after the platform arrives. The stanchions should be raised whenever the platform is not at the particular deck level. The stanchions can be raised manually by hand pump or crank when power is not available. Some platforms are supplied with portable deck stanchions for the periphery of the platform.

588-1.7.4 SLACK ROPE SWITCHES. Slack rope switches are installed in the machinery room to stop the travel of the platform should one or more of the hoist wire ropes break or otherwise lose tension. These switches are either mechanical-type switches or photoelectric cells.

588-1.7.5 **WARNING HORNS.** Each elevator is equipped with warning horns, audible at each level serviced by the elevator, which automatically sound whenever the platform is in motion. The warning horns can also be manually operated by switches at each elevator control station to warn of impending platform motion. A switch at the master (hangar deck) control station can silence the warning horn when conditions require.

588-1.7.6 **INTERLOCKS.** Safety interlocks are provided to prevent inadvertent operation of the elevator before all operating conditions are met. Bypassing the interlocks can damage the elevator or other equipment, or cause injury or death to personnel. Typical interlocks on aircraft elevators prevent:

- a. Operation of the elevator when lockbars are extended, except to raise the platform off the locks for retraction.
- b. Lockbar operation, except when the platform is at the flight deck.
- c. Lockbar retraction when the hydraulic pressure is insufficient to support the weight of the platform.
- d. Retraction of the lockbars when a slack rope condition exists.
- e. Operation of the elevator or flight deck stanchions in aircraft launching or recovering areas during flight operations.
- f. Operation of the elevator during operation of the boat and airplane crane.
- g. Operation of the elevator when one or more hoist cables are slack.

588-1.7.7 **WHEEL STOPS, SAFETY NETS AND MACHINERY GUARDS.** Elevator platforms are provided with hinged or portable wheel stops for aircraft wheels. Safety nets are provided on the outboard edge of deck edge elevators to provide a measure of protection against personnel falling overboard. Guards should be installed around all rotating machinery and hoist wire ropes in manned spaces to prevent injury to personnel.

SECTION 2.

GENERAL OPERATING REQUIREMENTS

588-2.1 OPERATOR REQUIREMENTS

588-2.1.1 All aircraft elevator operators must be trained and be qualified on each elevator they operate. To operate the elevator, qualified operators must be stationed at the gallery deck control station and at the hangar (main) deck control station. In addition, a qualified operator must be stationed at the elevator machinery room control station. Communications must be established between each of the control stations and the machinery room.

588-2.2 ELEVATOR OPERATION

588-2.2.1 **GENERAL.** The aircraft elevators are designed to operate with rated load under moderate sea conditions as defined for the particular ship. Elevator operation can be accomplished in three modes: electric, manual or emergency. Electric, manual and emergency operation procedures can be found in the equipment-level technical manuals and on label plates mounted at each deck station and in the elevator machinery room.

588-2.2.2 **PRE-OPERATIONAL PROCEDURE.** All areas containing elevator equipment; including: wire ropes, guide rails, sheaves, stanchions and lockbars; must be cleared of personnel and obstacles before activat-

ing the elevator systems. This should be done with special diligence during in-port and yard periods when personnel may be working on this equipment. In any mode of operation, the edges of the platform, the deck adjacent to the elevator, and all cable trunks and sheaves must be cleared of personnel and obstacles before initiating platform motion. The first run of each shift or operating period should be at slow speed.

588-2.2.2.1 Machinery Room. The machinery room operator is responsible for verifying that all fluid levels are at their proper marks, all hydraulic lines and equipment are properly vented, all valves are properly aligned, all equipment is operating correctly and all moving pieces of equipment are clear of personnel or obstacles. Communication must be established with the hangar deck and gallery deck control stations.

588-2.2.2.2 Gallery Deck. The gallery deck operator is responsible for verifying that all spaces containing hoist wire ropes, sheaves, lockbars, stanchions or other elevator equipment at that level are clear of personnel or obstacles. The operator must also verify that the platform, if present, and the area around the platform are clear, all status lights indicate the system is ready, and communications are established with the other control stations.

588-2.2.2.3 Hangar Deck. The hangar deck operator is responsible for verifying that the guide rails, the platform, if present, and the area around the platform are clear, all status lights indicate the system is ready, and communications are established with the other control stations.

588-2.2.3 ELECTRIC OPERATION. Electric operation of the aircraft elevator is the normal and preferred mode of operation since it is the only mode of operation that does not bypass any safety interlocks. To operate the platform in electric mode, electric power must be available, the hydraulics must be fully pressurized, the platform lockbars retracted, and all the safety devices functional and permitting elevator operation. To lower the platform from the flight deck, the gallery deck operator observes that the platform area is clear and sounds the warning horn. The hangar deck operator observes that the deck adjacent to the elevator is clear and depresses or turns, and then holds the MASTER switch. The gallery deck operator receives the CONTROL ENERGIZED signal on the gallery deck panel and momentarily depresses the DOWN pushbutton. The platform travels to the hangar deck. To raise the platform from the hangar deck, the hangar deck operator observes that the platform area is clear and the platform is safely loaded, sounds the warning horn and depresses or turns, and then holds the MASTER switch. Upon hearing the horn and receiving the CONTROL ENERGIZED signal on the panel, the gallery deck operator observes that the deck adjacent to the elevator is clear. The gallery deck operator momentarily depresses the UP pushbutton and the platform ascends to the flight deck. Some elevators require both operators to select the direction of platform movement and hold the switch for the duration of the cycle. When conditions require, the elevator can be operated without the warning horns or indicator lights.

588-2.2.4 MANUAL OPERATION. The aircraft elevator can be operated in a manual mode when conditions do not permit electric operation. Extreme care must be exercised when operating in manual mode as some of the safety interlocks and safeguards are bypassed. On some elevators, automatic speed control is lost and platform speed is controlled by the operator at the hangar deck control station. Procedures for manual operation vary from elevator to elevator. All manual procedures involve bypassing the electric controls and safety interlocks. The equipment technical manual must be consulted to be aware of all the safety precautions before manually operating the elevator.

588-2.2.5 EMERGENCY OPERATION. Several emergency modes of operation exist to return the elevator platform to the flight deck under casualty conditions. In case of loss of power to the elevator hydraulic pumps, fluid in the accumulators or high-pressure tank can be used to return the platform to the flight deck. This should be done and the platform locked in place as soon as possible after pump failure because the reserve pressure in the high-pressure tank or accumulators gradually diminishes due to internal system leakage. If pressure is lost in

the accumulators or high-pressure tank, the sump pump can be used to raise the elevator platform to the flight deck. On some ships, compressed air or nitrogen is stored in tanks for emergency raising of the platform. To lower the platform, hydraulic fluid can be bled out of the hydraulic engine. Specific procedures vary from ship to ship and are addressed in the equipment-level technical manuals.

588-2.2.6 ELEVATOR SECURE. At the end of aircraft elevator operations, the platform should be secured at the flight deck with the platform lockbars in place. When the platform is secured, the hydraulics should also be secured according to procedures found in the equipment technical manual. When desired, folding platforms may also be stored in the folded position.

SECTION 3.

ELEVATOR MAINTENANCE AND INSPECTION

588-3.1 GENERAL

588-3.1.1 Although aircraft elevators are designed for use in a marine environment, scheduled maintenance is necessary for sustained, reliable performance. Inspection schedules are designed to detect problems before serious damage occurs. Specific requirements for maintenance and inspection are contained in the Planned Maintenance System (PMS) for each elevator.

588-3.2 DAILY INSPECTION

588-3.2.1 The aircraft elevator system should be inspected daily, prior to operations. The daily inspection should include, as a minimum, where applicable, the following:

- a. Verify that no obstructions are in the way of movement of the platform, traveling sheave block, wire ropes, platform lockbars and stanchions.
- b. Inspect all gauges for proper mounting and valid calibration.
- c. Verify that all hydraulic filters are within cleanliness limits.
- d. Verify that the hydraulic system has been bled of air.
- e. Inspect hydraulic piping connections for leakage.
- f. Inspect limit switches for freedom of movement.

588-3.3 ANNUAL INSPECTION

588-3.3.1 The elevator system should be inspected annually in conjunction with planned maintenance requirements. The following areas should be checked as a minimum:

- a. Elevator platform. Inspect the platform and roller assemblies for:
 - 1 Broken or damaged parts
 - 2 Cracked welds
 - 3 Excessive wear on bearing surfaces

- 4 Free roller movement
 - 5 Crimped, missing or damaged lubrication lines
 - 6 Corrosion.
- b. Hoist machinery. Inspect the hydraulic engine, sheaves and associated foundations for:
- 1 Cracked welds
 - 2 Missing or loose fasteners
 - 3 Leaking hydraulic fluid
 - 4 Pitted, scored or gouged hydraulic ram
 - 5 Excessive wear pattern
 - 6 Corrosion
 - 7 Misalignment
 - 8 Evidence of sheave bearing damage
 - 9 Loose or missing personnel barriers
 - 10 Crimped, missing or damaged lubrication lines.
- c. Hydraulic system. Inspect hydraulic system components and piping for:
- 1 Leakage from connections and valves
 - 2 Excessive hydraulic pump and motor shaft leakage
 - 3 Broken or damaged sight glasses
 - 4 Improperly calibrated gauges
 - 5 Corrosion
 - 6 Fill connection locking caps installed
 - 7 Clear vent for atmospheric tanks.
- d. Electrical system. Inspect the electrical motors, controllers, limit switches and wiring for:
- 1 Moisture damage
 - 2 Frayed and cracked insulation
 - 3 Loose wires and connections
 - 4 Evidence of arcing
 - 5 Rough or burned contact points
 - 6 Deteriorated or damaged gaskets
 - 7 Cracked or missing indicator light lenses
 - 8 Loose, bent, corroded or missing limit switch arms.

588-3.4 WIRE ROPE

588-3.4.1 GENERAL. The hoisting wire rope is essential to the aircraft elevator. Neglect of the hoisting wire rope can lead to premature failure of the rope. Proper maintenance, frequent inspection and, when necessary, replacement of the hoisting wire rope will result in a more reliable aircraft elevator. The schedule and criteria for wire rope inspection and lubrication is provided by Maintenance Requirement Cards (MRC's). A log should be kept of all inspections and lubrication. The Type Commander shall report by letter or message to NAVSEA code 56W43 each time a set of elevator wire ropes is replaced. This report will assist in planning for future wire rope replacements. The report should contain the following information:

- a. The date the wire ropes were originally installed.
- b. The wire rope manufacturer, size and type.
- c. The date the wire ropes were replaced.
- d. The activity replacing the wire ropes.
- e. Any pertinent remarks concerning the condition of the removed wire ropes.

588-3.4.2 LUBRICATION. Proper lubrication of the hoisting wire rope is essential to reliable aircraft elevator operation. Wire rope is delivered with internal lubrication and a preservative coating. The preservative coating should be removed immediately prior to installation and the ropes lubricated with wire rope grease (MIL-G-18458). The wire rope grease lubricates the outer portion of the ropes to minimize wear as they roll over the sheaves and also prevents water from entering the rope where it can remove lubricant and cause undetected corrosion. The internal lubrication provides an oil film between rubbing surfaces of individual wires and strands inside the rope and protects the wires against moisture and corrosion. Wire rope on deck edge aircraft elevators is especially susceptible to corrosion damage caused by seawater spray. Frequent lubrication of the hoisting wire rope will help alleviate corrosion damage.

WARNING

When cleaning wire rope with JP-5, it is mandatory that safety goggles, gloves and protective clothing be worn. Use a well-ventilated area, preferably open air, to reduce the possibility of fume inhalation. See NSTM Chapter 670, Stowage, Handling, and Disposal of Hazardous General Use Consumables.

Prior to lubrication, the wire rope should be cleaned. This can be done by using wire brushes, scrapers, compressed air, superheated steam, JP-5 or turbine oil MIL-L-17331 (2190). The intent is to remove all foreign matter and old lubricant from the valleys between the strands and the spaces between the outer wires.

CAUTION

Under no circumstances is wire rope to be soaked in JP-5 because it may cause the inner lubricants to be removed from the wire rope and core. Wire rope may be soaked in turbine oil if soaking is desired.

Solvents should be avoided because they also have a tendency to remove the internal lubricant. On deck edge elevators, the portions of the wire rope that are exposed to the weather are susceptible to corrosion and should be thoroughly cleaned and lubricated every two weeks while at sea, quarterly while operating in protected areas, and during each overhaul. The grease to be used should for all parts of lifting wire ropes should comply with MIL-G-18458.

588-3.4.3 TENSIONING. Maintaining equal tension in all ropes and fittings within a hitch group is essential to long service and proper operation of the elevator. The tension of wire ropes within a hitch group should be maintained within a five percent tolerance. If one rope is tensioned much higher than the other ropes in its group, it will take a greater share of the load and wear out sooner. If too little tension is applied to a rope, it may fall

off the sheave. An approved tension meter should be used to determine rope tensions. Required tension values and procedures are included in the MRC's. Rope tensions should be checked annually, or as follows:

- a. At initial installation
- b. After elevator rope replacement
- c. After every overhaul
- d. During each shipyard availability
- e. After a suspected overload
- f. After a collision involving the elevator
- g. After a fire in the vicinity of the elevator platform or hoisting machinery
- h. One month and six months after replacement of elevator ropes
- i. Upon detection of problems extending or retracting the platform locking bars
- j. In preparation for an extended deployment.

588-3.4.4 INSPECTION REQUIREMENTS. A thorough visual inspection of the entire length of each elevator wire rope and all sockets and eye bolts should be conducted on all aircraft elevators monthly or as follows:

- a. After a suspected overload
- b. After any shipping of water by the platform
- c. After a collision involving the elevator
- d. After a fire in the vicinity of the elevator platform or any of the hoist machinery.

NOTE

The approximate maximum temperature of the wire rope during a fire can be determined after the fact by surface color determination as follows: After the ropes are safely accessible, carefully wipe a section with a soft cloth, removing the residue to determine the surface color for comparison with [Table 588-3-1](#). This method is only suitable for bare carbon steel. Do not attempt to use on galvanized or stainless steel.

Table 588-3-1. MAXIMUM FIRE TEMPERATURE

Degrees (Fahrenheit)	Color of Steel
430	Very pale yellow
440	Light yellow
450	Pale straw-yellow
460	Straw-yellow
470	Deep straw-yellow
480	Dark yellow
490	Yellow-brown
500	Brown-yellow

Table 588-3-1. MAXIMUM FIRE TEMPERATURE - Continued

Degrees (Fahrenheit)	Color of Steel
510	Spotted red-brown
520	Brown-purple
530	Light purple
540	Full purple
550	Dark purple
560	Full blue
570	Dark blue
640	Light blue

Wire ropes, sheaves and sockets should be inspected for wear, corrosion and broken strands. Special attention should be given to the wire ropes and associated fittings in the following areas:

- a. At connections on platforms
- b. Any portion of wire rope that travels over sheaves and is exposed to the weather
- c. The portion of wire rope at the hydraulic engine that passes over the traveling sheave.

588-3.4.5 REPLACEMENT CRITERIA. All deck edge aircraft elevator wire ropes should be replaced every five years. Inboard aircraft elevator wire ropes should be replaced every seven years. When practical and appropriate, replacements should be made during regular overhauls. Wire ropes should be scheduled for replacement at the soonest availability after any replacement criterion on the wire rope inspection MRC's has been met. Individual wire ropes on an aircraft elevator platform should generally not be replaced. A new rope would have a spring rate (due to constructional stretch) different than the older ropes and would not achieve its full permanent stretch until after it had been in service for awhile. This would make level adjustments and tensioning difficult. If one wire rope breaks or becomes badly worn, it is an indication that the other ropes have similar appreciable wear. Evidence of pitting on a wire rope is usually an indication of operation without the proper protective grease coating. This lack of coating leads to seawater penetration into the core of the rope where it can wash out the lubricants and cause unseen corrosion. All elevator wire ropes should be replaced when a fire on the platform, or in the immediate vicinity of the elevator, subjects the wire ropes to a temperature of over 600°F. During in-port inspections, a conservative assessment of wire rope condition is necessary because of the difficulty of replacing wire ropes while deployed and the severe impact on air operations caused by the loss or downgrading of an elevator.

NOTE

The hoisting engine stops have been adjusted so that maximum ram force is applied to the wire ropes whenever the platform is leveled at the flight deck. In the cases, the tension of the ropes exceeds the rope tension caused by the maximum allowable live load, and is the same, whether the platform is fully loaded or unloaded. If the ropes are condemned by any of the criteria in the MRC's the platform should not be operated under any condition.

588-3.4.6 REPLACEMENT EXCEPTIONS. Although from an operability standpoint it is desirable to always have new hoist wire ropes, it is not feasible from an economic standpoint. Hoisting wire ropes that pass all the replacement criteria other than age may have their lives extended beyond the normal service life. Elevators with

a damaged group of ropes or individual ropes may only need to replace the damaged ropes. The following paragraphs provide guidance for exceptions to the replacement requirements.

588-3.4.6.1 Extended Service. Wire rope replacement may be extended beyond the normal service life if the condition of all the wire ropes of an elevator is found to be acceptable by a knowledgeable inspector. Wire rope service life starts at the end of the availability in which the wire ropes were replaced. The inspection should be made by shore facility personnel familiar with wire rope inspections such as, Sea Support Center or NAVSSES personnel. The inspection should be based on the applicable MRC's, with a particular emphasis placed on the section of wire rope near the hitch girder and any section that may be exposed to seawater, including those in the machinery room near leaking stanchions. Wire rope tension should also be checked. Results of the inspection should be recorded in the inspection report. The report should include the elevator inspected, inspecting activity, any portion of the ropes that could not be inspected, success of tensioning efforts, condition of the ropes, and any evidence of pitting, corrosion, lack of lubrication or diameter measurements not in accordance with the MRC. If the inspection reveals the wire ropes are in satisfactory condition, a message can be sent by the ship, requesting authorization to extend wire rope service life. The message should contain the following information:

- a. Date the wire ropes were placed in service (availability completion date)
- b. Elevators affected
- c. Date of proposed change-out
- d. Inspecting activity point of contact
- e. Inspecting activity report reference.

The message should be sent through the chain of command, with the Type Commander forwarding it to NAVSEA code 56W43. NAVSEA will review the message and inspection report and respond to the Type Commander with the recommended action. Typical requirements to permit extended service will be: increased lubrication, inspection and wire rope tensioning frequency.

588-3.4.6.2 Damaged Wire Rope. If one or more wire ropes have been damaged and require replacement for reasons other than corrosion, wear or fire damage, a number of factors should be considered before replacing all the wire ropes on the elevator. The time and cost involved in replacing one or more wire ropes, the cost of operational and load testing the elevator, and the availability of the ship should all be weighed against the remaining service life of the other ropes. The following guidelines aid in this decision:

- a. A single damaged wire rope with a service life of one year or less may be replaced without replacing the other wire ropes. It is recommended the replacement wire rope be from the same production lot as the existing ropes. If this is not possible, the replacement rope should be from the same manufacturer. As a minimum, the rope should have the same construction and number of wires as the existing ropes. This is necessary to ensure the modulus of elasticity is equal for all ropes within the hitch group. All the wire ropes in the affected hitch group should be retensioned monthly for three months to remove the constructional stretch of the new rope.
- b. A single damaged wire rope with a service life of more than one year but less than three years requires replacement of the hitch group. If the elevator has a low frequency of operation, lengthy ship's availabilities during the service period or scheduled periods that would allow tension checks, it may be acceptable to replace only the damaged wire rope. Naval Sea Systems Command should be contacted when considering this option.
- c. When half or more of the wire ropes at a hitch point are damaged, all the wire ropes in that hitch group should be replaced unless all the ropes have been in service less than one year.

- d. When replacing one or more wire ropes on an elevator having ropes that have been in service for more than three years, replacement of all the wire ropes should be considered.

588-3.4.7 **WIRE ROPE INSTALLATION.** Aircraft elevator wire rope is prestressed by the manufacturer to remove constructional stretch. Constructional stretch is the lengthening of a wire rope caused by individual wires within the rope becoming seated within the strands as a load is applied. Prestressing does not remove all the constructional stretch. Much of the benefit of prestressing is lost during shipment and installation. After reeving and prior to cutting to length for the platform end poured fitting, all slack must be taken out of the wire rope. This can be done by suspending weights from the rope or by pulling on the rope with a chain fall. The wire rope should be cut to length with the attachment bolt in the machinery room positioned to permit maximum adjustment of tension during the life of the rope. A poured zinc socket end fitting shall be installed in accordance with **NSTM Chapter 613** to the platform end of the wire rope. These end fittings are not required to be pull tested. Prior to connection to the platform, grease shall be applied to the ropes, from the socket to a point ten feet above the socket, using a wire rope lubricator, AEL-2-920014777 or similar. After installation the wire ropes should be tensioned per the instructions found in the MRC's for that elevator. The newly installed wire ropes should be tensioned after one month and again after six months of service to compensate for any constructional stretch.

588-3.5 HYDRAULICS

588-3.5.1 The hydraulic system is essential to the operation of the elevator. If hydraulic pressure is lost, the elevator is inoperable. Cleanliness is the key to reliable hydraulics. Serious failure of the hydraulic system can often be avoided by detecting and resolving problems early, before irreparable damage is done. The following maintenance steps will improve the reliability of the hydraulic system:

- a. All hydraulic fluid levels should be checked and corrected before starting elevator operations.
- b. Only clean hydraulic fluid, matching the existing fluid, should be added to the system. Procedures for loading fluid into the system should be in general accordance with **NSTM Chapter 556**.
- c. All high-pressure lines should be kept tight.
- d. Sump leak-off connections should be inspected monthly and excessive leakage corrected.
- e. The hydraulic engine piston rod and seal require frequent inspection and maintenance to ensure proper sealing. The actual frequency depends on the particular installation and the cleanliness of the machinery room. If appropriate maintenance is not performed, foreign matter can accumulate on the exposed surface of the piston rod and can cause excessive wear of the packing and scratches on the piston rod.
- f. The hydraulic system must be kept clean. Only clean, lint-free wiping rags should be used on the interior surfaces of hydraulic components. The immediate vicinity of any hydraulic equipment should be kept clean. All spills should be cleaned immediately and the source of the leak identified and repaired as soon as possible.
- g. Pipe dopes or string packing should not be used for threaded connections. Leaky threaded connections can be repaired by tinning the last two or three threads. Fittings should not be tightened while the system is pressurized because this could induce stresses that could cause the piping to rupture.
- h. All gear for handling or repairing hydraulic components should be clean. Cleanliness will reduce the chance of the introduction of foreign materials into the hydraulic system.
- i. Contaminated fluid systems should be cleaned by circulating the fluid through the system filters, by solvent or oil flushing, or by shop cleaning in accordance with MIL-STD-419 and **NSTM Chapter 556, Hydraulic Equipment (Power Transmission and Control)**.

- j. Air should be bled from all hydraulic bleed valves at the start of each shift's operations.
- k. When the elevator hydraulic system is being drained it is desirable to have the platform at the bottom of its travel to avoid the possibility of dropping the platform. If the system is drained with the platform at the flight deck, special precautions should be taken to ensure that the platform lockbars are, and will remain, completely engaged.
- l. Nitrogen, where installed, should be maintained at 97 percent (minimum) purity by volume to provide the intended protection. Nitrogen purity should be checked by qualified personnel every ten days. Spaces containing hydraulic systems which include nitrogen should be ventilated. Caution should be exercised when handling and bleeding tanks containing nitrogen. Vigilance should be maintained against leaks in nitrogen piping to avoid the possibility of asphyxiation.
- m. Sump and storage tank vents should be inspected every 60 days and maintained to ensure their intended function. Vent filters, where installed, should be kept clean.
- n. Filters and strainers should be cleaned or the element should be replaced according to the schedule in the PMS for the particular elevator. Filters fitted with dirty filter indicators should be cleaned or have the element replaced as soon as practicable after dirty filter indication.

588-3.6 STANCHIONS AND PLATFORM LOCKBARS

588-3.6.1 Stanchions and platform lockbars are exposed to the weather and are subject to the seawater spray. Rigorous adherence to the maintenance schedules and procedures in the aircraft elevator PMS is essential for reliable operation. Protecting exposed components during non-skid application and removal operations will greatly reduce clean-up and maintenance time required to keep these components operational.

SECTION 4. ELEVATOR TESTING

588-4.1 GENERAL

New and modified aircraft elevators are tested prior to regular operation to ensure proper performance of all elevator components. There are no periodically required tests of aircraft elevators. However, because load testing and operational testing are required whenever hoisting wire ropes are replaced, every aircraft elevator will be tested at least once every five years.

588-4.2 LOAD TESTING

Load testing proves the ability of an elevator to perform properly through the complete range of operating limits at rated speed with the platform loaded to rated capacity. The aircraft elevators require load testing with rated load only. Static and dynamic load testing (200 and 150 percent of rated load) are not required for aircraft elevators. Other weight handling devices are normally tested with static and dynamic loads while the ship is at pierside to simulate the effects of ship motion on the load bearing components. With the aircraft elevators, the stress applied by ship motion on the load bearing components is less than the stress due to normal operation. The operational characteristics of the aircraft elevator require that additional loading effects of ship motion on the platform and its rated load at the flight deck level will not stretch the wire ropes and cause the platform to drop below the deck level. The platform is held tight to the flight deck because the hydraulic engine applies a load to the wire ropes beyond that which would be added by ship motion. This loading is applied every time the platform reaches the flight deck, regardless of the weight on the platform. A static and dynamic load test would not provide any additional assurance of proper elevator operation.

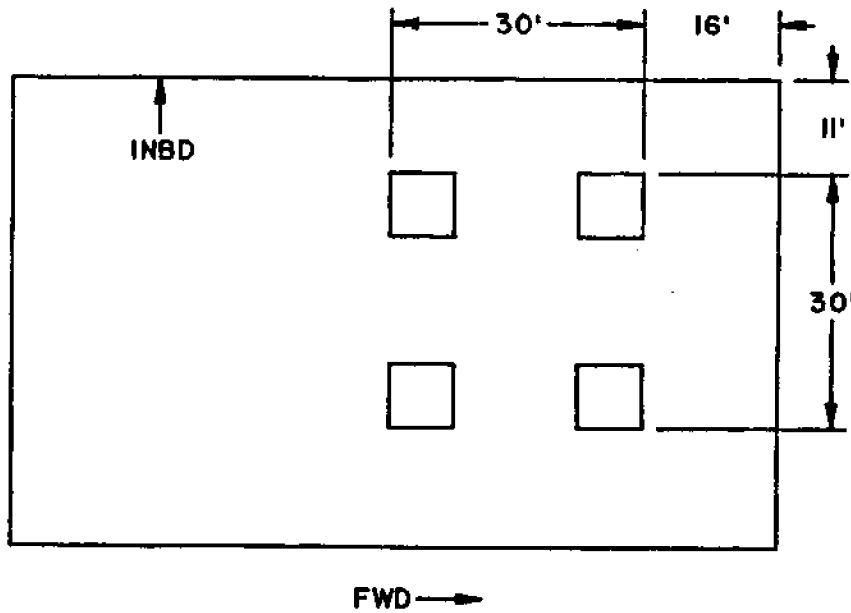
588-4.2.1 REQUIRED LOAD TESTING. An aircraft elevator must be fully load tested after replacement or major repair of any of the following components:

- a. Wire ropes
- b. Sheaves and crosshead
- c. Hydraulic engine (ram or cylinder)
- d. Guide rails
- e. Platform structure
- f. Guide or face rollers.

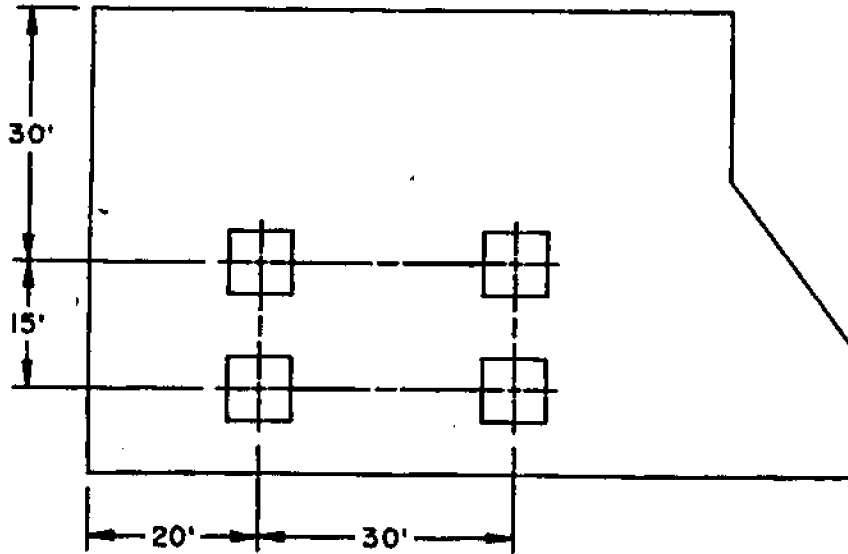
588-4.2.2 LOAD TEST REQUIREMENTS. The test load for aircraft elevators should be equal to 100 percent of the rated capacity of the elevator if the test is conducted pierside or anchored in calm seas. Load testing should be performed only after the hoisting wire ropes have been properly tensioned. The rated load test should be preceded by a component inspection and an operational test. Load placement shall be as close as practical to the configuration shown in [Figure 588-4-1](#). The load test requires the test load to be moved through the complete operating range of the elevator for a minimum of 20 cycles. Satisfactory completion of this test demonstrates proper operation and repeatability of all functions without overheating pump motors, hydraulic machinery or showing other signs of malfunction. Regardless of the reason for load testing, the following parameters should be measured and compared to the elevator design standards:

- a. Time for the elevator platform to travel from hangar deck to flight deck
- b. Time for the elevator platform to travel from flight deck to hangar deck
- c. Proper lockbar operation
- d. Proper lockbar mechanical interlock operation
- e. Smooth acceleration and deceleration of the platform.

If the load test must be accomplished while the ship is at sea, the sea state must be 3 or less (Beaufort scale) and the test load should be 80 percent of the rated capacity. Satisfactory completion of the at-sea test requires the elevator to be downgraded to 80 percent of the rated capacity. Upon returning to port the elevator should be retested to full capacity. The location of the test load should be such that it simulates the most adverse loading configuration that meets the rated capacity.

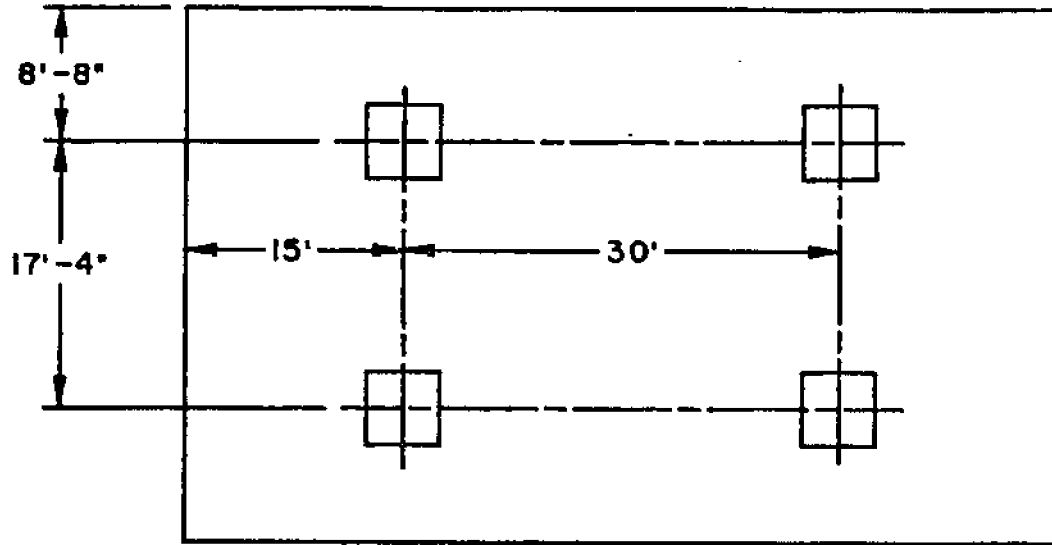


130,000 LB DISTRIBUTED BY 4-32,500 LB FOR CV41
110,000 LB DISTRIBUTED BY 4-27,500 LB FOR
CV59 THRU CV62

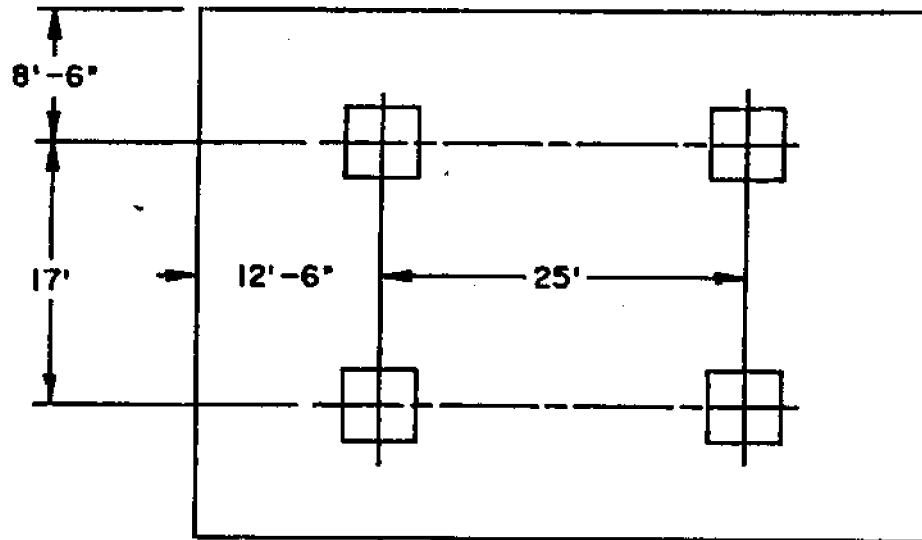


130,000 LB DISTRIBUTED BY 4-32,500 LB
FOR CV 63 THRU CVN 68 CLASS

Figure 588-4-1. Test Load Positioning (Sheet 1 of 3)

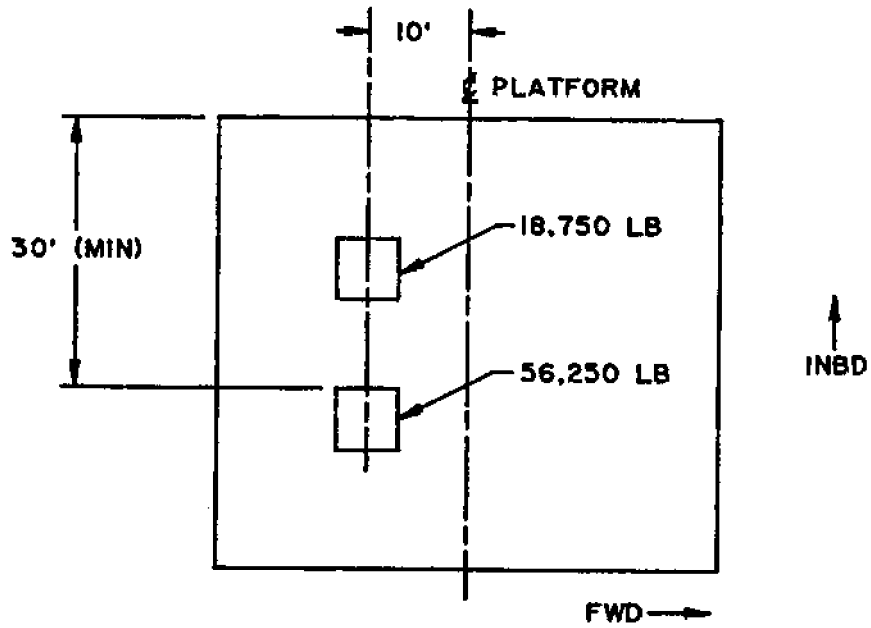


**80,000 LB DISTRIBUTED BY 4-20,000 LB
FOR LHA AFT ELEVATOR**

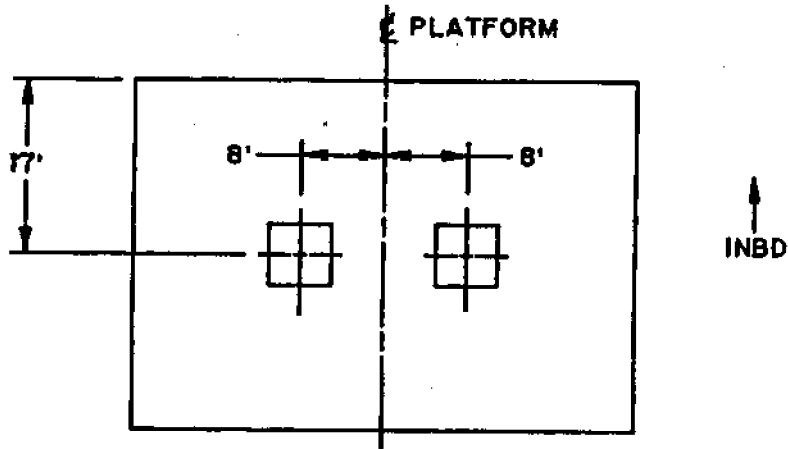


**40,000 LB DISTRIBUTED BY 4-10,000 LB
FOR LHA DECK EDGE ELEVATOR**

Figure 588-4-1. Test Load Positioning (Sheet 2 of 3)



**75,000 LB DISTRIBUTED WITH 75% OF LOAD
AT LEAST 30 FT FROM THE INBOARD EDGE
FOR LHD**



**50,000 LB DISTRIBUTED BY 2 - 25,000 LB
FOR LPH**

Figure 588-4-1. Test Load Positioning (Sheet 3 of 3)

588-4.3 OPERATIONAL TESTING

Operational testing of the aircraft elevator proves the ability of any component of the elevator to operate properly. The operational test can be tailored to test a single component, a group of components or all the components of the elevator. After an overhaul, a period of inactivity of more than thirty days or construction of a new elevator, all the components and features of the elevator should be tested for proper operation. The platform is required to attain rated speed consistently and have all components function properly throughout the test.

588-4.3.1 REQUIRED OPERATIONAL TESTING. An aircraft elevator must be operationally tested after replacement or major repair of any of the following components:

- a. Limit switches
- b. Elevator control switches
- c. Electric motors (sump and main pump)
- d. Electric motor controllers
- e. Main pumps
- f. Sump pumps
- g. Slack cable devices
- h. Platform lockbars
- i. Any hydraulic component or pipe joint
- j. Feedback system
- k. Speed control gearboxes
- l. Speed control motor
- m. Main control valve.

588-4.3.2 OPERATIONAL TEST REQUIREMENTS. The operational test may be accomplished with no load or with any load up to the full capacity of the platform. The parameters measured should be sufficient to show that all components that were repaired, replaced or disturbed during repairs are functioning properly within the system. A typical operational test consists of raising and lowering the platform with no load through five complete cycles, two at slow speed and three at rated speed. New elevators or existing elevators completing a class B overhaul should be operationally tested with rated load for one hour to prove performance and durability. The following parameters should be measured and compared to the elevator and component design standards:

- a. Proper functioning of all control switches and indicators
- b. Proper functioning of all electrical interlocks
- c. Proper functioning of platform lockbars and mechanical interlocks
- d. Proper functioning of slack cable devices
- e. Current, voltage and insulation resistance readings (hot and cold) on all electric motors in the system
- f. Fluid pressures in all parts of the hydraulic system during each phase of operation, i.e. platform raise, platform descend, main pumps off stroke, main pumps just coming on stroke and sump pumps running

- g. Fluid temperatures (pipe temperatures) in various parts of the system, including: exhaust tank, high-pressure tank, accumulators, main pump inlet, main pump discharge, main pump case drain, sump tank, and fluid cooler inlet and outlet
- h. Time for main pumps to return high-pressure tank or accumulators to full pressure after the platform is raised from the hangar deck to the flight deck
- i. Sump pump cycle time
- j. Smooth acceleration and deceleration of the platform and traveling sheave block
- k. Elevator speed and cycle time
- l. Leveling at the flight deck and hangar deck
- m. Time for sump pump raise of platform
- n. Unusual noise or vibration in the machinery or hydraulic system.

588-4.4 HYDRAULIC TESTING

The following notes apply to testing of aircraft elevator hydraulic systems:

- a. Relief valves should be tested and adjusted only by approved facilities.
- b. Pressure switches should be tested and adjusted to ensure proper operation.
- c. New, modified or overhauled sump tanks or reservoirs should be hydrostatically tested to 8 lb/in² to demonstrate fluid tightness.
- d. All new or modified rams, cylinders, accumulators, valves, piping, fittings and pressure tanks should hydrostatically tested to design pressure after installation.
- e. Overhauled rams, cylinders, accumulators, valves, piping, fittings and pressure tanks should be hydrostatically tested before installation to 135 percent of design pressure and then to design pressure after installation to demonstrate that there is no leakage.
- f. Overhauled systems should be operationally tested at design pressure to demonstrate satisfactory operation of all system components.
- g. Gauges should be calibrated as specified in **NSTM Chapter 504, Pressure, Temperature, and Other Mechanical and Electromechanical Measuring Instruments**.
- h. Overhauled pumps should be tested for satisfactory performance at design pressure and rated flow.
- i. After overhaul or major repairs, heat exchangers should be tested to system pressure.
- j. The degree of fluid system cleanliness should be determined by fluid sampling and analysis as specified in **NSTM Chapter 556, Hydraulic Equipment (Power Transmission and Control)**.
- k. Tightness testing should be performed whenever any joint within the hydraulic system is disturbed.

REAR SECTION

NOTE

TECHNICAL MANUAL DEFICIENCY/EVALUATION EVALUATION REPORT (TMDER) Forms can be found at the bottom of the CD list of books. Click on the TMDER form to display the form.

