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REVISION 2

NAVAL SHIPS' TECHNICAL MANUAL

CHAPTER 772

CARGO AND WEAPONS ELEVATORS

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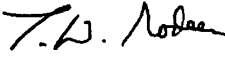
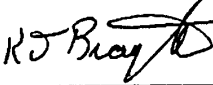
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CHAPTER 772

CARGO AND WEAPONS ELEVATORS

SECTION 1.

INTRODUCTION

772-1.1 GENERAL INFORMATION

772-1.1.1 PURPOSE. This chapter provides information to personnel of the United States Navy charged with the safe and reliable operation, maintenance and testing of installed cargo and weapons elevator equipment. Related elevator equipment and systems manuals, Ship's Information Books (SIBs), Elevator Military Specifications (MIL-SPECs), General Specifications for Ships of the United States Navy (GENSPECs), OPNAV Instructions, Ordnance Publications (OPs), Technical Manuals (TMs), appropriate Maintenance Requirement Cards (MRCs), together with this NSTM, will mesh system components with their appropriate test instrumentation, gauges, controls, tools, spare and repair parts, equipment information, and drawings. This NSTM is not intended to be a compendium of total elevator system design and engineering information, nor an all encompassing document covering all configurations of shipboard installed equipment. It provides guidance and information that personnel must have to obtain optimum elevator performance throughout its life cycle.

772-1.1.2 SCOPE. This chapter will generally identify the various cargo and weapons elevators (henceforth referred to as elevators) and subsystems under the cognizance of Naval Sea Systems Command (NAVSEA). In addition, it will generally define elevator system function, operating requirements, weight testing, safety, and training requirements. Data covered is applicable to a class of elevators, or common to a majority of installations.

772-1.1.2.1 Requirements. This NSTM provides the ship and the chain of command minimum requirements for operation, maintenance, testing and inspection of elevators. These requirements should not be construed as limiting the authority of a Command or a Type Commander to impose additional or devise more restrictive, reasonable requirements. This document does not limit the Commanding Officer from assessing the risks involved and, if operational conditions dictate, overriding the requirements.

772-1.1.3 RESPONSIBILITY. Elevator readiness is continually reduced with age and operation through corrosion, wear, fatigue, and other environmental factors. The rate of degradation and the potential for failures are directly related to the care provided in operation and maintenance. Ship's personnel have the responsibility to provide this care during their daily contact with the elevators. Operation in accordance with posted operating instructions reduce the risks to equipment and personnel during movement of the elevator. Diligent and thorough completion of preventative and corrective maintenance in accordance with MRCs and technical manuals will keep the elevators in safe working condition.

772-1.1.3.1 Shipboard Organization. An organizational structure with defined responsibilities for the operation and maintenance of the elevators shall be established. The officer in charge of this organization shall be designated in writing by the commanding officer.

772-1.1.3.2 Technical Support. The technical support network for elevators consists of three sources. The sources are the elevator support units (ESU), the in-service engineering agent (ISEA), and the life cycle manager (LCM). These sources provide different levels of support and have different responsibilities.

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772-1.1.3.2.1 Elevator Support Units. The ESUs are based at FTSC/LANT and FTSC/PAC. Responsibilities of the ESUs include: assessing the elevator to ensure it is safe to operate; alerting the Commanding Officer if the elevator is unsafe; assisting ship's force to make repairs as tasked; and providing reports of assessment findings to the Type Commanders, technical community, and others as tasked.

772-1.1.3.2.2 In-Service Engineering Agent. The elevator ISEA is Naval Surface Warfare Center, Carderock Division, Ship System Engineering Station (NSWCCD-SSES), formerly called NAVSSES. Responsibilities of the ISEA include: evaluate technical problems identified by ESUs; present design recommendations to the LCM; and provide inputs to update technical documentation, i.e. technical manuals, PMS, COSAL, etc.

772-1.1.3.2.3 Life Cycle Manager. The elevator LCM is Naval Sea Systems Command (NAVSEA). Responsibilities of the LCM include: set policy regarding design, construction, operation, and maintenance of elevators; provide technical guidance in the form of MILSPECs, ship specifications, and other requirements documents; evaluate technical recommendations from ISE; develop ship alteration documents to make shipboard modifications.

772-1.1.4 APPLICABILITY. NSTM Chapter 772 applies to the operation and maintenance of all cargo and weapons elevators installed in U.S. Navy ships and includes installations used for training ashore. This NSTM is neither intended to replace nor be a substitute for approved Elevator Technical Manuals.

772-1.1.5 GENERAL BACKGROUND. Shipboard elevator installations are defined as a machinery arrangement consisting of mechanical (electric or hydraulic) hoist machinery, platforms, hoist wire ropes, sheaves, rails, closures (hydraulic/pneumatic powered), a trunk, communications circuits, and a logic control system. Together they vertically move cargo and weapons safely and efficiently.

772-1.1.6 GLOSSARY. Definitions are provided for terms directly associated with elevators, and for terms having a specific meaning within this chapter.

Accumulator - A device for storing liquid under pressure, usually consisting of a chamber separated into a gas compartment and a liquid compartment by a piston or diaphragm. An accumulator also serves to smooth out pressure surges in a hydraulic system.

Actuating Cylinder - A device which converts fluid power (pressure energy) into linear mechanical force and motion (mechanical energy).

Actuator - A device which converts fluid power (pressure energy) into mechanical force and motion (mechanical energy).

Brake - A device (drum or disc) used to stop elevator platform motion by the action of friction between a rotor and discs, or between linings and a drum.

Buffer Spring - A shock absorbing device, installed in the bottom of the trunk, commonly called the pit. The device is designed to cushion the impact of the platform if it overtravels downward below the lowermost deck level served. Buffer Springs are designed to support the platform with its rated load.

Casualty - A failure occurring within a system or subsystem which causes the elevator to be unsafe to operate or inoperable.

- Caution - Identifies an operating or maintenance procedure, practice, condition, or statement that, if not strictly observed may result in damage or destruction of equipment or loss of mission effectiveness.
- Check Valve - A valve which permits fluid flow in one direction, but prevents flow in the reverse direction.
- Circuit - An arrangement of interconnected electrical, hydraulic or pneumatic component parts.
- Component - Individual equipment that performs a single function; for example a brake stops the platform.
- Control - A means or device used to regulate the function of a unit. For example, valves may be controlled hydraulically, manually, mechanically, electrically, or pneumatically. In turn, the valve controls the function of some unit.
- Control Panel - An arrangement of switches, push buttons, and indicator lamps which transmit the control functions and communicates messages necessary for elevator operation to the elevator logic controller. It also provides status information to the operator.
- Control Signal - A signal used to control electronic, hydraulic, pneumatic or mechanical devices.
- Control Station - The location (deck, level or elevator platform) from which the platform can be dispatched by an operator using a control panel.
- Controller (Logic) - A logic device used to process the signals received from the control stations and the information received from the platform and trunk sensing switches.
- Controller (Motor) - An electromechanical device which sends direction and speed demands to the elevator hoist machinery motor.
- Corrosion - The deterioration or oxidation of materials by chemical or electrolytic action.
- Drum, Wire Rope - A grooved cylinder, which is a component of the elevator hoist machinery. It is used to wind or unwind the platform hoist or the overspeed governor wire rope.
- Emergency Stop Switch - An electrical device which when actuated will interrupt electrical power to stop the elevator or prevent elevator movement.
- Filter - A device containing an element used to remove minute contaminants from a hydraulic or pneumatic system.
- Function Diagram - A system drawing consisting of connected blocks depicting the logical breakdown of equipment functions from input to output.
- Guide Roller Assembly - An arrangement of components mounted as a unit to the side of the platform. The guide rollers ride along the guide rails and are designed to control platform horizontal movement as it travels up and down the elevator trunk.
- Hatch - A horizontal watertight closure, mounted in or at the top of the elevator trunk.
- Heat Exchanger - A device which transfers heat through a conducting wall from one fluid to another.

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Hoist Machinery -

An electromechanical drive system comprised of a motor, sheaves, a brake, wire ropes, drums, a speed reducer, couplings, and pillow block bearings. Hoist machinery is used to raise and lower the elevator platform.

Hydraulic Power Unit -

A combination of electrohydraulic components (including hydraulic pumps, electric motors, fluid reservoirs, heat exchangers, controls and associated valves and piping) that are used for the transmission of fluid power for the operation of elevator platforms, elevator closures and associated system components.

Interlock -

A protective device designed to prevent the unsafe operation of equipment or to sequence the action of systems, components, or component parts.

Jog -

The action of moving the elevator platform up or down in slow speed using the momentary contact JOG UP/JOG DOWN switches/buttons.

Knurled Roller Assembly -

A hardened roller with a number of diagonal intersecting surface ridges fitted in a wedged-shaped housing. Its function is to stop platform downward movement by jamming (wedging) itself between the guide rail and roller housing when an overspeed, or broken hoist wire rope condition occurs.

Latch -

A locking device engaged mechanically, pneumatically, or hydraulically which prevents hatches and upward opening doors from accidentally closing when in the fully open position.

Limit Switch -

A mechanically actuated, electrical device that senses the position of the platform and/or other elevator components and transmits the appropriate signals to the logic controller.

Linear Mechanical Force -

Mechanical force applied in a straight line.

Machinery Space -

A room, usually adjacent to each elevator trunk, where the hoisting machinery is located.

Major Deficiency -

A material deficiency directly affecting the operation, safety, or reliability of the elevator.

Minor Deficiency -

A material deficiency which does not directly impact safe elevator operation.

MRC -

Maintenance Requirement Card

Note -

Used to highlight certain operating or maintenance conditions or statements which are essential but not of a known hazardous nature as indicated by warnings and cautions.

Operator Rider Elevator -

A manually controlled elevator where the operator rides on the platform.

Overspeed -

To travel faster than rated speed (usually downward direction).

Overtravel -

To travel beyond the desired stopping point.

PMS -

Planned Maintenance System.

Positive Stop -

A weldment or fixture secured to the top of the guide rails or a fixed structure to stop the platform in the event of an upward overtravel.

PQS -

Personnel Qualification Standards

Pressure Regulator -

A valve which limits the maximum pressure at its outlet regardless of the inlet pressure.

- Proximity Switch - A sensing device for non-contact position sensing of ferrous objects which transmits its designated signal to the logic controller.
- Pump - A device which converts mechanical energy into fluid energy.
- Ramp - A structure used to bridge the gap between the platform and deck level served. Ramps are either fixed, hinged or portable and are either manually, pneumatically, mechanically, or hydraulically operated.
- Relief Valve - A pressure control valve used to limit system pressure.
- Safety Device - Any component, mechanism or assembly designed to prevent equipment damage or personnel injury resulting from abnormal conditions, system or component failure or improper sequencing of events.
- Sheave - A rotatable wheel with a grooved rim used to reeve the wire rope from the hoisting drum to the platform.
- Shunt Trip - An electrical device, when energized by the actuation of an emergency stop (E-stop) pushbutton or in-trunk high speed stop switch, is designed to stop or prevent elevator movement by securing power to the system.
- Slack Rope Device - An electromechanical device, usually installed between the platform and the hoisting drum, designed to stop the platform by shutting off power to the hoist machinery when the hoist wire rope becomes slack or broken.
- Strainer - A coarse filter.
- Subsystem - A term of reference that groups functional areas of the system, e.g., hydraulic subsystem, control subsystem.
- System Interface - How outside influences affect the operation of a system, or how the operation of a system affects the operation of other systems or equipment.
- System - Group of components that operate together to complete specific task; for an elevator system, hoisting and lowering a load.
- Tolerances - The allowable deviation from a standard or total permissible variation of size.
- Undervoltage Safety Circuit - An electrical circuit which will disconnect power to the entire elevator when an emergency stop (E-stop) pushbutton or in-trunk high speed stop switch is actuated.
- Weapon Elevator Operating Procedure (WEOP) - A bulkhead mounted operating procedure installed at each elevator control station.

SECTION 2.

FUNCTIONAL DESCRIPTION

772-2.1 INTRODUCTION

772-2.1.1 ELEVATOR SYSTEMS. [Section 2](#) covers the elevator component functional description as it relates to overall system operation. The function of each subsystem is described along with the components that are contained within that subsystem. Detailed and additional general information on cargo and weapons elevators, as

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well as the pneumatic and hydraulic systems that complement the above subsystems, are covered in the appropriate technical manuals. Additional reference material is found in [Appendix A](#) and the following associated publications:

- a. NSTM Chapter 700, Shipboard Ammunition Handling and Stowage
- b. NSTM Chapter 793, Security of Stowed Nuclear Weapons
- c. NSTM Chapter 556, Hydraulic Equipment (Power Transmission and Control)
- d. NSTM Chapter 503, Pumps
- e. NSTM Chapter 613, Wire Rope
- f. MIL-E-17807, Elevator, Weapon and Cargo, Electromechanical (Shipboard)

772-2.1.2 CLASSIFICATION. There are three different classifications of elevators used aboard Navy ships. These are cargo/weapons elevators, personnel/medical evacuation elevators, and aircraft elevators. Each of these are designed and operated differently. They may also transport a working load different than what is listed in their title.

772-2.1.3 CARGO/WEAPONS ELEVATORS. Cargo/weapons elevators defines a family of elevators which go by the name of cargo, weapons, ammunition, pallet, freight, stores, torpedo, component, or vehicle elevators. The name does not define what can or can not be transported by the elevator. All of these elevators are required to meet the same safety and testing criteria defined in this chapter. The names may be different but the intended purpose of the elevator is the same. These elevators are used to vertically transport ordnance and cargo to and from magazine spaces, handling spaces, and ship's holds to various decks in support of the ship's mission. Transported ordnance can be either moved in the All-Up- Round (AUR) Ready-For-Issue (RFI) configuration, the component configuration, or palletized as a Fleet Issue Unit Load (FIUL). Personnel are not authorized to ride on cargo/weapons elevators except for the operator on operator rider elevators, certain PMS requirements, and when used to evacuate personnel in a mass casualty or medical emergency situation.

772-2.1.4 PERSONNEL/MEDICAL EVACUATION (CASUALTY) ELEVATORS. Personnel elevators are used for transporting personnel between ship's deck levels. Usually restricted in use, this type elevator is found on some aircraft carriers and large amphibious assault ships. Casualty elevators, with the exception of LHAs and LHDs which have a dedicated Medical Evacuation (MEDEVAC) elevator, are normally cargo or weapons elevators which in cases of medical emergencies or mass casualties are used to transport injured personnel to medical spaces. When elevators are used in this manner, special operating procedures must be followed.

772-2.1.5 AIRCRAFT ELEVATORS. Aircraft elevators are normally used to transport aircraft between the hangar and the flight deck on aircraft carriers, LPHs, LHDs and LHAs. By virtue of their location, size, and weight capacity, these elevators are used as multifunction elevators transporting palletized cargo, weapons, mobile aircraft support equipment, and personnel. They are addressed in NSTM Chapter 588 .

772-2.2 ELEVATOR TYPES

772-2.2.1 GENERAL. U.S. Navy shipboard elevators are either electromechanical or electrohydraulic (ram) types. The majority of electromechanical elevators use wire rope in conjunction with hoist machinery as the lifting device. However, one variant, the screw type, employs a direct drive mechanism to effect desired movement. The ram and screw type elevators are normally used as transfer elevators and typically service only two decks.

772-2.2.2 ELECTROMECHANICAL WIRE ROPE ELEVATORS. Vertical movement of the elevator platform takes place when the wire ropes are payed onto or off the winding drums. A reversible electric motor, controlled by either a manual or an automatic motor controller, drives the winding drums through a speed reducer and couplings. The motor is connected to a brake which automatically sets when the motor is deenergized. The hoist ropes are led from the winding drums over a system of sheaves to the elevator platform, dead-ending there or at the elevator trunk. Safety devices monitor rope tension and platform speed and actuate the platform safety linkage and safety switches to stop the platform and motor should a broken rope, slack rope, or platform downward overspeed condition occur. The platform is guided during raising and lowering by guide roller assemblies which are attached to the platform and ride on the guide rails. Platform leveling is achieved by adjustment of the platform hoist wire ropes. Elevator platforms are accessed by hatches, side or end opening doors. Hatches and access doors are opened and closed either manually or automatically using hydraulic or pneumatic devices. Their operation will be discussed in the Closure Subsystem part of this section (paragraph 772-2.3.4). Examples of electro-mechanical elevators are shown in [Figure 772-2-1](#) (Sheet 1 of 2) and [Figure 772-2-1](#) (Sheet 2 of 2).

772-2.2.3 SCREW TYPE ELEVATORS. Screw type elevators are operated by a reversible electric motor turning a set of lift screws. An example of a screw type elevator and associated machinery is shown in [Figure 772-2-2](#). The platform is attached to the lift screws by large nuts. As the electric motor rotates the reduction gear and worm gear assemblies, the lift screws rotate, raising or lowering the platform. A brake holds the platform in position and the torque coupling acts as a limited slip device to prevent motor damage.

772-2.2.4 ELECTROHYDRAULIC RAM ELEVATORS. Electrohydraulic ram elevators are operated by means of a hydraulic power plant. A typical ram elevator and associated machinery space location is depicted in [Figure 772-2-3](#). The ram and cylinder assembly is rigidly mounted in the base of the elevator trunk. Fluid pressure is applied to the bottom of the ram causing the platform to move upwards. Using gravity, the platform is lowered by bleeding off a controlled amount of hydraulic fluid from the bottom of the ram back to the hydraulic tank.

772-2.3 BASIC ELEVATOR SUBSYSTEMS.

772-2.3.1 GENERAL. Regardless of ship class, there are subsystems common to all classes and types of elevator systems. For purposes of discussion within this section, the elevator system is divided into the six subsystems. Component variations to these basic subsystems accommodate the unique requirements and mission assigned to the elevator. The six subsystems that make up an elevator are:

- a. Trunk (including the platform)
- b. Hoist Machinery
- c. Closures (doors and hatches)
- d. Controls
- e. Communications
- f. Safety Devices

772-2.3.2 TRUNK SUBSYSTEM. Elevators operate within an enclosed vertical, and on some ships, watertight trunk. Trunks can be of different designs and configurations but they serve the same function and basically contain similar equipment. Trunk bulkheads shall be painted white except at weather deck openings where darken ship conditions require black. This increases the effectiveness of the trunk lighting, making it easier to see dur-

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ing load/unload operations. Depending upon the complexity of the specific elevator system, trunks will contain some, or all, of the following components: fixed guide rails, hinged guide rails, positive stops, shock absorbers, buffer springs, ramps, protective barriers, platform, platform guide roller assemblies, platform limit switch/interlock cams, proximity switch target vanes, proximity switches or limit switches, platform mounted mechanical safety subsystem, trunk drain system, warning alarm, and trunk lighting system. Doors, flame seal doors, hatches, and hatch drain systems, though they form a part of the trunk, will be in this section under the Closure Subsystem.

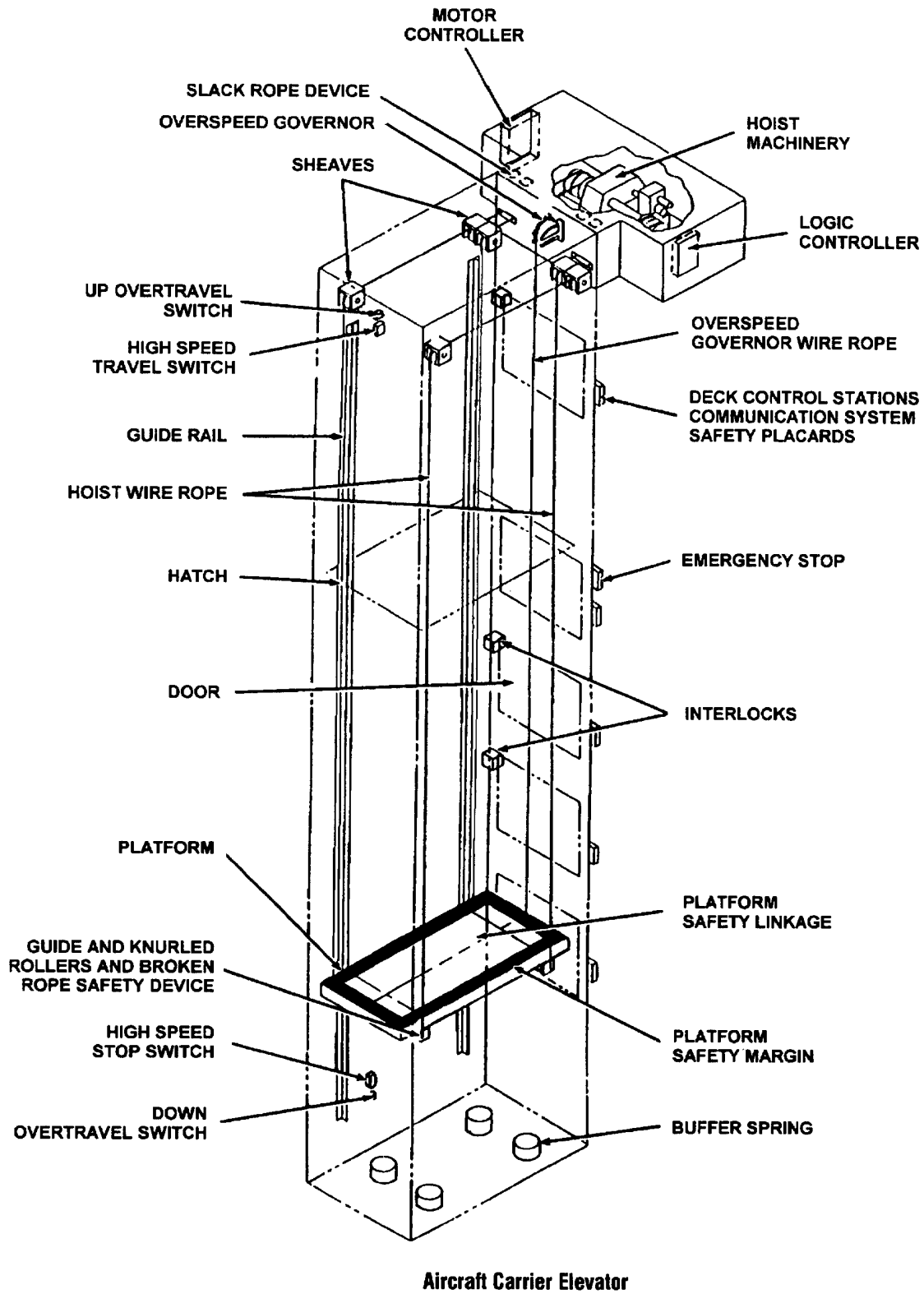


Figure 772-2-1. Example of Aircraft Carrier/Auxiliary Ship Elevators (Sheet 1 of 2)

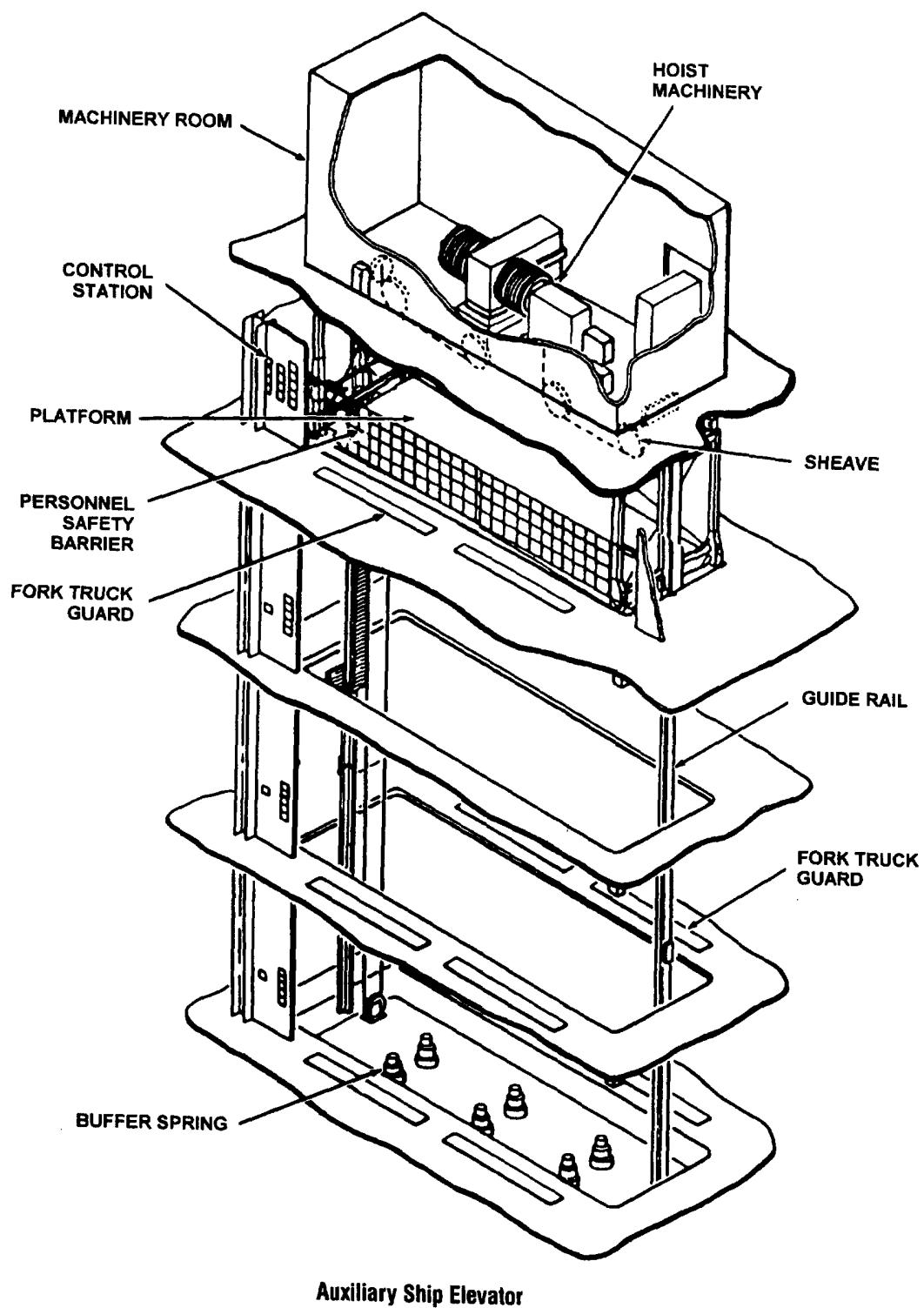


Figure 772-2-1. Example of Aircraft Carrier/Auxiliary Ship Elevators (Sheet 2 of 2)

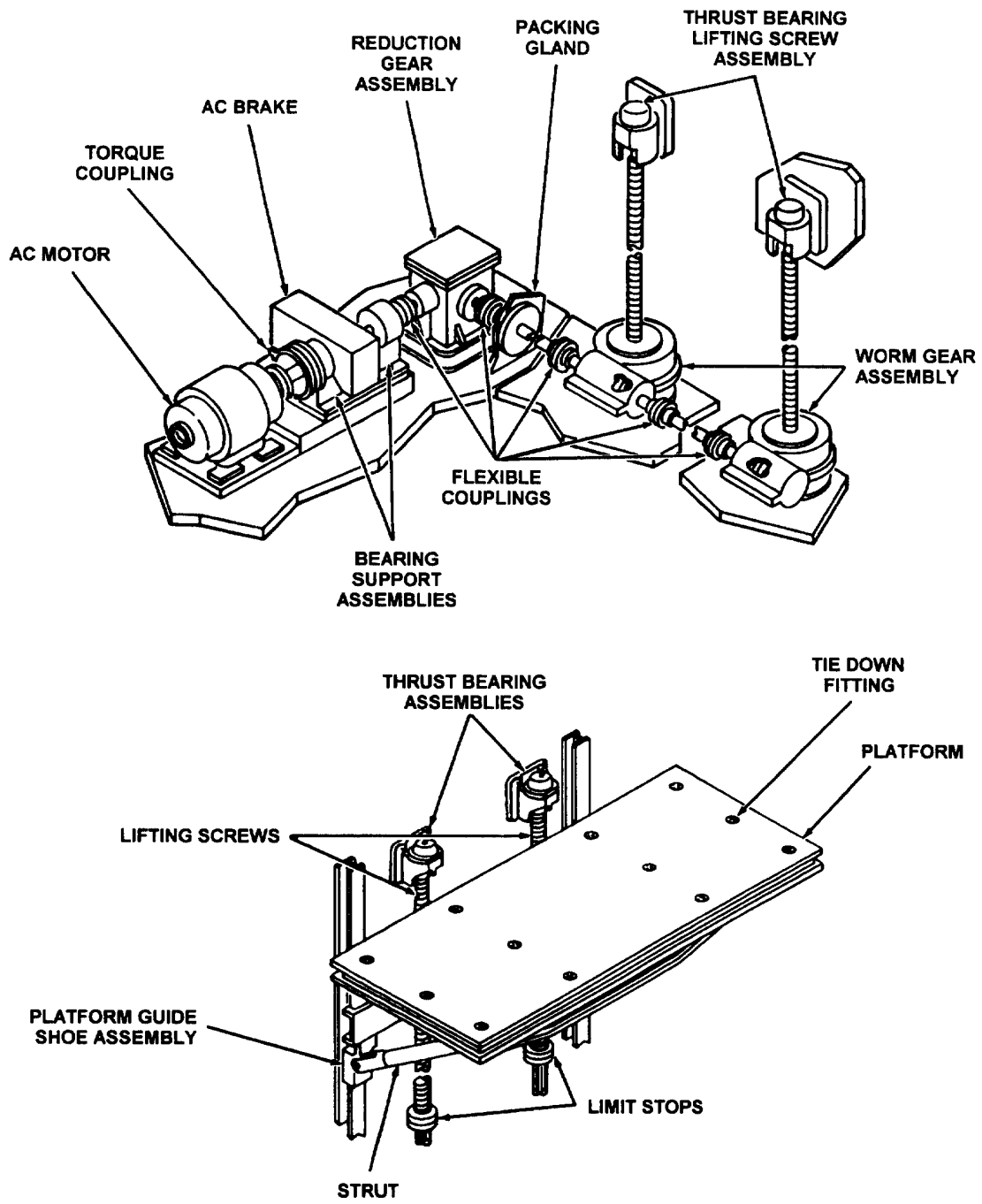


Figure 772-2-2. Screw Type Elevator and Machinery

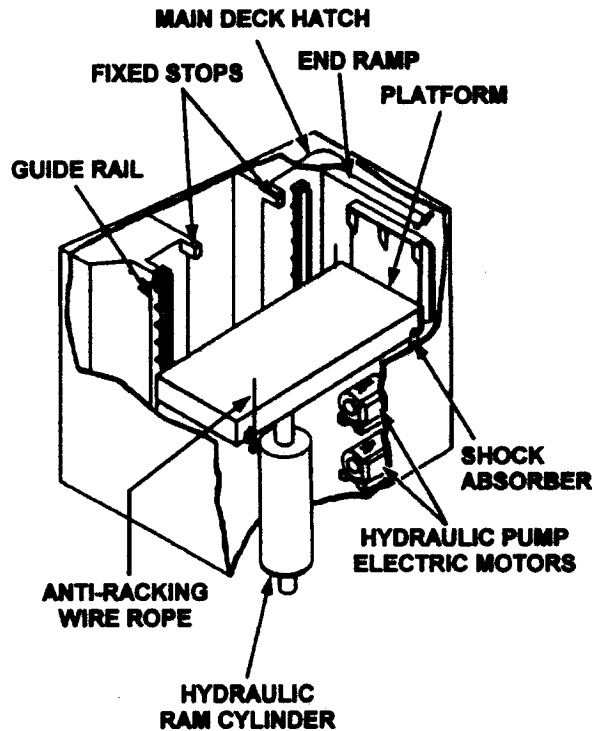


Figure 772-2-3. Ram Elevator

772-2.3.2.1 Platforms. Elevator platforms are fabricated structures consisting of a frame and a deck. A representative elevator platform and selected components are shown in [Figure 772-2-4](#). The deck is flush, and in some instances, is provided with recessed tiedown fittings for securing loads. The deck surface must be covered with a non-skid coating and has a safety border around the perimeter of the platform that identifies the safe loading area. The components attached to the elevator platform perform the following functions:

- a. Guide roller assemblies stabilize the platform and provide the only contact between the platform and guide rails.
- b. Cams actuate limit switches or interlock devices.
- c. Target vanes activate proximity switches.
- d. Platform safety linkages engage the knurled rollers and stop downward movement of the platform in the event of an overspeed or broken rope condition.

772-2.3.2.1.1 Dual Platform Elevators. Some elevators on auxiliary class ships are dual or split type elevators ([Figure 772-2-5](#)). They consist of two separate and complete elevator systems whose platforms operate side by side in the same trunk. The platforms can be operated independently of each other, or, in the synchronous mode, they can be locked together mechanically and electrically to operate as one.

772-2.3.3 HOIST MACHINERY SUBSYSTEM. The two basic types of hoist machinery used in cargo and weapons elevator systems are electromechanical hoist and electrohydraulic ram.

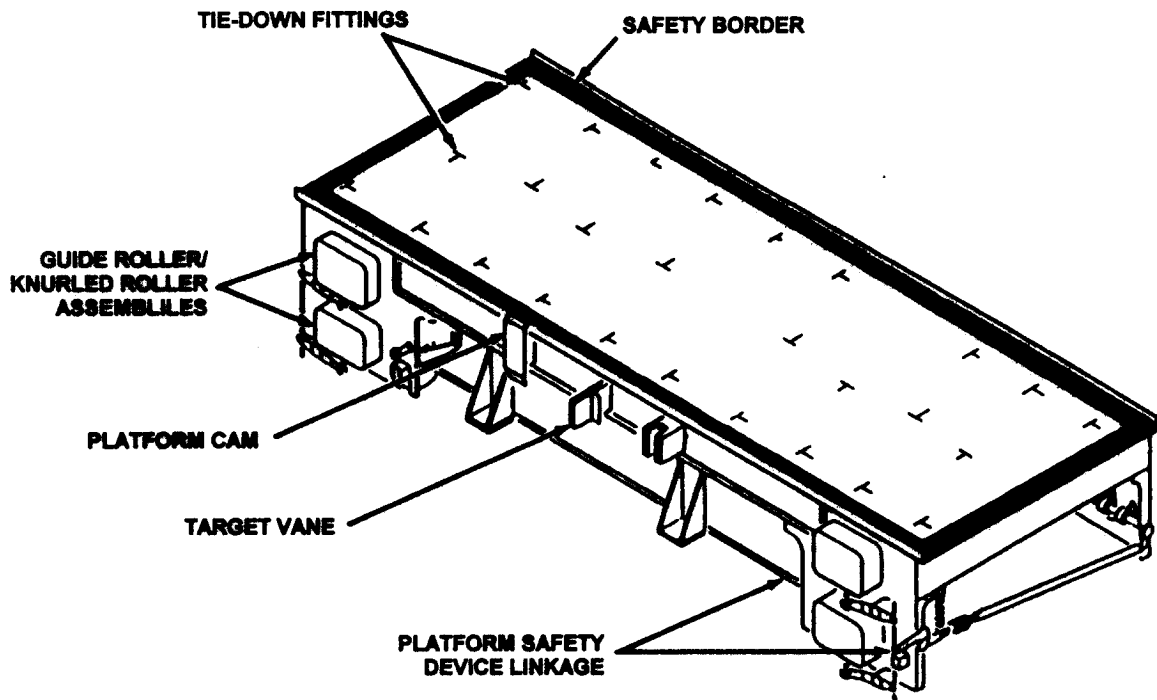


Figure 772-2-4. Representative Elevator Platform

772-2.3.3.1 Electromechanical Hoist Machinery. Hoist machinery causes vertical platform movement within the trunk. Electromechanical hoist machinery components consist of an electric motor; magnetic brake assembly; reduction gear assembly; flexible couplings; drum shaft assembly; wire rope; and sheaves. Typical electromechanical hoist machinery layouts are shown in [Figure 772-2-6](#). Hoist machinery components should have fill and drain connections, access plates, lubrication and adjustment points, and electrical connections located on the periphery of the machinery envelope.

772-2.3.3.2 Electric Motor. Electric motors provide power to raise and lower the platform. Electric motors are of differing sizes, speeds, and horsepower depending on the performance requirements, the rated load of the elevator, and the reduction gear ratio used in the hoist machinery. The motor receives electrical inputs from the motor controller and raises or lowers the platform. The platform is dispatched at high speed. Prior to arrival at the selected destination, the elevator switches automatically to low speed.

772-2.3.3.3 Magnetic Brake Assembly. In the most common drive machinery arrangement, the shaft of the main hoist electric motor extends out both ends of the motor. One end couples to the reduction gear box. The other is attached to an electrically released, spring set magnetic brake. This magnetic brake, when deenergized, prevents the platform from moving. There are two types of magnetic brakes: the drum type and the disc type ([Figure 772-2-7](#)). Each of these brakes can be released manually by a handle or lever and each automatically resets when the manual release lever or handle is released. When deenergized, the brake is designed to stop the platform within a distance of 3 feet while the platform is traveling downward at rated speed and supporting 150 percent of rated load. The brake is designed to hold the platform with a static load of at least 200 percent rated load.

772-2.3.3.4 Reduction Gear Assembly. The speed rotation of the motor output shaft is reduced to a lower operating rate for turning the hoisting drum. Speed reduction is achieved by either a reduction gear box, a bull gear and pinion, or a combination of both ([Figure 772-2-8](#)). When the drive shafts penetrate bulkheads, watertight seals are provided by bulkhead stuffing boxes.

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772-2.3.3.5 Flexible Couplings. Flexible couplings (Figure 772-2-9) connect the motor to the reduction gear assembly. The coupling compensates for slight shaft misalignment. Each coupling usually consists of two hubs, one keyed to each shaft, and a two piece housing. The housing bolts together over the hubs. In the case of a gear type coupling, the drive is transmitted through the hub teeth to the teeth in the housing. The tapered grid type coupling transmits the drive from the teeth of one hub to the teeth of the other by a flexible grid type spring. Another type of flexible coupling is the jaw type flexible coupling (Figure 772-2-10) which consists of two hubs, one attached to each shaft. The hubs interlock into a central synthetic rubber spider.

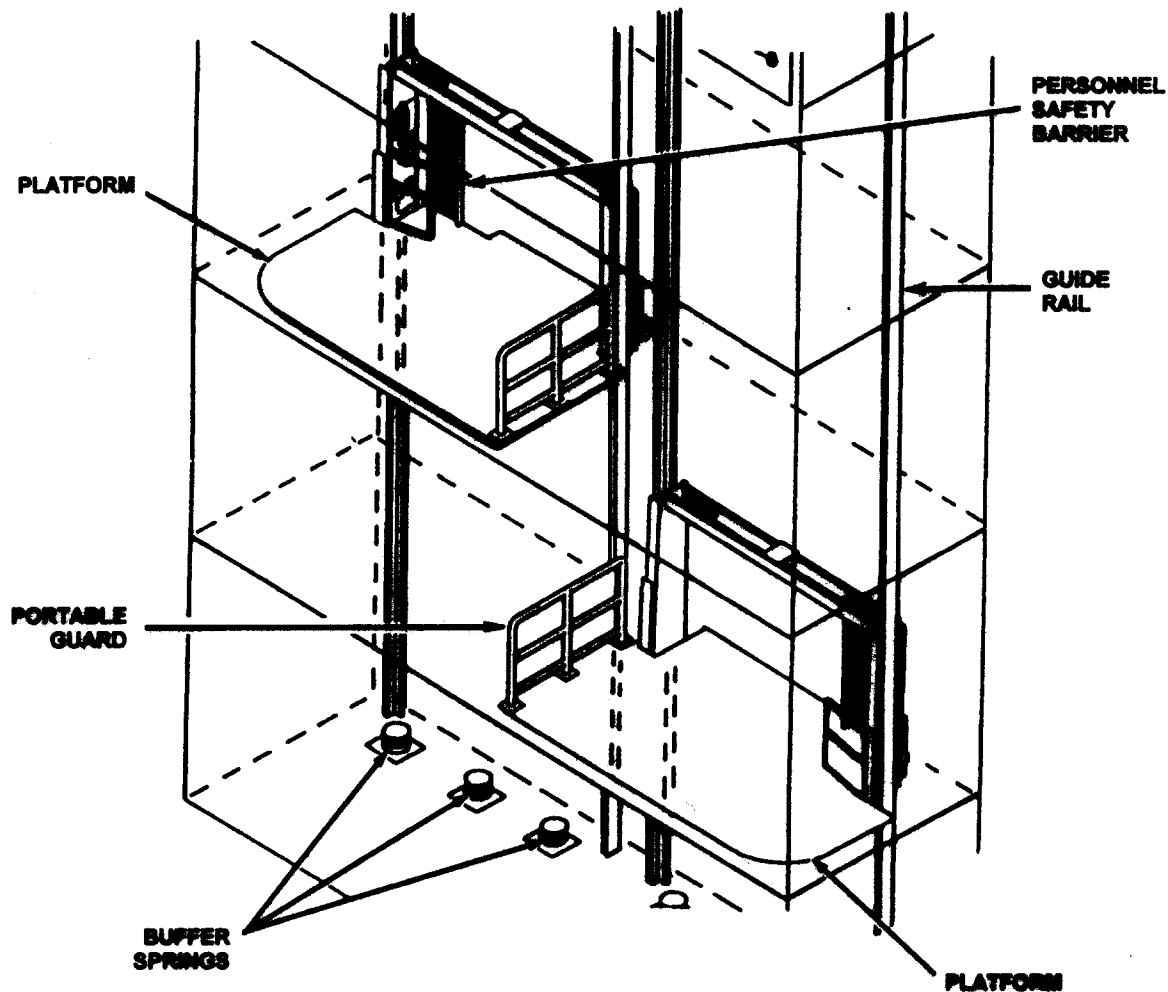


Figure 772-2-5. Dual Elevator Platforms

772-2.3.3.6 Wire Rope. Wire ropes, used for raising and lowering and holding elevator platforms, are constructed of Independent Wire Rope Core (IWRC), uncoated, prestressed, extra improved plow steel 6 x 37 in accordance with Federal Specification RR-W-410. The minimum factor of safety for wire rope is 5. The maximum allowable stretch of wire rope is 1/2 inch between rated load and no-load conditions at any level. When an elevator platform is lowered onto the buffer springs, at least one-and-a-half turns of wire rope must remain on the winding drum. Ropes are secured to the inside of the winding drums and to the platform or trunk with fittings that will allow for wire rope length adjustment. Wire ropes for the overspeed governor are constructed of stainless steel. (Plow steel ropes, where currently installed, are allowable but must be replaced with stainless steel during changeout/normal replacement). Criteria governing wire rope replacement is in Section 5.

772-2.3.3.7 Drum Shaft Assembly. The drum shaft assembly secures, winds, and unwinds the hoist wire ropes, and sometimes the overspeed governor wire ropes. The drum shaft assemblies consist of drum shafts, hoist drums, flexible couplings, speed governor drums, and pillow blocks. The drum shaft is driven by a speed reducer assembly or a bull gear connected to the shaft and driven by a pinion. Right- and left-hand grooves on the hoist drums wind the hoist wire rope outward from the center or unwind it to the center. Pillow blocks support and align the shafts.

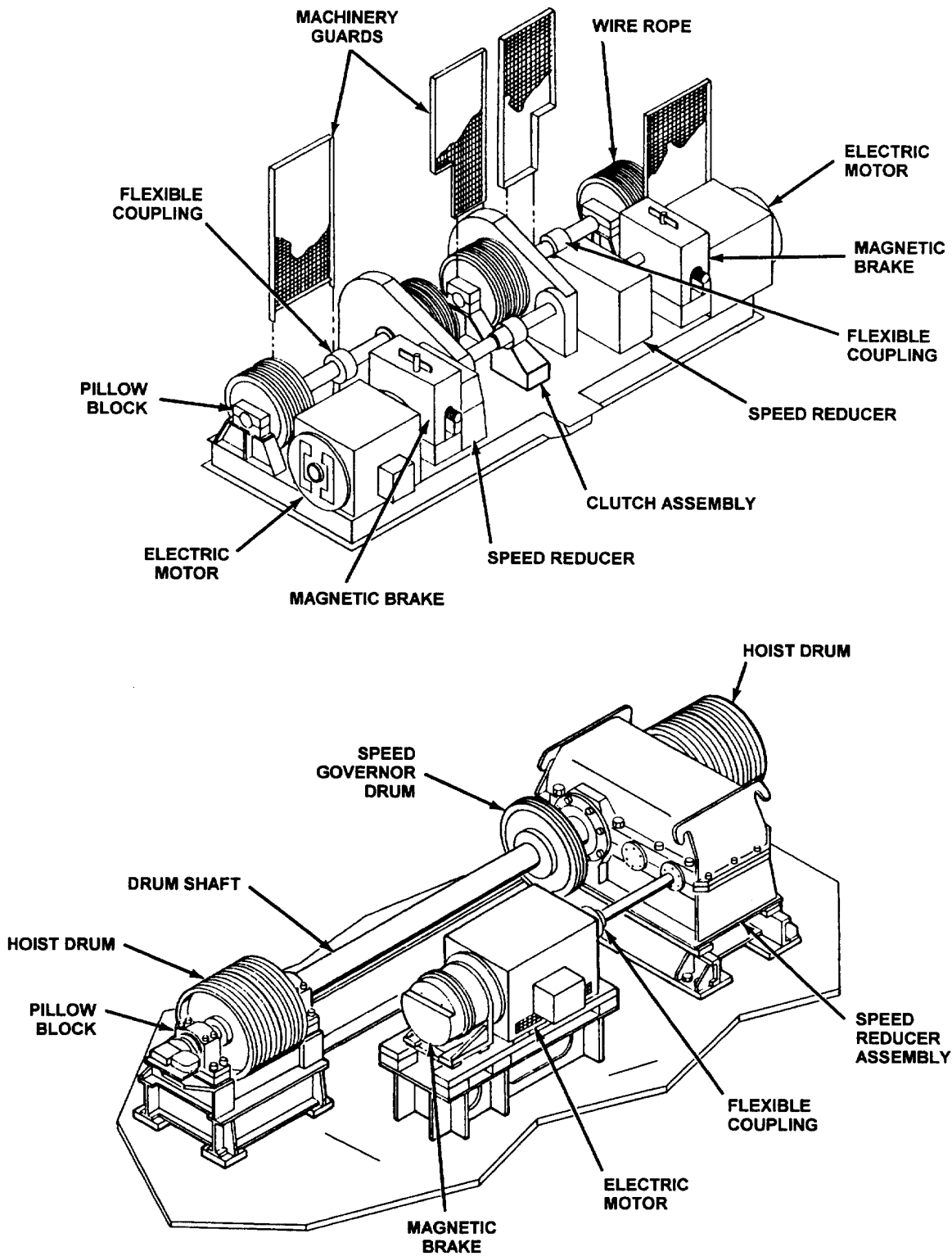


Figure 772-2-6. Electromechanical Hoist Machinery Arrangements

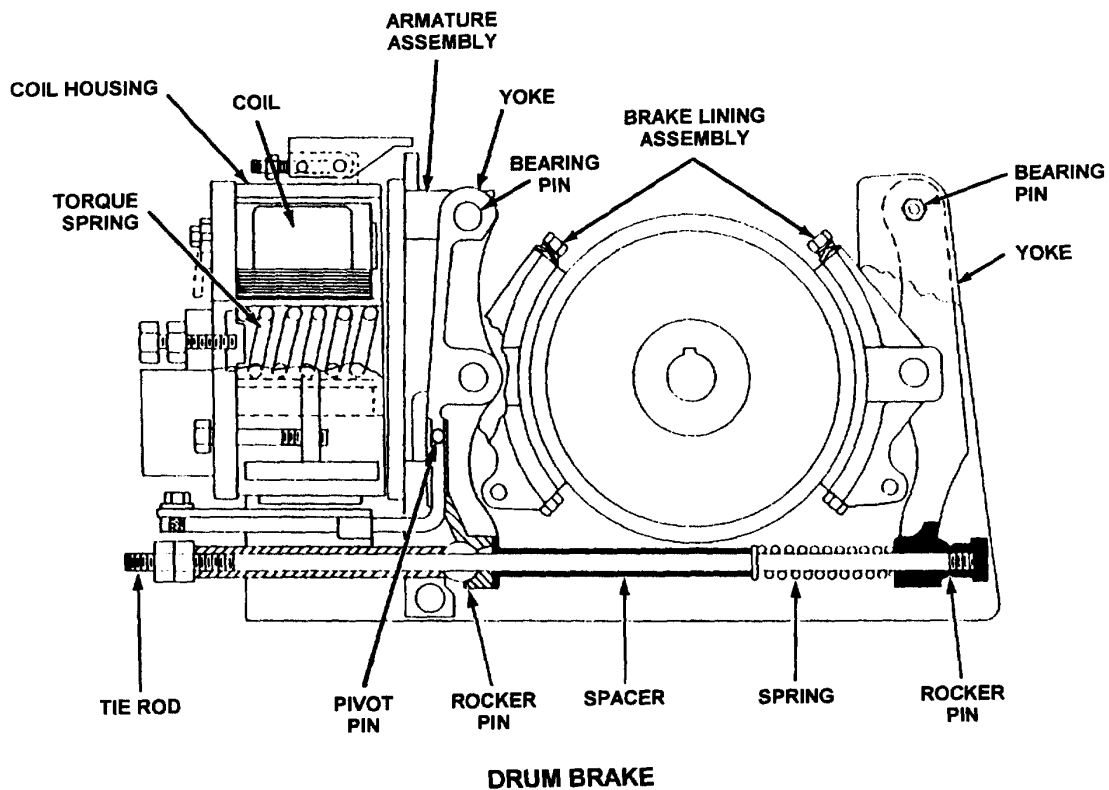
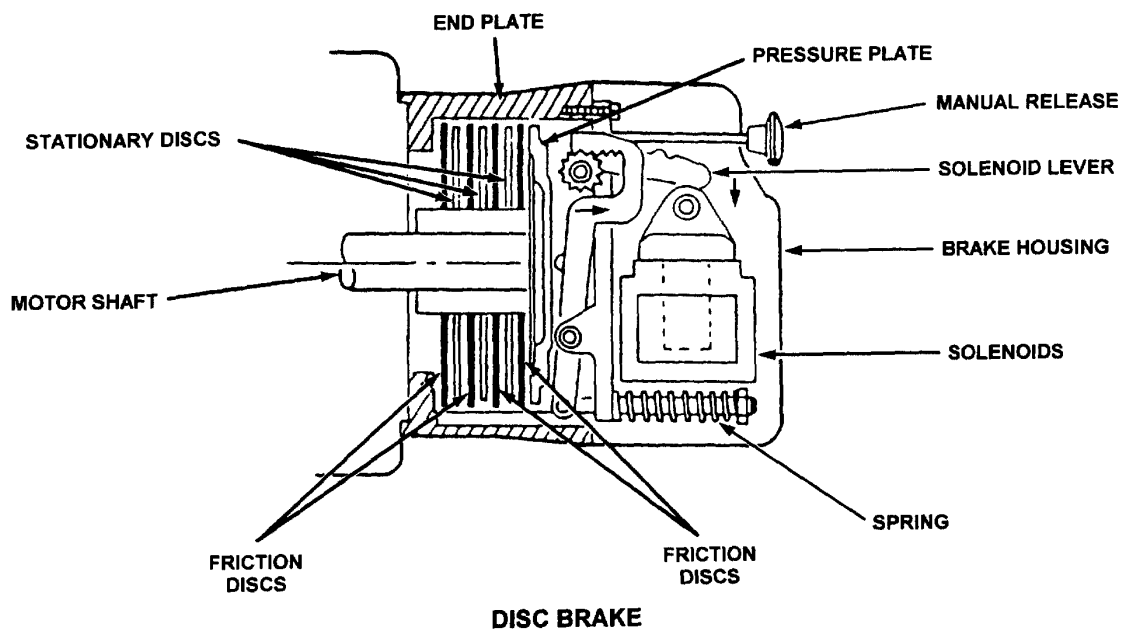


Figure 772-2-7. Magnetic Brake Functional Cutaway

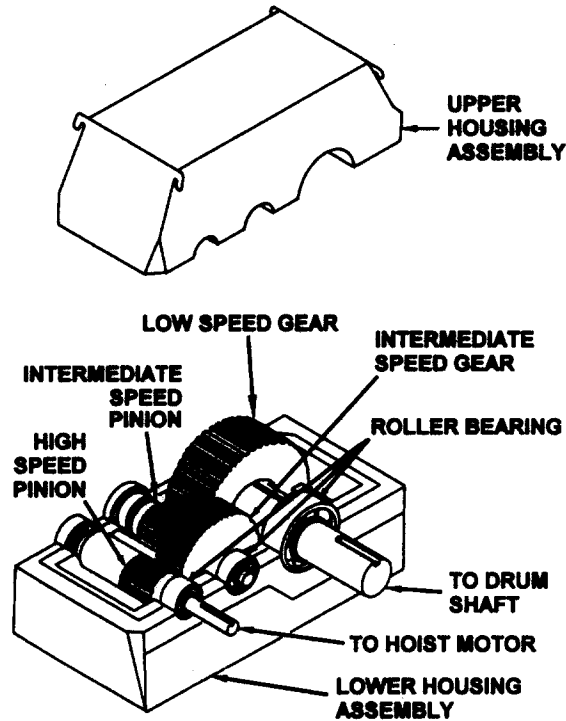


Figure 772-2-8. Reduction Gear Assembly

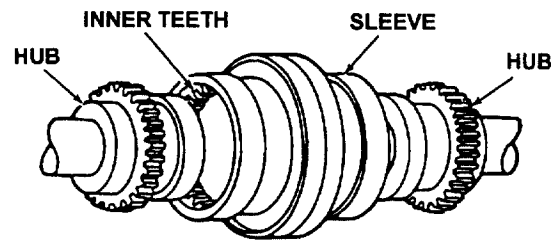
772-2.3.3.8 Hoist Sheaves. Hoist and deflection sheaves mounted on antifriction roller bearings or bushings direct the wire ropes from the drum to the platform or trunk. The sheaves are equipped with retaining bars to prevent the rope from jumping the sheave under all conditions. The groove of the sheave should be smooth and free from any damage that could cut the wires of the rope that pass around it.

772-2.3.3.9 Electrohydraulic Ram Hoist Machinery. The platform is connected directly to a hydraulic cylinder ram and the cylinder is mounted rigidly in the base of the elevator trunk (Figure 772-2-11). The platform is raised by applying hydraulic fluid pressure from the Hydraulic Power Unit (HPU) to the underside of the cylinder ram. It is lowered by the controlled release of this fluid back to the hydraulic sump tank. Guide rails and platform guide roller assemblies guide the elevator platform during raising and lowering operations. Anti-racking wire ropes prevent platform tipping and minimize the bending loads on the hydraulic ram.

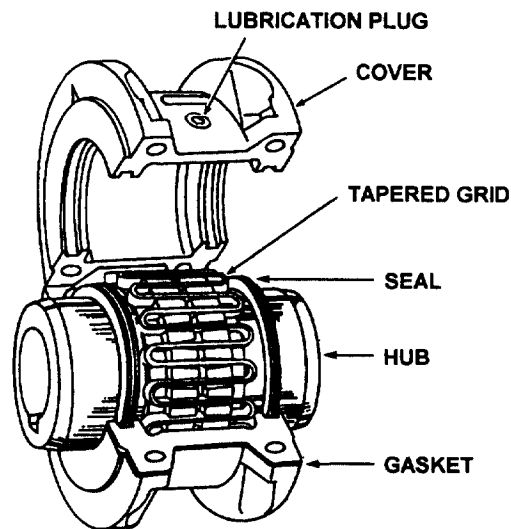
772-2.3.4 CLOSURE SUBSYSTEM. Closures fulfill several functions. On some ships, they provide watertight and ballistic integrity, while on others they provide fire/gas protection. They provide access to the trunk and platform at all deck levels served, and when closed, act as security, personnel, and equipment safety barriers. Closures consist of doors and hatches and are classified by type. Doors and hatches can be hydraulically, pneumatically, electrically, or manually operated. They may or may not be counterbalanced. Doors are either Vertical Sliding Watertight (VSWT) (with or without flame seal), Vertical Rolling Watertight (VRWT), Overhead (OVHD), Horizontal Rolling Watertight (HRWT), or Hinged Watertight (HWT). Hatches are either hinged, or horizontal rolling. On some ships, horizontal sliding aluminum door panels (J-Panels) are located on the sides of the elevator at all operating levels served. Some ships also use roller curtain weather doors which are opened and closed either electrically or manually.

772-2.3.4.1 Hatch Seal and Drain System. Flight deck, main deck, and weather deck hatches are sealed against water intrusion by the use of gaskets and knife edges. Additionally, hatches either have a drain channel and drain

pipes to prevent water intrusion into the elevator shaft (trunk) or they have a hatch coaming. The drain channel and drain pipes normally discharge overboard by way of a drain system.



GEAR TYPE COUPLING



**TAPERED GRID TYPE
COUPLING**

Figure 772-2-9. Flexible Couplings

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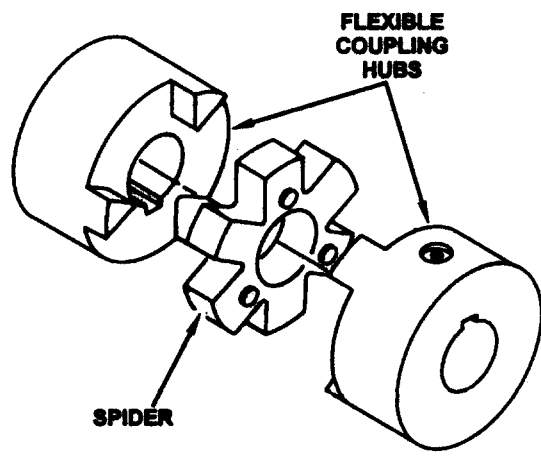


Figure 772-2-10. Jaw Type Flexible Coupling

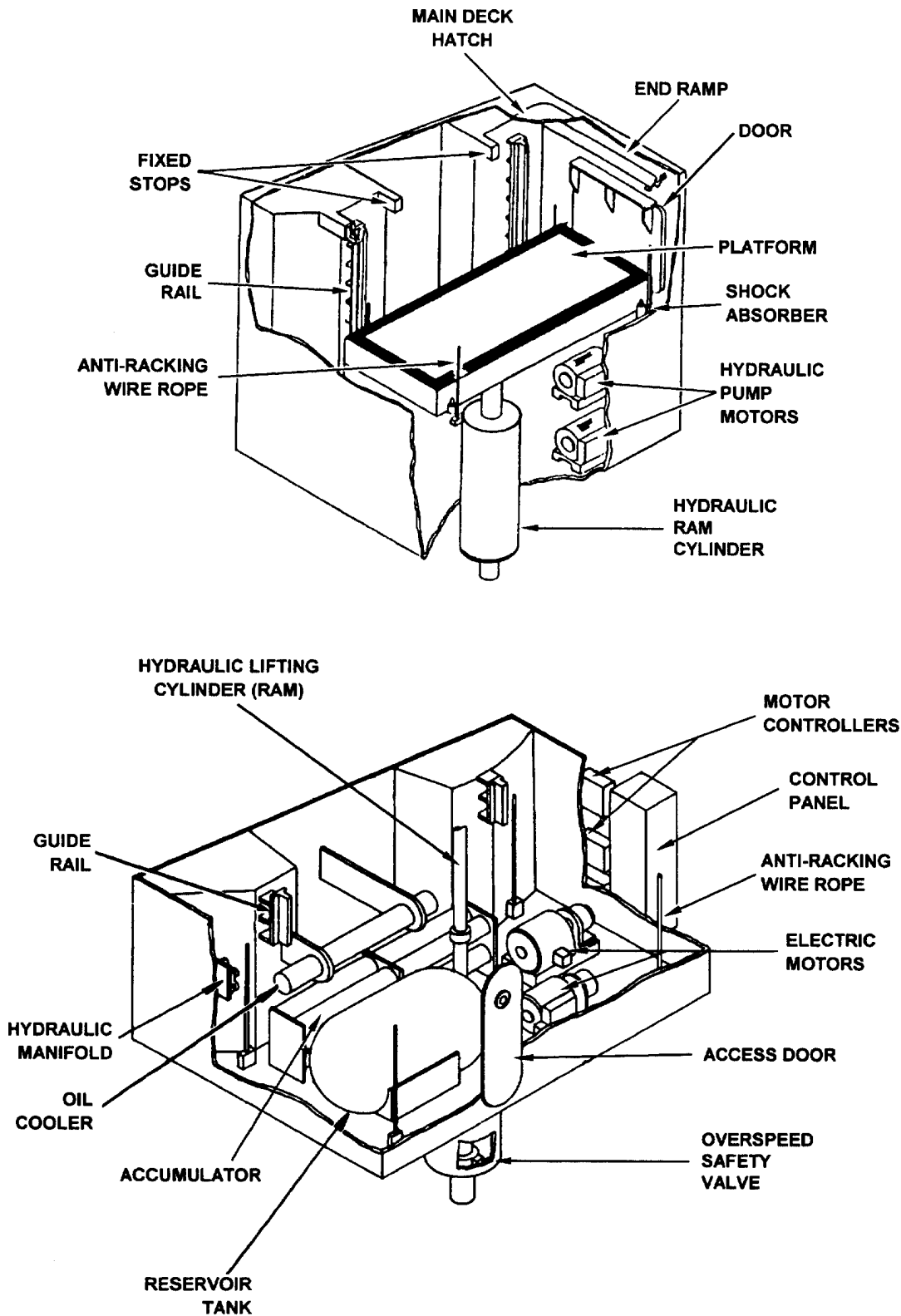


Figure 772-2-11. Electrohydraulic Ram Elevator and Hoist Machinery

772-2.3.4.2 Vertical Sliding Watertight (VSWT) Doors. VSWT doors (Figure 772-2-12) open upward or downward along the trunk on vertical guide rails. A VSWT door may be moved manually with counterweights, directly powered by a cylinder, or powered by a cylinder-counterweight combination. A counterweight reduces the effective operating weight of the door. A latching mechanism engages when the door is in the open position, mechanically preventing the door from inadvertently closing. Some up-to-open doors have safety pins which have to be manually installed to prevent the door from inadvertently closing. The door dogging mechanism can be either manual or automatic.

772-2.3.4.3 Vertical Rolling Watertight (VRWT) Doors. VRWT doors (Figure 772-2-13) open upward on guide rails that extend outside the trunk along the overhead, similar to an overhead garage door. The door cylinder attaches with wire ropes to a counterweight. (Not all doors have counterweights.) Wire ropes attached to the counterweight raise and lower the door as the cylinder extends or retracts. Guide roller assemblies at each corner of the door ride in grooves in the guide rails and support the weight of the door in the guide rails when in the open position. A manual or powered latching mechanism engages when the door is in the full up-and-open position to prevent the door from inadvertently closing.

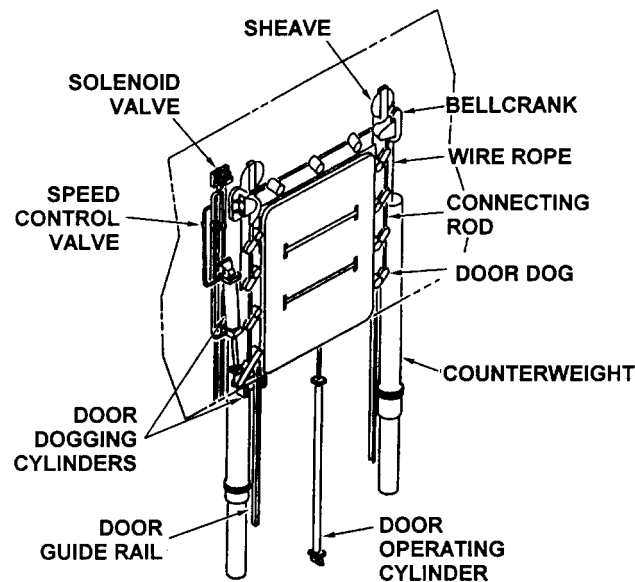


Figure 772-2-12. Vertical Sliding Watertight Door

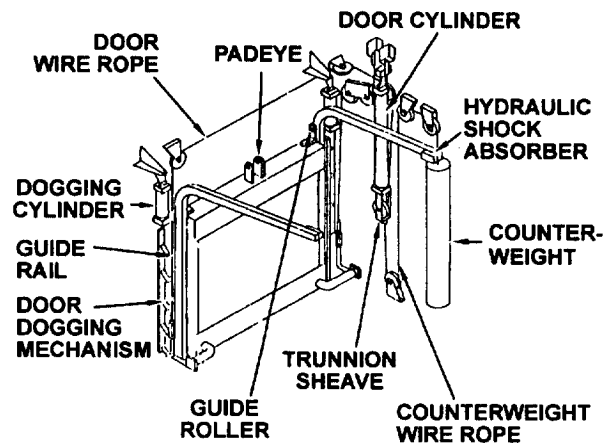


Figure 772-2-13. Vertical Rolling Watertight Door

772-2.3.4.4 Horizontal Rolling Watertight (HRWT) Doors. HRWT doors (Figure 772-2-14) open and close by moving horizontally on guide rollers riding in roller guides. The door open-close cylinder is normally mounted above the door. The rollers on these doors are in guides either on top of or in tracks at the bottom of the door.

772-2.3.4.5 Hinged Watertight (HWT) Doors. HWT doors (Figure 772-2-15) open outward on left-hand or right-hand hinges. A single roller on the door rides on the deck supporting the weight of the door. The door cylinder can either be mounted above the door or on the bulkhead nearest the hinge behind the door in the space that the door opens into. There are left or right side hinged horizontal watertight doors which are manually opened or closed and can be split or full sized doors (Figure 772-2-16).

772-2.3.4.6 Extruded Aluminum (J Panel) Doors. Extruded aluminum (J Panel) doors (Figure 772-2-17) are door panels reaching from the deck to the overhead and are used to seal off an elevator shaft. These door panels shall be removed or installed only when the elevator platform is at that deck level. The door panels shall be removed only at the deck levels where access to the trunk is necessary for loading/unloading the platform or conducting maintenance. When the elevator operation or maintenance is complete, the door panels must be replaced. The doors are removed manually by releasing toggle clamps which hold the end panels in place. After removing the end panel, the remaining panels are removed for stowage by sliding them to the track cut-out and removing them. A personnel safety barrier is then placed across the entrance of the elevator shaft to guard against personnel falling into the open shafts. Some ships have magazines with these type doors configured with a security alarm system built into each panel, but the door and the security alarm system act together as a unit.

772-2.3.4.7 Roller Curtain Weather Doors. Metal roller curtain weather doors (Figure 772-2-18) are installed to keep out the weather. The roller curtain doors are opened and closed by an electric motor. In case of an electrical or motor failure, they can be opened and closed manually using a chain and sprocket assembly. Some ships have roller curtain doors installed across each deck level entrance to the elevator shaft. These roller curtain doors are raised and lowered manually.

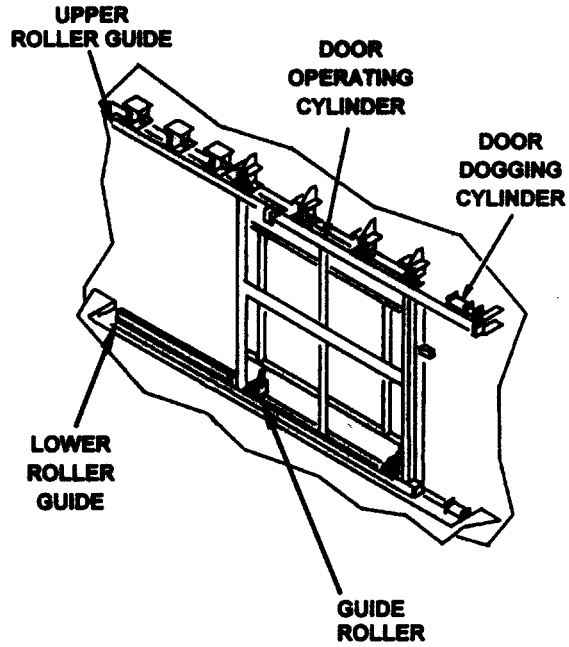


Figure 772-2-14. Horizontal Rolling Watertight Door

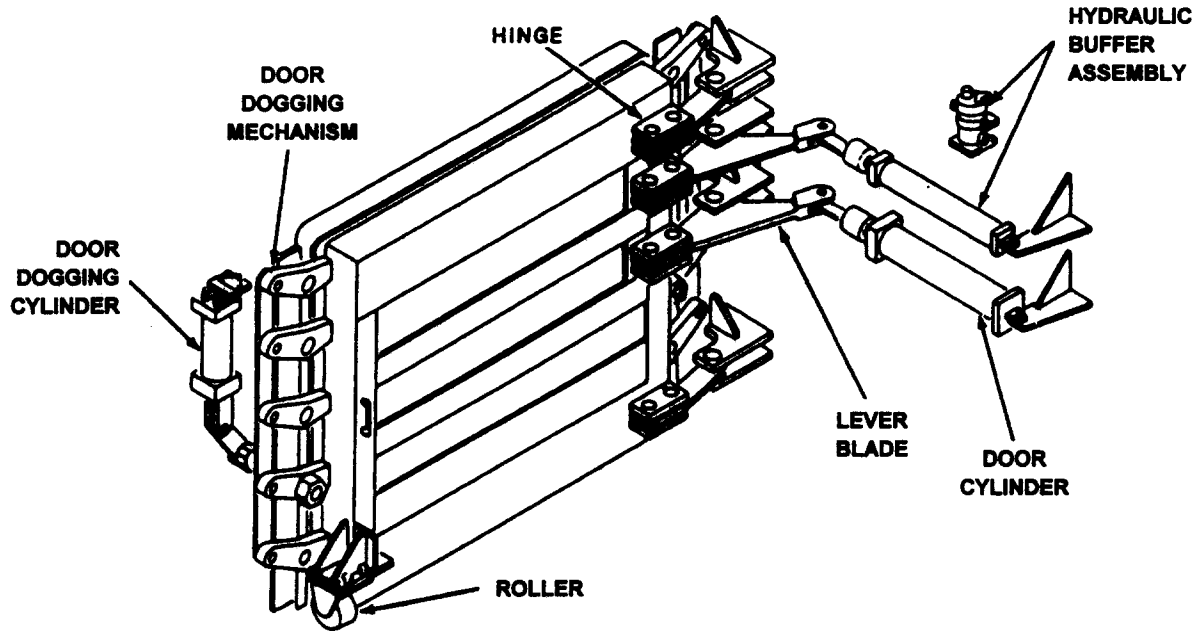


Figure 772-2-15. Powered Hinged Watertight Door

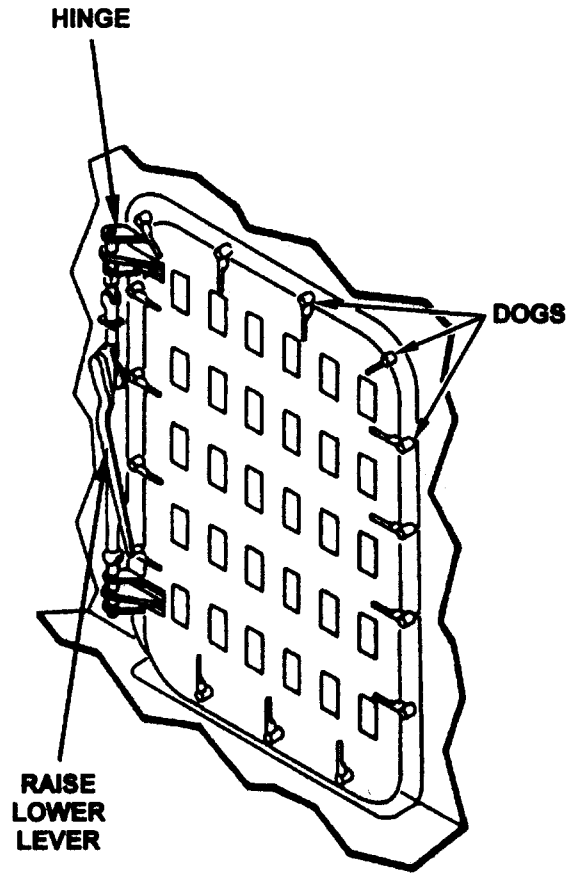


Figure 772-2-16. Manual Hinged Watertight Door

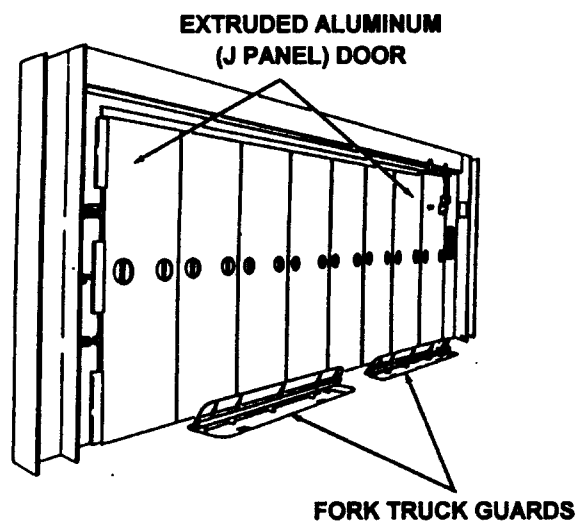


Figure 772-2-17. Extruded Aluminum (J-Panel) Door

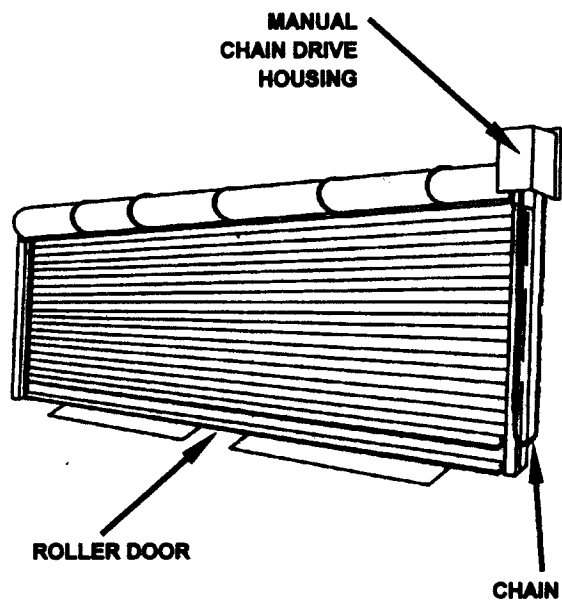


Figure 772-2-18. Roller Curtain Weather Door

772-2.3.4.8 Flame Seal Doors. Flame seal doors (Figure 772-2-19) are designed to contain a fire in the trunk when the manually operated door is open. Flame seal doors are installed and stowed inside the trunk.

772-2.3.4.9 Hinged Watertight Hatch (HWTH). This hatch type (Figure 772-2-20) may be manual or powered. The manually operated HWTH is normally fitted with counterbalance springs or weights to enable it to be opened and closed manually. The hatches are secured in the closed position by either individual or interconnected dogs which are either manually, hydraulically, or pneumatically operated. Hinged watertight hatches are secured in the open position by either a securing dog, a latch pin, a toggle arm on the hinge assembly which provides a mechanical lock, or by a retractable stop at the hinge assembly.

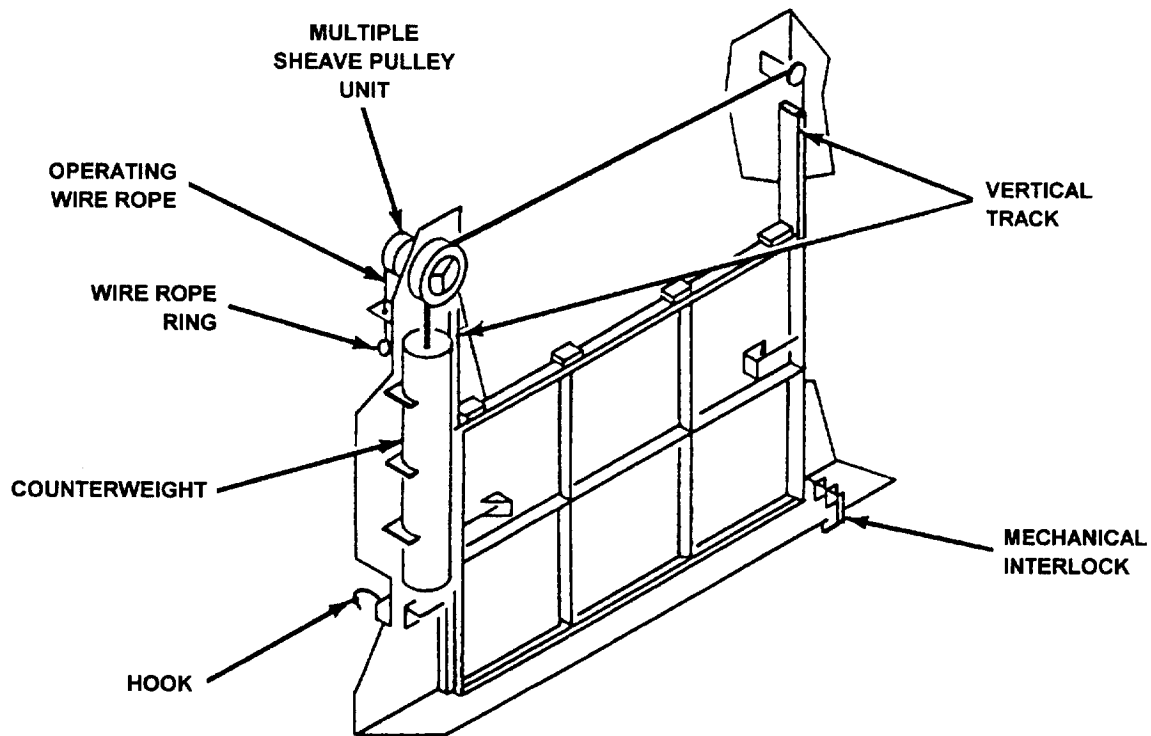


Figure 772-2-19. Flame Seal Door

772-2.3.4.10 Vertical Rolling Watertight Hatch (VRWTH). The VRWTH (Figure 772-2-21) is opened by applying hydraulic or pneumatic pressure to two hatch operating cylinders. The force from the retracting cylinders pulls on the lifting arms and lifts the edge of the hatch nearest to the cylinders up, putting two of the hatch guide rollers into the vertical guide roller tracks. Further retraction of the cylinders moves the hatch towards the open position. The other two hatch mounted rollers ride in the horizontal hatch guide roller tracks. When the hatch reaches the vertical up-and-open position, it is secured by means of a hatch latch mechanism. On hatch closing, the hatch latch mechanism is unlatched, then the cylinders extend and the guide roller tracks guide and position the hatch to the down-and-closed position. After closing, the hatch is then dogged.

772-2.3.4.11 Horizontal Rolling Watertight Hatch (HRWTH). The HRWTH (Figure 772-2-22) is operated in three stages: undog-dog, raise-lower, and open-close. The undog-dog stage is accomplished either manually, hydraulically, or pneumatically and the raise-lower by hatch positioning cylinders. The open-close stage is accomplished by an electrically powered snaking winch assembly. The hatch cover has four guide rollers mounted on it which roll along tracks mounted on the deck.

772-2.3.4.12 Snaking Winch Assembly. A snaking winch (Figure 772-2-23) provides power to open and close the HRWTH. It consists of a motor, a winch assembly, flexible couplings, a magnetic brake, and wire rope. The snaking winch motor provides the power to operate the winch assembly. A flexible coupling connects the winch to the motor. The brake stops rotation of the motor shaft when the motor is de-energized. When the snaking winch motor is energized, the winch assembly main shaft turns the drum, opening or closing the hatch cover through a system of wire ropes and sheaves.

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772-2.3.4.13 Door and Hatch Dogs and Dogging Mechanisms. Doors and hatches are secured tightly, in the closed position, by a series of separate or interconnected dogs or dog bars. The dogs or dog bars are manually, pneumatically, or hydraulically actuated. Each dog engages a wedge which forces the door or hatch tightly closed as the dog mechanism is operated.

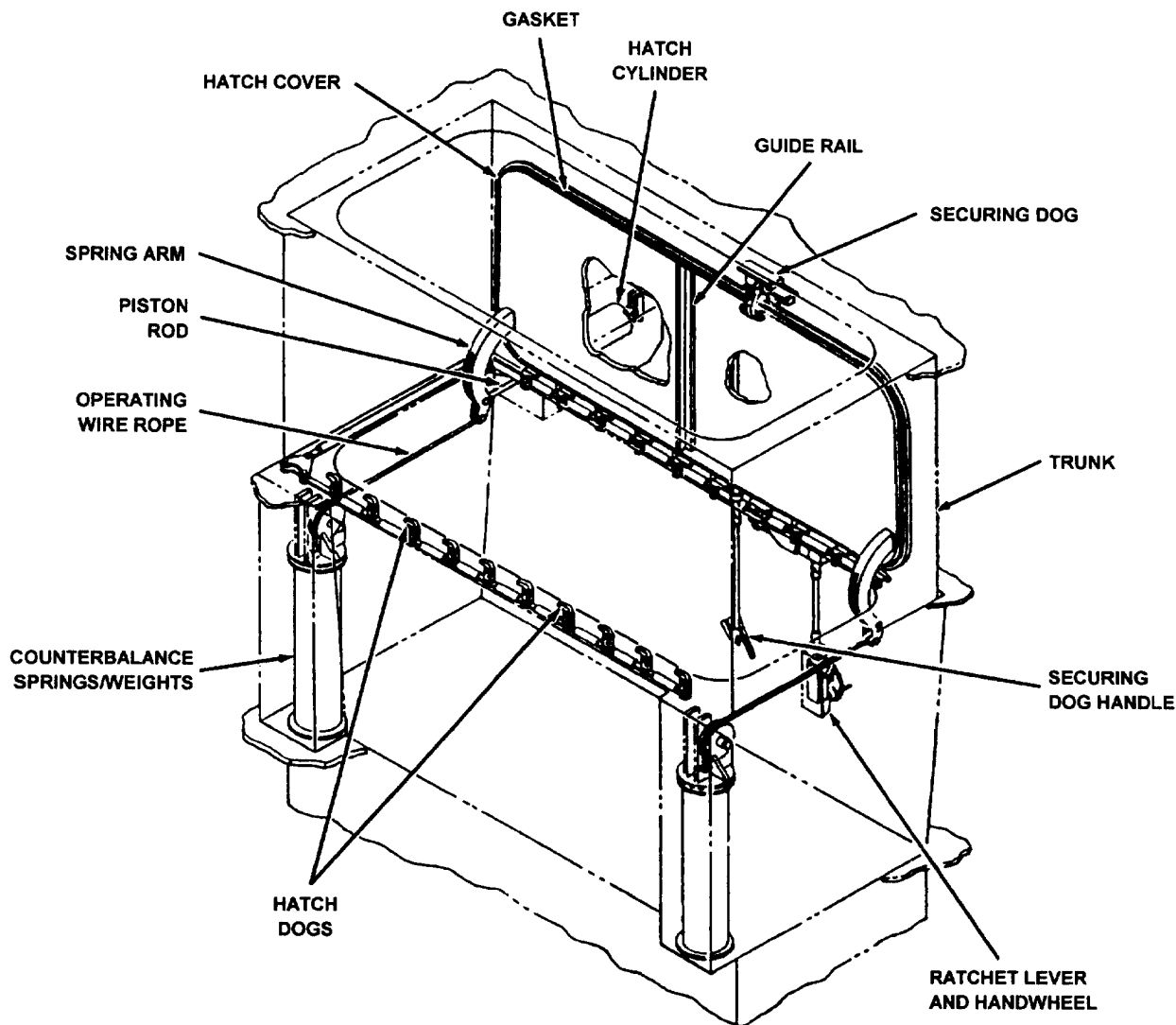


Figure 772-2-20. Hinged Watertight Hatch

772-2.3.4.14 Door and Hatch Actuating Mechanisms. Door and hatch actuating mechanisms consist of manual, hydraulic, and pneumatic systems.

772-2.3.4.14.1 Manual, Hydraulic and Pneumatic Systems. Doors, hatches, their dogs and latches can be positioned manually, hydraulically or pneumatically. In the manual mode, doors are opened with the aid of counterweights and kept open with locking pins, rings, or spring-loaded latches. On some ships, doors are hand-cranked open and locked open with pins. For safe operation of the powered doors, hatches, dogs and latches, the system used must include a means of controlling the direction and speed of operation. The methods used to control door

and hatch speeds are fixed orifices, adjustable flow control valves, and orifices and check valves in parallel. Doors should be timed to open or close in 8 to 12 seconds, hatches 18 to 22 seconds, and dogs and latches 1 to 3 seconds.

772-2.3.4.14.2 Door and Hatch Hydraulic Control Systems. Some doors and hatches are dogged, undogged, latched, unlatched, and positioned by hydraulic cylinders. The cylinders are controlled by electrohydraulic solenoid valves, interlock valves or sequence valves. Lockable covers or metal cages are installed over controls, components, and system safety features which are exposed to possible tampering by unauthorized personnel, where such tampering could result in damage/injury, defeat of control or safety features, or access to magazines. Valves and valve manifolds that can be manually actuated or adjusted are also required to have protection. For valves and valve manifolds located in locked spaces, lockable covers are not necessary.

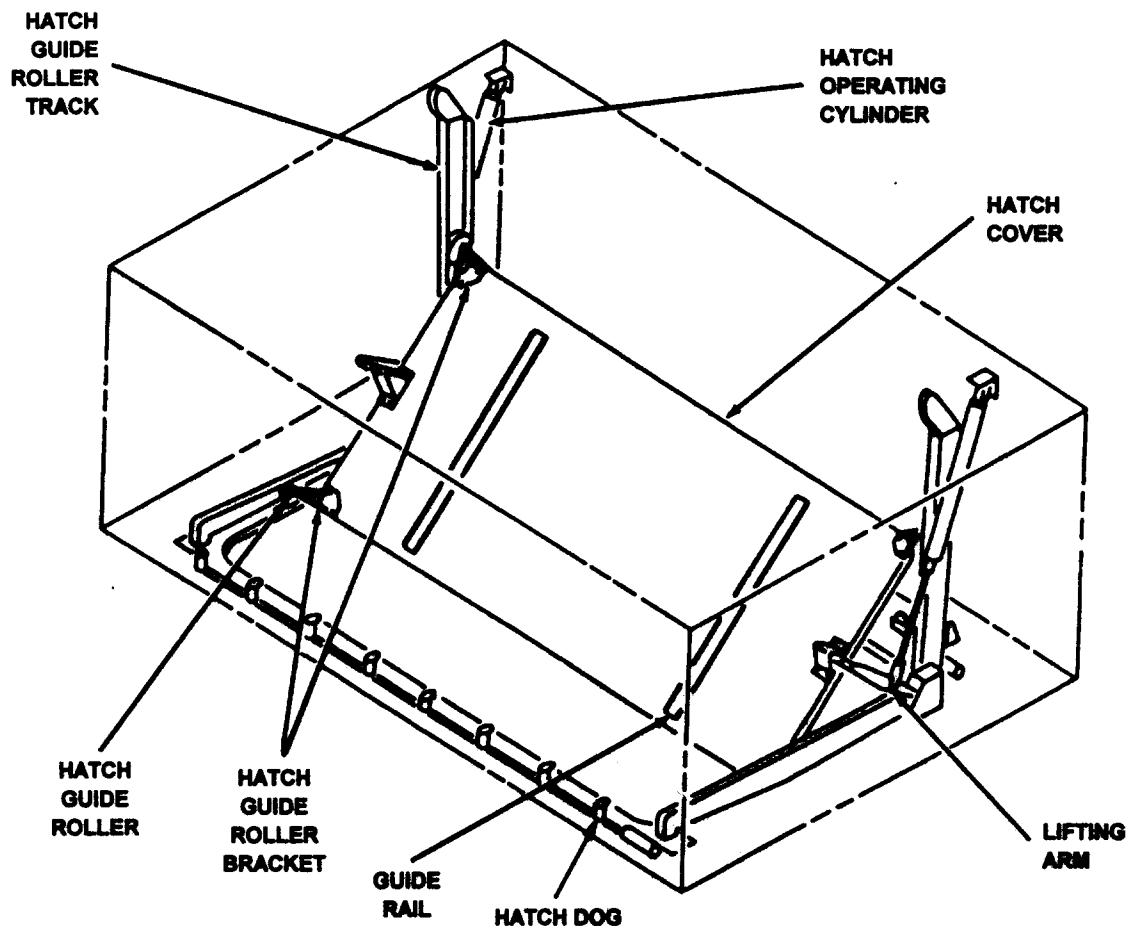


Figure 772-2-21. Vertical Rolling Watertight Hatch

772-2.3.4.15 Hydraulic Power Units. Hydraulic fluid is supplied to the door or hatch system from a Hydraulic Power Unit (HPU) pump room (Figure 772-2-24). HPUs are of varying design and size depending on the size of the system being supplied. Some doors have their own individual HPU (Figure 772-2-25) which is a small self-contained hydraulic system located adjacent to the door. Larger hatches and doors require a larger, more complex HPU. Some HPUs supply hydraulic power to more than one elevator. A header tank or a sump tank stores and collects hydraulic fluid and supplies this fluid, through a strainer, to the suction side of the hydraulic pump(s). An electric motor provides the necessary power to operate the hydraulic pump. Fluid from the hydraulic pump passes through a high pressure filter assembly into the system and fills the main and control accumulators. A pressure

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relief valve protects the system from over pressurization. The accumulator stores pressurized system fluid and augments pump output during periods of high demand. In case of pump failure the accumulators provide fluid pressure to close doors and hatches. The control accumulator controls system pressure by placing the variable displacement hydraulic pump on or off stroke as required. A hydraulic cooling system maintains hydraulic fluid temperature between 37.8°C and 54.4°C (100°F and 130°F).

772-2.3.4.16 Door/Hatch Pneumatic Control System. On some elevators, a pneumatic system operates the watertight doors and hatches, as well as the door and hatch dogging and latching mechanisms. A general arrangement of a pneumatic system is shown in [Figure 772-2-26](#). Air is directed from ship's service low pressure air or in some cases reduced HP air, to an accumulator in the pneumatic system. It is then directed through a series of filters, lubricators, pressure regulators, control valves and sequence or interlock valves and piping to the pneumatic powered components. On other elevators the pneumatic system operates just the doors and hatches. The dogging and latching mechanisms are manually actuated. The hatch is undogged manually by using the dog/undog handwheel. The hatch is raised and lowered using the pneumatic system. The hatch is latched in the raised or open position and must be unlatched to be closed. To prevent unauthorized operation, all solenoid valves in non-secure spaces shall have lockable solenoid covers installed, similar to the requirements for hydraulic systems.

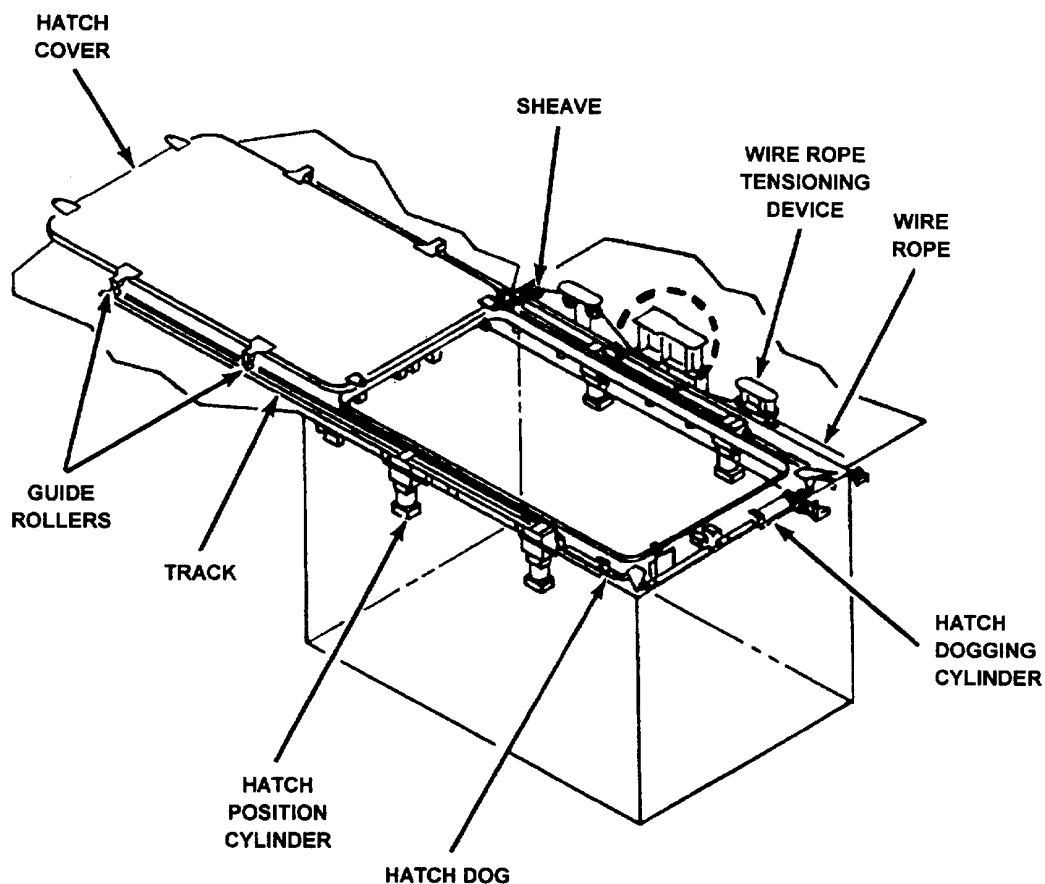


Figure 772-2-22. Horizontal Rolling Watertight Hatch

772-2.3.5 CONTROL SUBSYSTEM. The control subsystem ([Figure 772-2-27](#)) controls the direction and speed of the elevator platform and the operation of the closure components. The control subsystem consists of a

motor controller, logic controller, control stations, hatch control/interlock circuits, trunk switches, and door and dog switches. The control subsystem receives 440-VAC 3-phase, 60-Hz electrical power from the ship's service switchboards through their respective load centers or power panels. The electrical system in turn supplies power to the motor controllers and consists of power panel supply circuit breakers.

772-2.3.5.1 Power Panel Circuit Breakers. The control for the 440-VAC power supply in each elevator system is the power panel disconnect switch. It serves as the on/off switch to provide power to or remove power from each elevator. This disconnect switch also acts as a circuit breaker. Circuit breakers receive 440-VAC, 3 phase, 60-Hz power from the power panel and in turn, supply this power to their respective motor controller. The circuit breaker isolates and protects the circuit during overload conditions, and if tripped, must be manually reset.

772-2.3.5.2 Logic Controller. The logic controller can be either a relay logic (electromechanical) or a static logic (solid state) type controller. During normal operation, it is the primary elevator control unit receiving its 115-VAC power from the motor controllers. It also receives inputs from hatch, door, trunk and platform limit and proximity switches. Signals from limit and proximity switches are used to monitor platform location and door and hatch status. These inputs determine whether safe operating conditions exist and which control station to enable for platform dispatch. Dispatch signals from a control station are processed with switch signals to determine the speed and direction of platform travel. Signals are then directed to the appropriate motor controller contactor. The logic controller continues to process these signals until a safety circuit or an emergency stop signal interrupts 115-VAC power.

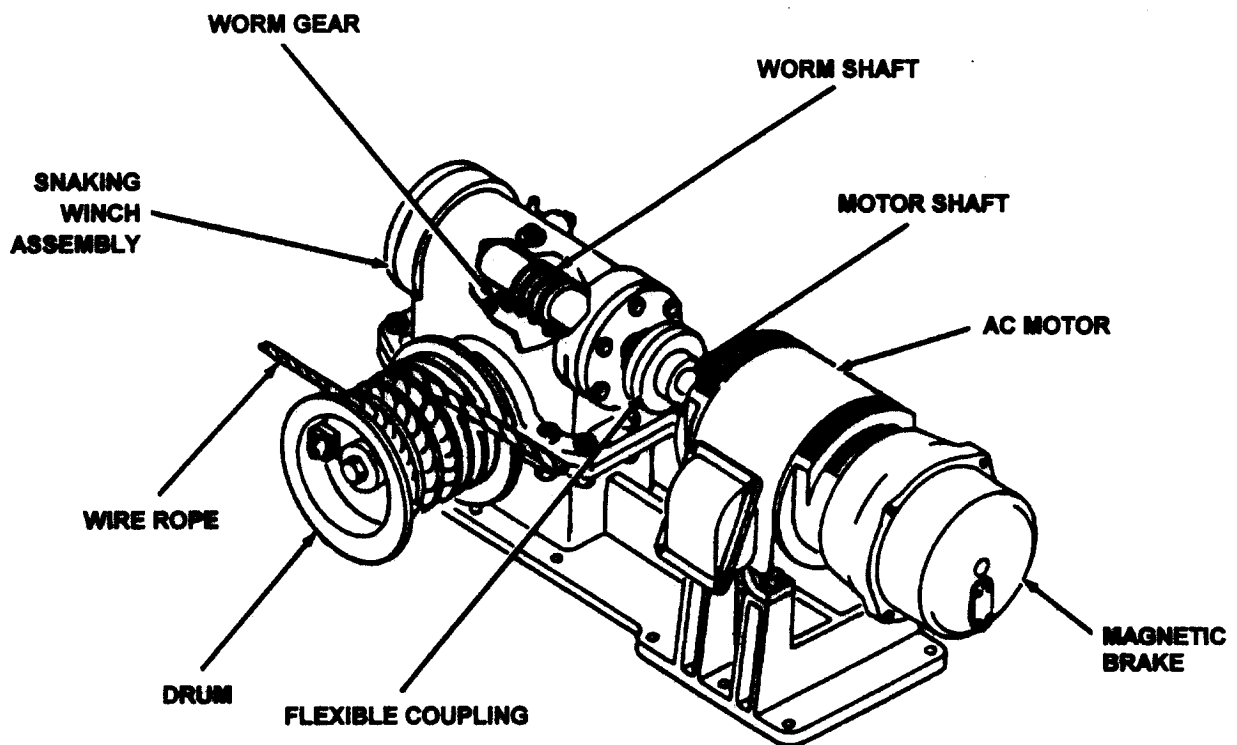


Figure 772-2-23. Snaking Winch Assembly

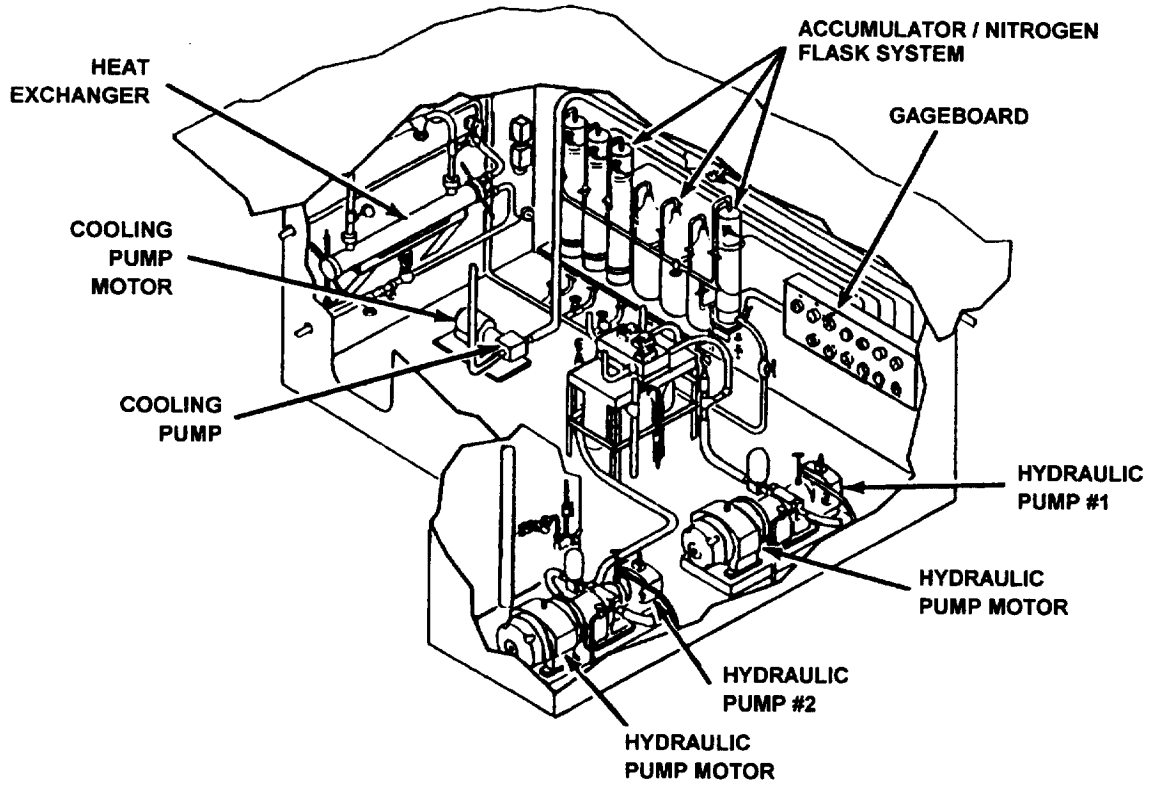


Figure 772-2-24. Aircraft Carrier Hydraulic Pump Room

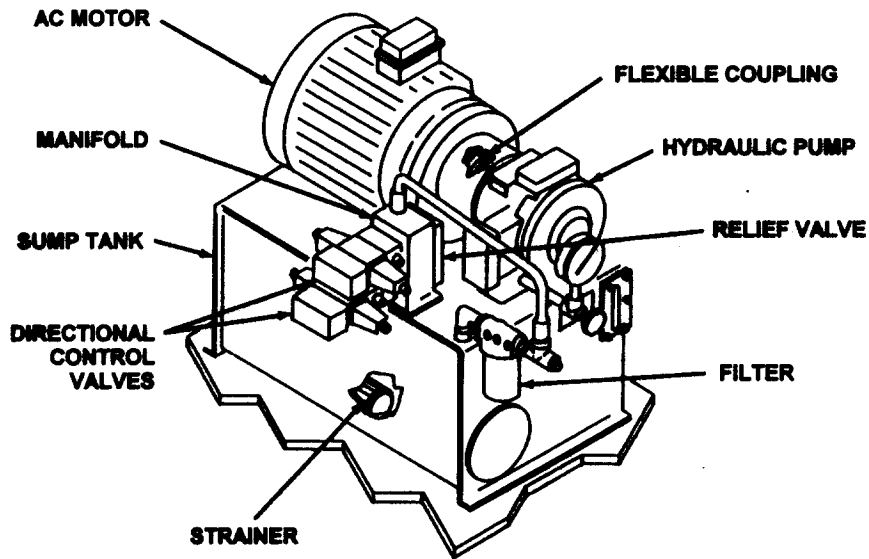


Figure 772-2-25. Individual Hydraulic Power Unit

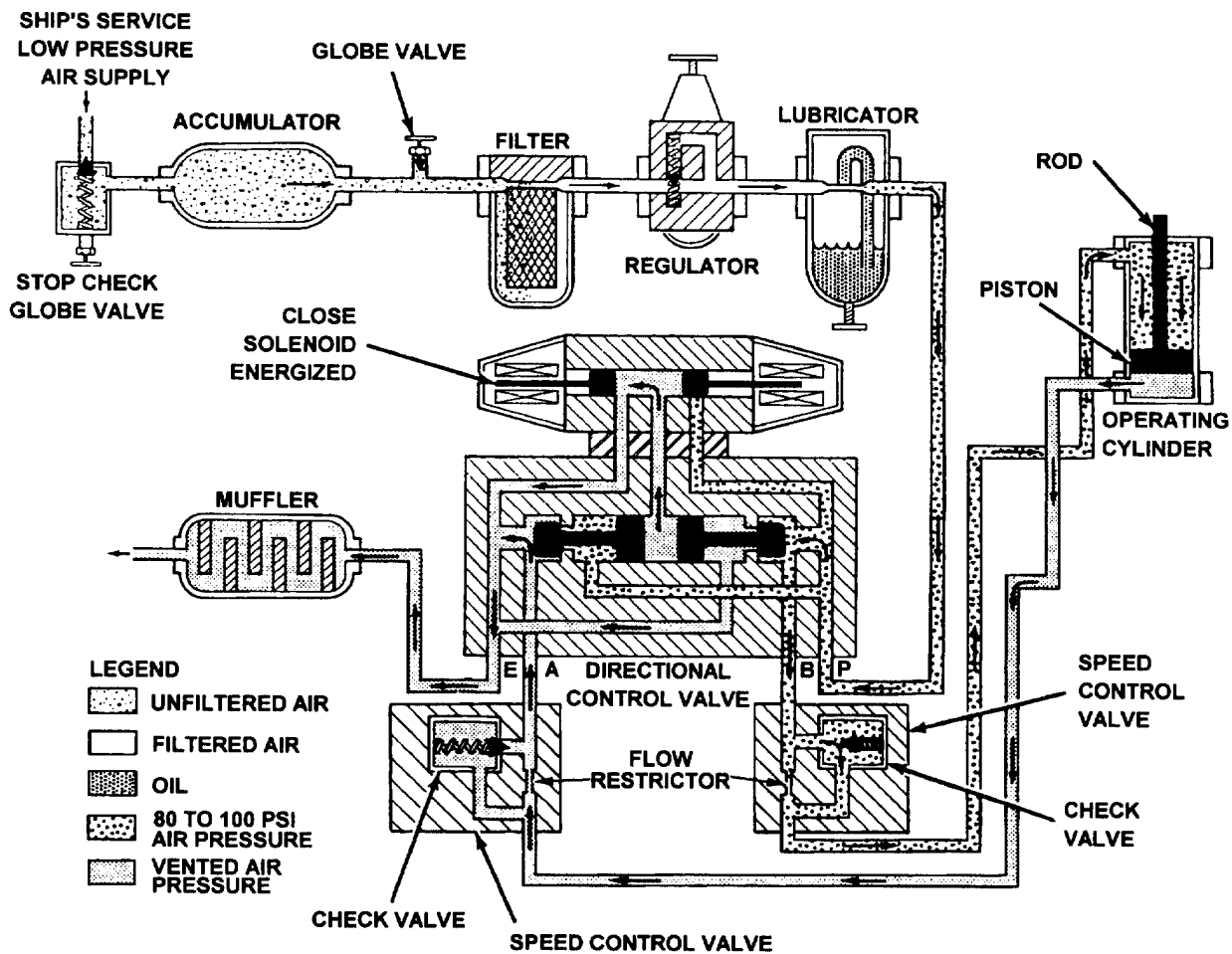


Figure 772-2-26. Pneumatic System General Arrangement

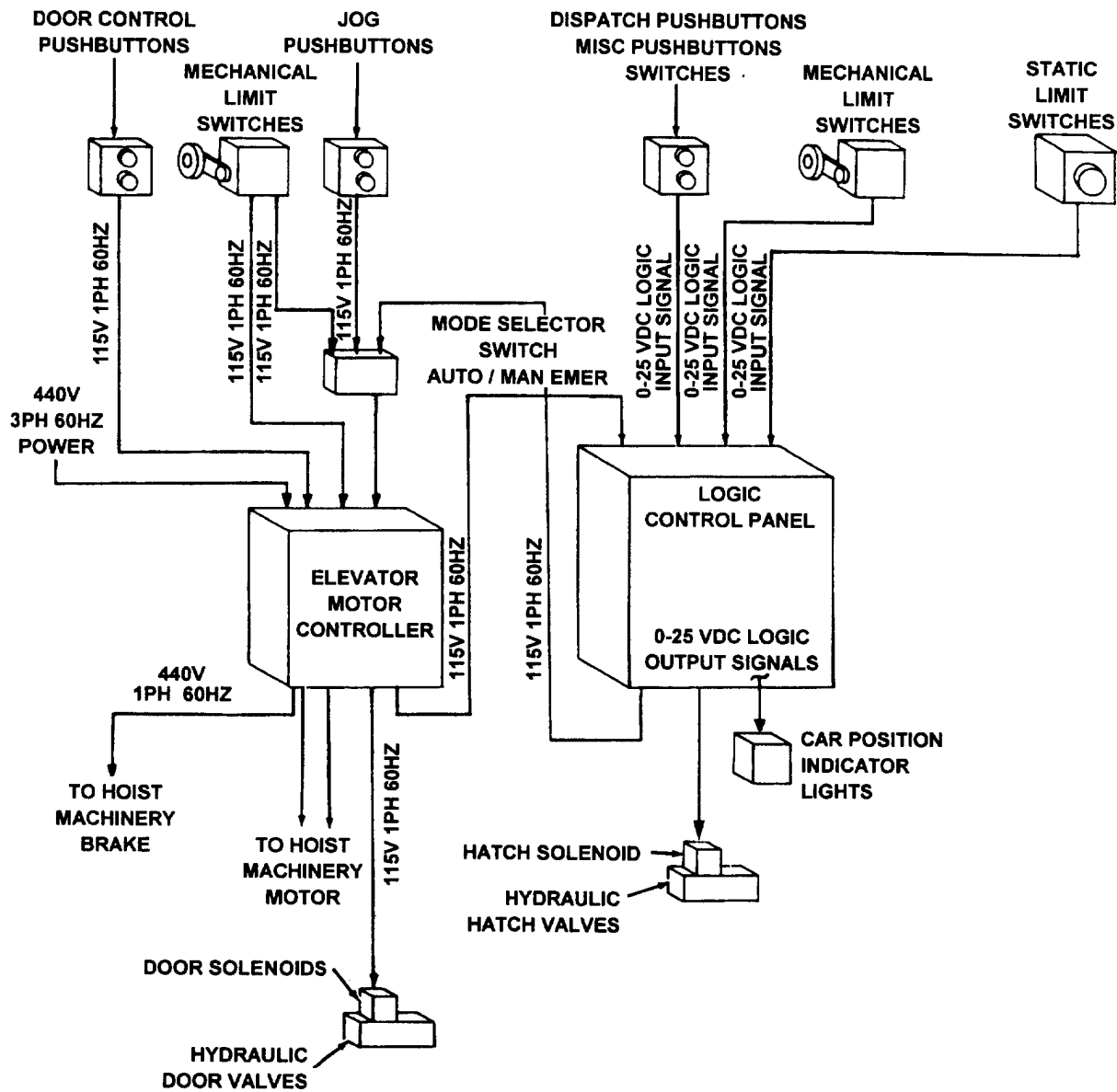


Figure 772-2-27. Control Subsystem Block Diagram

772-2.3.5.3 Motor Controller. The motor controller is generally an AC magnetic type controller. It comes in various sizes, depending on the horsepower of the motor. The motor controller connects power to the motor and brake solenoids in response to inputs from the logic controller. An illustration of a typical machinery room motor controller is provided in [Figure 772-2-28](#).

772-2.3.5.4 Master Control Station. The Master Control Station serves as the main control point for elevator operations. The master control station contains all the switches, indicators and communications necessary to operate and monitor the elevator system. Some typical master control station panels are shown in [Figure 772-2-29](#).

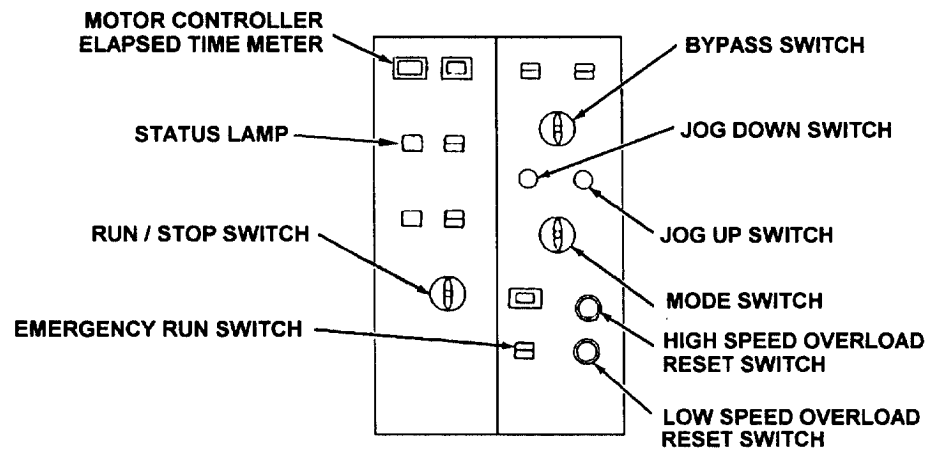


Figure 772-2-28. Motor Controller

772-2.3.5.5 Local Deck Control Station. Local deck control stations (Figure 772-2-30) are located at each deck level served and provide dispatch and deck level selection to the logic controller, emergency control, and dispatch commands to the motor controller. Elevator systems are normally designed so that the platform cannot be called from another deck level. Dispatch commands can only be initiated from the deck control station at which the platform is located. A typical control station contains dispatch pushbuttons, an elevator run/stop switch, an emergency stop switch, platform position indicator lights, and where applicable, a door open-close switch. On operator rider elevators, control panels are located on the platform.

772-2.3.5.6 Jog Operation. Jog operation is a method of moving the platform in slow speed. This mode of operation is necessary if the platform has stopped between deck levels, overtraveled, or for maintenance purposes. In the jog mode, the platform moves at slow speed only and control is by a normal/maintenance jog selector switch and jog up and jog down pushbuttons.

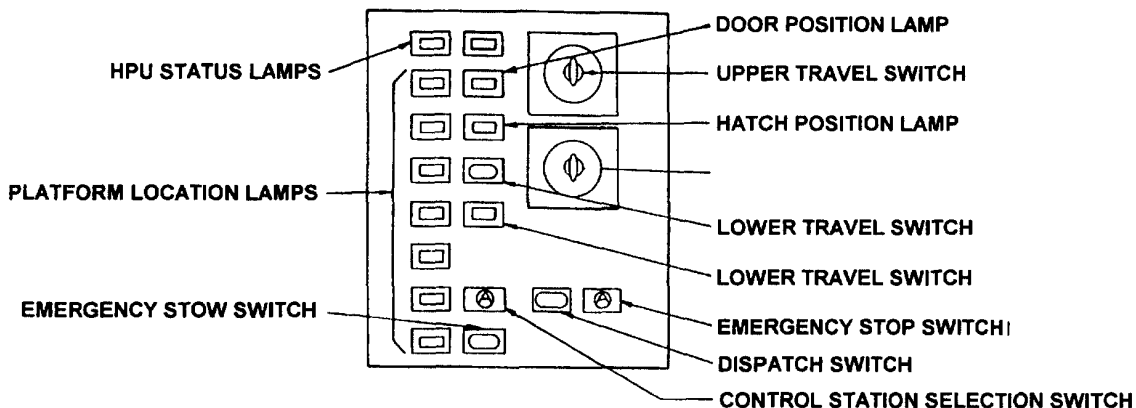
772-2.3.5.7 Normal/Jog Selector Switch. The normal/jog selector switch can be either a two position or a three position operation selector switch. Placing the two position switch from normal to jog bypasses the automatic circuitry and allows the platform to be operated at slow speed between adjacent decks or the terminal level, using the jog up or jog down pushbuttons. Placing the three position switch from normal to maintenance jog (maint jog) bypasses the automatic circuitry and allows the platform to be operated at slow speeds using the jog up and jog down pushbuttons through deck levels between the terminal levels. Placing the three position switch to deck jog bypasses the automatic circuitry and allows the platform to be operated at slow speed to an adjacent deck, using the jog up or jog down pushbuttons.

772-2.3.5.8 Jog Up and Jog Down Pushbuttons/Selector Switch. These are momentary contact switches which must be held down to operate the hoist machinery and move the platform. Since the jog mode of operation uses low motor speeds, prolonged jogging must be minimized, otherwise motor damage due to overheating could result.

772-2.3.5.9 Lighting. The lighting circuit is part of the electric subsystem and uses 115-VAC power to illuminate the trunk. Incandescent or fluorescent type lighting is used to illuminate the platform so that the cargo or weapons can be positioned within the yellow safety margin and for maintenance. The electric sub-system consists of transformers, circuit breakers, switches, and lamps. Darken ship switches and lighting are installed where

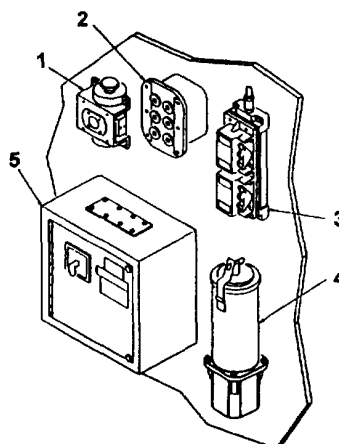
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required. Trunk lighting is normally activated by control switches located near the elevator operator's control station. Elevator trunks shall be painted white, except as required by darken ship conditions.



MASTER CONTROL STATION

1. CONTROL, ONE ELEMENT (JOG UP)
2. INDICATOR, SIX ELEMENT
3. CONTROL, FOUR ELEMENT (DOWN, JOG DOWN)
4. SWITCH, EIGHT POSITION
5. SWITCH, ONE POSITION (SLACK CABLE OVERTRAVEL BYPASS)



HYDRAULIC FILTER DIRTY

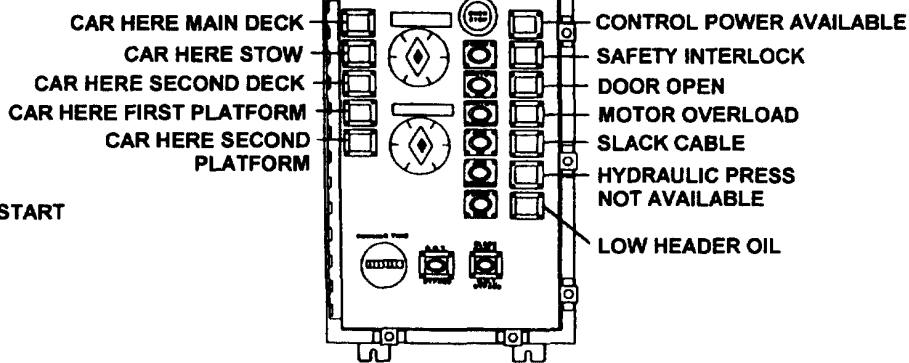
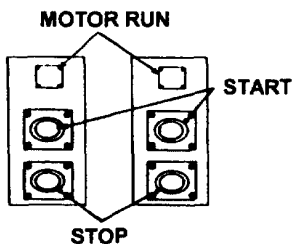


Figure 772-2-29. Typical Master Control Stations

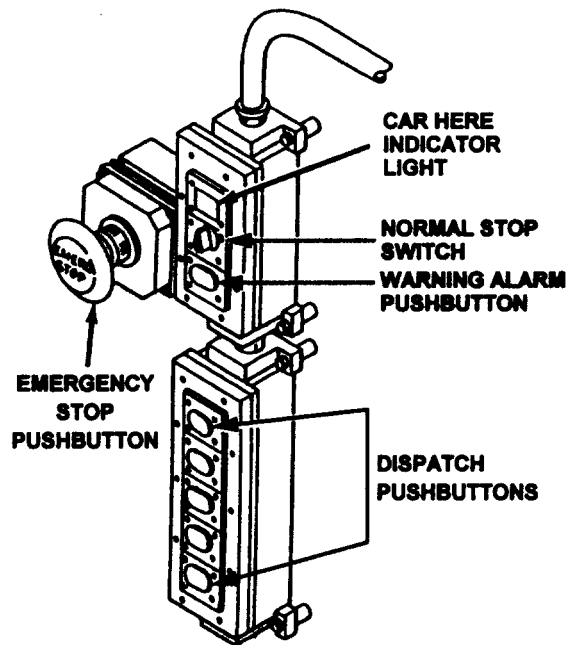


Figure 772-2-30. Typical Local Deck Control Station

772-2.3.6 COMMUNICATIONS SUBSYSTEM. Communication systems are used to inform elevator personnel of actions to be taken, loading requirements, platform movements, fault conditions, safety hazards, and any other information deemed necessary. Before any platform movement takes place, it is imperative that communications be established between operators at the deck levels where elevator operation is expected. Additional information on communication systems can be found in NSTM, Chapter 430, Interior Communication Installations.

772-2.3.6.1 Communication Circuits. All elevator control stations are connected by a communication circuit. Depending on the type of ship and the service of the elevator, different circuits are used to communicate movement orders. These circuits include various sound powered phone circuits and the intercommunication circuits 39MC and 46MC.

772-2.3.6.1.1 Sound Powered Phone Circuits. The sound powered phone circuits, such as X19J, X20J, and X24J provide a means of communication for operation and maintenance of the elevator. Communication stations are provided at each control station and in the machinery room. Some ships use a hand/head set which plugs into a bulkhead mounted socket. Others have a signal station, Type IC/D which is permanently bulkhead mounted.

772-2.3.6.1.2 Circuit 39MC - Cargo Control Announcing System. This circuit provides for the transmission of orders and information between cargo control central and cargo handling spaces.

772-2.3.6.1.3 Circuit 46MC - Aviation Weapons Movement Control Announcing System. This circuit provides for the transmission of orders and information between the aviation weapons movement control station and the weapons handling spaces, including magazines and assembly areas.

772-2.3.7 SAFETY DEVICE SUBSYSTEM. A number of devices are installed in the elevator system to protect personnel. There are other components installed to protect the load or the elevator equipment from damage

in a system failure. Not all components listed here are necessary for a safe elevator design, but they are installed on some elevators. The components required for safe elevator operation and their minimum acceptable condition are listed in [Appendix C](#). The safety components discussed in this section are: overspeed governor; mechanical safety subsystem; knurled roller assembly; broken hoist wire rope safety device; hoist slack wire rope safety device; overtravel switches; closed hatch to platform interlocks; emergency stop pushbuttons; shunt trip safety circuit; undervoltage safety circuit; personnel barriers and safety chains; overhead safety guards for operator rider elevators; protective barriers in trunks and around platforms; audible alarms; fork truck guards; personnel guards around rotating machinery; positive stops; sliding stop blocks; buffer springs; run/stop switches; interlocks; emergency stop for flush deck hatches; positive control and deadman function; and high-speed stop switches .

772-2.3.7.1 Overspeed Governor (OSG). The OSG monitors downward platform speed. If the platform speed exceeds a predetermined maximum, the governor actuates, thereby disconnecting power to the hoist motor and brake. Simultaneously, the platform linkage of the mechanical safety subsystem will be actuated causing the knurled rollers to wedge against the guide rails and preventing further downward movement of the platform. Different designs of OSGs are found in the fleet ([Figure 772-2-31](#)). Elevator technical manuals should be checked to determine the type and the speed at which the OSG will cause the mechanical safety system to actuate. The OSG slack rope device is a maintenance assistance device and by itself is not a safety feature. Most overspeed governors have a slack rope device ([Figure 772-2-32](#)). Some are used to tension the OSG wire rope, but all types sense wire rope tension by maintaining contact with the OSG wire rope. A slack condition relieves tension on the slack rope device and opens an electrical contact, which in turn deenergizes the hoist motor and sets the brake. The OSG slack rope device automatically resets for normal operation when the rope becomes tight.

772-2.3.7.2 Mechanical Safety Subsystem (MSS). The MSS is an emergency braking system made up of interconnecting linkages, pushrods, springs, and knurled rollers. There are many different variations of this subsystem. A typical arrangement is illustrated in [Figure 772-2-33](#). The system is designed to stop downward platform travel by wedging the knurled rollers against all guide rails. This can occur when either the overspeed governor senses an overspeed condition or the broken rope safety device senses breaking or slacking of the hoist wire ropes. Either of these conditions causes activation of the MSS. Except on ships with the trigger mechanism type, the MSS can be automatically reset for normal operation after correcting the problem by raising the platform from the wedged position in the jog mode.

772-2.3.7.3 Knurled Roller Assembly. The knurled roller assembly ([Figure 772-2-34](#)) stops downward platform movement when the Mechanical Safety Subsystem is actuated. Each knurled roller assembly consists of a housing which contains a hardened steel knurled roller and a wear plate. A tapered cut-out in the housing holds the knurled roller. During normal operation, the roller rests in the wide portion of the cut-out away from the guide rail. When the MSS is actuated, pushrods jam the knurled rollers upwards into the narrow part of the cut-outs. As the platform moves downward, the knurled rollers jam tightly against the guide rails stopping the platform. The platform must then be jogged up to disengage the knurled rollers.

772-2.3.7.4 Broken Hoist Wire Rope Safety Device. Although different variations of broken wire rope devices exist, the principle of operation is fundamentally the same. With the weight of the platform being supported by the hoist wire ropes, there is sufficient tension in each hoist wire rope to compress the individual springs at each wire rope MSS interface. Should a hoist wire rope break or slacken, the corresponding spring will expand, activate the MSS, and cause the knurled rollers to set and stop the platform. This safety subsystem actuates independently from the overspeed governor safety device and can be automatically reset by raising the platform.

772-2.3.7.5 Hoist Slack Wire Rope Safety Device. Hoist slack wire rope devices come in many different designs ([Figure 772-2-35](#)), but all types sense wire rope tension by maintaining contact with the hoist wire ropes.

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When any of the hoist wire ropes go slack, the slack rope device operates and disconnects power to the hoist motor and brake. The slack rope device automatically resets for normal operation when the rope becomes tight.

772-2.3.7.6 Overtravel Switches. The overtravel switches prevent the platform from traveling beyond the limits of the guide rails in the event of failure of any of the normal control components to stop the elevator. These switches (limit or proximity type) are located at the extreme ends of platform travel. They deenergize the main hoist motor and stop platform travel when actuated. To reset the system out of up overtravel, the elevator platform must be jogged down or lowered by the manual brake release. To reset the system from a down overtravel condition, the elevator must be jogged up. The down overtravel switch is not considered to be a safety feature. If the platform travels beyond the lowest level, the buffer springs will protect the equipment from damage and the slack rope device will prevent further hoist drum rotation.

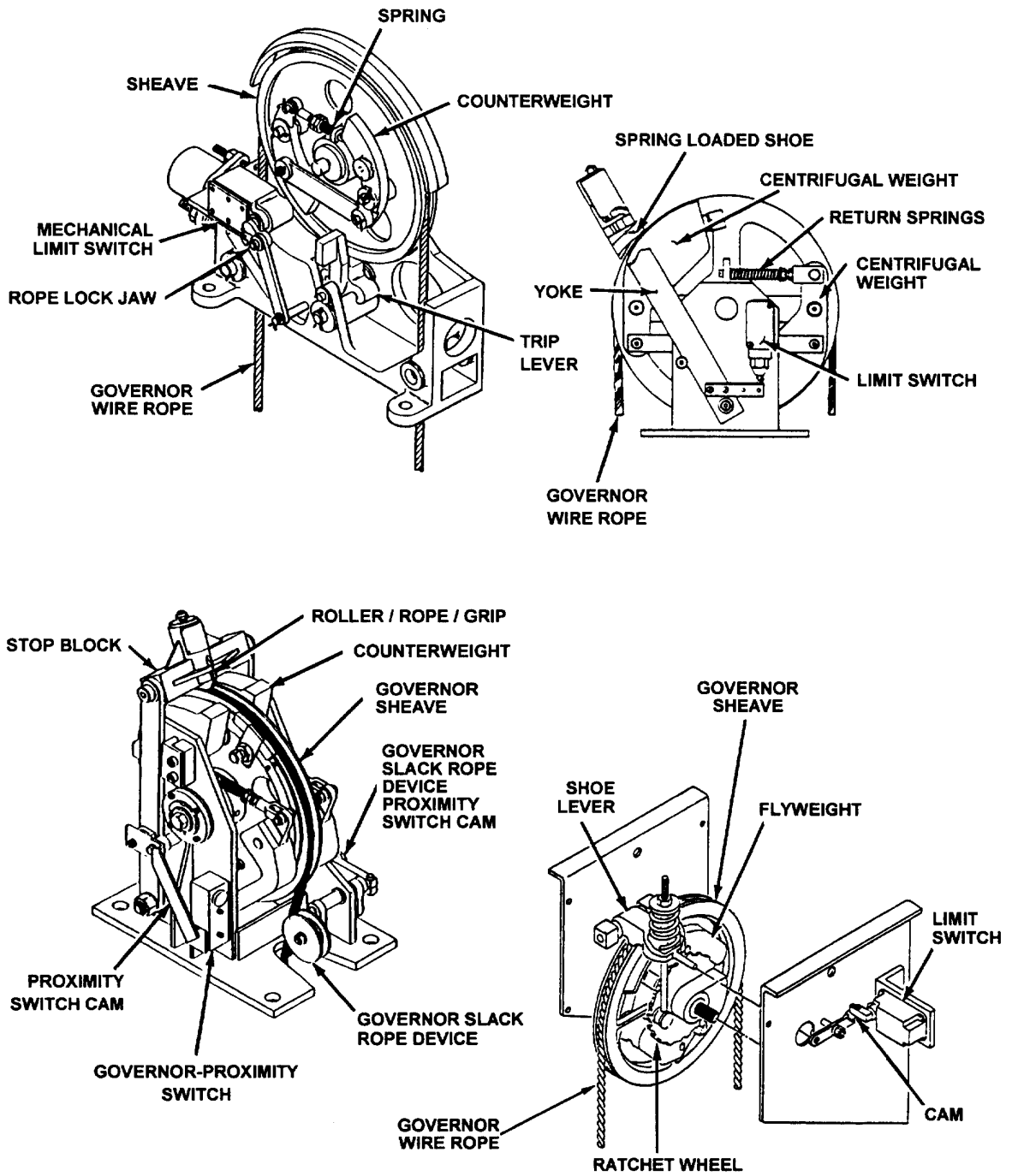


Figure 772-2-31. Overspeed Governor Systems

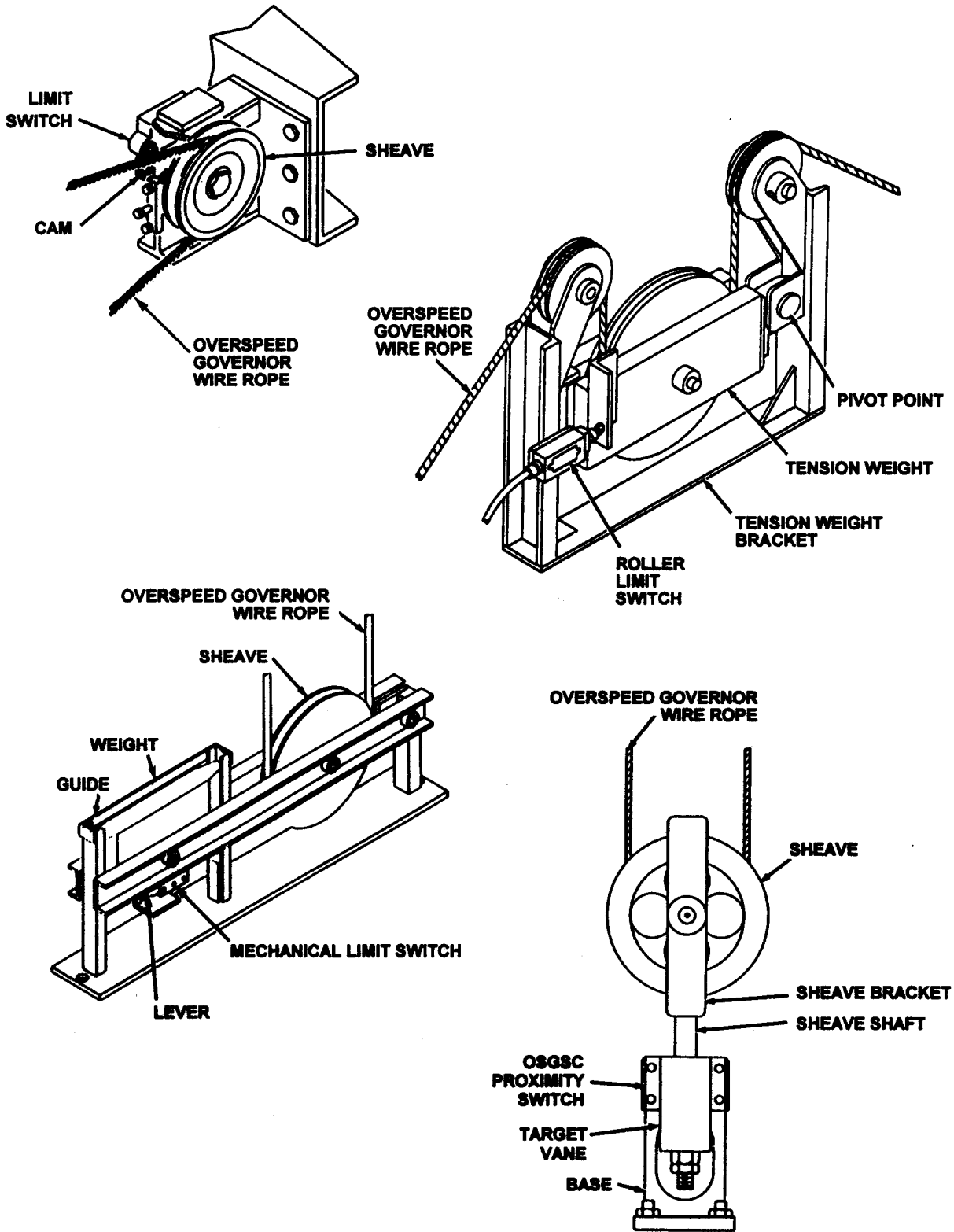


Figure 772-2-32. Overspeed Governor Slack Wire Rope Devices

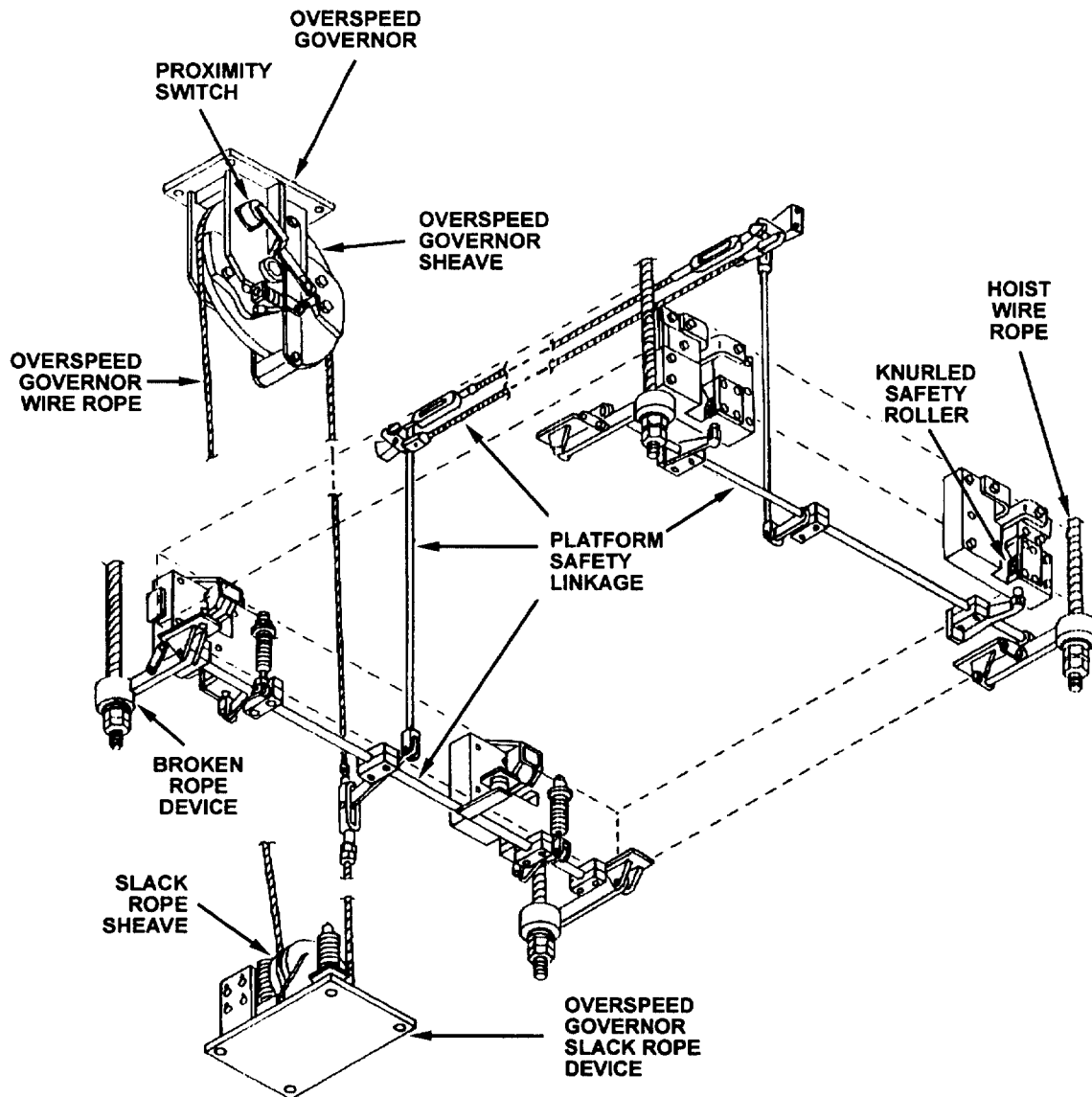


Figure 772-2-33. Mechanical Safety Subsystem/Knurled Roller Linkage Installation

772-2.3.7.7 Closed Hatch to Platform Interlocks. On elevators with hatches, closed hatch to platform interlocks consist of limit and or proximity switches to prevent platform movement to a hatch location if the hatch is not fully opened and latched. Hatch movement, open or close, is also prevented if the platform is not in the proper position for hatch sequencing to occur. The closed hatch to platform interlocks disconnect power to the hoist motor preventing both high and low speed platform operation. These interlocks actuate to stop platform motion at least 6 feet from a hatch cover that is not fully open.

772-2.3.7.8 Emergency Stop Pushbutton. The emergency stop pushbutton is installed at deck level control stations and elevator machinery space. When actuated, it will deenergize undervoltage or energize the shunt trip coil to trip the disconnect switch and cuts off all power to the motor controller and elevator control system. The main disconnect circuit breaker must be reset to resume elevator operation.

772-2.3.7.9 Shunt Trip Safety Circuit. The shunt trip safety circuit for each elevator is activated by a separately mounted, manually operated disconnect switch. The disconnect switch automatically disconnects electrical power

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to the entire elevator circuit when the shunt trip coil is energized by any emergency stop pushbutton or in-trunk high speed stop switch actuation. Once tripped, the shunt trip circuit breakers must be manually reset to restore elevator operation.

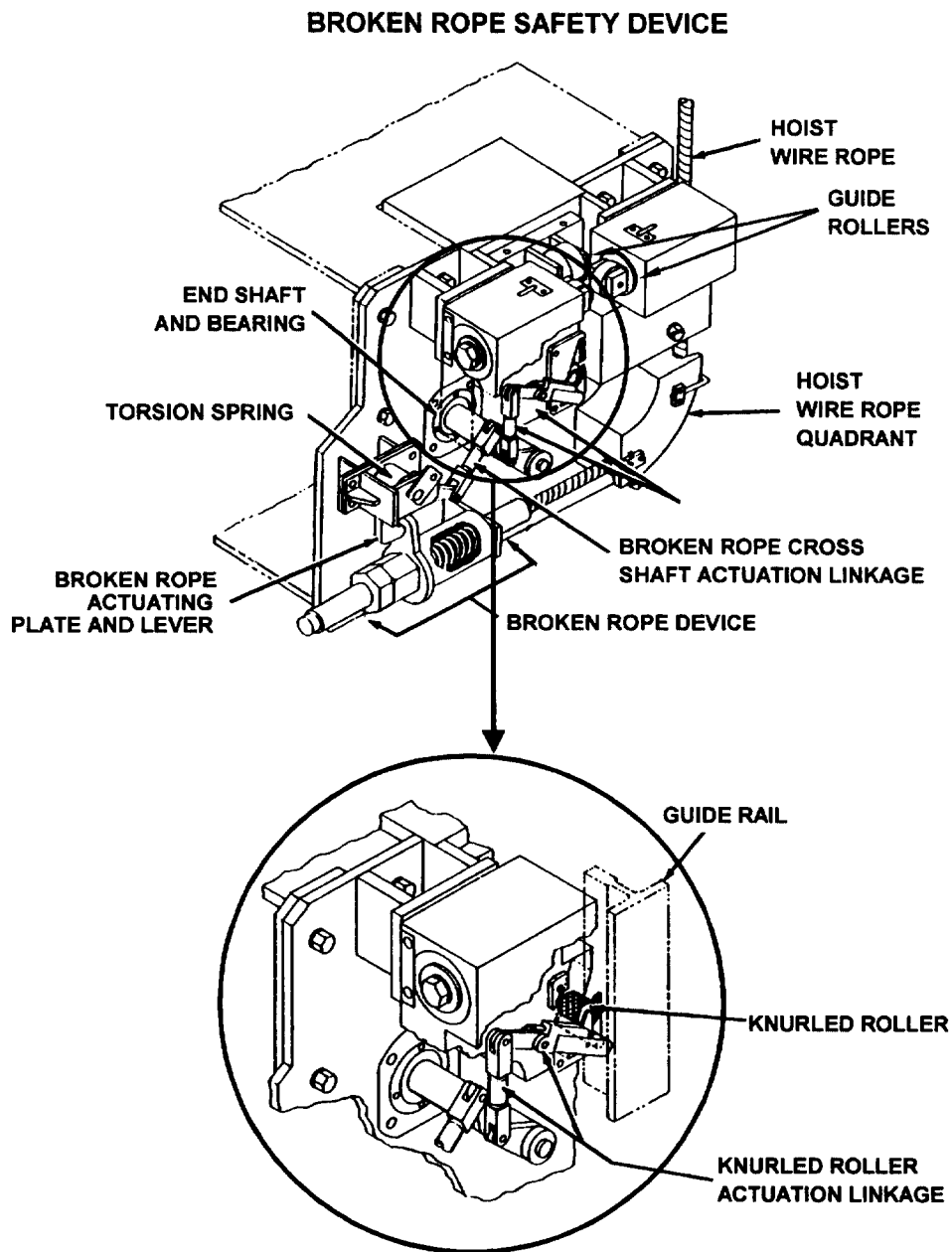


Figure 772-2-34. Knurled Roller Assembly

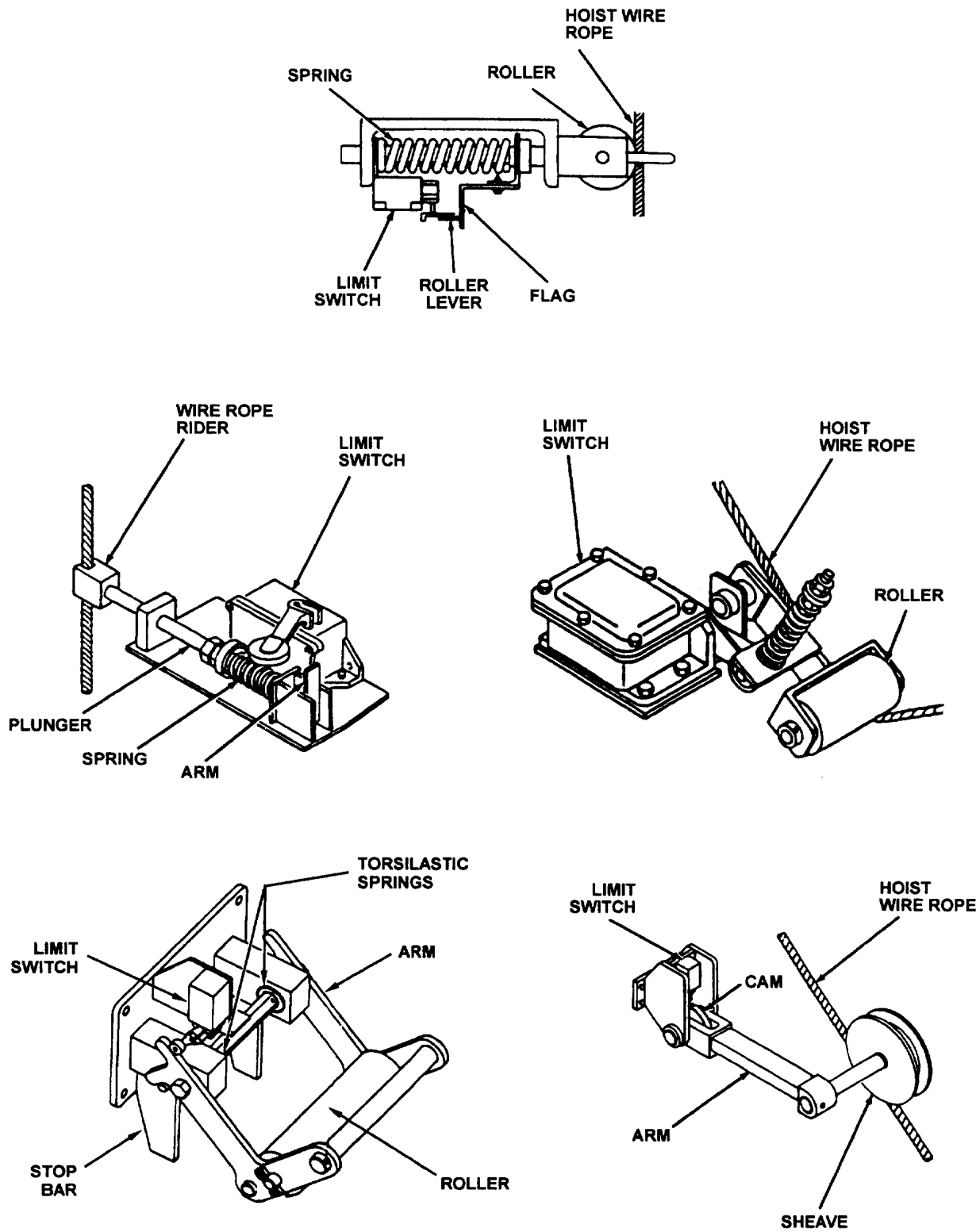


Figure 772-2-35. Hoist Slack Wire Rope Devices

772-2.3.7.10 Undervoltage (UV) Safety Circuit. The UV safety circuit performs the same functions and monitors the same circuits as the shunt trip safety circuit and may be installed in place of the shunt trip safety circuit. The UV safety circuit for each elevator uses a separately mounted disconnect switch and a Control Switch Undervoltage Power (CSUVP). The disconnect switch automatically disconnects power to the entire elevator circuit (except the UV circuit) when the UV trip coil is deenergized by any emergency stop pushbutton or in-trunk high speed stop switch actuation. In addition, it monitors system voltage. Once tripped, the CSUVP must be actuated before the disconnect switch can be energized.

772-2.3.7.11 Personnel Barriers and Safety Chains. Liferails, lifelines, or safety nets shall be installed around open hatches or elevator trunk openings to prevent personnel from falling to a lower level. Safety stanchions and chains are generally used around open hatches on flight or hangar decks. Maintenance safety chains are used on those elevator openings normally closed during elevator operation, but required to be open for some maintenance function (Figure 772-2-36). Safety nets, or personnel barriers, are installed on elevators that are designed to operate with the trunk doors open or removed at the levels being used to load/unload the platform (Figure 772-2-37). A safety interlock system prevents elevator operation when the personnel barrier is not in place.

772-2.3.7.12 Overhead Safety Guards for Operator Rider Elevators. Elevators requiring operators to ride the platform have overhead safety guards installed to protect personnel against falling objects and platform overtravel into the overhead (Figure 772-2-38).

772-2.3.7.13 Protective Barriers in Trunks and Around Platforms. Where platform gaps greater than six inches exist at any load level in the elevator trunk, protective barriers (safety guard rails or deck aprons) in trunks and around platforms are installed to prevent personnel from falling down the trunk during cargo loading and unloading operations and during the performance of maintenance. Platform safety barriers are either fixed, movable or a combination of both.

772-2.3.7.14 Audible Alarms. Alarm bells or warning horns are designed to warn personnel near elevators which have no doors or do not have interlocked doors when the platform is to be dispatched or jogged. The warning horn or bell shall be heard at all load levels. On these elevators, the alarm sounds immediately after the send pushbutton is pressed, and continues to sound until the elevator stops at the selected deck. The alarm also sounds whenever the elevator is jogged, but not while the brake is being slipped during maintenance.

772-2.3.7.15 Fork Truck Guards. On ships where fork truck operations are conducted, retractable fork truck guards (Figure 772-2-39) are required for hatch and trunk openings that remain open when the platform leaves that particular deck. Fork truck guards prevent forklift trucks from inadvertently being driven or rolling into the elevator trunk when the platform is not at that level. When the elevator platform is to be loaded, the truck guards are manually pressed and solenoid or catch-locked in a position flush with the deck. When the platform moves from that level and activates a release switch, the fork truck guards, which are spring loaded, raise automatically.

772-2.3.7.16 Personnel Guards Around Rotating Machinery. Personnel safety guards shall be installed around all rotating machinery components and hoist ropes that are easily accessible to operating personnel. Safety guards around drums, shafts, and wire ropes should be constructed of pipe and expanded steel and be easily removable. They shall be fitted into sockets in the deck or the machinery foundation to permit self-support without pins or fasteners. When required, safety guards for smaller components, such as couplings and slack rope devices, may be designed to swing away from machinery components to permit easy access for maintenance. Guards are not required around hoist machinery located in the trunk overhead, or around slow speed (20 rpm or less) shafting and couplings.

772-2.3.7.17 Positive Stops. Where installed, positive stops act as a hard stop in case a system malfunction cause the platform to travel beyond the up overtravel position. Positive stops are designed to withstand the maximum attainable impact load when struck by a moving platform at high speed or by the load due to electric motor locked rotor torque, whichever is higher.

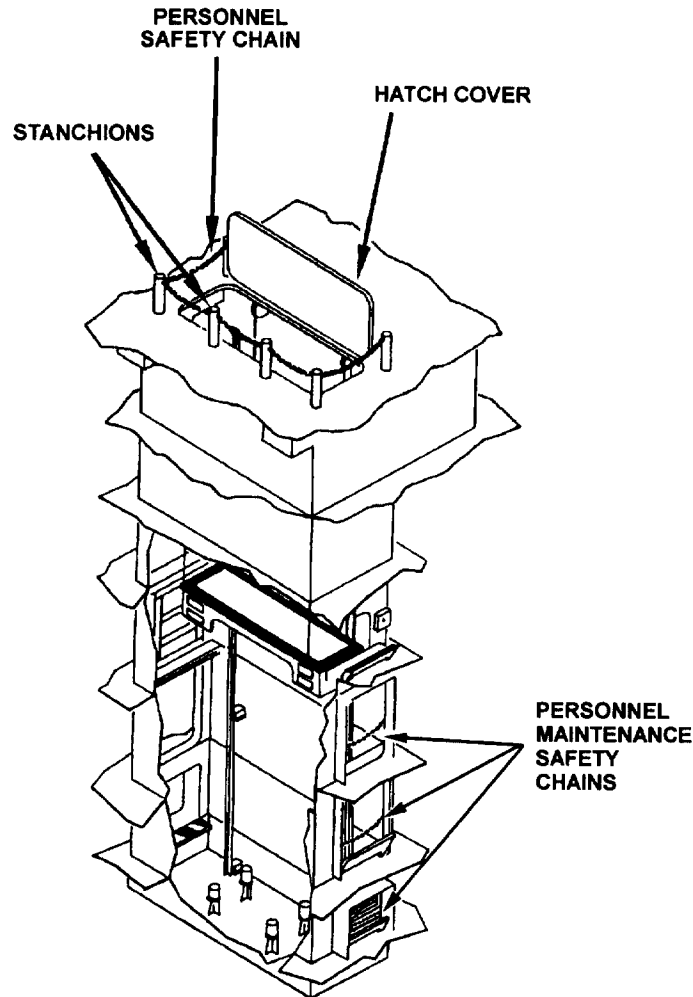


Figure 772-2-36. Personnel Safety Chains

772-2.3.7.18 Sliding Stop Blocks. Some elevators have positive stop assemblies called sliding stop blocks bolted around the top of the guide rails a few inches from the positive stops (Figure 772-2-40). The purpose of the sliding stop blocks is to absorb the initial kinetic energy of the platform during an up overtravel condition and to slow down the platform before it hits the positive stops.

772-2.3.7.19 Buffer Springs. Buffer springs are installed at the bottom of the elevator trunk, commonly called the pit. Each buffer consists of a tempered steel coil spring retained in a housing. Buffer springs cushion platform impact in the event of a platform down overtravel condition. Buffer springs support the platform during maintenance and are designed to support the weight of the platform with its rated load.

772-2.3.7.20 Run/Stop Switches. Run/stop switches are installed at all deck level control stations and machinery rooms. They interrupt the run permissive Safety Interlock Relay (SIR) circuit to allow stopping of the eleva-

tor. Returning the switches to the run position re-enables the run permissive SIR circuit, allowing the elevator to be operated. The switch shall be in the stop position when loading or unloading the platform.

772-2.3.7.21 Interlocks. Various electrical, mechanical, hydraulic and pneumatic interlocks are installed throughout the elevator system to perform the following functions:

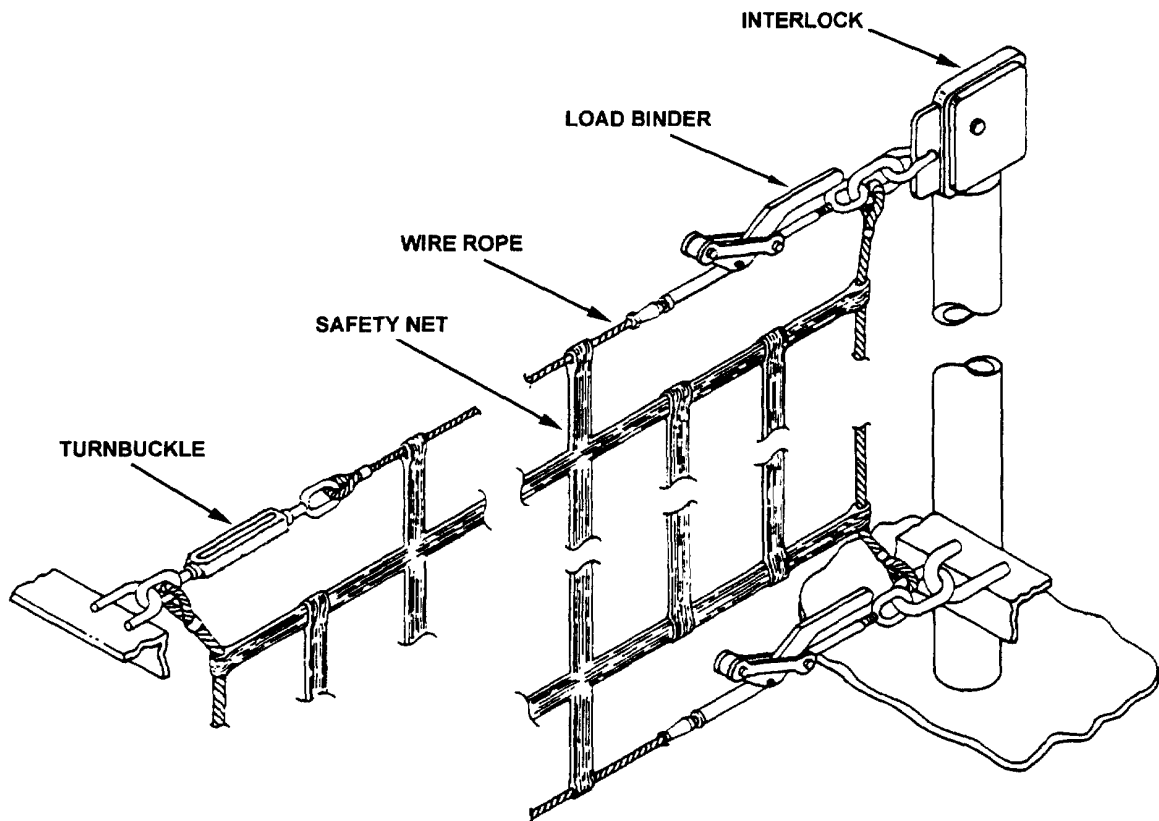


Figure 772-2-37. Personnel Safety Barrier

- a. Prevent platform operation unless all doors at all levels are closed and dogged, or safety barriers are properly installed.
- b. Prevent door and dog movement or fork truck guard latching unless the platform is at that level.
- c. Prevent more than one door at the same level from being opened; however, where two doors at the same level serve the same space, they may both be open at the same time if required.
- d. Prevent hatch or platform movement if either are incorrectly positioned.
- e. Prevent two hatches of one elevator from opening at the same time.
- f. Prevent dog movement if door or hatch is incorrectly positioned.
- g. Prevent door or hatch movement if dogs are incorrectly positioned.
- h. Prevent ramp movement if door is incorrectly positioned.
- i. Prevent latch movement if hatch is incorrectly positioned.

- j. Prevent hatch movement if latch is incorrectly positioned.

772-2.3.7.22 Emergency Stow Circuit for Flush Deck Hatches. When installed, operation of the emergency stow circuit pushbutton at the hatch control stations will automatically cause the platform to return to sequence, stow, or next lower level and the hatch to close and dog. This will occur even if the run/stop switches are in the stop position. The emergency stow feature allows the operator to quickly close hatches located in aircraft launch, recovery, and handling areas and near fuel delivery stations and depart the area, isolating the elevator during an emergency (fuel spill/fire). At some hatch control station(s), there is a third position labeled CANCEL E-STOW on the run/stop switch. Turning this spring return switch to the CANCEL E-STOW position immediately halts emergency stow action but permits emergency stow to continue when the emergency stow pushbutton is pressed again. The emergency stow circuit does not override the slack rope devices.

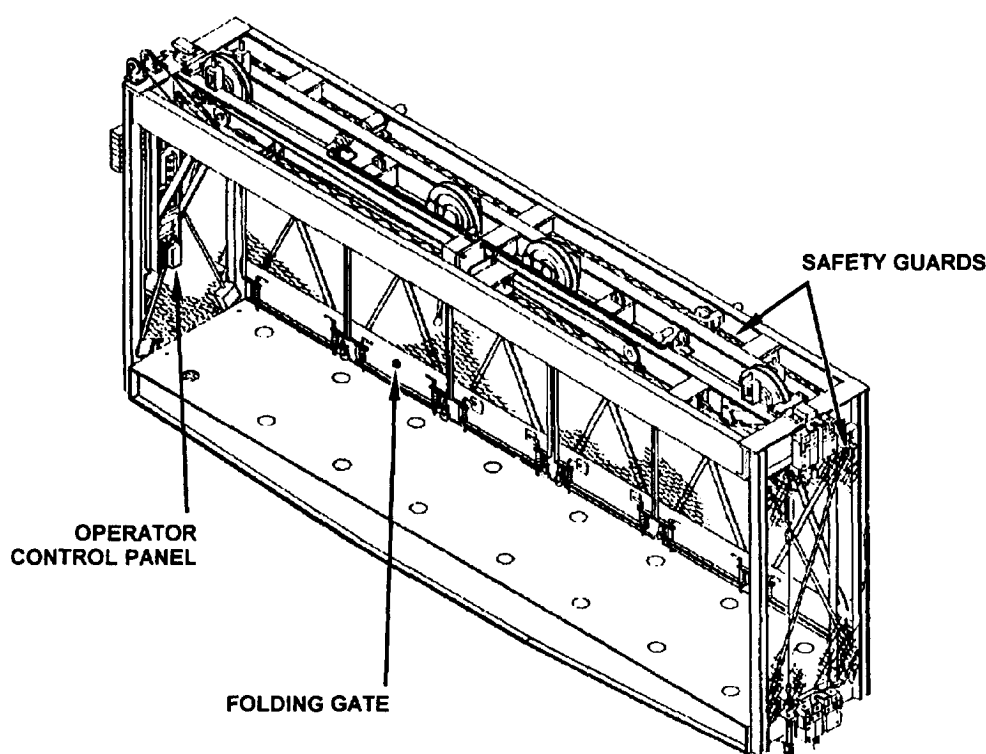


Figure 772-2-38. Overhead Safety Guards

772-2.3.7.23 Positive Control for Hatches and Deadman Function for Control of Doors. When installed, the run/stop switch gives the operator the capability to stop movement of the door/hatch. The door/hatch will stop within six inches after de-activation. A three position control switch or manual valve, with a spring return to "OFF", must be installed such that the operator must be constantly holding the switch in the "OPEN" or "CLOSE" position for door/hatch movement, and door/hatch movement stops when the operator releases the switch or manual valve.

772-2.3.7.24 High Speed Stop Switches. The high speed stop switches prevent the platform from traveling into a terminal level or sequence level in high speed. If the normal control components fail to slow the elevator, the high speed stop switch will deenergize the undervoltage or energize the shunt trip coil to trip the disconnect

switch. This shuts off all power to the motor controller and elevator control system. The down high speed stop switch is not considered to be a safety feature. If the platform travels to the lowest level in high speed, the buffer springs will protect the equipment from damage.

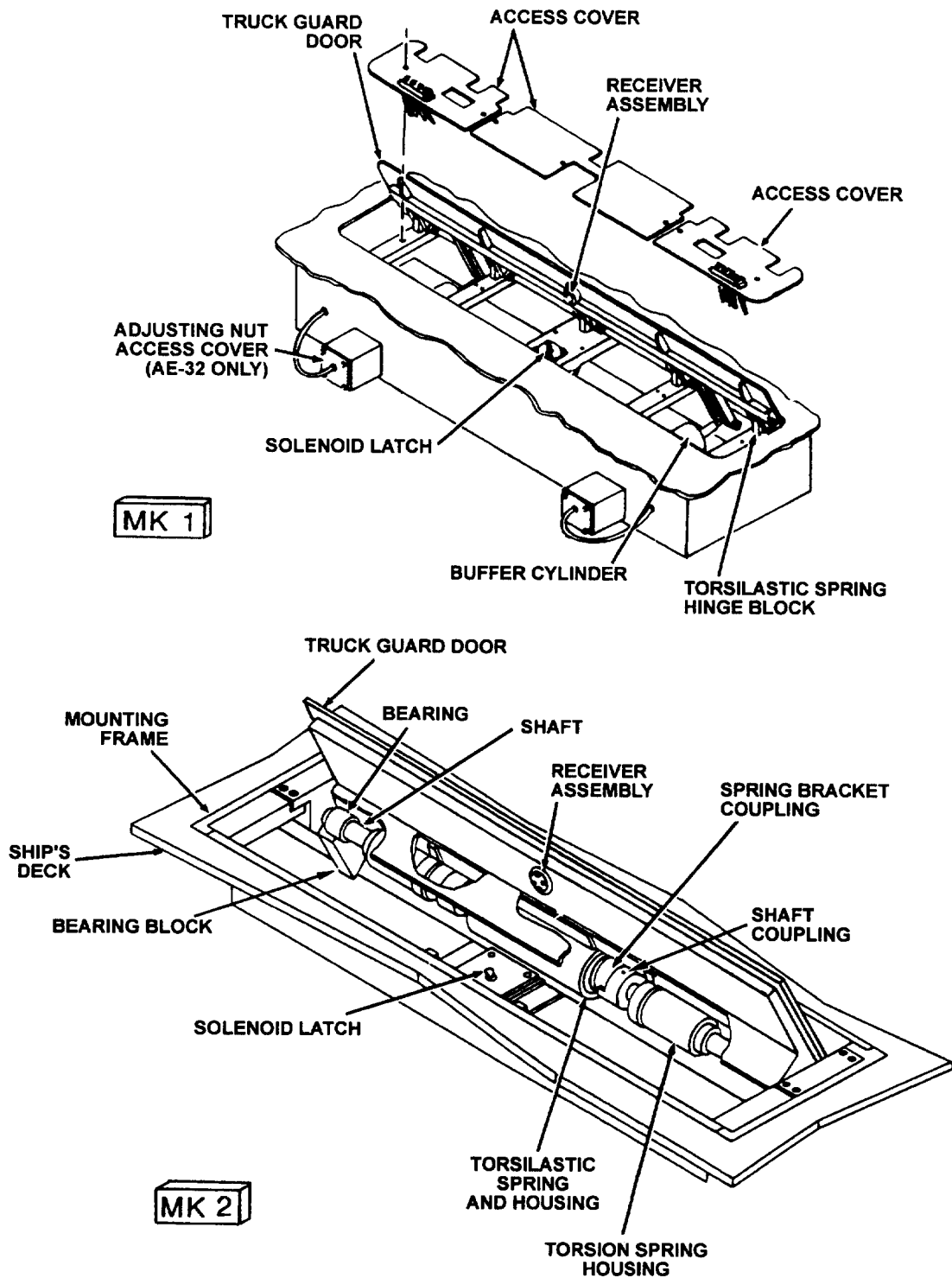


Figure 772-2-39. Fork Truck Guards

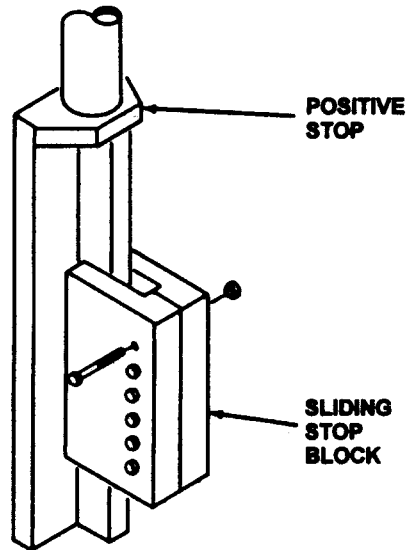


Figure 772-2-40. Stop Assembly

SECTION 3.

GENERAL OPERATING REQUIREMENTS

772-3.1 INTRODUCTION

772-3.1.1 GENERAL. General operating requirements are intended to standardize cargo and weapons elevator operating procedures and achieve a degree of commonality. They also provide guidance to aid the cognizant department head in establishing minimum requirements for safe and reliable cargo and weapons elevator operation.

772-3.2 REQUIREMENTS

772-3.2.1 ELEVATOR OPERATIONS. The following requirements and responsibilities shall be observed for all elevator operations:

- a. Cargo and weapons elevators shall not be operated with any feature listed in [Appendix C](#) deteriorated beyond the stated limits, unless a Departure From Specification has been approved. NAVSEA has provided each ship with recommended operating restrictions and/or other guidance to mitigate potential safety hazards where features listed in [Appendix C](#) were not originally installed.
- b. The preoperational checks specified in the appropriate elevator technical manuals or posted operating instructions (WEOPS) shall be completed prior to elevator operation.
- c. Operators shall be qualified and designated in writing by the ship to operate the elevator being used.
- d. The master control station operator or supervisor shall be responsible for conducting the overall safe operation of the elevator.
- e. For elevators which do not have interlocked closure doors, prior to initiating any elevator operation, the mas-

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ter control station operator or supervisor shall ensure all doors are in place or closed except at those levels where loading or unloading the platform will take place and where applicable, all personnel barriers are in place.

- f. Personnel are prohibited from riding on the platform of cargo/weapons elevators in motion unless permission is obtained from the Commanding Officer or his/her delegate. The only exception is elevators which have an operator's station on the platform and require the operator to ride the platform during elevator movement. In this case, only the operator is permitted to ride the platform.
- g. Operators shall be responsible for the safe operation and control of their control station. Operator responsibilities include, but are not limited to:
 - 1. Proper loading and unloading of the elevator platform when at their level.
 - 2. Verifying platform load does not exceed elevator rating.
 - 3. Checking the load for balanced placement, security, and adequate clearance.
 - 4. Ensuring platform load does not extend onto solid yellow safety margins painted on platforms. The extremities of the load may extend over the inner edge of the safety margin. However, because the risk of damage increases as the load approaches the outer margin, the department head and the ship's safety officer shall be made aware and approve the weapon/cargo intrusion into the safety margin.
 - 5. Visually checking, prior to initiating any elevator movement, the area of operation for personnel or obstructions that would interfere with the safe operation of the elevators.
 - 6. Ensuring no personnel are riding the platform except for operators on designated operator rider elevators.
 - 7. Operating the elevator in accordance with posted operating instructions (WEOPS).
- h. Positive voice communication shall be established between operators at control stations required to be manned for elevator operation before any platform or weapons movement takes place.
- i. The dispatching operator shall communicate with the receiving operator before dispatching the elevator.
- j. Upon completion of elevator operations, each control station operator shall inspect and secure the elevator in accordance with the procedures specified in the appropriate technical manual and the current ship's elevator operating instructions.
- k. Report all cargo or weapons elevator defects to the elevator maintenance supervisor immediately.

Specific elevator emergency operational procedures are provided in the technical manual.

772-3.2.2 OPERATOR RIDER ELEVATOR. Some elevators have the operating control panel mounted on the platform. The operator rides the platform during elevator operation. Personnel other than operators shall not ride the elevator unless permission is obtained from the Commanding Officer or the Commanding Officer's delegate.

772-3.2.3 MAINTENANCE AND INSPECTION OPERATION. There are maintenance and inspection tasks which cannot be realistically performed unless personnel are on the elevator platform during movement. While on the platform, personnel are not protected from the hazards associated with the moving machinery. To minimize the hazards, the number of personnel riding on the platform to perform these tasks shall be kept to an absolute minimum. Personnel riding the platform shall be protected from falls over the side. This protection can be provided by a fixed or portable perimeter railing or by using an approved personnel safety harness for each individual on the platform. The harness shall be attached to the platform whenever the gap between the platform and trunk structure exceeds six inches. Permission for personnel to ride on an elevator when in motion must be obtained from the Commanding Officer or the Commanding Officer's delegate.

772-3.2.3.1 Manned Maintenance Operation. The MRC provides specific instructions for boarding and positioning the platform when manned maintenance operations are required to perform periodic maintenance actions. The following guidance shall be followed when no other specific procedures are available. It is imperative that effective communications be established between all maintenance personnel before any platform movement is considered safe.

- a. Moving the platform with personnel riding shall be performed only as a last resort, if no other means of access is reasonable. The preferred method for moving the platform is with the hoist motor deenergized, and tagged out, manually releasing the brake.
- b. If releasing the brake will not permit proper positioning of the platform, jogging the platform in only the down direction is the next preferred alternative.
- c. If jogging down will not permit proper positioning of the platform, only as a last resort, the platform may be jogged in the up direction. This movement puts personnel at the greatest risk and should be avoided if at all possible.

772-3.3 BASIC ELEVATOR OPERATION

772-3.3.1 INTRODUCTION. There are three methods used to move platforms from one level to another.

772-3.3.2 DISPATCH OPERATION. There are two types of dispatch operation designs used in the fleet. The first type allows any deck level operator to dispatch the platform from his/her station to another, but the master control operator must first select the desired deck level on the master control panel. After the desired selection is made, the platform can be dispatched. Subsequent platform movement must go through the master control station operator to make the desired deck level selection. The second dispatch type is similar to the first, however, the master control station is not required to choose the deck levels to be served. The deck level operator chooses where to send the platform.

772-3.3.3 CALL OPERATION. The second method is similar to elevators in office/apartment buildings. The deck level operator, after receiving an all-clear signal, calls the platform to his/her level. With this control system, proper functioning of interlocks on doors, safety gates and personnel barriers, and run/stop switches are critical to ensure safety of personnel. The operator controlling platform movement relies on these interlocks to prevent platform movement if personnel are entering or exiting the platform. Communication between deck levels is required.

772-3.3.4 OPERATOR RIDER ELEVATOR OPERATION. The third method is the operator rider elevator. The platform is manually controlled and has to be ridden to the various levels. The operator controls the movement of the platform through a multiposition master control lever which is spring loaded to the OFF position ([Figure 772-3-1](#)). Slowing and stopping at intermediate levels is a manual operation, however, the platform will slow and stop automatically at the terminal levels.

772-3.4 MEDICAL EMERGENCY OPERATION

772-3.4.1 When an elevator is required to transport personnel during a medical emergency, several precautions must be taken.

- a. The number of personnel riding the platform must be kept to an absolute minimum.

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- b. Personnel should be positioned in the center of the platform.
- c. The patient should be secured to prevent rolling off the platform.
- d. The elevator trunk may become dark when the doors and hatches close. A battle lantern or flashlights are recommended for all medical assisting personnel.

772-3.5 SECURING FROM OPERATION

772-3.5.1 Upon completion of elevator usage, the platforms shall be cleared of debris and made ready to secure. After examination for overall integrity, platforms will be returned to their stow position, doors and hatches closed, and the elevator secured as required by the technical manual or posted operating instructions (WEOPS). Ensure that when the elevator is secured, it is in a status where either unauthorized or inadvertent operation of the platform or access to the trunk via one of the doors or hatches is prevented. Maintaining trunk integrity when the elevator is not in operation is vital to ensuring personnel safety and the safety of the ship. All removed J-panel doors shall be replaced after operation to ensure personnel are not exposed to the danger of an open elevator trunk and to reduce the potential for spread of fire/smoke in the area of the trunk.

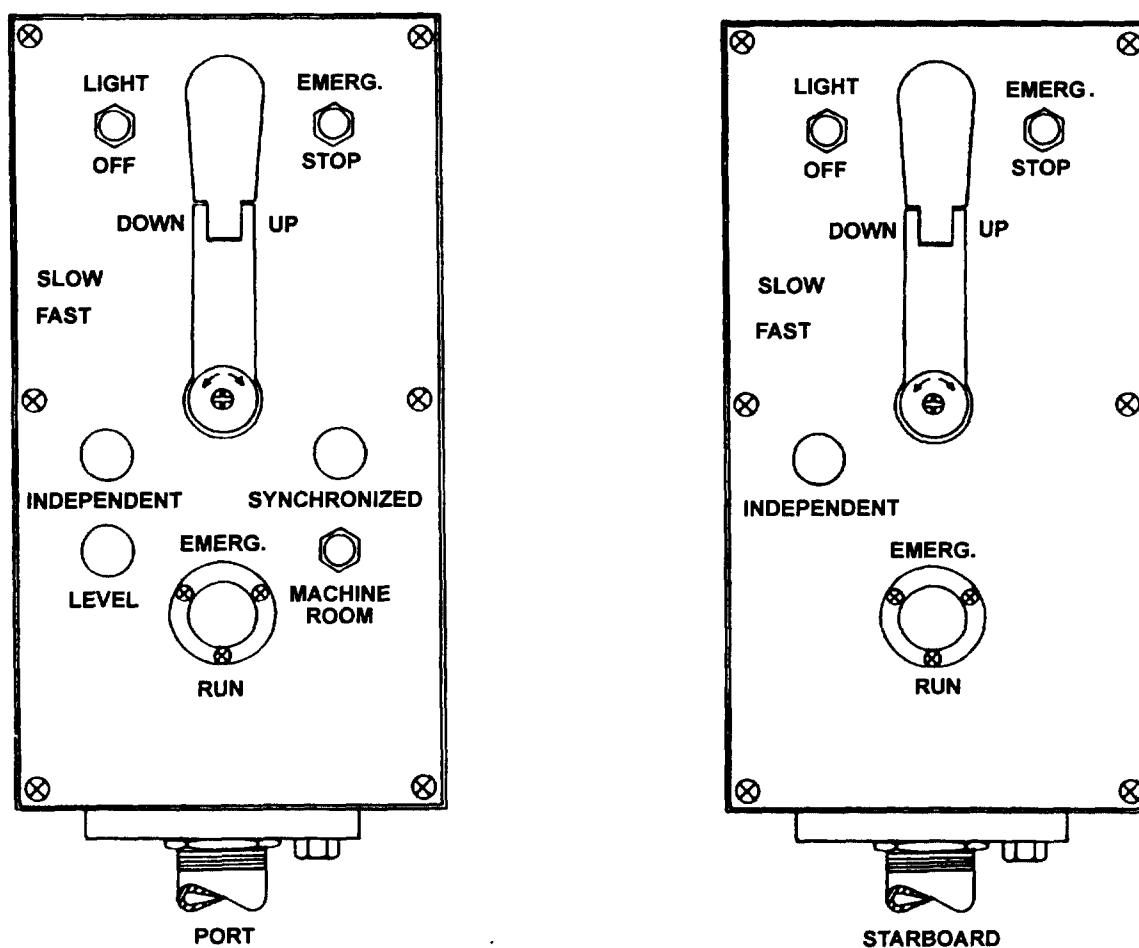


Figure 772-3-1 Operator Rider Control Stations

SECTION 4.

SAFETY

772-4.1 INTRODUCTION

772-4.1.1 SAFETY PRECAUTION. Safety precautions in this chapter are, of necessity, basic and general in nature. It may be necessary to consult other Navy publications such as OPNAVINST 8023.2 series, U.S. Navy Explosive Safety Policies, Requirements and Procedures ; OPNAVINST 5100.19 series, Navy Safety Precautions for Forces Afloat ; CINCLANT/PACINST 8023.5 series, Non-Nuclear Ordnance/Explosive Handling Qualifications and Certification Program ; NAVSEA OP4 Ammunition Afloat ; Technical/Operating Manuals; equipment Planned Maintenance System (PMS) Maintenance Requirement Cards (MRCs); and posted Weapons Elevator Operating Instructions (WEOPs) for complete safety precautions. While precautions in this manual constitute minimum standards to be observed, nothing herein precludes local commanders from prescribing supplementary or more stringent precautions for special conditions as deemed necessary.

772-4.2 RESPONSIBILITIES

772-4.2.1 GENERAL. It shall be the responsibility of the operator to ensure that the referenced material, as well as all appropriate command instructions are read and understood.

772-4.2.2 INSTRUCTION. The responsibility for the promulgation and instruction of all applicable safety precautions is specifically addressed by OPNAVINST 5100.19.

772-4.2.3 SUPERVISORY RESPONSIBILITIES. All personnel who supervise the operation and maintenance of cargo or weapons elevators shall be thoroughly familiar with all the safety precautions. They shall continually instruct those whom they supervise in the care and concern for safety in the performance of their work. Supervisory personnel shall be alert to detect any hazardous procedures. They shall take immediate corrective action to remedy the situation and prevent accidents. They shall inform all personnel of any equipment, material, or practice which they consider to be unsafe; and warn others who may be endangered by the hazard to observe posted safety precautions.

772-4.2.4 OPERATOR QUALIFICATION. The safe operation of elevator systems requires specific training, safety, and equipment knowledge. Ships shall develop a qualification instruction outlining the requirements for designation as an elevator operator. Guidelines and requirements for designation are outlined in greater detail in [Section 6](#) of this chapter. The requirements shall satisfy NAVEDTRA 43108, Personnel Qualification Standards (PQS), Weapons/Cargo Elevators . Following the successful completion of the Shipboard PQS Program, the operator or maintenance technician should be qualified and designated in writing by the cognizant Department Head.

772-4.2.5 SAFETY OBSERVER QUALIFICATION. Personnel designated as safety observers shall be qualified to the safety observer watchstation standard in NAVEDTRA 43108, Personnel Qualification Standards (PQS), Weapons/Cargo Elevators, Section 301. When performing the function of a safety observer, personnel shall not perform elevator operating procedures or cargo/weapons handling operations.

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772-4.3 OPERATION AND CONTROL

772-4.3.1 GENERAL OPERATION. Operators are responsible for the safe operation and control of their elevator control stations. Operator responsibility includes checking the loading and unloading of the elevator platform and checking the load for correct storage, security, and adequate clearance prior to platform dispatch. The master control station operator shall also be responsible for conducting the overall safe operation of the elevator. Operators shall be familiar with elevator capacities and limitations, as well as current problems and deficiencies that may exist for the particular elevator being authorized for operation.

772-4.3.2 COMMUNICATIONS. Before any elevator platform movement takes place, positive voice communications shall be established between operators at control stations required to be manned for elevator operation. As a minimum, communications must be established between the sending and receiving stations. During maintenance actions, effective communications between all personnel is critical for safety reasons. Positive voice communications shall be established between all manned areas of the elevator, including the machinery room, deck levels, and platform.

772-4.3.3 WEAPONS ELEVATOR OPERATING PROCEDURES (WEOPS). The correct operating procedures, along with any pertinent warnings and cautions, shall be prominently posted at all elevator control stations and machinery rooms. Any errors found with the operating procedures should be reported using the same Technical Feedback Report (TFBR) form (OPNAV 4790/7B) as used by the Preventative Maintenance Subsystem (PMS). Specific guidance for completing the form is provided on page 2 of the WEOP drawing.

772-4.3.4 SAFETY OBSERVER. The supervisor shall ensure that a safety observer is posted when a hatch or a moving elevator component is in an area not fully visible to the operator. Communication shall be established between the control station and the safety observer. Each safety observer shall keep assigned areas clear.

772-4.3.5 ELEVATOR CONTROL STATIONS. If the elevator control station is located in an unlocked space, the control stations should be protected by a lockable cage to limit panel access to authorized personnel. If a lockable cage is not feasible, electrical power shall be isolated at the disconnect switch when the elevator is not in use.

772-4.3.6 PERSONNEL SAFETY. Cargo and weapons elevators are designed with safety devices to protect the system equipment, the load being carried, and personnel during loading and unloading operations. No safety devices are provided on elevator platforms to protect passengers from the dangers of the equipment in motion, such as being caught between the platform and trunk structure or falling off the edge of the platform. Designated operator rider elevators have protective cages to isolate the operators from some of these dangers. To minimize the hazards, personnel are prohibited from riding on a cargo/weapons elevator during any movement, unless specifically required to perform maintenance, troubleshooting, repair, or inspection and no other practical means exists. Paragraph [772-4.4.2](#) provides the requirements for personnel to ride on a platform in motion.

772-4.3.7 AREA SAFETY. Prior to initiating any movement, the elevator operator shall visually check the area of operations for personnel or obstructions that would interfere with the safe operation of the elevator. For elevators which do not have interlocked doors, prior to initiating any elevator operation, the master control station operator or supervisor shall ensure all doors are in place or closed except at those levels where loading or unloading the platform will take place. The operator shall start up and secure the elevator system in accordance with applicable technical manuals and posted operating instructions (WEOPS).

772-4.3.8 ELEVATOR CONTROL TESTING. At the start of each new evolution, all indicator lights on all control stations should be operable and indicate a ready and safe condition. The operator shall test for proper elevator response. This shall be accomplished by cycling the elevator in an unloaded condition in accordance with the System Operability Test Level I MRC.

772-4.3.9 YELLOW SAFETY MARGINS.. The platform load shall not extend over the inner edge of the solid safety margin painted on the platform unless specific permission has been obtained from the department head and ship's safety officers. The load shall never extend beyond the outer edge of the platform.

772-4.4 MAINTENANCE SAFETY

772-4.4.1 MAINTENANCE/REPAIR. Before any maintenance or repair takes place on the elevator system, permission must be obtained from the cognizant division head. Once permission has been obtained, the elevator platform can be moved to the required position.

772-4.4.2 MAINTENANCE OPERATION. Maintenance personnel are responsible for accomplishing maintenance actions as prescribed in the Maintenance Required Card (MRC). The goal of each MRC is to accomplish the required maintenance in the safest and most efficient manner possible. In order to perform elevator maintenance actions safely, MRCs are normally written so that the elevator system is de-energized and the elevator platform is stationary while maintenance actions are performed.

772-4.4.2.1 Manned Maintenance Authority. Various maintenance tasks require that maintenance personnel board the elevator platform to gain access to elevator components. This is usually accomplished by pre-positioning the platform to the desired deck level before de-energizing the elevator system. However, there are maintenance, troubleshooting, repair, and inspection requirements which cannot be realistically performed with the platform stationary. To minimize the hazards of riding on an elevator platform, the number of personnel on the platform shall be kept to the absolute minimum necessary to perform the task. Personnel are not permitted to ride the platform during these evolutions for the purpose of saving time. Personnel riding the platform shall be protected from falls over the side. This protection can be provided by a fixed or portable perimeter railing or by using an approved personnel safety harness for each individual on the platform. The harness shall be attached to the platform whenever the gap between the platform and trunk structure exceeds six inches. The platform shall not be moved at rated speed with personnel riding on the platform unless there is an emergency, such as medical evacuation. To ensure personnel are reminded and aware of the hazards associated with the moving elevator platform, permission must be obtained from the Commanding Officer or the Commanding Officer's delegate before any personnel are permitted on an elevator platform in motion.

772-4.4.3 HOIST MACHINERY MAINTENANCE. To prevent freefall, the platform shall be placed on the buffer springs before any maintenance is undertaken on the hoist machinery, braking system, or shaft coupling. To prevent the weight of the extended hoist wire rope from acting on and rotating the hoist drum while the platform rests on the buffer springs, the hoist drum should be tied off or wedged.

772-4.4.4 ELECTRICAL MAINTENANCE. Electrical maintenance, repair, or adjustment of energized equipment shall not be attempted alone. The immediate presence of someone capable of rendering aid is required. Circuits must be grounded and all capacitors discharged prior to attempting repairs. Detailed safety precautions are contained in NSTM Chapter 300, Electric Plant General, NSTM Chapter 400, Electronics , NAVSEA 0967-LP-000-0100 Chapter 3, Electronics Installation and Maintenance Book (EIMB) , and Type Commander instructions.

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772-4.4.5 PRESSURIZED EQUIPMENT. Prior to commencing work on any pneumatic or hydraulic pressurized system, the system shall be secured, depressurized, and tagged Out of Service . When it is not feasible to depressurize the complete system, isolate by closing two valves (tag out valves) and depressurize that part of the system on which work is to be performed.

772-4.4.6 PNEUMATIC & HYDRAULIC SYSTEM PIPELINES. Pneumatic and hydraulic system pipelines shall be so identified. The direction of flow shall be indicated by means of flow arrows painted on the pipelines in accordance with NSTM Chapter 9480, Piping Systems .

772-4.4.7 TAG OUT-TAG IN PROCEDURES. Tag out-tag in procedures provide a standardized procedure to be used to prevent improper system operation when a component, equipment, system, or portion of a system is isolated or in an abnormal condition. Steps shall be taken to ensure compliance with the tag out procedures contained in OPNAVINST 3120.32 series, Standard Organization and Regulations of the U.S. Navy , Chapter 630.17 and applicable ship's instructions.

772-4.4.7.1 Tag Out Procedure. Tag out procedures shall be stringently enforced during operations, as well as during construction, testing, repair, or maintenance. To ensure continuous respect for all tags issued and displayed, strict enforcement of tag out procedures is required by ship's force and by the construction, maintenance, overhaul, or repair activity.

772-4.5 FEATURES VITAL TO ELEVATOR SAFETY

772-4.5.1 GENERAL. The material condition of an elevator is critical to ensuring its safe operation. Safety features are installed on cargo and weapons elevators to prevent personnel injury, to prevent the cargo or weapons from being damaged by the elevator, to prevent the elevator from catastrophically damaging itself during a malfunction, and to prevent elevator malfunctions from damaging the ship. These features are described in [Section 2](#) of this chapter. Their general locations are shown in [Figure 772-4-1](#). Many features inherent to the basic operation of the elevator are also vital to safety. A list of all features required to be in good working condition for safe elevator operation is contained in [Appendix C](#). The minimum acceptable in-service limits for these features is also provided. These limits are applicable to features observed or inspected during normal elevator operation, scheduled maintenance, troubleshooting, and formal inspection. These limits are quite different from the SOT III depot level tests, which determine that the elevator has been properly installed, repaired, and adjusted. The limits provided in [Appendix C](#) are not intended to overrule a certified elevator assessor's judgment that an elevator system is unsafe to operate. The safe operating limits were derived from an analysis of general elevator designs and the criteria may not cover every design and installation difference. An accumulation of local deficiencies can also be rationale for an assessor to conclude an elevator system is unsafe to operate.

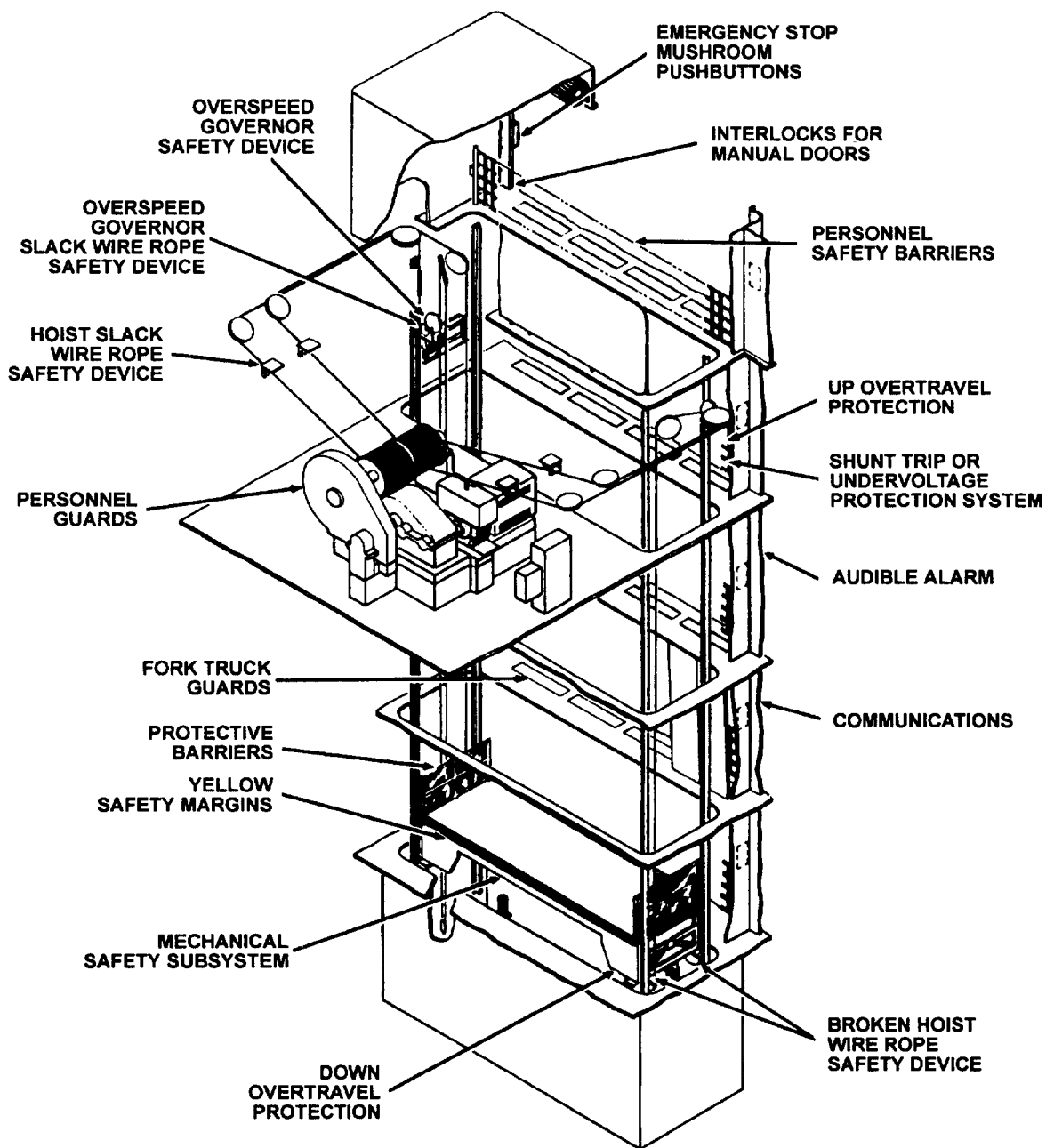


Figure 772-4-1. General Location of Safety Features (Sheet 1 of 2)

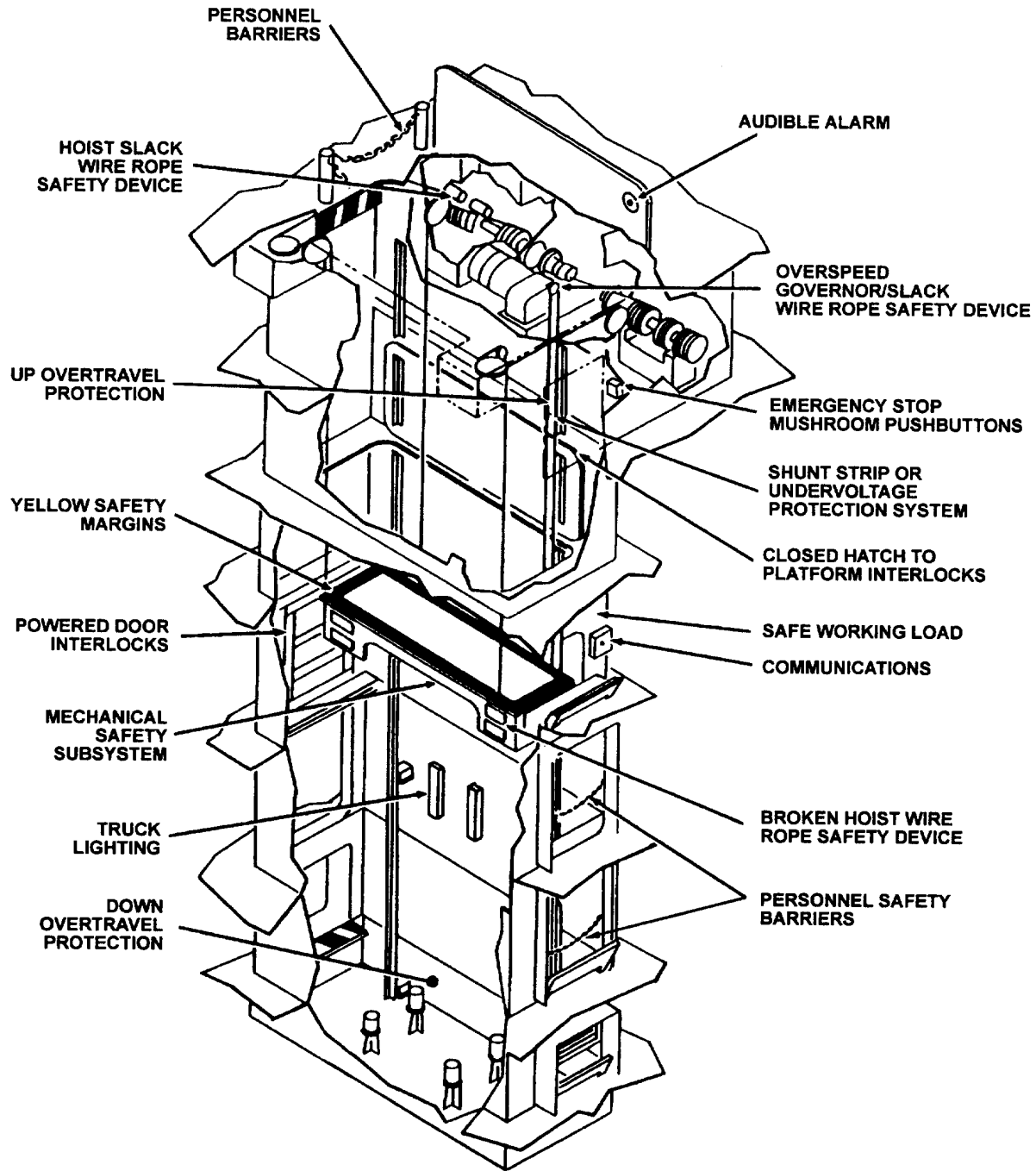


Figure 772-4-1. General Location of Safety Features (Sheet 2 of 2)

772-4.5.1.1 Departure from Specification. It is important to note that elevator operation is prohibited when any of the features listed in [Appendix C](#) have deteriorated beyond the stated limits unless a Departure From Specification (DFS) is approved. DFS approval must come from the Type Commander. Each DFS approval must state operational restrictions or alternate means of attaining safety. NAVSEA provides recommended operating restrictions and/or other guidance to mitigate potential safety hazards where features listed in [Appendix C](#) were not originally installed. However, different elevator features have different impacts on elevator safety. For most features, deterioration below the acceptable limits means that special actions to compensate for the loss of this feature may not be possible. Determination of the appropriate actions for DFS must come from NAVSEA and will be based on the specific elevator configuration, affected feature, and elevator operational requirements.

772-4.5.1.1.1 Departure from Specification Recommendation. For a select group of features, special actions can be taken which will compensate for the loss of that feature. The following paragraphs provide recommendations for actions and restrictions that may be included in a DFS message approving continued operation of the elevator. These actions are designed to return safety to an acceptable level. The restrictions listed cannot be assumed to provide sufficient safety if any other component fails to function properly. These actions are not to be implemented by the ship unless specifically directed by the TYCOM.

- a. Lighting - Safety observer shall ensure cargo handlers have flashlights to enable seeing placement of the load. Safety observer shall check positioning and security of load to ensure inside the perimeter yellow lines.
- b. Personnel guards in trunks, on platform or decking - Prohibit loading/unloading at that level. If maintenance is required, safety harness shall be worn.
- c. Securing device (door open/ramp up) - Prohibit opening affected door.
- d. Door physical interlock - Padlock affected door except when operating to/from that level. Safety observer shall ensure door is opened only when the "car here" light is illuminated. Safety observer shall ensure door is closed and dogged before permitting platform movement. Safety observer shall order elevator operation halted if the door is opened after the platform has left the deck level. The elevator platform shall be returned to that level and the door closed prior to any other elevator operation.
- e. Fork truck guards
 1. Fork truck guards which do not open to the required height or do not stay latched down when platform is at the deck level: Fork truck operations on decks, in the area where inoperative fork truck guards are located should be suspended.
 2. Fork truck guards which do not open automatically when platform leaves the deck level, but will open by applying foot pressure (toe tappers): Safety observer shall ensure the operator applies foot pressure to the fork truck guard immediately after the platform leaves the deck level and the guard opens to full height. Safety observer shall direct fork truck operation stopped immediately if the fork truck guard does not open after toe tapping.
- f. Personnel barrier interlock - Safety observer shall be stationed at load/unload level(s) with inoperative personnel barrier interlocks. Safety observer shall perform the following: Prior to operation, ensure all J-doors are installed securely in their tracks and completely cover all trunk opening(s) at all levels, except for the sending and receiving levels. Confirm run/stop switch is in the stop position prior to permitting loading/unloading. Ensure during loading/unloading, that operator is stationed at the deck level emergency stop (e-stop) pushbutton to stop the elevator if inadvertent platform movement begins. Ensure that personnel barrier is installed and tensioned prior to permitting operation. Order elevator operation halted if barrier is taken down after platform has left the deck level. The platform shall be returned to that level and the barrier installed prior to any other elevator operation.
- g. Communications where hatch not visible - Prohibit operation of affected hatch.

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h. Run/stop switch

1. If the door/personnel barrier interlock or the emergency stop pushbutton is not installed or non-operational, elevator operation from that level is prohibited.
2. If door/personnel barrier interlocks are installed and operational: at the deck level of the discrepancy, verify proper door/personnel barrier interlock operation weekly. Position the platform at the deck level and open the door or remove personnel barrier interlock blade. Attempt to dispatch the platform. The platform should not move. A safety observer shall be stationed at the level to perform the following: prior to permitting loading/unloading, identify the location of the door/personnel barrier interlock switch to the cargo handlers with instruction to avoid contact. During loading/unloading, ensure the operator remains stationed at the deck level emergency stop (e-stop) pushbutton to stop the elevator if inadvertent platform movement begins. After loading/unloading, ensure the door is closed and dogged or the personnel barrier is installed and tensioned before permitting elevator operation.

i. Emergency stop pushbutton - Prohibit operation to the affected deck level.

j. Positive control of powered closures - Safety observer stationed at each door to be opened or closed. Safety observer shall monitor door movement and ensure all personnel, weapons/cargo, and handling gear are clear of the door path prior to permitting door operation.

k. Closure hinges - Prohibit operation of affected closure.

l. Closure actuators - Prohibit operation of affected closure.

m. Personnel barrier - J-panel doors must remain in place (closed) and prohibit loading/unloading from the affected deck level.

n. Door/hatch guide rails/rollers - Prohibit operation of affected door/hatch.

o. Lifelines around flight/hangar deck hatches - Prohibit operation of affected flight/hangar deck hatch.

p. J-panel doors - Safety observer posted during elevator operation at all levels where doors are deficient to ensure personnel do not place objects close to the trunk opening or extend their heads or arms into the trunk opening.

772-4.5.2 INTERLOCK SWITCHES AND VALVES. Interlock switches and valves are provided for safety of personnel and equipment. They should be used only for the purpose intended. They should not be bypassed, tied off, or otherwise modified, except when required for maintenance or testing.

772-4.6 LABELS AND MARKINGS

772-4.6.1 TYPICAL LABELS AND MARKING. Cargo and weapons elevators are dangerous work areas. Platforms have weight or load limitations, which will vary for each elevator type. To remind and inform personnel of the dangers and weight limitations, various signs and markings should be displayed either on, in, or adjacent to the elevator trunk, platform control stations, and machinery rooms. The following paragraphs identify some typical labels and markings which must be found on cargo and weapons elevators.

772-4.6.2 ELEVATOR PLATFORM SAFETY MARKINGS. Each shipboard elevator platform shall have a peripheral, painted solid yellow safety margin to aid in ensuring that cargo/weapons loads do not overhang the platform. It shall extend from the platform's edges inboard 3 inches. Where a ramp extends onto the platform, the painted margin shall extend 3 inches beyond the maximum inboard extension of the ramp. The only exception is where wheeled dollies are used for the transfer of ordnance. Then, the platform's end edges and ramps

shall have a safety margin of 5 inches, with the 3 inch requirement still applicable to the side edges. Elevators with platform mounted safety gates or expanded metal cages, and elevators with platform transfer tables are not required to have the yellow safety margin.

772-4.6.3 FLUSH DECK HATCH SAFETY MARKING. Elevators with flush deck hatches shall have a red and yellow striped safety margin painted around the hatch opening (Figure 772-4-2).

772-4.6.4 RAMP MARKINGS. All platform, mechanical, hydraulic or pneumatically operated movable ramps shall be painted in black and yellow diagonal striping.

772-4.6.5 LOAD TEST LABEL. Equipment that has satisfactorily passed any load test shall be so marked. The facility performing the test shall mark the equipment with a test label plate. The label plates shall include the name of the testing facility, the date tested (month and year), the type of test, and the test weights. A record of each test shall be maintained by the testing facility and the ship. It is recommended that the label plate be mounted in a visible location in the elevator machinery room.

772-4.6.6 SAFE WORKING LOAD WARNING. A metal plate, placard, or stencil sign with minimum 2-inch lettering indicating the safe working load in pounds shall be prominently displayed on the elevator trunk bulkhead opposite each opening and on the outside of all doors at each load level. The warning will state "Safe Working Load XXX Lbs."

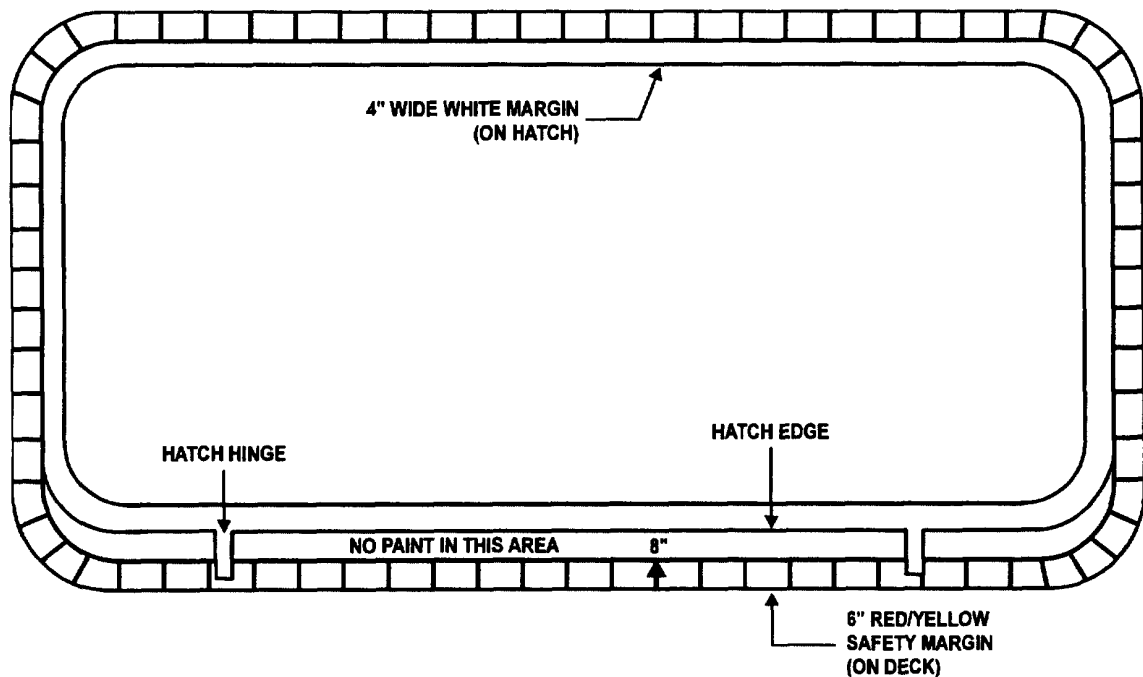


Figure 772-4-2. Safety Margin Elevator Hatches Hangar Deck and Flight Deck

772-4.6.7 OPERATOR RIDER WARNING. Cargo/weapons elevators which require the operator to ride the platform during elevator movement shall carry a metal plate or placard with 1/4 inch lettering stating "This is Not a Passenger Elevator. No Persons Other Than the Operator are Permitted to Ride on this Elevator." This sign shall be located near the operator station.

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772-4.6.8 NO RIDER WARNING. Cargo or weapons elevators should not carry passengers. A metal plate, placard, or stencil sign with 2-inch lettering indicating "Keep Off this Elevator When in Operation" shall be prominently displayed on the elevator trunk bulkhead opposite each opening and on the outside of all doors at each load level.

772-4.6.9 FORK TRUCK GUARD MARKING. The top and underside of all fork truck guards shall be painted yellow.

772-4.6.10 J-PANEL DOOR. Each portable (removable) J-panel door associated with an elevator opening shall have an 8 1/2 X 11-in vinyl placard (yellow/black background with black/yellow lettering) with the following wording: "WARNING Platform Must be Present Before Removing/Installing J-Panels Doors" affixed to the panel at eye level.

SECTION 5.

INSPECTION AND TESTING

772-5.1 INTRODUCTION

772-5.1.1 [Section 5](#) describes the requirements, instructions, and general information that will aid in the inspection and testing of cargo/weapons elevators. Appropriate technical manuals, instructions and Planned Maintenance System (PMS) for each specific piece of equipment should be reviewed for detailed information regarding specific inspection and testing procedures.

772-5.2 REQUIREMENTS

772-5.2.1 GENERAL. Cargo and weapons elevator components are monitored for wear, deterioration, or malfunction by a series of tests and inspections. These occur at different times and serve different purposes. The tests and inspections generally fall into two categories:

- a. Verification of adequacy of a new installation or repair of equipment (paragraphs [772-5.2.2](#) through [772-5.2.5](#)).
- b. Periodic verification that elevator components and systems are functioning properly (paragraphs [772-5.2.6](#) through [772-5.2.9](#)).

772-5.2.2 INITIAL ACCEPTANCE. New elevators are tested according to the procurement specification, generally the ships specification and MIL-E-17807. This testing ensures the elevator was manufactured and installed in accordance with the requirements.

772-5.2.3 SHIPS INSTALLATION ASSURANCE TEST. This inspection/test is conducted to ensure that new or modified air-launched weapons facilities fulfill the weapons handling, stowage, assembly, and checkout operation requirements.

772-5.2.4 POST-CORRECTIVE MAINTENANCE TESTS. All components and equipment that have been disassembled for repair and maintenance shall be inspected and tested prior to being returned to service. Load test-

ing is required prior to resumption of load handling operation and following corrective maintenance or replacement of load bearing and load controlling components of the elevator. System Operability Test (SOT) Level III procedures shall be used to perform these tests.

772-5.2.4.1 System Operability Test Level III. System Operability Test (SOT) Level III procedures are industrial level test procedures which provide step-by-step actions to inspect and test all aspects of the elevator system, including no-load tests, static load test, dynamic load test, and rated-load test. These procedures are designed for use either in their entirety, to test the elevator system, or sectionally, to test a specific component or portion of the system. Paragraph 772-5.4 and Table 772-5-1 provide a guide to determine which type of load tests are required after repair of a specific component. If the SOT Level III test is performed outside of a depot level availability, a certified assessor (paragraph 772-5.3.3) shall be present to witness the test.

772-5.2.5 POST-OVERHAUL TEST. Upon completion of an overhaul of the elevator, testing shall be accomplished prior to load handling operation. SOT Level III procedures shall be used to perform these tests.

772-5.2.6 PLANNED MAINTENANCE SYSTEM (PMS). PMS procedures are designed to prevent equipment failures which might result in repeated corrective maintenance actions. SOT Levels I and II are PMS procedures used to determine the material readiness of the elevator. SOT Level I tests the elevator system for correct operation. SOT Level II visually inspects and tests key safety features for proper operation. SOT Level II procedures are used to ensure the elevator is safe to operate.

772-5.2.7 PRE-OVERHAUL INSPECTION. In order to identify maintenance actions to be accomplished during a ship overhaul period, inspection and testing of the elevator should be conducted. The results of this inspection will then be used to plan the corrective actions.

Table 772-5-1 COMPONENT LOAD TEST REQUIREMENTS

COMPONENT	SUB-COMPONENT OR CONDITION	NO-LOAD	STATIC LOAD	DYNAMIC LOAD	RATED-LOAD
Platform	---	X	X		
Wire Rope/End Fittings	---	X	X		
Hoist Rope Sheaves	Foundation/ Foundation bolting	X ¹	X		
	Sheave/Pin/ Shaft/Bearing	X		X	X
Hoist Rope Drum	---	X	X	X	
Reduction Gear	---	X	X	X	X
Motor (if located between reduction gear and brake)	Repaired	X		X E-stop	X
	New	X	X	X E-stop	X
Motor (all other locations)	Repaired	X		X	X
	New	X		X E-stop	X
Brake	Reinstalling brake, replacement of any load holding component	X		X E-Stop	

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Table 772-5-1 COMPONENT LOAD TEST REQUIREMENTS - Continued

COMPONENT	SUB-COMPONENT OR CONDITION	NO-LOAD	STATIC LOAD	DYNAMIC LOAD	RATED-LOAD
	Disassembly of load holding portion of brake for inspection; adjustments; no new components	X E-Stop			
Connecting Shafts/ Couplings	Directly connected to brake or motor	X		X E-stop	
	All other	X	X	X	
Hoist Machinery Bedplate	---	X	X		
LEGEND X - Required test X E-Stop - Required test plus emergency stop X ¹ - Performed before and after static load test X - Controlled Assembly Procedures may be used in place of static load test. See paragraph 772-5.4.13 .					

772-5.2.8 BOARD OF INSPECTION AND SURVEY (INSURV). These inspections are normally conducted as Underway Material Inspections (UMIs). They consist of operational tests and demonstrations of major elevator systems and equipments. Approved testing and inspection procedures, including SOT Level II, are used.

772-5.2.9 MANDATORY PERIODIC TESTS. There are several different tests which must be performed periodically for each cargo/weapons elevator. These are no-load tests, load tests, and overspeed governor/mechanical safety subsystem tests. As a minimum the no-load and load tests shall be performed every 48 months, not to exceed 72 months. The overspeed governor trip speed shall be calibrated every six years. General procedures for performing these tests are included in paragraph [772-5.4](#). SOT Level III procedures contain specific guidance for conducting these tests.

772-5.3 ELEVATOR ASSESSMENT

772-5.3.1 ASSESSMENT REQUIREMENTS. The condition of cargo/weapons elevators shall be assessed a minimum of once per operating cycle (18 months). The assessment shall evaluate the condition of the elevator and all safety features and ensure all complete repair, maintenance actions and design changes conform to the latest standards. In addition, a general review of the Integrated Logistics Support (ILS) documents (technical manuals, APL, PMS) for discrepancies shall also be accomplished during the assessment.

772-5.3.2 ASSESSMENT TEAM. The assessment team shall be lead by at least one certified assessor who is a government employee. The assessor shall be assisted by at least one member of Ship's Force knowledgeable in the operation and maintenance of the elevator system. There shall be additional personnel, either Ship's Force or others, as necessary to ensure safe elevator operation.

772-5.3.3 ELEVATOR ASSESSOR QUALIFICATIONS. Technical support activities are responsible for conducting their own Cargo/Weapons Elevator Assessor Certification Program upon accreditation by NAVSEA. The technical support activity is responsible for ensuring that each assessor meets all technical standards and qualifications under their program and ensuring the assessor is certified upon meeting these standards and qualifications.

772-5.3.4 ELEVATOR ASSESSOR RESPONSIBILITIES. The assessor is responsible for ensuring that all elevator functions, subsystems and components, whether new or altered, conform to the latest elevator standards set forth by NAVSEA.

772-5.3.5 SHIP'S FORCE ASSESSMENT RESPONSIBILITIES. During an assessment, ship's force shall provide qualified operators as necessary to safely perform all elevator operations. Ship's force shall ensure all members of the assessment team comply with shipboard safety requirements. Ship's force shall ensure all necessary tag-out procedures are accomplished in accordance with shipboard instructions.

772-5.3.6 ELEVATOR ASSESSMENT OPERATION. The elevator shall not be operated for an assessment until all emergency stop switches have been tested satisfactorily. The assessor shall ensure that a safety observer is stationed near a control station with an emergency stop switch. Effective communications must be established between all personnel manning the required stations as specified by the assessor. The assessor and/or any member of the assessing team shall wear a safety harness when working near an unprotected elevator opening.

772-5.3.6.1 During the assessment, elevator operation shall not be permitted without direct approval of the elevator assessor. A certified elevator assessor is permitted to ride the elevator platform in order to accomplish the proper assessment of the elevator system and components. Personnel riding the platform shall be protected from falls over the side. This protection can be provided by a fixed or portable perimeter railing or by using an approved personnel safety harness for each individual on the platform. The harness shall be attached to the platform whenever the gap between the platform and trunk structure exceeds six inches. While the platform is in motion, personnel shall stand near the center of the platform. The safety harness lanyard shall be held taut to prevent becoming tangled on trunk structure.

772-5.3.6.2 When manned operation is required, the assessor shall determine the safest method possible for moving the platform. The approved methods for manned elevator operation are manually releasing the hoist machinery brake and lowering the platform, or by jogging the platform in either the up or down direction. Under no circumstance is an assessor permitted to ride an elevator platform in high speed in either the up or down direction unless the elevator is a designated operator rider elevator. No other personnel are permitted to ride the platform during manned operation unless given permission and accompanied by a certified assessor. The assessor shall obtain permission from the Commanding Officer or the Commanding Officer's delegate prior to commencing actions which require manned operation.

772-5.4 TESTING

772-5.4.1 GENERAL. Testing of cargo/weapons elevators is required periodically and after working on an elevator component. Testing after adjusting a component may be necessary to verify the correct operation of that component. Depending on the component affected, testing may include a combination of the following: component inspection, no-load operational test, and load tests. Any required repairs and adjustments shall be made before inspection and testing. Personnel performing inspections and tests shall be thoroughly familiar with the equipment and its function. Repairs or adjustments found necessary during any inspection or testing phase shall be completed, and the previous inspection and testing phase shall be repeated before the next phase begins. Elevators that can be operated in the synchronous or independent mode shall be tested in both modes, however static load testing is not required in the synchronous mode. Specific testing procedures tailored to individual elevator systems are contained in System Operability Tests (SOT) Level III. SOT Level III procedures can be obtained from Carderock Division, Naval Surface Warfare Center, Philadelphia, Pennsylvania.

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772-5.4.1.1 Procedures. Tests shall be performed under the supervision of a Test Director. Test Directors, if shipboard administered, shall be designated in writing by the Commanding Officer. If an operational or weight test is performed by an outside activity, the Test Director shall be provided by that activity. In that event, the assigned elevator maintenance officer will review the test procedure to ensure compatibility with the elevator being tested.

772-5.4.1.2 Deficiency Reporting. Tests or inspections that reveal deficiencies affecting the operability of an elevator shall be reported immediately by the Test Director to the officer responsible for elevator maintenance.

772-5.4.1.3 Completion Reporting. Copies of the completed test forms shall be forwarded to ship's force and NSWCCD-SSES.

772-5.4.2 TESTING REQUIREMENTS. A complete load test consists of a component inspection, no-load test, static load test, dynamic load test, and rated-load test. A component inspection shall come before any other testing. A component inspection may be the only test required if the component is non-load bearing and no other operational check is practical, such as for a buffer spring. A no-load operational test is required whenever it is necessary to verify the operation of a non-load bearing component, such as a deck level stop switch. A no-load test shall also be performed before any load testing. Load testing confirms the elevator system can safely carry the cargo or weapons placed on the platform. This is accomplished by testing the portions of the elevator system which support the load, referred to as load bearing components. These components include not only the major portions of the elevator, such as hoist motor, brake, platform, etc. but also the associated pins, bolts, and other attachment devices which connect these components to each other and their foundations. Any loosening, removal, repair, replacement, or modification of these load bearing components requires a load test to reconfirm the elevator system can safely carry the load. Since the stress level in each component is different, the load test requirement for some components does not include all four tests. [Table 772-5-1](#) provides guidance on the test requirements for the different load bearing components. For components identified in [Table 772-5-1](#) controlled assembly may be used as an alternative to load testing after repair or replacement. The requirements for controlled assemblies are provided in paragraph [772-5.4.13](#).

772-5.4.3 COMPONENT INSPECTION. Inspections shall consist of observations on the functional condition of all component parts before operation. Inspection shall be performed by sight, sound, touch, measurement and instrumentation. Inspections shall be conducted to ensure the equipment will function properly in all operating modes, obvious deficiencies are corrected, and adjustments critical to safety and reliability are made. Specific inspections are to be conducted in accordance with the SOT Level I, II, and III procedures.

772-5.4.3.1 General. The following procedures shall be performed for the post-installation inspection and functional test:

- a. Inspect backing structure, foundation, surrounding area for evidence of failure, deformation or corrosion. Deteriorated areas that are considered acceptable structurally shall be cleaned and preserved. Other deteriorated areas not acceptable structurally shall be repaired as required and preserved.
- b. Inspect all equipment foundations for proper bolting (i.e. all bolts installed and properly tightened). Bolts or nuts that are prone to loosening shall be replaced with self locking type.
- c. Inspect equipment and ensure that it has been properly lubricated in accordance with the appropriate technical manual.

- d. If a flexible coupling(s) was disturbed or if the entire piece of equipment was removed and reinstalled, inspect the axial (peripheral) and angular (facial) alignment. Inspect alignment pins to ensure that they have been installed on motors/pumps as required.
- e. Inspect electrical equipment controllers for proper size control fuses and overload heaters, clean contacts on relays, integrity of wire insulation, proper sealing of stuffing tubes, and proper dressing of wiring. Also inspect the controllers to ensure that they are clean and that their housing do not contain any open penetrations. Accurate wiring schematics shall be provided with controllers and, if possible, installed in the controller cabinet.
- f. With all motors connected to their controllers, inspect the cold insulation resistance of the motors using a 500V megohmmeter. Adjust the insulation resistance values to 25 degrees C using a nomograph in accordance with NSTM Chapter 300. Minimum acceptable value shall be 4.0 megohm. If the reading is less than 4.0, the motor shall be disconnected from the controller and the readings then checked. The minimum acceptable value for the motor isolated is 1.0 megohm. Motors with insulation resistance readings between 0.2 and 1.0 megohm may be operated with close monitoring during operation. If moisture is present and is lowering the reading, the motor should dry out during operation and shall rise above 1.0 megohm. Otherwise, the motor shall be scheduled for cleaning/repair at the first opportunity.
- g. Inspect hydraulic oil fluid level in accordance with the applicable equipment manual.
- h. Verify that permanently installed gauges are within current calibration.
- i. Verify that high pressure relief valves have been set point tested and are within current calibration.

772-5.4.4 NO-LOAD TEST. The purpose of the no-load test is to determine if the equipment is capable of safe operation during all functional modes. Reference to the equipment specification, technical manual, SOTs or MRCs will aid in defining the scope and procedures for this test. While the test is being performed, the equipment shall be required to function through full specified operating ranges and directions. As a minimum, cargo and weapons elevators shall be raised and lowered through the full range of travel at rated speed for two complete cycles. The first cycle requires raising and lowering the platform, stopping at each level served. During the second cycle, the platform shall be stopped at the terminal levels only. Equipment shall be operated using normal operating and control procedures. The performance data shall be recorded on a form similar to Load Test Procedure Record ([Figure 772-5-1](#)).

772-5.4.5 STATIC LOAD TEST. A static load test physically tests the structural and mechanical integrity of the elevator. Loads may be applied by test weights or by NAVSEA approved hydraulic load test device in accordance with NAVSEA drawing 701-6737468 shown in [Figure 772-5-2](#). For elevators which have overhead hatches, position the platform at the lowest level served, open the hatch, and use a crane to lower the test weights onto the platform. For elevators which do not have overhead hatches, it is permissible to use the elevator to move the test weights to the lowest level served. The elevator shall be operated in jog mode while loaded, with the load not exceeding 50 percent of the safe working load of the elevator. General static load test procedures for cargo and weapons elevators are outlined in paragraphs [772-5.4.5.1](#) through [772-5.4.5.4](#).

772-5.4.5.1 Platform Positioning. During static load testing the elevator platform shall be positioned 3 inches above the lowest level served and shall not be resting on the buffer springs, or at a predetermined location (approved by NAVSEA) for use of approved mechanical or hydraulic load test device.

USS _____
 _____ POUND ELEVATOR LOCATION _____

MOTOR	MANUFACTURER			TYPE OR MODEL			SERIAL NO.			
	VOLTS	PHASE	HERTZ	AMPS			RPM			
	H.P.	DUTY	TEMP RISE	FRAME			ENCLOSURE			
CONTROLLER	MANUFACTURER			TYPE OR MODEL			SERIAL NO.			
	VOLTS	PHASE	HERTZ	H.P.(MAX)			SIZE			
	OVERLOAD PROTECTION			HEATER SIZE			DWG NO.			
BRAKE	MANUFACTURER			VOLTS			TYPE			
	MODEL			SERIAL NO.			ENCLOSURE			
LOAD TEST WEIGHT	OPERATION	SPEED	RPM	MOTOR VOLTAGE			AMPS			REMARKS
				AB	BC	CA	A	B	C	
NO LOAD TEST 0 LBS	RAISE	HI								
		LO								
	LOWER	HI								
		LO								
RATED LOAD TEST _____ LBS	RAISE	HI								
		LO								
	LOWER	HI								
		LO								
150% OF RATED LOAD TEST _____ LBS	RAISE	HI								
		LO								
	LOWER	HI								
		LO								
INSULATION RESISTANCE READINGS										
COLD	PARA. _____	AMB TEMP °F _____			HOT	PARA. _____	AMB TEMP °F _____			
	(1)					(1)				
	(2)					(2)				
	(3)					(3)				

- (1) RECORD AB, BC, AND CA PHASE VOLTAGES. ACCEPTABLE VOLTAGE IS 396-484 VOLTS (440 ± 10%).
- (2) RECORD A, B, AND C PHASE CURRENT. ACCEPTABLE CURRENT SHOULD NOT EXCEED NAMEPLATE CURRENT RATING FOR NO LOAD AND RATED LOAD TESTS AND 150% OF NAMEPLATE CURRENT FOR 150% OF RATED LOAD TEST.
- (3) CURRENT BALANCE IN ANY PHASE SHOULD NOT DIFFER BY MORE THAN 5% OF AVERAGE MAXIMUM AND MINIMUM PHASE CURRENT.
- (4) INSULATION RESISTANCE READINGS IN MEGOHMS SHOULD BE CORRECTED TO 25°C.

NOTE: FOR ANY READINGS THAT CANNOT BE OBTAINED,
 RECORD THE REASON(S) IN "REMARKS" SECTION.

Figure 772-5-1. Load Test Procedure Record

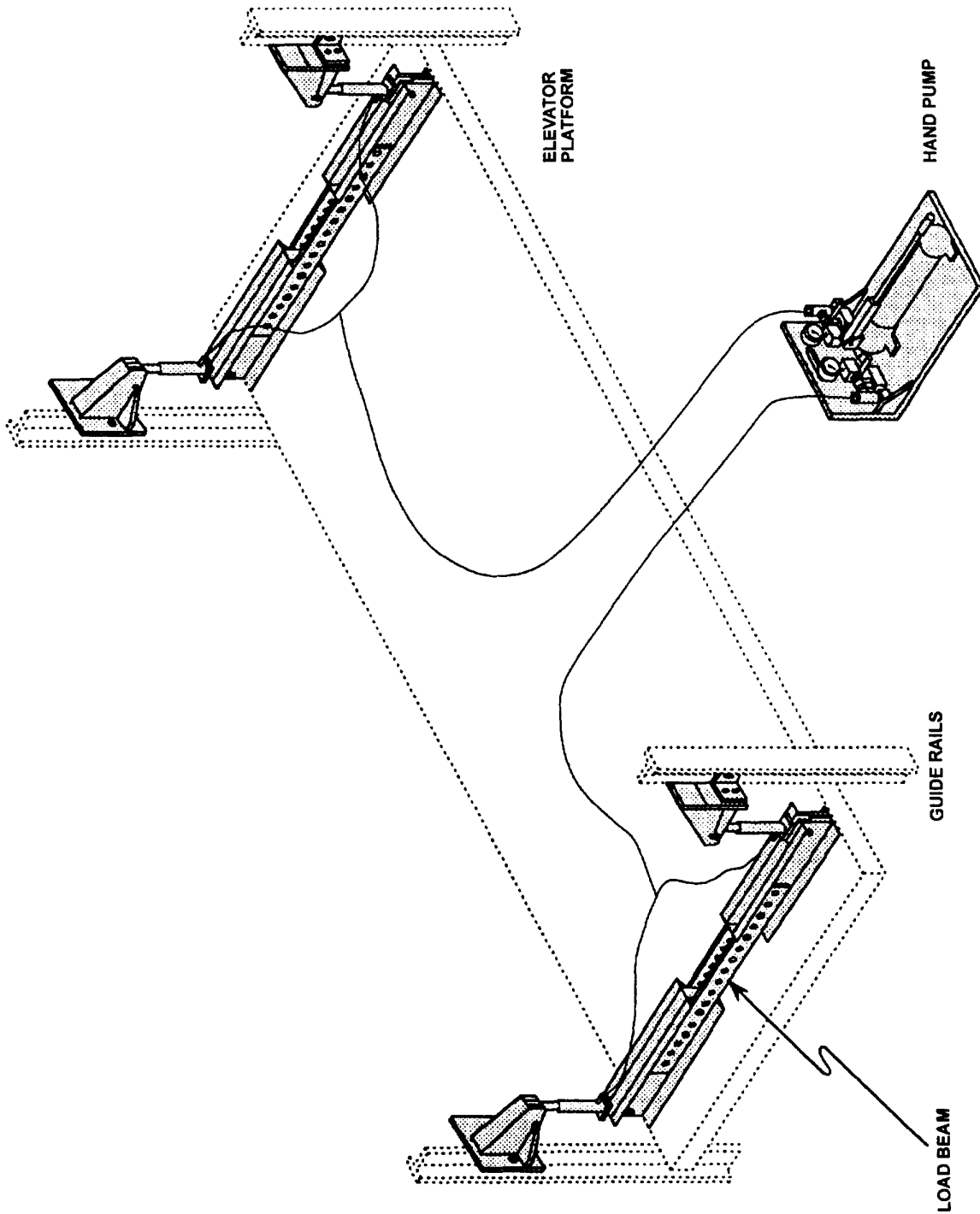


Figure 772-5-2. Hydraulic Load Test Device for Cargo/Weapons Elevators

CAUTION

When loading static test weights, ensure that weight handling equipment (normally a fork truck) is not placed on the elevator platform in addition to the static test load.

772-5.4.5.2 Static Test Load. Elevators that are not loaded by forklift trucks shall have a static test load of 200% (plus 5% minus 0%) of the rated-load evenly distributed on the platform. Elevators that are loaded by forklift trucks shall have either a 300/100%, 200/100%, or other static load test depending on the elevator. For example, a 300/100% load test on an elevator consisting of a load of 300% of the rated-load is centered 1/4 of the length from one end of the platform and a load of 100% of the rated-load is similarly centered from the other end. Dual elevators that are in the synchronized mode shall have a 200% static load test. The applicable SOT Level III procedure provides the specific test weight requirements. The static test load shall be applied while the ship is pierside or anchored in calm seas. If the static test must be conducted while the ship is underway, the sea state must be 3 or less (Beaufort scale), and the static test load shall be 150% of rated-load. Satisfactory completion of an at-sea test requires the elevator to be downrated to 80% of the rated-load. Upon returning to port, retesting shall be accomplished.

772-5.4.5.3 Static Load Test Requirements. The equipment undergoing test shall hold the test load for a minimum of 10 minutes. Equipment shall be visually inspected for evidence of permanent deformation, brake slippage, or other damage.

772-5.4.5.4 Inspections and Observations. Inspections and observations of the following items shall be made during and immediately following static load testing.

1. Inspect structural and load bearing components for:
 - a. Binding
 - b. Warping
 - c. Permanent deformation
 - d. Cracking
 - e. Loose foundation bolts
 - f. Broken welds
 - g. Malfunction of components
2. Inspect hoist wire rope for broken strands and slippage in rope sockets and end fittings.

772-5.4.6 DYNAMIC LOAD TEST. A dynamic load test demonstrates the capability of an elevator to operate with rated-load under the dynamic conditions of ship motion and equipment operation. The performance data shall be recorded on the form shown in [Figure 772-5-1](#), or similar form.

772-5.4.6.1 Dynamic Test Load. Dynamic test load shall be equal to 150% (plus 5%, minus 0%) of rated-load. It shall be applied while the ship is pierside or anchored in calm seas. If the dynamic load test must be conducted while the ship is underway, the sea state must be 3 or less (Beaufort scale), and the dynamic test load shall be 125% of rated-load. Satisfactory completion of an at-sea test requires that the elevator be downrated to 80% of the rated-load. Upon return to port, retesting shall be accomplished.

772-5.4.6.2 Dynamic Load Testing Requirements. The elevator platform shall be evenly loaded with the required weights. The platform shall be raised and lowered through two complete cycles at maximum attainable speed.

772-5.4.6.3 Inspections and Observations. Inspections and observations of the following items shall be made, during and immediately following dynamic load testing.

1. Inspect structural and load bearing components for:
 - a. Binding
 - b. Warping
 - c. Permanent deformation
 - d. Cracking
 - e. Loose foundation bolts
 - f. Broken welds
 - g. Malfunction of components
2. Inspect hoist wire rope for broken strands and slippage in rope sockets and fittings.
3. Inspect brakes for:
 - a. Overheating and vibration during elevator operation
 - b. Proper stopping
4. Inspect drive machinery for:
 - a. Abnormal noise or vibration
 - b. Misalignment
 - c. Overheating
 - d. Damage or abnormal wear patterns
5. Inspect hoist wire rope sheaves and drum spooling for:
 - a. Proper operation
 - b. Freedom of movement
 - c. Abnormal noise or vibration
6. Inspect electrical drive components for:
 - a. Proper operation
 - b. Misalignment
 - c. Freedom from chatter, noise or vibration
 - d. Overheating
7. Where installed, inspect the electrohydraulic RAM elevator system for:
 - a. Leaks
 - b. Freedom from chattering, noise or vibration

772-5.4.7 RATED-LOAD TEST. Following satisfactory completion of the dynamic load test, the elevator shall be subjected to a rated-load test. Rated-load tests are used to demonstrate the elevator's capability to operate with a full load, at rated speed, through the complete range of operating limits. The performance data shall be recorded on the Load Test Procedure Record ([Figure 772-5-1](#)).

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772-5.4.7.1 Rated Test Load. The rated-load is specifically designated and identified for each elevator. The test load equals 100% (plus 5% minus 0%) of the rated capacity of the elevators, while the ship is pierside or anchored in calm seas. If the rated-load test must be conducted while the ship is underway, the sea state must be 3 or less (Beaufort scale), and the rated test load shall be 80% of rated-load. Satisfactory completion of an at-sea test requires the elevators to be downrated to 80% of the rated-load. Upon return to port, retesting shall be accomplished.

772-5.4.7.2 Rated-Load Testing Requirements. The rated test load shall be moved at rated speed through the complete operating range of the elevator. The rated-load test shall be repeated an adequate number of cycles to demonstrate proper operation and repeatability of all functions without overheating drive motors, gear boxes, or brakes, or without giving other evidence of malfunction.

772-5.4.7.3 Inspection and Observations. During and following completion of the rated-load test, inspect the platform, wire ropes, sheaves, and hoist machinery using paragraph 772-5.4.6.3 as guidance to verify that no damage has occurred.

772-5.4.8 EMERGENCY STOP (E-STOP) TEST. An E-stop test is performed to ensure the brake is capable of stopping a downward moving elevator platform from high speed within a reasonable distance. This stopping ability is necessary to ensure the safety of personnel and the elevator. Also, the stress placed on many elevator components during this test differs from all other type testing, and, when applied, verifies the component repair.

772-5.4.8.1 Emergency Stop Test Load. The load used to perform the E-stop test differs with the component being tested. The E-stop test is conducted as part of a no-load test or a dynamic load test.

772-5.4.8.2 Emergency Stop Test Requirements. The E-stop test shall be performed with the platform moving down at rated speed.

CAUTION

The platform shall be stopped at the lowest level possible without its contacting the buffer springs.

After actuating the emergency stop pushbutton, the platform shall travel no more than three feet. Table 772-5-1 provides guidance on when the E-stop test is required.

772-5.4.9 OVERSPEED GOVERNOR/MECHANICAL SAFETY SUBSYSTEM TEST. The overspeed governor and mechanical safety subsystem combine to stop the elevator platform if a certain downward speed is exceeded or a hoist rope has broken. If the platform speed has increased enough to actuate the overspeed governor, it is likely that some failure occurred which would permit the platform to crash into the bottom of the trunk, unless the safety subsystem prevents further downward movement. Also, if a hoist rope breaks and the platform is not designed to wedge itself between the guide rails, the safety subsystem must actuate to hold the platform level and prevent the load from falling off the tilted platform. Complete testing of the overspeed governor and the mechanical safety subsystem consists of five tests. These tests must be conducted in order to ensure discrepancies can be identified and corrected before damage to the elevator system occurs.

772-5.4.9.1 Overspeed Governor Trip Speed Calibration. Ensuring the overspeed governor is adjusted to the correct trip speed is vital to ensuring its correct operation. If the trip speed is set too low, the governor will set frequently, becoming a nuisance and possibly hiding a real problem. If the trip speed is set too high, the governor may not protect the elevator equipment from further damage. To ensure the overspeed governor is set at the correct trip speed, the governor shall be calibrated every six years and the trip speed adjustment shall be lock wired or sealed. Lock wiring or sealing the adjustment is necessary to ensure no unauthorized changes to the trip speed have been made between calibrations. A tag shall be attached to the governor stating the date of calibration, the testing activity, and the calibration speed.

772-5.4.9.2 Mechanical Safety Subsystem Test. The mechanical safety subsystem (MSS) test demonstrates the capability of the MSS to wedge the knurled rollers against the guide rails. This is accomplished by manually actuating the MSS and verifying contact between the knurled roller and the guide rail. If the platform has broken rope devices installed, these are also demonstrated by setting the platform on supports or the buffer springs. When the hoist ropes become slack, the broken rope devices actuate the MSS to wedge the knurled rollers.

772-5.4.9.3 No-Load Slow Speed Test. The No-Load Slow Speed test demonstrates the ability of the knurled rollers to stop, and hold level a moving platform. The test is usually performed by manually actuating the overspeed governor while the platform is moving down at slow speed. This test is performed with no-load on the platform and at slow speed to minimize damage to the elevator if the MSS is misadjusted, allowing the platform to tilt.

772-5.4.9.4 No-Load Rated Speed Test. The No-Load Rated Speed test provides an intermediate step in the testing of the MSS. This test is accomplished by manually actuating the overspeed governor while the unloaded platform is moving down at rated speed. Performing this test with no-load on the platform minimizes the damage which might occur if the MSS is improperly adjusted.

772-5.4.9.5 Rated-Load Rated Speed Test. The Rated-Load Rated Speed test provides a realistic representation of system operation during an actual overspeed condition. This test shall only be accomplished after successful completion of the previous osg/MSS tests. This test is accomplished by manually actuating the overspeed governor, while the platform is moving down at rated speed with the rated-load. When the MSS is properly adjusted, the rated-load rated speed test will not damage the elevator. Some localized denting of the guide rails from the knurled rollers is normal and should be dressed smooth before resuming normal operations.

772-5.4.10 INSPECTION AND TEST RECORDS. Following satisfactory completion of periodic inspections, overhaul load tests and post-repair load tests, all test information and data, including [Figure 772-5-1](#), shall be maintained by the officer responsible for elevator maintenance. The elevator shall be marked in accordance with paragraph [772-4.6.5](#).

772-5.4.11 WIRE ROPE END FITTING TEST PROCEDURES. Wire ropes are used in several different locations in the elevator system, such as the hoist machinery, overspeed governor, doors, and ramps. General requirements for the installation and testing of the wire ropes and their end fittings are contained in NSTM Chapter 613 . Two exceptions to the test requirements are the end fittings for ramp wire ropes and the drum end of the hoist wire ropes. These fittings shall be assembled and inspected in accordance with the requirements of NSTM Chapter 613 ; no pull testing is required.

772-5.4.12 WIRE ROPE REPLACEMENT CRITERIA. When practical and appropriate, wire rope replacements should be made during regular overhauls. Wire ropes should be scheduled for replacement at the soonest

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availability after any replacement criterion on the wire rope inspection MRCs have been met. Individual wire ropes on an 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 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 may lead to seawater or AFFF 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 operations caused by the loss or downgrading of an elevator.

772-5.4.13 CONTROLLED ASSEMBLY. Controlled assembly is a process for ensuring maintenance completed was authorized, proper material utilized, critical technical specifications met, and required tests satisfactorily completed. Quality assurance personnel provide verification of satisfactory performance of the work procedure.

772-5.4.13.1 Procedure. The controlled assembly procedure shall provide sufficiently detailed instruction to ensure the work can be performed correctly. The controlled assembly procedure shall:

- a. Identify the general scope of work to be performed.
- b. Identify the specific piece of equipment to be repaired/replaced.
- c. List all applicable reference sources.
- d. Identify the required precautions.
- e. Identify any special conditions.
- f. List required tools.
- g. List required replacement parts.
- h. Provide a step-by-step work procedure with appropriate signature blanks for each step, detailing disassembly, repair, assembly, inspection and adjustments.
- i. Provide a step-by-step test procedure with appropriate signature blanks for each step, and include initial conditions, precautions and the test sequence.
- j. Provide for review and certification of accomplishment by designated QA personnel.

772-5.4.13.2 Documentation. The planning yard shall review the controlled assembly procedure to ensure the correct technical specifications or requirements are provided. The planning yard generally has the resource information (drawings, original calculations, etc.) available to correctly identify the necessary replacement parts, tools and other products required to completely define the job requirements.

772-5.5 EXCEEDING RATED-LOAD

772-5.5.1 GENERAL. The inspection, testing, and reporting requirements to reuse an elevator after its rated-load has been exceeded during operation are explained in paragraphs [772-5.5.2](#) through [772-5.5.5](#). This section does not apply to exceeding rated-load during elevator testing.

772-5.5.2 DETERMINING OVERLOAD CONDITION. When the rated-load capacity has been exceeded, the elevator should be placed temporarily out of commission. Once the overload has been determined, a departure-from-specification should be forwarded to the TYCOM. The departure-from-specification should describe the overload condition, identify inspections and tests to be performed prior to reuse, and recommended elevator restrictions. An elevator which has been overloaded should not be used for cargo or ordnance handling prior to testing and being placed back in service.

772-5.5.3 OVERLOAD INSPECTION REQUIREMENTS. A visual inspection of all load bearing and load controlling components shall be performed. Discrepancies noted in load bearing and load controlling components shall be corrected prior to load testing. If immediate repair or replacement of defective components cannot be accomplished due to the nature of the deficiency, load testing and limited load handling operations may be authorized by the Commanding Officer in his/her departure-from-specification report.

772-5.5.4 OVERLOAD TESTING REQUIREMENTS. Following satisfactory completion of the inspections defined in paragraph [772-5.5.3](#), testing shall be performed in accordance with paragraphs [772-5.4.4](#) through [772-5.4.7](#), to include a no-load test, a static test, a dynamic test, and a rated-load test. Upon the satisfactory completion of the required inspections and tests, the elevator may be placed back into commission.

772-5.5.5 FORK TRUCK OVERLOADING. There are some situations where an elevator may be overloaded due to the transportation of a fork truck between levels. These unique situations can only be authorized by NAVSEA in response to an appropriate waiver request.

SECTION 6.

TRAINING AND QUALIFICATION

772-6.1 INTRODUCTION

772-6.1.1 TRAINING. The Navy Training Systems Plan (NTSP) for Shipboard Cargo/Weapons Elevators (NTP-S-40-7901) identifies training requirements for elevator operators and maintenance personnel. The NTSP supports and/or identifies:

- a. Formal training
- b. On-board proficiency/team training
- c. Billet and personnel requirements for each applicable ship class
- d. Personnel Qualification Standards (PQS)
- e. Related NTSPs
- f. Related training

772-6.1.2 QUALIFICATION. To ensure the safe and efficient operation and maintenance of shipboard cargo/weapons elevator systems, Commanding Officers shall promulgate a qualification program for elevator operators and maintenance personnel. This program shall include, as a minimum, the requirements listed in NAVEDTRA 43108, Personnel Qualification Standards (PQS) for Weapons/Cargo Elevators, and any other PQS applicable to the ship's cargo/weapons elevator systems.

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772-6.2 TRAINING

772-6.2.1 FORMAL TRAINING. Formal elevator operator and maintenance training is available in a 4 week training course at Navy Training Center (NTC), Great Lakes. The training curriculum is structured into two tracks. Track 1, electrical maintenance, leads to the assignment of Navy Enlisted Classification (NEC) 4671; track 2, mechanical maintenance, leads to the assignment of NEC 4296. Both tracks receive common training in system introduction, basic theory of operation, and basic troubleshooting in addition to their respective electrical and mechanical maintenance instruction. The elevator curriculum utilizes a Full-Scale Elevator Trainer (FSET), to supplement classroom instruction and provide hands-on operator and maintenance training.

772-6.2.2 ON-BOARD PROFICIENCY/TEAM TRAINING. On-board operator and maintenance training has been developed in accordance with ship's respective technical manuals. Training is divided into three modules: operator training, maintenance training, and troubleshooting. These modules may be presented in part or together, depending on the ship's needs. These courses are funded by Type Commanders and conducted by Fleet Technical Support Centers.

772-6.2.3 RELATED TRAINING. A partial listing of other elevator training and associated system training is provided in [Appendix B](#).

772-6.3 SHIPBOARD TRAINING AND QUALIFICATION

772-6.3.1 SHIPBOARD ORGANIZATION. Commanding Officers shall designate in writing:

- a. **Qualifying Officer.** An officer of the command, department head, to be responsible for the implementation, management, and administration of training, testing, and qualification of elevator operators and maintenance personnel. This officer shall make final recommendation to the Commanding Officer, or his/her designated representative, for all PQS watchstation qualifications, and shall sign the PQS final qualification card in the line reserved for the department head recommendation.
- b. **Qualifying Personnel.** PQS qualified personnel, normally E-5 and above, responsible for training, testing, and signing off individual PQS practical factors.

772-6.3.2 QUALIFICATION REQUIREMENTS. Selected elevator operator and maintenance candidates shall successfully complete a training and qualification program before receiving final qualification as elevator operators or maintenance personnel. The training and qualification program shall include:

- a. All applicable elevator PQS.
- b. Training requirements identified in PQS. These requirements are considered the minimum necessary to attain qualification.
- c. Formal watchstation qualification through completion of all applicable PQS practical factors.
- d. Oral and written examinations for each PQS watchstation. Examinations shall be administered upon completion of all PQS line items for the applicable watchstation. Examination questions, both oral and written, shall be taken directly from PQS fundamentals, systems, and watchstation practical factors. The oral examination shall be administered in the presence of the Qualifying Officer. Minimum passing grade for the written examination is 70%.
- e. Final qualification. Upon completion of PQS fundamentals, systems, watchstation practical factors, examina-

tions, and with appropriate recommendations of the chain-of-command, the Commanding Officer, or his/her designated representative, may approve final qualification. Each PQS watchstation requires separate final qualification.

772-6.3.3 ORDNANCE QUALIFICATION. Elevator operators, safety observers, and safety supervisors must complete final watchstation PQS qualifications prior to being qualified under the Explosives Handling Personnel Qualification and Certification Program (OPNAVINST 8023.2 Series and CINCLANTFLT/CINCPACFLT 8023.5 Series). Annual recertification for ordnance handling requires maintenance of elevator PQS qualifications; annual PQS requalification is not required.

772-6.3.4 DURATION OF QUALIFICATION. Qualification, unless revoked for cause, shall remain valid until the qualified person transfers to another command, or is assigned to duties not involving elevator operations and/or maintenance for a period greater than three months.

772-6.3.5 DISQUALIFICATION. Elevator operators and maintenance personnel shall be disqualified and removed from watchstanding duties for any of the following reasons:

- a. If determined to be responsible for a reportable mishap, in accordance with OPNAVINST 5102.2 Series, Accident Investigation and Reporting
- b. Significant or recurring safety infractions
- c. Bypassing elevator safety features

772-6.3.6 REQUALIFICATION. Requalification is required whenever a previously qualified person returns to duties involving elevator operations and/or maintenance, reports from another command, or has been disqualified for cause. Requalification requirements include:

- a. Successful completion of a comprehensive examination on applicable PQS fundamentals and systems for the watchstation(s) in which the person is attempting requalification. Failure to successfully complete examination shall require the person to complete applicable PQS fundamentals and systems.
- b. Successful completion of watchstation practical factors; practical factors shall not be waived.

772-6.3.7 RECORDS. Training and qualification records shall be maintained for each elevator operator and maintenance person. Records shall include:

- a. PQS final qualification cards for each watchstation for which a person is qualified
- b. A copy of the written exam, or a record of the grade received, for each watchstation
- c. Records of all training received, to include formal, on-board, or related systems training

APPENDIX A

REFERENCE MATERIAL

Table 772-A-1 REFERENCE MATERIAL

CODE OF FEDERAL REGULATIONS:		
Title 46, Part 146-29	-	Detailed Regulations Governing the Transportation of Military Explosives and Hazardous Munitions Onboard Vessels
Title 49, Parts 171-179	-	Hazardous Materials Regulations of the Department of Transportation
OPNAV INSTRUCTIONS:		
3100.6 (Series)	-	Special Incident Reporting (OP-REP-3) Procedures
5100.19 (Series)	-	Navy Occupational Safety and Health (NOSH) Program Manual for Forces Afloat
5102.1 (Series)	-	Accident Investigation and Reporting
8020.8 (Series)	-	Responsibilities of Naval Commands with Respect to the Department of Defense Explosive Safety Board (DDESB)
8023.2 (Series)	-	U. S. Navy Explosives Safety Policies, Requirements and Procedures
8023.20 (Series)	-	Waivers and Exemptions of Explosives Safety Requirements; Policies and Procedures for Requesting
NPFC PUBLICATION:		
2002	-	Navy Stock List of Forms and Publications
NAVSEA INSTRUCTIONS:		
8020.9 (Series)	-	Non-Nuclear Ordnance and Explosive Qualification Certification Program
NAVSHIPS/NAVSEA PUBLICATIONS:		
NAVSEA S9086-AA-STM-000 (NSTM)	-	Naval Ships' Technical Manual Index
NAVSEA S9AA0-AA-SPN-010/GEN SPEC	-	General Specifications for Ships
NAVSEA S9AA0-AB-GOS-010/GSO	-	General Specifications for Overhaul of Surface Ships
NAVSEA S9000-AB-GTP-010	-	Shipboard Safety and Damage Control Facilities for Stowage of Hypergolic Fueled Missiles and Fuel-Air-Explosive (FAE) Bombs
NAVSHIPS 0250-LP-560-4000	-	Lighting on Naval Ships
NAVSHIPS 348-LP-078-1000	-	Magazine sprinklers system description operation and maintenance
NAVSHIPS 0900-068-8010	-	Torpedo MK 48 Safety Criteria and General Casualty Control Procedures for OTTO Fuel II Spills and Hot Runs
NAVSEA/NAVORD PUBLICATIONS:		
OP O	-	Index of Naval Sea Systems Command Ordnance Publications
OP 4	-	Ammunition Afloat
OP 1014	-	Ordnance Safety Precautions; Their Origin and Necessity

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Table 772-A-1 REFERENCE MATERIAL - Continued

CODE OF FEDERAL REGULATIONS:		
OP 2165, Volumes 1 and 2	-	Navy Transportation Safety Handbook for Hazardous Materials
OP 2173, Volumes 1 and 2	-	Approved Handling Equipment for Weapons and Explosives
OP 2238/NAVAIR 11-1-117	-	Identification of Ammunition
OP 3206	-	Handling and Stowage of Naval Ordnance Aboard Ammunition Ships
OP 3221/TM 55-607	-	Shiploading and Dunnaging of Military Explosives Cargo Aboard Merchant Type Ships
OP 3347	-	United States Navy Ordnance Safety Precautions
OP 3368	-	Otto Fuel II Safety, Storage and Handling
OP 3565/NAVAIR 16-1-529	-	Hazards of Electromagnetic Radiation to Ordnance Personnel and Fuel (U)
OP 4098	-	Handling Ammunition, Explosives, and Hazardous Materials with Industrial Materials Handling Equipment (MHE)
OP 4550	-	Handling and Stowage of Amphibious Assault Ammunition Aboard Amphibious Ships
NAVSEA/NAVORD OD'S:		
OD 44941	-	Periodic Testing Arrangements for Ordnance Handling Equipment

APPENDIX B**LISTING OF CARGO/WEAPONS ELEVATOR AND ASSOCIATED SYSTEM TRAINING**

The following Navy training courses and schools are available through the Naval Education and Training Command (NAVEDTRA) & Type Commanders (TYCOM):

Table 772-B-1 LISTING OF CARGO/WEAPONS ELEVATOR AND ASSOCIATED SYSTEM TRAINING

NUMBERS	COURSE TITLE	COURSE LOCATION	LENGTH OF COURSE
A-690-0099	Cargo/Weapons Elevator Maintenance (Electrical)	SSC Great Lakes	26 days
A-690-0100	Cargo/Weapons Elevator Maintenance (Mechanical)	SSC Great Lakes	26 days
A-100-0072	Miniature Electronics Repair	Various	26 days
A-651-0053	Machinist Mate Class A	SSC Great Lakes	26 days
K-652-2146	Engineering Hydraulic Systems and Components Basic	FTC San Diego FTC Norfolk	12 days
A-662-0016	Electricians Mate Class A	SSC Great Lakes	26 days
J-662-0044	Electrical Control Devices	FTC Norfolk	24 days
A-662-0156	Solid State Uninterruptible	NCTC DET Sheppard AFB	122 days
K-690-0028	Underway Replenishment Mechanical and Hydraulic Component Maintenance	EWTGLANT (Eff: Jun 97)	47 days
K-690-0029	UNREP Electrical and Electronic Controls Maintenance	EWTGLANT (Eff: Jun 97)	19 days

APPENDIX C

FEATURES REQUIRED TO BE IN GOOD WORKING CONDITION FOR SAFE ELEVATOR OPERATION

Features and their in-service limits required for safe elevator operation

This appendix provides the list of features which must be in good working condition for an elevator to be considered safe to operate. It also provides the in-service limits for the material condition of each feature.

The in-service limits are to be used during normal elevator operation, troubleshooting, scheduled maintenance and as the basis for other inspections such as elevator support unit visits and underway material inspections. When any of the listed features are missing or has deteriorated beyond these limits, the elevator is unsafe to operate. The missing or deteriorated feature must be repaired, readjusted, replaced or installed prior to further elevator operation. When missing or deteriorated applicable feature(s) cannot be installed, repaired or replaced in a timely manner, and mission essential elevator operation is being suspended, a request for Departure From Specification (DFS) shall be submitted. The DFS will be approved only when operational restrictions or alternative means of attaining elevator safety can be implemented.

The in-service limits should not be confused with the requirements stated in the System Operability Tests (SOT) level III, because the SOT level III requirements are more rigid. SOT level III tests are depot level tests, which are performed periodically and after each major elevator overhaul/repair. SOT level III tests are designed to demonstrate that the elevator system or elevator feature has been properly installed, overhauled or repaired to original design operating and performance characteristics.

Table 772-C-1 FEATURES REQUIRED TO BE IN GOOD WORKING CONDITION FOR SAFE ELEVATOR OPERATION — HOISTING MACHINERY

FEATURES		IN-SERVICE LIMITS
HOISTING MACHINERY		
1	Machinery foundations, welds, and fasteners	All fasteners are properly sized, installed and tight. No cracked, deformed, loose, or missing components apparent by visual and hands-on inspection. No more than 15% loss in material thickness of strength bearing portions is permitted.
2	Brake	Unloaded platform stops from down high speed in less than 3 ft. Brake adjustment shall meet the requirements in the applicable MRC. No loose electrical connections based on visual inspection. No loose or missing fasteners which would directly result in brake failure.
3	Reduction/pinion/bull gear set	No unusual noise during operation. No cracked or broken reduction/pinion/bull gear teeth visible through inspection port.
4	Hoisting machinery shafts/couplings/bearings/keys/keyways	All fasteners are properly sized, installed and tight. No cracked, deformed, or missing components apparent by visual and hands-on inspection. No unusual noise during operation.
5	Hoist wire rope sheaves	Sheaves shall rotate freely and have no unusual noise during operation. Sheave foundations and ship structure at foundations are free of visible cracks or deformation. All fasteners are properly sized, installed and tight.
6	Hoist wire ropes	No kinks visible with wire rope tensioned by weight of platform. No visible signs of "hour-glass" shaped wire ropes, indicating failed core. No more than 6 broken wires per rope lay length or no more than 3 broken wires per strand in a rope lay length.

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Table 772-C-1 FEATURES REQUIRED TO BE IN GOOD WORKING

CONDITION FOR SAFE ELEVATOR OPERATION — HOISTING

MACHINERY - Continued

FEATURES		IN-SERVICE LIMITS
HOISTING MACHINERY		
7	Hoist wire rope end fittings	No cracked, deformed, loose, or missing components apparent by visual and hands-on inspection. No evidence of wire rope pulling from end fitting. Fiege fittings shall have wires visible through the inspection hole.
8	Hoist rope end fitting-to-platform or trunk attachments	All fasteners/hardware are properly sized, installed and tight. No cracked, deformed, loose or missing components apparent by visual and hands-on inspection. No more than 15% loss in material thickness of strength bearing portions is permitted.
9	Platform structure	No cracked, missing, or loose components apparent by visual and hands-on inspection. No more than 15% loss in material thickness of strength bearing portions is permitted.
10	Guide rollers/blocks/rails	Guide rollers/blocks/rails shall be adjusted to prevent platform shifting more than $\pm 3/8$ inch, at the upper terminal and sequence level, in the horizontal direction. All fasteners are properly sized, installed and tight.
11	Platform-to-deck and platform-to-trunk clearances	When all ramps are retracted, clearance between the platform and any deck, trunk structure, wiring, piping, etc. shall be greater than 1/2 inch in all parts of the trunk where the platform may travel (including normal travel and overtravel). This clearance may be less than 1/2 inch if the maximum possible platform movement is less than the clearance.
12	Positionable guide rail actuator in way of in-trunk hatches	Actuators shall be securely attached to foundation. No cracked, deformed, loose, or missing components apparent by visual and hands-on inspection of actuator foundation or ship's structure in the area of the foundation.
13	Guide rail segment securing device in way of in-trunk hatches	Rail segment securing device shall operate freely through entire range of motion and securely latch the rail in-line with the fixed rails. No cracked, deformed, loose, and missing components apparent by visual and hands-on inspection.

FEATURES REQUIRED TO BE IN GOOD WORKING CONDITION FOR
SAFE ELEVATOR OPERATION — INTERLOCKS & SAFETY DEVICES

FEATURES		IN-SERVICE LIMITS
INTERLOCKS & SAFETY DEVICES		
1	Overspeed Governor (OSG)	When the OSG is actuated, the OSG shall engage the Mechanical Safety Subsystem (MSS). When the OSG is actuated, OSG switch shall disconnect power to hoist motor and brake, causing the brake to set. OSG counterweights move freely throughout full range of motion and contact the OSG stop (bail) block. No cracked, deformed, loose, or missing components apparent by visual and hands-on inspection. OSG shall have been calibrated within the last six years and the trip speed adjustment shall be lock-wired or sealed to provide an indication if the adjustment has changed.

FEATURES REQUIRED TO BE IN GOOD WORKING CONDITION FOR
SAFE ELEVATOR OPERATION — INTERLOCKS & SAFETY DEVICES -

Continued

FEATURES	IN-SERVICE LIMITS
INTERLOCKS & SAFETY DEVICES	
2	<p>Broken Rope Safety Device (BRSD)</p> <p>Slacking all the hoist ropes shall cause the BRSD(s) to engage the Mechanical Safety Subsystem (MSS).</p> <p>* A BRSD is not required on the following elevators, due to the platform's ability to wedge in the trunk if hoist ropes on one side of the platform were to break (part): SHIP/CLASS ELEVATOR NO.</p> <p>AE 21 Class 1-7 AOE-1 & 2 1A, B & 2A, B AOE-3 & 4 1A, B & 4A, B CV 62 LS3, 8 CV 63 LS3, 6 CV 64 LS3, 6 CV 66 LS4, 5; US1, 2, 4 CV 67 US1 CVN 65 LS4, 4A, 7, 7A US12, 15 CVN 68-71 LS1-6; US1, 2, 4 CVN 72-75 LS1-6; US1-3 LHA 1 Class 4, 5F, 5A, 10 LKA 113 Class 1-4, 6</p>
3	<p>Mechanical Safety Subsystem (MSS)</p> <p>When the OSG is manually actuated with the platform moving down in slow speed (jog or after the platform has traveled one deck height while manually releasing the brake), the MSS shall set the knurled rollers, stopping the platform, such that at least one knurled roller shall wedge against each guide rail. Wedged shall be defined as in contact with the guide rail and wear plate or tapered surface of safety block.</p> <p>If the above criteria can not be satisfied, the following alternate criteria may be substituted:</p> <ul style="list-style-type: none"> •When the MSS is actuated manually at a point close to the OSG wire rope connections, with the platform stationary, and a knurled roller contacts the guide rail and wear plate or tapered surface of safety block, all other rollers in that horizontal plane shall be within .030 inch of the guide rail and in contact with the wear plate or tapered surface of safety block. For elevators with double guide rollers assemblies, this procedure should be repeated for both horizontal planes.
	AND
	<ul style="list-style-type: none"> •When the unloaded platform is moving downward by manually releasing the brake and the OSG is manually actuated, the MSS shall stop the platform by setting one or more knurled rollers.
	<p>When the BRSD(s) is/are actuated, the MSS shall set the knurled rollers such that at least one roller shall wedge against each guide rail. Wedged shall be defined as stated above. Knurled rollers shall reset, and remain reset, after hoist ropes are tensioned by platform weight. No cracked, deformed, loose, or missing components apparent by visual and hand-on inspection.</p>
4	<p>Spring buffers in pit</p> <p>No cracked or deformed components apparent by visual and hands-on inspection. All springs are in place, captured to prevent movement out of position, and each spring is free to compress. The springs, foundations, and supporting deck shall have no more than 15% loss in material thickness.</p>

FEATURES REQUIRED TO BE IN GOOD WORKING CONDITION FOR
SAFE ELEVATOR OPERATION — INTERLOCKS & SAFETY DEVICES -

Continued

FEATURES		IN-SERVICE LIMITS
INTERLOCKS & SAFETY DEVICES		
5	Hoist Wire Rope Slack Rope Device	When actuated (platform resting on buffer springs, ropes slack), each slack rope device shall disconnect power to the hoist motor and brake causing the brake to set.
6	Positive stops at upper terminal level	Positive stops shall be positioned (and rope end fittings adjusted) such that in an up-overtravel, the platform is stopped, horizontally within ± 1 inch at any edge, by the positive stops before any contact occurs between any other components, including: <ul style="list-style-type: none"> •hoist rope end fittings and sheaves, •hoist rope end fittings (or platform) and OSG •OSG rope end fitting and OSG or lead sheave. Guide rail mounted, clamping type positive stops fasteners shall be properly sized and installed. No cracked, deformed, loose, or missing components apparent by visual and hands-on inspection.
7	Lighting in trunk and/or adjacent decks to provide adequate visibility at each level used for operation	Enough light fixtures are functioning to provide adequate visibility in trunk and/or adjacent decks. Specifically, there is enough light to allow cargo loaders and elevator operators to ensure that loads are not overhanging the edges of the platform.
8	Personnel guards in trunks, on platform or decking around platform at all levels	At any load level the gap between the platform and the deck apron, coaming, trunk, or other structure shall not exceed six inches, unless one of the following is installed: <ul style="list-style-type: none"> •Bulkhead mounted safety barrier within six inches of the platform and a minimum of 36 inches in height. •Platform mounted liferails/end guards a minimum of 36 inches in height.
9	Personnel guards around rotating machinery	Metal guards shall be installed around all wire rope drums, couplings, exposed gears, and hoist wire ropes that are easily accessible to operating personnel.
10	Securing Device (holds vertical-sliding-up and all hinged doors/hatches in open position; holds ramp in stowed positions except no securing device required for hydraulically operated hinged doors)	Door/hatch/ramp securing device shall operate freely through entire range of motion and securely latch the door/hatch/ramp in the open/stowed position. No cracks, deformation, loose, or missing components apparent by visual and hands-on inspection.
11	Door physical interlocks (where no personnel barriers are installed)	Each elevator door shall be interlocked to prevent opening unless the platform is at that level. When the elevator serves more than one space at a level, the door to each space shall be interlocked so only one of the doors can be undogged and open at a time.
12	Door to platform interlocks (where no personnel barriers are installed)	Each elevator door shall be interlocked with the control system such that all doors must be closed before platform can be jogged, dispatched, or called.
13	Hatch electrical interlock	Upward platform movement shall be stopped at least six feet from a hatch that is not fully open and latched. Downward platform movement shall be stopped before platform comes off rails or strikes an in-trunk hatch which is not fully open and latched.

FEATURES REQUIRED TO BE IN GOOD WORKING CONDITION FOR
SAFE ELEVATOR OPERATION — INTERLOCKS & SAFETY DEVICES -

Continued

FEATURES		IN-SERVICE LIMITS
INTERLOCKS & SAFETY DEVICES		
14	Fork Trunk Guards (FTG) at each trunk opening served by fork trucks where structural doors are not installed.	The FTG shall automatically open to a minimum height of 8 inches when the platform leaves that level. It can be depressed with force no greater than 120 lbs and latched down when platform is at the level and cannot be latched down after platform leaves.
15	Audible alarm for open trunk elevators.	The platform motion warning horn or bell shall sound automatically during platform movement. The alarm should be audible to a person on the deck at the trunk opening farthest from the alarm bell.
16	Overhead Safety Guards for operator-rider elevator control station.	An overhead safety guard covering operator station completely (on platform) shall be installed.
17	Personnel barrier interlock	Each personnel barrier shall have an electrical interlock switch preventing elevator operation from any control station, when any one barrier is not installed across the trunk opening.
18	Communications for elevators where hatch is not fully visible to operator or call type control system exists	When hatch controls do not allow full hatch visibility, there shall be an operable communication circuit between safety observer stationed at the hatch and the hatch operator. When elevator has call type control system there shall be an operable communication circuit between all operating levels (calling, loading/unloading).
19	Positionable guide rail Interlock (where guide rails translate or rotate)	Platform shall not travel past sequence level with rail out of position and shall stop if rail moves out of position while platform is below the sequence level.
20	In-trunk interference electrical interlock	All equipment that may be temporarily positioned within the elevator trunk, such as EOH platforms, booms, and monorails, shall be electrically interlocked to prevent platform motion unless the equipment is clear of the elevator platform.

FEATURES REQUIRED TO BE IN GOOD WORKING CONDITION FOR
SAFE ELEVATOR OPERATION — CONTROLS

FEATURES		IN-SERVICE LIMITS
CONTROLS		
1	Elevator logic controller	Elevator successfully dispatches and stops in accordance with SOT I test. Elevator does not exhibit inadvertent starts, stops, or unexpected response to control switches. No moisture or broken connections apparent in the controller based on visual inspection.

FEATURES REQUIRED TO BE IN GOOD WORKING CONDITION FOR
SAFE ELEVATOR OPERATION — CONTROLS - Continued

FEATURES	IN-SERVICE LIMITS
CONTROLS	
2	<p>In-Trunk Platform Control Switches</p> <ul style="list-style-type: none"> •Terminal level slow and stop switches •Up overtravel switch •Up high speed stop switch •Sequence level slow, stop and up high speed stop switches
	<p>Switches are correctly oriented and securely fastened. Platform shall slow and stop (terminal/sequence level) or stop (up overtravel/high speed stop) when the switch(es) is/are actuated in accordance with SOT II.</p> <p>The mechanical limit switch are roller shall not be less than 3/4 inch from either edge of the cam.</p> <p>At least 1/2 of the proximity switch face shall be covered by the flag when the switch is actuated. The proximity switch-to-flag distance shall be greater than 1/4 inch but closer than:</p> <p>Switch Type Distance (inches)</p> <p>Go Switch 11/16 (model 43-100D, 300D)</p> <p>Go Switch (all others) 7/16</p> <p>Cutler Hammer 1-7/8</p> <p>Navy Std. (MIL-S-24711) 1-3/8</p> <p>The capture (vane) type switch shall be aligned with the switch vane such that the switch body and vane do not come into contact with each other throughout the full travel of the vane through the switch.</p>
3	<p>Platform mounted targets (vaness/flags/cams) for terminal level Slow and Stop switches, and sequence level switches.</p>
	<p>Targets (vaness/flags/cams) are correctly oriented and securely mounted to platform. No cracked, deformed, loose, or missing components apparent by visual and hands-on inspection.</p>
4	<p>A platform mounted target (vane/flag/cam) to actuate Up-High Speed Stop (UHSS) and Up-Overtravel (UOT) switches (separate from target that actuates deck-level switches in up direction).</p>
	<p>This target (vaness/flags/cams) shall be correctly oriented and securely mounted to platform. No cracked, deformed, loose, or missing components apparent by visual and hands-on inspection.</p>
5	<p>Motor controller contactors (U, D, HS, LS)</p>
	<p>No loose or missing electrical or mechanical connections on motor controller contactors apparent by visual and hands-on inspection. Contactor armature operates smoothly with no evidence of binding or sticking when manually depressed.</p>
6	<p>Run/Stop Switch</p>
	<p>Each control station area and platform (operator-rider elevator only) shall have a Run/Stop switch. With any Run/Stop switch in the STOP position, it shall not be possible to dispatch or jog platform from any control station.</p>
7	<p>Power disconnect switch with undervoltage trip or shunt trip function.</p>
	<p>The undervoltage or shunt trip system shall disconnect power to the elevator when any E-Stop pushbutton is depressed or, when the terminal level up high speed stop or sequence level up/down high speed stop switch is actuated when the platform is traveling in high speed.</p>
8	<p>Master Control Lever on Person-Rider elevators.</p>
	<p>Control lever is securely fastened and switch positions are clearly labeled. Lever spring returns to center (stop) after release. The control lever shall be protected to prevent an inadvertent actuation.</p>

FEATURES REQUIRED TO BE IN GOOD WORKING CONDITION FOR
SAFE ELEVATOR OPERATION — CONTROLS - Continued

FEATURES		IN-SERVICE LIMITS
CONTROLS		
9	Emergency Stop (E-STOP) mushroom pushbuttons.	Open trunk elevators shall have an E-Stop at each control station and in the machinery room. Closed trunk elevators on non-CV/CVN without a master control station shall have an E-Stop at each control station and the machinery room. Closed trunk elevators on CV/CVN and other ships with a master control station shall have an E-Stop at the master control station, secondary master control (if applicable) and machinery room. Depressing any E-Stop pushbutton shall trip (open) the U/V circuit or energize the shunt trip circuit to open the circuit breaker. The E-Stop pushbutton location shall be readily accessible.
10	Positive control of powered closures (to allow operator to stop door/hatch movement at any time).	For powered hatches except in-trunk hatches, the hatch controls shall be such that hatch movement can be stopped within six inches. For powered doors, a spring return-to-off control switch, manual valve, or momentary contact pushbuttons shall be installed such that operator must be constantly holding switch, valve handle, or pushbutton in the "OPEN" or "CLOSE" position for door movement to continue, and door movement stops when operator releases switch or manual valve.

FEATURES REQUIRED TO BE IN GOOD WORKING CONDITION FOR
SAFE ELEVATOR OPERATION — CLOSURES

FEATURES		IN-SERVICE LIMITS
CLOSURES		
1	Closure hinges	Hinges and their attachments to ship's structure shall not have any missing or loose hardware or visible cracks. Hinges shall operate freely through entire range of motion without unusual noise.
2	Closure actuators	Actuators shall be securely attached to foundation. No cracked, deformed, loose or missing components apparent by visual and hands-on inspection.
3	Personnel barriers across trunk openings where interlocked closure doors are not installed.	A safety net, minimum 42 inches in height, shall be strung across each trunk opening, at all levels served, to prevent a person from falling in trunk. All hardware shall be in good working order and properly sized.
4	Door/hatch guide rails and rollers	Door/hatch rollers shall be securely attached. Door/hatch shall operate freely in the guide rails through the complete range of motion. Rollers must engage rails sufficiently to avoid door/hatch coming adrift. No cracked, loose, or missing components apparent by visual and hands-on inspection.
5	Door/hatch/ramp wire rope	No kinks visible with wire rope under normal tension. No more than 6 broken wires per rope by length or no more than 3 broken wires per strand in a rope lay length.
6	Door/hatch/ramp wire rope end fittings	No cracked, deformed, loose, or missing components apparent by visual and hand-on inspection. No evidence of wire rope pulling from end fitting. Fiege fittings shall have wires visible through the inspection hole.
7	Lifelines around flight and hangar deck opening hatches	Lifelines shall be installed around hatch openings on the flight, hangar, and weather decks. Minimum allowable height is 36" at low point in catenary of chain/lifeline.

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FEATURES REQUIRED TO BE IN GOOD WORKING CONDITION FOR
SAFE ELEVATOR OPERATION — CLOSURES - Continued

FEATURES		IN-SERVICE LIMITS
CLOSURES		
8	Personnel barrier across trunk opening in machinery room	A locked door with a posted warning sign, gate, safety net, or liferail/chain shall be installed across opening in machinery room to prevent a person from falling into trunk.
9	Removable panels across trunk openings (J-"Panel" Doors) for open trunk elevators when personnel barriers are not erected.	Each panel shall fit securely in the tracks to close the elevator opening. The door panels shall be restrained such that a panel will not give way if a person leans on the panel.

REAR SECTION

NOTE

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