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MILITARY SPECIFICATION

ELEVATOR, WEAPON AND CARGO, ELECTROMECHANICAL (SHIPBOARD)

This specification is approved for use by the Naval Sea Systems Command and is available for use by all Departments and Agencies of the Department of Defense.

1. SCOPE

1.1 Scope. This specifications covers the general requirements for the design, construction, testing, and installation of electromechanical elevators used to handle bombs, ammunition, weapons, other explosives, and general cargo for shipboard applications.

1.2 Design philosophy. The design philosophy for the electromechanical elevators is to use, the latest standardized construction techniques and to achieve reliability and maintenance levels in accordance with requirements specified herein.

1.3 Classification. Electromechanical elevators covered by this specification shall be of the following types, classes, control systems, and methods specified (see 6.2.1):

Type I - Standard platform (see 3.5.2).
Type II - Special platform (see 3.5.3).
Class 1 - Four guide rail with four-wire rope suspension.
Class 2 - Special guide rail and wire rope suspension.
Control 1 - Manual, nonselective (see 3.16).
Control 2 - Automatic (see 3.17).
Method A - Electrolmechanical relay logic (see 3.17.5).
Method B - Programmable controller (see 3.17.6).
Method C - Static logic (see 3.17.7).

2. APPLICABLE DOCUMENTS

2.1 Issues of documents. The following documents, of the issue in effect on date of invitation for bid or request for proposal, form a part of the specification to the extent specified herein.

SPECIFICATIONS

FEDERAL
FF-B-171 - Bearings, Ball, Annular (General Purpose).
FF-B-185 - Bearings, Roller, Cylinderical; and Bearings, Roller, Self-Aligning.
FF-B-187 - Bearing, Roller, Tapered.
FF-B-195 - Bearing, Sleeve, Bronze, Plain or Flanged.
FF-S-85 - Screw, Cap, Slotted and Hexagon Head.
FF-S-86 - Screw, Cap, Socket-Head.
FF-S-92 - Screw, Machine: Slotted, Cross-Recessed or Hexagon Head.
FF-S-200 - Setscrew: Hexagon Socket and Spline Socket, Headless.
FF-S-210 - Setscrews; Square Head and Slotted Headless.
QQ-S-763 - Steel Bars, Wire, Shapes and Forgings, Corrosion-Resisting.
QQ-Z-325 - Zinc Coating, Electrodeposited, Requirements for.
RR-W-410 - Wire Rope and Strand.
TT-P-645 - Primer, Paint, Zinc-Chromate, Alkyd Type.
GGG-P-781 - Puller, Mechanical Puller Attachment, Mechanical and Puller Set, Mechanical.

Beneficial comments (recommendations, additions, deletions) and any pertinent data which may be of use in improving this document should be addressed to: Commander, Naval Ship Engineering Center, SEC 6124, Department of the Navy, Washington, DC 20362 by using the self-addressed Standardization Document Improvement Proposal (DD Form 1426) appearing at the end of this document or by letter.

MILITARY

MIL-S-901 - Shock Tests, H.I. (High Impact); Shipboard Machinery, Equipment and Systems, Requirements for.
MIL-E-917 - Electric Power Equipment, Basic Requirements For (Naval Shipboard Use).
MIL-S-1222 - Studs, Bolts, Hex Cap Screws, and Nuts.
MIL-L-2105 - Lubricating Oil, Gear, Multipurpose.
MIL-C-2212 - Controllers, Electric Motor, AC or DC and Associated Switching Devices, Naval Shipboard.
MIL-R-2765 - Rubber Sheet, Strip, Extruded, and Molded Shapes, Synthetic, Oil Resistant.
MIL-P-3184 - Packaging of Machinery: Deck and Vehicle Mounted with Associated Equipment and Repair Parts.
MIL-F-3541 - Fittings, Lubrication.
MIL-B-3990 - Bearings, Roller, Needle, Airframe, Antifriction.
MIL-B-5687 - Bearing, Sleeve, Washers, Thrust, Sintered, Metal Powder, Oil Impregnated.
MIL-W-5693 - Wire Strand, Steel (Corrosion-Resistant) Preformed (Aircraft Applications).
MIL-B-8942 - Bearing, Plain, Tfe Lined, Self-Aligning.
MIL-B-8943 - Bearing, Sleeve, Plain and Flanged, Tfe Lined.
MIL-B-8948 - Bearing, Plain, Rod End, Tfe lined, Self-Aligning.
MIL-B-13506 - Bearing, Sleeve (Steel-Backed).
MIL-P-15024 - Plates, Tags and Bands for Identification of Equipment.
MIL-P-15024/5 - Plates, Identification.
MIL-S-15083 - Steel Castings.
MIL-E-15090 - Enamel, Equipment, Light-Gray (Formula No. 111).
MIL-P-15328 - Primer (Wash) Pretreatment, Blue (Formula No. 117-B for Metals).
MIL-S-16113 - Steel Plate, High Tensile (HT), Hull and Structural.
MIL-B-16392 - Brakes, Magnet, Naval Shipboard.
MIL-M-17060 - Motors, 60 Hertz, Alternating Current, Integral HP, (Shipboard Use).
MIL-C-17361 - Circuit Breakers, Air, Electric, Insulated Housing, (Shipboard Use).
MIL-B-17380 - Bearing, Roller, Thrust.
MIL-P-17545 - Primer Coating, Alkyd-Red Lead Type Formula No. 116 and Formula No. 116D.
MIL-F-18240 - Fastener, Externally Thread, 250°F, Self-Locking Element for.
MIL-R-19523 - Relays, Control, Naval Shipboard.
MIL-S-22473 - Sealing, Locking, and Retaining Compounds; Single-Component.
MIL-S-22698 - Steel Plate, Carbon, Structural, for Ships.
MIL-D-23003 - Deck Covering Compound, Nonslip, Lightweight.
MIL-B-23063 - Bearing, Ball, Annular, Instrument Precision.
MIL-P-23236 - Paint Coating Systems, Steel Ship Tank, Fuel and Salt Water Ballast.
MIL-S-24093 - Steel Forgings, Carbon and Alloy Heat Treated.
MIL-I- 24137 - Iron Castings, Nodular Graphitic (Ductile Iron) and Nodular Graphitic (Corrosion Resisting, Austenitic Low Magnetic Magnetic permeality) (For Shipboard Application).
MIL-G-24139 - Grease, Multi-purpose, Quiet Service.
MIL-D-24483 - Deck Covering, Spray-on, Nonslip.
MIL-N-25027 - Nut, Self-Locking, 250°F, 450°F, and 800°F, 125 KSI FTU, 60 KSI FTU, and 30 KSI FTU.

STANDARDS

MIL-STD-130 - Identification Marking of US Military Property.
MIL-STD-167-1 - Mechanical Vibrations of Shipboard Equipment (Type I-Environmental and Type II - Internally Excited).
MIL-STD-167-2 - Mechanical Vibrations of Shipboard Equipboard (Reciprocating Machinery and Propulsion System and Shafting) Types III, IV and V.
MIL-STD-278 - Fabrication, Welding and Inspection; and Casting Inspection and Repairing for Machinery, Piping and Pressure Vessels in Ships of the United States Navy.
MIL-STD-461 - Electromagnetic Interference Characteristics Requirements for Equipment.
MIL-STD-721 - Definitions of Effectiveness Terms for Reliability, Maintainability, Human Factors, and Safety.
MIL-STD-740 - Airborne and Structureborne Noise Measurements and Acceptance Criteria of Shipboard Equipment.

STANDARDS (Continued)

MIL-STD-781 - Reliability Tests: Exponential Distribution.
MIL-STD-1399, Section 103 - Interface Standard for Shipboard Systems, Electric Power, Alternating Current.
MS15004 - Fittings, Lubrication (Hydraulic) Surface Check, 1/4-28 Taper Threads, Nickel-Copper Alloy, Type IV.
MS15005 - Fittings, Lubrication, Throat or Surface Check, 1/8 Pipe Threads, Nickel-copper Alloy Type V.
MS17324 - Meter, Time Totalizing, 60 Cycle.
MS21209 - Insert, Screw Thread, Coarse and Fine, Screw Locking, Helical Coil, CRES.
MS33537 - Insert, Screw Thread, Helical Coil, Coarse and Fine Thread, Standard Dimensions For.

HANDBOOKS

MILITARY

MIL-HDBK-231 - Encoder Shaft Angle to Digital.

PUBLICATIONS

MILITARY

NAVSEA 0908-LP-000-3010 - Surface Ship Shock Design Criteria.
NAVSEA 0900-LP-008-2010 - Instructions for Design and Care of Wire Rope Installations.

(Copies of specifications, standards, drawings, and publications required by contractors in connection with specific procurement functions should be obtained from the procuring activity or as directed by the contracting officer.)

2.2 Other publications. The following documents, form a part of this specification to the extent specified herein. Unless otherwise indicated, the issue in effect on date of invitation for bids or request for proposal shall apply.

NATIONAL BUREAU OF STANDARDS

Handbook H28 - Screw Thread Standards for Federal Services.

(Application for copies should be addressed to the Superintendent of Documents, Government Printing Office, Washington, D.C. 20402.)

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

B15.1 - Mechanical Power Transmission Apparatus, Safety Standard for.
B46.1 - Surface Texture.

(Application for copies should be addressed to the American National Standards Institute, 1430 Broadway, New York, NY 10018.)

AMERICAN GEAR MANUFACTURERS ASSOCIATION (AGMA)

(Application for copies should be addressed to the American Gear Manufacturers Association, 1330 Massachusetts Avenue, N.W., Washington, D.C. 20005.)

AMERICAN IRON AND STEEL INSTITURE (AISI)

Steel Product Manual

(Application for copies should be addressed to the American Iron and Steel Institute, 150 East Forty-Second Street, New York, NY 10017.)

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

ASME Boiler and Pressure Code, Section III, Rules for Construction of Nuclear Vessels.

(Application for Copies should be addressed to the American Society of Mechanical Engineers, 345 East 47th St. New York, N.Y. 10018.)

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

ICS-1970 Industrial Controls and Systems, Part 2-321B.

(Application for copies should be addressed to the National Electrical Manufacturers Association, 155 East 44th Street, New York, N.Y. 10017.)

STEEL STRUCTURES PAINTING COUNCIL
Surface Preparation Specification - SSPC-SP10

(Application for copies should be addressed to the Steel Structures Painting Council, 4400 5th Avenue, Pittsburgh, PA 15213.)

(Technical society and technical association specifications and standards are generally available for reference from libraries. They are also distributed among technical groups and using Federal agencies.)

3. REQUIREMENTS

3.1 General characteristics. Elevator shall be electric, winding drum type consisting basically of an electric motor drive and a platform lifted by means of wire rope winding on one or more drums. Elevator component requirements shall be as specified herein.

3.2 Material and components. Material shall be as specified herein. Components that are in or supported by the Federal Supply system shall be used to the fullest extent possible.

3.2.1 Magnesium or its alloys shall not be used. Cast iron or brittle material is prohibited, where the command or agency accepts its use for a particluar application or it is proven acceptable by mechanical shock tests. Brittle material is material showing less than 10 percent elongation in 2 inches for the standard tensile test. For the static loading case (normal ship operation), brittle material is material being used below its Nil Ductility Transition (NDT) temperature as measured by the Naval Research Laboratory (NRL) drop weight test. Charpy V-notch impact strength values may be used as criteria when these have been correlated with drop weight test results.

3.2.2 Aluminum alloys T-6061-T6 and 70XX-T6 shall not be used for load bearing fittings and components.

3.2.3 Steel plate shall be in accordance with MIL-S-22698 or MIL-S-16113.

3.2.4 Cast steel to be welded shall conform to grade B of MIL-S-15083.

3.2.5 Forged steel to be welded shall conform to class H, type V of MIL-S-24093.

3.2.6 Fabrication, welding, and inspection. Fabrication, welding, and inspection shall be in accordance with MIL-STD-278, class M. Where practicable, welded steel construction shall be used in lieu of castings. Equipment exposed to the weather shall have continuous welds. The design shall eliminate pockets where water can collect.

3.2.7 Castings shall be nondestructively tested in accordance with MIL-STD-278.

3.2.8 Mercury. Mercury in any form shall not be used in shipboard equipment, including materials and parts thereof. Mercury shall not be used in manufacturing and test processes (including test equipment such as mercury indicators) applying to the basic equipment; but may be used in the manufacturing and test processes for materials and parts provided it is used in such a way that the materials and parts themselves cannot be contaminated. No instruments containing mercury shall be used in the manufacture of testing of any equipment destined for installation on a nuclear powered ship. Test reports (see 4.7) shall contain a certification signed by a responsible official of the contractor that no mercury instruments containing have been used in the manufacture or testing of the equipment.

3.2.9 Materials shall be free from any defects that might affect the serviceability or appearance of the finished product.

3.2.10 Preferred material reference. Where materials of identical or equal quality can be identified by more than one specification or standard, the drawings shall reference only one such specification or standard. In selecting the specification or standard to be referenced for material not specified, the following is the order of preference:

(a) Industry and technical society specification or standard.
(b) Military specification.
(c) Federal specification.
(d) Manufacturer's specification or standard.

3.2.11 Material substitutions. Where materials other than as covered by 3.2.10(b), and (c) are to be used, the drawings shall show the complete chemical and physical properties of the material.

3.3 Design.

3.3.1 Special emphasis shall be placed on producing equipment which will have minimum weight and require a minimum of space.

3.3.2 Elevators shall withstand dynamic forces produced by motion of the ship in a seaway. Elavators shall be capable of holding the rated-load and maintaining a static position under storm conditions and loading factors as specified (see 6.2.1).

3.3.3 Elevators shall be capable of operating with rated-load and at rated-speed under the moderate sea conditions and loading factors or motion conditions as specified (see 6.2.1).

3.3.4 Equipment installed in locations exposed to the weather shall be capable of operating satisfactorily throughout an ambient temperature range of minus 20°C to plus 65°C. Equipment not exposed to the weather shall be capable of operating satisfactorily throughout an ambient temperature range of 0°C to plus 50°C.

3.3.5 The elevator shall not require replacement of component parts during a minimum life of 250,000 cycles at an operation rate of 16 cycles per hour for 10 hours per day, unless otherwise specified (see 6.2.1). A cycle is a round trip between the extremes of the elevators hoist and lower range. Exceptions to part replacement requirement are the planned replacement type components such as the hoist ropes, brake linings, and relay contacts.

3.3.6 Elevators requiring operators to ride the platform shall have safety guards to protect personnel against falling objects and platform overtravel into the overhead.

3.3.7 Elevator equipment shall be capable of "fail-safe" operation. This is defined as the ability to maintain the safety of the weapon or cargo, equipment, and personnel at all times. Failure of the power source or manual or power-operated drive mechanism shall not result in damage to the weapon or cargo, handling equipment, or jeopardize the safety of personnel or result in uncontrolled movement of the equipment and load. In event of power failure, the elevator shall be immobilized. "Fail-safe" shall not be applied to static components or to structural members or other static parts of mechanisms.

3.3.8 Lubrication fittings in accordance with MS15004, MS15005, and types V, VII, and VIII of MIL-F-3541 shall be provided for bearing points not equipped with special lubrication means. Fittings shall be accessible for the use of a hand lubrication gun and shall utilize the same type and grade of lubricant. Where practicable, points requiring lubrication may be permanently lubricated for the life of the elevator except that lubrication points exposed to weather shall be provided with lubrication fittings with flushing vents. When installed onboard ship, equipment and machinery shall maintain satisfactory lubrication with no loss of lubricant under the pitch, roll, trim, and list conditions as specified (see 6.2.1).

3.3.9 Where used, straight cut keyways in couplings and gear shafts shall be closed end to prevent loss of keys.

3.3.10 Bearings capable of meeting the physical, functional, environmental, and service life requirements of the application shall conform to one or more of the following specifications:

FF-B-171	MIL-B-3990	MIL-B-8948
FF-B-185	MIL-B-5687	MIL-B-13506
FF-B-187	MIL-B-8942	MIL-B-17380
FF-B-195	MIL-B-8943	MIL-B-23063

Rotating anti-friction bearings shall be selected to result in an L-10 life of not less than 10,000 hours. Design shall be such as to permit the replacement of bearings with one of the tools contained in a Naval shipboard set of tools specified in GGG-P-781. Where special tools are required. They shall be provided. Special tools are defined as those tools not listed in the Federal Supply Catalog (copies of this catalog may be consulted in the office of the Defense Contract Administration Service (DCAS)). Brass or bronze bearing surfaces shall not be used in direct sliding or rolling contact with stainless steel.

3.3.11 Screw threads, except as noted below, shall be unified 2A/2B fit in accordance with Handbook H28. Class 3 fit shall be used for the setting end of studs and for special fitted work where thread interference is required and disassembly is unlikely. Thread locking compound, in accordance with MIL-S-22473, grade CV (blue) or commercially available loctite 242 (blue) shall be used. When grade A high-impact shock in accordance with

MIL-S-901 is specified, unified 3A/3B fit shall be used in lieu of unified 2A/2B and bolts and nuts shall be of the plastic insert, self-locking type. Bolts for holding-down grade A and grade B equipment to their foundations or sub-bases shall be installed in holes no greater than the following sizes:

Nominal bolt diameter (inches)	Maximum diameter of hole (inches)
3/4 and smaller	Nominal bolt diameter plus 1/32
Larger than 3/4	Nominal bolt diameter plus 1/16

NOTE: The above applies to clearance holes only. Where alinement must be maintained, fitted bolts or dowels shall be used (see 3.3.20).

3.3.12 Cap screws, machine screws, setscrews, bolts, and nuts shall comply with FF-S-85, FF-S-86, FF-S-92, FF-S-200 or FF-S-210 and MIL-S-1222.

3.3.13 For a threaded fastener, not less than one thread but no more than four threads shall protrude beyond the crown of the nut. With plastic insert self-locking nuts, the end of the thread runout shall be at least one thread above the top of the plastic insert. Washers shall not be used under the nut for the sole purpose of lessening thread protrusion.

3.3.14 Thread engagement for the setting end of a stud shall be such that the shear load strength of the engaged threads is more than the tensile load strength of the stud.

3.3.15 For materials having similar mechanical properties, the full thread engagement of studs shall be not less than 1 major diameter (ID). For materials having dissimilar mechanical properties, the minimum engagement of stud setting threads shall be computed in accordance with Handbook H28, part I, appendix 5, using the maximum tensile strength of the stud material and minimum specified tensil strength of the body material, plus one thread; but in no instance less than ID.

3.3.16 Bottom tapping is permissible only where metal thickness is insufficient for ID full thread engagement plus thread run-out and beveled end. Bottom-tapped holes shall have full threads for the entire depth.

3.3.17 Foundation bolts or studs shall comply with MIL-S-1222, grade 5 and shall be not less than 1/2 inch in diameter.

3.3.18 Through-bolting shall be used wherever possible. Foundation bolting, wherever possible, shall be installed with the bolt head down. Where use of such bolting is not possible, studs, tap bolts, socket head, or machine screws shall be used.

3.3.19 For foundation bolting, forged steel nuts shall be examined for defects in accordance with MIL-S-1222. Nuts machined from steel bars shall be only from stock found by magnetic analysis to have no seam depth outside the limits for cold finished bars in accordance with the AISI Steel Products Manual. To prevent loosening due to shock or vibration, self-locking nuts in accordance with MIL-N-25027 shall be used. Bolts shall have self-locking elements as specified in MIL-F-18240, except for use with self-locking nuts.

3.3.20 Foundation and bedplate hold-down, shear, alinement bolting, and doweling shall be fitted and the holes reamed with the coupled parts in position. Where practicable, the shank of the bolt shall have definite interference with the metal surrounding the hole. Shear shall be through the body of the bolt, not through threaded portion. The fit shall be as specified in table I. The mating surfaces of the bolt and bolt hole shall have a maximum surface smoothness of 63 micro-inches roughness height rating (RHR) in accordance with ANSI B46.1.

TABLE I. Fit limits for fitted hold-down bolting.

Nominal size (inches)	Maximum clearance (+) and interference (-), inches
1/2 to 1-1/8	+ 0.0005 - .0010
1-1/4 to 1-7/8	+ .0006 - .0013
2 to 3	+ .0007 - .0016

3.3.21 Aluminum and aluminum alloy parts shall be assembled with steel bolts zinc-coated in accordance with QQ-Z-325. This also applies to aluminum and aluminum alloy parts mounted on steel. Where the connection is exposed to moisture, bolts made of corrosion-resistant steel conforming to QQ-S-763 shall be used. Where through-bolting is not possible, corrosion-resistant steel inserts to take fasteners shall be turned into the aluminum or aluminum alloy. Inserts shall be collar-, key-, pin-, ring-, or swage-locked, or nylon-element locked to prevent backing out. Where bolting stress is primarily in tension, solid wall, (bushing) type inserts shall be used. Where bolting stress is primarily in shear and tension stress is negligible, either solid wall, (bushing) type or helical coil type stainless steel inserts in accordance with MS33537 and MS21209 may be used; except that the latter type shall not be used where bolt thread engagement is less than 1D. Helical, coil type inserts are also excluded where bolt engagement is less than 1-1/2D. Alloys of copper (brass, copper-nickel) shall not be used in threaded contact with aluminum or aluminum alloys. Washers of the same material and coating as the bolts and nuts shall be provided below all nuts and bolt heads which adjoin aluminum or aluminum alloys.

3.3.22 Metallurgy processes shall not be used for fasteners fabricated by powder.

3.3.23 Where a thread-sealing or thread-locking compound is used the material and its application shall comply with MIL-S-22473.

3.3.24 Stationary machinery or components weighting in excess of 90 pounds shall be provided with padeyes, eyebolts, or equivalent means for attachment of lifting gear.

3.3.25 Elevator systems shall be in accordance with NAVSEA 0908-LP-000-3010 and shall be capable of meeting the shock requirements of MIL-S-901, when specified (see 6.2.1).

3.3.26 When specified (see 6.2.1) elevator systems shall meet the vibration requirements of MIL-STD-167-1 and MIL-STD-167-2.

3.3.27 Explosionproof equipment requirements shall be as specified (see 6.2.1).

3.3.28 When air or electrical power is required on a platform, take-up devices shall be provided to keep the hoses and electric cables under control and functioning properly. Sheaves for electric cables shall have flat-bottomed grooves with loose fit.

3.3.29 Elevator systems shall be designed to allow rotating machinery to be installed with the axis of rotation as nearly horizontal to the baseline and parallel or perpendicular to the longitudinal centerline of the ship as practicable.

3.3.30 Elevator systems shall be designed and tested to meet the airborne noise requirements of MIL-STD-740. The contractor shall obtain measurements in accordance with the requirements, measurements, and data reporting procedures of MIL-STD-740. The equipment shall not exceed grade D airborne noise criteria of MIL-STD-740.

3.4 Factors of safety and maximum allowable stresses.

3.4.1 Wire rope. The factor of safety for wire rope shall be a minimum of 5, based on the ratio of the minimum breaking strength as specified in RR-W-410 to the operating design load. Single suspension, including multiple purpose arrangements, shall have a minimum factor of safety of 10. Operating design load is an equivalent load consisting of a load equal to the rated-load (total load plus platform weight), plus the load imposed by the dynamic forces of the ship during equipment operating conditions, plus the load due to acceleration, or deceleration of the handling equipment. In cases where the equipment is required to move and support weapons at inclined angles, design consideration shall be based on the appropriate vector component of the operating design and holding design loads as applicable.

3.4.1.1 Hoisting machinery, platform, and structural parts. Calculated stresses shall not exceed the following:

(a) Under equipment operating conditions, combined stresses, acting both individually and concurrently, for machine and structural components not exceed 35 percent of the yield point of the material in any part.
(b) The allowable combined stress for the hoisting machinery and structural components shall not exceed 70 percent of the yield point of the material when the platform has reached the extremity of its movement or is physically restrained against further movement; or under the maximum torque of the electric motor or the brake, whichever is greater.

(c) In stress calculations, the following strength relationship shall exist:

(1) Design:

Strength (working loads)	Percent of tensile yield point
Direct shear	60
Torsional shear	65
Compression (bearing)	160

(2) Other values may be used if substantiated by test and accepted by the command or agency concerned.

(d) Parts subject to fatigue from cyclic stresses shall not exceed the maximum stresses specified 3.27.3 for the required design life.

3.5 Platform.

3.5.1 The platform shall be a fabricated structure consisting of a frame and deck. The overall size, clear load area, and ingress and egress routes to avoid interferences with door and hatch cover operating gear, ramps, speed governor device, and so forth shall be as specified (see 6.2.1).

3.5.1.1 The types of loads, manner handled, and their weight and centers-of-gravity to aid in the design of the platform frame and deck shall be as specified (see 6.2.1). Platform decking shall be capable of withstanding the maximum specified wheel loading without permanent deformation.

3.5.1.2 The top surface of the elevator platform shall be covered with a slip-resistant deck covering conforming to MIL-D-23003, type II or MIL-D-24483, type I. Black and yellow diagonally striped borders 4-inches wide, minimum, shall be painted on the perimeter of the platform to indicate unsafe loading areas.

3.5.2 Type I. Standard platforms shall have a flat-loading area and shall be provided with flush recessed tie-down fittings for securing loads.

3.5.2.1 Tie-down fittings shall be provided to permit varied loadings on the elevator platforms. Fittings shall be located to insure that loads can be positioned on the platform within the designated safe loading area as specified (see 6.2.1). The quantity and spacing of the fittings shall be as specified (see 6.2.1).

3.5.2.2 Side-loading elevator platforms shall withstand the static and dynamic forces imposed during elevator platform loading operations. Unless otherwise specified (see 6.2.1), these forces shall consist of those imposed by driving two fork-lift trucks or pallet transporters each carrying a maximum weapon or cargo load simultaneously side-by-side onto the elevator platform, with the platform 1/2-inch above or below the level of the deck, and applying the brakes to stop the trucks or transporters.

3.5.2.3 End-loading elevator platforms shall withstand the static and dynamic forces imposed during elevator platform loading operations. Unless otherwise specified (see 6.2.1), these forces shall consist of those imposed by driving two fork-lift trucks or pallet transporters each carrying a maximum weapon or cargo load simultaneously onto opposite ends of the same elevator platform, with the platform 1/2-inch above or below the level of the deck, and applying the brakes to stop the trucks or transporters.

3.5.3 Type II. Special platforms shall be as specified (see 6.2.1).

3.5.4 Lockbars. Lockbars shall be furnished when specified (see 6.2.1). Lockbars shall be capable of engagement and disengagement with platform loaded or unloaded. Lockbars shall be able to engage their sockets when platform is plus or minus 1/2 inch out of level with deck or stowage position. The end of the elevator hoisting ropes shall be spring-loaded to prevent excessive stress on the wire rope during lockbar engagement. Springs shall be preloaded to a value 10 percent greater than the force due to a fully loaded platform.

3.5.4.1 When specified (see 6.2.1), lockbars for stowage purposes shall be capable of withstanding grade A, high-impact shock as specified in MIL-S-901 with platform unloaded.

3.5.5 Switch cams and vanes. Cams and vanes for operating the various control switches shall be made in accordance with control manufacturer's specifications.

3.6 Safety devices. Safety devices as specified herein shall be provided for all elevators. Linkages for the safety devices shall have positive action in both the operating and retracting direction of operation. Safety devices shall be readily accessible for examination, maintenance, repair, and test.

3.6.1 Broken rope safety device. The broken rope safety device shall consist of a system of spring-operated levers and shafts connected to each hoisting rope and operated so that:

(a) Breaking of any of the hoisting ropes shall cause the lever and shaft to activate the broken rope device and simultaneously wedge knurled rollers against all guide rails to prevent further downward movement of the platform.
(b) Device shall automatically reset for normal elevator operation by raising the platform.
(c) Broken rope device and speed governor safety device shall each be able to operate and wedge the knurled rollers independently of the other.

3.6.2 Speed governor safety device. Speed governor safety device shall operate in the event the elevator reaches a downward speed of 40 percent more than the rated-speed or a maximum speed 175 feet per minute (ft/min) whichever is lesser and shall comply with the following:

(a) Safety device shall operate an electrical switch to disconnect power from the electric motor and set the electric brake.
(b) Governor rope shall be attached to the platform in such a manner that after safety device operates, further downward movement of the platform will simultaneously wedge knurled rollers against all of the guide rails.
(c) Governor rope shall be a minimum of 1/4 inch diameter, 7 X 19 in accordance with MIL-W-5693.
(d) Safety device shall automatically reset for normal elevator operation by raising the platform.
(e) Means for adjusting the length of the rope shall be provided.

3.6.3 Speed governor slack rope safety device. Speed governor slack rope device shall operated an electrical switch to disconnect power from the electric motor and set the brake should the speed governor rope become slack or broken. The slack rope device shall automatically reset for normal elevator operation when the rope becomes tight.

3.6.4 Hoisting rope-slack rope safety devices. Hoisting rope-slack rope safety device shall be designed to operate an electrical switch to disconnect power from the electric motor and set the brake should any hoisting rope become slack. Slack rope devices are required on each hoisting rope on the elevator. They shall be designed to automatically reset for normal elevator operation when ropes become tight.

3.7 Guide rails and rollers. Steel guide rails shall be used to guide the platform. Guide rails shall withstand the stopping of a fully loaded platform resulting from the application of safety devices and shall hold a fully loaded platform under storm conditions as specified (see 6.2.1). Guide rails shall be of sufficient length to permit a minimum of 3 inches of overtravel at the top and bottom of elevator travel. Fitted bolts shall be used to secure the rails to their foundations at installation.

3.7.1 Unless otherwise specified (see 6.2.1), elevators shall be furnished with "T" rail or angle shaped guide rails and arranged as shown on figure 1. Guide rollers shall be adjustable spring-load to allow for plus or minus 1/4 inch of side or end movement of the platform and for misalinement of the guide rails in a four-guide rail system. One roller and safety shoe assemble shall operate on each rail except two assemblies shall be provided to span any gaps which may be required for hatch cover installations.

3.7.2 When specified (see 6.2.1) by the procuring activity, the master guide rail concept as shown on figure 2 shall be used for the guide rail and guide roller installation. The master guide rail shall restrain that corner of the platform in both the fore-aft direction and athwartship direction. The secondary master rail shall restrain rotary motion of the platform. Each master rail shall provide continuous roller running surfaces for the entire length of travel. Guide rollers shall be of fixed type and mounted in housings

attached to the platform. A 1/16-inch clearance shall be provided between rollers and rail surface. One guide roller assembly and one safety shoe assembly shall operate on each master rail. One safety shoe assembly shall operate on each safety rail except two safety shoe assemblies shall be provided to span any gaps which may be required in the safety rails for hatch cover installations.

3.8 Hoisting rope. Wire ropes for raising and lowering the platform shall be type I, class 3, 6 by 37 construction 7 or 8 Independent wire rope core (IWRC), uncoated, extra improved plow steel in accordance with RR-W-410. Rope size for the elevator shall be selected in accordance with 3.4.1 and have a maximum stretch of 1/2-inch between loaded and no-load condition at any level. Ropes shall permit the lowering of the platform to the fully compressed bumper and have remaining on the drum not less than 1-1/2 turns. Ropes shall be secured to the inside of the winding drums with drum sockets or dead-end clamps. Means shall be provided to adjust the length of each rope.

3.9 Bumpers. Spring type bumpers shall be furnished for installation in the elevator pit to stop the platform in the event of overtravel when traveling at full rated-load and speed.

3.10 Sheaves. Sheaves shall be provided to guide the hoisting ropes and speed governor rope. Depth, throat, rim thickness, neck, and groove diameters of sheaves shall be in accordance with NAVSEA 0900-LP-008-2010. Tread diameter of sheaves shall be as large as practicable and in no case shall the diameter be less than 21 times the wire rope diameter. Sheaves shall be shrouded to keep the rope in place under all conditions and shall be mounted on anti-friction roller bearings. Sheaves shall be mounted to the foundations with fitted bolts.

3.11 Hoisting machinery.

3.11.1 Drums. Hoisting drums shall be grooved and of sufficient size to stow the hoisting rope in one layer without rubbing of one part of wrap of rope against another. The maximum fleet angle between hoisting drum and sheaves shall be as small as practicable and not greater than 2 degrees. The method of proportioning the hoisting drums shall be as specified in NAVSEA 0900-LP-008-2010. Pitch diameter of drum shall be a minimum of 30 times the rope diameter. Pitch diameter tolerances for hoisting drums shall be held to a minimum so that elevator will be not be more than 1/8-inch out of level between the top and bottom of travel. Speed governor drum shall have the same pitch diameter and tolerance as the hoisting drum. Drums shall have expanded metal guards for personnel safety. Hand holed in the guards may be used for aid in correction of slack rope conditions.

3.11.2 Gearing. Gearing shall be spur or helical in accordance with AGMA publications. The minimum service factor shall be 1.50. Gearing shall have machine cut teeth and a 20 degree pressure angle or larger. Gearing shall be totally enclosed in a single oil tight case and shall be lubricated by an oil bath. Gear cases shall permit ready examination, repair, and removal of gears. Nuts and bolts within gear cases shall be drilled and wired. Sealing gaskets shall be in accordance with MIL-R-2765. Oil filling, drainage, and vent fitting shall be provided. The filler hole shall have a strainer, fixed with fasteners requiring hand tools for removal. Caps or covers shall be provided. A dipstick shall be provided for indicating the oil level. The dipstick shall be marked to indicate the "full" and "add oil" oil levels. Oil seals shall be provided to prevent leakage of oil where shafts penetrate the gear housing. Shafts shall be mounted on anti-friction bearings. Bearings shall be fitted for high pressure grease lubrication, except that bearings in gear casings may be oil lubricated if proper and adequate circulation of oil through the bearing is provided under all operating conditions including list. When grease lubricated, a seal shall be installed to prevent the oil and grease from mixing. Lubricating oil shall be in accordance with MIL-L-2105. Grease shall be in accordance with MIL-G-24139.

3.11.3 Couplings. Flexible couplings shall be all-metal of the gear or spring grid type and installed to connect the electric motor to the hoisting machinery except where the electric motor is integral to the elevator hoisting machinery. Units of the machinery shall be mounted on a common bedplate. A friction clutch or other nonpositive method of drive shall not be used between the drive electric motor and the hoisting drums.

3.11.4 Shafts. Drum shafts shall be mounted in self-alining spherical roller bearings in accordance with FF-B-185, class 6. Long shaft runs may have flexible metallic couplings installed. Bearings shall allow for expansion and contraction of shaft length and shall be fitted with high-pressure grease fittings and vents.

3.11.5 Bedplates. Bedplates shall be of welded steel construction, stiff enough to maintain alinement of machinery mounted thereon without aid from the deck foundation. Bedplates shall be furnished with flat machined underside and topside bearing surfaces.

3.12 General requirements for electrical equipment.

3.12.1 Electrical equipment shall be in accordance with the requirements of MIL-E-917.

3.12.2 Solenoid which operate valves shall be rated for continuous engergization.

3.12.3 Electrical equipment shall operate on a ship's power supply, 440 volts, 3 phase, 60 hertz, (Hz), three-wire ungrounded type 1 power complying with the steady state and transient characteristics and ranges as specified in MIL-STD-1399, section 103.

3.13 Electric hoisting motors.

3.13.1 Unless otherwise specified (see 6.2.1), electric motors shall be in accordance in the following requirements of MIL-M-17060:

(a) Frame and service-service A; "T" frame.
(b) Ambient temperature-50°C.
(c) Voltage-440.
(d) Duty-intermittent.
    (1) Number of starts.
    (2) Number of plug stops.
    (3) Number of direct current (dc) dynamic braking stops.
    (4) Number of plug reversals.
    (5) Connected inertia at shaft speed.
    (6) Starting torque.
    (7) Acceleration torque.
    (8) Periods of running.
    (9) Condition of loads during running, including no-load conditions.
    (10) Time frame for one complete duty cycle, (1) through (9).
    (11) The maximum periods and sequence of times the duty cycle (1) through (9) will be imposed in a 24-hour period.
    (12) In applications where the duty cycle may be more severe by operator control or by change in equipment operation mode, which could result in exceeding motor thermal limits mechanically or electrically, the motor shall then be provided with the following thermal protection:
        a. A minimum of three imbedded integral thermal temperature detectors.
        b. Temperature detectors shall be compatible with a circuit which provides a means external to the motor of calibrating the operating set point of the temperature sensing network.
        c. The signal from operating of the temperature sensing network at the set point shall be capable of energizing an alarm or de-engerizing the motor control.
(e) Enclosure-dripproof protected or explosionproof, group D.
(f) Horsepower.
(g) Speed-1800 revalutions per minute (r/min), single speed or 1800 r/min and 300 r/min, two-speed.
(h) Type-squirrel cage induction.
(i) Design-D.
(j) End shield design.
(k) Bearing type-ball.
(l) Conduit openings.
(m) Insulation-class B, F, or H.
(n) Numbers of motors per ship-one for each elevator.
(o) Degree of balance-standard.
(p) Structureborne noise levels.
(q) Type of shock test-type A.
(r) Levels of preservation, packaging, packing and marking.

3.13.2 Torque requirements. For two-speed squirrel cage induction motors, the locked rotor torque at low speed shall be not less than 180 percent of the high speed full-load torque.

3.14 Electric brakes.

3.14.1 Unless otherwise specified (see 6.2.1), brakes shall be of the disc type in accordance with the following requirements of MIL-B-16392:

(a) Torque.
(b) Supply voltage-110 or 440 volts.
(c) Duty-continuous.

(d) Mounting-motor mounted.
(e) Enclosure-dripproof or explosionproof, class I, group D.
(f) Brake coil: class H insulation.

3.14.2 In addition to the requirements of MIL-B-16392, the brake shall comply with the following:

(a) Rotating brake discs shall be provided with heavy duty lining bonded to a bronze carrier ring.
(b) Stationary discs shall be nodular or ductile iron, in accordance with MIL-I-24137.

3.14.3 A brake controller shall be provided where required. When such a controller is required, the supply voltage of 3.14.1(b) shall mean the supply voltage to the controller. If the controller is housed in a separated enclosure, the enclosure shall be of the same type as the motor controller enclosure (see 3.15.3.1).

3.14.4 The brake shall have a capacity to stop the platform within a distance of 3-feet while the platform is travelling downward at rated-speed and supporting 150 percent of rated-load. The brake shall also have a capacity to hold the platform while supporting 200 percent of the rated-load.

3.15 Control system.

3.15.1 The elevator control system shall consist of a motor controller, a power disconnect switch, control devices, and control stations as are required for proper operation of the elevator. For control 2, method B and C, a motor controller and separate logic controller shall be provided.

3.15.2 The control system shall:

(a) Permit the motor to start and accelerate to high speed.
(b) Automatically transfer the motor to low speed.
(c) Automatically stop the platform within plus or minus 1/4 inch of the selected level when loaded or unloaded.

3.15.3 Motor controller and associated master switches.

3.15.3.1 Unless otherwise specified (see 6.2.1), motor controllers and master switches shall be in accordance with the requirements of MIL-C-2212, with the following characteristics:

(a) Voltage and phase rating 440 Volts, 3 phase, 60 Hz.
(b) Control voltage-110 volts, 60 Hz, single-phase.
(c) Duty and service-special.
(d) Operation-magnetic or solid-state.
(e) Emergency run feature-required.
(f) Protection-low voltage protection, overload relay and imbedded motor temperature sensing devices.
(g) Enclosure-dripproof.
(h) Indicator lights - see 3.15.3.2 (h) through (k).

3.15.3.2 The following control devices shall be provided in the machinery room:

(a) "Emergency Stop" momentary contact pushbutton switch with normally open contacts.
(b) "Normal-Stop" maintained position selector switch.
(c) "Emergency Run" momentary contact pushbutton switch.
(d) "Overtravel Bypass" momentary contact pushbutton switch.
(e) "Slack Rope Bypass" momentary contact pushbutton switch.
(f) "Jog Down - Off - Jog Up" selector switch with a spring return to "Off" position.
(g) "Normal - Jog" maintained position selector switch.
(h) "Power Available" indicator light with white lens.
(i) "Stop" indicator light with red lens.
(j) "Motor Overtemperature" indicator light with red lens.
(k) "Motor Overload" indicator light with red lens.
(l) Operating time indicator (elapsed time meter) in accordance with MS17324 (National Stock No. 6645-00-952-9069).

3.15.3.3 Magnetic contactors shall be used for "Up", "Down", "High Speed" and "Low Speed" and shall be of the same NEMA size and rating. The contactors shall be electrically and mechanically interlocked to prevent both of the speed and both of the direction contactors from operating simultaneously. Contactors for jogging service shall be derated as specified in NEMA ICS-1970, part 2-321B.

3.15.3.4 The control system power shall be derived from a 440/115 volt transformer installed within the motor controller and shall be provided with protective fuses. The secondary winding shall not be grounded; the primary and secondary winding shall be electrically isolated from each other.

3.15.4 Each control system shall be provided with a separately mounted manually operated power disconnect switch, type AQB in accordance with MIL-C-17361, modified for NBQ operation and containing a shunt trip coil. The current rating of the switch when actuated shall safely interrupt power to the motor under conditions of fault current. The shunt trip coil shall operate from 110 volts, 60 Hz power. The switch shall be so connected that the shunt trip coil will be energized when any "emergency stop" switch is actuated. Power for the shunt trip coil shall be derived from the same source as the control system and shall not be interrupted by additional fusing. The disconnect switch shall be provided with an enclosure of the same type as provided for the motor controller.

3.15.5 The power disconnect switch, motor controller, and logic controller shall be located in the elevator machinery room in a readily accessible location.

3.15.6 Limit switches.

3.15.6.1 Electromechanical limit switches shall be in accordance with the requirements of MIL-C-2212 as follows:

(a) Voltage rating-115 volts, single-phase.
(b) Location-remote.
(c) Enclosure-watertight or explosionproof as specified (see 6.2.1).
(d) Contacts-at least one set of normally closed and one set of normally open contacts, electrically isolated from each other.
(e) Construction-heavy duty with a 2 inch minimum roller diameter.

3.15.6.2 Proximity switches shall be in accordance with the following:

(a) Enclosure - watertight and capable of withstanding repeated immersion in petroleum based, water-glycol, and phosphate ester based synthetic hydraulic oils.
(b) Maximum switching hysteresis - less than 0.1 inch. This is the distance between the point of actuation and, upon return of the target along the same path over the face plate of the switch, the point of deactuation.
(c) Maximum actuating distance - not less than 0.5 inches nor more than 2 inches. Repeatability shall be plus or minus 1/32 inch.
(d) Limit switches shall be capable of operation in an ambient temperature between 0°C and 65°C.
(e) Electromagnetic compatibility requirements. Elevator electrical and electronic subsystems shall comply with the requirements of MIL-STD-461, and shall be capable of operation in a space with the following power densities:

Frequency range	Units	
Communications	Volts per meter	
250 KHz to 30 MHz	50	
Radar	Average (mW/cm^2)	Peak (mW/cm^2)
200 MHz to 225 MHz	7	1,500
400 MHz to 450 MHz	5	300
850 MHz to 940 MHz	12	400
1.215 GHz to 1.365 GHz	3	3,900
2.7 GHz to 3.7 GHz	78	32,000
5.4 GHz to 5.9 GHz	2	1,400
16.3 GHz to 33 GHz	1	1,000

(f) Electrical termination - Each switch shall be provided with an integral 20-foot length of cable.

3.15.7 Control Stations. Control stations shall be provided with pushbuttons, selector switches, and indicator lights as specified (see 6.2.1). Each control station shall contain an "Emergency stop" pushbutton and other controls necessary for the proper operation of the elevator. The "Emergency stop" pushbutton shall be of the palm operated mushroom type, red in color and shall, function to energize the shunt trip coil of the power disconnect switch described in 3.15.4. Controls and indicators shall be clearly and permanently marked with their functions.

3.15.8 Design requirements.

3.15.8.1 Dispatch orders or travel permissive signals shall be established by actuating a device thereby changing the input voltage into the control system to a value different from that of ground or chassis. Input circuitry of the control system where the opening of an external input circuit results in a voltage on a control system input different from ground or chassis shall not be used. This requirement applies primarily to low voltage d.c. control systems.

3.15.8.2 Safety feature systems, components, or controls shall not be exposed to possible damage under normal operating conditions or be exposed to encourage possible tampering by operating personnel, where such exposure could lead to defeating the purpose of the safety feature.

3.15.8.3 Elevator control systems shall be provided with the following safety features:

(a) "Up" overtravel limit switch to prevent overtravel in the event of failure of any of the normal control components to stop the elevator. The "Up" overtravel limit switch shall be wired into both the up and down circuits.
(b) "Down" overtravel limit switch.
(c) Switch for each of the following:

(1) Hoisting rope-slack rope safety device (see 3.6.4)
(2) Speed governor slack rope safety device (see 3.6.3)
(3) Overspeed governor device (see 3.6.2)

(d) When lockbars are furnished, interlock switches shall be provided to prevent platform travel when the lockbars are not fully retracted. The circuitry shall permit manual jogging in the "up" direction to take up hoisting rope-slack when the lockbars are extended.
(e) Overtravel limit switches shall be provided for the elevators furnished with hatch covers to prevent the platform from running into a hatch cover that is not fully open.

3.15.8.4 Elevator control systems designed for two-speed motor operation, the "high speed" contactor shall be deactuated when the "low speed" contactor is energized. Power shall be removed from the motor when this condition is not met.

3.15.8.5 A "Normal - Stop" selector switch shall be provided at each elevator control station. When any switch is in the "Stop" position, it shall not be possible to initiate or continue platform motion. When access to the elevator platform from the compartment served is controlled by an electrically interlocked door, this function of the associated "Normal - Stop" switch is not required.

3.15.8.6 Electrical interlocks shall be provided as follows:

(a) Each door shall be interlocked to prevent it from being opened, unless the platform is stopped at the corresponding door level.
(b) Each door shall be interlocked to prevent elevator travel operation, unless the door is fully closed and dogged.
(c) When more than one door is provided at any 1 level, each door shall be interlocked so that only 1 door can be in the open position at any time.

3.16 Control 1 (manual nonselective) (see 6.2.1).

3.16.1 Control 1 elevators shall have a platform mounted control master switch to control the speed and direction of the platform. This switch shall be lever operated, spring return to off position, and shall include "Emergency Run" and "Emergency Stop" switches. The control shall include the necessary platform actuated switches to automatically slow down and stop the elevator platform at the highest and lowest levels regardless of the position of the platform master switch.

3.16.2 In addition to the master control switch specified in 3.16.1 and the controls specified in 3.15.7 and 3.15.8, the following control components shall be provided for the platform mounted control station:

(a) "Warning Alarm" momentary contact pushbutton switch.
(b) Warning horn or bell of 90 decibels (dB) minimum.
(c) "Emergency Run" momentary contact pushbutton switch to function in parallel with the emergency run pushbutton switch described in 3.15.3.2(c).
(d) A platform light.
(e) Platform light switch rated at 5 amperes, 115 volts, 60 Hz.
(f) When lockbars are provided, a red lockbar extended indicator light and a green lockbar retracted indicator light.
(g) When lockbars are electrically controlled, "Extend Lockbars" and "Retract Lockbars" momentary contact pushbutton switches.
(h) Controls to open electrically controlled doors from inside the elevator trunk.

3.16.2.1 The warning horn or bell required (see 3.16.2) shall be energized when the platform mounted master control switch is not in the "off" position.

3.17 Control 2 (automatic) (see 6.2.1).

3.17.1 Control 2 elevators shall provide one of the following types of control as specified in the contract or order:

(a) The operator at the master control station shall select by use of a selector switch or switches the two levels between which the platform will operate. Pushbutton switches at each level served shall be used to send the platform up or down.
(b) The operator at each level shall be able to select the level to which the platform will be sent.

3.17.2 In addition to the requirements specified in 3.15.7, control stations shall include the following:

(a) For master control stations:
  (1) "Emergency Stop" switch.
  (2) "Normal - Stop" switch.
  (3) Pushbutton switches for dispatch to each other level.
  (4) Platform position indicator lights, one for each level served.
  (5) Door "Open - Close" switch.
  (6) "Power On" indicator light.
(b) For all other control stations:
  (1) "Emergency Stop" switch.
  (2) "Normal - Stop" switch.
  (3) Pushbutton switches for dispatch to each other level.
  (4) "Car Here" indicator light.
  (5) Door "Open - Close" switch.

3.17.3 When the "Normal - Jog" switch on the motor controller is in the "Jog" position, essential safety devices, safety features, and interlocks shall remain effective.

3.17.4 A set of lights shall be provided for installation in the elevator machinery space to indicate the level at which the platform is positioned.

3.17.5 Method A controls (electromechanical relay logic).

3.17.5.1 Method A control systems shall use relays in accordance with MIL-C-2212 or MIL-R-19523, category A or B, class 1.

3.17.5.2 The control system shall provide the required elevator operation without being critically dependent upon relay pick-up or drop-out times.

3.17.6 Method B controls (programmable controller).

3.17.6.1 The programmable controller shall be a general purpose controller basically comprised of control logic, input/output logic, and a memory. The control logic shall act upon programmed instructions, and shall sample proper input/output points (both internal and external) and set each output "on" or "off" based on the current input/output conditions.

3.17.6.2 The programmable controller shall be solid-state designed and shall not contain any mechanical relays or mercury wetted contacts.

3.17.6.3 The controller shall be furnished with an optical read-out for platform position. This platform position shall be displayed as a number in the octal or decimal numberinging system.

3.17.6.4 Outputs of the programmable controller shall be capable of controlling 115 volts, 60 Hz, single-phase power. Outputs shall have current carrying capacity capable of handling the inrush and steady-state current requirements of the contractors in the associated motor controller.

3.17.6.5 Platform position shall be monitored by means of a shaft angle encoder. Output of this encoder shall consist of a number in natural binary notation of binary coded decimal notation where the least significant digit shall correspond to not more than 0.1 inch of platform travel. The complement of each digit shall also be provided by the encoder and shall be used by the programmable controller to verify that the output of the encoder is valid. A noncomplementary output shall cause the elevator to stop and all dispatch orders to be cancelled.

3.17.6.5.1 The shaft angle encoder selection and application shall be in accordance with MIL-HDBK-231.

3.17.6.6 A programming panel capable of diagnosing failures of the controller to perform its normal operating function and to identify specific fault loaction shall be provided. Whether the progamming panel is to be provided for each controller, or be a portable unit capable of being used with more than one controller shall be as specified (see 6.2.1).

3.17.7 Method controls (static logic).

3.17.7.1 A solid-state logic controller is a system which provides logic functions to command and control the sequence of elevator operation by means of solid-state components without the use of electromechanical relays and where the control functions are not stored in a programmable memory.

3.17.7.2 The d.c. power source for the internal electronic operation shall be separate and isolated from other power souces and shall not be used for any external function.

3.17.7.3 All external circuits shall operate at 20 volts d.c. or alternating current (a.c.) minimum.

3.17.7.4 Electromechanical contacts shall switch at 2 minimum of 5 volt amperes.

3.17.7.5 The controller shall be provided with a manual monitoring system that will allow examination of the state of each input, output function and each static control element.

3.17.7.6 A printed circuit board tester or test system shall be provided capable of testing all circuits on those boards on a "Go - No Go" basis.

3.18 Painting. Electrical and mechanical components preservation shall be as specified herein. If component specifications do not specify painting, then painting shall be as follows except as noted in 3.18.1

(a) External ferrous surfaces: One coat each of pretreatment MIL-P-15328, primer MIL-P-17545, and two finish coats MIL-E-15090, type II class 2.
(b) External aluminum surfaces: One coat each of pretreatment MIL-P-15328, primer TT-P-645, and two finish coats MIL-E-15090, class 2.
(c) Touch up of damaged paint shall be in accordance with (a) and (b).
(d) Bearing and machined surfaces, lubrication filling lubricating oil reservoirs, or interior "oil wetted" surfaces shall not be painted.
(e) Surfaces to be painted shall be completely free of rust, mill scale, dirt, oil, grease, moisture, deteriorated paint, and other surface contaminants. Coating shall be applied as soon as practicable after cleaning. Metal to be coated shall have surfaces prepared to "near-white" metal in accordance with Steel Structures Painting Council, Surface preparation specification SSPC-SP 10.

3.18.1 Surfaces subject to phosphate ester fluid. As specified (see 6.2.1), external surfaces to be painted subject to leakage or spillage from a hydraulic system using phosphate ester base hydraulic fluid shall be coated with type 1, class 1, machinery gray paint in accordance with MIL-P-23236. Manufacturer's recommendations shall be followed for application.

3.19 Lubrication and operating instruction charts. Lubrication and operating instruction charts shall be furnished for each elevator. Charts shall be in accordance with type F of MIL-P-15024 and MIL-P-15024/5.

3.19.1 Operating instruction chart. An operating instruction chart shall be provided for installation in each machinery room. Each chart shall give specific instructions for the operation of the elevator or control equipment at the room.

3.19.2 Lubrication charts. Lubrication charts installed in machinery room by the shipbuilder shall fully indicate all points at which lubricants shall be applied, frequency of application, and designation of lubricant.

3.20 Identification plates for product marking. Identification plates or other means of manufacturer's identification shall be affixed to components for proper identification to aid in replacements and repair parts. MIL-STD-130 shall be used as a guide.

3.21 Reliability.

3.21.1 General definitions. Reliability terms shall be defined according to MIL-STD-721.

3.21.2 Reliability requirements. The elevator system shall satisfy minimum mean-cycles-between-failure (MCBF) or mean-time-between-failure (MTBF) as specified (see 6.2.1).

3.21.3 Definition of failure. An elevator system failure is defined as any event which necessitates corrective maintenance.

3.21.4 Reliability data. The contractor shall prepare a reliability program plan; failure mode and effects analysis (FMA); reliability prediction report; and reliability status report in accordance with the data ordering documents included in the contract or order (see 6.2.2).

3.22 Maintainability.

3.22.1 General definitions. Maintainability terms shall be defined according to MIL-STD-721.

3.22.2 Maintainability requirement. The elevator shall satisfy as specified maximum mean-time-to-repair (MTTR) or equipment repair time (ERT) as specified (see 6.2.1).

3.22.3 Maintainability data. The contractor shall prepare a maintainability program plan and maintainability prediction and program status reports in accordance with the data ordering documents included in the contract or order (see 6.2.2).

3.23 Drawings. The contractor shall prepare drawings in accordance with the data ordering document included in the contract or order (see 6.2.2). In addition, control system drawings shall include the following features:

(a) A list of material listing all components. Each item shall be identified by the catalog number assigned by the original manufacturer of that item.
(b) Outline with front and side view of the enclosure together with overall and mounting dimensions including mounting holes and bolt sizes. The center-of-gravity shall be shown in both views of the enclosure when over 100 pounds.
(c) Connection and schematic diagrams of the control circuit including connections to master switches and other remote devices.
(d) Description of operation of the control system.
(e) Description of adjustments which can be made on the equipment such as the range of time for a timing relay or time delay.
(f) A schematic diagram of each circuit board with complete identification such as wattage and resistance for resistors, capacitance and working voltage of capacitors, semiconductor type numbers as assigned by the semiconductor manufacturer, amperage rating of fuses, etc.
(g) A diagram showing the location of the various circuit boards in their slots.

(h) The interconnecting wiring behind the circuit board slots for custom built control systems.
(i) A complete set of control or boolean equations.
(j) A guide for failure analysis to permit the location of the probable failure. This may be included in the technical manual where furnished and at the contractor's option.
(k) The weight of the control system enclosure and the weight of major external components.
(l) In cases where the contractor uses a so-called "off-the-shelf" type of control system and adapts it for the particular application of elevator control, the commercial manuals normally furnished with the control system may be substituted for that part of the drawing material requirements that is provided by the material in the manuals.

3.24 Microfilming of engineering documents, 35mm and PCAM preparation, microfilm aperture card. The contractor shall prepare microfilm, aperature/tabulating cards and listing in accordance with the data ordering document included in the contract or order (see 6.2.2).

3.25 Calculations. The contractor shall prepare calculations in accordance with the data ordering document included in the contract or order (see 6.2.2). Calculations shall include the unique features specified in 3.25.1 through 3.25.4.

3.25.1 Power calculations. A complete set of power calculations to justify the size of the electric motor, gears, gear reducer, and electric brake shall be provided.

3.25.2 Stress calculations. A complete set of stress calculations to justify the sizes of parts and materials selected for gears, bearings, shafts, keys, holding-down bolts, structural members, brake, and other components shall be provided.

3.25.3 Fatigue calculations. Allowable stresses in parts subjected to cyclic stress shall be documented by failure stress versus life cycle data for the materials used, and by calculations showing the number of cycles and range of stress fluctuation per cycle. The expected life for the part shall exceed the required design life of the equipment. Calculations shall include consideration of surface conditions, size, temperature, stress concentration, and type of stress, (torsion, bending, conbinations, etc.). Method of calculation may vary according to the form to the stressed part, but shall be a generally recognized procedure for fatigue analysis. Specified methods in the ASME Boiler and Pressure Code, Section III, Nuclear Vessels and ANSI B-15.1 may be used for guidance.

3.25.4 Heat calculations. A complete set of heat calculations for the electric motor and controllers shall be provided. Calculations shall be based upon the duty cycle requirements.

3.26 Manuals. The contractor shall prepare technical manuals in accordance with the data ordering document included in the contract or order (see 6.2.2).

4. QUALITY ASSURANCE PROVISIONS

4.1 Responsibility for inspection. Unless otherwise specified in the contract, the contractor is responsible for the performance of all inspection requirements, as specified herein. Except as otherwise specified in the contract, the contractor may use his own or any other facilities suitable for the performance of the inspection requirements specified herein, unless disapproved by the Government. The Government reserves the right to perform any of the inspections set forth in the specification where such inspections are deemed necessary to assure supplies and services conform to prescribed requirements.

4.1.1 Quality requirements. The contractor shall maintain a level of quality in accordance with the provisions of the contract or order and the orderding data (see 6.2.1) of this specification. In the event the quality requirements of the contract and this specification conflict, the quality requirements of the contract takes precedence.

4.1.2 Gear reducer cleanliness. The gear reducer castings and component parts shall be cleaned of sand, scale, metallic chips and trimmings, and other foreign matter and examined for cleanliness before assembly. After assembly and before installation, the gear reducer shall be inspected to ensure that cleanliness has been maintained.

4.1.3 In-process inspection. Parts of subsystems that will be closed, sealed, or covered at final assembly shall be inspected for conformance to applicable specifications and workmanship prior to closure.

4.2 Quality conformance inspection.

4.2.1 Examination. The hoisting machinery, platform, and accessories shall be examined for any defects jeopardizing the requirements of this specification and include the specific items of table II.

TABLE II. Classification of defects.

Major	Defect
101.	Material not as specified.
102.	Parts, components, or accessories incomplete, missing, or not as specified.
103.	Misalinement of machinery or bedplate.
104.	Assemblies and components not readily accessible for maintenance and repairs.
105.	Casting not examined in accordance with the requirements of MIL-STD-278.
106.	Fabrication, welding, and examination for machinery not in accordance with class M of MIL-STD-278.
107.	Welder and equipment qualification not in accordance with MIL-STD-278.
108.	Parts hazardous to operating and maintenance personnel not fully enclosed, properly guarded, or insulated.
109.	Drums not of specified dimensions or unable to contain the length and size of wire rope specified.
110.	Hoisting machinery platform and accessories not provided with means for lubrication at readily accessible locations.
111.	Linkages not operating smoothly and without lost motion.
112.	Fasteners not secure.
113.	Winch or platform components not as specified.
114.	Direction of rotation incorrect for proper operation of safeties.
115.	Controls not labeled, not illuminated or readily visible by operator.
116.	Indicating lights not provided as required.
117.	Gear reducer oil level capacity insufficient.
118.	Mechanical safety device linkages not having a positive push pull action.
119.	Each item of equipment not marked in a conspicuous manner on lubrication charts to indicate the grades of oils and greases used.
120.	Identification markings, instruction, information, and warning plates incorrect, illegible, or missing.
121.	Treatment and painting not as specified.
122.	Workmanship not as specified.
123.	Standard parts not being used where practicable.
124.	Bearings not as specified.

4.3 Shipbuilder test requirements. The shipbuilder test requirements shall be specified (see 6.2.1) so that contractors will be aware of the test requirements of his elevator equipment when installed onboard ship. Duty cycles shall be called out in sufficient detail to describe elevator door and hatch cover operation, times and speeds of door, hatch cover and elevator platform operation, stowage level and number of cycles per hour, and number of hours of operation per 24-hour period to assist the contractor with his selection of components. Duty cycles for control 2 systems shall include both manual and automatic modes. For control 1 systems, duty cycles for both speeds of a two speed system shall be required. The contractor shall be responsible for satisfactory operation of contractor furnished equipment.

4.4 Tests.

4.4.1 Test conditions. Prior to test, the hoisting machinery and platform shall be lubricated with oils and greases specified in the applicable lube charts. If the contractor is not furnishing the elevator platform, a wire rope and weight arrangement shall be used for testing the hoisting machinery. Pay out of rope for dead-load handling shall be equal to length of platform travel onboard ship. During testing, foundations and hold-down bolts and nuts shall be examined to detect sign of inadequacy, such as excessive foundation vibration, slippage of equipment, and loosening of nuts.

4.4.2 Static load test. Elevator hoisting machinery and sheaves shall be subjected to a static load of 200 percent of rated-load plus the platform weight for 10 minutes. The platform shall be subjected to a static load of 200 percent of rated-load for 10 minutes. If a platform is equipped with lockbars, bars shall be extended at one of the levels served to engage their sockets or supports. Hoisting ropes shall be slacked and a static load of 200 percent of rated-load shall be applied to the platform for a period of 10 minutes. No part of the equipment shall take a permanent set nor shall degradation of any operating or control function occur as a result of this test. The brake shall be capable of holding the elevator platform and static load without slippage.

4.4.3 Safety device test. The mechanical safety device shall be tested for its ability to stop and hold the platform when carrying rated-load at high speed. Scoring of guide rails or damage to the equipment resulting from this test shall be repaired prior to conducting operating tests.

4.4.4 No-load test. Elevator hoisting machinery and sheaves shall be operated through 25 complete cycles of hoist and lower operation through the full hoisting range at rated-speed with a load equal to platform weight.

4.4.5 Slow speed test. Elevator hoisting machinery and sheaves shall be operated through one complete cycle of hoist and lower operation through the full hoisting range at slow speed with rated-load (plus platform weight).

4.4.6 Overload test. Hoisting machinery and sheaves shall be operated through two complete cycles of hoist and lower operation through the full hoisting range at maximum attainable speed with the platform weight plus 150 percent of rated-load. During this test, hoisting machinery shall be deenergized while traveling downward at full speed to set the brake. The load shall travel no more than 3-feet after the hoisting machinery is deenergized.

4.4.7 Rated-load test. Elevator hoisting machinery and sheaves shall be operated through fifty complete cycles of hoist and lower operation through the full hoisting range at rated-speed with a load equal to rated-load plus platform weight. There shall be an 8 second stop at each limit of travel.

4.4.8 Emergency stop test. Each "Emergency Stop" pushbutton switch shall be actuated to demonstrate proper operation of the power disconnect switch. At least one disconnect switch operation shall be performed while carrying full elevator motor current.

4.4.9 Emergency run test. Proper operation of the elevator shall be demonstrated by actuation of each "Emergency Run" pushbutton switch with the associated contact(s) of the overload relay(s) disabled.

4.4.10 High-impact shock tests. When specified (see 6.2.1), components shall be tested for HI-shock in accordance with of MIL-S-901.

4.4.11 Vibration tests. When specified (see 6.2.1), components shall be tested for vibration in accordance with MIL-STD-167-1 or MIL-STD-167-2.

4.4.12 Airborne noise test. The units shall be airborne noise tested under normal operating conditions to duplicate shipboard installation in accordance with MIL-STD-740.

4.4.13 Reliability. A failure shall be as specified in 3.21.3 for reliability assurance testing purposes. The elevator system shall be tested by one of the following reliability test procedures as specified (see 6.2.1).

(a) Test procedure I. The elevator shall be cycled continuously with rated-load, plus platform weight, at rated-speed with interruption by failure for 250 cycles. Each cycle shall consist of a hoist and lower operation with half cycle travel equal to the elevator's full hoist range. The elevator test cycle shall simulate the actual installation stop and speed sequencing, and hatch sequencing if applicable.

(b) Test procedure II. The same procedure as test procedure I except that a total number of test cycles shall be as specified (see 6.2.1). The last 250 test cycles shall be without failure.

(c) Test procedure III. The specified MCBF or MTBF requirement (see 3.21.2) shall be demonstrated by the successful completion of a reliability test in accordance with MIL-STD-781. Applicable test level and test plan of MIL-STD-781 shall be specified (see 6.2.1).

4.4.13.1 The contractor shall prepare a reliability test procedure report in accordance with the data ordering document included in the contract or order (see 6.2.2).

4.4.14 Maintainability. As specified (see 6.2.1), MTTR requirement of 3.22.2 shall be demonstrated by the successful completion of a maintainability assurance test.

4.4.14.1 The contractor shall prepare maintainability test procedure report in accordance with the data ordering document included in the contract or order (see 6.2.2).

4.5 Rejection. Failure of the hoisting machinery, platform or accessories to pass any of the examinations or tests shall be cause for rejection.

4.6 Controls used for testing. Hoisting machinery controls used for testing shall be the same control that will be installed onboard ship unless otherwise specified (see 6.2.1).

4.7 Test report. The contractor shall prepare a test report covering all tests in accordance with the data ordering document included in the contract or order (see 6.2.2).

4.8 Inspection of preparation for delivery. Sample packages and packs and the inspection of the preservation and packaging, packing and marking for shipment and storage shall be in accordance with the requirements of Section 5.

5. PREPARATION FOR DELIVERY

(The preparation for delivery requirements specified herein apply only for direct Government procurements. For the extent of applicability of the preparation for delivery requirements of referenced documents listed in section 2, see 6.4.)

5.1 Preservation-packaging, packing and marking. As specified (see 6.2.1) elevators, elevator components repair parts, tools, and technical manuals shall be preserved-packaged level A or C; packed level A, B, or C; and marked in accordance with MIL-P-3184.

6. NOTES

6.1 Intended use. It is intended that this specification be used for reference in Ship Specifications and for direct reference in contracts or orders for elevators. The intent is to set forth the conditions within which the equipment must operate satisfactorily and reliably.

6.2 Ordering data.

6.2.1 Procurement requirements. Procurement documents should specify:

(a) Title, number, and date of this specification.
(b) Types, classes, control systems, and methods (see 1.2).
(c) Storm conditions and loading factors (see 3.3.2 and 3.7).
(d) Rated-speed requirements, moderate sea conditions and loading factors (see 3.3.3).
(e) Speed and duty cycle, if other than as specified (see 3.3.5).
(f) Pitch, roll, trim, and list conditions (see 3.3.8).
(g) Shock requirements, and if test is required (see 3.3.25 and 4.4.10).
(h) Vibration and if tests are required (see 3.3.26 and 4.4.11).
(i) Explosion proof equipment requirements (see 3.3.27).
(j) Overall size, clear load area, and ingress and egress routes (see 3.5.1).
(k) Elevator capacity types of loads, how handled, their weights and centers-of-gravity (see 3.5.1.1, 3.5.2.2 and 3.5.2.3).
(l) Disignated safe loading area and quantity and spacing of fittings (see 3.5.2.1).
(m) Special platform requirements (see 3.5.3).
(n) Lockbars when required (see 3.5.4 and 3.5.4.1).
(o) Type of guide rails, guide rollers and safety show assemblies (see 3.7.1).
(p) When the master guide rail concept shall be used for guide rail and guide roller installation (see 3.7.2).
(q) Duty cycle and enclosure for motor, type of motor, horsepower, and motor insulation, if other than as specified (see 3.13.1).
(r) Torque, brake voltage, and brake enclosure, if other than as specified (see 3.14.1).
(s) Motor controller operation and enclosure requirements (see 3.15.3.1).
(t) Enclosure for limit switches (see 3.15.6.1).
(u) Control station requirements (see 3.15.7).

(v) Control type and method of control required (see 3.16 and 3.17).
(w) Whether programming panel will be provided each controller or be a portable unit (see 3.17.6.6).
(x) Special painting required (see 3.18.1).
(y) Mean cycles between failure (MCBF) and Mean time between failure (MTBF) requirement values (see 3.21.2).
(z) Mean time to repair (MTTR) or equipment repair time (ERT) as specified (see 3.22.2). Shipbuilder test requirement (see 4.3).
(aa) The level of quality desired in accordance with MIL-I-45208 (see 4.1.1).
(bb) Hoisting machinery controls (see 4.6).
(cc) Reliability test procedure required (see 4.4.13).
(1) Number of repetitive cycles required for reliability test procedure II.
(2) Test level and plan required for reliability test procedure III.
(dd) Specify if a maintainability demonstration is required and, if a demonstration is required, specify the applicable test method of MIL-STD-471 (see 4.4.14).
(ee) Preservation-packaging, backing, and marking required (see 5.1).

6.2.2 Data requirements. When this specification is used in a procurement which invokes the provision of the "Requirements for Data" of the Armed Services Procurement Regulations (ASPR), the data identified below, which are required to be developed by the contractor, as specified on an approved Data Item Description (DD Form 1664), and which are required to be delivered to the Government, should be selected and specified on the approved Contract Data Requirement List (DD Form 1423) and incorporated in the contract. When the provisions of the "Requirements for Data" of the ASPR are not invoked in a procurement, the data required to be developed by the contractor and required to be delivered to the Government should be selected from the list below and specified in the contract.

Paragraph	Data requirements	Applicable DID	Option
3.21.4	Plan, reliability program	DI-R-2113	---
3.21.4	Report, failure mode, and effects analysis (FMEA)	DI-R-2115	---
3.21.4.1	Report, reliability prediction	DI-R-2117	---
3.21.4	Report, reliability status	DI-R-2119	---
3.22.3	Plan, maintainability program	UDI-R-23558	---
3.22.3	Report, Maintainability prediction	UDI-R-23567	---
3.22.3	Reports, Maintainability program status	UDI-R-23561	---
2.23	Drawings, Engineering and Associated Lists	DI-E-7031	Level 3 Design activity-procuring activity Drawing number-procuring activity Associated list-procuring activity Delivery of hard Copy & microfilm-procuring activity
3.24	Microfilming of Engineering Documents, 35mm and PCAM Preparation, Microfilm Aparture Card	UDI-E-23140	---
3.25	Calculations	UDI-E-23213	---
3.26	Technical manual quality assurance data	DI-M-2051	MIL-M-15071, type I and type II
4.4.13.1	Report, reliability test procedures	UDI-T-23710	---
4.4.14.1	Report, maintainability test procedures	UDI-T-23711	---
4.7	Reports, test	DI-T-2072	---

(Copies of data item descriptions required by the contractors in connection with specific procurement functions should be obtained from the procuring actitity or as directed by the contracting officer. Unless otherwise indicated, the issue in effect on date of invitation for bids or request for proposal shall apply.)

6.2.2.1 The data requirements of 6.2.2 and any task in section 3, 4, or 5 or the specification required to be performed to meet a data requirement may be waived by the procuring/purchasing activity upon certification by the offeror that identical data were submitted by the offeror and accepted by the Government under a previous contract for identical item procured to this specificaiton. This does not apply to specific data which may be required for each procurement regardless of whether an identical item has been supplied previously (for example, test reports).

6.3 Sub-contracted material and parts. The preparation for delivery requirements of referenced documents listed in Section 2 do not apply when material and parts are procured by the contractor for incorporation into the equipment and lose their separate identity when the equipment is shipped.

6.4 Changes from previous issue. The symbol "#" is not used in this revision to identify changes with respect to the previous issue, due to the extensiveness of the changes.

Preparing activity:
Navy - SH
(Project 3960-N003)

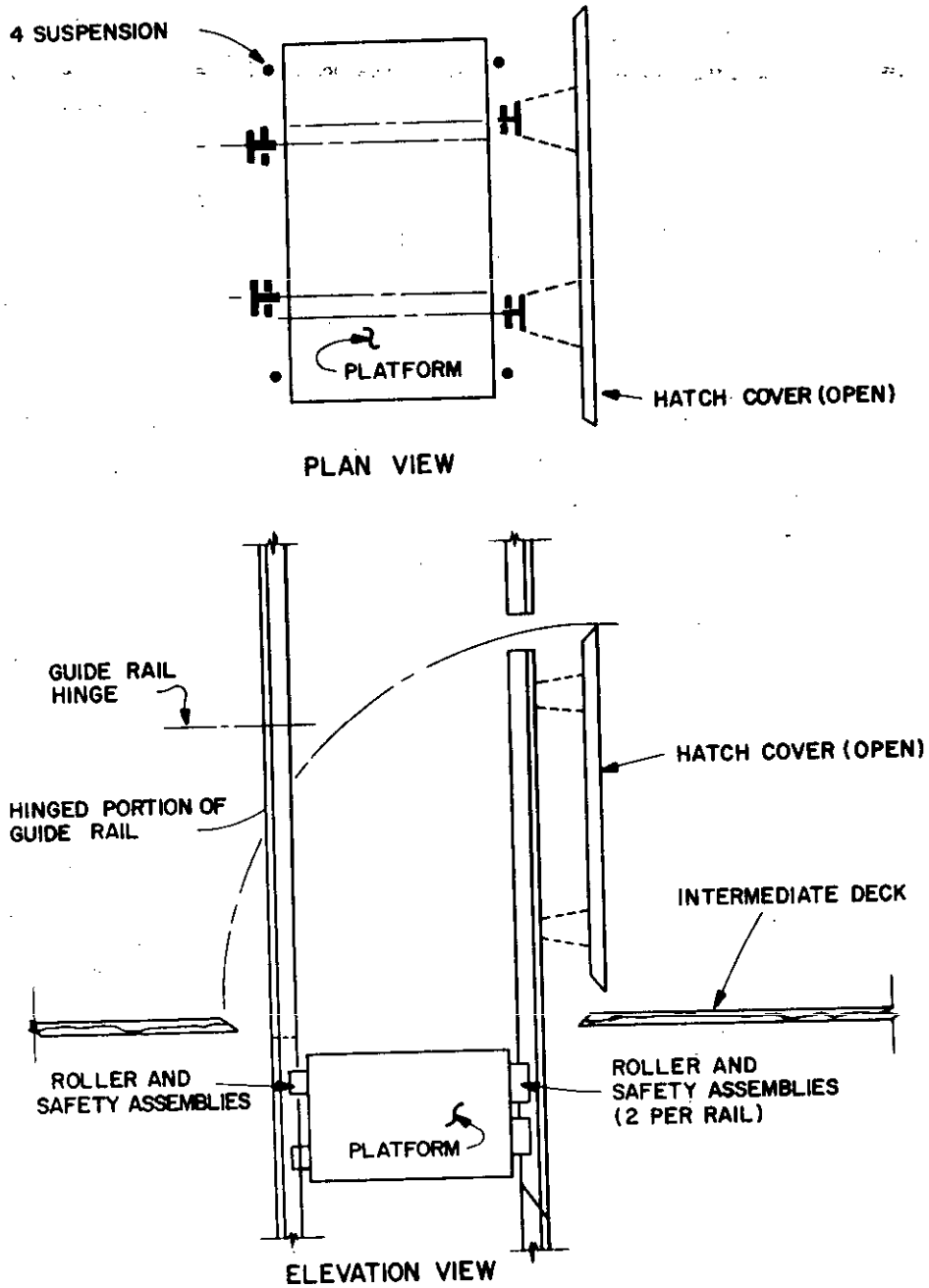

Figure 1 - Four-rail "T" section.

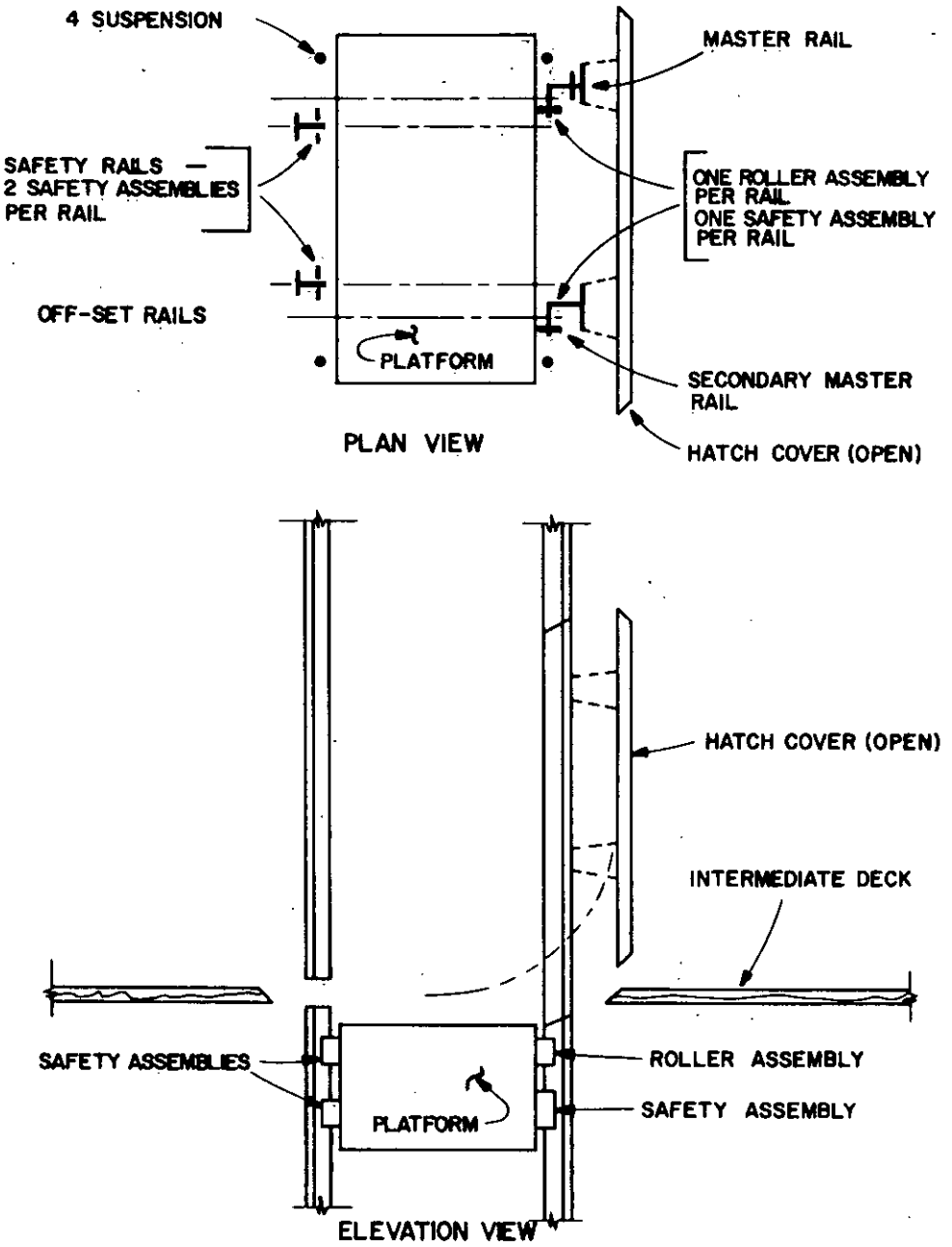

Figure 2 - Four-rail-master guide rail type.

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STANDARDIZATION DOCUMENT IMPROVEMENT PROPOSAL

OMB Approval
No. 22-R255

INSTRUCTIONS: The purpose of this form is to solicit beneficial comments which will help achieve procurement of suitable products at reasonable cost and minimum delay, or will otherwise enhance use of the document. DoD contractors, government activities, or manufacturers/vendors who are prospective suppliers of the product are invited to submit comments to the government. Fold on lines on reverse side, staple in corner, and send to preparing activity. Comments submitted on this form do not constitute or imply authorization to waive any portion of the referenced document(s) or to amend contractual requirements. Attach any pertinent data which may be of use in improving this document. If there are additional papers, attach to form and place both in an envelope addressed to preparing activity.

DOCUMENT IDENTIFIER AND TITLE: MIL-E-17807 B

NAME OF ORGANIZATION AND ADDRESS

CONTRACT NUMBER

MATERIAL PROCURED UNDER A

☐ DIRECT GOVERNMENT CONTRACT ☐ SUBCONTRACT

1. HAS ANY PART OF THE DOCUMENT CREATED PROBLEMS OR REQUIRED INTERPRETATION IN PROCUREMENT USE?
   A. GIVE PARAGRAPH NUMBER AND WORDING.

   B. RECOMMENDATIONS FOR CORRECTING THE DEFICIENCIES

2. COMMENTS ON ANY DOCUMENT REQUIREMENT CONSIDERED TOO RIGID

3. IS THE DOCUMENT RESTRICTIVE?
   ☐ YES ☐ NO *(If "Yes", in what way?)*

4. REMARKS

SUBMITTED BY *(Printed or typed name and address - Optional)*

TELEPHONE NO.

DATE

DD FORM 1 JAN 72 1426 REPLACES EDITION OF 1 JAN 66 WHICH MAY BE USED S/N 0102-014-1802