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(See 6.4)

MILITARY SPECIFICATION

CRANE, ELECTRO-HYDRAULIC AND DIESEL-HYDRAULIC, SHIPBOARD

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

1. SCOPE

1.1 Scope. This specification covers the general requirements and performance characteristics of various types of electro-hydraulic and diesel-hydraulic rotating cranes for installation on Navy ships and floating dry-docks. These cranes are suitable for ship equipment handling, including weapons handling.

1.2 Classification. Cranes shall be of the following types, as specified (see 6.2.1):

Type A - Kingpost crane.
Type B - Pedestal crane.
Type C - Locomotive crane with power cable.
Type D - Locomotive crane with diesel engine.

2. APPLICABLE DOCUMENTS

2.1 Issues of documents. The following documents, of the issue in effect on date of invitation for bids 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, Cylindrical; and Bearings, Roller, Self-Aligning.

Benefical comments (recommendations, additions, deletions) and any pertinent data which may be of use in improving this document should be addressed to: Commander, Naval Sea Systems Command, SEA 3112, 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.

FEDERAL (Continued)

FF-B-187	-	Bearings, Roller, Tapered.
RR-W-410	-	Wire Rope and Strand.
TT-E-490	-	Enamel, Silicone Alkyd Copolymer, Semigloss, (For Exterior and Interior Non-Residential Use).

MILITARY

MIL-S-901	-	Shock Tests, H.I. (High Impact); Shipboard Machinery, Equipment and Systems, Requirements for.
MIL-C-915	-	Cable and Cord, Electrical, For Shipboard Use; General Specifications for.
MIL-E-917	-	Electric Power Equipment, Basic Requirements (Naval Shipboard Use).
MIL-C-2212	-	Controller, Electric Motor, A.C. or D.C., and Associated Switching Devices, Naval Shipboard.
MIL-P-3184	-	Packaging of Machinery: Deck and Vehicle Mounted with Associated Equipment and Repair Parts.
MIL-L-17331	-	Lubricating Oil, Steam Turbine and Gear, Moderate Service.
MIL-L-17672	-	Lubricating Oil, Hydraulic and Light Turbine, Noncorrosive.
MIL-P-17869	-	Pumps and Motors, Power, Oil Hydraulic. (Nava Shipboard Use).
MIL-G-18458	-	Grease, Wire Rope - Exposed Gear.
MIL-F-18953	-	Fan, Vaneaxial and Tubeaxial, Fixed and Portable, Ventilation and Air Conditioning, Naval Shipboard.
MIL-F-19004	-	Fan, Centrifugal, Fixed and Portable, Ventilation, Naval Shipboard.
MIL-P-23236	-	Paint Coating Systems, Steel Ship Tank, Fuel and Salt Water Ballast.
MIL-E-24091	-	Extinguisher, Fire, Portable, Potassium Bicarbonate, Dry Chemical, Cartridge Type.
MIL-I-24137	-	Iron Castings, Nodular Graphitic (Ductile Iron) and Nodular Graphitic (Corrosion Resisting, Austenitic, Low Magnetic Permeability) (For Shipboard Application).
MIL-F-24402	-	Filter, (Hydraulic), Filter Elements (High Efficiency) and Filter Differential Pressure Indicators.
MIL-P-24441	-	Paint, Epoxy-Polyamide, General Specification For.
DOD-G-24508	-	Grease, High Performance, Multi-Purpose (Metri
MIL-I-45208	-	Inspection System Requirements.
MIL-V-81940	-	Valve, Sampling and Bleed, Hydraulic, Type II Systems.
MIL-R-83248	-	Rubber, Fluorocarbon Elastomer, High Temperatu Fluid, and Compression Set Resistant.

STANDARDS

MILITARY

MIL-STD-108 - Definition of and Basic Requirements for Enclosures for Electric and Electronic Equipment.
MIL-STD-167-1 - Mechanical Vibrations of Shipboard Equipme (Type I - Environmental and Type II - Internally Excited).
MIL-STD-278 - Fabrication Welding and Inspection; and Ca Inspection and Repair for Machinery, Pipi and Pressure Vessels in Ships of the Unit States Navy.
MIL-STD-419 - Cleaning and Protecting Piping, Tubing, an Fittings for Hydraulic Power Transmission Equipment.
MIL-STD-454 - Standard General Requirements for Electron Equipment.
MIL-STD-740 - Airborne and Structureborne Noise Measure- ments and Acceptance Criteria of Shipboar Equipment.
MIL-STD-882 - System Safety Program Requirements.
MIL-STD-1310 - Shipboard Bonding, Grounding and Other Techniques for Electromagnetic Compatibil and Safety.
DOD-STD-1399 - Section 300, Interface Standard for Shipbo Systems Electric Power, Alternating Curre (Metric).
MIL-STD-1472 - Human Engineering Design Criteria for Mili Systems, Equipment and Facilities.
MS33649 - Bosses, Fluid Connection - Internal Straig Thread.
AN814 - Plug and Bleeder - Screw Thread.

DRAWINGS

NAVAL SEA SYSTEMS COMMAND

NAVSHIPS S1701-921849 - Crane Hook and Swivel (10,000, 15,0 and 30,000-lb. Cap.) Details.
NAVSHIPS S1701-921850 - Crane Hook and Swivel (10,000, 15,0 and 30,000-lb. Cap.) Assemblies an Details.

(Copies of specifications, standards, drawings, and publications re- quired by contractors in connection with specific acquisition functions sh be obtained from the contracting 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.

AMERICAN GEAR MANUFACTURER'S ASSOCIATION (AGMA) STANDARDS

(Application for copies should be addressed to the American Gear Manufacturer's Association, 1330 Massachusetts Avenue, N.W., Washington, DC 20005.)

STEEL STRUCTURES PAINTING COUNCIL (SSPC)

Painting Manual, Volume 2, Systems and Specifications, Surface Preparation Specification SP10 - Near White Blast Cleaning.

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

AMERICAN INSTITUTE OF STEEL CONSTRUCTION (AISC)

Manual of Steel Construction, Seventh Edition - Specification for the Design, Fabrication and Erection of Structural Steel for Buildings.

(Application for copies should be addressed to the American Institute of Steel Construction, 1221 Avenue of the Americas, New York, NY 10020.)

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

B16.5 - Steel Pipe Flanges and Flanged Fittings.

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

AMERICAN BUREAU OF SHIPPING (ABS)

Rules for Building and Classing Steel Vessels.

(Application for copies should be addressed to the American Bureau of Shipping, 45 Broad Street, New York, NY 10004.)

UNITED STATES COAST GUARD (USCG)

CG-259 - Electrical Engineering Regulations.

(Application for copies should be addressed to Department of Transportation, U.S. Coast Guard, Washington, DC 20591.)

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

Standard 45 - Recommended Practice for Electric Installations on Shipboard.
Standard 444 - Standard practices and Requirements for Thyristor Converters for Motor Drives.

(Application for copies should be addressed to Institute of Electrical and Electronics Engineers, 345 East 47th Street, New York, NY 10017.)

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA WC 3 - Rubber-Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy.

(Application for copies should be addressed to National Electrical Manufacturers Association (NEMA), 2101 "L" Street N.W., Washington, DC 20037.)

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

A 48 - Gray Iron Castings.
B 584 - Copper Alloy Sand Castings for General Applications,
E 208 - Drop-Weight Test to Determine Nil-Ductility Transition Temperature of Ferritic Steels, Conducting.

(Application for copies should be addressed to American Society for Testing and Materials, 1916 Race Street, Philadelphia, PA 19103.)

SOCIETY OF AUTOMOTIVE ENGINEERS, INC. (SAE)

Standard J744c - Hydraulic Power Pumps

(Application for copies should be addressed to Society of Automotive Engineers, Inc., 400 Commonwealth Drive, Warrendale, PA 15096.)

(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 Materials.

3.1.1 General. Materials shall be suitable for use in locations exposed to the weather, including presence of salt spray, and shall be free from any defects and imperfections that might affect the serviceability of the finished product. Materials shall be in conformance with the requirements specified herein. Materials not definitely specified herein shall be of a quality to meet the requirements specified herein and shall be selected in the order of preference specified in 3.1.2.1.

3.1.2 Material identification.

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

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

3.1.2.2 Material substitutions. Where materials other than as covered by 3.1.2.1(a), (b), and (c) are to be used, drawings shall show the complete chemical and physical properties of the material.

3.1.3 Magnesium. Magnesium and magnesium base alloys shall not be used.

3.1.4 Brittle material. Brittle material is defined as material showing less than 10 percent tensile elongation.

3.1.4.1 Cast iron in any form shall not be used in structural applications except where permitted by referenced specifications. In these instances, the material shall be limited to ASTM A 48, class 35 or classes of lower tensile strength. Cast nodular graphitic iron conforming to MIL-I-24137 may be used for machinery equipment components.

3.1.4.2 Other brittle materials may be used only where it is satisfactory to the contracting activity for a particular application.

3.1.5 Aluminum. Only 5000-series aluminum alloys may be used for aluminum parts.

3.1.6 Steel. Steel intended for use in welded fabrication, including weld repair, shall be of a grade/composition considered readily weldable and shall have maximum carbon content of 0.03 percent. Structural steels used in the crane for main load-carrying members, fracture of which would cause a catastrophic failure of the structure or machinery, shall be tested in accordance with ASTM E 208 and shall demonstrate a nil-ductility transition temperature of 0°F or below.

3.1.7 Asbestos. Asbestos materials shall not be used in any part of the crane nor in packaging materials.

3.1.8 Corrosion resistance. Metals usually considered to be susceptible to corrosion attack by a seawater environment shall be processed (treated, plated, or painted) to provide corrosion resistance. In order to minimize corrosion attack due to electrolytic action between dissimilar metals in contact with each other, direct metal-to-metal contacts shall be limited to those metals, which, when coupled, are designated by an open square, an open triangle, or an open triangle with a cross bar shown in table entitled "Sea Water Corrosion of Galvanic Couples", of MIL-E-917 under the following conditions:

(a) For combinations of metals subject to immersion, splashing, or spray from seawater, condition S, E, or L, as applicable shall apply.
(b) For combinations of metals exposed to atmosphere but not subject to immersion, splashing, or spray from seawater, condition E shall apply.

If a metal is coated or plated, the coating or plating metal rather than the base metal shall be considered. Metal-to-metal contact shall be considered to exist between parts that depend upon painting for corrosion resistance. Cadmium plating shall not be used on any part.

3.1.9 Fabrication. Crane machinery and structures shall be fabricated and inspected in accordance with MIL-STD-278 as specified for class M machinery.

3.1.10 Recovered materials. All equipment, material, and articles incorporated in the crane shall be new and shall be fabricated using materials produced from recovered materials to the maximum extent practicable without jeopardizing the intended use. The term "recovered materials" means materials which have been collected or recovered from solid waste and reprocessed to become a source of raw materials, as opposed to virgin raw materials. None of the above shall be interpreted to mean that the use of used or rebuilt products is allowed under this specification.

3.2 General design. Crane shall be complete in all respects including operating controls and other equipment that may be necessary for operation. Special tools required for maintenance shall be provided (one set each crane), including stowage provision. Equipment shall reflect trade-offs of simplicity, reliability, maintainability, minimum size and weight, and the minimum life cycle cost in relation to the requirements herein. Equipment shall demonstrate compliance with these requirements by successful completion of the tests specified herein.

3.2.1 Service life. Crane shall have a service life of 20,000 operating hours (20 years) and shall operate over a period of 5 years (approximately 5000 hours) before overhaul or major repair is required.

3.2.2 Parts. Parts shall be as light and compact as practicable, consistent with the required strength and stiffness, and shall be arranged to provide access for inspection, repairs, replacement, and lubrication. Parts subject to periodic overhauling shall be removable without dismantling adjacent parts. Lifting eyes shall be provided on all equipment components weighing over 75 pounds.

3.2.3 Interchangeability. Machine components, electric motors, and controllers shall be identical and interchangeable, where possible. Identical parts, including repair parts built to the same drawings, shall be fully interchangeable.

3.2.4 Fail-safe operation. Crane shall be provided with interlocks, safety devices, and protective devices so that it will be fail-safe. Fail-safe is defined as requiring that failure of the operating power source or power operated drive mechanism shall not jeopardize the safety of the personnel, the load being handled, or the crane unit.

3.2.5 Reliability. Crane shall have a 0.80 probability of starting and completing a mission of 40 crane operational cycles performed continuously with no failure. An operational cycle shall include: hoisting rated load from full down to full up position with the boom at maximum reach, topping the boom through half its arc, rotating the crane through half its rotational arc, traveling half the crane's traveling distance (type C and D cranes), lowering the load, pausing for 5 minutes, then returning to the original position with no load on the hook; all operations shall be run at rated speed with slowdown and intermediate stops at ends of travel.

3.2.6 Failure definition. Equipment failure is defined as occurring when the crane fails to start or ceases to function or its performance degrades below the requirements of this specification.

3.2.7 Failure mode and effect analysis (FMEA). A FMEA shall be performed for critical items. The analysis shall be an organized procedure for identifying, evaluating, and analyzing all known potential failure modes for the equipment, together with the causes, and any recommendations to preclude such failures. As part of the FMEA, the contractor shall conduct a design review between his personnel and Government representatives in accordance with the data ordering document included in the contract or order (see 6.2.2). This review will primarily be concerned with a discussion of the FMEA and the contractor's recommendations for improvement of the equipment.

3.2.8 Maintainability. Design concept for maintainability shall be expressed in terms of replacement of complete assemblies and subassemblies with a minimum disassembly of parts. Subassembly interfaces shall be keyed, wherever necessary and practicable, to help prevent misalinement and incorrect installation. Crane shall have a probability of 95 percent that no fault correction time (nonschedule) shall exceed 18 hours, 75 percent that no fault correction time shall exceed 6 hours, and 50 percent that no fault correction time shall exceed 1 hour. The time for maintenance shall not include administrative and supply time.

3.2.9 Safety.

3.2.9.1 Safety criteria and considerations. Equipment design and operational procedures developed by the contractor shall incorporate, but not be limited to the following:

(a) Avoidance or elimination of identified hazards by design selection or material selection.
(b) Control and minimization of hazards to personnel, equipment, and material which cannot be avoided or eliminated.
(c) Isolation of hazardous substances, parts, and operations from other activities, areas, personnel, and incompatible materials.
(d) Incorporation of fail-safe principles where failures would result in injury to personnel or damage to equipment.
(e) Location of equipment parts so that access to them by personnel during operation, maintenance, repair, or adjustment shall not require exposure to hazards such as chemical burns, electrical shock, cutting edges, sharp points, or toxic atmospheres.

(f) Provision of warning and caution notes in operations, assembly, maintenance, and repair instructions.
(g) Specific warnings of hazards on the equipment (placards, see 3.8).

3.2.9.2 System hazard analysis. Contractor shall conduct a system hazard analysis in accordance with the requirements of MIL-STD-882.

3.2.9.3 Operating hazard analyses. Contractor shall conduct operating hazard analyses in accordance with the requirements of MIL-STD-882.

3.2.9.4 Data use. Engineering data, procedures, and instructions developed from the engineering design and the FMEA shall be used in support of the effort required in 3.2.9.2 and 3.2.9.3.

3.2.9.5 System safety precedence. Safety hazards shall be resolved in accordance with the precedence established by MIL-STD-882.

3.2.10 Airborne noise. Airborne sound pressure levels for the crane shall not exceed those specified in table I when measured in accordance with MIL-STD-740, except that there shall be 3 microphone measuring points: One measuring point at the center of cab and the other two on opposite sides of the crane at a distance of 25 feet from the centerline of rotation and 6 feet above the deck. Noise data shall be documented in accordance with MIL-STD-740.

TABLE I. Airborne sound pressure levels.

Octave band center frequencies (Hz)									
	32	63	125	250	500	1000	2000	4000	8000
SPL	99	94	91	84	← SIL 1/ value →			79	80
(Re 0.0002 microbars)									

1/ The speech interference level (SIL) value shall be 72 decibels (dB) and determined as the arithmetic average of the sound pressure level (SPL) in the 500, 1000, and 2000 hertz (Hz) octave bands.

3.3 Performance characteristics.

3.3.1 Rated loads. Crane shall operate with the rated loads, speeds, and outreaches as specified (see 6.2.1), under the dynamic ship conditions as specified (see 6.2.1), and within the rotation limits as specified (see 6.2.1). Concurrent wind force and main hoist load area shall be as specified (see 6.2.1). Minimum boom topping angle at rated load shall be 30 degrees above horizontal. The crane shall be operated at reduced load capacity with boom topped from 0 to 30 degrees above horizontal (see 3.8.2).

3.3.2 Stowed loads. Crane, when stowed, shall withstand forces caused by ship motions, ice load, and wind load as specified (see 6.2.1). Ship motion load factors include gravity and inertial components.

3.3.3 Load definitions. As used in this specification, "rated load" is defined as the maximum weight that the crane shall handle on the hook. "Design load" is defined as the "rated load" plus dead load of structure, including operating components, as increased by the load factors resulting from dynamic motions of the crane and from the wind load (see 3.3.1). Dynamic motions shall include acceleration and deceleration of the rated load.

3.3.4 Modes of operation. Crane shall be capable of simultaneous and independent operation of any combination of two modes of operation (hoist, topping, rotation, and, if applicable, travel) in either direction at any speed from zero to maximum, except that simultaneous operation of main and auxiliary (if applicable) hoists is not required. Crane shall be capable of stopping and holding the rated load at any point within the specified operating range. Crane shall withstand loads imposed under the following conditions:

(a) Normal condition.
(b) Maximum condition.
(c) Stowed condition.

3.3.4.1 Normal condition. For the normal condition, the following effects shall be combined to determine the maximum stress in the various structural and machinery components:

(a) Rated hook load.
(b) Dead load.
(c) Wind load while operating.
(d) Load effect due to list and trim.
(e) Load effect due to roll and pitch.
(f) Load effect due to dynamic motions of the crane.

3.3.4.2 Maximum condition. For maximum conditions, loads due to brake slip or loads applied during tests, whichever are greater, shall be used to determine the maximum stress in each structural and machinery component.

3.3.4.3 Stowed condition. For the stowed condition, the following effects shall be combined to determine the maximum stress:

(a) Dead load.
(b) Wind load.
(c) Ice load.
(d) Ship motion load factors (see 3.3.2).

3.3.5 Design loads. Magnitude for the effects specified in 3.3.4.1 through 3.3.4.3 shall be as specified (see 6.2.1). Design loads shall be obtained by multiplying the load factors indicated by the weight of the component part or item of equipment under consideration. Wind loads from 3.3.1 or 3.3.2, as applicable, shall be assumed to act in the direction giving maximum stress in the member under consideration.

3.3.6 Machinery components. Machinery components shall be analyzed considering appropriate factors which shall include, but not be limited to, the following:

(a) Antifriction bearing efficiency: 0.98 per pair of bearings.
(b) Gear efficiency: 0.98 - Herringbone and helical.
0.96 - Machine cut spur.
0.80 - (Maximum) worm drives.

3.3.7 Structural components. Structural components shall be analyzed considering bending, tension, compression, shear, and torsion. Structural members subjected to both axial compression and bending stresses shall be proportioned to meet the requirements of AISC Manual of Steel Construction, Seventh Edition, except that allowable stresses used therein shall be reduced to meet stress level specified in 3.3.8 and 3.3.9.

3.3.8 Stresses. Shear, torsion, and bearing stresses shall be related to the material yield point in tension as follows:

(a) Direct shear - 60 percent of minimum tensile yield point.
(b) Torsion - 65 percent of minimum tensile yield point.
(c) Bearing - 160 percent of minimum tensile yield point.

3.3.9 Allowable stresses. For the normal and stowed conditions, the allowable stress for machinery and structural components shall not exceed 35 percent of the tensile yield strength where tension, shear, and compression have been combined. Members subjected to pure shear, torsion, or bearing shall not be stressed more than 35 percent of the respective values specified in 3.3.8. For the maximum condition, the allowable stress shall not exceed 70 percent of the tensile yield strength where all stresses have been combined.

3.3.10 Bolt stresses. Under normal conditions of loading, combined stresses for hold down connection bolts for critical strength applications shall not exceed 25 percent of yield strength. Critical strength applications are those where failure of one or more bolts would cause a catastrophe resulting in injury to personnel or damage to equipment. Bolts for tension applications and bolts clamping friction joints shall be tightened to provide a preload stress of 75 to 80 percent of yield strength. Torque data shall be shown on drawings and in the equipment technical manuals.

3.3.11 Temperatures. Equipment shall be safely operable in a temperature range from 0°F and concurrent wind velocity of 45 knots to 120°F.

3.3.12 Power requirements. Powering of the various motions shall be based upon handling the load under the conditions specified in 3.3.12.1 through 3.3.12.3.2.

3.3.12.1 Hydraulic power unit (HPU) motor load not to exceed full load rating when operating with rated load (type A, B, and C cranes).

3.3.12.1.1 Hoist power requirements shall be based on the rated load, dead load, and efficiency losses.

3.3.12.1.2 Topping, slewing, and (if applicable) traveling power requirement shall be based on the rated load, dead load, list, trim, and efficiency losses.

3.3.12.2 HPU motor load not to exceed 125 percent of full load rating when operating under normal conditions (type A, B, and C cranes).

3.3.12.2.1 Hoist power requirement shall be based on the rated load, dead load, roll, pitch, and efficiency losses.

3.3.12.2.2 Topping, slewing, and (if applicable) traveling power requirements shall be based on the rated load, dead load, wind load, list, trim, roll, pitch, and efficiency losses.

3.3.12.3 HPU motor load not to exceed 125 percent of full load rating when operating under test (type A, B, and C cranes).

3.3.12.3.1 Hoist power requirement shall be based on the dead load, efficiency losses, and 150 percent (see 6.1.1 and 6.2.1) of the rated load.

3.3.12.3.2 Topping, slewing, and (if applicable) traveling power requirement shall be based on the dead load, list, trim, efficiency losses, and 150 percent (see 6.1.1 and 6.2.1) of the rated load.

3.3.13 Shipboard electric power supply (type A, B, and C cranes). Crane electrical equipment shall operate from 440 volts (V), 60 Hz, 3-phase, 3-wire, ungrounded, type 1 power complying with steady state and transient characteristics and ranges as specified in DOD-STD-1399, Section 300.

3.3.14 Diesel engine electric power supply (type D crane). Diesel engine alternator or generator shall provide electric power for auxiliary services and control.

3.3.15 High-impact (HI) shock. When specified (see 6.2.1), design shall provide for capability of unloaded crane in stowage position to withstand HI shock in accordance with grade B of MIL-S-901.

3.4 Component parts.

3.4.1 Machinery. Crane machinery shall include, but not be limited to, the following components:

(a) Hoisting and topping winches with wire rope drums, gear boxes, hydraulic motors and brakes, couplings, and limit stops. Twin topping cylinders with counterbalance valve and pilot-operated check valves may be used in lieu of topping winch. Cylinders shall have heads secured by tie rods, studs, bolts, or screw threads. Piston rods shall be chrome plated to a thickness of 0.003 inch minimum. Cylinder assemblies shall incorporate piston rod scrapers for removing ice and debris from the rods.
(b) Rotation (slewing) drive with bull gear, pinion gear(s) (preferably two or more, evenly spaced around the bull gear),

reduction gears, hydraulic motors and brakes, couplings, and limit stops (unless full, unrestricted rotation is specified (see 6.2.1)).

(c) Travel drive (type C and D cranes) with rack(s) and pinion(s) if specified (see (6.2.1), reduction gears, hydraulic motors and brakes, couplings, and limit stops.

(d) Bumpers for rotation limits (unless full, unrestricted rotation is specified (see 6.2.1)) and (if applicable) for travel limits.

(e) Mechanical and electrical devices, operating, centering, and limit stop devices for control of the hoisting, topping, rotating, and (if applicable) traveling operations of the crane, indicators, bearings, stuffing boxes, brackets, shafts, levers, turnbuckles, and gears, as necessary.

(f) Machine bedplates, frames, pedestals, and mountings, and all bearings.

(g) Electrical wiring within and between the electrical units and safety devices, and the resistors, electrical indicators, and switches.

(h) Guards to cover moving parts and protect personnel. Corrosion resistant fasteners shall be used for all removable covers.

(i) Identification plates and information plates.

(j) Cable reel (type C crane) to transmit power from the ship to the crane. Means, such as level-wind mechanism, shall be provided to insure proper spooling of cable.

(k) HPU (type A, B, and C cranes) consisting of electric motor and and multiple pumps.

(l) Hydraulic and electric power supply (type D crane) consisting of a diesel engine, multiple pumps, generator or alternator, swivel valve and slip ring assembly to transmit hydraulic and electric power from the rotating portion of the crane to the base (if full, unrestricted rotation is specified (see 6.2.1)). Diesel engine shall include 100 gallon (minimum) fuel tank, heavy duty air cleaner, heavy duty radiator, adjustable speed governor, tachometer and hourmeter (in cab), oil pressure and water temperature gages (in cab), cold weather starting aid, drip pan, starter, batteries, and air closure device to aid in runaway engine securing. Air closure device shall require manual resetting and shall block combustion air supply if engine speed reaches 115 percent of full rated speed. Diesel engine components (filters, hoses) for fuel shall be positioned or shielded to avoid spray type leakage onto hot engine parts or air intake.

3.4.1.1 Hook and swivel. Crane hooks and swivels shall be similar to Drawings S1701-921849 and S1701-921850 except that capacities shall be as specified (see 6.2.1) and swivels shall incorporate antifriction thrust bearings. Insulator links shall be provided if specified (see 6.2.1).

3.4.1.2 Load acceleration. Acceleration (and deceleration) of the rated load at the main hoist hook shall be limited so that loads imposed on the crane do not exceed maximum condition loads (see 3.3.4.2). The acceleration limit

may be met by natural elastic characteristics of the crane wire rope installation and structure or by shock absorbers installed in the hook assembly or by a combination of both.

3.4.1.3 Wire rope. Wire rope shall be in accordance with RR-W-410, type I, class 3 Warrington-Seale construction or equal, independent wire rope core (IWRC), 6 by 37 improved plow steel or extra improved plow steel, uncoated, preformed, right or left regular lay (see 3.5.1).

3.4.1.4 Warning horn. Crane shall be provided with a manually actuated warning horn, operable from the cab.

3.4.1.5 Alarm bell (type C and D cranes). Base or car shall be provided with an alarm bell which automatically sounds when the travel control lever is moved in either direction from the neutral position.

3.4.1.6 Fire extinguisher. Machinery house and operator's cab each shall be equipped with a fire extinguisher in accordance with MIL-E-24091, class 1, size 1. Mounting shall be on a positive locking quick release bracket in an accessible position with the extinguisher nozzle protected against damage.

3.4.2 Structural components. Structural components shall include, but not be limited to, the following:

(a) Boom.
(b) Mast and kingpost (type A crane).
(c) Pedestal (type B crane).
(d) Base or car (type C and D cranes).
(e) A-frame (type B, C, and D cranes), unless topping cylinders are used (see 3.4.1(a)).
(f) Machinery house.
(g) Operator's cab.
(h) Rotation positive stops and limit switch cams (if applicable).
(i) Travel positive stops and limit switch cams (type C and D cranes).
(j) Boom stowage support.
(k) Hook and block stowage devices.
(l) Mounting bolts.
(m) Boom up positive stop and limit switch cam.
(n) Foundation ring(s) to attach kingpost or pedestal to ship structure (if applicable; type A and B cranes).
(o) Rails (type C and D cranes), unless existing rails are to be used for replacement cranes (see 6.2.1).

3.5 Detail design.

3.5.1 Wire rope installations. The factor of safety of wire rope, when subjected to design loads due to normal conditions, shall be at least five. For the maximum condition of test loads or brake slip, the factor of safety of wire rope shall be at least 2-1/2. Wire rope end connections shall be poured socket type.

3.5.1.1 Wire rope drums shall be grooved and shall hold the required wire rope preferably in a single layer. When payed-out to the down-stop limit (see 3.5.7.1.2), at least 2-1/2 turns shall remain on the drums. Drum pitch diameter shall be at least 24 times the rope diameter. Wire rope anchorage to the drum shall sustain a line pull equal to twice the design load on the rope with 2-1/2 turns remaining on the drum. Standing end of each hoisting purchase shall have a swivel.

3.5.1.2 Sheaves shall be of rolled or forged steel with machined groove and fitted with antifriction bearings, sealed, and lubricated. Sheave tread diameter shall be at least 18 times the rope diameter. Sheave guards shall be provided to keep wire rope from coming out of the groove.

3.5.1.3 Single or multipurchase blocks shall be constructed to meet strength requirements, and tested and marked with load ratings and test data.

3.5.1.4 Grease for wire ropes shall be in accordance with MIL-G-18458.

3.5.2 Gears.

3.5.2.1 Load capability. Load capability of the gearing shall be computed and rated in accordance with AGMA standards practice quality six or better gear tolerance and service factor of 1.0.

3.5.2.2 Reduction and transmission gears. Reduction and transmission gearing shall be spur or helical and shall be in accordance with AGMA standards. Gearing shall have machine cut teeth and a 20 degree pressure angle or larger. Gearing, where rotation exceeds 10 revolutions per minute (r/min), shall be totally enclosed in a single oil tight case and shall be lubricated by an oil bath. Gear shafting shall be installed with antifriction bearings. Heat generated shall be satisfactorily dissipated under the most severe operating conditions without resort to special external cooling.

3.5.2.3 Slow speed reductions. Slow speed reduction, such as bull gears and their pinions, may be of straight spur gear type and may be of open construction. Open gears shall be furnished with removable covers capable of protecting the machine components from accidental physical damage, such as by dropped hand tools, and capable of protecting personnel from injury by the moving open gears. Covers shall permit ready access for lubrication.

3.5.2.4 Right angle drives. Right angle drives may be bevel gears of true spiral tooth design, or high efficiency worm gearing of the overhauling type which will permit the worm wheel to reverse and drive the worm.

3.5.2.5 Gear cases. Gear cases shall permit safe, ready inspection, repair, and removal of gears. Nuts and bolts inside gear cases shall be self-locking. Oil resistant sealing gaskets shall be provided to prevent leakage. Oil filling, drainage, and vent fittings shall be provided. The filler hole shall have a strainer fixed with fasteners requiring hand tools for removal. Tight fitting caps or covers shall be provided. A dipstick or gage shall be provided for indicating the oil level and marked to indicate the "full" and "add oil" oil levels. Each gear case shall be fitted with a drain which will permit complete draining of the gear case. A vent, suitably located and baffled to prevent the loss of oil under operating and stowage conditions, and screened to exclude foreign matter, shall be provided.

3.5.2.6 Seals. Oil seals shall be provided to prevent leakage of oil where shafts penetrate the gear housing. Bearings in gear casings may be oil lubricated if proper and adequate circulation of oil through the bearing is provided under all specified operating conditions, including list. Where bearings are grease lubricated, a seal shall be installed to prevent the gear case oil and bearing from mixing.

3.5.2.7 Oil and grease. Lubrication oil shall be 2190-TEP in accordance with MIL-L-17331. Grease shall be in accordance with DOD-G-24508 except for open gears which shall use grease in accordance with MIL-G-18458.

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

3.5.3 Bearings. Antifriction bearings shall be lubricated with oil where practicable. Access to check, drain, and add oil shall be provided. Where oil lubrication is not practicable, grease lubrication shall be used. Grease lubricated bearings shall be fitted with corrosion resistant steel or nickel-copper alloy pressure grease fittings. Grease drain plugs shall be incorporated when pressure grease fittings are used. Bronze bushings may be used only in applications satisfactory to the contracting activity. Material for bronze bushings shall be in accordance with ASTM B 584 alloy number C94700 or C94700HT. Positive means shall be provided to prevent bronze bushings from turning and cutting off the supply of lubricant.

3.5.3.1 Bearing life. Antifriction bearings shall be selected to result in a minimum L-10 life of 10,000 hours, calculated in accordance with FF-B-171, FF-B-185, or FF-B-187, as applicable.

3.5.4 Electrical requirements.

3.5.4.1 General. Electrical equipment shall be in accordance with the applicable requirements of ABS Rules, USCG 259, IEEE 45, and as specified herein. Electrical system shall be ungrounded.

3.5.4.1.1 Conduit boxes and cable entrance shall be for marine service and to suit the specified equipment enclosure. Cable entrance plates to accomodate stuffing tubes shall be provided.

3.5.4.1.2 Equipment shall be capable of meeting the requirements of MIL-STD-167-1 for type I vibrations (non-rotating equipment) and types I and II vibrations (rotating equipment). Tests will not be required unless required by specific equipment Military specification.

3.5.4.1.3 Screening shall be provided over ventilation openings for electrical equipment where necessary to meet ratproofing requirements.

3.5.4.1.4 Equipment shall meet the electrical shock hazard requirements of MIL-E-917.

3.5.4.1.5 Electrical creepage and clearance distances shall be in accordance with MIL-E-917.

3.5.4.1.6 Threaded parts and fastening devices shall meet the requirements of MIL-E-917.

3.5.4.2 Cabling requirements.

3.5.4.2.1 Flexible cables shall be watertight flexing service or non-watertight flexing service in accordance with either MIL-C-915 or NEMA WC 3. All other cables and conductors shall be in accordance with MIL-C-915. Cables exposed to the weather shall be watertight. Armored cabling shall be used in the machinery house and operator's cab wherever exposure to damage is a reasonable possibility. Cables in walkways shall be covered by tapered shrouds to minimize tripping hazard.

3.5.4.2.2 Cables shall be installed within the kingpost (type A crane), pedestal (type B crane), or base (type C and D cranes) with adequate length to allow for crane rotation and for cable exits through terminal tubes below deck to permit connection of associated ship's cable (type A and B cranes) or for connection to cable reel (type C crane). Means shall be provided to secure the upper portion of the flexible cables to the rotating portion of the crane to permit connections of the cables to the associated electrical equipment. Cables required to be connected to the crane shall be as follows:

(a) Control for emergency stop switches (located remotely on type A and B cranes and on base of type C and D cranes); (see 3.5.4.3.4).
(b) Communication for sound-powered telephone (voice and call), connecting cab, machinery house, and remote or base location (as applicable) and including headsets and buzzers.

3.5.4.2.3 Power shall be transferred between the fixed and rotating portions of the crane by slip ring assemblies. A loop cable configuration may be used in lieu of slip ring assemblies. A loop cable configuration may be used in lieu of slip rings if rotation arc is restricted (see 6.2.1).

3.5.4.2.4 Wiring necessary for crane operation shall be installed complete.

3.5.4.2.5 Connection boxes shall be used where necessary to join flexible cable to fixed cable.

3.5.4.3 Power distribution.

3.5.4.3.1 Fused or circuit breaker distribution boxes shall be used to provide protection to auxiliary services equipment such as heaters, wiper motors, lighting and ventilation fans (up to 7-1/2 hosepower (hp)). Circuit breakers shall be provided in appropriate enclosures where loads exceed 7-1/2 hp.

3.5.4.3.2 Manual controllers (up to 7-1/2 hp) or magnetic controllers shall be used for heaters and ventilation motors. Line switches shall be provided for cab window wipers, defroster, and maintenance lighting in the cab and machinery enclosures.

3.5.4.3.3 Transformers (450 to 120 volt) shall be provided as required for auxiliary services.

3.5.4.3.4 One main line magnetic contactor shall be provided for controlling power to HPU motor (type A, B, or C cranes) or for starting and stopping diesel engine (type D crane). The contactor shall be controlled through the action of one "power on-emergency stop" pushbutton switch (or separate switches, (see 3.5.6(b) and (c)) located at the crane operator's control stand and through two "emergency stop" switches located remotely on the ship (type A and B cranes) or on opposite ends of the base (type C and D cranes).

3.5.4.4 Electrical-mechanical operation.

3.5.4.4.1 Master switches for hoisting, topping, rotating, and (if applicable) traveling shall provide stepless control for any load from zero to full load. If auxiliary hoist is required (see 6.2.1), a selector switch shall be provided to select main or auxiliary hoist operation through a single hoist master switch. Master switches shall be used in conjunction with servo controllers or servo valve specified in 3.5.5.4.

3.5.4.4.2 Means shall be provided at the master switch to permit the crane operator to "float" the load and to move the load slowly in either direction of travel. This action shall initially release the brakes without change in load position and shall allow control of the load in either direction, passing through the "neutral" position without setting the brakes (see 3.5.6(a)).

3.5.4.4.3 If duty cycle computations indicate that cooling is necessary, forced-air cooling shall use one or more ventilation fans in accordance with MIL-F-18953 type X-L (tubeaxial) or MIL-F-19004 type C (centrifugal). Air filters used with forced-air cooling shall be corrosion resistant.

3.5.4.5 Motor. HPU motor (type A, B, and C cranes) shall be a.c. industrial motor suitable for shipboard operation as follows:

(a) Service - Marine.
(b) Ambient temperature - 120°F.
(c) Voltage - 440 V a.c., 3-phase, 60 Hz.
(d) Duty - Constant.
(e) Enclosure - Dripproof; force-ventilated if duty cycle computations indicate that cooling is necessary.
(f) Power - As required.
(g) Type - A.c. industrial, suitable for crane operation.
(h) Design - Squirrel-cage, induction, not to exceed 1800 r/min.
(i) Bearings - Ball.
(j) Insulation - Class B with corresponding temperature rise.
(k) Additional requirements - Motor shall be provided with over-temperature sensors and have facility to accept a substitute without rewinding (see 3.5.6(q)). Neither silicone materials nor aluminum wire shall be used in the motor.

3.5.4.6 Controller and control accessories. HPU motor controller shall be full voltage type (across-the-line) for HPU motor up to 150 hp. HPU motor controller shall be reduced voltage type (auto-transformer) for HPU motor exceeding 150 hp. Accessories, such as pushbutton switches, relays, contactors,

master switches and other electro-mechanical devices, as well as HPU motor controller, shall be in accordance with MIL-C-2212.

3.5.4.6.1 Control enclosures shall be splashproof.

3.5.4.6.2 Control accessories which perform similar functions shall be standardized and interchangeable to the maximum extent practicable. The number of different parts in the controls shall be kept to a minimum consisent with the intended use. Selection of parts not otherwise specified shall be in accordance with MIL-STD-454. Request for the use of nonstandard parts shall conform to requirement 22 of MIL-STD-454.

3.5.4.6.3 Semiconductor devices shall be chosen and applied in accordance with requirement 30, and microelectronic devices (IC's) in accordance with requirement 64, of MIL-STD-454.

3.5.4.6.4 Cable and enclosure bonding and grounding shall conform to MIL-STD-1310.

3.5.4.6.5 Operation of controller (type A, B, and C cranes) shall be limited to input current waveform distortion consistent with section 7 of IEEE 444.

3.5.5 Hydraulic requirements.

3.5.5.1 General. Systems shall be arranged to facilitate solvent flushing, air venting, and oil sampling. Systems shall incorporate protection against overload damage and against runaway operation. Accumulators and neutral bypass valves shall not be used.

3.5.5.2 Pumps and motors. Hydraulic pumps and motors shall be variable displacement axial piston type and fixed displacement axial piston type, respectively, in accordance with MIL-P-17869 class 1. Motors shall be flange-mounted and shall have 30-degree involute splines in accordance with SAE J744c. If topping cylinders are used, topping pump shall be pressure-compensated.

3.5.5.3 Brakes. Hydraulic brakes shall be provided for each hoist, topping, rotate, and (if applicable) travel motor. Brakes shall stop and hold the dynamic test load of 150 percent of rated load (see 6.1.1 and 6.2.1). Brakes shall hold the static test load of 200 percent of rated load (see 6.1.1 and 6.2.1). Brakes shall be interlocked with their respective motors so that the brakes will set when the control is on neutral, when the motor is stopped, and upon failure of power (see 3.5.4.4.2 for float mode). Brakes shall be in accordance with the following:

(a) Type - Disc or shoe, hydraulic.
(b) Mounting - Flange and 30-degree involute spline in accordance with SAE J744c.
(c) Other data - Manually operated brake release pump with isolation valve shall be provided for each brake.

3.5.5.4 Servo controllers. Drive systems shall utilize pump-mounted electro-hydraulic servo controllers which incorporate fail-safe mechanisms to return pumps to zero stroke if power is lost. If topping cylinders are used, topping speed control shall be by electro-hydraulic servo valve, not necessarily pump-mounted, and topping controls shall incorporate fail-safe features to stop boom motion if power is lost (see 3.5.4.4.1).

3.5.5.5 Hydraulic fluid. Hydraulic fluid shall be in accordance with MIL-L-17672. Fluid operating temperature shall not exceed 160°F. Maximum system pressure shall not exceed 3000 pounds per square inch (lb/in^2) under normal operating conditions. Relief valves shall be set 5 percent above the maximum pressure expected under all operating and test conditions.

3.5.5.6 Filter. Closed loop systems shall incorporate an inlet filter in the suction line between reservoir and charge pump. This filter shall be 25-micron absolute or as recommended by the pump manufacturer. An open loop system (topping system using cylinders in lieu of winch) shall incorporate a filter conforming to MIL-F-24402 in the pump discharge line and a strainer in the suction line.

3.5.5.7 Heater element. Each reservoir shall incorporate a heater element to facilitate cold weather operation. Element shall have a maximum rating of 22 watts per square inch (W/in^2) and shall be thermostatically controlled with on-off switch in the operator's cab.

3.5.5.8 Piping arrangement. Piping shall be arranged in a neat, orderly manner and with hydraulic lines kept as short as practicable to minimize pressure losses. Piping shall not obstruct visibility and access required to control, monitor, or adjust machinery and equipment. Hydraulic lines, 1/4 inch through 3/4 inch, shall incorporate short high-pressure flexible hose assemblies between rigid tubing and connecting pumps, motors, and manifolds to eliminate rupture and leakage caused by vibration of the rigid tubing. A manually operated, lockable bypass valve shall be provided for each hydraulic motor for inspection and maintenance purposes. The number of joints in piping systems shall be minimized through the maximum application of tube bends. Where tube bends are not practical, butt-welded, socket-welded, or brazed joints shall be used to the maximum extent, with the use of flanged and similar takedown joints minimized. Suction line(s) in reservoir shall terminate at least 2 inches above the bottom of the reservoir. Drain line(s) shall permit complete drainage of reservoir.

3.5.5.9 Tubing, cylinders, fittings, and clamps. Tubing and fittings shall be type 304L or 316L corrosion-resisting steel. The factor of safety of tubing and (if applicable) cylinders, when subjected to maximum system pressure under normal operating conditions, shall be at least four. Clamps and similar support devices shall not be welded to the component or system being supported.

3.5.5.10 Connections. Tapered pipe thread connections, "Teflon" tape (or equivalent), and thread dope shall not be used. Takedown pipe connections shall be ANSI B16.5 flanges modified for O-ring face seals or Combination Pump Valve (CPV) Company O-ring face seal unions or equivalent, except that connections to components may be straight thread O-ring fittings. All

penetrations into the primary hydraulic systems for instruments and test points shall be straight thread O-ring bosses conforming to MS33649. All test points and ports not having permanently installed instruments shall be closed with safety plugs conforming to AN814.

3.5.5.11 Vent and bleeder valves. Vent and bleeder valves shall be installed at all high points in the piping and in components where air may be trapped. The valves shall be similar to Fluid Regulators Corporation part number 7579 or equal, sized as required to facilitate venting.

3.5.5.12 Sampling valves. To allow sample taking at full flow and rated pressure, a hydraulic fluid sampling valve conforming to MIL-V-81940 shall be installed in each drive system at the lowest point in the tubing which carries maximum flow for that system.

3.5.5.13 O-rings. O-rings shall be in accordance with MIL-R-83248.

3.5.5.14 Flushing. Prior to initial charging of the system with hydraulic fluid, solvent flushing of the system shall be accomplished in accordance with MIL-STD-419.

3.5.6 Control console. Controls, including those required to start and operate the diesel engine (type D cranes), shall be from a console in the cab and shall be arranged in accordance with MIL-STD-1472 for ease of operation. There shall be no combination of controls which could result in a failure or allow the load to fall. When the master switch is placed in neutral, the operation shall stop promptly and the load shall maintain its position. The following operating controls and indicators shall be installed:

(a) Master switches for hoisting, topping, rotating, and (if applicable) traveling drives shall provide stepless speed control. Master switches shall be lever-operated type with central neutral position and spring return to neutral. Hoist master switch operating level shall move back to hoist up and forward to hoist down. Topping master switch operating level shall move back to top up and forward to top down. Rotate master switch operating lever shall move left to rotate counter-clockwise and right to move clockwise. Travel master switch operating lever (if applicable) shall move back to travel aft and forward to travel forward. Thumb-operated momentary contact switch for brake release at neutral position shall be provided for floating load and obtaining minimum speeds for each drive.

(b) Power on switch to control main power contactor supplying power to the drive system controls; may be combined with "emergency stop" switch.

(c) Emergency stop switch (red) to control main power contactor and shut down all drives and controls; located remotely from other switches on the console to avoid operator error; may be combined with "power on" switch.

(d) Emergency run-off switch for HPU motor (type A, B, and C cranes) to provide emergency operation of drives by bypassing motor protective circuits. This switch shall be momentary contact type to prevent accidentally leaving the switch in bypass position during normal operation.
(e) Ammeter to indicate current drawn by HPU motor (type A, B, and C cranes).
(f) Indicator lights dimmer switch (for all green, white, and amber indicator lights).
(g) Boom angle and load monitoring system with indicators and automatic shutdown feature when an unsafe condition exists.
(h) Cab heater on-off switch.
(i) Windshield wiper on-off switch.
(j) Windshield defroster on-off switch.
(k) Exhaust fan on-off switch to control operation of the exhaust fan in the operator's cab.
(l) Hoist selector switch, two-position: main and auxiliary (if applicable; see 6.2.1).
(m) Light (amber) to indicate fuel level at 10 gallons and less (type D cranes).
(n) Boom stow-unstow switch to permit bypassing the boom down-stop limit switch, allowing the stowing of the boom using the topping master switch. This switch shall be momentary contact to prevent accidentally leaving the switch in the bypass position during normal operation.
(o) Hoist stow-unstow switch to permit bypassing the two-block limit switch(es), allowing the hoist(s) to be raised to the boom for stowing. This switch shall be a foot-operated deadman type to prevent accidentally leaving the switch in the stow position during normal operation.
(p) Light (green) to indicate that the hoisting, topping, rotating, and (if applicable) traveling motor controls are energized.
(q) Light (red) to operate in conjunction with protection (overheat) systems of the HPU motor (type A, B, and D cranes).
(r) Lights (amber) to operate when upper and lower boom angle limits are reached.
(s) Light (amber) to indicate boom stow-unstow switch in bypass position.
(t) Light (white) to indicate cab heater on.
(u) Light (white) to indicate defroster on.
(v) Horn pushbutton switch.
(w) Individual on-off switch for each floodlight.
(x) Indicator lights test pushbutton switch (if double bulb indicator lamps are not used).
(y) Sound-powered telephone headset and buzzer.
(z) Lights (red) to indicate loss of charge pressure in hydraulic systems.

3.5.7 Limit switches. Limit switches shall be of the gear, traveling nut, cam, or lever-operated type. Limit switches specified in 3.5.7.1 through 3.5.7.6 shall be installed with splashproof enclosures and rollers not less than 1-1/2 inches in diameter.

3.5.7.1 Hoist limit switches. Main and (if applicable) auxiliary hoist drive systems shall each incorporate an up-stop and a down-stop limit switch. Both switches shall be contained in a single unit driven by the hoist drum. In effect, the switch unit counts the revolutions of the drum, thereby limiting the amount of wire rope remaining on the drum to 2-1/2 turns, or preventing the block from striking the boom from overtravel.

3.5.7.1.1 Up-stop limit switches shall establish the highest point that the main and (if applicable) auxiliary hooks can be raised with respect to the boom. With the boom stationary at any point in its normal range, the up-stop limit switch shall be tripped if the main and auxiliary hooks are raised past the up-stop limits specified (see 6.2.1).

3.5.7.1.2 Down-stop limit switches shall establish the maximum amount of wire rope that can be spooled off the hoist drums. With the boom in maximum topped position, the main and auxiliary hooks shall reach the down-stop limits specified (see 6.2.1) before the limit switches are tripped. When the switches are tripped, 2-1/2 turns of wire rope shall remain on each drum.

3.5.7.2 Topping limit switches. Topping limit switches shall be essentially the same as those of the hoist systems, unless topping cylinders are used (see 3.4.1(a)), in which case the switches may be of a different type. Up-stop limit switch shall function when the boom has been raised to angle which provides minimum outreach. Down-stop limit switch shall be set for a boom angle of 30 degrees. To lower the boom below this point for stowage requires that the limit switch be bypassed. A boom stowage switch (boom stow-unstow) on the console shall provide this capability. An additional limit switch shall trip when the boom is lowered to horizontal, at which point 2-1/2 turns of wire rope shall remain on the topping drum (if applicable).

3.5.7.3 Two-block limit switches. Two-blocking (running the load block against the boom) shall be prevented during normal operation by the up-stop limit switches on the main and auxiliary hoists. As an added precaution, an overtravel limit switch for each hoist shall be mounted on the boom. Tripping this switch shall shut down the topping drive in the down direction and make it impossible to raise the hoist.

3.5.7.4 Boom overtravel limit switches. Boom up and boom down over-travel limit switches shall be provided to prevent driving the boom into positive stops or allowing less than 2-1/2 turns of wire rope to remain on the drum (if applicable) in case of failure of the normal control components to stop boom operation.

3.5.7.5 Rotating drive limit switches. Unless full, unrestricted rotation is specificed, crane rotation shall be restricted by limit switches to the rotation limits specified (see 6.2.1). Two single roller-type switches shall be used for the clockwise and counter-clockwise limits. A similar switch shall be used to prevent crane rotation if the machinery house ladder is not properly stowed.

3.5.7.6 Rotation overtravel limit switches. Clockwise and counter-clockwise rotation overtravel limit switches shall be provided to prevent driving the crane into positive stops in case of failure of the normal control components to stop rotation drive.

3.5.7.7 Travel limit switches (type C and D cranes). Fore and aft limit switches shall limit total travel of the crane to the distance specified (see 6.2.1). These switches shall be mounted on the base or car and shall engage cams permanently mounted on the ship.

3.5.7.8 Base overtravel limit switches (type C and D cranes). Fore and aft overtravel limit switches shall be provided to prevent driving the base into positive stops in case of failure of the normal control components to stop travel operation.

3.5.7.9 Limit switch recovery. From any tripped limit switches, recovery shall be effected by reversing the motion. The construction of master switches shall permit the open limit switch contact to be bypassed.

3.5.8 Lights.

3.5.8.1 Incandescent or fluorescent lighting shall be provided in the machinery house and operator's cab for maintenance purposes. Lighting shall provide a minimum initial average of 7.0 footcandles of general illumination calculated for a horizontal plane 30 inches above the deck. Lights shall be controlled by switches adjacent to each access door.

3.5.8.2 Machinery house shall be provided with two double receptacles and the operator's cab with one double receptacle for supplying power for portable lights and power tools.

3.5.8.3 Control console illumination for night operation shall be provided for crane control gages and indicators. Intensity of indicator lights shall be controlled from a single dimmer switch. Night lighting shall provide adequate vision of the controls without impairing the operator's vision of the crane operations.

3.5.8.4 One adjustable floodlight shall be provided on top of operator's cab to illuminate the working area. Floodlight shall be 120 V, 300 W (minimum).

3.5.8.5 Two 400 W (minimum) sodium vapor floodlights shall be provided near the boom tip to illuminate boom operating area.

3.5.8.6 Control of floodlights shall be from the operator's cab (see 3.5.6(w)).

3.5.9 Structure.

3.5.9.1 Plate forming main frame and other primary structure shall be not less than 1/4 inch thick. Webs of rolled sections and other secondary members shall be not less than 1/4 inch thick.

3.5.9.2 Plates in compression forming post or girder flanges, and plates in shear forming girder webs, shall have a width to thickness ratio not greater than 60.

3.5.9.3 Boom may be of tubular or structural shape construction proportioned to provide the desired outreach and clearance.

3.5.9.4 Boom and other structural parts either shall be totally sealed or shall provide for easy maintenance with access for painting the interiors. Drainage provision shall ensure that water will not be trapped.

3.5.9.5 Crane, excluding the boom, shall not extend outside of a circle of radius specified (see 6.2.1).

3.5.9.6 Kingpost, pedestal, or base (as applicable) shall consist of a structure of adequate strength to support the design loads, bearings, rotating structure, and attachments. Forces transmitted to the deck shall include horizontal, vertical, and overturning moment (i.e., fixed). Interface and envelop of kingpost, pedestal, or base (as applicable) shall be as specified (see 6.2.1). On type C and D cranes, base shall be secured to the rails or track by rollers which resist tipping of the base. Trucks shall be connected to the base structure through equalizing type trunnions to assure equal wheel loading.

3.5.9.7 Access doors shall be splashproof.

3.5.9.8 Walkways, and fixed and folding platforms shall be provided and shall have nonskid surfaces. Access doors, handrails, ladders and climber safety rails or cages shall be provided where required for safety and where required for servicing and maintaining the equipment. Safe access to and exit from cab shall be provided for all cab positions. Provision shall be made to secure all access doors in the open position. Handrail shall be provided around the full periphery of the top of the machinery house. Walkway and handrail shall be provided the full length of the boom if the top chords of the boom are over 7 feet above the deck in the stowage position.

3.5.9.9 Provision shall be made to positively secure the crane and boom in the stowed position. Supports and other securing fittings shall be provided to withstand the forces due to the stowed condition as specified in 3.3.4.3. Stow brackets for hoist block(s) and hooks shall be provided. On type C and D cranes, wheel chocks shall be provided which restrain the base in the stow position and which permanently mount on the base.

3.5.9.10 Bedplates for hoisting, topping, rotating, and (if applicable) traveling machinery shall be of adequate strength to maintain component alinement. Holding down bolt spacing shall be not greater than 15 times the bolt diameter, and the thickness of the flange at these bolt holes shall at least equal the diameter of the bolts used. Provision, such as locating dowels, body bound bolts or welded-down shear strips, shall be made to prevent shifting or misalinement of machinery components on the bedplates. Design shall eliminate pockets in which water can stand or collect, or drainage shall be provided.

3.5.9.11 Machinery house shall be splashproof and shall serve as a protection to the machinery and control equipment. Mechanical ventilation, thermostatically controlled with on-off override switch, shall be provided if necessary to dissipate heat generated by the crane machinery and equipment. On type D cranes, a small deck sump shall be provided in the machinery space with drain and closure valve to allow used engine lubricating oil and spilled fluids to be discharged via gravity to drums on the deck of the ship or wingwall of the floating drydock.

3.5.9.12 A splashproof operator's cab (operating station) shall be provided as part of the rotating structure. An adjustable seat and foot rest for the operator shall be provided. Seat shall be capable of being secured for the crane stowage condition. Control console and operator's cab shall permit the operator to observe all operations including stowing of the boom, in accordance with MIL-STD-1472. Layout of operator's cab, showing controls and their location as well as arcs of vision, shall be prepared for review. Heating and ventilation shall be provided to permit prolonged operation under a varied temperature range. Ventilation shall be provided on the basis of 5°F rise over outdoor weather air temperature or a 1-minute rate of change of total volume of air inside the cab, whichever results in the larger air quantity. Heat shall be provided to maintain 60°F during the heating season. Cab shall be provided with tinted safety glass windows equipped with defrosters and wipers to provide an unobstructed view of the entire operating range and stowage of the crane. Windows shall open with a minimum entry of rain and spray. Terminal boxes shall not be mounted on or in the floor of the cab.

3.5.9.13 Rotating crane structure shall provide support for the rotating components of the crane, including the rigging, boom, and operator's cab. Rotating crane structure shall be supported by the kingpost, pedestal, or base (as applicable) through antifriction bearings as specified in 3.5.3.

3.5.9.14 Unless full, unrestricted rotation is specified (see 6.2.1), a positive stop mechanism shall be provided to limit the rotational movement of the crane approximately to the range specified. The positive stop device shall insure that movement will not exceed its limit of travel and shall include provision for buffering to limit deceleration to acceptable values.

3.5.9.15 A positive stop device shall be provided to prevent topping the boom into the mast or A-frame (as applicable).

3.5.9.16 On type C and D cranes, safety bumpers shall be provided at each end of the rails (or tracks) to prevent the crane from running off the rails (or tracks). The safety bumpers shall be equipped with shock absorbers capable of absorbing 70 percent of a shock load resulting from the fully loaded crane running into the bumpers at full speed.

3.6 Weight and Stability. Weight of the crane shall be kept to a minimum consistent with the design requirements, but shall not be greater than that specified (see 6.2.1) when ready for operation. On type C and D cranes under the most adverse no load and test load conditions, the center of gravity of the crane shall be located so as to insure stability against tipping with a safety margin of 10 percent minimum.

3.7 Finish. Before assembly, the crane structure, machinery and consoles shall be thoroughly cleaned and abrasive blasted to near white metal in accordance with SSPC SP10. Steel parts, except for corrosion resisting steels and parts not to be painted as defined in MIL-E-917, shall be coated with an inorganic zinc primer conforming to MIL-P-23236, class 3 applied at 3 to 5 mils dry film thickness (dft). Mixing and curing shall be in accordance with manufacturer's instructions. Prior to overcoating, residual deposits formed during curing shall be removed by high pressure fresh water and scrubbing, or by the manufacturer's recommended cleaning procedure. A coat of formula 150 of MIL-P-24441 which has been thinned with one pint of thinner per gallon shall be applied at a wet film thickness of 3 mils. This shall be followed by a full coat of formula 151 of MIL-P-24441, applied at 2 to 4 mils dft, and two coats of silicone alkyd enamel conforming to TT-E-490 (haze gray), applied at 1 to 2 mils dft per coat. The first coat of enamel shall be applied when the formula 151 is in the tack stage. When tested as specified in 4.2.6, the coating shall exhibit no cohesive or adhesive defects. Other metals that are not inherently corrosion resistant as defined by MIL-E-917 shall be processed (treated, plated, or painted) in accordance with MIL-E-917 to provide corrosion resistance.

3.8 Identification plates.

3.8.1 Component parts which will be shipped by the manufacturer in an unassembled state shall be provided with identification plates to permit their identification as part of the unit. This same identity of each part shall be included on the general arrangement and installation drawings.

3.8.2 Laminated plastic safe load, lubrication, and operation charts shall be provided in the operator's cab. Load chart shall include maximum loads for the boom angle range 0 to 30 degrees at 5 degree intervals and limiting values of ship motion.

3.9 Special tools. Crane design shall minimize the need for special tools for operation and maintenance. Special tools are defined as those tools not listed in the National Supply Catalog (copies of this catalog may be consulted in the office of the Defense Contract Administration Service Management Area (DCASMA)). Special tools shall be marked for the service for which they are intended.

3.10 Technical data. Contractor shall prepare technical data in accordance with the data ordering documents included in the contract or order (see 6.2.2), and as specified in 3.10.1 through 3.11.

3.10.1 Technical manual. Contractor shall prepare a technical manual describing operation and maintenance of the crane. The following features shall be included:

(a) Lists of drawings, repair parts, and special tools furnished shall be included where not shown on the drawings.

(b) The following prints of drawings, reduced for folding in the lengthwise direction only, shall also be made a part of the technical manual:
  (1) General arrangement, including calculated weight and center of gravity.
  (2) Cross-section assembly and subassembly drawings in sufficient number to adequately identify parts.
  (3) Bedplate or foundation drawings.
  (4) Lubrication charts with lubricants listed according to Government specification number or symbol number and periodicity of lubrication.
  (5) Operating instructions.
  (6) Electrical system schematics and wiring diagrams with parts lists.
  (7) Electric motor (type A, B, and C cranes) and controller drawings including rewind in lap arrangement, bearing installation, and complete performance data for motor.
  (8) Hydraulic system schematics with parts lists.
  (9) Hydraulic pump, motor, cylinder (if applicable), and valve cross-sections.
  (10) Cross-section of gear reducers.
  (11) Operator's cab, showing controls and their location.
  (12) Flushing diagram and instructions.
  (13) Sampling diagram and instructions.

(c) Manual shall include a list of all preventive maintenance tasks that contractor recommends should be performed, including periodicity and the expected time it takes to perform these tasks. Hazards to personnel safety shall be stated as "WARNINGS". Hazards involving integrity of equipment shall be stated as "CAUTIONS".

3.10.2 Calculations. In addition to the general requirements stated by the contract or order, the features specified in 3.10.2.1 through 3.10.2.6 shall be included.

3.10.2.1 Stress calculations shall be complete and show that under specified conditions the combined stress in any part does not exceed stress limits specified herein.

3.10.2.2 A complete set of stress calculations of crane structure, gears, bearings, shafts, keys, holding-down bolts, wire rope, and brakes shall be prepared. Calculations shall show maximum working loads, stresses, bearing pressures, and deck reactions. Force and moment diagrams or a complete record of internal forces, obtained from analysis of the boom, mast and kingpost (if applicable) under maximum design loads shall be included. An analysis using a recognized digital computer solution is acceptable. Calculations shall be complete and in such form that they may be easily reviewed. Source of formulas and definitions of symbols shall be included. Calculations shall include diagrams and sketches when needed for clarity.

3.10.2.3 Calculations shall be prepared to show compliance with load acceleration requirements specified in 3.4.1.2.

3.10.2.4 Power calculations for determining the sizes of HPU motor hydraulic pumps, motors, and brakes, and (if applicable) diesel engine shall be prepared.

3.10.2.5 Contractor shall determine deck reactions and deck interface requirements. Design of supporting deck structure will be the responsibility of the Government.

3.10.2.6 Contractor shall prepare and maintain a record of weight and center of gravity of major assemblies. Calculated total weight of crane and location of center of gravity shall be included.

3.10.3 Hazard analysis report. Contractor shall prepare a hazard analysis report in accordance with the data ordering documents included in the contract or order (see 6.2.2).

3.10.4 Certification sheets. Contractor shall prepare certification sheets for the hook, plus test data from any shop tests performed in accordance with the data ordering documents included in the contract or order (see 6.2.2). Certification sheets shall contain sufficient information to trace material to manufacturer's lot number, indicate minimum strength characteristics, and indicate suitability for its intended purpose.

3.10.5 Drawings. Contractor shall prepare production drawings with integral parts lists in accordance with the data ordering documents included in the contract or order. Contractor's format, identifiers, and numbering shall be used. Assembly drawings shall identify items in the crane to the piece part level. Drawings shall provide sufficient information to allow complete identification of all parts for provisioning purposes.

3.11 Engineering services. Services of the contractor's engineering staff shall be available upon request in order to provide engineering and technical service as follows:

(a) Assist the installing activity in preparing the crane for installation and installing it in the ship.
(b) Provide technical assistance for corrective action in case of unexpected problems.
(c) Assist in inspection and test of crane after installation.
(d) Participate in technical meetings.
(e) Assist the ship's crew in becoming familiar with crane operation.

A maximum of 20 mandays per crane will be allowed. A technical service report shall be prepared in accordance with the data ordering document included in the contract or order.

3.12 Workmanship. Workmanship of component and assembly fabrication shall be of sufficiently high grade to provide satisfactory operation of the crane consistent with the other requirements of this specification. All components used in the assembly shall be sufficiently clean for the purpose of assembly and operation, as applicable; welded parts shall be free of weld spatter, and soldered connections free of loose solder and excess flux. All parts shall be free of burrs and sharp or ragged edges.

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 Contractor shall be responsible for assuring proper fit and function of the entire crane system when installed on board the ship by the Government. Prior to shipping, static controls shall be subjected to a burn-in test at the contractor's or control manufacturer's facility. Static controls shall be energized under simulated 125 percent load condition and operated continuously for at least 24 hours to burn out as many marginal components as possible. Immediately following, static controls shall operate through all functional modes at 100 percent load condition satisfactorily for 1 hour.

4.1.2 Inspection system. Contractor shall provide and maintain an inspection system acceptable to the Government for supplies and services covered by this specification. The inspection system shall be in accordance with MIL-I-45208.

4.1.3 Inspection of packaging. Sample packages and packs and the inspection of the preservation-packaging, packing and marking for shipment and storage shall be in accordance with the requirements of section 5.

4.1.4 Examination. Each crane manufactured in accordance with this specification shall be examined for compliance with all nonoperating requirements specified herein prior to crane operation.

4.2 Load and performance tests. Following installation on board ship or floating drydock, the crane shall be subjected to the tests specified in 4.2.1 through 4.2.6 and in the following sequence. Tests will be conducted by the Government (see 6.2.1), assisted by the contractor.

4.2.1 No load operation test. A no load operating test shall be conducted following completion of installation, post installation inspection and crane operational checkout. This test is conducted to determine if the crane is capable of safely operating through each specified functional mode. In conducting the test, the crane shall be required to function through full operating ranges in all directions specified for the equipment. During the test, operation of the travel limit switches, overtravel limit switches, emergency stop and (if applicable) emergency run switches, and limit switch recovery features shall be demonstrated. Specifically, the crane shall:

(a) Raise and lower load hook(s) through full range of travel at speeds varying from zero to maximum for 5 complete cycles. Two-block limit switch(es) and up-stop and down-stop limit switches on hoist drum(s) shall be demonstrated satisfactorily.

(b) Top the boom through full range of travel from stow position to maximum for 5 complete cycles at speeds varying from zero to maximum. During one topping cycle, boom shall be slowed to about 20 percent of maximum near top and bottom of travel and run into the boom up and boom down over-travel limit switches to demonstrate that switches stop boom. The up-stop, down-stop limit switches and boom stow, hoist stow switches shall be demonstrated.

(c) Rotate through full range at varying speeds from zero to maximum for 5 complete cycles. Limit switches and overtravel limit switches shall be demonstrated (if applicable).

(d) On type C and D cranes, travel through full range at varying speeds from zero to maximum for 5 complete cycles. Limit switches and overtravel limit switches shall be demonstrated.

(e) Demonstrate emergency stop and (if applicable) emergency run operation (see 3.5.6(c) and (d)).

(f) Demonstrate proper operation of the indicator lights and gages, lights and auxiliary equipment (ventilators, fans, heater(s), defrosters, and windshield wipers).

(g) Demonstrate simultaneous drive operation (see 3.3.4).

(h) Demonstrate compliance with noise level requirements (see 3.2.10).

4.2.2 Static load test. Crane shall be subjected to static load test by suspending test load(s) equal to 200 percent of the rated load(s) (see 6.1.1 and 6.2.1) on the main and (if applicable) auxiliary hoist hooks. Test loads shall not be applied to the hooks simultaneously. Crane shall not be operated with static test loads. Crane shall be:

(a) Positioned with hoist hook(s) outboard over pier or barge, topped to 30 degrees above horizontal and positioned to provide maximum protection to ship, equipment, and personnel in case of failure.

(b) Static load tested by suspending the test loads from the main and auxiliary hooks, in order, using an auxiliary crane to gradually apply the test loads and to continue support in event of crane deformation or failure.

(c) Required to support the static test load for a minimum of 10 minutes and until it can be determined that there is no evidence of deformation, brake slippage or other damage.

(d) Inspected following test to verify that there is no permanent set, deformation or other damage to any part of the crane machinery, structure, rigging, or hoist hooks.

4.2.3 Dynamic load test. Crane shall be subjected to dynamic test by operating the crane through full ranges of motions and speeds with test load(s) of 150 percent of rated load (see 6.1.1 and 6.2.1) on the hook(s). Main and (if applicable) auxiliary hoist test loads shall not be lifted or suspended simultaneously. At Government option, the dynamic test may be restricted to operations outboard and clear of the ship for safety purposes. Crane shall be:

(a) Positioned with hoist hook(s) outboard over pier or barge, topped initially to 30 degrees above horizontal and positioned to provide maximum protection to ship, equipment, and personnel in case of failure.
(b) Dynamic load tested by lifting the main and auxiliary hoist test loads, in order, from position of rest on the barge or pier at slow speed until about 2 feet clear and then stopped for 5 minutes. Test load shall be restarted and raised and lowered through full range of hoist travel at varying speeds from zero to maximum attainable in each direction. Test load shall be raised and lowered three times and stopped three times during lowering to test brake.
(c) Topped, rotated, and (if applicable) traveled through full ranges simultaneously with hoisting operation for 3 cycles each.
(d) Inspected during and after dynamic test to verify that brakes, controls, and machinery demonstrate satisfactory operation without excessive overheating, excessive noise, or excessive vibration. HPU motor (type A, B, and C cranes) shall not be overloaded more than 25 percent during this test (see 3.3.12.3).

4.2.4 Rated load test. Crane shall be subjected to rated load tests by operating the crane through full ranges of motions and speeds with rated load on the main and (if applicable) auxiliary hooks (not simultaneously). This test shall also serve as the reliability demonstration test (see 3.2.5). Accordingly, the 40 cycle testing (see 4.2.4(d)) shall be failure-free. Crane shall be:

(a) Positioned with hoist hook(s) outboard over pier or barge, topped initially to 30 degrees above horizontal and positioned to provide maximum protection to ship, equipment, and personnel in case of failure.
(b) With rated load on the main hoist hook, the crane shall be rotated against a lateral force, applied at the boom tip, of such magnitude that it will induce a torque equivalent to that due to the list specified (see 6.2.1).
(c) Tested by lifting the rated load from position of rest and moved through complete ranges of hoisting, topping, rotating and (if applicable) travel at speeds varying from zero to maximum. Simultaneous operation shall be demonstrated.
(d) Tested a minimum of 40 complete cycles. Proper operation of controls, limit switches, and brakes shall be demonstrated a sufficient number of times during this test to assure repeatability.
(e) Inspected to verify that brakes, controls, and machinery demonstrate satisfactory operation without overheating, excessive noise, or vibration.
(f) Demonstrated to have incorporated the fail-safe and hazard reduction features (see 3.2.4 and 3.2.9.1).

4.2.5 Splashproof test. Machinery compartment, operator's cab, access doors, and operator's cab windows shall be hose tested for being splashproof in accordance with MIL-STD-108 (see 3.5.9.7, 3.5.9.11, and 3.5.9.12).

4.2.6 Paint test. Painted steel parts (see 3.7) shall be subjected to tape test to verify cohesion and adhesion. Any paint damage caused by firmly applying and removing a 1 inch (minimum) wide strip of masking tape shall be cause for rejection. Masking tape used for this test shall be Minnesota Mining Company, Code No. 250, or equal.

4.2.7 Shock test. If HI shock requirements are invoked (see 6.2.1), the Government may perform shock tests on the ship with the crane in the stowed position to verify compliance with 3.3.15.

5. PACKAGING

(The preparation for delivery requirements specified herein apply only for direct Government acquisitions. For the extent of applicability of the preparation for delivery requirements of referenced documents listed in section 2, see 6.3.)

5.1 Preservation-packaging, packing, and marking. The equipment, accessories, tools, manuals and data shall be preserved-packaged level A or C, packed level A, B, or C as specified (see 6.2.1) and marked in accordance with MIL-P-3184, except that descriptive details and plans of a sample packed as specified in MIL-P-3184 are not required; (see 3.1.7 also).

5.1.1 Cushioning, filler, dunnage, and wrapping material.

5.1.1.1 Level A preservation-packaging, levels A and B packing. Use of all types of loose-fill materials for applications such as cushioning, filler, stuffing and dunnage for material destined for shipboard use is prohibited, except that vermiculite is approved for packaging applications of liquid products.

5.1.1.2 Level C preservation and packing. When loose-fill type materials are used for preservation and packing applications such as cushioning, filler and dunnage, all containers (unit, intermediate and shipping) shall be marked or labelled with the following information:

"CAUTION

Contents cushioned with loose-fill material which is not to be taken aboard ship. Remove and discard loose-fill material. If required, recushion with cellulosic material, bound fiber, fiberboard or transparent flexible cellular material."

5.1.1.3 Cushioning, filler, dunnage and wrapping materials selected, whenever available, shall exhibit improved performance for resistance to fire.

6. NOTES

6.1 Intended use. The cranes described herein are intended for shipboard weapons handling and general cargo handling and repair service. High impact shock requirements may be specified if crane is to be installed on combatant ship where possibility of high impact shock environment exists.

6.1.1 Cranes handling fleet ballistic missile (FBM) or intended for floating drydocks. Cranes which will handle FBMs and cranes intended for use on floating drydocks are subject to static and dynamic tests of 150 and 125 percent, respectively, in lieu of 200 and 150 percent.

6.2 Ordering data.

6.2.1 Acquisition requirements. Acquisition documents should specify the following:

(a) Title, number, and date of this specification.
(b) Type of crane required (see 1.2).
(c) Rated load, outreach, travel distance (if applicable), rotation limits, and speeds required (see 3.3.1, 3.3.5, 3.4.1(b),(d), and (1), 3.4.1.1, 3.5.4.2.3, 3.5.4.4.1, 3.5.6(1), 3.5.7.5, 3.5.7.7 and 3.5.9.14); if required, rated load, outreach, and speed of auxiliary hoist also.
(d) Wind force and main hoist load area (see 3.3.1 and 3.3.5).
(e) Dynamic ship conditions, including initial list and trim angles, angles and periods of roll and pitch along with roll and pitch radii (see 3.3.1, 3.3.5 and 4.2.4(b)).
(f) Ship motion load factors,ice load, and wind load for stowed condition (see 3.3.2 and 3.3.5).
(g) Whether HI shock requirements are invoked (see 3.3.15 and 4.2.7).
(h) Whether insulator links are required on hooks (see 3.4.1.1).
(i) Whether rack and pinion drive is required (type C and D cranes) (see 3.4.1(c)).
(j) Whether existing rails are to be used and, if so, their cross-section description (type C and D cranes) (see 3.4.2(o)).
(k) Up-stop limits of main and (if applicable) auxiliary hooks above some reference plane on the crane (see 3.5.7.1.1).
(l) Down-stop limits of hooks (see 3.5.7.1.2).
(m) Maximum size of crane, excluding boom (see 3.5.9.5).
(n) Interface and envelope of kingpost, pedestal, or base (as applicable) (see 3.5.9.6).
(o) Maximum weight of crane (see 3.6).
(p) Level of preservation-packaging, packing and marking (see 5.1).
(q) Whether FBMs will be handled and whether cranes are intended for floating drydocks (see 3.3.12.3.1, 3.3.12.3.2, 3.5.5.3, 4.2.2 and 4.2.3).
(r) Government activity assigned to conduct load and performance tests (see 4.2).
(s) Any additional requirements peculiar to the crane being acquired.

6.2.2 Data requirements. When this specification is used in a contract which invokes the provision of the "Requirements for Data" of the Defense Acquisition Regulation (DAR), 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 DAR are not invoked in a contract, 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
3.2.7	Report/minutes, record of meeting	UDI-A-23083	-----
3.10.1	Technical manual manuscript copy	DI-M-2042	Type I of MIL-M-15071
3.10.1	Manual, technical, standard	DI-M-2044	-----
3.10.2	Calculations	UDI-E-23213	-----
3.10.3	System safety Hazard analysis	DI-H-7048	-----
3.10.4	Certification data/ report	UDI-A-23264	-----
3.10.5	Drawings, engineering, and associated lists	DI-E-7031	Level 3
3.10.5	Card, imaged aperture/tabulating	UDI-E-20477	-----
3.11	Report, contractor engineering and technical services (CETS)	UDI-E-23127	-----

(Copies of data item descriptions required by the contractors in connection with specific acquisition functions should be obtained from the contracting activity 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 of the specification required to be performed to meet a data requirement may be waived by the contracting/acquisition 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 acquired to this specification. This does not apply to specific data which may be required for each contract 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 acquired by the contractor for incorporation into the equipment and lose their separate identity when the equipment is shipped.

6.4 Changes from previous issue. Asterisks (*) are 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 3950-N223)

STANDARDIZATION DOCUMENT IMPROVEMENT PROPOSAL

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