SECTION 14630

OVERHEAD ELECTRIC CRANES
06/98

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN GEAR MANUFACTURERS ASSOCIATION (AGMA)

AGMA 390.03a	(1980) Gear Handbook Gear Classification, Materials and Measuring Methods for Bevel, Hypoid, Fine Pitch Wormgearing and Racks Only as Unassembled Gears
AGMA 2000-A	(1988; Errata Jan 1989) Gear Classification and Inspection Handbook
AGMA 2001-B	(1988) Fundamental Rating Factors and Calculation Methods for Involute Spur and Helical Gear Teeth
AGMA 6010-E	(1988; Errata Nov 91) Standard for Spur, Helical, Herringbone and Bevel Enclosed Drives
AGMA 6019-E	(1989) Gearmotors Using Spur, Helical, Herringbone, Straight Bevel, or Spiral Bevel Gears

AMERICAN INSTITUTE OF STEEL CONSTRUCTION (AISC)

AISC S329	(1986) Allowable Stress Design Specification for Structural Joints Using ASTM A325 or ASTM A490 Bolts

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 159	(1983; R 1993) Automotive Gray Iron Castings
ASTM A 325	(1993) Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength
ASTM A 668	(1993) Steel Forgings, Carbon and Alloy, for General Industrial Use
ASTM B 438	(1983a; R 1989) Sintered Bronze Bearings (Oil-Impregnated)

ASTM B 439	(1983; R 1989) Iron-Base Sintered Bearings (Oil-Impregnated)
ASTM B 612	(1991) Iron Bronze Sintered Bearings (Oil-Impregnated)
ASTM B 633	(1985) Electrodeposited Coatings of Zinc on Iron and Steel
ASTM E 125	(1963; R 1993) Standard Reference Photographs for Magnetic Particle Indications on Ferrous Castings (R 1985)

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

ASME B30.2	(1990; B30.2a; B30.2b; B30.2c) Overhead and Gantry Cranes (Top Running Bridge, Single or Multiple Girder, Top Running Trolley Hoist)
ASME B30.16	(1993; B30.16a) Overhead Hoist (Underhung)
ASME B30.17	(1990; Errata; B30.17a) Overhead and Gantry Cranes (Top Running Bridge, Single Girder, Underhung Hoist)
ASME HST-1M	(1989) Electric Chain Hoists
ASME HST-2M	(1989) Hand Chain Manually Operated Chain Hoists
ASME HST-3M	(1991) Manually Lever Operated Chain Hoists
ASME HST-4M	(1991) Performance Standard for Overhead Electric Wire Rope Hoists
ASME HST-5M	(1991) Air Chain Hoists
ASME HST-6M	(1986) Air Wire Rope Hoists
ASME NOG-1	(1989; Errata Oct 1990; NOG-1a; NOG-1b) Rules for Construction of Overhead and Gantry Cranes

AMERICAN WELDING SOCIETY (AWS)

AWS D14.1	(1985) Welding of Industrial and Mill Cranes and Other Material Handling Equipment

CODE OF FEDERAL REGULATIONS (CFR)

\&10 CFR 435&\	Energy Conservation Voluntary Performance Standards for New Buildings; Mandatory for Federal Buildings
\&29 CFR 1910&\	Occupational Safety and Health Standards

MATERIAL HANDLING INSTITUTE (MHI)

MHI CMAA 70	(1994) Electric Overhead Traveling Cranes
MHI CMAA 74	(1994) Top Running & Under Running Single Girder Electric Overhead Traveling Cranes Utilizing Under Running Trolley Hoist

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA ICS 2	(1993) Industrial Control Devices, Controllers and Assemblies
NEMA ICS 6	(1993) Enclosures for Industrial Control and Systems
NEMA MG 1	(1993) Motors and Generators

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(1993) National Electrical Code

UNDERWRITERS LABORATORIES (UL)

UL 50	(1992; Rev thru Feb 1994) Enclosures for Electrical Equipment
UL 489	(1991; Rev thru Apr 1994) Molded-Case Circuit Breakers and Circuit-Breaker
UL 943	(1993) Ground-Fault Circuit-Interrupters
UL 1449	(1985; Errata Apr 1986) Transient Voltage Surge Suppressors

1.2 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-01 Data

Overhead Crane System; [FIO].

A complete list of equipment and materials, including manufacturer's descriptive data and technical literature, performance charts and curves, catalog cuts, and installation instructions.

Spare Parts; FIO.

Spare parts data for each different item of material and equipment specified, after approval of the detail drawings and not later than 2

months prior to the date of beneficial occupancy. The data shall include a complete list of parts and supplies, with current unit prices and source of supply.

SD-04 Drawings

Overhead Crane System; GA.

Detail drawings containing complete wiring and schematic diagrams. Diagrams shall indicate each numbered wire, where wire initiates, where wire terminates, and any other details required to demonstrate that the system has been coordinated and will properly function as a unit. Drawings shall show layout and anchorage of equipment and appurtenances, and equipment relationship to other parts of the work including clearances for maintenance and operation. All drawings must be stamped by a licensed State of California Engineer.

SD-06 Instructions

Framed Instructions; FIO.

Diagrams, instructions and safety requirements.

SD-09 Reports

Acceptance Testing; FIO.

Test reports in booklet form showing all field tests performed to adjust each component and all field tests performed to prove compliance with the specified performance criteria, upon completion and testing of the installed system. The report shall include the information as required by paragraph ACCEPTANCE TESTING.

SD-19 Operation and Maintenance Manuals

Overhead Crane System; GA

Six copies of operation and six copies of maintenance manuals for the equipment furnished. One complete set prior to performance testing and the remainder upon acceptance. Operation manuals shall detail the step-by-step procedures required for system startup, operation and shutdown. Operation manuals shall include the manufacturer's name, model number, parts list, and brief description of all equipment and basic operating features. Maintenance manuals shall list routine maintenance procedures, possible breakdowns and repairs, and troubleshooting guides. Maintenance manuals shall include piping and equipment layout and simplified wiring and control diagrams of the system as installed. Operation and maintenance manuals shall be approved prior to the field training course

1.3 QUALIFICATION

Electric overhead cranes shall be designed and manufactured by a company with a minimum of 10 years of specialized experience in designing and manufacturing the type of overhead crane required to meet requirements of the Contract Documents. The crane manufacture shall be an active member an active member of the CMAA-Crane Manufactures Association of America.

1.4 TESTING AND INSPECTIONS

1.4.1 Pre-Delivery Inspections

Contractor shall be responsible for performance of quality control inspections, testing and documentation of steel castings and hook assembly as follows.

1.4.2 Inspection of Hook Assembly

Hook and nut shall be inspected by a magnetic-particle type inspection or X-rayed prior to delivery. Documentation of hook inspection shall be furnished to Contracting Officer at the field operational testing. As part of the acceptance standard, linear indications will not be allowed. Welding repairs of hook will not be permitted. A hook showing linear indications, damage or deformation will not be accepted, and shall be replaced. The inspection should be per ANSI spec B30.1.

1.5 DESIGN CRITERIA

Cranes shall operate in the given spaces and shall match the runway dimensions and rails indicated. Hook coverage, hook vertical travel, clear hook height, lifting capacity, and load test weight shall not be less than that indicated.

1.5.1 General

The hoisting equipment shall include the following:
Two cranes located in the building. One in area "D" & the other in area "B". Each shall be 35 tons. The contractor sahll assure that the hoists shall be supplied by the same manufacture

1.5.2 Classification

Crane shall be designed and constructed to MHI CMAA 70 Class B, light service MHI CMAA 74 moderate service requirements for operation in non-hazardous environment with hoist in accordance with ASME HST-4M.

1.5.3 Rated Capacity and Speeds

Rated capacity of crane shall be (35 tons). Lower load block or assembly of hook, swivel bearing sheaves, pins and frame suspended by the hoisting ropes shall not be considered part of the rated capacity. Rated speeds (feet per minute)) for the hoist, bridge and trolley at the rated load shall be as follows:

Rated Speeds

Description	Minimum	Maximum
Main Hoist	2.3	7.0
Trolley	7.0	75
Bridge	1.0	150

1.6 DELIVERY AND STORAGE

Equipment delivered and placed in storage shall be stored with protection from the weather, humidity and temperature variations, dirt and dust, and other contaminants.

1.7 FIELD MEASUREMENTS

Before performing any work, Contractor shall become familiar with all details of the work, verify all dimensions in the field, and submit a letter describing the results of this verification including discrepancies to the Contracting Officer and crane manufacture.

PART 2 PRODUCTS

2.1 MATERIALS

2.1.1 General

Materials and equipment shall be standard products of manufacturers regularly engaged in the fabrication of complete and totally functional cranes including necessary ancillary equipment.

2.1.2 Nameplates

Nameplates shall be secured to each major component of equipment with the manufacturer's name, address, type or style, model or catalog number, and serial number. Two bridge identification plates shall be provided, one for each side of bridge. Identified plates shall be noncorrosive metal with letters which are easily read from the floor, showing a separate number such as BC-1, BC-2, for each bridge crane.

2.1.3 Use of Asbestos Products

Materials and products required for designing and manufacturing cranes shall not contain asbestos.

2.1.4 Capacity Plates

Two capacity plates indicating the crane capacity in metric tons and tons (tons) are required, one secured to each side of bridge. Each capacity plate shall be fabricated of a steel backing plate and exterior quality/fade-resistant stick-on labels with letters large enough to be easily read from the floor. Capacity plates shall be placed in a location visible to pendant operator's position after the crane has been installed.

2.1.5 Safety Warnings

Readable warning labels shall be affixed to each lift block or control pendant in a readable position in accordance with ASME B30.16, ASME B30.2 and ASME B30.17. The word "WARNING" or other legend shall be designed to bring the label to the attention of the operator. Warning labels shall be durable type and display the following information concerning safe-operating procedures: Cautionary language against lifting more than the rated load; operating the hoist when the hook is not centered under the hoist; operating hoist with twisted, kinked or damaged rope; operating damaged or malfunctioning hoist; operating a rope hoist with a rope that is not properly seated in its hoist drum groove; lifting people; lifting loads over people; and removing or obscuring the warning label.

2.1.5.1 Directional Arrows

To avoid operation of crane in the wrong direction, the words "FORWARD" and "REVERSE" and accompanying directional arrows shall be affixed in a location on the trolley and bridge which are visible and readable to the operator from pendant station. The words "FORWARD" and "REVERSE" shall agree with the markings on control pendant. Directional arrows shall not be indicated on control pendant.

2.2 STRUCTURAL MATERIALS

2.2.1 Bolts, Nuts and Washers

High-strength bolted connections shall utilize SAE Grade 5 bolts with corresponding lockwashers, nuts, etc., conforming to requirements of AISC S329 bolts. Bolts, nuts and washers shall conform to ASTM A 325 bolts. Galvanized bolts are not acceptable.

2.2.2 Bridge Girders or Girders

Bridge girders shall be wide flange beams, standard I-Beams, reinforced beams or sections fabricated from rolled plates and shapes.

2.2.3 Bridge Rails or Bars

Rail shall be ASCE type. Trolley runway rails, crane girders and other sections shall be straight and true. When loaded with motor driven cranes the deflection of rails shall not exceed 1/800 of the span. The deflection shall be calculated with the worst case of two loaded bridge cranes located adjacent each other. Rail joints shall be flush and true without misalignment of running tread and shall be designed to minimize vibration. The gap between adjacent rail ends and the vertical misalignment of running treads shall not exceed 1.588 mm. (0.0625 inch.) The bridge rail shall be leveled to a plus-or-minus 3 mm (1/8 inch) at all rail support joints. Bridge rail shall be fastened to top cover plate wide flange or centered on flange or offset near web plate for welded box sections, complete with welded clips. Bridge rail joints shall be bolted using standard joint bars. Rail joints shall be staggered. A positive stop shall be provided at bridge rail ends to prevent creep.

2.2.4 End Ties and Bridge Girder End Connections

Welded steel box sections shall be used for end ties, full depth diaphragms shall be provided at girder connections and jacking points. Horizontal gusset plates shall be provided at the elevation of top and bottom end tie flanges for connection to girder ends. End connections shall be made with high-strength bolts. Body-bound bolts fitted in drilled and reamed holes shall be used to maintain the crane square.

2.2.5 Bridge End Trucks

End trucks shall be the rotating axle type fabricated of structural tubes or from structural steel to provide a rigid box section structure. Jacking pads shall be provided for removal of wheel assemblies. End truck wheel bearings shall be enclosed in a steel housing.

2.2.6 Trolley Frame

The top-running trolley shall be of modular construction. The hoist and trolley frame shall be integrally designed to limit the over all dimension above the rail.

2.2.7 Stops and Bumpers

Crane runways and bridge girders shall be fitted with structural steel end stops. Bridge end trucks and trolley frames shall be fitted with shock-absorbing, spring or hydraulic type bumpers capable of decelerating and stopping the bridge and/or trolley within the limits stated by OSHA and MHI CMAA. Trolley end stops shall be of sufficient strength to withstand the impact of a fully loaded trolley moving at 50 percent of maximum rated travel speed.

2.2.8 Runway Rails

The runway rail size shall be as recommended by crane manufacturer.

2.3 MECHANICAL EQUIPMENT

2.3.1 Drives

2.3.1.1 Bridge Drives

Bridge drives shall be type A1. as specified in paragraph 4.10 of CMAA #70. Open gearing is not permitted. The output of gear reducers shall be connected directly to the wheel axles by means of suitable shafts and couplings. Worm gears, overhung gears and overhung wheels shall not be used.

2.3.1.2 Trolley Drives

Trolley shall be complete with a drive arrangement with a minimum of 2 wheels driven by an integral electric motor. Drive mechanism shall run in totally enclosed oil bath. Limit switches are optional for drive mechanism. Acceleration and deceleration controls shall meet requirements specified in this section.

2.3.2 Load Blocks

2.3.2.1 Main Hoist Load Blocks

Load block sheaves shall be of steel construction. Hoist Load Block shall have lifetime lubricated bearings. The pitch diameter of the running sheaves shall be 15 inches, providing a 34:1 sheave to rope ratio. Equalizer sheaves shall have a 12:1 sheave to rope ratio. Sheave blocks shall be constructed to provide maximum personnel safety and to prevent the hoist rope from leaving the sheaves under normal operating conditions.

2.3.2.2 Hook Assembly

Hooks shall be single barbed and shall be made of forged steel complying with ASTM A 668. Hooks shall be fitted with safety latches designed to preclude inadvertent displacement of slings from the hook saddle. Painting or welding shall not be performed on the hook. Hook nut shall be secured with a removable type set screw or other similar fastener, but shall not be welded. Hooks shall be designed and commercially rated with

safety factors in accordance with MHI CMAA. The hook shall be free to rotate through 360 degrees when supporting the rated load.

2.3.3 Hoisting Ropes

Hoisting ropes shall be regular lay, preformed, uncoated, improved plow steel, 6 by 37 construction, with independent wire rope core. Ropes shall be suited to meet the service requirements. Rope socketing or U-bolt clip connections shall be made in accordance with clip or rope manufacturer's recommendation, and shall be equal to or greater than the rope strength. Hoisting ropes shall be the rated capacity load plus the load block weight divided by the number of rope parts, and shall not exceed 20 percent of the certified breaking strength of rope. Hoisting ropes shall be secured to hoist drum so that no less than 2 wraps of rope remain at each anchorage of hoist drum at the extreme low position (limit switch stop).

2.3.4 Sheaves

Sheaves shall be of cast, forged, rolled, or welded structural steel. Sheave grooves shall be accurately machined, smoothly finished and free of surface defects.

2.3.5 Hoist Drums

Hoist drums shall be of welded rolled structural steel, cast steel, or seamless steel pipe. Diameter of drum shall be not less than 26 times the diameter of hoist cable. Drums shall be machined and provided with right-hand and left-hand grooves to take the full run of cable for the required lift without overlapping, plus a minimum of 2 full wraps of cable when load is on floor. Drum grooves shall be cut from solid stock and have sufficient depth for size of cable required. Drum flanges shall be guarded so that the cable cannot wedge between drum flange and hoist frame.

2.3.6 Gearing

Gearing shall be of the enclosed gear reducers type. Gears and pinions shall be spur, helical, or herringbone type only, and shall be forged, cast or rolled steel; open-type gearing is not acceptable. Gears and pinions shall have adequate strength and durability for the crane service class and shall be manufactured to AGMA 2001-B Quality Class 6 or better precision per AGMA 390.03a & AGMA 2000-A.

2.3.6.1 Gear Reducers

Gear reducers shall be standard items of manufacturers regularly engaged in the design and manufacture of gear reducers for Class D and G cranes or shall be integral components of standard hoists or hoist/trolley units of manufacturers regularly engaged in the design and manufacture of hoists or hoist/trolley units for Class A, B or C cranes. Gear reducers shall be designed, manufactured and rated in accordance with AGMA 6010-E, AGMA 6019-E (for trolley drives only), as applicable. Except for final reduction, the gear reduction units shall be fully enclosed in oil-tight housing. Gearing shall be designed to AGMA standards and shall operate in an oil bath. Operation shall be smooth and quiet.

2.3.7 Brakes

Brakes shall be of the shoe or disc type with thermal capacity suitable for class and service specified in this section. Shoe and disc brakes shall be

spring-set and electrically-released by a continuously rated direct acting magnet. Brakes shall be self-aligning and provide for easy adjustment for torque setting and lining wear. Brake lining material shall be asbestos free. Brake wheels shall be cast iron conforming to ASTM A 159 or shall be the manufacturer's standard high-strength ductile cast-iron, provided that the material exhibits wear characteristics in the form of powdered wear particles and is resistant to heat-checking. Disc brakes shall be totally enclosed and have multiple discs with stationary releasing magnets.

2.3.7.1 Hoist Holding Brakes

Each hoist shall have one electric motor brake, one mechanical load brake, and one drum-mounted, spring set, air released twin-caliper disc type emergency brake rated at 150%. The emergency brake shall set during loss of power, emergency stop, and if the drum exceeds 110% of the max speed of the hoist.

2.3.7.2 Trolley Brake

Trolley braking system shall be provided with spring-applied and electrically-released shoe brakes or disc brakes. Braking system shall be automatically set when controls are released or power is interrupted. Provisions shall be made to facilitate easy brake adjustment. Brakes shall have a torque rating of at least 50 percent of trolley drive motor rated torque.

2.3.7.3 Bridge Brakes

Bridge braking system shall be provided with a DC shoe brake for each bridge drive motor. Brakes shall have a torque rating of at least 100 percent of bridge drive motor rated torque, and be adjustable to 50 per cent of the motor torque.

2.3.8 Wheels

Wheels shall be manufactured of rolled or forged steel. Bridge and trolley wheels shall be double-flanged. Trolley wheels shall have straight treads. Bridge wheels shall be tapered for driver and straight for the idler. Wheels shall be equipped with self-aligning double-row spherical roller-bearings of capacity as recommended by bearing manufacturer for design load of trolley or bridge.

2.3.9 Bearings

Bearings shall be antifriction type, except bearings which are subject only to small rocker motion. Equalizer sheaves shall be equipped with sintered oil-impregnated type bushings in accordance with ASTM B 438, ASTM B 439, or ASTM B 612.

2.3.10 Anti-Drip Provisions

The crane shall be provided with drip pans installed under gear boxes and hoist drums and other components where leakage of grease, oil or other contaminants could occur. Drip pans shall be made of steel and designed to permit removal of collected lubricants.

2.3.11 Lubrication System

Splash-type oil lubrication system shall be provided for hoist, trolley and

bridge gear cases; an oil pump shall be used on vertical-mounted gear cases exceeding 2 reductions. Oil pumps shall be the reversible type capable of maintaining the same oil flow direction and volume while being driven in either direction. Electric motor-driven pumps may be used when input shaft speed is too low at any operating condition to ensure adequate oil flow. In such applications, pump shall be energized whenever drive mechanism brakes are released.

2.4 ELECTRICAL COMPONENTS

2.4.1 Control Systems

2.4.1.1 Hoist Control System

Main hoist motion control system shall be two speed, with ac magnetic control of ac squirrel cage motor. Control shall provide for reversing, and for a mechanical load brake.

2.4.1.2 Travel Control System

The bridge shall be a 5-step adjustable frequency drive with AC adjustable frequency control and the trolley 3-step adjustable frequency drive with AC adjustable frequency control.

2.4.2 Power Sources

2.4.2.1 System Supply Voltage

Cranes shall be designed to be operated from a 460 volt, three-phase, 60 Hz, alternating current system power source. Energy isolating devices for such machine or equipment shall be designed to accept a lockout device in accordance with \&29 CFR 1910&\.

2.4.2.2 Transformers

Transformers shall be dry type suitable for the application.

2.4.3 Motors

2.4.3.1 General Requirements

Motors shall be designed specifically for crane and hoist duty. The bridge motors shall conform to the requirements of NEMA MG 1. One thermal sensitive device embedded in the hoist motor windings shall be provided.

2.4.3.2 Main Hoist Motor

Hoist motor shall be two-speed; two-winding, NEMA Design D squirrel cage AC type.

2.4.3.3 Bridge and Trolley Drive Motors

Bridge and trolley drive motors shall be AC type designed for AC adjustable frequency operation.

2.4.3.4 Motor Enclosures

Motor enclosures shall be totally enclosed, non-ventilated (TENV).

2.4.3.5 Hoist Motor Insulation and Time Rating

Hoist motors shall be provided with insulation which has a class B, 30 minute minimum motor time rating based on a 75 degree C rise above 40 degree C ambient temperature.

2.4.3.6 Bridge and Trolley Motor Insulation and Time Rating

Bridge motors shall be class F, 60 minute rated . Trolley motors shall be class B, 30 minute rated.

2.4.4 Electric Brakes

2.4.4.1 Automatic Stop System

Electrically-controlled brakes shall be fail-safe spring set when power is interrupted. Brakes shall be released with a mainline contactor POWER-OFF pushbutton or a master switch for the associated drive. Brakes shall automatically stop when there is a power failure. Electric shall be designed to be mechanically released. Enclosures for electrical-controlled brake components shall be NEMA ICS 6]. Direct current shunt magnetic shoe brakes shall be provided with an electrical forcing circuit for rapid release of brake. Each shunt coil brake shall be circuited for both conductors to open simultaneously when the brake is de-energized.

2.4.5 Control System

A separate controller shall be provided for each motor. Overload protection shall be in conformance with requirements of NEMA ICS 2 NFPA 70. When contractors are used for starting, stopping and reversing, contractors shall be mechanically and electrically interlocked.

2.4.5.1 Control Panels

Control panels shall be fabricated of solid steel designed and constructed to conform to requirements of NEMA ICS 6 Type 3R and 12.

2.4.5.2 Main Hoist Control

Hoist motor control system shall provide two speeds in each direction with of an electrically-operated, full-magnetic, across-the-line reversing type starter. Electrical and mechanical interlocks shall be used to prevent the operation of high speeds and low speeds. NEMA rated contactors are required, the use of IEC type is not allowed.

2.4.5.3 Bridge and Trolley Control

Bridge and trolley main central systems shall employ ac adjustable-frequency, speed-regulated, control of ac squirrel cage motors. Control shall provide continuous-speed adjustment from minimum speed (2.5 percent at no-hook load) to full-speed. Control shall provide automatic regenerative or dynamic braking for speed reduction and slow down before brake setting. Control shall provide a minimum 40-to-1 speed range with constant torque acceleration, for base and subbase speeds.

2.4.6 Pendant Control Station

2.4.6.1 General

Pendant control station shall be NEMA Type 4. Aseparate corrosion-resistant support cable shall be provided.

2.4.6.2 Operating Pushbuttons

Operating pushbuttons shall be heavy-duty, dust-and-oil-tight type with distinctly-felt operating positions which meet requirements of NEMA ICS 2. Pendant control buttons shall be momentary pushbuttons. Pushbuttons (except the POWER-OFF button) shall be the recessed type to avoid accidental operation. Diameter of buttons shall be a size which will make operation possible with a thumb while holding the pendant with same hand. Nameplates shall be provided adjacent to each pushbutton. Barriers shall be provided on pendant between various pushbutton functions, except on elements mounted in junction box. In a multi-speed application, dual-position pushbuttons shall have a definite click-detent position for each speed. Pushbuttons shall be designed and manufactured not to hang up in control case. Pendant shall include a separate set of pushbuttons for each motion and for POWER-ON POWER-OFF. Pushbuttons shall be as follows:

POWER-OFF.
POWER-ON
Hoist-up
Hoist-down
Bridge-[right]
Bridge-[left].
Trolley-[right].
Trolley-[left].

2.4.6.3 Light Indicators

Pilot lights shall meet heavy-duty requirements of NEMA ICS 2. One amber pilot light to indicate excessive hoist motor temperature shall be provided on pendant station. A blue pilot light shall be provided to indicate that the main contactor is energized, and a white pilot light to indicate that power is available on the load side of crane disconnect switch. A bright red mushroom head shall be provided with the POWER-OFF pushbutton.

2.4.7 Protection

2.4.7.1 Main Line Disconnect

A main line disconnect consisting of a combination circuit breaker (50,000 AIC) and non-reversing starter, starter without overloads (mainline contactor) in NEMA Type 12 enclosure shall be provided. Mainline disconnect shall be controlled by a control circuit so that all crane motions will be stopped upon mainline undervoltage, overload, control circuit fuse failure, or operation of POWER OFF pushbutton. Mainline disconnect shall be equipped with energy isolating devices designed to accept lockout devices.

2.4.7.2 Circuit Breakers

Circuit breakers shall meet the requirements of UL 489.

2.4.7.3 Overloads

Alternating current circuit overload relays shall be of the ambient compensated, automatic reset, inverse time type located in all phases individual motor circuits. Overload relays shall be arranged to de-energize the associated motor on an overload condition.

2.4.8 Limit-Switches

Geared limit-switches shall be heavy-duty quick-break double-pole double-throw type conforming to NEMA ICS 2. The geared limit-switch interruption of a motion in one direction shall not prevent the opposite motion. Geared limit-switches shall reset automatically. Limit-switch housings shall be NEMA Type 3.

2.4.8.1 Hoist Upper Limit-Switches

Two limit-switches shall be provided for each hoist. A rotating-type adjustable geared-control circuit interrupt limit-switch shall provide hoist-up limiting. A secondary hoist-upper-limit shall be provided with a weight-operated power circuit limit-switch to prevent the hoist from raising beyond the safe limit. The secondary limit-switch shall operate to interrupt power to all hoist motor conductors, set the hoist holding brakes and directly open all "raise" power circuits.

2.4.8.2 Hoist Lower Limit-Switches

Hoists shall be provided with a rotating-type adjustable geared-control circuit interrupt limit-switch for hoist-down travel limiting. The hook downward vertical travel of the hook shall be field-adjustable to approximately 150 mm (6 inches) above working surface.

2.4.8.3 Bridge and Trolley Travel Limit-Switches

Runway (track-type) limit-switches shall be provided for crane bridge and trolley motions to stop the bridge and trolley motions, respectively. Limit-switch actuators shall be installed on building and trolley frame to actuate the limit-switches and stop the crane bridge or trolley prior to contacting the trolley frame bumpers. Trip mechanism for trolley motion shall be located on crane runway to trip the switch before the bumper contacts the stop. Trip mechanism for bridge motion shall be located on crane runway to trip switch before bumper contacts the stop. When the switch is tripped, the switch shall permit opposite travel in the direction of stop and then automatically reset.

2.4.9 Wiring

Wires shall be numbered or tagged at connection points. Splices shall be made in boxes or panels on terminals boards or standoff insulators. Motor loop, branch circuit and brake conductor selection shall be based on NFPA 70 for 90 degree C conductor rating on indoor cranes, and for 75 degree C conductor rating on outdoor cranes. Wire insulation shall be Type XHHW. Conductors in the vicinity of resistors and conductors connected to resistors shall be Type 5RML.

2.4.10 Electrification

2.4.10.1 Main Power Electrification

Main power electrification system shall provide power to crane starter/disconnect circuit breaker.

2.4.10.2 Crane Runway Conductors

Crane runway conductor system shall be the continuous copper (no splices) covered conductor bar system type designed and manufacured to meet UL requirements. Protective covers shall be the rigid or flexible self-closing type designed to cover all live conductors and shall be shaped to prevent accidental contact with conductors. Collectors shall be heavy-duty sliding shoe type compatible with the electrification system. Two tandem designed collector heads shall be provided for each conductor rail to provide redundancy.

2.4.10.3 Bridge Span Conductors

Bridge span conductor system shall be the festooned type consisting of a support rail, electrical cables, junction boxes, and accessories. Cable loops shall not drop below the hook high position.

2.4.10.4 Pendant Festoon System

Pendant festoon system shall consist of a support rail, cables, junction boxes, cable cars and accessories. Cable loops shall not drop below the hook high position. Pendant control car shall be provided with NEMA Type 3R & 12 junction box. Pendant festoon shall be independent of trolley motion.

2.4.11 Special Requirements

2.4.11.1 Warning Horn

A solid-state electronic warning horn shall be provided on the crane. Any bridge or trolley motion shall be accompanied by a continuous series of alternating tones. The warning horn shall not sound when the crane is in the micro-drive mode.

2.4.11.2 Accessory Power

Three-phase 208Y/120 volt ac power supplied via a circuit breaker and isolation transformer from the line side of the main line disconnect shall be used for heaters, and accessory circuits on the crane. The circuit breaker shall have a NEMA Type 12 enclosure. The enclosure shall have provisions to lock the breaker in the OFF position. Each circuit breaker pole shall have individual thermal and magnetic trip elements, and the enclosure cover shall be complete with a button for mechanically tripping the circuit breaker. A three-phase 480 volt delta primary and 208Y/120 volt wye secondary general lighting transformer shall be supplied from the accessory circuit breaker and shall feed a 208Y/120 volt UL listed circuit breaker panelboard and a heater circuit breaker/combination starter. The panelboard shall supply branch circuits for utilization of various accessories such as receptacles, motor heaters and control enclosure which meets NEMA requirements. Transformer and panelboard shall have the same NEMA classification as the circuit breaker.

2.4.11.3 Receptacles

Receptacles shall be single-phase, 120-volt 15-amp, grounded, duplex types complete with metal weather-proof enclosure with self-closing weatherproof receptacle cover. A receptacle shall be provided on the trolley at each end of the front bridge walkway in the vicinity of bridge travel drive motors. Several receptacles shall be provided in the vicinity of the control equipment equally spaced every 3 m. (10 feet.) Breakers used to protect circuits supplying the receptacles for outside cranes shall incorporate ground fault current interruption feature and meet the requirements of UL 943.

2.4.11.4 Anti-Condensation Heaters

Motor and control panels shall be equipped with anti-condensation heaters. Thermostatically-controlled heaters shall be provided in each static-control panel to keep control enclosure temperatures at or above 0 degrees C. Circuit breaker combination magnetic starter shall be NEMA Type 12 enclosure. Magnetic starter shall be equipped with manually-reset overload relays and interlocked with the mainline disconnect so that anti-condensation heaters are de-energized when the mainline contactor is energized and the magnetic starter is energized when the mainline contractor is de-energized.

2.4.11.5 Electrically-Driven Oil Pump Alarm

Electrically-driven lubricating pump shall be complete with an audible alarm and red light for indication of pump malfunction. Location of alarm shall be the factory standard location.

2.4.12 Load-Limit System

A load-limit visual/audible system shall be provided for the main hoist to inform the operator that the preset load has been exceeded. The load-limit system shall consist of the hoist manufacturer's standard load limiting device, overload indicator lights, overload alarm bell and alrm cut-out switch.

2.4.12.1 Load-Sensing Electronics

Load-sensing electronics shall be NEMA Type 3R enclosures. Alarm setpoint shall be adjustable. The load must be measured to within 1% accuracy with a readout at the hoist control panel.

2.4.12.2 Alarm and Indicator Light

An overload alarm light shall be provided to indicate a load greater than the preset maximum. Overload alarm shall be indicated with a red light and clearly labeled "OVERLOAD". A bell shall be provided to indicate when an overload condition exists. Provision shall be made to turn off the bell. Location of overload light will be at the hoist control panel.

2.5 WARRANTY

Warranty service shall be provided for each crane for a period of 12 months after date of acceptance by Contracting Officer. Warranty service shall be performed only by trained crane mechanics during reular working hours and and shall include manufacturer's warranty requirements including but not limited to adjusting, lubricating and cleaning of equipment and furnishing

supplies and parts to keep cranes in operation.

PART 3 EXECUTION

3.1 ERECTION

The entire crane erection shall be performed in accordance with manufacturer's instructions under the full-time supervision of the manufacturer's representative. Contractor shall provide a written certificate from crane manufacturer indicating the crane is erected in accordance with manufacturer's recommendations before testing the completed installation.

3.1.1 Shop Assembly

Major crane components shall be shop assembled as completely as possible. Disassembled parts shall be match marked and electrical connections tagged after complete no-load shop testing. Parts and equipment at site shall be protected from weather, damage, abuse and loss of identification. Erection procedures shall ensure that the crane is erected without initial stresses, forced or improvised fits, misalignments, nicks of high-strength structural steel components, stress-raising welds and rough burrs. Damaged painted surfaces shall be cleaned and repainted after crane is erected.

3.1.2 Mechanical Alignment

Motors, couplings, brakes, gear boxes and drive components shall be aligned when reinstalled in accordance with manufacturer's instructions.

3.1.3 Electrical Alignment

Control system shall be aligned in accordance with manufacturer's instructions. A copy of the final alignment data shall be stored in control panel door and shall include but not be limited to timer settings, resistor tap settings, potentiometer settings, test-point voltages, supply voltages, motor voltages, motor currents and test conditions such as ambient temperature, motor load, date performed and person performing the alignment.

3.1.4 Welding

Welders, welding operations and welding procedures shall be qualified or prequalified in accordance with AWS D14.1. Welding shall be performed indoors and the surface of parts to be welded shall be free from rust, scale, paint, grease or other foreign matter. Minimum preheat and interpass temperatures shall conform to the requirements of AWS D14.1. Welding shall be performed in accordance with written procedures which specify the Contractor's standard dimensional tolerances for deviation from camber and sweep. Such tolerances shall not exceed those specified in accordance with AWS D14.1. Allowable stress ranges shall be in accordance with MHI CMAA 70. Welding of girders and beams shall conform with AWS D14.1.

3.1.5 Field Painting

Painting required for surfaces not otherwise specified, and finish painting of items only primed at the facility, shall be as specified in Section 09900 PAINTING, GENERAL. Bridge crane including bridge, trolley, hoist and all attached items shall be painted in accordance with the manufacturer's standard practice. The complete crane shall be of one color. Bridge rail,

supports and bracing shall be painted in accordance with Section 09900 PAINTING, GENERAL. Items such as surfaces in contact with the rail wheels, wheel tread, hooks, wire rope, surfaces on the electrical collector bars in contact with the collector shoes and nameplates shall not be painted. The requirements of explosion proof cables shall be coordinated with cable manufacturer.

3.2 ACCEPTANCE TESTING

3.2.1 General

Contractor shall provide all personnel necessary to conduct the required testing which shall include but not be limited to crane operators, riggers, rigging gear and test weights. Testing shall be performed in the presence of Contracting Officer or his designated representative. The Contractor shall provide a person who is licensed by the California Crane Certificate Agency. Contractor shall notify Contracting Officer 10 days prior to testing operations. Contractor shall operate all equipment and make all necessary corrections and adjustments prior to the testing operations witnessed by Contracting Officer. A representative of the Contractor responsible for procuring and installing hoist equipment shall be present to direct the field testing. Test loads shall be compact and permit a minimum of 50 percent of vertical lift. Test loads shall be minus 0 percent to plus 5 percent of the required weight, and shall be verified prior to testing. Test weights required are (10 tons,20 tons & 30 tons Operational testing shall not be performed until after building interior has been painted. Three copies of all test reports shall be furnished to Contracting Officer.

3.2.1.1 Test Sequence

Crane shall be tested in accordance with applicable paragraphs of this procedure in the sequence provided.

3.2.1.2 Test Data

Operating and startup current measurements shall be recorded for coils, hoist, trolley, and bridge motors using the appropriate instrumentation. Speed measurements shall be recorded as required by facility evaluation tests (normally at 100 percent load). Recorded values shall be compared with design specifications or manufacturer's recommended values and the abnormal differences shall be justified in the remarks or appropriate adjustments performed. The high temperatures or abnormal operation of any equipment or machinery shall be noted, investigated and corrected. Hoist, trolley and bridge speeds shall be recorded during each test cycle.

3.2.1.3 Equipment Monitoring

Improper operation or poor condition of safety devices, electrical components, mechanical equipment and structural assemblies shall be monitored during the load test. Defects observed to be critical during the testing period shall be reported immediately to the Contracting Officer and the testing operations shall be suspended until the defects are corrected. During each load test and immediately following each load test, the following inspections shall be made:

a. Inspect for evidence of bending, warping, permanent deformation, cracking or malfunction of structural components.

b. Inspect for evidence of slippage in wire rope sockets and fittings.

c. Check for overheating in brake operation; check for proper stopping. All safety devices including emergency stop switches and POWER-OFF pushbuttons shall be tested and inspected separately to verify proper operation of the brakes. When provided, safety accessories including warning horn, lighting, gauges, warning lights and accuracy of wind indicating device and alarm shall be inspected.

d. Check for abnormal noise or vibration and overheating in machinery drive components.

e. Check wire rope sheaves and drum spooling for proper reeving and operation, freedom of movement, abnormal noise or vibration.

f. Check electrical drive components for proper operation, freedom from chatter, noise, overheating, and lockout/tagout devices for energy isolation.

g. Inspect gears for abnormal wear patterns, damage, or inadequate lubrication.

h. Verify that locations of crane capacity plates are visible from pendant operator's position.

3.2.1.4 Hooks

Hooks shall be measured for hook throat spread before and after load test. A throat dimension base measurement shall be established by installing 2 tram points and measuring the distance between the tram points to within 0.4 mm. (1/64 inch.) This base dimension shall be recorded. Distance between tram points shall be measured before and after load test. An increase in throat opening by more than 1 percent from base measurement shall be cause for rejection.

3.2.2 No-Load Testing

3.2.2.1 Hoist Operating and Limit Switch Test

Load hook shall be raised and lowered through the full range of normal travel at rated speed and other crane speeds. Load hook shall be stopped below the geared limit-switch upper setting. In slow speed only, proper operation of upper and lower limit-switches for primary motions shall be verified. The test shall be repeated a sufficient number of times (minimum of 3) to demonstrate proper operation. Brake action shall be tested in each direction. Proper time-delay shall be verified between the actuation of dual brakes.

3.2.2.2 Trolley Travel

Trolley shall be operated the full distance of bridge rails exercising all primary drive speed controls in each direction. Brake operation shall be verified in each direction. In slow speed or micro-drive, trolley bumpers shall contact trolley stops located on the bridge girders. In slow speed the proper operation (interrupt power, automatic reset) of the trolley limit-switches at both limits of trolley motion shall be tested.

3.2.2.3 Bridge Travel

Bridge shall be operated in each direction the full distance of runway exercising all primary drive speed controls. Brake operation shall be verified in each direction. In slow speed the proper operation (interrupt power, automatic reset) of the bridge limit-switches at both limits of bridge motion shall be tested. In slow speed the crane bridge bumpers shall contact the runway rail stops.

3.2.2.4 Hoist Loss of Power No-Load Test

Using the primary drive, hooks shall be raised to a height of approximately 3.5 m (12 feet) or less. While slowly lowering the hook the main power source shall be disconnected, verifying that the hook will not lower and that both brakes will set.

3.2.2.5 Travel Loss of Power No-Load Test

With the hook raised to clear obstructions and trolley traveling in slow speed, the main power source shall be disconnected, verifying that the trolley will stop and the brake will set. Test shall be repeated slow speed primary drive controls.

3.2.3 Load Test

3.2.3.1 Hoist

Unless otherwise indicated, the following tests shall be performed using a test load of 125 percent (plus 5 percent, minus 0 percent) of rated load.

a. Hoist Static Load Test: Holding brakes and hoisting components shall be tested by raising the test load approximately 300 mm (1 foot) and manually releasing one of the holding brakes. Load shall be held for 10 minutes. First holding brake shall be reapplied and second holding brake released. Load shall be held for 10 minutes. Any lowering that may occur indicates a malfunction of brakes or lowering components.

b. Dynamic Load Test: Test load shall be raised and lowered through the full range operating in each speed. Machinery shall be completely stopped at least once in each direction to ensure proper brake operation.

c. Hoist Mechanical Load Brake: With test load raised approximately 1.5 m (5 feet) and with the hoist controller in the neutral position, holding brake shall be released. Mechanical load brake shall be capable of holding the test load. With holding brake in released position, test load shall be lowered (first point) and the controller shall be returned to OFF position as the test load lowers. Mechanical load brake shall prevent the test load from accelerating.

d. Hoist Loss of Power Test: After raising test load to approximately 2.5 m, (8 feet,) slowly lowering the test load, the main power source and control pushbutton shall be released verifying that the test load will not lower and that both brakes will set.

e. Trolley Dynamic Load Test: While operating the trolley the

full distance of bridge rails in each direction with test load on the hook (one cycle), proper functioning of all primary drive control points and proper brake action shall be tested.

f. Bridge Dynamic Load Test: With test load on hook, bridge shall be operated for the full length of runway in both directions with trolley at each extreme end of bridge. Proper functioning of all primary drive speed control points and brake action shall be verified.

3.2.3.2 Trolley and Bridge Loss of Power Test

A test load of 100 to 105 percent of rated load shall be raised clear of any obstructions on operating floor. Starting at a safe distance from walls or other obstructions, a slow speed shall be selected using the trolley and bridge primary drive. While maintaining a safe distance to obstructions, the main power source shall be disconnected and brakes shall be verified to have set and that the equipment stops within the distance recommended by manufacturer.

3.2.4 Overload Tests

After the operational tests, bridge crane system and all functions of bridge crane shall be tested at 125 percent of rated load.

3.2.5 Acceleration and Deceleration Tests

The acceleration and deceleration of bridge and trolley shall be tested with approximately 10 percent of rated load at lowest possible location of hook. Bridge and trolley shall be operated to run up to high speed and then stopped without jarring or swinging the load.

3.2.6 Grounding Test

Hoist shall be tested to determine that the hoist, including hook and pendant, are grounded to building during all phases of hoist operation. The grounding of bridge and trolley shall be tested with approximately 10 percent of rated load on hook. Grounding shall be tested between hoist hook and the structure's grounding system.

3.2.7 Adjustments and Repairs

Adjustments and repairs shall be performed by Contractor under the direction of the Contracting Officer at no additional cost to the Government, until satisfactory conditions are maintained, and contract compliance is affected. After adjustments are made to assure correct functioning of the components, pertinent testing shall be repeated.

3.3 SCHEMATIC DIAGRAMS

Schematic diagrams for equipment shall be stored where indicated on drawings.

3.4 MANUFACTURER'S FIELD SERVICE REPRESENTATIVE

Contractor shall furnish a qualified experienced manufacturer's field service representative to supervise the crane installation, assist in the performance of the on site testing, and instruct personnel in the operational and maintenance features of the equipment.

3.5 FIELD TRAINING

Contractor shall conduct a training course for the operating staff. Training period shall consist of a total of 8 hours of normal working time and shall start after the system is functionally completed but prior to final acceptance. Course instructions shall cover pertinent points involved in operating, starting, stopping, and servicing the equipment, including all major elements of operation and maintenance manual. Course instructions shall demonstrate all routine maintenance operations such as lubrication, general inspection. Contracting Officer shall be given at least 2 weeks advance notice of field training.

3.6 ACCEPTANCE

Final acceptance of crane system will not be given until Contractor has successfully completed all testing operations, corrected all material and equipment defects, made all proper operation adjustments, and removed paint or over-spray on wire rope, hook and electrical collector bars.

-- End of Section --