
USACE / NAVFAC / AFCEA / NASA UFGS-41 22 13.14 20 (April 2006)

Preparing Activity: NAVFAC Replacing without change
 UFGS-14637N (August 2004)

UNIFIED FACILITIES GUIDE SPECIFICATIONS

References are in agreement with UMRL dated 9 October 2006

Revised throughout - changes not indicated by CHG tags

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SECTION 41 22 13.14 20

CRANES, OVERHEAD ELECTRIC, UNDERRUNNING 04/06

NOTE: This guide specification covers requirements for underrunning overhead electric traveling cranes with capacities of less than 10 metric tons tons.

Use this guide specification to specify general purpose cranes that are procured as part of a building construction contract for such applications as machine shops, warehouses, and other areas that do not require specialized weight handling equipment.

The crane specified herein will handle loads which average 50 percent of rated capacity with 5 to 10 lifts per hour averaging 5 m 15 feet with not over 50 percent of the lifts at rated capacity.

This guide specification shall not be used to procure cranes of 10 metric ton ton capacity or greater.

This guide specification shall not be used to procure cranes that operate in "hazardous locations" as defined in the NFPA 70; nonstandard cranes; or cranes that handle hot (molten) metals or fissionable materials. Requirements for procurement of such cranes and all cranes of 10 metric ton ton capacity or greater shall be forwarded to Northern Division, Naval Facilities Engineering Command, Attn: 09A4, Crane Center, 10 Industrial Highway, Mail Stop #82, Lester, PA 1993-2090. (See NAVFAC Instruction 11450.1A).

Comments and suggestion on this specification are welcome and should be directed to the technical proponent of the specification. A listing of the technical proponents, including their organization designation and telephone number, is on the Internet.

Recommended changes to a UFGS should be submitted as a Criteria Change Request (CCR).

Use of electronic communication is encouraged.

Brackets are used in the text to indicate designer choices or locations where text must be supplied by the designer.

NOTE: TO DOWNLOAD UFGS GRAPHICS

Go to <http://www.wbdg.org/ccb/NAVGRAPH/graphdoc.pdf>.

NOTE: The following information shall be shown on the project drawings:

1. Sketch NFGS-14637-1, including data.
2. Runway track system.
3. Electrical junction box location (including mounting height).

PART 1 GENERAL

1.1 REFERENCES

NOTE: This paragraph is used to list the publications cited in the text of the guide specification. The publications are referred to in the text by basic designation only and listed in this paragraph by organization, designation, date, and title.

Use the Reference Wizard's Check Reference feature when you add a RID outside of the Section's Reference Article to automatically place the reference in the Reference Article. Also use the Reference Wizard's Check Reference feature to update the issue dates.

References not used in the text will automatically be deleted from this section of the project specification when you choose to reconcile references in the publish print process.

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

AMERICAN INSTITUTE OF STEEL CONSTRUCTION (AISC)

AISC S329 (20045) Allowable Stress Design
Specification for Structural Joints Using
ASTM A 325 or A 490 Bolts

AMERICAN WELDING SOCIETY (AWS)

AWS D14.1 (1997) Welding Industrial and Mill Cranes
and Other Material Handling Equipment

ASME INTERNATIONAL (ASME)

ASME B1.1 (2001; R 2003) Unified Inch Screw Threads
(UN and UNR Thread Form)

ASME B18.2.2 (1987; R 2005) Square and Hex Nuts

ASME B30.10 (2005) Hooks

ASME B30.11 (1998) Monorails and Underhung Cranes

ASME B30.16 (2003) Overhead Hoists (Underhung)

ASME HST-4 (1999; R 2004) Overhead Electric Wire Rope
Hoists

ASTM INTERNATIONAL (ASTM)

ASTM A 194/A 194M (2005) Carbon and Alloy Steel Nuts for
Bolts for High Pressure or High
Temperature Service or Both

ASTM A 275/A 275M (2003) Magnetic Particle Examination of
Steel Forgings

ASTM A 307 (2004) Carbon Steel Bolts and Studs, 60
000 PSI Tensile Strength

ASTM A 325 (2004b) Structural Bolts, Steel, Heat
Treated, 120/105 ksi Minimum Tensile
Strength

ASTM A 325M (2004b) Structural Bolts, Steel, Heat
Treated, 830 Mpa Minimum Tensile Strength
(Metric)

ASTM A 563 (2004a) Carbon and Alloy Steel Nuts

ASTM A 563M (2004) Carbon and Alloy Steel Nuts (Metric)

ASTM A 668/A 668M (2004) Steel Forgings, Carbon and Alloy,
for General Industrial Use

ASTM F 436 (2004) Hardened Steel Washers

ASTM F 436M (2004) Hardened Steel Washers (Metric)

MONORAIL MANUFACTURERS ASSOCIATION (MMA)

MMA MH27.1 (2003) Underhung Cranes and Monorail Systems

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA 250 (2003) Enclosures for Electrical Equipment (1000 Volts Maximum)

NEMA ICS 3 (2005) Industrial Control and Systems: Medium Voltage Controllers Rated 2001 to 7200 Volts AC

NEMA MG 1 (2003; R 2004) Motors and Generators

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70 (2005) National Electrical Code

SOCIETY OF AUTOMOTIVE ENGINEERS INTERNATIONAL (SAE)

SAE J429 (1999) Mechanical and Material Requirements for Externally Threaded Fasteners

SAE J995 (1999) Mechanical and Material Requirements for Steel Nuts

THE SOCIETY FOR PROTECTIVE COATINGS (SSPC)

SSPC SP 6 (2000; R 2004) Commercial Blast Cleaning

U.S. GENERAL SERVICES ADMINISTRATION (GSA)

FS RR-W-410 (Rev E) Wire Rope and Strand

1.2 DEFINITIONS

- a. Crane Runway: The track system along which the crane operates horizontally, including track hangar rods, track connection devices, and runway structural supports.
- b. Underrunning (Underhung) Crane: An electric overhead traveling crane that is supported by crane end trucks suspended below the crane runway.
- c. Crane Bridge: That part of an overhead crane system consisting of girder, end trucks, and end truck drive mechanisms that drives the bridge in a direction parallel to the runway.
- d. Girder: The principal horizontal beam of the crane bridge. It is supported by the crane end trucks. Normally the crane trolley mounted hoist is suspended from the girder below the crane.
- e. Trolley Mounted Hoist: A combined unit consisting of a wheeled trolley that provides horizontal motion along the bridge girder, and a hoist suspended from the trolley, that provides lifting and lowering of a freely suspended load.

- f. Patented Track: A generic term referring to track built in accordance with MMA MH27.1 utilizing a composite track section incorporating a proprietary bottom flange shape. For this crane system, it is provided for the crane bridge girder and also the crane runway track.
- g. Dead Loads: The loads on a structure which remain in a fixed position relative to the structure.
- h. Live Load: A load which moves relative to the structure under consideration.
- i. Rated Load: For the purpose of this specification the rated load is defined as the maximum working load suspended under the load hook. Load block and ropes are not included in the rated load.
- j. Standard Commercial Cataloged Product: A product which is currently being sold, or previously has been sold, in substantial quantities to the general public, industry or Government in the course of normal business operations. Models, samples, prototypes or experimental units do not meet this definition. The term "cataloged" as specified in this section is defined as "appearing on the manufacturer's published product data sheets. These data sheets shall have been published or copyrighted prior to the issue date of this solicitation and shall have a document identification number or bulletin number.

1.3 VERIFICATION OF DIMENSIONS

Contractor is responsible for coordination and proper relation of all work to the building structure and to the work of all trades. The Contractor shall verify all dimensions of the building that relate to fabrication of the crane and notify the Contracting Officer of any discrepancy before the order for the crane is finalized.

1.4 SUBMITTALS

NOTE: Review submittal description (SD) definitions in Section 01 33 00 SUBMITTAL PROCEDURES and edit the following list to reflect only the submittals required for the project. Submittals should be kept to the minimum required for adequate quality control.

A "G" following a submittal item indicates that the submittal requires Government approval. Some submittals are already marked with a "G". Only delete an existing "G" if the submittal item is not complex and can be reviewed through the Contractor's Quality Control system. Only add a "G" if the submittal is sufficiently important or complex in context of the project.

For submittals requiring Government approval on Army projects, a code of up to three characters within the submittal tags may be used following the "G" designation to indicate the approving authority. Codes for Army projects using the Resident

Management System (RMS) are: "AE" for Architect-Engineer; "DO" for District Office (Engineering Division or other organization in the District Office); "AO" for Area Office; "RO" for Resident Office; and "PO" for Project Office. Codes following the "G" typically are not used for Navy, Air Force, and NASA projects.

Choose the first bracketed item for Navy, Air Force and NASA projects, or choose the second bracketed item for Army projects.

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are [for Contractor Quality Control approval.] [for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government.] The following shall be submitted in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Crane system[; G][; G, [____]]

Submit shop drawings in the Contractor's standard format and show the general arrangement of all components in plan, elevation, and end views; clearances, hook approaches on all four sides, and principal dimensions, demonstrating compliance with the clearances indicated; assemblies of hoists, trolley, and bridge drives.

Drafting quality of the shop drawings shall be equivalent to the drafting quality of the contract drawings accompanying this contract solicitation.

Provide integral schedule of crane components on each drawing.

Provide maximum wheel loads (without impact) and spacings that will be imparted to the runway track beams. Indicate the crane speeds along the runway, the trolley speeds along the bridge girder, and the hoist lifting speeds; all speeds indicated are speeds with hoist loaded with rated crane capacity load.

SD-03 Product Data

Crane system[; G][; G, [____]]

Submit data for all system components bridge end trucks, hoist including hoist trolley, hoist, crane controllers, couplings, pendant push-button station, crane electrification, motors and brakes.

Crane runway track system[; G][; G, [____]]

SD-05 Design Data

Crane bridge girder[; G][; G, [____]]

Crane runway track system[; G][; G, [____]]

Submit manufacturer's standard published tables that verify the

crane bridge girder and crane runway track are sized in compliance with all specification requirements. When standard published tables are not available, provide calculations for the strength design and deflection of the bridge beams.

If any runway track suspension device is not the track manufacturer's standard commercial cataloged product, submit complete design data for each instance to substantiate that the device complies with the requirements of **MMA MH27.1**.

Custom runway track suspension devices[; G][; G, [____]]

SD-06 Test Reports

Hook and hook nut magnetic particle tests[; G][; G, [____]]

Hoisting rope breaking strength[; G][; G, [____]]

post-erection inspection report[; G][; G, [____]]

Operational test report[; G][; G, [____]]

SD-10 Operation and Maintenance Data

Crane system, including runway system, Data Package 4[; G][; G, [____]]

Submit data package in accordance with Section **01 78 23**, "Operation and Maintenance Data."

1.5 HIGH-STRENGTH BOLTS, NUTS, AND WASHERS

Provide high-strength bolts and nuts of U.S. manufacture, plain (non-coated), and permanently marked (by embossing or indentation) with the ASTM or SAE designation, grade, and manufacturer's identification for all connections provided by this section.

PART 2 PRODUCTS

2.1 CRANE SYSTEM

Provide underrunning overhead electric crane system with electrically operated bridge, trolley/hoist, controlled by a pendant pushbutton station suspended from a festooned cable system along the bridge. All components of the crane system shall comply with **MMA MH27.1**, Class C (Moderate Service), except as modified and supplemented in this specification section. Reference in publications to the "authority having jurisdiction" shall be interpreted to mean the "Contracting Officer."

The crane shall, as a minimum, be in accordance with the requirements of this specification and shall be the manufacturer's standard commercial cataloged product.

The crane shall operate in an [indoor][and][outdoor] environment having an ambient temperature [range] of [____] [to [____]] degrees **C F**. Maximum crane wheel loads (without impact) due to dead and live loads, with the trolley in any position, shall not cause a more severe loading condition in the runway support structure than that produced by the design wheel loads and spacings indicated on the design drawings.

2.1.1 Crane Safety

Comply with the mandatory and advisory safety requirements of ASME B30.11, ASME B30.16, ASME HST-4 and NFPA 70.

2.1.2 Power Characteristics

NOTE: Specifier shall coordinate thoroughly with the electrical designer to ensure that the crane power characteristics specified below agree with the crane power characteristics indicated on the drawings.

The crane shall operate from [_____] volt AC, 60 Hz three phase power source.

2.1.3 Capacity

NOTE: Indicate on the drawings the required capacity. Specifier shall coordinate thoroughly with the designer to ensure that the crane capacity specified below agrees with the crane capacity indicated on the drawings.

The crane shall have a minimum rated capacity of [_____] metric tons tons (one ton equals 2000 pounds).

2.1.4 Speeds

NOTE A: Slow full-load operating speeds invariably provide improved load control and increased productivity. The full-load speeds enclosed in brackets are recommended for most applications. However, should other speeds be required, the following guidelines are provided:

1. Hoist

TYPICAL HOIST LIFT RANGES AND RATED LIFTING SPEED RANGES

Rated load capacity (metric tons)	Hoist lift range (m)	lifting speed range (mm/s)	
		Low	High
1/2	3 to 30	75 to 300	
1	3 to 30	75 to 300	
2	3 to 28	75 to 250	
3	3 to 28	90 to 200	
5	3 to 18	50 to 200	
7-1/2	3 to 12	50 to 225	

TYPICAL HOIST LIFT RANGES AND RATED
LIFTING SPEED RANGES

Rated load capacity (metric tons)	Hoist lift range (m)	lifting speed range (mm/s)	
		Low	High
10	6 to 38	50	200

TYPICAL HOIST LIFT RANGES AND RATED
LIFTING SPEED RANGES

Rated load capacity (tons)	Hoist lift range (ft)	lifting speed range (fpm)	
		Low	High
1/2	10 to 100	15	60
1	10 to 100	15	60
2	10 to 84	15	70
3	10 to 84	18	51
5	10 to 56	10	40
7-1/2	10 to 36	10	45
10	20 to 115	10	40

2. Trolley: Trolley travel speed should approximate the speed required to traverse the bridge span in 45 seconds. (12 m40 ft span - trolley speed 250 to 300 mm/s 50 to 60 ft/min).

3. Bridge: Bridge travel speed should not exceed the maximum speed that the floor walking, crane pendent control operator can comfortably negotiate in a work area, approximately 750 mm/s 150 ft/min.

The crane shall have the following rated load speeds (plus or minus 15 percent):

- a. Hoist - high speed of [75 mm/s] [15 feet per minute (fpm)] [_____]
- b. Trolley - high speed of [250 mm/s] [50 fpm] [_____]
- c. Bridge - high speed of [250 mm/s] [50 fpm] [_____]

2.1.5 Crane Bridge

2.1.5.1 Crane Bridge Girder

Provide a patented track for the crane bridge girder. The summation of all normal stresses on a girder section under analysis shall not exceed the allowable stress for tension or compression.

2.1.5.2 Bridge End Trucks

The wheel assemblies for the crane end trucks shall be the swiveling type so that connections between the end truck and the wheel assemblies shall have rotational movement in two axes. Further, these connections shall ensure contact of all end truck wheels with the runway operating (lower) flange at all times. End truck wheels shall be hardened to a minimum hardness of 375 BHN, and have flat treads with side guide rollers.

2.1.5.3 Bridge Brake

NOTE: Select "100 percent" for an outdoor crane,
"50 percent" for an indoor crane.

Provide bridge drive with an electro-mechanical brake. Provide brake a minimum torque rating of [100] [50] percent of the drive motor rated torque and adjustable down to 85 percent of its torque rating. Select disc brake (if applicable) having housing which permits easy access for wear and setting inspection of the friction discs.

2.1.5.4 Bumpers

NOTE: Select "spring" type bumpers if bridge speed
is 250 mm/s 50 fpm or slower; otherwise, select
"hydraulic" type bumpers.

Provide elastomeric type bumpers on the trolley. Provide [spring or elastomeric] [hydraulic] type bumpers on bridge end trucks.

2.1.6 Hoist Trolley

The wheel assemblies for the hoist trolley shall be the swiveling type so that connections between the trolley and the wheel assemblies shall have rotational movement in two axes. Further, these connections shall ensure contact of all hoist trolley wheels with the crane bridge operating (lower) flange at all times. Hoist trolley wheels shall be hardened to a minimum hardness of 375 BHN, and have flat treads.

2.1.6.1 Trolley Drive

Provide motor-driven trolley.

2.1.6.2 Trolley Brake

NOTE: Select "100 percent" for an outdoor crane,
"50 percent" for an indoor crane.

Provide trolley drive with an electro-mechanical brake. Provide brake with a minimum torque rating of [100] [50] percent of the drive motor rated torque and adjustable down to 85 percent of its torque rating. Select disc brake (if applicable) having housing which permits easy access for wear and setting inspection of the friction discs.

2.1.1.7 Hoist

ASME HST-4, Class H3, except as modified and supplemented in this section.

2.1.1.7.1 Load Block

NOTE: Include sentences for custom design load
block with trunnion if requested by using activity.

NOTE: Include sentence for safety latch on hook if
requested by using activity.

Construct the load block entirely of steel. The design shall preclude the wire rope from being cut, pinched, crushed, or chafed in case of two-blocking.

[Provide load block with a trunnion separate from the sheave pin. Bore the trunnion for swivel mounting of the hook and securely retain in the block side plates. The trunnion shall rotate about its horizontal axis in holes bored in the side plates.]

Construct the load block so that the hook and hook nut may be removed from the load block without disassembly of the block. Hook and hook nut shall be forged from steel conforming to ASTM A 668/A 668M. [Provide the hook with a safety latch.] Provide the equalizer bar or sheave perpendicular to the running sheaves. Mark hoist capacity in pounds on both sides of the load blocks.

Hook and hook nut shall be capable of complete disassembly that enables access to all surfaces of hook, including shank and hook nut for inspection purposes. Provision shall be made for the hook nut, or other hook-to-block fastener, to be keyed to hook shank by means of a set screw or similar, easily removable, securing device.

2.1.1.7.2 Hook and Hook Nut

ASME B30.10, except as modified and supplemented in this specification section.

Magnetic-particle inspect the entire surface area in accordance with ASTM A 275/A 275M. Acceptance standard shall be no defects. A defect is defined as a linear indication that is greater than 3 mm 1/8 inch long whose length is equal to or greater than three times its width.

Each hook, including shank and hook nut, shall be inspected over the entire surface areas by magnetic particle inspection. If hook nut is not used, any device that functions the same as the hook nut shall be inspected by magnetic particle inspection.

- a. Procedure: Magnetic particle inspection shall be conducted in accordance with ASTM A 275/A 275M. This inspection shall be conducted at the factory of the hook manufacturer or hoist manufacturer. Alternately, a recognized independent testing lab may conduct the inspections if equipped and competent to perform such a service, and if approved by the Contracting Officer.

- b. Acceptance Criteria: Defects found on the hook or hook nut shall result in rejection of defective items for use on furnished hoist.
For this inspection, a defect is defined as a linear or non-linear indication for which the largest dimension is greater than 3 mm 1/8 inch.
- c. Test Report: A test report of the magnetic particle inspection of each hook and hook nut provided shall be submitted to and approved by the Contracting Officer prior to final acceptance of hoist installation. Test reports shall be certified by the testing organization.
- d. Weld Repair: Weld repairs for defects on hooks or hook nuts will not be acceptable.

2.1.7.3 Hoisting Rope

FS RR-W-410, improved or extra improved plow steel, regular lay, uncoated, 6 by 37 class construction, with an independent wire rope core. Provide double reeved reeving arrangement. Connect hoisting rope dead end to equalizer bars (if used) by means of zinc-speltered sockets or swaged fittings installed in a manner which develops the full breaking strength of the hoisting rope.

Anchor hoisting rope ends on the drum by means of swaged fittings or by clamping. Neatly and securely seize hoisting rope ends with corrosion resistant wire, except where terminated in zinc-speltered sockets or swaged fittings.

Provide wire rope minimum safety factor of 5 to 1 based on the ratio of actual minimum wire rope breaking load to the calculated load on rope when hoist is assumed loaded to rated capacity. Certification from rope manufacturer verifying provided wire rope breaking strength, shall be approved by the Contracting Officer. No paint or coatings will be allowed on the wire rope. Minimum length of the wire rope shall enable the load hook to operate through its full hook lift range and still have a minimum of two full wraps of wire rope around the rope drum.

2.1.7.4 Sheaves

NOTE: Select "24" if custom design load block with
trunnion has been specified; otherwise, select "16".

Provide steel sheaves. Machine or grind the grooves to contour and rim toughen or flame or induction harden to not less than 320 BHN. Provide minimum pitch diameters of running sheaves of not less than [24] [16] times the rope diameter. Provide sheave groove depth of not less than 1.15 times the hoisting rope diameter.

2.1.7.5 Drum

Provide drum with turned helical grooves cut right and left hand to receive, in a single layer, the full winding length of the rope plus not less than two dead wraps on each end.

The drum shall be of steel construction. Design drum so that not less than

two dead wraps of hoisting rope will remain on each anchorage when the hook is in its extreme low position. Drum grooving shall be right and left hand. Minimum drum groove depth, shall be 0.375 times the rope diameter.

Minimum drum groove pitch shall be either 1.14 times the rope diameter, or the rope diameter plus 3 mm 1/8 inch, whichever is smaller. Minimum drum pitch diameter shall be [16] [18] times the rope diameter. The surface of the drum which comes in contact with wire rope shall not be painted, coated, or galvanized.

2.1.7.6 Hoist Brake

Provide electro-mechanical holding brake and mechanical load brake.

2.2 STRUCTURAL

2.2.1 Welding

AWS D14.1 for welding design and procedures, including pre-weld and postweld heat treatments. However, the minimum classification of electrodes shall be the E70 series.

2.2.2 Structural Bolted Connections

Make structural connection of girder to end truck with ASTM A 325M ASTM A 325 plain (non-coated) bolts; appropriate ASTM A 194/A 194M or ASTM A 563M ASTM A 563 plain nuts; and ASTM F 436M ASTM F 436 plain, through hardened, flat, circular washers. Match bolt and nut threads (oversize tapping is not permitted); bolt and nut threads shall conform to ASME B18.2.2 and ASME B1.1. Galvanized or coated bolts and ASTM A490 bolts shall not be used. Make structural bolted connections not referenced above with ASTM A 325M ASTM A 325 or ASTM A 307 bolts. Install ASTM A 325M bolts in accordance with AISC S329.

2.3 MECHANICAL

2.3.1 Threaded Fasteners

Fasten base-mounted and flange-mounted components and all mechanical connections subjected to calculable loads with ASTM A 325M ASTM A 325 plain uncoated bolts with appropriate ASTM A 194/A 194M or ASTM A 563M ASTM A 563 plain nuts; and ASTM F 436M ASTM F 436 plain, through hardened, flat, circular washers. Alternatively, provide SAE J429, Grade 5, screws with properly torqued matched SAE J995, Grade 5 nuts. Match bolt and nut threads. Oversize tapping is not permitted. Bolt and nut threads shall conform to ASME B18.2.2 and ASME B1.1. Bolts and screws may be installed into tapped holes only in heat treated steel with a minimum hardness of 195 BHN.

2.3.2 Antifriction Bearings

Provide antifriction type bearings, except where bushings are specifically permitted or required. Provide grease lubricated bearings with means for relubrication through easily accessible lubrication fittings or provide permanently lubricated and sealed bearings.

2.3.3 Bushings

Provide manufacturer's standard bronze alloy bushings and thrust washers.

Provide means for relubrication of grease lubricated bushings through easily accessible lubrication fittings or provide oil impregnated type bushings.

2.4 ELECTRICAL

The design, selection, rating, and installation of the electrical portions of the crane and its accessories shall conform to the requirements of **NEMA ICS 3**, **ASME HST-4**, and **NFPA 70**, and other requirements specified herein.

The crane manufacturer shall furnish and install all electrical equipment on the crane, including motors, electrically released brakes, switches, controllers, panels, operating station, wiring system, cables, and bridge-to-trolley electrification[, and the runway electrification].

2.4.1 Wiring System

Provide the wiring system, with all of its associated hardware, fittings, and devices, in accordance with **NFPA 70**. Provide type THHN or TFFN conductors in raceways and type [MTW or TFFN] [double rated MTW/THHN] conductors on control panels. Provide type MTW or TFFN insulation for conductors connected to, or routed above, resistors.

Provide ferrous rigid metal conduit raceways suitable for wet locations; where flexible connections are necessary, provide liquidtight flexible metal conduit. Provide an equipment grounding conductor, sized in accordance with Section 250-95 of **NFPA 70**, with all ungrounded conductors. Provide No. 4 AWG (25 mm²) minimum for leads from the runway contact conductors. Number or tag wiring at connection points.

2.4.2 Motors

NEMA MG 1. Provide AC squirrel cage induction type motors for the bridge and trolley drives. Provide two speed, AC squirrel cage induction type motor for the hoist. Motor insulation shall be Class F. Provide totally enclosed non-ventilated (TENV) motor enclosures, bridge drive motor may be totally enclosed fan-cooled (TEFC). Hoist motor speed shall not exceed 1800 RPM..

2.4.3 Pendant Pushbutton Station

Crane bridge, hoist and trolley motions shall be controlled by crane operator from a pendant pushbutton station. Locate station [1.2 m] [4 feet] [_____] above the finished floor.

Suspend pendant pushbutton station from festooning type electrification utilizing flat cables suspended from carriers riding in an enclosed steel track along the bridge. Suspend station by a small cord strain lead 3 mm 1/8 inch (minimum), 7 by 19 construction, made from corrosion resistant steel, and conforming to **FS RR-W-410**. Provide Type SO cable for pendant cable with a minimum of 20 percent of its conductors reserved as spares at the time of crane acceptance by the Contracting Officer.

Arrange pushbuttons in accordance with **ASME B30.11** recommendations, except as supplemented or modified herein. On the pushbutton station, provide a pilot light to indicate that the pendant is energized . Provide a pilot light on the crane mounted electrical panel to indicate that power is available to the crane .

2.4.4 AC Controls

NOTE: Select one of the following options. The first option provides magnetic controls for the bridge, trolley, and hoist. The second option provides electronic controls for the bridge and trolley and magnetic controls for the hoist.

[2.4.4.1 Magnetic Two-speed Controls

Provide two-speed magnetic controls for the bridge drive, trolley drive, and hoist motors. Ensure that an energized drive motor initially rotates only in the direction selected by the operator by depressing the corresponding pushbutton; i.e., is not overhauled. Feed control circuits from a single phase, air cooled, double wound transformer with a grounded metal screen between the primary and secondary windings of the transformer.

- a. Bridge and Trolley Control: Provide bridge drive and trolley drive motor control systems with a solid state soft start, adjustable for both time and torque. Ensure smooth acceleration and deceleration.
- b. Hoist Control: Feed control circuit from a single phase, air cooled, double wound transformer with a grounded metal screen between the primary and secondary windings of the transformer. Hoist shall be equipped with a mechanical load brake.

] 2.4.4.2 Electronic and Magnetic Controls

Provide provide two-step adjustable frequency controls for the bridge and trolley drive motors and two-speed magnetic controls for the hoist motor. Ensure that an energized drive motor initially rotates only in the direction selected by the operator by depressing the corresponding pushbutton; i.e., is not overhauled.

- a. Bridge and Trolley Control: Provide static reversing, dynamic braking, adjustable frequency (achieved by sinusoidal pulse width modulation), constant torque controllers for the bridge and trolley drive motors. Size each of the controllers so as to provide sufficient starting torque to initiate motion of that crane drive from standstill with rated load under the hook.

The acceleration time and the deceleration time shall be independently adjustable from 2 to 20 seconds; initially, set acceleration at 5 seconds and deceleration at 2 seconds.

The motor shall run smoothly, without torque pulsations at the lowest speed, and shall be energized at a frequency not exceeding 60 Hz at the highest speed. Include with the controller a full wave rectifier and a three-phase inverter.

Select diodes and power transistors so that their current ratings are not less than 200 percent of full load motor current. Provide motor overload protection utilizing a thermal sensitive device embedded in its windings.

Provide dynamic braking. Connect resistors to the controller's DC bus whenever motor regeneration causes the DC voltage to rise to a predetermined unacceptable level. Provide resistors continuously rated at a minimum of 125 percent of the full load motor current.

- b. Hoist Control: Feed control circuit from a single phase, air cooled, double wound transformer with a grounded metal screen between the primary and secondary windings of the transformer. Hoist shall be equipped with a mechanical load brake.

]2.4.5 Protection

Not less than that required by NEMA ICS 3, and NFPA 70. Provide enclosed type circuit breaker for crane disconnect. The main line contactor shall be the floor operated disconnect.

2.4.6 Resistors

NOTE: Include "125 percent of" only if electronic controls have been selected previously.

Provide resistors rated for continuous duty operation based upon [125 percent of] the motor nameplate amperes and fabricated of corrosion resistant metal; the use of "wire wound" type resistors is prohibited for segments of 8 ohms or less. Mount resistors in substantial, ventilated enclosures constructed entirely of non-combustible materials. Provide resistors with terminals fitted in the coolest position in the enclosure.

2.4.7 Limit Switches

Provide upper and lower limit switches which de-energize the hoist motor. Provide lift limiting and overload limiting devices, clutch-to-stop devices shall not be furnished with the hoist.

2.4.8 Electrification

NOTE: Select runway electrification installation to suit other contract requirements. Select Type 1 enclosures for an indoor crane; select Type 3 enclosures for an outdoor crane.

Runway electrification includes providing conductors between the electrification system and the junction box indicated on the drawings. Provide NEMA Type [1][3], as defined by NEMA 250, enclosures for control panels, for pendent pushbutton station, and for auxiliary devices and mount along the bridge. For runway electrification provide copper conductors enclosed in a solid plastic cover. Provide two sets of current collectors for each conductor.

NOTE: Festooned type electrification is preferred along runway for short bridge crane runway lengths or along the crane bridge when there are hoist trolley runs along a short crane bridge. Enclosed

safety bar electrification are recommended where crane runway lengths are longer or hoist trolley runs along a long crane bridge.

If festooned electricification is used on crane runways, allow space for a parking area of the festoon trolley.

Runway electrification shall be of the [flat festooned type] [enclosed safety bar type with four [continuous] copper conductors]. Provide electrical work for the crane system in accordance with NFPA 70.

2.5 CRANE PAINTING

Blast clean all portions of the crane to be painted to the requirements of SSPC SP 6. As soon as practical after blasting, but before any evidence of rust, coat all surfaces with a yellow zinc phosphate primer, applied to a minimum dry film thickness of 0.05 mm 2.0 mils but not exceeding 0.1 mm 4.0 mils. Apply finish coat of high gloss silicone alkyd copolymer enamel, applied to a minimum dry film thickness of 0.04 mm 1.5 mils but not exceeding 0.08 mm 3.0 mils.

Coat faying surfaces of bolted connections with a yellow zinc phosphate primer, but do not apply finish paint. The color of the finish coat shall be brilliant yellow. The load block shall be brilliant yellow with black diagonal striping, 25 mm one inch wide diagonal black stripes located on 50 mm 2 inch centers. Factory paint electrical and mechanical equipment in accordance with the manufacturer's best standard practice (for the specified environment), except that electrical equipment doors, which expose current-carrying electrical conductors when opened, shall be orange.

Do not paint over the hook, equipment information plates, including nameplates, or identification plates. Do not paint over lubrication fittings, stainless steel or aluminum, or mating surfaces of structural bolted connections.

2.6 CRANE IDENTIFICATION PLATES

Provide identification plate on the crane and hoist. The identification plates shall be of noncorrosive metal with clearly legible permanent lettering giving the manufacturer's name, model number, capacity in both kilogram and pound units printed in different colors, and other essential information or identification.

2.7 MARKINGS ON CRANE

Markings shall include: bridge motion direction arrows on both sides of the bridge; and trolley motion direction arrows on both sides of trolley. Markings shall be visible from push button station and from the loading point and shall correspond to the push button labeling on the pendant pushbutton station. Mark the hook rated capacity on both sides of the hoist or hoist load block.

2.8 PATENTED TRACK

Provide specially designed beam, i.e., patented track beam, constructed from welded steel components. Provide patented track fabricated by a manufacturer regularly engaged in the production of this type of beam. The

lower flange (T-rail) of the beam section shall have a flat wheel tread surface. Minimum lower flange width shall be 81 mm 3.25 inches and shall have a chemical composition of 0.45 to 0.60 percent carbon content, 0.60 to 1.1 percent manganese content. The lower flange wheel tread surface shall be hardened to a minimum hardness of 225 BHN.

The upper flange and web of the beam section shall be structural steel, provided as one monolithic piece rolled to shape or fabricated from two pieces with the flange and web continuously fillet welded on both sides. The joint between the web and the T-rail shall be continuously welded from both sides. Size beam, as a minimum, to withstand all expected forces and the load combinations specified herein.

2.9 CRANE RUNWAY TRACK SYSTEM

Provide patented track runway track beams designed and constructed in compliance with MMA MH27.1, Class C (Moderate Service), except as modified and supplemented in the section.

It shall be the Contractor's responsibility to provide the complete runway track suspension system that is required to hang the crane runway track at its indicated location from the structural supports indicated on the drawings. For the track suspension system, provide all the standard commercial cataloged products possible. Custom runway track suspension devices that are not standard commercial cataloged products, designed and constructed for this particular application, are acceptable if their design documentation is approved by the Contracting Officer.

Provide flexible suspension type runway system including runway track beams, hanger rods, suspension fittings, lateral and longitudinal sway bracing, and necessary hardware.

Select runway suspension hanger rods fabricated from alloy steel with rolled threads. Provide threads of sufficient length to permit at least 1.0 inch of vertical adjustment (up or down) after runway installation. Provide rods with self-aligning gimbal or ball-and-socket joints at each end which allow at least 5.0 degrees of deflection from the vertical. Provide not more than two rods per suspension point and in such cases consider the unequal loads induced in the rods. Fluid-filled load equalizing cells are not acceptable.

PART 3 EXECUTION

3.1 POST-ERECTION INSPECTION

After erection, the Contractor and the Contracting Officer shall jointly inspect the crane bridge and hoist systems and components to verify compliance with specifications and approved shop drawings and manufacturer's data. The Contractor shall notify the Contracting Officer [_____] days before the inspection.

The results of this inspection shall be documented by the Contractor and the post-erection inspection report submitted to the Contracting Officer for approval.

3.2 OPERATIONAL TEST

After erection and inspection, test the hoist, bridge, and trolley as specified herein. All tests shall be witnessed by a technical representative of the Contracting Officer.

The 125 percent rated load test shall be made with the bridge and trolley located to obtain maximum loads on the runway and bridge girders. The systems shall be tested in service to determine that each component of the system operates as specified, is properly installed and adjusted, and is free from defects in material, manufacture, installation, and workmanship. The Contractor shall rectify all deficiencies disclosed by testing and retest the system or component to prove the crane meets the specified requirements.

The Contractor shall provide all personnel and equipment required to meet the specified test requirements. This includes test loads, and rigging gear, crane operating personnel, instruments, and all other necessary apparatus.

3.2.1 Operational Test Report

Record crane test data on appropriate test record forms suitable for retention for the life of the crane. Include in the test records:

- a. Test date
- b. Crane identification number
- c. Weather conditions (temperature, humidity, barometric pressure, dew point, [prevailing wind direction and velocity,] and crane orientation)
- d. Identification of each test performed
- e. Results of each test performed
- f. Data collected during testing
- g. Remarks

Record operating and startup current and motor terminal voltage measurements for electrical equipment (motors) using appropriate instrumentation (e.g., clamp-on ammeters). Recorded values shall be compared with design specifications or manufacturer's recommended values; abnormal differences (i.e., greater than 10 percent from manufacturer's or design values) shall be justified or appropriate adjustments performed. In addition, high temperatures or abnormal operation of any equipment or machinery shall be noted, investigated, and corrected. Record hoist, trolley, and bridge speeds during each test cycle.

3.2.2 Hook

Measure hook for hook throat spread before and after load test. Establish a throat dimension base measurement by installing two tram points and measuring the distance between these tram points (plus or minus 0.4 mm 1/64 inch). Record this base dimension. Measure the distance between tram points before and after load test. An increase in the throat opening by more than one percent from the base measurement shall be cause for rejection.

3.2.3 No-Load Test

Raise and lower the hook through the full range of normal travel at rated

speed for three complete cycles. Then raise and lower the hook through the full range of normal travel in slow speed. Verify proper operation of hoist limit switches. Operate the bridge and trolley in each direction the full distance between end stops; bring bumpers into contact with bumper stops at each end of travel. Perform one complete cycle to check each speed point and verify proper brake operation.

3.2.4 Hoist Load Test

Perform the following tests, as specified, with test loads of 100 and 125 percent (plus 5 minus 0) of rated load.

- a. Static Load Test (125 percent only): Check entire structure, holding brake and hoisting components as follows: Raise the test load approximately one foot. Hold the load for 10 minutes. Rotate load and hook to check bearing operation. Observe lowering that may occur which indicates a weakness in the structure or malfunction of hoisting components or brakes.
- b. Dynamic Load Test (100 percent only): Raise and lower the test load through the full lift height to test limit switches. Check speed points during raising and lowering. Lower the load to the floor, wait 5 minutes, then raise and lower the load through two more cycles, in order to demonstrate proper operation and repeatability of all functions without component overheating or malfunction. Completely stop the machinery at least once in each direction during each cycle to ensure proper brake operation.
- c. Hoist Load Brake (125 percent only): Raise test load approximately 1500 mm 5 feet. With neither pushbutton depressed, release (by hand) the holding brake. The load brake shall hold the test load. Again with the holding brake in the released position, start the test load down (first point) and then release the pushbutton as the test load lowers. The load brake shall prevent the test load from accelerating.
- d. Hoist Loss of Power Test (125 percent only): Raise the test load to approximately 2400 mm 8 feet. While slowly lowering the test load, disconnect the crane's power source. Verify that the test load does not lower and that the brake is set.

3.2.5 Trolley/Hoist Load Test

Operate the trolley/hoist the full distance of the bridge rails in each direction with a test load of 125 percent of rated load on the hook (one cycle). Check proper functioning of all drive speed control points. Verify proper brake action.

3.2.6 Bridge Load Test

With a test load of 125 percent of rated load on the hook, operate the bridge for the full length of the runway in one direction with the trolley/hoist at the extreme end of the bridge, and in the opposite direction with the trolley at the opposite extreme end of the bridge (one cycle). Check proper functioning of all drive speed control points. Check for any binding of the bridge end trucks and verify proper brake action. Record deficiencies. Secure from testing if deficiencies are found.

3.2.7 Rated Travel Test

Repeat travel tests for trolley/hoist and bridge with a test load of 100 percent of rated load. Repeat the test for 2 cycles to demonstrate proper operation and repeatability of all functions without the overheating or malfunction of any components. Check speed points during each cycle. Completely stop the machinery at least once in each direction during each cycle to ensure proper brake action.

-- End of Section --