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USACE / NAVFAC / AFCEC / NASA **UFGS-41 22 13.55 (November 2020)**

Preparing Activity: NAVFAC

UNIFIED FACILITIES GUIDE SPECIFICATIONS

References are in agreement with UMRL dated January 2021
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DIVISION 41 - MATERIAL PROCESSING AND HANDLING EQUIPMENT

SECTION 41 22 13.55

BRIDGE CRANES, UNDER RUNNING, AIRCRAFT HANGAR

11/20

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SECTION 41 22 13.55

BRIDGE CRANES, UNDER RUNNING, AIRCRAFT HANGAR
11/20

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NOTE: This guide specification addresses requirements for under running bridge cranes that are procured as part of a building construction contract for Aircraft Maintenance Hangars. As a result of the installation location, all cranes will meet hazardous area requirements.

This guide specification covers requirements for under running single or double girder electric traveling (OET) cranes with under running trolleys and hoists, Crane Manufacturers Association of America (CMAA) 74 Class C and D and with capacities up to 9.1 metric ton 10 ton 9,100 kg 20,000 pounds, suitable for indoor use in hazardous area environments.

This guide specification incorporates the design criteria and requirements identified in NAVCRANECEN INSTRUCTION 11450.2A (December 2018). Also included are hangar crane requirements identified in UFC 4-211-01 Change 2, 2020. This guide specification does not cover requirements for custom built-up hoists, which would be an abnormal requirement for an aircraft hangar crane. Contact NAVY CRANE CENTER for assistance with this hoist type.

Consider the use of multiple bridge spans for total crane span lengths greater than 12 meters 40 feet or capacities greater than 9,100 kg 20,000 pounds. See Section 41 22 23.19 MONORAIL HOISTS for any aircraft hangar monorail hoists.
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NOTE: Forward all procurement of OET systems at Naval Shore based activities with rated capacities of 9000 kg 20,000 pounds or greater or for use in specialized applications (e.g. ordnance handling, molten metal handling, special purpose service as defined in NAVSEA Publication 0989-030-7000, hazardous/explosive area environments, or precision

handling operations requiring complex or synchronized lifting capacity) to: Naval Facilities Engineering Command, Navy Crane Center, Building 491, Norfolk Naval Shipyard, Portsmouth, Va., 23709-5000. (See NAVCRANECEN INSTRUCTION 11450.1C of 11 July 2019).
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NOTE: This guide specification includes tailoring options for NAVFAC, pounds (per NAVFAC P-307), and tons. The NAVFAC tailoring option also includes requirements specific to the Navy and Marine Corps. Crane procurements for the Navy and Marine Corps must select the NAVFAC tailoring option.

Crane tailoring options are included for the Army, Air Force, Navy, and maximum hazardous (explosive) environments. The default crane configuration includes additional minimum anti-spark, hazardous area requirements. Maximum anti-spark protection includes requirements that are in addition to the minimum anti-spark requirements.

Selection or deselection of a tailoring option (select view-tailoring options) will include or exclude that option in the section. Specific project editing is still required for the resulting section.
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NOTE: Adhere to UFC 1-300-02 Unified Facilities Guide Specifications (UFGS) Format Standard when editing this guide specification or preparing new project specification sections. Edit this guide specification for project specific requirements by adding, deleting, or revising text. For bracketed items, choose applicable item(s) or insert appropriate information.

Remove information and requirements not required in respective project, whether or not brackets are present.

Comments, suggestions and recommended changes for this guide specification are welcome and should be submitted as a Criteria Change Request (CCR).

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NOTE: This specification covers cranes with under running bridge and under running trolley and hoist, single or double girder, with CMAA 74 service class C or D, with provisions for operation in hazardous areas.

Explanations of CMAA service classifications C and D

are covered in the "Notes" portion of paragraph CRANE DESIGN CRITERIA, sub-paragraph CLASSIFICATION. The minimum allowable classification for hangar cranes is CMAA service class C.

Explanations of hazardous areas are covered in the DEFINITIONS paragraph as well as the "Notes" portion of paragraph CRANE DESIGN CRITERIA, sub-paragraph CLASSIFICATION. All hangar cranes must meet minimum anti-spark protection.

Control types and systems may be specified as follows:

1. Remote or Pendant Crane Controls or a combination of the two can be provided.

2. Alternating current (AC) control systems must be specified. The vast majority of new cranes are AC powered and AC controlled.

Terminology: - refer to DEFINITIONS in this specification.

a. Under running bridge is a bridge with end trucks supported on tracks attached to the bottom flanges of beams or supported on the beam bottom flanges. These beams make up the crane runway.

b. Under running trolley is a trolley which travels on tracks attached to the bottom flange of the crane girder beam or supported on the girder beam bottom flange.

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NOTE: The RFP must provide the relevant dimensions and load data for the crane. See "Crane Inquiry Data Sheet" in CMAA 74 section 6.1 or see "Crane Information Form for Underrunning Cranes(s)" pages 5 and 6 at the following Navy Crane Center link:

https://www.navfac.navy.mil/navfac_worldwide/specialty_centers/ncc/about_us/resources/downloads.html

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NOTE: Show the following information, as a minimum, on the project drawings:

1. Complete details of plan, elevations, and sections of crane.

2. Runway track system (if installed), including span and size of girder(s), runway rail size, channel cap size, size and location of crane stops, and building clearances.

3. Electrical junction box location (including mounting height).

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PART 1 GENERAL

1.1 REFERENCES

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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 Reference Identifier (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.

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

AMERICAN GEAR MANUFACTURERS ASSOCIATION (AGMA)

AGMA 908	(1989B; R 1999) Information Sheet: Geometry Factors for Determining the Pitting Resistance and Bending Strength of Spur, Helical and Herringbone Gear Teeth
ANSI/AGMA 2001	(2004D; R 2010) Fundamental Rating Factors and Calculation Methods for Involute Spur and Helical Gear Teeth
ANSI/AGMA 6013	(2006A; R 2016) Standard for Industrial Enclosed Gear Drives
ANSI/AGMA 6113	(2016B) Standard for Industrial Enclosed Gear Drives (Metric Edition)

AMERICAN INSTITUTE OF STEEL CONSTRUCTION (AISC)

AISC 360	(2016) Specification for Structural Steel Buildings

AMERICAN SOCIETY OF CIVIL ENGINEERS (ASCE)

ASCE 7-16	(2017; Errata 2018; Supp 1 2018) Minimum Design Loads and Associated Criteria for

Buildings and Other Structures

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

ASME B1.1	(2003; R 2018) Unified Inch Screw Threads (UN and UNR Thread Form)
ASME B18.2.2	(2015) Nuts for General Applications: Machine Screw Nuts, Hex, Square, Hex Flange, and Coupling Nuts (Inch Series)
ASME B30.10	(2019) Hooks
ASME B30.16	(2017) Overhead Underhung and Stationary Hoists
ASME B30.17	(2015) Overhead and Gantry Cranes (Top Running Bridge, Single Girder, Underhung Hoists)
ASME HST-4	(2016) Performance Standard for Overhead Electric Wire Rope Hoists
ASME NUM-1	(2016) Rules for Construction of Cranes, Monorails, and Hoists with Bridge or Trolley or Hoist of the Underhung Type.

AMERICAN SOCIETY OF SAFETY PROFESSIONALS (ASSP)

ASSP Z359	(2013) Fall Protection Code

AMERICAN WELDING SOCIETY (AWS)

AWS D1.1/D1.1M	(2020) Structural Welding Code - Steel
AWS D14.1/D14.1M	(2019) Specification for Welding of Industrial and Mill Cranes and Other Material Handling Equipment

ASTM INTERNATIONAL (ASTM)

ASTM A275/A275M	(2018) Standard Practice for Magnetic Particle Examination of Steel Forgings
ASTM A931	(2008; R 2013) Standard Test Method for Tension Testing of Wire Ropes and Strand
ASTM A1023/A1023M	(2019) Standard Specification for Stranded Carbon Steel Wire Ropes for General Purposes
ASTM E125	(1963; R 2013) Photographs for Magnetic Particle Indications on Ferrous Castings
ASTM E543	(2015) Standard Practice for Agencies Performing Non-Destructive Testing
ASTM E1417/E1417M	(2016) Standard Practice for Liquid Penetrant Testing

ASTM F436/F436M	(2019) Standard Specification for Hardened Steel Washers Inch and Metric Dimensions
ASTM F3125/F3125M	(2019) Standard Specification for High Strength Structural Bolts and Assemblies, Steel and Alloy Steel, Heat Treated, Inch Dimensions 120 ksi and 150 ksi Minimum Tensile Strength, and Metric Dimensions 830 MPa and 1040 MPa Minimum Tensile Strength

CRANE MANUFACTURERS ASSOCIATION OF AMERICA (CMAA)

CMAA 74	(2015) Specifications for Single Girder Cranes

ELECTRIFICATION AND CONTROLS MANUFACTURERS ASSOCIATION (ECMA)

ECMA 15	(2018) Cable-less Controls for Electric Overhead Traveling Cranes

MATERIAL HANDLING INDUSTRY OF AMERICA (MHI)

MHI MH27.1	(2009) Specifications for Underhung Cranes and Monorail Systems

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA 250	(2018) Enclosures for Electrical Equipment (1000 Volts Maximum)
NEMA ICS 3	(2005; R 2010) Medium-Voltage Controllers Rated 2001 to 7200 V AC
NEMA ICS 5	(2017) Industrial Control and Systems: Control Circuit and Pilot Devices
NEMA ICS 6	(1993; R 2016) Industrial Control and Systems: Enclosures
NEMA ICS 8	(2011) Crane and Hoist Controllers
NEMA MG 1	(2018) Motors and Generators

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(2020; ERTA 20-1 2020; ERTA 20-2 2020; TIA 20-1; TIA 20-2; TIA 20-3; TIA 20-4) National Electrical Code

RESEARCH COUNCIL ON STRUCTURAL CONNECTIONS (RCSC)

RCSC S348	(2014; Errata 2015) RCSC Specification for Structural Joints Using High-strength Bolts

SOCIETY FOR PROTECTIVE COATINGS (SSPC)

SSPC SP 6/NACE No.3	(2007) Commercial Blast Cleaning

SOCIETY OF AUTOMOTIVE ENGINEERS INTERNATIONAL (SAE)

SAE J429	(2014) Mechanical and Material Requirements for Externally Threaded Fasteners
SAE J995	(2017) Mechanical and Material Requirements for Steel Nuts

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

29 CFR 1910	Occupational Safety and Health Standards
29 CFR 1910.147	The Control of Hazardous Energy (Lock Out/Tag Out)
29 CFR 1910.179	Overhead and Gantry Cranes
29 CFR 1910.306	Specific Purpose Equipment and Installations

U.S. NAVAL SEA SYSTEMS COMMAND (NAVSEA)

NAVSEA T9074-AS-GIB-010/271	(1999; Notice 1) Requirements for Nondestructive Testing Methods

UNDERWRITERS LABORATORIES (UL)

UL 943	(2016; Reprint Feb 2018) UL Standard for Safety Ground-Fault Circuit-Interrupters
UL 1004-1	(2012; Reprint Nov 2020) UL Standard for Safety Rotating Electrical Machines - General Requirements

1.2 DEFINITIONS

a. Bridge Crane: That part of an overhead crane system consisting of a girder, end trucks, walkway, and drive mechanism which carries the trolley(s) and travels along the runway rails parallel to the runway.

b. Crane Runway: The track system along which the crane operates horizontally, including track hangar rods, track connection devices, and runway structural supports.

c. Dead Loads: The loads on a structure which remain in a fixed position relative to the structure.

d. Girder: The principal horizontal beam of the crane bridge. It is supported by the crane end trucks. Typically, for single girder cranes the trolley mounted hoist is suspended from the girder below the crane. For double girder cranes, the hoist can be mounted on top of the under running trolley.

e. Lifted Load: The load consisting of the rated load and the weight of lifting devices attached to the crane such as the load block, bucket, or other supplemental devices.

f. Pendant: A control for a hoist and a crane. The pendant hangs from the hoist or the crane by a cable at a height that is easy for the operator to reach.

g. Patented Track: A generic term referring to track built in accordance with MHI 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, if under running.

h. Rated Load: The maximum working load suspended under the load hook.

i. 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 must have been published or copyrighted prior to the issue date of this solicitation and have a document identification number or bulletin number.

j. Trolley Load: The weight of the trolley and its associated equipment carried by the trolley wheels.

k. Under running (Underhung) Crane: An electric overhead traveling crane that is supported by crane end trucks suspended below the crane runway. The load is supported by hanging from the lower flange of a beam or patented track.

l. Hazardous (Explosive) Operating Environment: Cranes operating in hazardous environments as defined by the cognizant activity safety office must be equipped with electrical safety features that meet NFPA 70 Article 500. The activity safety office must identify the specific Class and Division, as well as the envelope that the hazard exists, to allow proper design and must list these in this section. Materials for mechanical components must be chosen to minimize the potential for sparking, typically bronze, stainless steel, or aluminum. Hazardous environments are split into two groups: minimum anti-spark protection and maximum anti-spark protection.

   (1) Minimum Anti-Spark Protection is used when only the load block enters the explosive area.

   (2) Maximum Anti-Spark Protection is used when the hazardous area envelops the entire crane.

m. Original Equipment Manufacturer (OEM): the Company that produced the part or original equipment.

1.3 SYSTEM DESCRIPTION

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NOTE: Remove the following sentence if the runway rail is not to be installed as a part of the crane procurement. If rail is to be installed, ensure Section 05 12 00 STRUCTURAL STEEL is included in the Request for Proposal (RFP).

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[The requirements for the crane runway system and rail supporting structures are specified in Section 05 12 00 STRUCTURAL STEEL, and must conform to AISC 360.

]1.3.1 Crane Design Criteria

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NOTE: Clearly show the area of hook coverage, runway dimensions, rail size, hook vertical travel, clear hook height, and lifting capacity on drawings.
****

Cranes will operate in the given spaces and match the runway dimensions and rails indicated. Hook coverage, hook vertical travel, clear hook height, lifting capacity, and load test weight must not be less than that indicated. Provide loaded hook coverage to the maximum extent possible in the Aircraft Maintenance Bay.

1.3.1.1 General

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NOTE: Add number of cranes, hangar name, hangar bay location, and crane rated load capacity in kilograms pounds.
****

Include the following: Number of cranes [_____], located in Hangar identified as [_____],[bay [_____],] with the capacity expressed in [_____] metric tons tons kilograms pounds, for each overhead electric traveling (OET) crane. Also clearly locate and identify each hoist and system components.

1.3.1.2 Classification

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NOTE: Refer to NFPA 70 National Electric Code (NEC) for environmental requirements.

Section 500.5 covers classifications of hazardous locations: Classes I, II, and III, along with Divisions 1 and 2. It is unlikely that Classes II or III will be required for Aircraft Hangars.

Section 500.6 covers material groups A, B, C, D, E, F and G.

Section 513 covers specific requirements for Aircraft Hangars.
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NOTE: Make a selection from the following CMAA 74 service classifications:

Class C (Moderate Service): This service covers cranes which may be used in moderate service requirements such as machine shops of paper mill machine rooms. In this type of service, the crane

will handle loads which average 50 percent of the rated capacity with 5 to 10 lifts per hour, averaging 4.5 m 15 feet, not over 50 percent of the lift at rated capacity.

Class D (Heavy-Duty): This service covers cranes which may be used in heavy machine shop, foundries, fabricating plants, steel warehouses, container yards, or lumber mills and standard duty bucket and magnet operations where heavy-duty production is required. In this type of service, loads approaching 50 percent of the rated capacity will be handled constantly during the working period. High speeds are desirable for this type of service with 10 to 20 lifts per hour averaging 4.5 m 15 feet, not over 65 percent of the lifts at rated capacity. This service is the minimum requirement for Ordnance/Explosive Handling.

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NOTE: Crane Operating Environments

Hazardous (Explosive) Environments: Cranes operating in hazardous environments as defined by the cognizant activity safety office must be equipped with electrical safety features that meet NFPA 70 Article 500. The activity safety office must identify the specific Class and Division, as well as the envelope that the hazard exists, to allow proper design and must list these in this section. Materials for mechanical components must be chosen to minimize the potential for sparking, typically bronze, stainless steel, or aluminum. Hazardous environments are split into two groups: minimum anti-spark protection and maximum anti-spark protection.

a. Minimum Anti-Spark Protection is used when only the load block enters the explosive area. This is a default requirement for aircraft hangar cranes.

b. Maximum Anti-Spark Protection is used when the hazardous area envelops the entire crane.

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NOTE: NFPA 70, Section 513 Aircraft Hangars. See also NEC Handbook, Section 513.3, Exhibit 513.1 for visual representation of these requirements.

Pits or Depression: In accordance with NFPA 70, Section 513.3, any pit or depression below the level of the hangar floor shall be classified as a Class I, Division 1 or Zone 1 location that shall extend up to said floor level. Items that may be installed or operated in these areas such as wiring, radio

controller, and pendant controller shall comply with the requirements of Section 513 of NFPA 70.

Aircraft Maintenance and Storage Hangars: In accordance with NFPA 70, Section 513.3, the hangar is classified as Class 1, Division 2 up to 18 inches above the floor and within 5 feet horizontally from engines and fuel tanks up to 5 feet above the engine or fuel tank enclosure. Items that may be installed or operated in these areas such as wiring, radio controller, and pendant controller shall comply with the requirements of Section 513 of NFPA 70.

Aircraft Painting Hangars: In accordance with NFPA 70, Section 513.3, the hangar is classified as Class 1, Division 2 up to 18 inches above the floor and Class I, Division 1 or Class I, Zone 1 within 3 m 10 ft horizontally from aircraft surfaces from the floor to 3 m 10 ft above the aircraft. The area horizontally from aircraft surfaces between 3.0 m and 9.0 m 10 ft and 30 ft from the floor to 9.0 m 30 ft above the aircraft surface shall be classified as Class I, Division 2 or Class I, Zone 2. Electrical and mechanical items that are installed or operated in these areas shall comply with the requirements of Section 513 of NFPA 70.

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NOTE: Ensure the correct hazardous area is specified (class, division, and group) for the actual hangar bay.

The first of the options provided is the more likely option for a standard aircraft hangar crane: NEC Class I, Division 2 hazardous area. Another potential option for aircraft hangars: NEC Class 1, Division 1 hazardous area.

Group requirements are dependent on Class and combustible gases/vapors in the hangar. For Class I locations, Groups A, B, C, and D a possible.

The blanks are provided should a slight variance exist in the hangar bay hazardous classification.

The height of the hazardous area directly affects crane requirements. For areas that encompass the floor and immediate area around the aircraft, the default anti-spark provisions for crane components entering the hazardous area are sufficient (anti-spark measures for the hook, load block, wire rope, and pendant). For hazardous areas that cover the entire crane envelope (i.e. bridge and trolley), the "maximum hazardous" tailoring option must be selected. This tailoring option adds anti-spark measures for the entire crane, such as electrical enclosures and wheels.

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NOTE: Either single or double girder cranes can be used, whichever minimizes the lowest overall crane depth for the configuration.

The minimum hook clearance height requirements, (measured from the finished floor elevation to the saddle of the hook at full elevation are referenced in each specific Service's Chapter of UFC 4-211-01.

Cranes may have wire connected controls (pendants) or wireless controls. Coordinate the selection of wire connected controls and wireless controls with the users. When wireless controls are provided, coordinate the frequency of wireless controls with the local frequency manager.

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Provide under running, [single] [double] girder bridge overhead electric traveling crane(s) (OET), with under running trolley mounted hoist, conforming to CMAA 74 service class [C] [D] for operation in an indoor environment, hazardous area service, meeting the requirements of ASME B30.16 and ASME B30.17, with an ambient temperature range of [_____] to [_____] degrees Celsius Fahrenheit. This crane must operate in an NFPA 70 Class [I] [_____], Division [2] [1] [_____], Group [D] [_____] hazardous area. Hazardous protection is required for the [0.450 meters 1.5 feet above floor level] [3 meters 10 feet above floor level] [full height of the crane]. The crane span must be [_____] meters feet with a vertical lift of [_____] meters feet and as specified herein.

The crane must be [pendant controlled] [radio controlled] and operate in the spaces and within the loading conditions indicated. Provide a crane, including hooks and hoisting ropes, that in all operating configurations is able to clear the vertical lift fabric door maintenance catwalk.[The pendant controller must be mounted on a separate festooned cable system from the trolley power supply.] The crane must operate on [_____]-volts AC, 60 Hz [_____], [single] [three] phase power source. Maximum crane wheel loads (without impact) due to dead, trolley, and lifted loads, with the trolley in any position, must not cause a more severe loading condition in the runway support structure than that produced by the design wheel loads and spacing indicated.

1.3.1.3 Rated Speeds

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NOTE A: Slow full-load operating speeds invariably provide improved load control and increased productivity.

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NOTE: Specify the maximum rated speed under full load for the main hoist, bridge, and trolley.

1. Hoist: Select hoist speed which conforms to the recommendations of CMAA 74 or ASME tables. A table of suggested hoisting speeds can be found at the end of section 6 in CMAA 74.

2. Trolley: Trolley travel speed must conform to the recommendations of CMAA 74. A table of suggested travel speeds can be found at the end of section 6 in CMAA 74.

3. Bridge: Bridge travel speed must 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, and as recommended in CMAA 74. A table of suggested travel speeds can be found at the end of section 6 in CMAA 74.

Examples of maximum rated speeds are provided in the tables below. These maximum rated speeds are considered 'mid-range', however speeds may vary based on long travel distances or command preferences:

Suggested medium operating speeds for pendant controlled cranes			
Capacity mton tons	Hoist m/s fpm	Trolley m/s fpm	Bridge m/s fpm
2.7 3	0.175 34	0.40 79	0.60 118
4.5 5	0.150 29	0.40 79	0.60 118
6.8 7.5	0.150 29	0.40 79	0.60 118
9.1 10	0.100 20	0.40 79	0.60 118

Suggested medium operating speeds for radio controlled cranes			
Capacity mton tons	Hoist m/s fpm	Trolley m/s fpm	Bridge m/s fpm
2.7 3	0.175 34	0.40 79	0.75 148
4.5 5	0.150 29	0.40 79	0.75 148
6.8 7.5	0.125 25	0.40 79	0.75 148
9.1 10	0.125 25	0.40 79	0.75 148

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Provide the crane with rated (maximum) speeds within plus or minus 10 percent (in meters/second feet/min) for the main hoist, bridge, and trolley at the rated load as specified in the table below. The minimum speed must not exceed the values listed.

Rated Speeds meters/second feet/minute		
Description	Minimum	Maximum
Main Hoist	[_____]	[_____]
Trolley	[_____]	[_____]
Bridge	[_____]	[_____]

1.4 VERIFICATION OF DIMENSIONS

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

1.5 SUBMITTALS

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NOTE: Review Submittal Description (SD) definitions in Section 01 33 00 SUBMITTAL PROCEDURES and edit the following list, and corresponding submittal items in the text, to reflect only the submittals required for the project. The Guide Specification technical editors have classified those items that require Government approval, due to their complexity or criticality, with a "G." Generally, other submittal items can be reviewed by the Contractor's Quality Control System. Only add a "G" to an item if the submittal is sufficiently important or complex in context of the project.

For Army projects, fill in the empty brackets following the "G" classification, with a code of up to three characters 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.

The "S" classification indicates submittals required as proof of compliance for sustainability Guiding Principles Validation or Third Party Certification and as described in Section 01 33 00 SUBMITTAL PROCEDURES.

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" or "S" classification. Submittals not having a "G" or "S" classification are [for Contractor Quality Control approval.][for information only. When used, a code following the "G" classification identifies the office that will review the submittal for the Government.] Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Overhead Electric Crane System; G[, [_____]]

Complete Schematic Wiring Diagram; G[, [_____]]

Control System and Network Drawings; G[, [_____]]

SD-03 Product Data

****
NOTE: Each catalog cut must be marked-up to fully identify the model or size/rating of the item and supplemental pages with data or information to demonstrate specification compliance.
****

Hoist Brakes; G[, [_____]]

Travel Brakes; G[, [_____]]

Couplings; G[, [_____]]

Load Block and Hook; G[, [_____]]

Hoist and Trolley Units; G[, [_____]]

Bridge End Trucks; G[, [_____]]

Crane Bridge Girder; G[, [_____]]

End Stops; G[, [_____]]

Bumpers; G[, [_____]]

[Crane Runway System; G[, [_____]]

] Motors; G[, [_____]]

Enclosures; G[, [_____]]

Circuit Breakers; G[, [_____]]

Contactors and Relays; G[, [_____]]

Fuses; G[, [_____]]

Variable Frequency Drives; G[, [_____]]

Limit Switches; G[, [_____]]

Resistors; G[, [_____]]

[Radio Control System; G[, [_____]]

][Pendant Push-Button Station; G[, [_____]]
]

Pendant Conductor System; G[, [_____]]

Crane Controllers; G[, [_____]]

[Control Parameter Settings; G[, [_____]]

][Pilot Devices; G[, [_____]]

][Warning Devices; G[, [_____]]

][Floodlights; G[, [_____]]

] Runway Conductor System; G[, [_____]]

Bridge Conductor System; G[, [_____]]

Overload Protection; G[, [_____]]

Load Indicating Device; G[, [_____]]

Painting System; G[, [_____]]

Control System and Network; G[, [_____]]

SD-05 Design Data

Load and Sizing Calculations; G[, [_____]]

SD-06 Test Reports

[Hook Proof Test; G[, [_____]]

][Hook Non-Destructive Test (NDT); G[, [_____]]

] Post-Erection Inspection; G[, [_____]]

Operational Tests; G[, [_____]]

Hook Tram Measurement; G[, [_____]]

Load Tests; G[, [_____]]

SD-07 Certificates

Wire Rope; G[, [_____]]

Crane Runway; G[, [_____]]

Hazardous Material; G[, [_____]]

Loss of Power Test; G[, [_____]]

Coupling Alignment Verification Record; G[, [_____]]

Overload Test; G[, [_____]]

Brake Adjustment Record; G[, [_____]]

Compliance with Listed Standards; G[, [_____]]

Contractor Hazardous Environment; G[, [_____]]

Hoist Manufacturer Hazardous Environment; G[, [_____]]

Public Domain Software; G[, [_____]]

Software and Services; G[, [_____]]

SD-10 Operation and Maintenance Data

Operation and Maintenance Manuals, Data Package 3; G[, [_____]]

SD-11 Closeout Submittals

Disabled Ports, Connectors, and Interfaces; G[, [_____]]

Network-Capable Control Devices; G[, [_____]]

Control System Access Control; G[, [_____]]

Control System Account Management; G[, [_____]]

Patch Management and Updates; G[, [_____]]

Malware Detection and Protection; G[, [_____]]

Wireless Technology Provisions; G[, [_____]]

Control System Inventory; G[, [_____]]

Evaluation Status of Hardware and Software; G[, [_____]]

1.6 QUALITY ASSURANCE

1.6.1 Manufacturer Qualification

Overhead Electric Crane System, including sub-system components manufactured by vendors, must 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 design must be accomplished by, or directly supervised by, a registered professional engineer (PE). PE licensing must be by a board or agency authorized to license and register professional engineers. The PE may be a Contractor's regular employee or a consultant. The PE's review and attestation of specification compliance and professional responsibility must be signified by his or her PE original seal and dated signature on the final drawings. The professional engineers must only undertake and perform work under this contract in the branch(s) of engineering in which they are licensed.

1.6.2 Pre-Delivery Inspections

Contractor is responsible for performance of quality control inspections, testing, and documentation. Submit all crane test data recorded on appropriate test record forms suitable for retention for the life of the crane.

1.6.2.1 Inspection of Steel Castings

****
NOTE: Navy Crane Center does not require magnetic-particle testing of steel castings. For NASA projects, select both magnetic particle testing and ultrasonic testing. Magnetic testing for USACE projects should be co-coordinated with the Contracting Officer.
****

Visually inspect [and test]load-carrying steel castings[using the magnetic-particle inspection method][using ultrasonic testing].[Reference allowable degree of discontinuities to ASTM E125, and relationship to service loads and stresses, critical configuration, location and type.] All load bearing components, couplings, shafts, and gears, in the hoist drive train must be rolled or forged steel, except brake drums which may be ductile iron. Methods of repairing the discontinuities is subject to review by the Contracting Officer.

1.6.2.2 Hook Proof Test

****
NOTE: Hook proof tests are required for custom designed or non-ferrous (bronze or stainless steel) hooks. Bronze/stainless steel hooks are generally associated with the minimum hazardous area requirements, which applies to all cranes specified by this document.
****

Proof test the load hook per ASME B30.10. Perform the proof test prior to Hook NDT.

1.6.2.3 Inspection of Hook Assembly

****
NOTE: Recommend that linear indications greater than 1.5 mm 1/16 inch not be allowed. If the activity prefers a different acceptance criteria, the bracketed option may be changed.
****

Inspect hook [by a magnetic-particle type inspection][and X-rayed][and tested ultrasonically] prior to delivery. Furnish documentation of hook inspection to Contracting Officer prior to field operational testing. As part of the acceptance standard, linear indications greater than [1.5 mm 1/16 inch] [_____] are not allowed. Welding repairs of hook are not permitted. A hook showing linear indications, damage or deformation is not acceptable.

[1.6.2.3.1 Hook Non-Destructive Test (NDT)

****

NOTE: Delete this paragraph if selected agency does not require magnetic particle testing.

Recommend that linear indications greater than 1/16 inch not be allowed. If the activity prefers a different acceptance criteria, the bracketed option may be changed.

NOTE: For NAVFAC, substitute tailored paragraph.

****

Magnetic-particle inspect the hook over the entire area in accordance with ASTM A275/A275M. Acceptance standard is no defects. A defect is defined as a linear indication that is greater than [3 mm 1/8 inch][1.5 mm 1/16 inch] long. For hooks of non-magnetic material, NDT shall be liquid penetrant (PT) method in accordance with ASTM E1417/E1417M. For PT testing of hooks containing stainless steels, titanium, or nickel based alloys, total halogens and Sulphur used in the NDT process shall be controlled as specified in NAVSEA T9074-AS-GIB-010/271.

Inspect each hook and shank over the entire surface area by magnetic particle inspection.

a. Procedure: Conduct magnetic particle inspection in accordance with ASTM A275/A275M with the following restrictions: Do not use DC yokes (including switchable AC/DC yokes used in the DC mode) or permanent magnet yokes. Do not use automatic powder blowers or any other form of forced air other than from a hand-held bulb for the application or removal of dry magnetic particles. Remove arc strikes. Equipment ammeters must have an accuracy of plus or minus 5 percent of full scale (equipment ammeter accuracy other than that stated is acceptable provided the MT procedure states that a magnetic field indicator is used to establish and verify adequate field strength for all aspects of the inspection).

b. Acceptance Criteria: Defects found on the hook will result in rejection of defective items for use on furnished hoist. For this inspection, a defect is defined as a linear indication for which the largest dimension is greater than 1.5 mm 1/16 inch.

c. Test Report: Submit a test report of the magnetic particle inspection of each hook provided the Contracting Officer for approval prior to final acceptance of hoist installation. Certify test reports by the testing organization. The performing organization must provide a written statement of certification to ASTM E543, current within one year of the date the NDT was performed. The NDT procedures including technique sheets specific to the types, shapes, and size of the parts being examined must adequately describe the orientation of the hooks within the magnetizing equipment. The performing organization must have the NDT procedures and its technique sheet used for testing of the hook reviewed and approved by an independent Level III examiner. Submit the (Level III examiner) approved procedures, technique sheets, and certification to the Contracting Officer with the test report.

]1.6.3 Drawings: Overhead Electric Crane System

a. Submit drawings showing the general arrangement of all components in plan, elevation, and end views. Show all major features of the crane including: hook approaches on all four sides, clearances and principal dimensions, assemblies of hoist, trolley and bridge drives, motor nameplate data, overcurrent protective device ratings, and electrical schematic drawings. Include weights and centers of gravity of major components.

b. Submit shop drawings of all fabricated components. Shop drawing quality must be equivalent to the contract drawings accompanying this solicitation. Drawings must be reviewed, signed, and sealed by a licensed professional engineer.

c. Provide integral schedule of crane components on each drawing. The schedule must provide a cross reference between manufacturer data and shop drawings. Components listed on the schedule of crane components must include total quantity, description, original manufacturer, and part number. Distributing agents will not be acceptable in lieu of the original manufacturer.

d. Provide control system and network drawings. Network diagram must show equipment locations, names, models, and IP addresses on network communications schematic for all Programmable Logic Controllers (PLCs), Remote Terminal Unit (RTU), Supervisory Controller, and Other Network-Capable Devices. In addition, the drawings shall consist of all software block, flow, and ladder diagrams.

1.6.4 Design Data: Load and Sizing Calculations

****

NOTE: Design data for Load and Sizing Calculations, and welding procedures, may not be available for commercially procured hoists and trolleys.

****

Submit complete list of equipment and materials, including manufacturer's descriptive data and technical literature, performance charts and curves, catalog cuts, and installation instructions. Submit calculations reviewed, signed, and sealed by a registered professional engineer verifying the load cases, sizing of the bridge girder(s), end trucks, travel drives, motors, overcurrent protection, and conduit. Provide a list of all codes and standards, design assumptions, equations, specified efficiencies, limits, factors of safety, component ratings, and sources of values used. Include free body diagrams or sketches of each load case.[Include seismic analysis of crane.]

1.6.5 Certificates

All certifications shall be dated and shall bear the original signature (above the printed name) of the authorized representative of the Contractor or the manufacturer of the items or equipment being certified. Each certification shall clearly identify the crane, the drives, components, and location (as applicable) to which it applies:

a. Submit a Wire Rope Certification with the wire rope manufacturer's certification that the rope meets the published breaking strength or the actual breaking strength of a sample taken from the reel and

tested. Certification shall be traceable to the hoist, crane, and reel.

b. Submit a Crane Runway Certificate stating that the new crane will operate properly on the runway. For runways provided by Contractor, include statement certifying runway has been aligned in accordance with MHI MH27.1. If runway is existing and if the crane(s) cannot operate without restriction, the Contractor shall indicate crane limitations.

c. Submit a Hazardous Material Certificate that the crane does not contain hazardous material including asbestos, lead, cadmium, chromium, PCBs, or elemental mercury. Products required for the designing and manufacturing of cranes must not contain the prohibited materials.

d. Submit a Loss of Power Test Certificate stating that a test may be performed in which power is removed from the crane while the hoist, bridge, and trolley are in operation to simulate a loss of power.

e. Submit a Certificate of the Coupling Alignment Verification Record. Coupling alignment verification records are not required for couplings between components mounted via c, d, or p-face flanges.

f. Submit an Overload Test Certificate stating that the crane can be periodically load tested to 125 percent (plus 0 minus 5 percent) of rated load.

g. Submit an Overload Test Certificate stating that the crane can be periodically load tested to 125 percent (plus [0] [_____] minus [5] [_____] percent) of rated load.

h. Submit a Certificate of the Brake Adjustment Record. Provide a brake adjustment record and installation/maintenance manuals for each brake on the crane. Each brake measurement must have a tolerance traceable to the associated brake manual or documentation provided by the brake manufacturer, location of measurements, and the actual brake setting. Changes made to settings of the brake, at any time, will void the record.

i. Submit a Certificate of Compliance with Listed Standards.

j. Provide a Contractor Hazardous Environment Certificate stating that the new crane and all associated components excluding the hoist are designed for operation in the hazardous environment specified in the Classification section.

k. Provide a Hoist Manufacturer Hazardous Environment Certificate from the hoist manufacturer stating that the hoist is designed for operation in the hazardous environment specified in the Classification section.

l. The Contractor shall provide a Public Domain Software Certificate declaring that public domain software (e.g., freeware, shareware) is not used in the system.

m. The Contractor shall provide a certificate stating that all Software and Services that are not required for operation and/or maintenance of the product have been removed. The software/services to be removed are

identified in SOFTWARE AND SERVICES.

1.6.6 Welding Qualifications and Procedure

Welding must be in accordance with qualified procedures using AWS D14.1/D14.1M as modified. Written welding procedures must specify the Contractor's standard dimensional tolerances for deviation from camber and sweep and not exceed those specified in AWS D14.1/D14.1M and MHI MH27.1. Welders and welding operators must be qualified in accordance with AWS D1.1/D1.1M or AWS D14.1/D14.1M.

1.7 CRANE SAFETY

Comply with the mandatory and advisory safety requirements of ASME B30.10, ASME B30.16, ASME B30.17, ASME HST-4, 29 CFR 1910.147, 29 CFR 1910.179, 29 CFR 1910.306, and all applicable provisions of 29 CFR 1910 and NFPA 70. Where personal fall arrest anchorages are provided, design anchorages in accordance with ASSP Z359.

PART 2 PRODUCTS

2.1 MATERIALS

2.1.1 General

Provide materials and equipment which are standard products of manufacturers regularly engaged in the fabrication of complete and totally functional cranes including necessary ancillary equipment. Material will be free from defects and imperfections that might affect the serviceability and appearance of the finished product. All material must be new and unused.

2.1.2 Nameplates

Secure nameplates to each major component of equipment with the manufacturer's name, address, type or style, model or catalog number, and serial number. Provide two bridge identification plates, one for each side of the bridge. Provide noncorrosive metal identification plates 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 Capacity Marking

Mark the rated capacity in metric ton ton kg pounds units on each side of the crane on the bridge girder. Capacity marks must be large enough to be clearly visible from the floor. Individual hoist units must have their rated capacity clearly marked on their bottom block, and additionally labeled on the hoist body. Rated capacity must include all accessories below the hook, such as load bars, magnets, and grabs, as part of the load to be handled.

2.1.4 Safety Warnings

Affix labels in a readable position to each lift block or control station in accordance with ASME B30.16 and ASME B30.17. Submit safety warnings, diagrams and other instructions suitably framed and protected for display as indicated by the Contracting Officer as follows:

Design and locate the word "WARNING" or other legend to bring the label to

the attention of the operator. Provide durable type warning labels 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.

2.2 STRUCTURAL REQUIREMENTS

Structural requirements must be in accordance with MHI MH27.1. Structural steel materials must conform to the standards permitted in MHI MH27.1 and AISC 360. Skewing and other applicable lateral loads must be considered in the design.

2.2.1 Structural Connections

High-strength bolted structural connections must be designed and installed in accordance with RCSC S348. Bolts must be of ASTM F3125/F3125M Grade A325/A325M or Grade A490/A490M material. Galvanized bolts are not acceptable.

Welded connections for the crane must be performed in accordance with AWS D14.1/D14.1M. Welded connections to the building must be performed in accordance with AWS D1.1/D1.1M. Allowable stress values must comply with MHI MH27.1.

2.2.2 Crane Bridge Girder

Provide a bridge girder of patented track conforming to MHI MH27.1. Intermittent ("skip") welds on bridge girder elements (e.g. web and flange interfaces) are prohibited. If the girder is notched to fit over the end trucks, reinforce the girder ends with vertical and horizontal stiffeners. Splices in the unsupported length of the girder are prohibited.

For the patented track girder, submit manufacturer's standard published tables that verify the crane bridge girder is 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. Patented track girder must be of welded steel construction and fabricated by a manufacturer regularly engaged in the production of this type of beam.

2.2.3 Bridge End Trucks

Provide bridge end trucks conforming to ASME B30.17 and MHI MH27.1. Configure end trucks with a feature that limits end truck movement to 25.4 mm one inch in the event of wheel or shaft failure.

2.2.4 End Stops and Bumpers

****

NOTE: For cranes in hazardous areas which encompass the entire crane envelope, the bumper to end stop connection poses a sparking risk if it is metal-to-metal. Use the maximum anti-spark tailoring option to minimize this sparking risk.

****

Fit bridge girders with structural steel end stops. Locate stops to permit maximum trolley travel. Fit bridge end trucks and trolley frames with shock-absorbing bumpers capable of decelerating and stopping the bridge and trolley within the limits stated by ASME B30.17. Ensure bumpers and end stops conform to ASME B30.17. Bumpers must fully engage end stops. Mount bumpers so that there is no direct shear on mounting bolts (if any) upon impact. Bumpers must provide adequate clearance between the crane and surrounding structure when compressed to preclude damaging equipment. When more than one crane is located and operated on the same runway, bumpers shall be provided on their adjacent ends or on one end of one crane. Fit the other end of the end-truck with a structural steel stop to engage the bumpers of the adjacent crane. Ensure bridge bumpers are properly aligned with runway end stops. Metal to metal contact at the bumper to end stop connection is not permitted.

[2.2.5 Crane Runway System

****

NOTE: For underrunning cranes, runway and its support structure is usually supplied by crane contractor. Use Crane Runway System only if crane contractor is to provide a new runway.

****

a. 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. Provide runway and support structure for underrunning crane of patented track girders conforming to MHI MH27.1.

b. Splice assemblies must be from the same manufacturer as the patented track and located under structural support members. Submit manufacturer's standard published tables that verify the crane runway track is sized in compliance with all specification requirements. When standard published tables are not available, provide calculations for the strength design and deflection of the beams.

c. Runway support structure must be designed, fabricated, and installed such that runway rails meet the alignment tolerances of MHI MH27.1. Provide means to allow for vertical adjustment of the runway track both before and after the system has been put in operation so that track can be erected and maintained level. Brace runway to restrain the track against damaging lateral and longitudinal movements. Where the runway track is suspended from hanger rods, provide means preventing the hanger rod nuts from backing off the rods. Allowable stress in hanger rods is 20 percent of the minimum specified ultimate strength of the material used.

][2.2.6 Seismic Forces

****

NOTE: Seismic forces for underrunning cranes are typically considered negligible. If not considered negligible, include the analysis section below. Seismic forces must be considered in the design of the cranes with a component importance factor of greater than 1.0 and in facilities with a Seismic

Design Category of D, E, or F per ASCE 7 or ASME NUM-1. Seismic input (e.g. design spectrum) must be specified for ASME NUM-1 analysis to be performed.
****

Perform a seismic analysis as a part of the design of the crane in accordance with ASCE 7-16[or ASME NUM-1]. The seismic analysis must be included in the MHI MH27.1 extraordinary load case (Case 3).

For project locations beyond the scope of ASCE 7-16, a widely accepted design standard may be used for seismic analysis.

]2.3 MECHANICAL REQUIREMENTS

Provide steel shafts, gears, keys, and couplings. Cast iron and aluminum used to support components of the hoist power transmission train must be ductile.

All mechanical components must be accurately aligned and positively secured to maintain the alignment. Parts must not be forced into position to obtain apparent alignment.

2.3.1 Threaded Fasteners

Fasten base-mounted and flange-mounted components and all mechanical connections subjected to calculable loads with SAE J429 Grade 5 fasteners, ASTM F436/F436M washers, and SAE J995 Grade 5 nuts. SAE J429 Grade 8 fasteners and SAE J995 Grade 8 nuts may be substituted for J429 Grade 5 fasteners and pre-loaded to their full installation torques only when so prescribed by the component manufacturer. All mechanical fasteners must be lubricated unless otherwise specified by the component OEM. Mechanical fastener installation torque should correspond to approximately 67 percent of the SAE J429 Grade 5 fastener material yield strength, except in applications where component manufacturers prescribe specific fastener torque requirements.

Match bolt and nut threads. Oversize tapping is not permitted. Bolt and nut threads must conform to ASME B18.2.2 and ASME B1.1. Bolts and screws may be installed into tapped holes provided that adequate thread engagement is provided to develop the full designed connection strength.

2.3.2 Hoist

****
NOTE: Generally, hoist duty class roughly aligns with CMAA class. An H3 hoist service duty class would typically be specified for a CMAA 74 service class C crane; H4 for service class D. See the Crane Design Criteria – Classification section to identify the CMAA service duty class specified for this crane.
****

Provide hoist conforming to ASME B30.16, ASME B30.17, and CMAA 74, double reeved, except as modified and supplemented in this section. Standard commercial hoist and trolley units (packaged hoists) must be electric wire rope hoist conforming to ASME HST-4 Duty Class [H3] [H4] or better.

Configure trolley such that the trolley frame contacts the trolley stops

and prevents the trolley from dropping more than one inch in the event of an axle or wheel failure.

2.3.2.1 Hoist Brakes

****

NOTE: Each hoist must have, at a minimum, two brakes.

Consider the CONTROLS paragraph under ELECTRICAL REQUIREMENTS. If a variable frequency drive (VFD) is selected for use, the brake configuration must reflect the type of VFD selected (open loop vs closed loop). If open loop controls are selected, brake configuration must be one electro-mechanical/thruster type brake and one mechanical load brake. If closed loop controls are selected, brake configuration must be two electro-mechanical/thruster type brakes. If not using a VFD, and electromatic controls are selected, the brake configuration can be the manufacturer's option as long as there are a minimum of two holding brakes provided.

Cranes with two electro-mechanical/thruster holding brakes must have a time delay between the setting of the primary and secondary brakes.

Service brakes which slow down and stop the load must be adjustable down to 50 percent of their torque rating. Holding brakes which hold the load after the variable frequency drive (VFD) slows down and stops the brake are not required to be adjustable.

NAVFAC tailoring option is for brakes utilized as holding brakes only.

****

a. Equip the hoist with two holding brakes, each with a minimum torque rating of 125 percent of the rated load hoisting torque. Provide a brake configuration with[one electro-mechanical or thruster brake and one mechanical load brake that stops and holds 125 percent of the hoist's rated load and does not require the load to be raised before being lowered][two electro-mechanical or thruster brakes].

[b. For cranes with two electro-mechanical or thruster brakes, designate each brake as primary or secondary with the primary brake being the brake mounted closer to the motor. Provide the primary brake with a non-time delayed setting and secondary brake with an adjustable setting time delay, set between one to three seconds after the primary brake in any stopping condition. Do not use an uninterruptible power supply (UPS) to create the secondary brake time delay.

] c. Electro-mechanical or thruster brakes [must be adjustable to 50 percent of its rated capacity, and]must have an externally accessible means of manual release. On drives where the brakes are utilized as holding brakes only, torque adjustment is not required. The brakes must be equipped with a manual self-return to ON brake release and

designed to permit inspection and adjustment without disassembly of the brake.

2.3.2.2 Load Block and Hook

****

NOTE: NAVFAC tailoring options for uniquely marked hook and nut and commercial blocks.

Tailoring option for maximum anti-spark protection (upper hooks must be non-sparking).

****

The load block must be constructed of non-sparking materials and designed to prevent metal-to-metal contact of moving parts. The block must be fully enclosed, concealing the sheaves and wire ropes, except for wire rope slots and drain holes. The design must preclude the wire rope from being cut, pinched, crushed, or chafed in case of two-blocking. The block must be clearly marked with the capacity in kilograms pounds on both sides. Standard commercial blocks may be used at their published ratings when their published design factors are 5.0 or greater.

Provide an unpainted single barbed hook of non-sparking material with a minimum material longitudinal elongation of 16 percent in 2 inches. Bronze clad hooks are prohibited. Hook dimensions must be as shown on the drawings. Fit hook with a safety latch designed to preclude inadvertent displacement of slings from the hook saddle. The hook and hook nut must be removable without unreeving of the hoist or disassembly of the block. Provide a hook nut secured to the hook with a commercial standard removable and reusable means. Do not weld hook nut. Uniquely mark the hook in a permanent fashion that is traceable to the NDT certification. The nut must be marked to match the hook. The hook nut must be of non-sparking materials. Hook must be free to rotate through 360 degrees when supporting the test load up to 125 percent of the rated capacity. Upper hooks of hook suspended hoists must be of non-sparking materials.

2.3.2.3 Wire Ropes

a. Wire rope must conform to ASTM A1023/A1023M and be tested as required by ASTM A931. The wire rope must be in a double reeved configuration with the equalizing method perpendicular to the running sheaves. Provide wire rope with a minimum design factor of 5 to 1 based on the load experienced at rated capacity and minimum breaking strength of the wire rope.

b. Provide stainless steel hoist ropes.

c. Hoisting rope end connections, other than drum connections, must be speltered sockets with forged steel terminals or swaged fittings installed in a fashion that provides 100 percent of the breaking strength of the wire rope. Anchor hoisting rope ends on the drum by means of swaged fittings or by clamping with hoisting rope ends neatly and securely seized with corrosion resistant wire. Provide proof of Wire Rope breaking strength. Wedge sockets or aluminum swages are not permitted on wire rope end connections.

2.3.2.4 Drum

Provide drum made of steel. Design the drum such that all hoisting rope

is wound in a single layer and so that not less than two dead wraps of hoisting rope remain on each anchorage when the hook is in its extreme low position. Do not paint, coat, or galvanize the surface of the drum which comes in contact with wire rope.

2.3.2.5 Sheaves

Provide sheaves constructed of non-sparking metals in the load block. Provide sheaves constructed of steel for the equalizer and in the upper sheave nest.

2.3.3 Drives

Provide travel assemblies with at least one quarter of all wheels driven for the crane and a minimum of one driven wheel on each side of the flange. No 3-bearing shaft configurations are allowed. The travel drive arrangement will be the contractor's design of choice.

2.3.3.1 Bridge Drives

****

NOTE: Bridge limit switches are an optional safety device.

Bridge travel limit switches are used to prevent the crane bridge trucks from contacting the travel end stops at high speed should the crane operator mistakenly forget to slow down. If selected, ensure the appropriate options are chosen in the ELECTRICAL REQUIREMENTS, Limit Switches section.

****

Acceleration and deceleration must meet the requirements specified in CMAA 74.[Provide bridge travel limit switches].

2.3.3.2 Trolley Drives

****

NOTE: Trolley limit switches are an optional safety device.

Trolley travel limit switches are used to prevent the crane trolley from contacting the travel end stops at high speed should the crane operator mistakenly forget to slow down. If selected, ensure the appropriate options are chosen in the ELECTRICAL REQUIREMENTS, Limit Switches section.

****

Provide a motor-driven trolley arrangement.[Provide trolley travel limit switches.]

2.3.4 Travel Brakes

****

NOTE: NAVFAC tailoring option for additional travel brake requirements.

****

Spring set brakes must be provided with an externally accessible means to manually release the brake. The brakes must be equipped with a manual self-return to ON brake release and designed to permit inspection and adjustment without disassembly of the brake.

2.3.4.1 Bridge Brake

****
NOTE: NAVFAC tailoring option to require electro-mechanical brakes be end-mounted.
****

Provide bridge drive with an end-mounted electro-mechanical brake conforming to the requirements of CMAA 74 or non-freecoasting mechanical drive capable of stopping the motion of the bridge within a distance in meters feet equal to 10 percent of the full load speed in meters feet per minute when traveling at full speed with a full load. Provide brakes with a minimum torque rating per CMAA 74 according to the applicable environment, but not sized larger than 150 percent of the drive motor rated torque.

2.3.4.2 Trolley Brake

****
NOTE: NAVFAC tailoring option to require electro-mechanical brakes be end-mounted.
****

Provide trolley drive with an end-mounted electro-mechanical brake conforming to the requirements of CMAA 74 or a non-coasting mechanical drive capable of stopping the trolley within a distance in meters feet equal to 10 percent of the rated speed in meters feet per minute when traveling at rated speed with rated load. Electro-mechanical brakes must be sized in accordance with ASME B30.17.

2.3.5 Gearing

Provide gearing of the enclosed gear reducers type. Provide steel spur, helical, or herringbone type gears and pinions only. Gearing must conform to ANSI/AGMA 2001 and AGMA 908. Internal and external gear dimensional tolerances must conform to the applicable AGMA standard for tooth geometry and tolerances. Open-type gearing is not acceptable, except for final drives

2.3.5.1 Gear Reducers

Gear reducers must 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 cranes of the selected Service Class. Gear reducers must be standard commercial products and conform to ANSI/AGMA 6113 (ANSI/AGMA 6013) (for travel drives only), as applicable. Except for final reduction, the gear reduction units must be fully enclosed in oil-tight housing. Gearing must be designed to AGMA standards and operate in an oil bath. Operation must be smooth and quiet.

2.3.5.2 Open Gearing

Open gears must be enclosed with safety guards, where feasible, with cover openings for inspection and access for grease lubrication.

2.3.6 Wheels

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NOTE: For maximum anti-spark protection, add the tailored words. Remove any conflicting items (i.e. wheels cannot be non-sparking and steel).

****

Under running wheels are to be flanged or provided with side guide rollers. Provide wheel sizing and flange-to-rail head clearances in accordance with MHI MH27.1 recommendations. Wheel material is to be steel or ductile cast iron. Provide wheels of non-sparking material. Minimum tread hardness for underhung wheels that run on patented track is 375 BHN. The minimum tread hardness for bronze wheels is 225 BHN.

[2.3.7 Drip Pans

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NOTE: Drip pans may also be added for any type of crane service if there is an additional requirement to prevent lubrication from falling to the floor or lifted load. Any portion of this section may be used to support the request of the Activity.

****

a. The crane must be designed to preclude leakage of lubricants onto the lifted loads or the floor. Equipment or components, which cannot be made leak-proof, must be fitted with unpainted corrosion resistant steel drip pans or must have the foundations seal welded to create a dam. Drip pans that utilize liquid sealant to prevent leakage of lubricants are not permitted.

b. The drip pans must be sized to hold the entire gear case fluid capacity, installed under all drive machinery, designed to permit easy removal of collected lubricant. A trolley floor designed to contain any lubricant drips may be used as fluid containment for any equipment that is mounted on it.

c. Provide drip pans fitted around the shank of the hook and extending outward to encompass all possible points of lubrication drips from the load block or wire rope and must be easily removable without disassembly of the hook or load block and shall not interfere with the crane structure during testing of the upper limits.

]2.4 ELECTRICAL REQUIREMENTS

a. The design, selection, rating, and installation of the electrical portions of the crane and its accessories must conform to the requirements of NEMA ICS 3, NEMA ICS 8, the applicable ASME HST standard, and NFPA 70, and other requirements specified herein.

b. All electrical components must be industrial grade, commercially available and comply with established national or internationally recognized approving organizations such as Underwriters Laboratories (UL) and Canadian Standards Association (CSA). All electrical components installed or operated in hazardous areas including but not limited to enclosures, junction boxes, disconnects, and electrification must be designed and rated for the NFPA 70 Hazardous

Classifications specified in Classification section.

c. All electrical components must be located so they are easily accessible for inspection and maintenance without removing other parts, doors, or door center posts. Each motion of the crane must be provided with a separate and independent variable frequency drive unit. The loss of any one function must not prevent the operation of other unaffected functions. Two independent relays, contactors, drive inputs, or other equivalent components/logic must be utilized for each function to provide directional control such that the failure of a single relay/contactor/component cannot result in motion in an unintended direction.

d. Disconnecting means for cranes must be in accordance with NFPA 70 Article 610.32. A permanent placard must be installed on the face of the main line disconnect that states "WARNING – THIS DOES NOT ISOLATE POWER TO LIGHTING, RECEPTACLES, AND ANCILLARY EQUIPMENT". Additionally, a lighting (ancillary equipment) disconnect must be provided, with lockout feature, as the isolation means for the lighting transformer and lighting circuit breaker panel, which must power the crane's ancillary equipment. It must feed 480 VAC to the primary side of the transformer directly from the runway conductors via tapping the line side of the main power disconnect. Provide individual disconnects, with lockout feature, capable of being locked in the open position for bridge lights and receptacles.

e. Unless otherwise specified, interconnecting wiring must be of copper stranded construction complying with Table 310.104(A) of NFPA 70. Interconnecting wiring containing asbestos in the insulation or outer covering are prohibited. Aluminum conductors shall not be used. Aluminum connectors are allowed if they are rated for use with copper conductors (marked "AL/CU"). All conductors connected to or routed above resistors must have insulation shown in NFPA 70 Table 610.14(a) for 125 degrees C 257 degrees F. Motor branch circuit conductors must be sized as to have an ampacity not less than 150 percent of the motor full load current rating and to be no smaller than 12 AWG. Conductors must be selected and de-rated based on maximum ambient temperature. Continuous loads such as utility, heating, lighting, and air conditioning must be multiplied by 2.25 to determine ampacity in order to permit application of NFPA 70 610.14 (A) for crane supply conductors. Wire-nuts are not permitted on splices. However, connections for lighting ballasts may be made using wire-nuts (if applicable).

f. Excluding conduit directly connected to dynamic breaking resistors, raceways must maintain a 12-inch clearance between the raceway and dynamic braking resistors. A separate grounding wire, sized in accordance with Section 250.122 of NFPA 70, must be routed with all ungrounded conductors. Only one equipment grounding conductor must be run in each conduit and be the largest size required for any circuit routed in that conduit. All wiring must be numbered or tagged at all connection points. Power conductors which are shielded such that their wire size cannot be easily determined must be labeled as to the conductor size. All unused conduit openings must be plugged.

g. When fiber optic cable is utilized, inspections and performance checks must be accomplished upon completion of on-site installation to ensure cable cleanliness and proper signal integrity. Testing and verification must be conducted by a knowledgeable fiber optics

technician using specialized, calibrated equipment. Cables must be tested for signal loss/attenuation. The fiber optic system must also be tested using an Optical Time Domain Reflectometer (OTDR). Final attenuation and OTDR readings from each fiber optic cable run, including spares, must be documented as a baseline for future reference. All spare fiber optic cables must have protective covers over their ends to maintain cleanliness while not in use. When fiber optic cable is utilized the drive OEM's recommendations for encoders and optical to digital converters must be followed. All system components utilized for this purpose must have known compatibility prior to integration.

h. Power cables and low voltage signal cables may not be mixed in the same conduit.

i. The crane manufacturer must furnish and install all electrical equipment on the crane conforming to NEMA ICS 6, including motors, conforming to NEMA MG 1, electrically released brakes, switches, crane controllers, panels, operating station, wiring system, cables, and crane electrification.

2.4.1 Motors

****

NOTE: Inverter duty motors are required for open loop variable frequency drives (VFD). Vector duty motors are required for closed loop variable frequency drives (VFD).

U.S. Navy allows only 60-minute duty rating motors. 30-minute duty rating motors require Navy Crane Center approval. For non-Navy applications, the motor duty rating may be selected to match what is required by the class of HST-4 hoist (such as H1, H2, H3) specified.

****

Motors must meet all applicable requirements of NEMA MG 1 and UL 1004-1. All motors must have a minimum of a 60 [30] [60] [_____] minute duty rating and be Totally Enclosed Non Ventilated (TENV), Totally Enclosed Fan Cooled (TEFC), or Totally Enclosed Blower Cooled (TEBC).[Provide inverter duty motors for Open Loop Variable Frequency Drives (VFD).][Provide vector duty motors for Closed Loop VFDs.][Provide [two] [single] speed AC squirrel cage induction type motors for the bridge and trolley drives.][Provide two speed, AC squirrel cage induction type motor for the hoist.] Provide motors with a minimum of Class F insulation. Provide motor overload protection utilizing a thermal sensitive device embedded in its windings.

2.4.2 Controls

****

NOTE: Use the first three paragraphs to select electronic variable frequency drive controls for either the hoist, bridge or trolley. With VFD controls the hoist can be configured as open loop or closed loop (flux vector). Open loop is more cost effective and requires a mechanical load brake while closed loop control offers better load control and

requires hoist motors with encoders for position feedback. Ensure the Hoist Brakes section of this specification reflect the type of controls chosen. Use the fourth, fifth, and sixth paragraphs to select one or two speed control for the hoist, bridge, or trolley. Selections can be made using a combination of electronic controls and one or two speed motor controls for the various functions.

When the two-speed bridge and trolley motor is specified, the slow speed will be 1/3 to 1/4 of rated travel speed. Reduced voltage starting, acceleration, and deceleration, serve to reduce the acceleration rate that is normal for squirrel-cage motors. Squirrel-cage motors with two-speed magnetic controls provide satisfactory results with slow bridge and trolley speeds, and should be specified when short travel distances are involved and where fine positioning is not required.

For faster bridge and trolley speeds or finer positioning requirements, specify electronic controls.

Various VFD manufacturers offer an option to overspeed the hoist to a value over 60Hz (usually 120Hz). This allows the operator to position the hoist at faster speeds when it is not loaded. When selecting this feature list the maximum no load speed in paragraph RATED CAPACITY AND SPEEDS.

NAVY requires hoist drives with a controller continuous rating of 125 percent of the motor full load current. Tailor to NAVFAC. All other groups may use 100 percent.

****

a. Provide static reversing, variable frequency drives (VFD) for the [bridge,] [trolley][and][hoist] electric controls.[Provide static reversing, VFD, speed regulated, closed loop, flux vector electric controls for the hoist[s]. For feedback, provide hoist motors with encoders. The hoist controller must enable the drive motor to develop full torque continuously at zero speed. The hoist secondary brake shall be controlled separate from the primary and connected to different output (within the drive) from the primary brake.]VFD controllers must meet NEMA ICS 8, Part 8 and at a minimum, provide under-voltage protection, electronic instantaneous over current protection, DC bus over voltage protection, and be able to withstand output line to line shorts without component failure. Select bridge and trolley drives such that the continuous rating of the controller is not less than the motor full load current. Select hoist drives such that the continuous rating of the controller is not less than 125 percent 100 percent of the motor full load current. All hoist drives must have a motor over-torque limit to lock out the hoist and prevent gross overload of the associated hoist. Provide dynamic braking for each electric drive that is sized per VFD manufacturer's requirements. Submit VFD Control Parameter Settings.

b. Provide speed control which is infinitely variable for each function,

controlled via [radio control system][and][pendant pushbutton station].[Provide controls designed such that the maximum speed of each function will be limited to 25 percent of rated speed when a slow speed switch is actuated on the controller[s].[Energize a yellow/amber light/indicator while in slow speed mode.]]

c. The [hoist][,] [trolley][,] and [bridge] brakes must set after the associated controller decelerates the drive motor to a controlled stop. The hoist, trolley, and bridge, controllers must be sized to provide sufficient starting torque to initiate motion of that crane drive mechanism from standstill with 0 to 125 percent of rated load on the hook. The hoist controller must prove torque before release of the brakes and enable the drive motor to develop full torque continuously at zero speed. Motors must operate smoothly at all speeds without torque pulsations and must only be energized within the frequency range of 50-60 Hz at rated speed.[The hoist control system may utilize overspeed up to 120hz, unloaded only, if the drivetrain equipment has all been balanced and is rated for the resulting speed.]

d. The use of definite purpose contactors is prohibited. If IEC contactors are used, the application cannot exceed the contactor manufacturer's AC3 ratings for the contactor at a minimum.

e. On hoist function roll-up must be less than 3 mm 1/8 inch measured at the hook block and roll-back must not occur over the entire load range.

f. Use of Uninterruptible Power Supplies (UPS) is prohibited. 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.

g. Provide a main line contactor. Energization of the main line contactor must be controlled by the POWER-OFF/POWER-ON switch/pushbutton on all controllers. Upon actuation of the POWER-OFF pushbutton; power to all drive motors, brakes, and controls must be removed. The mainline contactor must not be able to be energize while the POWER-OFF pushbutton is actuated. The POWER-OFF pushbutton circuitry must be independent of all controls or any other electronic devices.

2.4.3 Protection

Protection must not be less than that required by NEMA ICS 3, NEMA ICS 8, CMAA 74, NFPA 70, UL 1004-1, UL 943, 29 CFR 1910.147, 29 CFR 1910.179, 29 CFR 1910.306 and all applicable provisions of 29 CFR 1910. All protection must be by circuit breakers or fuses. Motor branch circuits must be individually protected by inverse time circuit breakers capable of being locked in the open position. The means for locking must remain in place with or without the lock installed. Motor full load current from NFPA 70 Article 430, Part XIV (Tables) must be used to calculate the circuit breaker size.

Provide disconnecting means on the crane in accordance with NFPA 70 Article 610.32. Provide an On/Off button that removes power from the motors, brakes and control circuit on all operator control station. Provide for lockout/tagout of all hazardous energy sources. Provide product data for all circuit breakers and fuses.

2.4.3.1 Conductors

a. The crane contractor shall be responsible to ensure that all conductors from the load side of the existing floor level disconnect to the motor branch circuits have adequate overcurrent protection complying with one of the following:

(1) Not be greater than the largest rating or setting of any branch circuit protective device plus the sum of the nameplate rating of all other loads per NFPA 70 Article 610.41(A).

(2) Not be greater than the ampacity of all feeder conductors after all ampacity correction factors have been applied.

b. Conductors for brake coils must be protected by fuses or other protective devices. The device must be chosen to protect the brake circuit conductors from ground faults or short circuits.

2.4.4 Resistors

Provide resistors with natural convection cooling sized as recommended by the VFD OEM 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.

[2.4.5 Transients and Harmonics Protection

****
NOTE: The following items are required only for VFD Controls.
****

Provide contactors and relays with appropriate Metal Oxide Varistors (MOV) or resistor-capacitor (R-C) surge absorbers installed across the respective coil.

Provide transient protection for electronic drive controllers that is either internal to the drive or via an MOV connected line-to-ground close to the line terminals of the drive.

Provide line reactors rated for continuous duty operation based upon the motor nameplate amperes. With motors of 50 horsepower or greater, harmonics protection must be provided by an isolations transformer or as recommended by the VFD OEM. For a drive motor branch circuit that exceeds 150 feet in length, a reactor must also be connected in series with the controller load (output) terminals to provide standing wave protection or as otherwise recommended by the VFD or motor OEM.

]2.4.6 Limit Switches

a. Limit switches must be rated for the NFPA 70 Hazardous Classifications specified in the Classification section of this specification.

b. Provide primary upper and lower geared limit switches. Geared limits must allow reversing direction to back out of the limit without resetting. The lower limit switch must be set such that there are a minimum of two wraps of rope on the hoist drum.

c. Provide a backup mechanical hook block activated upper limit switch wired independent of the directional controllers and the primary upper limit switch that removes power from the hoist motor, hoist brake and hoist controls conforming to NEMA ICS 5. The backup limit must require hoist resetting prior to operation of the hoist in any direction.

[d. Travel limit switches must be provided for the [bridge][and][trolley] motion to slow the crane to [25 percent] [_____] of its rated speed [[10] [_____] feet before the bridge end stops][and][[5] [_____] feet from the trolley end stops]. Limit switches must be mounted rigidly in a manner so as to protect the switch from misalignment or damage. The target/trip arm must be large enough to provide interception given a misalignment were to occur.

]2.4.7 Operator Controls

****

NOTE: Available operator controls are pendant, and radio control. Cranes can also be set-up to be controlled by two separate systems. For cranes with one set of controls use paragraph 1. For cranes with two sets of controls use paragraph 2. In such a case some type of interlock must exist to prevent control from both systems simultaneously.

The pendant can be suspended from the trolley or an independent festooned messenger track system. The festooned system allows the operator to have maximum separation from the load. When this is a requirement include section Pendant Conductor System section of this specification.

When specifying a radio control system, the following requirements must be considered and if needed added to the specification. None are hard requirements of NAVCRANECENINST 11450.2:

1. What type of batteries? Rechargeable?
2. Are spare batteries needed? How many?
3. Are spare remote control units required? How many?
4. Is a battery charger required?
5. Type of transmitter unit.
6. Is a belt/harness required for the remote control?

****

[Provide crane equipped with a [pendant pushbutton station][radio control system].

][Provide crane equipped with both a pendant pushbutton station and a radio control system. Provide a selector switch to allow the use of only one of the two available control stations on the pendant controller.

] If VFD controls are not provided, provide directional contactors with both mechanical and electrical interlocks.

Operator controls must be rated for the NFPA 70 Hazardous Classifications specified in the CLASSIFICATION section of this specification.

[2.4.7.1 Pendant Pushbutton Station

The cranes must be controlled from a pendant pushbutton station suspended from [the trolley] [an independent festooned messenger track system, operating the length of the bridge]. Provide multiconductor flexible cords for pendant pushbutton stations with #16 AWG minimum conductors. Provide a method of strain relief to protect the electrical conductors from damage. Locate the pendant pushbutton station [1200 mm 4 feet] [_____] above the finished floor. Pushbutton pendant station must have its elements legibly marked and arranged vertically, in order, in accordance with CMAA 74.[Provide [one speed] [two speed] [3-step infinitely variable] [2-step infinitely variable] pendant pushbuttons for control of the [hoist] [bridge][and][trolley].] Provide pendant pushbuttons for control that spring return to the OFF position. Voltage in the pendant pushbutton station must not exceed 150 Volts AC or 300 Volts DC.[Provide a maintained two-position selector switch for slow speed selection.] The pendant must be rated for the NFPA 70 Hazardous Classifications specified in the Crane Design Criteria "Classification" Section.

[2.4.7.1.1 Pendant Conductor System

Provide a festoon type pendant conductor system. The festoon cables must be flat cables suspended from carriers riding on an I-beam or C-track. The pendant controller must be capable of traveling the entire length of the bridge and move independently of the trolley. Festoon loops must not extend below the high hook position.

][2.4.7.1.2 Radio Control System

Provide each system with a [belly box] [handheld] [_____] type portable transmitter unit[and an identical back-up transmitter unit].[Provide each transmitter with an adjustable belt or harness to support it when worn by the operator.] Only one transmitter at a time can control the crane and there must be no interference from one crane's controller affecting operation of the other cranes in the building. Each transmitter must include: individual [infinitely variable spring return joystick motion control levers] [push button controls] for each hoist, trolley, and bridge; a maintained contact, keyed switch, marked ON-OFF, for portable transmitter unit power; indication of Battery Power, and indication of Transmitting Status; a red emergency STOP mushroom pushbutton;[and]a floodlight on/off pushbutton[and a maintained slow speed selector switch]. The transmitters and all controls must each be clearly and permanently labeled with functionality and direction. Directions for controllers must be in accordance with CMAA 74 recommendations. The remote radio control system must be designed to meet the requirements of NEMA ICS 8, Part 9 and ECMA 15. Each radio remote control lever must be in the OFF position before the associated crane function can begin. The system frequency must be within the unlicensed FCC Part 15 range. Each control unit must maintain a continuous status signal to the associated receiver during operation. There must be no significant loss in systems efficiency and function at the end of eight hours of continuous battery use.

]]2.4.8 Electrification Systems

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NOTE: Various methods may be used to transfer power from the runway to the crane (Runway Conductor System) and then again to the trolley (Bridge Conductor system). Typically, the Runway Conductor System is a set of conductor bars on the runway and collector shoes on the crane. The Bridge Conductor system is typically a set of festoon cables.

Site conditions and environment might require the design to deviate from the norm. Hazardous locations will need to be designed with either a cable reel or festoon system.

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2.4.8.1 Runway Conductor System

[Provide a rigid runway Conductor Bar System for the runway conductor system, including all necessary cables and hardware to the crane from a wall or column mounted disconnect switch. Provide electrification system with three power conductors and an equipment grounding conductor. The crane must be grounded through the runway electrification system. Provide runway conductors sized for simultaneous motions of the hoist, bridge, trolley mechanisms and any ancillary loads. If there is any way the hook block or wire rope can swing into the runway electrification, provide a guard installed to prevent contact.

Provide two Collector Shoes (tandem design) for each conductor; each collector shoe must be rated for not less than the runway conductor sizing, so as to provide redundancy.

][Provide a Festoon System for the runway conductor system utilizing cables suspended from carriers riding on an I-beam or C-track for the crane, including all necessary cables and hardware to the crane from a wall or column mounted disconnect switch. Provide electrification system with three power conductors and an equipment grounding conductor. Conductors must be fabricated from copper. The crane is required to be grounded through this conductor system. Provide conductors sized for simultaneous motions of the hoist, bridge, trolley mechanisms and any ancillary loads. Festooned cable loops must not extend low enough to come into contact with any obstructions.

][Provide a Cable Reel System for the runway conductor system, including all necessary cables and hardware to connect the cable reel to the floor level fused disconnect switch. The cable reel must have three power conductors and an equipment grounding conductor. The crane is required to be grounded through this conductor system. Conductors must be fabricated from copper, and sized for simultaneous motions of the hoist, bridge, trolley mechanisms and any ancillary loads.

][Provide a totally enclosed flexible cable tray electrification system (cable chain) for the runway conductor system, including all necessary cables and hardware to the crane from a wall or column mounted disconnect switch. The cable chain must have three power conductors and an equipment grounding conductor. The conductors must be selected so as to be of the longest length without splices. Conductors must be fabricated from copper, and sized for simultaneous motions of the hoist, bridge, trolley

mechanisms and any ancillary loads. The crane is required to be grounded through this conductor system.

]2.4.8.2 Bridge Conductor System

[Provide Festoon System for the bridge conductor system utilizing cables suspended from carriers riding on an I-beam or C-track. Conductors must be fabricated from copper. A minimum of 20 percent of the festoon control circuit conductors for each electrification system must be spares at the time of crane acceptance. The trolley is required to be grounded through this conductor system. Festooned cable loops must not extend low enough to come into contact with any obstructions.

][Provide a Cable Reel System for the bridge conductor system. The cable reel must have an equipment grounding conductor, and all necessary control cables. A minimum of 20 percent of the festoon control circuit conductors for each electrification system must be spares at the time of crane acceptance. The trolley must be grounded through the cable reel connection and all conductors must be of copper construction.

][Provide a totally enclosed flexible cable tray electrification system (cable chain) for the bridge conductor system. The cable chain must have three power conductors, an equipment grounding conductor, and all necessary control cables. The conductors must be selected so as to be of the longest length without splices and must be copper. A minimum of 20 percent of the control circuit conductors in the flexible cable tray system must be spares at the time of crane acceptance. The trolley is required to be grounded through this conductor system.

]2.4.9 Overload Protection[and Load Indicating Device]

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NOTE: Overload protection on a crane is required and is provided by two types of systems: Capacity Overload Protection and Over-Torque Limit.

The Over-Torque Limit only applies to cranes with VFD controls. It is a parameter setting in the drive and is typically set at 150 percent.

Capacity Overload Protection is usually adjustable. If adjustable, it needs to be set at less than the crane's minimum test load. This protection can take the form of one of the following devices:

1. Clutch – Not adjustable and is common on package hoists.
2. Load Limit Switch – Installed on the wire rope and measures deflection. Does not require a break in the wire rope and is simply clamped onto the wire. Typically used on smaller hoists that have magnetic controls. Can also be installed as part of the equalizer sheave.
3. VFD Drive Overload Protection – Similar to the Over-Torque Limit, but is set at a lower setting. Adjusted via parameters within the drive.
4. Separate Load Indicating Device – This involves the installation of a load cell and a digital readout that displays weight. The load cell is

usually bolted onto the end of the wire rope or is installed as a pin in one of the sheaves.
****

a. Provide a capacity overload protective device for all hoist systems[using VFD drive capacity overload protection (separate from torque limiting feature of the VFD)][using the load indicating device (LID) described in the next paragraph]. Set hoist capacity overload protection at [_____]. Hoist capacity overload protection must be adjustable between 80 and 150 percent of hoist capacity. Provide a keyed override or other means to disable the hoist capacity overload protection when performing a load test. If a non-adjustable slip clutch is utilized, the OEM factory setting is acceptable and must be identified.

[b. Provide an LID for the [main][and][auxiliary] hoist[s].[Provide [a display] [displays] installed on the underside of the bridge of each crane to provide load information from the load indicating system, to be displayed in kilograms pounds, for [both]the [main][and][auxiliary] hoist[s].][Provide [a display][displays] installed in the cab of each crane to provide alarm circuits and continual load readout information from the load indicating system, to be displayed in kilograms pounds, for [both]the [main][and][auxiliary] hoist[s].] The display[s] must be large enough so that the operator can read the load value[s] [from the ground level][and][while seated in the operator's cab]. The load indicating system capacity is to be compatible with the maximum test load for each hoist. The accuracy of the load indicating system is to be such that the indicated load is not less than 100 percent of the actual load, and not more than 110 percent of the actual load. The load indicating system must be configured with a set point for an overload limit. Provide Tare (zero) functionality at each operator's station for [the] [each] load indicating system. Any load bearing components used in the LID system must be steel, have a minimum design factor of 5 to 1 based on ultimate tensile strength and a hardness not to exceed HRC 40. Precipitation hardened stainless steel load bearing elements must be aged hardened at a minimum temperature of 1025 degrees F.

][c Initially, set the torque limiting capability of the VFD (that is separate from the capacity overload protective device) to 150 percent of the motor torque (amperage) necessary to hoist 100 percent load. It may be adjusted up only to avoid nuisance trips and adjusted down if possible while still avoiding nuisance trips.

]2.4.10 Enclosures

****
NOTE: Select classification of control panels, controls, and brakes based on the environmental conditions in which the crane will be installed:

1. Choose one of the following for an indoor installation: 1, 2, or 12.
2. Choose one of the following for an outdoor installation: 3, 4X, or 8.
3. Choose one of the following for a Class I Hazardous installation: 7 (indoor) or 8 (indoor/outdoor).
4. Choose one of the following for a Class II

Hazardous installation: 9 (indoor).

Other enclosure types exist that might be a better alternative for a particular installation. If necessary, refer to NEMA 250.

****

a. Provide enclosures for control panels, controls, and brakes in accordance with NEMA 250 and NEMA ICS 6, Classification Type [1 indoor, general purpose] [12 indoor without knockouts, general purpose] [2 indoor, drip-proof] [3 outdoor, dust-tight, rain-tight, sleet-resistant] [4X outdoor] [_____] [7 indoor Class I hazardous] [9 indoor Class II hazardous] [8 indoor/outdoor Class I hazardous], or all controls must be intrinsically safe as defined by NFPA 70 Article 504.

[b. Provide a non-resettable hour meter, connected across the main line contactor, readable from the exterior of the main control panel, to indicate the elapsed number of hours the crane is energized.

] c. Gaskets of enclosures and fixtures, and joints and contact surfaces of hazardous/explosive enclosures must be kept free of any paint to prevent damage during removal and reinstallation of gaskets of enclosures.

2.4.11 Warning Devices

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NOTE: A warning horn or light is required for all radio controlled cranes and recommended for all others.

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[Provide a warning horn that is operable from a push button at the[pendant pushbutton][radio control] station.] [Provide a warning[strobe][rotating beacon] that is illuminated at all times during movement of the hoist, trolley, or bridge function.]

[2.4.12 Floodlights

Provide evenly spaced floodlights along the bridge. Select floodlights to provide an illumination level of 40 foot-candles at three feet above the finished floor. All lights must be vibration resistant and designed to prevent any material from falling from the fixture. Switch the floodlights from the [pendant pushbutton][radio controlled]station.

][2.4.13 Pilot Devices

Provide Indicator Lights mounted in an enclosure on the bottom of the bridge with lights sized and positioned to be visible from the ground. The lights must be the dual-lamp type. Provide a white light to indicate that power is available to the crane and a blue light to indicate that the main contactor is energized. Light voltage must be 115 VAC. Provide nameplates that are legible from ground level. The nameplates must read, in their respective order, "POWER AVAILABLE" and "CRANE ENERGIZED". The POWER AVAILABLE light must be supplied by a separate, fused transformer for its energization.

][2.4.14 Electrical Outlets

Provide a minimum of [one] [_____] 120 VAC duplex outlet[s] on the crane, mounted [on] [in] the [outside of the control panel(s)] [trolley] [cab] [_____]. The circuit(s) supplying receptacles must incorporate ground-fault circuit-interrupter protection for personnel and be protected by a circuit breaker with a minimum rating of [15] [20] amps.

]2.4.15 Cyber Security of Control Systems

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NOTE: Tailor Cyber Security of Control Systems requirements to NAVFAC.
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****
NOTE: SECNAVINST 5400.15 designates NAVFAC as the functional technical authority for WHE. NAVFAC is designated as Functional Security Control Assessor (FSCA) and the Functional Authorizing Official (FAO) for Ashore Control Systems in their domain; therefore, this includes WHE control systems. WHE control system owners are responsible for the Information System Security Engineer (ISSE) functions and producing artifacts (documentation) for review by the FSCA and FAO.

All new and electrically overhauled cranes shall implement the following cybersecurity requirements as applicable to the control system architecture (i.e., networked drives, non-networked drives, and any wireless applications) so that supporting artifacts and considerations are available for the implementation of the RMF process.
****

a. Provide the following for PLC, RTU, Supervisory Controller, or other network-capable (whether networked or not upon delivery) control devices as applicable:

(1) Hardware list (Hardware list must include the following for each device):

(a) Manufacturer

(b) Model

(c) Location

(d) Key technical ratings (e.g. memory)

(e) Serial number

(f) MAC addresses

(g) IP addresses

(2) Software List (Software list must include the following for each device):

(a) Manufacturer

(b) Version/subversion

(c) Location/device

(d) Used network ports/protocols/services

(3) List and discussion of all security features of Contractor hardware and software.

b. For every PLC, RTU, Supervisory Controller, or other network-capable control devices (whether networked or not upon delivery), deliver the following on CD/DVD:

(1) Original firmware

(2) Original firmware hash

(3) SOP for application of firmware updates/patches

(4) POC or website for firmware updates/patches

(5) Count of interfaces and types

(6) Protocols in use, per interface

(7) Configuration file

(8) SOP for configuration

2.4.15.1 Control System and Network

****
NOTE: Select options a. & b. if a standalone laptop is required.
****

[a. Provide a rugged laptop type workstation (computer) complete with all compatible software (including software licenses), redundant physical back-up copies on CD/DVD of the installed software, and all necessary cables and special connectors to allow crane software to be troubleshot, checked and upgraded, and for the data recorder to be accessed and information retrieved. Equip the workstation with a CD/DVD drive and the associated CD/DVD burning software. The workstation must also be equipped with USB ports (2.0 and 3.0), an Ethernet port, and a serial port. Delivering the software on a USB (flash drive) device is prohibited.

b. The laptops must be designed for an industrial environment and must be shock resistant and weatherproof as a minimum. Provide the laptop with a built-in CD/DVD reader with the capability to burn CDs and DVDs including associated software to burn CDs and DVDs.

] c. The Contractor must provide all equipment, including software and hardware, necessary for testing, installation, and communicating/troubleshooting all systems provided with the crane (e.g. engine/generator, control system, LID, etc.). The Contractor

must provide all crane specific operational software files (e.g. ladder logic, functional block programming, etc.) for their associated systems (e.g. control systems, LID, engine generator, etc.).

d. A single common networked design must not be used for the control systems. A network for an individual function may be used as long as a failure of the network does not affect any other function/network except as defined for specific safety interlocks (e.g. LMI system). A common crane network may be used in a monitoring mode for recording faults and trending and is encouraged. Failure of the monitoring system must not affect crane functions.

e. All provided hardware and software must be currently marketed products, not currently scheduled for end of life or obsolescence, to ensure system sustainability.

f. Ensure there is no remote access capability enabled as remote access capabilities are prohibited. Physically disable or remove all modem/network devices not required for operational purposes.

2.4.15.2 Software and Services

a. Remove all Software and Services not required for operation and/or maintenance of the product. If removal is not technically feasible, then disable software not required for the operation and/or maintenance of the product. Configure the product to allow the ability to re-enable ports and/or services if they are disabled by software. The removal of software or services may not impede the primary function of the product. If software that is not required cannot be removed or disabled, document a specific explanation, and provide risk mitigating recommendations and/or specific technical justification. The software/service to be removed and/or disabled includes, but is not limited to:

(1) Cameras

(2) Games

(3) Device drivers for product components not procured/delivered

(4) Messaging services (e.g., email, instant messenger, peer-to-peer file sharing)

(5) Source code

(6) Software compilers in user workstations and servers

(7) Software compilers for programming languages that are not used in the control system

(8) Unused networking and communications protocols

(9) Unused administrative utilities, diagnostics, network management, and system management functions

(10) Backups of files, databases, and programs used only during system development

(11) All unused data and configuration files

(12) Remove and/or disable, through software, physical disconnection, or engineered barriers, all services and/or ports in the procured product not required for normal operation, emergency operations, or troubleshooting. This includes communication ports and physical input/output ports (e.g., USB docking ports, video ports, and serial ports).

b. Provide documentation showing all disabled ports, connectors, and interfaces for all network-capable devices. In addition, the documentation shall provide summary documentation of the procured product's security features and security-focused instructions on product maintenance, support, and reconfiguration of default settings.

c. For the evaluation status of hardware and software, the Contractor must provide information on Common Criteria or National Information Assurance Partnership (NIAP) or Federal Information Processing Standards (FIPS) evaluation status of hardware and software.

2.4.15.3 Access Control

a. The Contractor must configure each component of the procured product to operate using the principle of least privilege. This includes operating system permissions, file access, user accounts, application-to-application communications, and energy delivery system services.

b. Provide user accounts with configurable access and permissions associated with one or more organizationally defined user role(s), where roles are used.

c. Provide a system administration mechanism for changing user(s') role (e.g., group) associations.

d. The Contractor must document control system access control options by defining access and security permissions, user accounts, and applications with associated roles.

e. Provide recommended methods for the Acquirer to prevent unauthorized changes to the Basic Input/Output System (BIOS) and other firmware. If it is not technically feasible to protect the BIOS to reduce the risk of unauthorized changes, the Contractor must document this case and provide mitigation recommendations.

2.4.15.4 Control System Account Management

The Contractor must document all accounts (including, but not limited to, generic and/or default) that need to be active for proper operation of the procured product.

Remove or disable any accounts that are not needed for normal or maintenance operations, emergency, or troubleshooting of the energy delivery system.

2.4.15.5 Session Management

The Contractor may not allow multiple concurrent logins using the same authentication credentials, allow applications to retain login information between sessions, provide any auto-fill functionality during login, or

allow anonymous logins.

Provide account-based and group-based configurable session-based logout and timeout settings (e.g., alarms and human-machine interfaces).

2.4.15.6 Authentication/Password Policy and Management

Provide a configurable account password management system that allows for, but is not limited to, the following:

a. Changes to passwords (including default passwords)

b. Selection of password length

c. Frequency of change

d. Setting of required password complexity

e. Number of login attempts prior to lockout

f. Inactive session logout

g. Screen lock by application

h. Comparison to a library of forbidden strings

i. Derivative use of the user name

j. Denial of repeated or recycled use of the same password

The Contractor must time stamp log files.

2.4.15.7 Logging and Auditing

Provide logging capabilities that cover the following events, at a minimum (as appropriate to their function):

a. Information requests and server responses

b. Successful and unsuccessful authentication and access attempts

c. Account changes

d. Privileged use

e. Application start-up and shutdown

f. Application failures

g. Major application configuration changes

2.4.15.8 Heartbeat Signals

The Contractor must identify heartbeat signals or protocols and recommend which should be included in network monitoring. At a minimum, a last gasp report from a dying component or equivalent shall be included in network monitoring.

The Supplier must provide packet definitions of the heartbeat signals and

examples of the heartbeat traffic if the signals are included in network monitoring.

2.4.15.9 Patch Management and Updates

The Contractor must verify that procured products (including third-party hardware, software, firmware, and services) have appropriate updates and patches installed prior to delivery.

Provide documentation of the patch management program and update process (including third-party hardware, software, and firmware). This documentation must include resources and technical capabilities to sustain this program and process. Provide the Contractor's method or a recommendation for how the integrity of the patch is validated by the Acquirer as well as the Supplier's approach and capability to remediate newly reported zero-day vulnerabilities.

2.4.15.10 Malware Detection and Protection

a. The Contractor is required to implement at least one of the following:

(1) Provide a host-based malware detection capability that quarantines (instead of automatically deleting) suspected infected files. Provide an updating scheme for malware signatures. The Contractor must test and confirm compatibility of malware detection application patches and upgrades.

(2) If the Contractor is not providing the host-based malware detection capability, the Contractor must suggest malware detection products to be used and provide guidance on malware detection and configuration settings that will work with Contractor products.

b. The Contractor must validate that cybersecurity services running on the procured product (e.g., virus checking and malware detection) do not conflict with other such services running on the procured product.

c. For malware detection and protection, the Contractor must provide, or specify how to implement, the capability to automatically scan any removable media that is introduced to the product being acquired.

2.4.15.11 Physical Security

Provide lockable or locking enclosures or rooms for energy delivery systems and system components (e.g., servers, clients, and networking hardware) and for the systems used to manage and control physical access (e.g., servers, lock controllers, and alarm control panels). Provide a method for tamper detection on lockable or locking enclosures. If a physical security and monitoring system is used, tamper detection must be compatible. The Contractor must ensure that physical security features do not hamper the crane system operations. Provide the tools and instructions for making changes to locks, locking codes, keycards, and any other keyed entrances.

2.4.15.12 Wireless Technology

For wireless technology provisions, the Contractor must document:

a. Specific protocols and other detailed information required for

wireless devices to communicate with the control network, including other wireless equipment that can communicate with the Contractor-supplied devices.

b. Use, capabilities, and limits for the wireless devices.

c. Power and frequency requirements of the wireless devices (e.g., microwave devices meet the frequency requirements of Generic Requirements [GR]-63 Network Equipment Building System [NEBS] and GR-1089).

d. Range of the wireless devices and verify that the range of communications is minimized to both meet the needs of the Acquirer's proposed deployment and reduce the possibility of signal interception from outside the designated security perimeter.

e. Wireless technology and associated devices compliance with standard operational and security requirements specified in applicable wireless standard(s) or specification(s) (e.g., applicable IEEE standards, such as 802.11).

f. Configuration control options that enable varying of the security level of the devices.

2.4.15.13 Control System Inventory

Provide the complete control system inventory. The Control System Inventory must include the following attributes, in tabular format, as applicable:

General Information	Location Information	Hardware Details	Operating System and Platform	Network Information (Actual Function, not potential function)
Unique ID	Facility Name	Device Type	Embedded OS (Yes/No)	MAC Address(es)
Barcode or Identifier	NFAID	Device Sub-Type	OS Contractor	IP Address(es)
Region	Commodity	Device Function	Operating System (O/S)	Upstream Device
Installation	Floor	Manufacturer	O/S Version	Protocols In Use
Special Area (Option DNA1)	Room	Product Line	Platform Contractor	Host Name
	Location	Model #	Platform Product Line	
	System Type	Serial #	Platform	

	Functional System or Equipment Control	Remote Connectivity: (Wired / Wireless / None)	Platform Version	
		Network Type Used: (Serial / Ethernet / Both / None)		

2.5 PAINTING SYSTEM

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NOTE: Three-coat zinc primer/epoxy/polyurethane system is provided for mild to severe atmospheric, indoor and outdoor cranes. For cranes in abnormal environments including exposure to chemicals or in immersion service, a system designed for that environment should be used. Other systems may suffice for milder environments.

****

a. Remove all grease, oil, and surface debris by solvent wiping or detergent/water scrubbing, prior to blast cleaning. Prepare surfaces to be coated by abrasive blasting to SSPC SP 6/NACE No.3, Commercial Blast Cleaning, or in accordance with the coating manufacturer's requirements, whichever is more stringent.

b. Use a painting system appropriate for the conditions provided in the Crane Design Criteria section of this specification. Paint exposed portions of the crane [and crane runway system] using a [three][_____]-coat system as follows: [zinc-rich primer consisting of a minimum of 77 percent zinc by weight in the dry film, an anticorrosive epoxy intermediate coat, and an aliphatic polyurethane top coat][_____]. All paint products must be supplied by a single manufacturer and free of chromates, lead, and mercury. Apply each coat in accordance with manufacturer's instructions and requirements. Ensure each coat is smooth, even, and free of runs, sags, orange peel, and other defects. Desired color of finish coat is [brilliant yellow][_____]. Submit product data for painting system.

c. Coat faying surfaces of bolted connections per RCSC S348, but do not apply finish paint.

d. Paint, coatings, or galvanizing on the following items or areas is not acceptable: hoist wire ropes, hooks, hook nuts, running bearing surfaces (including sheaves and wheel treads), grease fittings, or other items not normally painted.

e. Factory paint electrical and mechanical equipment in accordance with the manufacturer's best standard practice (for the specified environment).

2.6 IDENTIFICATION PLATES

Furnish and install identification plates. Provide non-corrosive metal

identification plates with clearly legible permanent lettering giving the manufacturer's name, model number, serial number, capacity in both kilogram and pound units printed in different colors, and other essential information or identification.

2.6.1 Markings on Crane, Trolley, and Hook

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NOTE: NAVFAC requires markings to be indicated in pounds.
****

To avoid operation of the crane in the wrong direction, affix the appropriate directions (NORTH, SOUTH, EAST, and WEST) with arrows on both sides of the bridge and both sides of trolley, as applicable. Markings must be visible by the operator and from the loading point. Labels on the controls must have corresponding directional (NORTH, SOUTH, EAST, and WEST) markings. Markings must agree with the markings on controller. Do not indicate directional arrows on controller.

2.7 ELECTRICAL ASSEMBLY

Installation of all electrical wiring, conduit, and components must be performed in accordance with the requirements of NFPA 70. As a minimum, items a. through g. below must be followed:

a. All electrical connections must be installed in accordance with NFPA 70 Articles 110.14 or 430.9, as applicable, or as recommended by the device manufacturer.

b. Crimped terminal lugs, if used, must be properly sized for the wire and installed using the device(s) – e.g., crimping tool and indenter – recommended by the terminal lug manufacturer.

c. All spare conductors must be identified as spare conductors, and must have their ends insulated to preclude accidental contact with energized equipment.

d. Bonding straps and equipment grounding conductors must be connected to engineered ground points, have all paint removed from their termination points, or have tooth lockwashers (star lockwashers) installed, to insure proper grounding of the equipment.

e. Rigid Polyvinyl Chloride conduit may be used to protect festoon cable from physical damage when the cable is run along the footwalk of the crane, provided that only sections of conduit are used.

f. Festoon cable must be installed with suitable strain relief and shall be protected from physical damage in accordance NFPA 70 Article 610.11(E)(1). This includes damage from chafing against the crane structure and any other type of damage that may be incurred.

g. Fiber optic cable must be installed in accordance with the manufacturer's installation guidelines. However, at a minimum the following guidelines must be adhered to: no sharp bends (bend radii must be greater than 1 inch or as prescribed by the manufacturer), avoid tight loops, no zip ties, and no stretching of cable.

PART 3 EXECUTION

3.1 EXAMINATION

After becoming familiar with all details of the work, and before performing any work, verify all dimensions in the field. The Contractor is responsible for the coordination and proper relation of the contracted work to the building structure and to the work of all trades. Verify all dimensions of the building that relate to fabrication of the crane and notify the Contracting Officer of any discrepancy before finalizing the crane order.

[3.2 SHOP ASSEMBLY AND TESTS

Shop assemble major components as completely as possible, except for reeving of drums and sheaves. Functionally test the crane system at the construction facility prior to shipment. The Government reserves the right to inspect the crane for compliance with this specification and to witness the functionality tests. Notify the Contracting Officer [14] [_____] days prior to starting testing operations.

]3.3 ERECTION AND INSTALLATION

Perform the entire crane system erection in accordance with manufacturer's instructions under the full-time supervision of the manufacturer's representative.

3.3.1 Mechanical Alignment

Align motors, couplings, brakes, gear boxes, and drive components in accordance with manufacturer's instructions. Complete the Coupling Alignment Verification Record.

3.3.2 Electrical Adjustments

Adjust control system in accordance with manufacturer's instructions. Store a copy of all Control Parameter Settings (PLC, VFD). Provide the final settings and configurations data on the Complete Schematic Wiring Diagram, including but not limited to, timer settings, resistor tap settings, potentiometer settings, test-point voltages, supply voltages, motor voltages, motor currents. Provide the test conditions such as ambient temperature, motor load, date performed and person performing the adjustments as part of the Operational Tests report.

3.3.3 Field Welding

Perform welding indoors, where possible. Surface of parts to be welded must be free from rust, scale, paint, grease, and other foreign matter. Minimum preheat and interpass temperatures must conform to the requirements of AWS D14.1/D14.1M.

3.3.4 Field Painting

Perform painting indoors, where possible. Field painting (including touch-up) must conform to the requirements of the coating manufacturer and as specified in paragraph PAINTING SYSTEM.

3.4 FIELD QUALITY CONTROL

3.4.1 Post-Erection Inspection

After erection, the Contractor[, the Activity Crane Inspector/Test Director,] and the Contracting Officer must jointly inspect the crane bridge and hoist systems and components to verify compliance with specifications and approved submittals. Notify the Contracting Officer [_____] days before the inspection. Provide for approval a report of the inspection indicating the crane is considered ready for operational tests.

3.4.2 Operational Tests

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NOTE: Determine if Government furnished certified test weights are available at the site. If not, they must be provided by the Contractor.

****

Check the clearance envelope of the entire crane prior to picking or traversing any load to ensure there are no obstructions. Test the systems 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. Rectify all deficiencies disclosed by testing and retest the system or component to prove the crane is operational.[The Contractor must furnish test weights, operating personnel, instruments, and other apparatus necessary to conduct field tests on each crane. Solid weights must be measured using calibrated equipment traceable to National Institute of Standards and Technology (NIST) with a minimum accuracy of plus or minus two percent.]

3.4.2.1 No-Load Test

Raise and lower each hook through the full range of normal travel at rated speed for three complete cycles. Raise and lower each hook, testing other speeds of the crane. Verify proper operation of hoist limit switches. Operate the bridge and trolley in each direction the full distance between end stops. Operate through the entire speed range and verify proper brake operation. Verify correct operation of all indication and ancillary devices.

3.4.3 Test Data

Record test data on appropriate test record forms suitable for retention for the life of the crane. Record operating and startup current measurements for hoist, trolley, and bridge motors using appropriate instrumentation (i.e., clamp-on ammeters). Compare recorded values with design specifications or manufacturer's recommended values; abnormal differences (i.e., greater than 10 percent from manufacturer's or design values) must be justified or appropriate adjustments performed. In addition, note, investigate, and correct any high temperatures or abnormal operation of any equipment or machinery. Record hoist, trolley, and bridge speeds during each test cycle.

3.4.4 Hook Tram Measurement

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 from the base measurement is cause for rejection.

3.4.5 Load Tests

****
NOTE: NAVFAC Tailoring – the NAVY requires a load test of 125 percent (plus 0 minus 5) of the rated load.
****

Perform the following tests, as specified below.

Test loads used in this section are defined as the following:

Wire rope run-in load: 25 - 50 percent of rated load.

Rated load test: [100 percent (plus 0 minus 10)] [100 percent (plus [_____] minus [_____])] of rated load.

Overload test: [125 percent (plus 0 minus 5)] [125 percent (plus [0] [_____] minus [5] [_____])] of rated load.

3.4.5.1 Wire Rope Run-In

The primary purpose of this procedure is to exercise the newly installed wire rope.

Place the load on the hook. Start at ground level and hoist up to one foot below upper limit at slow speed. Hoist down to lower limit at slow speed. Repeat hoisting and lowering of the load for approximately 10 hoisting cycles, increasing the speed for each cycle. During this test, the capacity overload lockout should not activate.

3.4.5.2 Rated Load Test

3.4.5.2.1 Hoist

a. Static Load Test: With the trolley in the center of the bridge span, raise the test load approximately 300 mm one foot. Hold the load for 10 minutes. Rotate the load and hook 360 degrees to check bearing operation with no binding. Observe lowering that may occur which indicates a weakness in the structure or malfunction of hoisting components or brakes. Verify that maximum beam and girder deflections do not exceed MHI MH27.1 design limits.

   For hoists with primary and secondary holding brakes, raise the test load and release the secondary holding brake while testing the primary holding brake. Hold for 10 minutes. Observe for lowering of the load, which may indicate malfunction of hoisting components or brakes. Re-engage secondary holding brake and release the primary holding brake. Hold for 10 minutes. Observe for lowering of the load, which may indicate malfunction of hoisting components or brakes. Re-engage the primary holding brake. Recheck proper operation of time delay and ensure smooth positive stopping.

b. Hoist Mechanical Load Brake (if present): Raise test load approximately 1500 mm 5 feet. With the hoist controller in the

neutral position, release (by hand) the holding brake. Document the method used to release the holding brake. The load brake must hold the test load. Again, with the holding brake in the released position start the test load down at slow speed and return the controller to the "off" position as the test load lowers. The load brake must stop and hold the test load.

c. Raise and lower test load through the full lift range and visually observe smooth control and acceleration between points. Completely stop the machinery at least once in each direction to ensure proper brake operation.

d. Hoist Loss of Power Test: 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.

3.4.5.2.2 Trolley

Operate the trolley (if space is available) the full distance of the bridge rails in each direction with a test load on the hook. Check proper functioning through the range of speeds. Verify proper brake action.

3.4.5.2.3 Bridge

With a test load on the hook, operate the bridge for the full length of the runway (if space is available) in one direction with the trolley at the far end of the bridge, and in the opposite direction with the trolley at the opposite end of the bridge. Use extreme caution. Check proper functioning through the range of speeds. Check for any binding of the bridge end trucks and verify proper brake action. Record deficiencies. Secure from testing if deficiencies are found.

3.4.5.2.4 Trolley Loss of Power Test

With a test load of 100 percent of rated load, raise the test load approximately midway between the trolley and any permanent obstruction on the operating floor. Starting at a safe distance from walls or other obstructions, attain a slow speed of trolley travel. While maintaining a safe distance from obstructions, disconnect the main power source at the wall mounted safety switch (disconnect) to simulate a power failure. Verify that the trolley stops and that the brake sets properly. Measure the distance required for the trolley to stop.

3.4.5.2.5 Bridge Loss of Power Test

With a test load of 100 percent of rated load, raise the test load approximately midway between the trolley and any permanent obstruction on the operating floor. Starting at a safe distance from walls or other obstructions, attain a slow speed of bridge travel. While maintaining a safe distance from obstructions, disconnect the main power source at the wall mounted safety switch (disconnect) to simulate a power failure. Verify that the bridge stops and that the brake sets properly. Measure the distance required for the bridge to stop.

3.4.5.3 Overload Test

3.4.5.3.1 Hoist

Disconnect or adjust the overload limit device to allow the hoist to lift the test load. Verify proper operation of the overload limit device after it is reconnected.

a. Static Load Test: With the trolley in the center of the bridge span, raise the test load approximately 300 mm one foot. Hold the load for 10 minutes. Rotate the load and hook 360 degrees to check bearing operation with no binding. Observe lowering that may occur which indicates a weakness in the structure or malfunction of hoisting components or brakes.

   For hoists with primary and secondary holding brakes, raise the test load and release the secondary holding brake while testing the primary holding brake. Hold for 10 minutes. Observe for lowering of the load, which may indicate malfunction of hoisting components or brakes. Re-engage secondary holding brake and release the primary holding brake. Hold for 10 minutes. Observe for lowering of the load, which may indicate malfunction of hoisting components or brakes. Re-engage the primary holding brake. Recheck proper operation of time delay and ensure smooth positive stopping.

b. Raise and lower test load and visually observe smooth control. Stop the load during raising and lowering to verify that the brakes holds the load.

   c. Hoist Mechanical Load Brake (if present): Raise test load approximately 1500 mm 5 feet. With the hoist controller in the neutral position, release (by hand) the holding brake. Document the method used to release the holding brake. The load brake must hold the test load. Again, with the holding brake in the released position start the test load down at slow speed and return the controller to the "off" position as the test load lowers. The load brake must stop and hold the test load.

d. Hoist Loss of Power Test: 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.

3.4.5.3.2 Trolley

Operate the trolley the full distance of the bridge rails in each direction with a test load on the hook (one cycle) through the range of speeds. Verify proper brake action.

3.4.5.3.3 Bridge

With a test load on the hook, operate the bridge for the full length of the runway in one direction with the trolley 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 through the range of speeds. Check for any binding of the bridge end trucks and verify proper brake action. Record deficiencies. Secure from testing if deficiencies are found.

3.5 MANUFACTURER'S FIELD SERVICE REPRESENTATIVE

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.

3.6 OPERATION AND MAINTENANCE MANUALS

Provide [two] [_____] hard copies of operation and [two] [_____] hard copies of maintenance manuals for the equipment furnished along with an electronic copy (PDF) of each on a Compact Disc. Provide one complete set prior to performance testing and final copies upon acceptance. Provide operation manuals that detail the step-by-step procedures required for system startup, operation, and shutdown. Include the manufacturer's name, model number, parts list, and brief description of all equipment and basic operating features. List in the maintenance manuals routine maintenance procedures, including weekly, monthly, semi-annual, and annual required maintenance items, possible breakdowns and repairs, and troubleshooting guides. Also include as-built drawings, piping and equipment layout, design calculations, Control Parameter Settings and printouts of any software, and simplified wiring and control diagrams of the system as installed. Secure approval of operation and maintenance manuals prior to the field training course.

[3.7 FIELD TRAINING

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NOTE: Training is recommended, but not required.

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Conduct a training course for [_____] operating and maintenance staff[and provide a copy of the training material to each participant]. Provide a training period consisting of a total of [_____] hours of normal working time and starting after the system is functionally completed but prior to final acceptance. Cover all pertinent points involved in operating, starting, stopping, and servicing the equipment, including all major elements of the Operation and Maintenance Manuals. Demonstrate in course instructions all routine maintenance operations such as lubrication, general inspection, and [_____].

][3.8 FINAL ACCEPTANCE

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NOTE: Use this paragraph as written for projects where the crane is the principal construction element, or represents a very significant portion of the Contract cost. However, if the crane is part of a new facility or renovation, delete the acceptance paragraph from this section. Warranty period and operating and maintenance processes must coincide with the actual beneficial occupancy of the entire facility.

****

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 overspray on wire rope, hook, and electrical collector bars.

] -- End of Section --