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USACE / NAVFAC / AFCEC

UFGS-41 22 13.55 (November 2025)
Change 1 - 05/26

Preparing Activity: NAVFAC

Superseding
UFGS-41 22 13.55 (February 2022)

UNIFIED FACILITIES GUIDE SPECIFICATIONS

References are in agreement with UMRL dated April 2026

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BRIDGE CRANES, AIRCRAFT MAINTENANCE HANGAR

11/25, CHG 1: 05/26

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SECTION 41 22 13.55

BRIDGE CRANES, AIRCRAFT MAINTENANCE HANGAR
11/25, CHG 1: 05/26

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NOTE: This guide specification covers requirements for under running single girder bridge cranes with under running trolleys and hoists, electric powered, Monorail Manufacturers Association (MMA) MHI 27.1 Service Class C and D, suitable for indoor use in hazardous area environments. Crane capacities may be up to 9 metric tons (9,000 kg) 10 tons (20,000 pounds). The SI units in this specification are direct (soft) conversion from the U.S. customary units.

Use this guide specification to specify 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 electrical hazardous area requirements.

Contact NAVY CRANE CENTER when the crane capacity exceeds 9,000 kg 20,000 pounds, the travel speed of any single traversing function exceeds 48 meters/min 160 feet/min, or the hazardous area reaches an elevation that encompasses the crane hoist. Additional mechanical anti-spark protections, which are not included in this specification, are required when travel speeds exceed 48 meters/min 160 feet/min.

Consider the use of multiple bridge spans for total crane span lengths greater than 12 meters 40 feet. Contact Navy Crane Center for more information (Naval Facilities Engineering Command, Navy Crane Center, Building 491, Norfolk Naval Shipyard, Portsmouth, Va., 23709-5000).

This guide specification incorporates the design criteria and requirements identified in NAVCRANECEN INSTRUCTION 11450.2A (December 2018). This guide specification does not cover requirements for custom

built-up hoists, which would be an abnormal requirement for an aircraft maintenance hangar crane. Also included are aircraft maintenance hangar crane requirements identified in UFC 4-211-01 Change 3, April 20, 2021. This guide specification does not apply to cranes within aircraft construction control and paint facilities per UFC 4-211-02.

This specification covers requirements for environments designated as hazardous areas per NFPA 70. This is a facility based determination made by the responsible safety office at the location, activity, facility, or MILCON where the crane is to be installed, and made before the specification is finalized and included in an RFP.
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NOTE: Forward all procurement of crane systems at Naval Shore based activities with rated capacities of 18,000 kg 40,000 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 11450.1D of 14 August 2025).
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NOTE: This guide specification includes tailoring options for NAVFAC, which includes technical 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, and Navy. The default crane configuration includes additional minimum electrical anti-spark, hazardous area 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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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: 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.
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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" pages 8-9 (under running single girder crane) at the following Navy Crane Center link:

https://ncc.navfac.navy.mil/Popular-Links/DOWNLOADS/

Projects that are routed through Navy Crane Center should be accompanied by a completed Crane Information Form (CIF) per the above link.
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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, including building clearances.

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

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

PART 1 GENERAL

1.1 REFERENCES

****

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

Use the Reference Wizard's Check Reference feature when you add a 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.

****

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 INSTITUTE OF STEEL CONSTRUCTION (AISC)

AISC 360	(2016) Specification for Structural Steel Buildings

AMERICAN SOCIETY OF CIVIL ENGINEERS (ASCE)

ASCE 7-22	(2022; Supp 1 2023; Supp 2 2023; Supp 3 2025) Minimum Design Loads and Associated Criteria for Buildings and Other Structures

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

ASME B30.10	(2024) Hooks
ASME B30.16	(2022) Overhead Underhung and Stationary Hoists
ASME B30.17	(2020) Overhead and Gantry Cranes (Top Running Bridge, Single Girder, Underhung Hoists)
ASME B30.30	(2019) Ropes
ASME HST-4	(2021) Performance Standard for Overhead Electric Wire Rope Hoists

AMERICAN WELDING SOCIETY (AWS)

AWS D1.1/D1.1M	(2025) 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	(2023) Standard Practice for Magnetic Particle Examination of Steel Forgings
ASTM A1023/A1023M	(2021) Standard Specification for Stranded Carbon Steel Wire Ropes for General Purposes
ASTM E543	(2021) Standard Specification for Agencies Performing Non-Destructive Testing
ASTM F436/F436M	(2024) 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

BRITISH STANDARDS INSTITUTION (BSI)

BS ISO 4309	(2017) Cranes - Wire Ropes - Care and Maintenance, Inspection and Discard

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	(2016) Specifications for Underhung Cranes and Monorail Systems

NATIONAL ELECTRICAL CONTRACTORS ASSOCIATION (NECA)

NECA NEIS 1	(2015) Standard for Good Workmanship in Electrical Construction

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA 250	(2020) Enclosures for Electrical Equipment (1000 Volts Maximum)
NEMA ICS 8	(2011) Crane and Hoist Controllers

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(2026; TIA 26-1; ERTA 26-1; TIA 26-2; TIA 26-3; TIA 26-4; TIA 26-5; TIA 26-6; TIA

	26-7; ERTA 26-2; ERTA 26-3) National Electrical Code

RESEARCH COUNCIL ON STRUCTURAL CONNECTIONS (RCSC)

RCSC A348	(2020) 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. GENERAL SERVICES ADMINISTRATION (GSA)

FS RR-W-410	(2022; Rev J) Wire Rope and Strand

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	(2014; Revision 1) Requirements for Nondestructive Testing Methods

1.2 DEFINITIONS

a. Commercial Pre-Engineered End Trucks: These are standardized crane components designed, engineered, and mass-produced by established manufacturers within the crane industry. Available in both top-running and under-running configurations, commercial pre-engineered end trucks are typically catalogued, stocked, and readily available. They are generally manufactured for lower capacity applications compared to built-up or custom-designed end trucks.

b. Control System: For the purposes of this specification, the control system is the electronic system that monitors and operates each drive assembly (bridge, trolley, and hoist) separately. The system modulates the power frequency (e.g., variable frequency drive) and may integrate sensors, computers, or advanced software if necessary to execute complex lifting tasks with extreme accuracy.

(1) Open Loop System: A drive system where there is no motor shaft speed feedback to the drive controller.

(2) Closed Loop System: A drive system where there is motor shaft speed feedback to the drive controller by a tachometer-generator, encoder, or resolver.

(3) Microprocessor Drive: A generic term for a drive, either AC or DC that primarily uses electronics instead of contactors and relays to control the motion of motors. This term encompasses digital DC and variable frequency AC of both closed and open loop designs.

c. Crane Bridge: 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.

d. Crane Bridge Girder: The principal horizontal beam of the crane bridge structure. 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.

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

f. Dead Loads: The weight of all effective parts of the bridge structure, the machinery, and the fixed equipment supported by the structure.

g. Electro-mechanical spring set brakes: A type of brake that uses electrical and mechanical components to slow or stop a hoist or travel drive; they are "fail safe" spring set designs that are electrically released. For VFD controlled drive systems, brakes generally serve only as parking brakes since the microprocessor drive is capable of bringing the assembly to a stop before setting the brake. Common brake types that fall under this category:

(1) Disc Brakes: A brake that uses alternating stationary and rotating discs (pressure plates and friction discs) to develop a braking force. These may be powered via AC or DC.

(2) Shoe Brakes: A brake consisting of two external shoes, with riveted or bonded friction linings, that act on the outside diameter of a brake wheel. These may be powered via AC or DC.

h. 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.

i. Mechanical Load Brake: A type of automatic unidirectional friction brake that only supplies braking force in the lowering direction. In the hoisting direction the assembly does not supply braking force. Usually activated by a pawl and ratchet or roller ratchet. Used for moderate lifting heights and typically in package hoists.

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

k. Packaged Hoist: A commercially designed and mass produced hoist characterized by the motor, gearing, brake(s), and drum contained in a single package often connected by the use of c, d, or p-face flanges.

l. 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 monorail track.

m. Pendant: A device suspended from the crane to enable operation of the crane from the floor or other remote location.

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

o. Self-Locking Worm Gear: A worm gear set that will stop and hold the load (hoists) or will not be backdriven (travel). The set may or may not stop a lowering hoist load.

p. 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.

q. Trolley Load: The weight of the trolley and its associated equipment carried by the trolley wheels. The trolley load is not included as part of the lifted load.

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

1.3 SYSTEM DESCRIPTION

****

NOTE: Remove the following sentence if the runway track supporting structure is existing. If the track supporting structure is to be installed, ensure Section 05 12 00 STRUCTURAL STEEL is included in the Request for Proposal (RFP).

Under running runway rail is typically provided by the crane contractor. See also paragraph STRUCTURAL REQUIREMENTS.

****

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

]1.3.1 Crane Design Criteria

****

NOTE: Cranes installed outside the United States are still required to meet the requirements of U.S.

standards as well as the features and characteristics specified.

When necessary, the design may be able to use the host nation's consensus standards in lieu of U.S. standards, with prior approval (e.g., EN, ISO, or JIS in lieu of ASME). Contact Navy Crane Center for approval of foreign design standards prior to issuing the RFP. An equivalency study will be required from the contractor to justify use of the international standard.

****

Crane(s) will operate in the given spaces and match the runway dimensions and rails indicated. Hook coverage, hook lift, clearances, 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. Provide a crane that maintains minimum clearances of 50 mm 2 inch lateral and 76 mm 3 inch overhead between the crane and obstructions and as required in MHI MH27.1.

1.3.1.1 General

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NOTE: Add number of hoists, hangar name, hangar bay, crane hoist rated load capacity in metric tons tons.

The below selections are used for general sizing of the equipment, so reflecting the capacity in metric tons tons is acceptable.

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NOTE: For NAVFAC projects, capacity markings MUST be expressed in pound units and may have additional markings in metric units if the crane is located in Europe or Asia.

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Provide a total of [_____] cranes, located in Hangar identified as [_____],[bay [_____],] with the capacity expressed in [_____] metric tons tons, for each crane. Also clearly locate and identify each hoist and system components.

1.3.1.2 Classification

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NOTE: Make a selection from the following MH 27.1 service classifications.

Class C (Moderate Service): General machine shop, fabricating, assembly, storage, and warehousing. Loads and utilization randomly distributed. Total running time not over 25 percent of the work period.

Class D (Heavy-Duty): High volume handling of heavy loads, frequently near rated load in steel warehousing, machine and fabricating shops, mills,

and foundries, with total running time not over 50 percent of the work period; or manual or automatic cycling operations of lighter loads with rated loads infrequently handled such as in heat treating and plating operations, with total running time frequently over 50 percent of the work period.

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NOTE: Hazardous Area Crane Operating Environments.

The design engineer will have to determine if the hazardous area envelops just the pendant or the entire crane bridge girder and runway. The hazardous area encompassing just the pendant is standard for this specification. Contact Navy Crane Center if the hazardous area encompasses the entire crane and runway.

Hazardous (Explosive) Environments: Locations where fire or explosion hazards may exist due to flammable gases, flammable liquid-produced vapors, combustible liquid-produced vapors, combustible dusts, or ignitable fibers/flyings. 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 pendant enters the explosive area. Anti-spark protection is required for the pendant controller.

(2) Maximum Anti-Spark Protection is used when the hazardous area envelops the entire crane. Contact Navy Crane Center for assistance; in addition to the minimum anti-spark protections, the entire crane and runway components must also be protected against sparking.

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

Article 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.

Article 500.6 covers material groups A, B, C, D, E,

F and G.

Article 513 covers specific requirements for Aircraft Hangars.

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NOTE: NFPA 70 Article 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, Article 513.3, any pit or depression below the level of the hangar floor must be classified as a Class I, Division 1 or Zone 1 location that extends up to said floor level. Items that may be installed or operated in these areas such as wiring, radio controller, and pendant controller must comply with the requirements of Section 513 of NFPA 70.

Aircraft Maintenance and Storage Hangars: In accordance with NFPA 70 Article 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 must 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: NFPA 70 Class I, Division 2 hazardous area. Another potential option for aircraft hangars: NFPA 70 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 are possible. Group D is typical due to fumes from jet fuel.

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 pendant). For hazardous areas that cover the entire crane envelope (i.e., bridge and trolley), contact Navy Crane Center.

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NOTE: Minimize 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.

Electric powered 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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NOTE: The bracketed option for separate runways is necessary if ensuring more than one crane is not installed on the same runway for contracts with multiple cranes in the same building, bay, or location.

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Provide under running, single girder electric bridge crane(s), with under running trolley mounted hoist, conforming to MHI MH27.1, crane service class [C][D]. The crane(s) must be designed for operation in an indoor environment, general purpose service, in an electrically hazardous area, meeting the requirements of ASME B30.16 and ASME B30.17, with an ambient temperature range of [0][_____] to [40][_____] degrees Celsius [32][_____] to [104][_____] degrees Fahrenheit. The crane(s) must operate in an NFPA 70 Class [I][_____], Division [2][1][_____], Group [D][_____] hazardous area. Hazardous protection is required from the finished floor level up to[1.5 meters 5 feet above wing upper surface and engine enclosures][[_____] meters feet]. The total crane span must be [_____] mm [_____] ft-[0][_____] in with a minimum vertical hook lift of [_____] mm [_____] ft-[0][_____] in and as specified herein. Provide runways for multiple span cranes equally spaced apart.[Provide separate runways for each crane.]

The crane must be[pendant controlled][radio controlled][pendant and 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 or other obstructions.[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] [_____],[three][single] phase power source. Maximum loading on the facility (without impact) due to dead loads, trolley loads, and lifted loads, with the trolley in any position, must not exceed the allowable wheel loading and wheel spacing of the facility (or not exceed maximum hanger loading for under running cranes).

1.3.1.3 Rated Speeds

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

Maximum travel speed for any one function, bridge or trolley, is limited to 48 meters/min 160 feet/min. Cranes with travel speeds in excess of 48 meters/min 160 feet/min must be referred to Navy Crane Center for further evaluation.

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

1. Hoist and trolley speeds should conform to the recommendations of ASME HST-4 table.

2. 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 45 meters/min 150 feet/min.

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NOTE: Recommend "Medium" rated speeds, where appropriate. Another consideration for operating speeds is the distance traveled per minute (e.g., 6 meter 20 ft hook lift height corresponds to hook lift speed of 6 meters/min 20 feet/min). Consider limiting bridge or trolley travel speeds when operation occurs over shorter distances (e.g., for a 15 meter 50 ft runway, a bridge travel speed of 15 meters/min 50 feet/min may be more appropriate than the 35 meters/min 115 feet/min "medium" speed).

A common minimum speed selection is 1/10th of maximum speed. Cranes using variable frequency drive controls are more flexible regarding speed selection.

Common maximum speed ranges:
Wire Rope Hoists (ASME HST-4): 5 - 12 meters/min 15 - 40 feet/min
Trolley: 9 - 30 meters/min 30 - 100 feet/min
Bridge: 15 - 45 meters/min 50 - 150 feet/min

****

Provide the crane with speeds within plus or minus 10 percent (in meters/min feet/min) for the main hoist, trolley, and bridge at the rated load as specified in the table below. The maximum allowable nominal travel speed of any single traversing function is limited to 48 meters/min 160 feet/min.

Crane Speeds Travel in meters/min feet/min		
Description	**Maximum**	**Minimum**
Main Hoist	[_____]	[_____]
Trolley	[_____]	[_____]
Bridge	[_____]	[_____]

The hook lift and travel speeds must be the manufacturer's standard within the limits specified at rated capacity.

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. Coordinate with the crane support structure design, where applicable, to provide the desired crane operating envelope (i.e., hook envelope and hook height). Verify all dimensions of the building that relate to fabrication of the bridge crane system 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 and Air Force 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.

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. Submittals not having a "G" or "S" classification are 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 Bridge Crane System; G, [_____]

Complete Schematic Wiring Diagram; 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.
****

Crane Bridge Girder; G, [_____]

Bridge End Trucks; G, [_____]

End Stops; G, [_____]

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

[Crane Runway System; G, [_____]

] Hoist and Trolley Units; G, [_____]

Hoist Brakes; G, [_____]

Travel Brakes; G, [_____]

Motors; G, [_____]

Variable Frequency Drives; G, [_____]

Disconnect Switch; G, [_____]

Circuit Breakers; G, [_____]

Fuses; G, [_____]

Limit Switches; G, [_____]

****
NOTE: The crane can be controlled by pendant, radio, or both. Make selection(s).

If pendant controlled, the pendant can hang from a

separate messenger track (allowing maximum operator flexibility) or be suspended from the trolley itself (forcing the operator to walk with the load). Make selection for Pendant Conductor System if pendant will hang from a separate messenger track.

****

[Pendant Pushbutton Station; G, [_____]

[Pendant Conductor System; G, [_____]

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

] Runway Conductor System; G, [_____]

Bridge Conductor System; G, [_____]

Capacity Overload Protection; G, [_____]

Enclosures; G, [_____]

Warning Devices; G, [_____]

****

NOTE: Choose Pilot Devices option if additional visual indication is desired by the end user. These include indicator lights for power available and crane energized, located on the crane in the operators line of sight.

****

[Pilot Devices; G, [_____]

] Contractor's Painting System; G, [_____]

SD-05 Design Data

Load and Sizing Calculations; G, [_____]

SD-06 Test Reports

****

NOTE: Hook Non-Destructive Test (NDT) is required for all NAVY cranes.

Remove this selection if the selecting agency does not require hook non-destructive testing or the necessary non-destructive testing is not in accordance with NAVY requirements.

****

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

] SD-07 Certificates

Wire Rope; G, [_____]

Crane Runway; G, [_____]

Hazardous Material; G, [_____]

Loss of Power Test; G, [_____]

Overload Test; G, [_____]

Brake Adjustment Record; G, [_____]

Adjustable Parameters List; G, [_____]

Cybersecurity Supplement; G

SD-09 Manufacturer's Field Reports

VFD Control Parameter Settings and Adjustments; G, [_____]

Post-Erection Inspection; G, [_____]

Operational Tests; G, [_____]

Hook Tram Measurement; G, [_____]

SD-10 Operation and Maintenance Data

Operation and Maintenance Manuals, Data Package 3; 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 necessary to meet requirements of the Contract Documents. Provide a crane designed 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 their 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.

1.6.2.1 Inspection of Hook Assembly

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NOTE: For NAVY, carbon steel hooks require magnetic-particle type inspections.

NAVY acceptance criterion is no linear indications greater than 1.5 mm 1/16 inch. General recommendation is that linear indications greater than 1.5 mm 1/16 inch not be allowed.

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Inspect hook by a magnetic-particle type inspection prior to delivery. Furnish documentation of hook inspection to Contracting Officer prior to field operational testing.

Acceptance standard is no defects. A defect is defined as a linear indication for which the largest dimension is greater than [1.5][3][_____] mm [1/16][1/8][_____] inch long. Welding repairs of hook are not permitted. A hook showing linear indications, damage, or deformation is not acceptable.

[1.6.2.1.1 Hook Non-Destructive Test (NDT)

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NOTE: This subpart is required for NAVY cranes.

Remove this subpart if the selecting agency does not require hook non-destructive testing or the necessary non-destructive testing is not in accordance with NAVY requirements.

For NAVFAC, add tailored paragraphs with additional requirements.

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For hooks of ferromagnetic materials, magnetic-particle inspect the hook over the entire area in accordance with NAVSEA T9074-AS-GIB-010/271 or ASTM A275/A275M with restrictions identified below.

Inspect each hook and shank over the entire surface area. If NDT cannot be performed on surfaces inside small holes (e.g., hook/nut captivation roll pin holes), visually inspect those surfaces to the maximum extent practical.

a. Procedure for magnetic particle inspection: Conduct magnetic particle inspection in accordance with NAVSEA T9074-AS-GIB-010/271. ASTM A275/A275M may be used 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.

c. Test Report: Submit a test report of the inspection of each hook to 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, as applicable. The performing organization must have the NDT procedures and its technique sheet used for testing of the hook reviewed and approved by a Level III examiner who is independent from the NDT vendor. Submit the (Level III examiner) approved procedures, technique sheets, and certification to the Contracting Officer with the test report.

]1.6.3 Drawings: Overhead Bridge Crane System

a. Submit drawings showing the general arrangement of all components in plan, elevation, and end views to demonstrate proper interface with the facility and relation to other cranes on the same rail system, if applicable. Show all major features of the crane including: hook approaches on all four sides, maximum hook height at primary upper limit, clearances and principal dimensions, 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 (e.g., bridge girder, trolley/hoist).

b. Submit shop drawings of all fabricated components. Drawings must be reviewed, signed, and sealed by a licensed professional engineer.

c. Provide Bill of Material for crane components on each drawing. The schedule must provide a cross reference between manufacturer data and shop drawings. The schedule of crane components must include, for each item, the total quantity and a complete description. For purchased components, the original manufacturer and part number must be specified. For fabricated components, the size, material, and grade must be clearly indicated. Distributing agents will not be acceptable in lieu of the original manufacturer.

1.6.4 Design Data: Load and Sizing Calculations

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

Coordinate seismic analysis requirement with paragraph SEISMIC FORCES.

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Submit complete list of equipment and materials, including manufacturer's descriptive data, technical literature, and performance charts and curves. 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, and overcurrent protection. 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 must be dated, bear the original signature, and include the printed name of the authorized representative of the Contractor or the manufacturer of the items or equipment being certified. Submit certifications that clearly identify the crane, the drives, components, and location (as applicable) to which it applies:

a. Wire Rope Certification in accordance with ASME B30.30 for each hoist. The certification must include either the wire rope manufacturer's certification that the rope meets the published breaking force, or certification of the actual breaking force of a sample taken from the reel and tested. Show the published breaking force on the wire rope certificate; the actual wire rope breaking force must meet or exceed the published value. Certification must be traceable to the crane, hoist, and reel.

b. 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 the runway is existing and if the crane(s) cannot operate without restriction, the Contractor must indicate crane limitations.

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

d. Loss of Power Test Certificate stating that a test may be performed in which power is removed during operation without any detrimental effects to the crane.

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NOTE: NAVFAC requirement is for the crane to be periodically load tested to 125 percent (plus 0 minus 5 percent) of rated load.

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

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NOTE: See "Brake Adjustment Record Form (NCC Form 09-002)" at the following Navy Crane Center link:

https://ncc.navfac.navy.mil/Popular-Links/DOWNLOADS/

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f. 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 brake settings outside the allowable parameters, at any time, will void the record. A suitable brake record form can be located under downloads on the NAVFAC Navy Crane Center website.

g. Adjustable Parameters List Certificate for each electronic drive to document the crane designed parameter ranges in which each parameter can be safely tuned by the end user. The template that includes the format required for the "Adjustable Parameters Lists" is located on the NAVFAC Navy Crane Center website. The design parameter range, determined by the Crane Contractor, must be the applicable portion of

the drive's default range for each parameter. The Crane Contractor must provide justification for each range of each parameter on the list. When necessary, provide justification with appropriate calculations.

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NOTE: The Cybersecurity Supplement submittal is required for cranes with microprocessors (e.g., VFDs) or wireless controllers.
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NOTE: If purchasing a laptop for crane maintenance, see Section 25 05 11 CYBERSECURITY OF FACILITY-RELATED CONTROL SYSTEMS.
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h. Cybersecurity Supplement reporting cybersecurity information for each individual network capable device, including microprocessors (e.g., VFDs) or wireless devices (e.g., controllers or remote terminal units), using the Cybersecurity Supplement (NCC Form 24-003) available for download at the following Navy Crane Center link:

https://ncc.navfac.navy.mil/Popular-Links/DOWNLOADS/

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 HST-4, ASME B30.10, ASME B30.16, ASME B30.17, 29 CFR 1910.147, 29 CFR 1910.179, 29 CFR 1910.306 and all applicable provisions of 29 CFR 1910 and NFPA 70.

PART 2 PRODUCTS

2.1 MATERIALS

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.

2.2 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

a. High-strength bolted structural connections must be designed and installed in accordance with RCSC A348. Bolts must be of ASTM F3125/F3125M, Grade A325/A325M or Grade A490/A490M, unless otherwise approved by component OEM. Galvanized bolts are not acceptable.

b. 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

a. Provide a crane 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.

b. 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

c. Keep splices in the bridge girders to a minimum and splices in high stress locations must be avoided. Make splices with complete joint penetration welds. Field (on-site) welded splices are prohibited.

2.2.3 Bridge End Trucks

Provide commercial pre-engineered end trucks conforming to ASME B30.17 and MHI MH27.1. Configure end trucks with a feature that limits end truck movement to 25 mm 1 inch in the event of wheel or shaft failure.

2.2.4 End Stops

Fit the crane bridge girder(s) with structural steel end stops. Locate stops to permit maximum trolley travel. Design end stops in accordance with ASME B30.17. Provide a system in which the travel wheels do not contact the end stops. End stops must be designed to absorb the maximum kinetic energy and impact force developed by the bumper contact. Provide end stops compatible with trolley bumpers and designed to bolt to the crane bridge girder.

2.2.5 Bumpers

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 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 must 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.

[2.2.6 Crane Runway System

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

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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 conforming to MHI MH27.1.

b. Perform splices as necessary in accordance with the manufacturer's recommendations and requirements. Align ends of lower T-section to minimize the horizontal gap on the running surface to not greater than 1.5 mm 1/16 inch and not greater than a vertical difference of 0.75 mm 1/32 inch for the wheel running surface alignment for a smooth crossing by the wheels. Splice assemblies must be from the same manufacturer as the patented track and located under structural support members. When runways are suspended, bracing preventing damaging lateral or longitudinal movement is required. Loads transmitted to the building through the suspension must have the review and approval of the building engineer of record (EOR) prior to installation. 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.

d. Design, fabricate, and install new runway end stops in accordance with ASME B30.17 and MHI MH27.1. End stops must be designed to absorb the maximum kinetic energy and impact force developed by the bumper contact. Provide end stops compatible with end truck bumpers, designed to bolt to the runway support girders, and maximize bridge travel.

][2.2.7 Seismic Forces

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NOTE: Coordinate seismic requirements with

paragraph DESIGN DATA: LOAD AND SIZING CALCULATIONS.
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NOTE: If seismic forces are 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 7-22.
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Perform a seismic analysis as a part of the design of the crane in accordance with ASCE 7-22. The seismic analysis must be included in the MHI MH27.1 extraordinary load case (Case 3).

For project locations beyond the scope of ASCE 7-22, a widely accepted design standard may be used for seismic analysis.

]2.3 MECHANICAL REQUIREMENTS

All "should" statements in MHI MH27.1 and ASME B30 are considered to be mandatory requirements.

2.3.1 Threaded Fasteners

Fasten mechanical connections that are not part of a commercial packaged assembly with SAE J429 Grade 5 fasteners, ASTM F436/F436M washers, and SAE J995 Grade 5 nuts, as a minimum. Lubricate all mechanical fasteners unless otherwise specified by the original component manufacturer.

2.3.2 Hoist

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NOTE: Generally, hoist duty class roughly aligns with MHI crane classification. An H3 hoist service duty class would typically be specified for a MH27.1 service class C crane; H4 for service class D. See paragraph CRANE DESIGN CRITERIA, sub-paragraph CLASSIFICATION to identify the MHI service duty class specified for this crane.
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Provide commercially available package hoist units conforming to ASME B30.16 and ASME B30.17, except as modified and supplemented in this section. Packaged hoist and trolley units (packaged hoists) must be electric wire rope double reeved hoist conforming to ASME HST-4, hoist duty class[H3][H4] or better and be rated for the operating environment.

Configure trolley such that the trolley bumper contacts the trolley stops and prevents the trolley from dropping more than 25 mm 1 inch in the event of an axle or wheel failure.

2.3.2.1 Hoist Brakes

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NOTE: Each hoist must have, at a minimum, two brakes capable of stopping and holding 125 percent of the hoist's rated load.

Consider the CONTROL SYSTEM paragraph under ELECTRICAL REQUIREMENTS.

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 brake and one mechanical load brake (or self-locking worm gear). If closed loop controls are selected, brake configuration must be two electro-mechanical type brakes.

Cranes with two electro-mechanical holding brakes must have a time delay between the setting of the primary and secondary brakes of 1 to 3 seconds in any stopping condition, including emergency stop and loss of power.

Additional tailoring options are provided for NAVFAC cranes.

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a. Equip the hoist with two holding brakes, each with a minimum torque rating of 125 percent of the rated load hoisting torque.

b. Provide a brake configuration with two electro-mechanical spring set brakes. A mechanical load brake, or self-locking worm gear, may be utilized in place of one spring set brake as long as it meets the identified requirements and is compliant with the paragraph CONTROL SYSTEM.

(1) Spring set brakes must have means of manual release. The brakes must be equipped with a manual brake release mechanism; maintained manual release mechanisms must automatically reset when power is applied to the brake. Provide microprocessor controlled drive (i.e. VFD) with manual adjusting brakes.

(2) Mechanical load brakes, and self-locking worm gears, must be capable of stopping and holding 125 percent of the hoist's rated load and cannot require the load to be raised before being lowered.

(3) When using two electro-mechanical spring set brakes, hoist secondary brakes must have a delayed setting between 1 and 3 seconds after the primary brake, in any stopping condition including emergency stop and loss of power. The primary brake is the brake mounted closer to the motor.

2.3.2.2 Load Block and Hook

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NOTE: Some text tailored to NAVFAC.

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NOTE: Where space permits, the NAVY prefers forged carbon steel hooks due to NDT periodicity requirements, however that option is not mandated.

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a. Provide a load block constructed of steel. The load block must be designed to prevent steel-to-steel contact of moving parts.

b. Provide an unpainted and unplated forged[carbon] steel single barbed hook. Hooks must conform to the requirements of ASME B30.10. The hook must be a standard commercial product with a published design factor compliant with the requirements of ASME B30.16 for powered hoists. 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. Provide a hook nut secured to the hook with a commercial standard removable and reusable means. Do not weld the hook nut. Uniquely mark the hook in a permanent fashion that is traceable to the NDT certification. Hook must be free to rotate through 360 degrees when supporting the test load up to 125 percent of the rated capacity.

2.3.2.3 Hoisting Rope

a. Wire rope must comply with ASME B30.30 and FS RR-W-410, ASTM A1023/A1023M, or BS ISO 4309 and have a rope classification appropriate for the usage. Wire ropes must be handled and seized in accordance with ASME B30.30. The wire rope must be in a double reeved configuration equalized with a sheave. Select wire rope minimum design factor in accordance with ASME B30.16. Provide proof of wire rope breaking force.

b. Provide hoist wire ropes with extra-improved or extra-extra-improved plow steel (or appropriate ISO grades), pre-formed, regular lay, bright, and uncoated, with an independent wire rope, wire strand, or otherwise, steel core. Drawn galvanized wire rope is allowed in general purpose service; final-metallic coated wire rope is not permitted.

2.3.2.4 Drum

Provide grooved drum made of steel. Design drum in accordance with ASME B30.16. All hoisting rope is to be wound in a single layer and provided with no less than two dead wraps of hoisting rope remaining at each anchorage when the hook is in its extreme low position.

2.3.2.5 Sheaves

Provide steel sheaves. Size sheaves in accordance with ASME B30.16 for the minimum pitch diameters of running and equalizer sheaves.

2.3.3 Travel Drives

Provide under running assemblies with at least one quarter of all wheels driven for each travel function.

The travel drive arrangement must consist of motor(s) driving through self-contained gear reduction units located at each driven wheel assembly. Gear reducers must be fully enclosed in an oil-tight housing and provided with a convenient means of lubricant level indication and draining.

2.3.3.1 Trolley Drives

Provide a motor-driven travel drive arrangement.

2.3.3.2 Bridge Drives

Provide motor-driven, commercial pre-engineered end trucks.

2.3.4 Travel Brakes

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NOTE: The second paragraph contains a NAVFAC tailoring option for additional travel brake requirements.
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Provide travel drives with an end-mounted electro-mechanical spring set brake or non-freecoasting mechanical drive capable of stopping the motion of the travel function 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.

Spring set brakes must be provided with a means to manually release the brake. The brakes must be equipped with a manual brake release mechanism; maintained manual release mechanisms must automatically reset when power is applied to the brake. Provide microprocessor controlled drive (i.e., VFD) with manual adjusting brakes.

2.3.4.1 Trolley Brake

Spring set brakes for underrunning trolleys/carriers must be sized in accordance with ASME B30.17.

2.3.4.2 Bridge Brake

Spring set brakes must be provided with a minimum torque rating per ASME B30.17 according to the applicable environment, but not sized larger than 150 percent of the drive motor rated torque.

2.3.5 Wheels

Provide under running wheel sizing and flange-to-rail head clearances in accordance with MHI MH27.1 recommendations. The wheels must be compatible with their respective runway profile. Wheel material is to be cast or forged steel, or ductile or malleable cast iron. Hollow stamped wheels may not be used; the use of plate steel is prohibited. Provide underhung wheels running on patented track with a minimum tread hardness of 375 BHN in accordance with MHI MH27.1. Gray cast iron trolley wheels are acceptable if they are the manufacturer's standard offering; this material exception does not extend to bridge wheels.

[2.3.6 Drip Pans

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

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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 installed under all drive machinery (hoist and travel), and designed to permit easy removal of collected lubricant.

]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 8, the applicable ASME HST standard, and NFPA 70, and other requirements specified herein.

b. Each motion of the crane must be provided with a separate control system or drive. 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, or component cannot result in motion in an unintended direction.

c. Unless otherwise specified, interconnecting wiring must be of copper stranded construction. Interconnecting wiring containing asbestos in the insulation or outer covering are prohibited. Aluminum conductors must not be used. Aluminum connectors are allowed if they are rated for use with copper conductors (marked "AL/CU").

2.4.1 Motors

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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). Closed loop VFD's, are the specialized, less common, and more expensive hoist control option and should not be the first option considered; strongly recommend opened loop VFD/inverter duty motors. Vector duty motor(s) must generally meet these requirements: be able to develop constant torque at zero speed with a minimum 1000:1 constant torque speed ratio, be designed for use with flux vector controls, and have provisions for an encoder.

U.S. Navy recommends a minimum 60-minute duty rating motor for hoist, trolley, and bridge functions. 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.

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a. All motors must have a minimum of a [60][30][_____] minute duty rating.

(1) Provide inverter duty motors for open loop variable frequency drives (VFD).

[(2) Provide vector duty motors equipped with a minimum 1024 PPR encoder, capable of delivering constant torque at zero speed with a minimum 1000:1 constant torque speed ratio, and designed for operation with closed loop VFDs.

] b. Provide motors with a minimum of Class F insulation.

2.4.2 Control System

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NOTE: Ensure the HOIST BRAKES subpart of this specification reflect the type of controls chosen.

For open loop VFD hoist controls, the brake configuration is one electro-mechanical spring set brake and one mechanical load brake (or self-locking worm gear). This is the more cost effective control system and brake configuration.

For closed loop VFD hoist controls, the brake configuration is two electro-mechanical spring set brakes. This is the more capable, but also more expensive, control system and brake configuration.

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a. 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.

b. On hoist function roll-up must be less than 3 mm 1/8 inch measured at the hook block.

c. Programmable Logic Controllers (PLC's) may not be used.

2.4.2.1 Variable Frequency Drives (VFD)

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NOTE: When selecting VFD's, the OPEN LOOP controls subpart will always be included, even if only applying to the travel drives. OPEN LOOP controls will typically also apply to the hoist, although you may choose to have the hoist be CLOSED LOOP.

OPEN LOOP controls apply to VFDs and can apply to travel and hoisting functions. For hoists that use VFDs, the OPEN LOOP control method is the more typical configuration for commercial packaged hoist/trolley units.

CLOSED LOOP controls apply to VFDs and only to hoisting functions. This is the less standard

configuration for hoists on commercial packaged hoist/trolley units.

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a. 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.

b. Provide dynamic braking for each electric drive that is sized per VFD manufacturer's requirements. Submit VFD control parameter settings.

c. Motors must operate smoothly at all speeds without torque pulsations and must be energized at a frequency not to exceed 60 Hz at rated speed.

d. All hoist drives must have a motor over-torque limit to lock out the hoist and prevent gross overload of the associated hoist.

2.4.2.1.1 Open Loop

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NOTE: The travel function will be open loop VFD. The design engineer MUST decide if the hoist is also open loop controlled or the more involved closed loop.

If the hoist is to be open loop, choose the bracket option in paragraph a. Selecting to include this bracket option is the more standard selection. If the hoist is to be closed loop, do not include the bracket options identified. THIS DECISION IS REQUIRED.

OPEN LOOP is the more typical and cost effective hoist configuration for commercial packaged hoist/trolley units that use VFDs.

This selection aligns with HOIST BRAKES option for one electro-mechanical spring set brake and one mechanical load brake (or self-locking worm gear). Slow speed is not an option because too slow of hoist operation (e.g., 6 hz) can adversely affect the mechanical load brake.

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a. Provide static reversing, variable frequency drives (VFD) for the bridge, and trolley[, and hoist] electric controls.

b. Provide speed control, which is infinitely variable for each function, controlled via the operator control station(s).

c. The 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.

d. The electro-mechanical brakes must set without delay.

[2.4.2.1.2 Closed Loop

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NOTE: CLOSED LOOP controls only apply to VFDs and only to hoisting functions. This not the typical selection and all CLOSED LOOP controls will usually be removed.

CLOSED LOOP controls provide better precision and allow for the use of a slow speed switch. This selection aligns with HOIST BRAKES option for two electro-mechanical spring set brakes.
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NOTE: The final paragraph for hoist brake bypass keyswitch is optional and typically not recommended for cranes WITHOUT a walkway since a manlift will be required to utilize. Choose this option if the Activity wants the functionality; the intent for this keyswitch is to allow for potentially easier load testing of all hoist brakes while the crane is installed.
****

For the hoist(s):

a. Provide static reversing, variable frequency drives (VFD), speed regulated, closed loop, flux vector electric controls. 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 must be controlled separate from the primary and connected to a different output (within the drive) from the primary brake.

b. Provide speed control, which is infinitely variable, controlled via the operator control station(s).

[(1) Provide controls designed such that the maximum speed 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 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.

d. The electro-mechanical brakes must set after the associated controller decelerates the drive motor to a controlled stop.

e. Hoist roll-back must not occur over the entire load range.

[f. Provide a three-positioned maintained keyswitch on the outside of the control panel for each hoist. The keyswitch must allow for testing each brake independently. Label the far right position "PRIMARY BRAKE TEST" for testing the primary brake, and label the far left position "SECONDARY BRAKE TEST" for testing the secondary brake. Label the

center position of the keyswitch "NORMAL" for both brakes and the drive to work in their normal operating configuration. The keyswitch must also act as an electrical interlock to the drives, preventing all drives from operating while the keyswitch is in either the "PRIMARY BRAKE TEST" or "SECONDARY BRAKE TEST" position. The key may only be removable in the "NORMAL" position. Provide a time delay of 4-6 seconds in the design between moving the switch to the "SECONDARY BRAKE TEST" position and the primary brake releasing. This will prevent both brakes being open when the brake test keyswitch is cycled too quickly from the primary to the secondary position (the secondary brake has a delay on setting).

]]2.4.3 Electrical Overcurrent Protection

Protection must not be less than that required by NEMA ICS 8 and NFPA 70. Instantaneous trip circuit breakers are not acceptable to provide short circuit and ground fault protection.

Provide for lockout/tagout of all hazardous energy sources. Provide product data for the disconnect switch and all circuit breakers and fuses.

2.4.3.1 Conductors

The crane contractor is responsible for ensuring that the crane supply conductors and main contact conductors have adequate overcurrent protection.

2.4.4 Limit Switches

****

NOTE: For hoists with a primary upper limit switch and a secondary upper limit switch, a bypass keyswitch is recommended for easier testing of the secondary upper limit switch. Wiring requirements necessitate that the primary upper limit stops hoisting in the upward direction when activated, therefore a bypass switch that allows continued hoisting upward after primary switch activation would allow for easier verification of the secondary upper limit operation.

****

a. Provide primary upper and lower hoist geared limit switches. Geared limits must allow reversing direction to back out of the limit without requiring a reset. Set the lower limit switch so that no less than two dead wraps of hoisting rope remain at each anchorage on the drum when the hook is in its extreme low position.

b. Provide secondary (or final) upper limit protection. Provide a mechanical hook block activated secondary upper limit switch that removes power from the hoist motor, hoist brake(s), and hoist controls. The secondary upper limit switch must be wired independently of the directional contactors and the primary upper limit switch. The secondary upper limit must require manual resetting prior to operation of the hoist in any direction.[Provide a three-position spring-returned keyed bypass switch that allows for testing of the secondary upper limit by bypassing the primary upper limit and allows resetting of the secondary upper limit switch prior to resuming operation.]

c. The secondary upper limit switch must be wired to remove all power from the hoist drive motor and hoist brake(s) independently of the microprocessor drive.

2.4.5 Operator Controls

****

NOTE: Available operator controls are pendant and radio control. Cranes can also be set-up to be controlled by two separate systems. A selection must be made for operator controls.

For cranes with one set of controls select paragraph a.

For cranes with two sets of controls select paragraph b. In such a case some type of interlock must exist to prevent control from both systems simultaneously. This interlock can be a switch on the pendant controller OR can be any option, which could include a single barrel connection on the trolley. The switch on the pendant is easier to use, but potentially more expensive. The single barrel connection on the trolley may be cheaper, but more difficult to access.

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?

****

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

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

] c. Operator control station must have its elements clearly and permanently marked with functionality and direction which match the markings on the crane or facility.

d. Operator control stations must be rated for the NFPA 70 Hazardous Classifications specified in paragraph CRANE DESIGN CRITERIA, sub-paragraph CLASSIFICATION.

[2.4.5.1 Pendant Pushbutton Station

****
NOTE: When the pendant is suspended from the trolley (via first selection), delete the PENDANT CONDUCTOR SYSTEM paragraph. This selection requires the operator to walk with the trolley.

When the pendant is suspended from an independent festooned messenger track system, add the PENDANT CONDUCTOR SYSTEM paragraph. This selection allows the operator to move independently from the trolley.
****

****
NOTE: Add option for maintained two-position slow speed selector switch if slow speed capability is being provided under CLOSED LOOP CONTROLS.
****

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 a method of strain relief to protect the electrical conductors from damage; exposed metallic pendant cable strain relief elements and enclosures, where used, must be bonded to the crane's equipment grounding conductor. Locate the pendant pushbutton station [1200 mm] [4 feet] [_____] above the finished floor. Provide[3-step infinitely variable][2-step infinitely variable] pendant pushbuttons for control of the hoist, trolley, and bridge. Provide pendant pushbuttons for control that spring return to the OFF position. Voltage in the pendant pushbutton station must not exceed 150 Volts AC.[Provide a maintained two-position slow speed selector switch.]

Provide the pendant pushbutton station with a NEMA Type 7 enclosure for Class I, hazardous environments and NEMA Type 9 enclosure for Class II, hazardous environments, as classified by NFPA 70. Alternatively, a NEMA Type 12 enclosure is suitable with intrinsically safe circuitry, as defined in NFPA 70, for equipment in Class I, Division 1 or Division 2; Class II, Division 1 or Division 2 locations.

[2.4.5.1.1 Pendant Conductor System

****
NOTE: Remove this paragraph when the pendant is suspended from the trolley (via first selection). This selection requires the operator to walk with the trolley.

Add this paragraph when the pendant is suspended from an independent festooned messenger track system. This selection allows the operator to move independently from the trolley.
****

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.

]][2.4.5.2 Radio Control System

****
NOTE: Add option for maintained two-position slow speed selector switch if slow speed capability is being provided under CLOSED LOOP CONTROLS.
****

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 spring return controls for each hoist, trolley, and bridge function; indication of Battery Power, and indication of Transmitting Status; a red emergency STOP mushroom pushbutton[; and a maintained two-position slow speed selector switch]. 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.

The Contractor must submit the frequency allocation application to the National Telecommunications and Information Administration (NTIA) via the latest revision of EL-CID software found on NTIA.gov. Provide the temporary authorization, and the final approved application when available. The technical section of the application must be completed by the manufacturer of the radio control equipment being furnished under this contract. Verify frequency availability at this activity prior to design approval.

]2.4.6 Electrification Systems

****
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.
****

2.4.6.1 Runway Conductor System

****
NOTE: A rigid conductor bar system with collector shoes mounted to the crane is the most common runway electrification method.

Select only one of the available options.

****

[a. Provide a rigid runway conductor bar system using the manufacturer's standard catalog components for runway electrification. Include all necessary cables, connectors, and mounting hardware to connect the crane to the wall or column mounted disconnect switch. Provide electrification system of the safety enclosed type, with three power conductors and an equipment grounding conductor. If there is any way the hook block or wire rope can swing into the runway electrification, provide a guard installed to prevent contact.

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

][Provide a festoon system for runway electrification, utilizing cables suspended from carriers riding on an I-beam or C-track for the crane, including all necessary cables, connectors, and mounting hardware to connect the crane to the wall or column mounted disconnect switch. Provide electrification system with three power conductors and an equipment grounding conductor. Festooned cable loops must not extend low enough to come into contact with any obstructions.

][Provide a cable reel system for runway electrification, including all necessary cables, connectors, and mounting 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.

]2.4.6.2 Bridge Conductor System

****

NOTE: A festoon system is the most common electrification method for bridge conductor system, which supplies power to the trolley.

Select only one of the available options.

****

[Provide a festoon system for bridge electrification, utilizing cables suspended from carriers riding on an I-beam or C-track. Festooned cable loops must not extend low enough to come into contact with any obstructions.

][Provide a cable reel system for bridge electrification. The cable reel must have an equipment grounding conductor, and all necessary control cables.

]2.4.7 Capacity Overload Protection

****

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

Capacity Overload Protection may be adjustable. If adjustable, it MUST BE set at less than the crane's minimum test load; recommend setting at 100 percent of rated capacity or less. This protection can take the form of one of the following devices:

1. Clutch - Not adjustable and is common on package chain 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.

The Over-Torque Limit (i.e., torque limiting feature) only applies to cranes with VFD controls. It is a parameter setting in the drive and is typically set at 150 percent of rated motor torque.
****

a. Provide a capacity overload protective device for all hoist systems using VFD drive capacity overload protection; the capacity overload protection must be separate from torque limiting feature, however both may be controlled from the same VFD. Set hoist capacity overload protection at [100][_____] percent of rated capacity. 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.

[b. 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.

]2.4.8 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.

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 for the identified operating environment.

[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.

2.4.9 Warning Devices

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

Provide warning devices in accordance with ASME B30.17.[Provide a warning horn that is operable from a pushbutton at every operator control station.][Provide a warning[strobe light][rotating beacon] that is illuminated at all times during movement of the hoist, trolley, or bridge function.]

[2.4.10 Pilot Devices

****
NOTE: Choose this option if additional visual indication is desired by the end user.
****

Provide indicator lights mounted in an enclosure on the bottom of the control panel 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.

]2.4.11 Cybersecurity

Provide cranes with components that are not connected to the internet. At a minimum, cranes containing microprocessors (e.g., VFDs, computers, or load indicating devices) or wireless devices (e.g., controllers or remote terminal units) that are network capable must document and report cybersecurity information for each individual device.

2.5 PAINTING SYSTEM

Paint, coatings, or galvanizing on the following items or areas is not acceptable: hoist wire ropes, hooks, hook nuts, sheave and drum grooves, wheel treads, lubrication fittings, nameplates, flange mounting faces, corrosion resistant steel, bronze, or other items not normally painted.

2.5.1 OEM-Painted Components

Provide structural, electrical, and mechanical equipment, including hoist, trolley, girder(s), end trucks, and track (if applicable), with factory-applied coatings in accordance with the OEM's best standard practices. Coating systems must be suitable for the environmental conditions defined in paragraph CRANE DESIGN CRITERIA.

2.5.2 Contractor-Applied Coatings

Provide additional painting where structural elements or assemblies are not available with OEM-applied coatings, or where fabrication,

modification, or repair necessitates supplemental coating. Use a contractor's painting system appropriate for the environmental conditions defined in paragraph CRANE DESIGN CRITERIA.

Select a painting system from a recognized industrial coating manufacturer. All paint products must be supplied by a single manufacturer and free of chromates, lead, and mercury. The system must include surface preparation and coating layers, as applicable. Submit product data for painting system.

2.5.2.1 Surface Preparation

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.

2.5.2.2 Coating Thickness and Application

****

NOTE: Select the desired coating for indoor cranes.
a. The first two-layer option with polyamide epoxy primer and topcoat is recommended.
b. The second two-layer option with alkyd primer and topcoat is valid for "milder" environments but is not recommend. This option is of poorer quality, most likely to encounter issues, and provides the shortest service life.

For cranes in abnormal environments including exposure to chemicals or in immersion service, a system designed for that environment should be used.

****

a. Paint exposed portions of the crane and crane runway system (if applicable) using a multi-layer system, ensuring uniform coverage and adhesion, with[two-coats including a polyamide epoxy primer and a polyamide epoxy topcoat, each layer with a dry film thickness of 4-6 mils][two-coats including an alkyd primer and an alkyd topcoat] [_____].

b. 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.

c. Coat faying surfaces of bolted connections per RCSC A348, but do not apply finish paint.

[d. The color of finish coat is[brilliant yellow] [_____].

]2.6 EQUIPMENT LABELING AND NAMEPLATES

2.6.1 Crane Identification Labels

a. Furnish and install identification signage in accordance with ASME B30.17.

b. Provide identification label(s) or plate(s) with clearly legible

lettering giving the manufacturer's name, serial number, and other essential information or identification.

c. Provide signage with letters which are easily read from the floor, showing a separate number such as BC-1, BC-2, for each bridge crane.

2.6.2 Capacity Marking

****
NOTE: NAVFAC requires markings to be indicated in pound units. The kilogram marking option is provided for cranes installed in a foreign country.
****

a. Provide crane and hoist capacity markings in pound units[, with kilogram units listed separately].

b. Provide crane capacity identification labels on each side of the crane bridge girder with legible lettering and large enough to be clearly visible from the floor.

c. Individual hoist units must have their rated capacity clearly marked on both sides of the lower block (when present), or labeled on the trolley when a load block suitably sized to display the capacity is not installed.

d. If the bridge crane has multiple hoisting units, provide each hoist with identification markings on the trolley or load block. The trolley capacities and crane bridge capacity must be clearly indicated.

2.6.3 Directional Markings

To avoid operation of the crane in the wrong direction, affix the appropriate directions (NORTH, SOUTH, EAST, and WEST) with arrows on the equipment in a location that is visible to the operator. Markings must agree with the markings on controller. Do not provide directional arrows only on the controller.

2.6.4 Component Nameplates

Secure durable and permanent nameplates to each major component of equipment with the manufacturer's name, address, type or style, model or catalog number, and serial number.

2.6.5 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. Provide safety warnings, diagrams, and other instructions suitably located and protected for display 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.

2.7 ELECTRICAL ASSEMBLY

Installation of all electrical wiring, conduit, and components must be performed in accordance with the requirements of NFPA 70 and NECA NEIS 1.

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

****
NOTE: Shop testing is not typically justified for cranes utilizing commercial packaged hoist/trolley units.
****

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

3.3.1 Electrical Adjustments

Adjust control system in accordance with manufacturer's instructions. Provide an updated copy of all VFD Control Parameter Settings and Adjustments, including allowable ranges. 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.

3.3.2 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.

3.3.3 Field Painting

Repair any damage to coatings incurred during transport, erection, or

commissioning. 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 or Test Director,] and the Contracting Officer must jointly inspect the crane bridge, hoist systems, and components to verify compliance with specifications and approved submittals. Notify the Contracting Officer [14][_____] days before the inspection. Provide a report of the inspection indicating the crane is considered ready for operational tests.

Document the results of this inspection and submit the post-erection inspection report to the Contracting Officer for approval.

3.4.2 Operational Tests

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.

Testing of cranes must be done with the use of test weights. The use of dynamometers in lieu of lifting test weights is not permitted.

3.4.2.1 Test Preparation

3.4.2.1.1 Test Data

Submit all crane test data recorded on appropriate test record forms suitable for retention for the life of the crane. 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.

[3.4.2.1.2 Test Weights

****
NOTE: Determine if Government furnished certified test weights are available at the site, as recommended. If not, they must be provided by the Contractor. These weights are for acceptance testing and will not be permanently retained by the Government.
****

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.

Each test weight for crane tests must be marked with a unique

identification number and the weight in pounds. The weight marked must be the actual weight taken from the scale or other measuring device. Solid weights must be measured using calibrated equipment traceable to the National Institute of Standards and Technology (NIST), with a minimum accuracy of plus or minus two percent (i.e., indicated weight must be within plus or minus two percent of actual weight). A list of test weights, with identification numbers and weights, must be retained. The list must include the type and serial number (or other identifier) of the weighing device(s) used to weigh the test weights. Where a lifting attachment supports multiple test weights (e.g., stacked weights or multiple weights suspended from a padeye), the total capacity must be marked on the attachment. All rigging gear must meet OSHA and ASME requirements.

]3.4.2.2 No-Load Test

a. Record and submit the hook tram measurement for each hoist. 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.

b. 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 hoist brake operation in every stopping condition, including emergency stop and loss of power. Operate the bridge and trolley in each direction the full distance between end stops and bring bumpers into contact with the end stops. Operate through the entire speed range and verify proper brake operation for each function. Verify correct operation of all indication and ancillary devices.

c. Verify proper operation of hoist limit switches: Slowly raise the hoist into the primary upper limit switch and verify that the hoist stops when the limit switch is tripped and the hook is only capable of lowering. Ensure that the full speed runout distance after primary limit switch activation is less than the travel distance required to activate the secondary upper limit.

(1) Test the primary upper limit again, gradually increasing speed to full speed and verify that the secondary limit is not tripped when the primary limit is engaged at full speed.

(2) Raise the hook slowly through the upper limit switch by using the limit switch bypass (where applicable). Activate the secondary hoist upper limit switch.

(3) Slowly lower the hoist into the lower limit switch and verify that the hoist stops when the limit switch is tripped and the hook is only capable of raising.

3.4.2.3 Load Tests

****

NOTE: For NAVFAC, require a rated load test of 100 percent (plus 0 / minus 10) and an overload test of 125 percent (plus 0 / minus 5) of the rated load.

****

a. Perform the following tests, as specified below.

b. Test loads used in this subpart defined as the following:

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

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

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

3.4.2.3.1 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 300 mm 1 foot below the primary upper limit at slow speed. Hoist down to the 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.

3.4.2.3.2 Rated Load Test

3.4.2.3.2.1 Hoist

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

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

c. Hoist Loss of Power Test: Raise the test load to approximately 3000 mm 10 feet. While slowly lowering the test load, disconnect the crane's main power source via the wall (floor level) disconnect. Verify that the test load does not lower and that the brake is set.

3.4.2.3.2.2 Trolley

With a test load on the hook, operate the trolley (if space is available) the full distance of the bridge rails in each direction and through the range of speeds. Use extreme caution. Verify proper brake action and stopping distance.

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 via the wall (floor level) 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.

3.4.2.3.2.3 Bridge

With the trolley at one end of the bridge, operate the bridge the full distance of the runway (if space is available). With the trolley at the opposite end of the bridge, operate the bridge in the opposite direction the full distance of the runway (if space is available). Use extreme caution. Check proper functioning through the range of speeds. Check for any binding of the bridge end trucks. Verify proper brake action and stopping distance.

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 via the wall (floor level) 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.

3.4.2.3.3 Overload Test

3.4.2.3.3.1 Hoist

****

NOTE: The typical hoist brake configuration will be one electro-mechanical spring set brake and one mechanical load brake. The bracketed option in paragraph a. for hoists with primary and secondary holding brakes will not typically be needed and should generally be removed. The bracketed option for paragraph c. Hoist Mechanical Load Brake will generally be included.

For hoists using closed loop controls, add in the bracketed option in paragraph a. that includes provisions for independently testing each brake. Remove the bracketed option for paragraph c. Hoist Mechanical Load Brake.

****

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 1 foot. Hold the load for 10 minutes. Rotate the load and hook 360 degrees clockwise and counterclockwise to check bearing operation with no binding. Observe for lowering of the load, which may indicate a malfunction of hoisting components or brakes.

[(1) For hoists with primary and secondary holding brakes, raise the test load approximately 300 mm 1 foot 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. Re-engage

the primary holding brake. Recheck proper operation of time delay and ensure smooth positive stopping.

] b. Dynamic Load Test: Raise and lower test load and visually observe smooth control and acceleration between points or speed range. Stop the load during raising and lowering to verify that the brakes hold the load.

[c. Hoist Mechanical Load Brake (or Self-locking Worm Gear): Raise test load approximately 1500 mm 5 feet. With the hoist controller in the neutral position, release 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 neutral 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 3000 mm 10 feet. While slowly lowering the test load, disconnect the crane's main power source via the wall (floor level) disconnect. Verify that the test load does not lower and that the brake is set; Ensure the load stops moving before returning the controller to the neutral position and the brake is set.

3.4.2.3.3.2 Trolley

With a test load on the hook, operate the trolley (if space is available) the full distance of the bridge rails in each direction and through the range of speeds. Use extreme caution. Verify proper brake action.

3.4.2.3.3.3 Bridge

With the trolley at one end of the bridge, operate the bridge the full distance of the runway (if space is available). With the trolley at the opposite end of the bridge, operate the bridge in the opposite direction the full distance of the runway (if space is available). 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.

[3.5 MANUFACTURER'S FIELD SERVICE REPRESENTATIVE

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NOTE: This subpart is only recommended for larger and more involved projects. Provide consideration for number of cranes, type (power source) of cranes, and local command experience with cranes.

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Furnish a qualified experienced crane contractor 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 (as applicable).

[3.7 FIELD TRAINING

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NOTE: Training is recommended, but not required.

Additional items that could be included in the blank: general review of the entire capabilities, limitations, and safety features of the crane.
****

Conduct a training course for[eight] [_____] operating and maintenance staff[and provide a copy of the training material to each participant]. Provide a training period consisting of a total of [4][8][_____] 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 basic troubleshooting[, and [_____]].

] -- End of Section --