UNIFIED FACILITIES GUIDE SPECIFICATIONS

References are in agreement with UMRL dated January 2021
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-- End of Section Table of Contents --

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USACE / NAVFAC / AFCEC / NASA | **UFGS-41 22 23.19 (May 2020)**

Preparing Activity: NAVFAC | **Superseding 41 22 23.19 (April 2008)**

UNIFIED FACILITIES GUIDE SPECIFICATIONS

References are in agreement with UMRL dated January 2021

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SECTION 41 22 23.19

MONORAIL HOISTS

05/20

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NOTE: This guide specification covers the requirements for monorail hoists with manual, electric, or air powered lifting chains or wire rope; with or without manual, electric or air powered trolleys and other accessories; suitable for indoor or outdoor use in general purpose service, ordnance handling service, or hazardous area environments.

This guide specification incorporates the design criteria and requirements identified in NAVCRANECEN INSTRUCTION 11450.2A (December 2018).

This guide specification includes tailoring options for NAVFAC, pounds (per NAVFAC P-307), and tons. The NAVFAC tailoring option also includes requirements specific to the Navy and Marine Corps. Crane procurements for the Navy and Marine Corps must select the NAVFAC tailoring option.

Crane tailoring options are included for the Air Force, outdoor, ordnance/explosives handling, or hazardous (explosive) environments. Only one unique specialized application tailoring option should be selected at a time, however multiple can be used with additional specific project editing in the resulting sections. "General Purpose Service" is the default crane condition unless an alternate specialized tailoring option is selected. When "Maximum Anti-Spark" protection is required, the "Minimum Anti-Spark" tailoring option MUST ALSO be selected as the maximum requirements are in addition to the minimum 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.

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. Of particular note, if procurement is to go on an existing monorail system, all references to installing and testing a new monorail and associated equipment such as end stops must be removed.

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

****
NOTE: Use this guide specification to specify cranes that are procured as part of a building construction contract for such applications as machine shops, warehouses, and other areas that do require specialized weight handling equipment.

Forward all procurement of OET systems at Naval Shore based activities with rated capacities of 9000 kg 20,000 pounds or greater or for use in specialized applications (e.g. ordnance handling, molten metal handling, special purpose service as defined in NAVSEA Publication 0989-030-7000, hazardous/explosive area environments, or precision handling operations requiring complex or synchronized lifting capacity) to: Naval Facilities Engineering Command, Navy Crane Center, Building 491, Norfolk Naval Shipyard, Portsmouth, Va., 23709-5000. (See NAVFAC Instruction 11450.1B of 28 March 2014).
****

****
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.

Terminology: - refer to DEFINITIONS in this specification.

a. Ordnance/Explosives Handling – Cranes handling palletized or unpackaged ammunition, missiles,

torpedoes, and other types of ordnance. Hoists are required to must meet ASME HST-1 and ASME HST-4 duty class H4 (electric chain or wire rope hoists), ASME HST-5 and HST-6 duty class A4 (air chain and wire rope hoists), or the requirements of ASME HST-2 and ASME HST-3 (manual chain and manual lever hoists). Hoists are also required to have two brakes.

b. Hazardous (Explosive) Environments – Cranes operating in hazardous environments as defined by the cognizant activity safety office shall be equipped with electrical safety features that meet NEC Article 500. The activity safety office shall identify the specific Class, Division, and Group, as well as the envelope that the hazard exists, to allow proper design. Materials for mechanical components shall 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.

c(1) Minimum Anti-Spark Protection applies when only the load block enters the hazardous area.

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

****

****

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

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

****

****

NOTE: Indicate on the plan drawings a schematic line for the location of the centerline of monorail track beam, including curves and switches. Only indicate the dimensions that are critical to locating points such as the end of the travel range of the hoist operating hook at each end of the track beam. Indicate any critical clearance requirements for the area adjacent the monorail track beam.

Indicate on the elevation drawings a generic elevation for the monorail beam. Only indicate the dimensions that are critical to locating points such as the ends of the vertical travel range of the hoist operating hook. Indicate any clearance requirements for the area above the monorail track beam.

When there is one hoist on one monorail system, the capacity rating of the monorail track beam and beam hangers must be equal to the hoist capacity. When there is more than one hoist on the monorail track beam, design and construct the monorail track beam and beam hangers for the most stressful positioning of the hoists on the track beam.

Indicate on the plan drawings the 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 MECHANICAL ENGINEERS (ASME)

ASME B30.10	(2019) Hooks
ASME B30.16	(2017) Overhead Underhung and Stationary Hoists
ASME B30.17	(2015) Overhead and Gantry Cranes (Top Running Bridge, Single Girder, Underhung Hoists)
ASME HST-1	(2012) Performance Standard for Electric Chain Hoists

ASME HST-2	(2014) Performance Standard for Hand Chain Manually Operated Chain Hoists
ASME HST-3	(2017) Performance Standard for Lever Hoists
ASME HST-4	(2016) Performance Standard for Overhead Electric Wire Rope Hoists
ASME HST-5	(2014) Performance Standard for Air Chain Hoists
ASME HST-6	(2020) Performance Standard for Air Wire Rope Hoists
ASME NUM-1	(2016) Rules for Construction of Cranes, Monorails, and Hoists with Bridge or Trolley or Hoist of the Underhung Type.

AMERICAN WELDING SOCIETY (AWS)

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

ASTM INTERNATIONAL (ASTM)

ASTM A275/A275M	(2018) Standard Practice for Magnetic Particle Examination of Steel Forgings
ASTM E125	(1963; R 2013) Photographs for Magnetic Particle Indications on Ferrous Castings
ASTM E543	(2015) Standard Practice for Agencies Performing Non-Destructive Testing
ASTM E1417/E1417M	(2016) Standard Practice for Liquid Penetrant Testing
ASTM F3125/F3125M	(2019) Standard Specification for High Strength Structural Bolts and Assemblies, Steel and Alloy Steel, Heat Treated, Inch Dimensions 120 ksi and 150 ksi Minimum Tensile Strength, and Metric Dimensions 830 MPa and 1040 MPa Minimum Tensile Strength

CRANE MANUFACTURERS ASSOCIATION OF AMERICA (CMAA)

CMAA 74	(2015) Specifications for Single Girder Cranes

ELECTRIFICATION AND CONTROLS MANUFACTURERS ASSOCIATION (ECMA)

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

MATERIAL HANDLING INDUSTRY OF AMERICA (MHI)

MHI MH27.1	(2009) Specifications for Underhung Cranes and Monorail Systems
MHI MH27.2	(2009) Specifications for Enclosed Track Underhung Cranes and Monorail Systems

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA 250	(2018) Enclosures for Electrical Equipment (1000 Volts Maximum)
NEMA ESPG	(2009-2010) Electrical Standards and Product Guide (ESPG)
NEMA ICS 2	(2000; R 2005; Errata 2008) Industrial Control and Systems Controllers, Contactors, and Overload Relays Rated 600 V
NEMA ICS 5	(2017) Industrial Control and Systems: Control Circuit and Pilot Devices
NEMA ICS 6	(1993; R 2016) Industrial Control and Systems: Enclosures
NEMA ICS 8	(2011) Crane and Hoist Controllers
NEMA MG 1	(2018) Motors and Generators
NEMA MG 2	(2014) Safety Standard for Construction and Guide for Selection, Installation and Use of Electric Motors and Generators

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

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

RESEARCH COUNCIL ON STRUCTURAL CONNECTIONS (RCSC)

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

SOCIETY FOR PROTECTIVE COATINGS (SSPC)

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

U.S. AIR FORCE (USAF)

AFMAN 91-118	(2010) Safety Design and Evaluation Criteria for Nuclear Weapon Systems

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 1910.306	Specific Purpose Equipment and Installations

U.S. NAVAL SEA SYSTEMS COMMAND (NAVSEA)

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

UNDERWRITERS LABORATORIES (UL)

UL 1004-1	(2012; Reprint Nov 2020) UL Standard for Safety Rotating Electrical Machines - General Requirements

1.2 DEFINITIONS

a. Monorail Track: The track system along which the crane operates horizontally, including track hangar rods, track connection devices, and runway structural supports.

b. 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.

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

d. 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.

e. Enclosed Track: A generic term referring track built in accordance with MHI MH27.2 whose related equipment operates on the internal lower operating or running flange of such track.

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

g. 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.

h. Operating Environments:

h(1) General Purpose Service: This applies to most cranes and are, in large measure, the manufacturers' standard designs. Cranes should be classified as General Purpose Service if they are operating in routine environments.

h(2) Ordnance/Explosives Handling: Cranes handling palletized or

unpackaged ammunition, missiles, torpedoes, and other types of ordnance. Hoists are required to must meet ASME HST-1 and ASME HST-4 duty class H4 (electric chain or wire rope hoists), ASME HST-5 and ASME HST-6 duty class A4 (air chain and wire rope hoists), or the requirements of ASME HST-2 and ASME HST-3 (manual chain and manual lever hoists). Hoists are also required to have two brakes.

h(3) Hazardous (Explosive) Environments: Cranes operating in hazardous environments as defined by the cognizant activity safety office must be equipped with electrical safety features that meet NFPA 70 Article 500. The activity safety office must identify the specific Class, Division, and Group, as well as the envelope that the hazard exists, to allow proper design and must list these in this section. Materials for mechanical components must be chosen to minimize the potential for sparking, typically bronze, stainless steel, or aluminum. Hazardous environments are split into two groups: minimum anti-spark protection and maximum anti-spark protection.

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

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

1.3 SYSTEM DESCRIPTION

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

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

]1.3.1 Crane Design Criteria

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

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

1.3.1.1 General

****
NOTE: Add number of hoists, building name, and hoist rated load capacity in kilograms pounds.
****

Include the following: Number of hoists [_____], located in building identified as [_____], with the capacity expressed in [_____] metric tons tons kilograms pounds, for each hoist. Also clearly locate and identify each hoist and system components.

1.3.1.2 Classification

****
NOTE: For NAVFAC, specify ASME HST-1 and ASME HST-4 duty class H3 (electric) or ASME HST-5 and ASME HST-6 duty class A4 (air hoist) or higher.
****

****
NOTE: Refer to NFPA 70 for environmental requirements.
****

****
NOTE: Operating Environments

General Purpose Service: This applies to most cranes and are, in large measure, the manufacturers' standard designs. Cranes should be classified as General Purpose Service if they are operating in routine environments. Cranes operating in non-routine environments or unique, dedicated service should meet the requirements of one of the below Specialized Applications:

Ordnance/Explosives Handling: Cranes handling palletized or unpackaged ammunition, missiles, torpedoes, and other types of ordnance. Specify duty class as described in the paragraph DEFINITIONS for ordnance.

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

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

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

Provide a monorail system with [manual hoist][electric powered hoist][air-powered hoist] and [plain type (hand operated)][hand chain operated][electric powered]trolley for operation in an [indoor] [outdoor] environment, [general purpose] [ordnance handling] [hazardous area] service, with an ambient temperature range of [_____] to [_____] degrees Celsius Fahrenheit. This hoist must operate in an NFPA 70 Class [_____], Division [_____], Group [_____] hazardous area. Hazardous protection is required for the [full height of the crane] [18 inches above ground level] [_____]. Monorail, hoist, trolley, equipment, materials, installation, examination, inspection, and workmanship shall conform to the applicable requirements of NFPA 70, ASME B30.17, ASME B30.16,[ASME HST-1,][ASME HST-2,][ASME HST-3,][ASME HST-4,][ASME HST-5,][ASME HST-6,] MHI MH27.1[and MHI MH27.2], as modified and supplemented by this specification.

The hoist must be [pendant controlled] [radio controlled] and operate in the spaces and within the loading conditions indicated. The hoist must operate on [_____psi tool air] [[_____]-volts AC, 60 Hz [_____], [single] [three] phase] power source. Maximum trolley wheel loads (without impact) due to dead, trolley, and lifted loads, with the trolley in any position, must not cause a more severe loading condition in the track support structure than that produced by the design wheel loads and spacing indicated.

1.3.1.3 Rated Capacity and Speeds

****

NOTE: Plain type (hand operated) trolleys are recommended where trolley motion is infrequent or the distance is short, providing good load spotting ability and use for hoists of 3 metric ton 3 tons capacity and under. Plain type trolleys are not recommended for hoists of 3 metric ton 3 tons capacity and greater, or for tracks higher than 6 m 20 feet above the floor level. Motor operated trolleys are recommended where the operating frequency, travel distance, rated load, or beam elevation makes other types of trolleys impractical.

Unless otherwise specified, the nominal rated maximum speed of the hoists and trolley will be the manufacturer's standard within the limits of Table 2 of ASME HST-1, HST-4, HST-5, HST-6, AS APPLICABLE. For higher tonnage ratings, consult with the manufacturer(s).

****

Provide hoist with a rated capacity of [_____] metric tons tons kg pounds. The hook lift capacity and speed shall be the manufacturer's standard within the limits specified. The hoist and trolley shall meet the minimum design requirements specified in [ASME HST-1, Duty Class [H3][H4]][ASME HST-2][ASME HST-3][ASME HST-4, Duty Class [H3][H4][H5]][ASME HST-5, Duty Class [A4][A5]][ASME HST-6, Duty Class [A4][A5]].

1.4 VERIFICATION OF DIMENSIONS

The Contractor is responsible for the coordination and proper relation of their work to the building structure and to the work of all trades. Verify all dimensions of the building that relate to fabrication of the

monorail system and notify the Contracting Officer of any discrepancy before finalizing the crane order.

1.5 SUBMITTALS

****

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

For Army projects, fill in the empty brackets following the "G" classification, with a code of up to three characters to indicate the approving authority. Codes for Army projects using the Resident Management System (RMS) are: "AE" for Architect-Engineer; "DO" for District Office (Engineering Division or other organization in the District Office); "AO" for Area Office; "RO" for Resident Office; and "PO" for Project Office. Codes following the "G" typically are not used for Navy, Air Force, and NASA projects.

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

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

****

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

SD-02 Shop Drawings

Monorail Crane System; G[, [_____]]

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

SD-03 Product Data

Hoist Brakes; G[, [_____]]

[Trolley Brakes; G[, [_____]]

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

Hoist; G[, [_____]]

Trolley; G[, [_____]]

[End Stops; G[, [_____]]

][Bumpers; G[, [_____]]

][Monorail Track System; G[, [_____]]

][Motors; G[, [_____]]

][Variable Frequency Drives; G[, [_____]]

][Limit Switches; G[, [_____]]

][Air Hoist Limit Switches

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

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

][Controls; G[, [_____]]

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

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

][Overload Protection; G[, [_____]]

][[Air][Manual] Hoist Capacity Overload Protection; G[, [_____]]

][Load Indicating Device; G[, [_____]]Painting System; G[, [_____]]

] SD-05 Design Data

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

SD-06 Test Reports

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

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

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

Operational Tests; G[, [_____]]

Hook Tram Measurement; G[, [_____]]

Load Tests; G[, [_____]]

SD-07 Certificates

[Wire Rope; G[, [_____]]

][Load Chain; G[, [_____]]

][Monorail Track System Survey; G[, [_____]]

] Hazardous Material; G[, [_____]]

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

] Brake Adjustment Record; G[, [_____]]

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

SD-10 Operation and Maintenance Data

Operation and Maintenance Manuals; G[, [_____]]

1.6 QUALITY ASSURANCE

1.6.1 Manufacturer Qualification

Monorail System, including sub-system components manufactured by vendors, must be designed and manufactured by a company with a minimum of 10 years of specialized experience in designing and manufacturing the type of overhead crane required to meet requirements of the Contract Documents.

1.6.2 Pre-Delivery Inspections

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

[1.6.2.1 Inspection of Steel Castings

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

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

][1.6.2.2 Inspection of Hook Assembly

Inspect hook[by a magnetic-particle type inspection][and X-rayed][and tested ultrasonically] prior to delivery. Furnish documentation of hook inspection to Contracting Officer prior to field operational testing. As part of the acceptance standard, linear indications[greater than 1.5 mm

1/16 inch] are not allowed. Welding repairs of hook are not permitted. A hook showing linear indications, damage or deformation is not acceptable.

1.6.2.2.1 Hook Non-Destructive Test (NDT)

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

****
NOTE: For NAVFAC, substitute tailored paragraph.
****

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

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

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

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

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

][1.6.2.3 Hook Proof Test

****
NOTE: Hook proof tests are required for custom designed or non-ferrous (bronze or stainless steel) hooks. Bronze/stainless steel hooks are generally associated with minimum hazardous area requirements.
****

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

]1.6.3 Drawings

1.6.3.1 Monorail Crane System

a. Submit drawings showing the general arrangement of all components in plan, elevation, and end views. Show all major features of the crane including: [assemblies of hoist [and trolley] drive[s],]hook envelope, and the general arrangement of the track beam system with switches and curves, details of all structural connections, clearances and principal dimensions. Include weights and centers of gravity of major components.

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

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

[1.6.3.2 Complete Schematic Wiring Diagram

Provide electrical schematic drawings with motor nameplate data[, VFD drive nameplate data] and overcurrent protective device ratings

]1.6.4 Design Data: Load and Sizing Calculations

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

Submit complete list of equipment and materials, including manufacturer's descriptive data and technical literature, performance charts and curves, catalog cuts, and installation instructions. Provide a list of all codes and standards, design assumptions, equations, specified efficiencies, limits, factors of safety, component ratings, and sources of values used. Include free body diagrams or sketches of each load case.[Include seismic analysis of crane.]

1.6.5 Certificates

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

[a. Submit a Wire Rope Certification for each hoist with the wire rope manufacturer's certification that the rope meets the published breaking strength or the actual breaking strength of a sample taken from the reel and tested. Certification shall be traceable to the hoist, and reel.

][b. Submit a Load Chain Certification clearly indicating load chain breaking strength for each hoist, and clearly identified for traceability. Submit factory certification of load chain rated capacity.

][c. Submit a Monorail Track System Survey certifying monorails have been aligned in accordance with CMAA 74, MHI MH27.1, or MHI MH27.2 as applicable. If monorail(s) are existing and if the crane(s) cannot operate without restriction, the Contractor shall indicate crane limitations.

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

[e. Submit a Loss of Power Test Certificate stating that a test may be performed in which power is removed from the crane while the hoist and trolley are in operation.

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

g. Submit a certificate stating that the hoist, hook, and trolley system design and fabrication is in compliance with all listed standards.

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, MHI MH27.1, MHI MH27.2 and CMAA 74 as applicable. Welders and welding operators must be qualified in accordance with AWS D1.1/D1.1M or AWS D14.1/D14.1M.

1.7 CRANE SAFETY

Comply with the mandatory and advisory safety requirements of ASME B30.10, ASME B30.16, ASME B30.17, [ASME HST-1] [ASME HST-2] [ASME HST-3] [

ASME HST-4] [ASME HST-5] [ASME HST-6], 29 CFR 1910.147, 29 CFR 1910.306, and all applicable provisions of 29 CFR 1910 and NFPA 70.

[1.7.1 Nuclear Safety Analysis

****

NOTE: Certification is required for cranes handling nuclear materials. Results from the Safety Analysis will be utilized by the Using Agency as a basis for crane certification. Delete this paragraph if the crane is not required to handle nuclear materials.

This section is not applicable to NAVFAC projects. The Navy Crane Center must be involved with the procurement and overhaul of all NAVY cranes that handle Nuclear material as identified in the forward notes section of this specification.

****

Nuclear certification, testing, and rules of construction must be in accordance with 29 CFR 1910.147 and ASME NUM-1. Air Force Nuclear certified hoists must meet requirements of AFMAN 91-118. Submit analysis and test reports to Contracting Officer for approval.

]PART 2 PRODUCTS

2.1 MATERIALS

2.1.1 General

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

2.1.2 Nameplates

Secure nameplates to each major component of equipment with the manufacturer's name, address, type or style, model or catalog number, and serial number. Provide two monorail identification plates, one for each side of the track beam. Provide noncorrosive metal identification plates with letters which are easily read from the floor, showing a separate number such as M-1, M-2, for each monorail hoist.

2.1.3 Capacity Marking

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

2.1.4 Safety Warnings

Affix labels in a readable position to each lift block or control station

in accordance with ASME B30.16 and ASME B30.17.

2.2 STRUCTURAL REQUIREMENTS

Structural steel materials must conform to the standards permitted in CMAA 74, MHI MH27.1, MHI MH27.2 and AISC 360 as applicable.

2.2.1 Structural Connections

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

Welded connections for the crane must be performed in accordance with AWS D14.1/D14.1M. Welded connections to the building must be performed in accordance with AWS D1.1/D1.1M.

2.2.2 Monorail Track System

****

NOTE: For Monorail Hoists, track and its support structure is usually supplied by crane contractor. Use Monorail Track System only if crane contractor is to provide a new track.

Monorail tracks may be of three types. "Patented track" as defined in the definitions section and built IAW MHI MH27.1, "enclosed track" built IAW MHI MH27.2 and "rolled steel shapes" which is defined in CMAA 74. The activity may decide the track type to be used or allow the provider to decide, except ordinance handling cranes require patented track.

****

Provide the complete track suspension system that is required to hang the monorail track at its indicated location from the structural supports indicated on the drawings. Provide monorail and support structure for underrunning monorail of rolled steel shapes conforming to CMAA 74, patented track beams conforming to MHI MH27.1, or enclosed track beams conforming to MHI MH27.2.

For rolled steel shapes, locate splices under structural support members.

For patented track beams, 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 1.59 mm 1/16 inch and not greater than a vertical difference of 0.79 mm 1/16 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. Submit manufacturer's standard published tables that verify the monorail 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.

Monorail support structure must be designed, fabricated, and installed such that monorail meet the alignment tolerances of CMAA 74, MHI MH27.1 or MHI MH27.2, as applicable. Provide means to allow for vertical adjustment

of the track both before and after the system has been put in operation so that track can be erected and maintained level. Brace track to restrain against damaging lateral and longitudinal movements. Where the track is suspended from hanger rods, provide means preventing the hanger rod nuts from backing off the rods. Allowable stress in hanger rods is 20 percent of the minimum specified ultimate strength of the material used.

2.2.3 End Stops

Fit monorail track system with end stops at all open end locations. Locate stops to contact the trolley bumper and permit maximum trolley travel. Metal to metal contact at the bumper to end stop connection is not permitted.

2.2.4 Additional Provisions for Outside Service

****
NOTE: This paragraph is applicable for outdoor cranes only.
****

Provide hoist trolley with parking brakes which will sufficiently hold the crane against a wind pressure of 240 Pa 5 psf for in-service conditions. Provide hoist trolley with manually-operated pin locks at each rail, designed to securely anchor the crane against a wind pressure of 1.44 kPa 30 psf for out-of-service conditions. Design members to prevent the collection of water on crane.

2.3 MECHANICAL REQUIREMENTS

****
NOTE: For ordnance handling, further material restrictions exist.
****

Cast iron and aluminum used to support components of the hoist power transmission train must be ductile. Gray cast iron load bearing parts are prohibited.

2.3.1 Hoist

****
NOTE: Electric chain hoists (ASME HST-1) only have the possibility of hoist duty classes H2, H3, or H4.

For ordnance handling, packaged hoists must be HST-4 Duty Class H4 or better.

For ordnance handling, custom hoist shafts must have a fatigue design factor of 1.5.
****

[2.3.2 [Manual Hoist][Electric Chain Hoist][Air Chain Hoist]

Provide [manually][lever][Air] operated chain hoist conforming to ASME B30.16, and [ASME HST-2] [ASME HST-3] [ASME HST-5].[Electric chain hoist shall conform to ASME HST-1, NEMA ICS 8, NEMA MG 2, and NEMA ESPG] except as modified herein.

2.3.2.1 Hoisting Chain

a. Provide a welded link load chain.

b. Provide a chain stop or dead end connection to prevent the load chain from running out of the hoist at its fully extended position.

c. Provide chain hoists with 3 m (10 foot) lift or more with a load chain bucket.

][2.3.3 [Electric][Air]Wire Rope Hoist

Provide [Electric Wire Rope Hoist conforming to ASME HST-4][Air Powered Wire Rope Hoist conforming to ASME HST-6] except as modified herein.

2.3.3.1 Hoisting Ropes

****
NOTE: Paragraph b is shown as optional only because there is a tailored paragraph b option for minimum hazardous area. One of the two options must be chosen and included in the specification.
****

****
NOTE: For minimum anti-spark protection, add tailored paragraph section.
****

Provide the following:

a. Rope lengths sufficient to maintain a minimum of two full wraps of rope at the dead end(s) of the drum, with the block in its lowest indicated position. The wire rope must be in a double reeved configuration with the equalizing method perpendicular to the running sheaves.

b. Provide hoisting ropes with improved plow steel, extra improved plow steel, or extra-extra improved plow steel, regular lay, bright, and uncoated with an independent wire rope, wire strand, or otherwise, steel core. Hot-dipped galvanized wire rope is not permitted. Provide stainless steel hoist ropes.

2.3.3.2 Sheaves

Provide steel sheaves. Provide sheaves constructed of non-sparking materials.

2.3.3.3 Drum

Provide drum made of steel. Design the drum such that all hoisting rope is wound in a single layer and so that not less than two dead wraps of hoisting rope remain on each anchorage when the hook is in its extreme low position.

]2.3.4 Trolley

Provide a [manual][geared manual][air motor powered][electric motor powered] trolley drive designed to operate from [[_____] track beam section][the track beam section furnished under this contract]. Configure trolley such that the trolley frame contacts the track end stops or bumper of an adjacent trolley and prevents the trolley from dropping more than one inch in the event of an axle or wheel failure (drop lugs). Drop lug contact surfaces shall be of non-sparking materials.

2.3.4.1 Trolley Wheels

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

Wheel material is to be steel or ductile cast iron. Hollow stamped steel and gray cast iron wheels are prohibited. Wheels are to be made of forged steel. Provide wheels of non-sparking material. The minimum tread hardness for bronze wheels is 225 BHN.

[2.3.4.2 Bumpers

For powered trolleys, fit the trolley frames with shock-absorbing bumpers. Ensure bumpers and end stops conform to ASME B30.17. Mount bumpers so that there is no direct shear on mounting bolts (if any) upon impact. Bumpers must provide adequate clearance between the hoist and surrounding structure when compressed to preclude damaging equipment. When more than one hoist is located and operated on the same track, bumpers shall be provided on their adjacent ends or on one end of one hoist such that the trolley frame of the adjacent hoist comes in contact with the bumper.

][2.3.4.3 Trolley Brakes

****
NOTE: Only powered trolleys that don't have a non-coasting drive need a brake.
****

Provide trolley with either a non-coasting (i.e. worm) drive or with an end-mounted [air] [electro-mechanical] brake that is spring applied, [air] [electrically] released. The brakes must be equipped with a manual self-return to ON brake release and designed to permit inspection and adjustment without disassembly of the brake.

]2.3.5 Hoist Brakes

****
NOTE: NAVFAC requires each hoist to have, at a minimum, two brakes, with the exception of manual hoists and non-ordnance handling pneumatic hoists which may have only one, which is typically a mechanical load brake.
****

2.3.5.1 Hoist Mechanical Load Brake

Provide a mechanical load brake that is capable of stopping and holding [125][100]125 percent of the hoist's rated load and does not require the load to be raised before being lowered.

[2.3.5.2 Hoist Secondary Brake

Provide a spring set electro-mechanical brake that stops and holds [125][100]125 percent of the hoist's rated load. Equip spring set brake with a manual release mechanism that automatically resets when power is applied to the brake. If the hoist has more than one brake, each brake shall independently stop and hold [125][100]125 percent of rated capacity.

][2.3.5.3 Air Hoist Brake

Equip [air] hoists with a braking means that prevents the lowering of the load in the event of a loss of air supply, can stop and hold [125][100]125 percent of the hoist's rated load, and does not require the load to be raised before being lowered.

2.3.5.4 Air Hoist Secondary Brake

Ordnance handling air hoists are to be equipped with a second holding brake with a minimum torque rating of [125][100]125 percent of the rated load hoisting torque.

]2.3.6 Load Block and Hook

****
NOTE: Some text tailored to NAVFAC. For text tailored to Minimum Anti-Spark requirements, remove conflicting requirements (i.e. load block cannot simultaneously be steel.

For Ordnance Handling: The insulated link(s) are required unless the following conditions are met:
c. There is no threat of a lightning strike during operations;
d. There is no chance for contact with overhead power lines;
e. RF emissions control is in effect regardless of the HERO classification of the ordnance being held.
****

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

The load block must be constructed of steel non-sparking materials and designed to prevent metal-to-metal contact of moving parts. and designed to prevent metal-to-metal contact of moving parts. [The design must preclude the wire rope from being cut, pinched, crushed, or chafed in case of two-blocking.]The block must be clearly marked with the capacity in kilograms pounds on both sides. An insulated link must be provided on each hook block per the requirements of NAVSEA OP-5. Standard commercial blocks may be used at their published ratings when their published design factors are 5.0 or greater.

Provide an unpainted single barbed forged steel hook which complies with ASME B30.10. Provide an unpainted single barbed hook of non-sparking material with a minimum material longitudinal elongation of 16 percent in 2 inches. Bronze clad hooks are prohibited. Fit hook with a safety latch designed to preclude inadvertent displacement of slings from the hook saddle. The hook and hook nut must be removable [without unreeving of the hoist or]disassembly of the block. Provide an easily removable and reusable means to positively secure the hook nut to the hook shank. Do not weld hook nut. Uniquely mark the hook in a permanent fashion that is traceable to the NDT certification. The nut must be marked to match the hook. The hook nut must be of non-sparking materials. Hook must be free to rotate through 360 degrees when supporting the test load up to [125][100]125 percent of the rated capacity. Upper hooks of hook suspended hoists shall be of non-sparking materials.

2.3.7 Wind Speed Indicating Device

Provide a wind speed indicating device in accordance with the requirements of ASME B30.17.

[2.3.8 [Air][Manual] Hoist Capacity Overload Protection

Capacity overload protection which prevents further hoisting of a load set at or less than the crane's minimum test load. If a non-adjustable slip clutch is utilized, the OEM factory setting is acceptable and shall be identified. If the device is adjustable, it shall be adjusted to prevent hoisting in excess of the test load.

][2.3.9 Air Hoist Limit Switches

Provide a Hoist limit switch to limit hook over-travel in both the raising and lowering direction.[The lower limit switch shall be set such that there are no less than a minimum of two wraps of hoist on the hoist drum upon limit switch actuation.][For chain hoists, chain stops and an overload clutch that meets the requirements of ASME B30.16 are acceptable as upper and lower limit switches.]

2.3.10 Air Hoist Air Supply

****
NOTE: If the provided shop air is not lubricated chose the option to provide air lubricator.
****

The air supply hose must not hang below the high hook position.[Provide an air lubricator.]

][2.4 ELECTRICAL REQUIREMENTS

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.

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

electrification.

2.4.1 Motors

****

NOTE: Select two speed motors for trolley drives if magnetic controls are specified in paragraph CONTROLS; select single speed motors if electronic controls are specified in paragraph CONTROLS.

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

****

Motors must meet all applicable requirements of NEMA MG 1 and UL 1004-1. All motors must have a minimum of a 60 [30] [60] [_____] minute duty rating and be Totally Enclosed Non Ventilated (TENV), Totally Enclosed Fan Cooled (TEFC), or Totally Enclosed Blower Cooled (TEBC). Provide inverter duty motors if Variable Frequency Drives (VFD) are used. Provide motors with a minimum of Class F insulation. Provide motor overload protection utilizing a thermal sensitive device embedded in its windings. Provide motors painted to manufacturer's standard for "wash-down" service. Motors located outdoors must be furnished with anti-condensation heaters that remain energized when the mainline contactor is deenergized.

2.4.2 Controls

****

NOTE: Use the first three paragraphs to select electronic variable frequency drive controls for either the hoist or trolley.

Use the fourth paragraph to select one or two speed control for the hoist or trolley which the manufacturer may accomplish with magnetic controls or a simple VFD. Selections can be made using a combination of electronic controls and one or two speed motor controls split between the hoist and trolley.

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

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

Various VFD manufacturers offer an option to

overspeed the hoist to a value over 60Hz (usually 120Hz). This allows the operator to position the hoist at faster speeds when it is not loaded. When selecting this feature list the maximum no load speed in section "Rated Capacity and Speeds".

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

****

[Provide static reversing, variable frequency drives (VFD) for the [trolley][and][hoist] electric controls. VFD controllers must meet NEMA ICS 8, Part 8 and at a minimum, provide under-voltage protection, electronic instantaneous over current protection, DC bus over voltage protection, and be able to withstand output line to line shorts without component failure. Select trolley drive such that the continuous rating of the controller is not less than the motor full load current. Select hoist drives such that the continuous rating of the controller is not less than 125 100 percent of the motor full load current. All hoist drives must have a motor over-torque limit to lock out the hoist and prevent gross overload of the associated hoist. Provide dynamic braking for each electric drive that is sized per VFD manufacturer's requirements. Submit VFD Control Parameter Settings.

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

The [hoist][and][trolley] brakes must set after the associated controller decelerates the drive motor to a controlled stop. The hoist and trolley controllers must be sized to provide sufficient starting torque to initiate motion of that crane drive mechanism from standstill with 0 to 125 100 percent of rated load on the hook. The hoist controller must prove torque before release of the brakes and enable the drive motor to develop full torque continuously at zero speed. Motors must operate smoothly at all speeds without torque pulsations, and must only be energized within the frequency range of 50-60 Hz at rated speed.[The hoist control system may utilize overspeed up to 120hz, unloaded only, if the drivetrain equipment has all been balanced and is rated for the resulting speed.]

][Provide [one][two]-speed controls for the [trolley drive][and][hoist] drive. Controllers must meet the requirements of NEMA ICS 8. Ensure that an energized drive motor initially rotates only in the direction selected by the operator by activating the corresponding direction; i.e., is not overhauled. For AC squirrel cage motor controllers, the requirements of NEMA ICS 2, Part 2, for general-purpose controllers, must be met.

[Provide the trolley motor control systems with a drift point between OFF and the first speed control point in each direction.

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

]
[On wire rope hoist, roll-up must be less than 1/8-inch measured at the hook block and roll-back must not occur over the entire load range.

] Use of Uninterruptible Power Supplies (UPS) is prohibited. Feed control circuits from a single phase, air cooled, double wound transformer with a grounded metal screen between the primary and secondary windings of the transformer.

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

2.4.3 Protection

Protection must not be less than that required by NEMA ICS 8, CMAA 74, NFPA 70, UL 1004-1, 29 CFR 1910.147, 29 CFR 1910.306 and all applicable provisions of 29 CFR 1910. Provide enclosed type circuit breaker readily accessible to the crane operator for crane disconnect. Provide an On/Off button that removes power from the motors, brakes and control circuit on all [operator control stations][and][radio controllers]. Provide for lockout/tagout of all hazardous energy sources.

2.4.4 Resistors

Provide resistors with natural convection cooling sized as recommended by the VFD OEM and fabricated of corrosion resistant metal; the use of "wire wound" type resistors is prohibited for segments of 8 ohms or less. Mount resistors in substantial, ventilated enclosures constructed entirely of non-combustible materials. When mounted outdoors provide stainless steel resistor enclosures. Provide resistors with terminals fitted in the coolest position in the enclosure.

[2.4.5 Transients and Harmonics Protection

****
NOTE: The following items are required only for cranes with VFD or radio controls.
****

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

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

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

]]2.4.6 Limit Switches

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

Provide primary upper and lower geared limit switches. Geared limits must allow reversing direction to back out of the limit without resetting. [The lower limit switch must be set such that there are a minimum of two wraps of rope on the hoist drum.]Provide a backup mechanical hook block activated upper limit switch wired independent of the directional controllers and the primary upper limit switch that removes power from the hoist motor, hoist brake and hoist controls conforming to NEMA ICS 5. The backup limit must require hoist resetting prior to operation of the hoist in any direction. For chain hoists, chain stops and an overload clutch that meets the requirements of ASME B30.16 are acceptable as upper and lower limit switches.

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

]2.4.7 Operator Controls

****

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

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 11450.2A:
1. What type of batteries? Rechargeable?
2. Are spare batteries needed? How many?
3. Are spare remote control units required? How many?
4. Is a battery charger required?
5. Type of transmitter unit.
6. Is a belt/harness required for the remote control?

****

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

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

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

Operator controls must be rated for the NEC Hazardous Classifications specified in the Classification section of this specification.

[2.4.7.1 Pendant Pushbutton Station

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

][2.4.7.2 Radio Control System

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

][2.4.8 Runway Conductor System

Provide a rigid runway Conductor Bar System for the runway conductor system, including all necessary cables and hardware to the crane from a wall or column mounted disconnect switch. Provide electrification system with three power conductors and an equipment grounding conductor. UV resistant. Steel (non-stainless) conductor bars are prohibited. The crane must be grounded through the runway electrification system. The grounded conductors must be a minimum of 70 square millimeters. Provide runway conductors sized for simultaneous motions of the hoist, trolley

mechanisms, and any ancillary loads. If there is any way the hook block or [load chain] [wire rope] can swing into the runway electrification, provide a guard installed to prevent contact.

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

]2.4.9 Overload Protection [and Load Indicating Device]

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

The Over-Torque Limit only applies to cranes with VFD controls. It is a parameter setting in the drive and is typically set at 150 percent. Manual hoists, air hoists, and electric hoists with magnetic controls do not have this feature. Delete third paragraph if VFD controls are not specified.

Capacity Overload Protection is usually adjustable. If adjustable, it needs to be set at less than the crane's minimum test load. This protection can take the form of one of the following devices:
1. Clutch – Not adjustable and is common on package hoists.
2. Load Limit Switch – Installed on the wire rope and measures deflection. Does not require a break in the wire rope and is simply clamped onto the wire. Typically used on smaller hoists that have magnetic controls. Can also be installed as part of the equalizer sheave.
3. VFD Drive Overload Protection – Similar to the Over-Torque Limit but is set at a lower setting. Adjusted via parameters within the drive.
4. Separate Load Indicating Device – This involves the installation of a load cell and a digital readout that displays weight. The load cell is usually bolted onto the end of the wire rope or is installed as a pin in one of the sheaves.

****

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

[Provide an LID for the hoist[s]. Provide [a display][displays] installed on the underside of [each] hoist to provide load information from the load indicating system, to be displayed in kilograms pounds. The display[s] must be large enough so that the operator can read the load value[s] from the ground level. The load indicating system capacity is to be compatible with the maximum test load for each hoist. The accuracy of the load

indicating system is to be such that the indicated load is not less than 100 percent of the actual load, and not more than 110 percent of the actual load. The load indicating system must be configured with a set point for an overload limit. Provide Tare (zero) functionality at the operator's station for [the] [each] load indicating system. Any load bearing components used in the LID system must be steel, have a minimum design factor of 5 to 1 based on ultimate tensile strength and a hardness not to exceed HRC 40. Precipitation hardened stainless steel load bearing elements must be aged hardened at a minimum temperature of 1025 degrees F.

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

]2.4.10 Enclosures

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NOTE: Select classification of control panels, controls, and brakes based on the environmental conditions in which the crane will be installed:
1. Choose one of the following for an indoor installation: 1, 2, or 12.
2. Choose one of the following for an outdoor installation: 3, 4X, or 8.
3. Choose one of the following for a Class I Hazardous installation: 7 (indoor)or 8(indoor/outdoor).
4. Choose one of the following for a Class II Hazardous installation: 9 (indoor).
Other enclosure types exist that might be a better alternative for a particular installation. If necessary, refer to NEMA 250.

****

Provide enclosures for control panels, controls, and brakes in accordance with NEMA 250 and NEMA ICS 6, Classification Type [1 indoor, general purpose] [12 indoor without knockouts, general purpose] [2 indoor, drip-proof] [3 outdoor, dust-tight, rain-tight, sleet-resistant] [4X outdoor] [7 indoor Class I hazardous][9 indoor Class II hazardous] [8 indoor/outdoor Class I hazardous] [_____]. Provide enclosures with listed drains to prevent accumulation of water within the enclosure. There must not be any condensation inside the control panels. If anti-condensation heaters are provided, these heaters must remain energized when the main line contactor is deenergized.

[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.

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

[2.4.11 Warning Devices

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NOTE: A warning horn or light is required for all

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

][2.4.12 Indicator Lights

Provide Indicator Lights mounted in an enclosure on the bottom of the trolley 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.

]2.4.13 Wind Speed Indicating System

Provide a wind speed indicating device. The transmitter must be mounted on the highest unobstructed location.

][2.5 PAINTING SYSTEM

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

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.

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

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

Paint the load block [brilliant yellow] [_____] with black diagonal

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

Factory paint electrical and mechanical equipment including hoist, trolley, and track in accordance with the manufacturer's best standard practice (for the specified environment).

]2.6 IDENTIFICATION PLATES

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

2.6.1 Markings on Crane, Trolley, and Hook

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

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

PART 3 EXECUTION

3.1 EXAMINATION

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

[3.2 SHOP ASSEMBLY AND TESTS

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

]3.3 ERECTION AND INSTALLATION

Perform the entire monorail system erection in accordance with 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.[Store a copy of all Control Parameter Settings (PLC, VFD, and other microprocessor-controlled equipment).] Provide the final settings and configurations 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 configuration 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

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

3.4 FIELD QUALITY CONTROL

3.4.1 Post-Erection Inspection

After erection, the Contractor[, the Activity Crane Inspector/Test Director,] and the Contracting Officer must jointly inspect the crane monorail track and hoist systems and components to verify compliance with specifications and approved submittals. Notify the Contracting Officer [_____] 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

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

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

3.4.2.1 No-Load Test

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

3.4.3 Test Data

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

3.4.4 Hook Tram Measurement

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

3.4.5 Load Tests

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

Perform the following tests as specified below.

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

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

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

3.4.5.1 Rated Load Test

3.4.5.1.1 Hoist

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

components or brakes. Measure and verify deflection for the longest monorail beam section do not exceed MHI MH27.1/MHI MH27.2 and L/600 for rolled steel shapes design limits, as applicable.

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

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

c. Raise and lower test load through the full lift range. Stop the machinery at least once in each direction to ensure proper brake operation.

[d. Hoist Loss of Power Test: Raise the test load to approximately 2400 mm 8 feet. While slowly lowering the test load, disconnect the crane's power source. Verify that the test load does not lower and that the brake is set.

]3.4.5.1.2 Trolley

Operate the trolley the full distance of the monorail system including all curves and switches in each direction with rated load on the hook. Check proper functioning through the range of speeds. Completely stop the machinery at least once in each direction during each cycle to ensure proper brake action.

[3.4.5.1.3 Trolley Loss of Power Test

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

]3.4.5.2 Overload Test

3.4.5.2.1 Hoist

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

a. Static Load Test: With the trolley centered between vertical supports, raise the test load approximately 300 mm one foot. Hold the

load for 10 minutes. Rotate the load and hook 360 degrees to check bearing operation with no binding. Observe lowering that may occur which indicates a weakness in the structure or malfunction of hoisting components or brakes.

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

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

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

[d. Hoist Loss of Power Test: Raise the test load to approximately 2400 mm 8 feet. While slowly lowering the test load, disconnect the crane's power source. Verify that the test load does not lower and that the brake is set.

]3.4.5.2.2 Trolley

Operate the trolley the full distance of the monorail rail system including all curves and switches in each direction with a test load on the hook (one cycle) through the range of speeds. Verify proper brake action.

3.5 MANUFACTURER'S FIELD SERVICE REPRESENTATIVE

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

3.6 OPERATION AND MAINTENANCE MANUALS

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

design calculations, Control Parameter Settings and printouts of any software, and simplified wiring and control diagrams of the system as installed. Secure approval of operation and maintenance manuals prior to the field training course.

[3.7 FIELD TRAINING

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NOTE: Training is recommended, but not required.
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Conduct a training course for [_____] operating and maintenance staff[and provide a copy of the training material to each participant]. Provide a training period consisting of a total of [_____] hours of normal working time and starting after the system is functionally completed but prior to final acceptance. Cover all pertinent points involved in operating, starting, stopping, and servicing the equipment, including all major elements of the Operation and Maintenance Manuals. Demonstrate in course instructions all routine maintenance operations such as lubrication, general inspection, and [_____].

][3.8 FINAL ACCEPTANCE

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

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

] -- End of Section --