
USACE / NAVFAC / AFCEC / NASA UFGS-41 22 13.13 (April 2008)

Preparing Activity: NAVFAC Superseding
UFGS-41 22 15.00 10 (April 2006)

UNIFIED FACILITIES GUIDE SPECIFICATIONS

References are in agreement with UMRL dated April 2017

SECTION TABLE OF CONTENTS

DIVISION 41 - MATERIAL PROCESSING AND HANDLING EQUIPMENT

SECTION 41 22 13.13

BRIDGE CRANES

04/08

PART 1 GENERAL

- 1.1 REFERENCES
- 1.2 DEFINITIONS
- 1.3 SYSTEM DESCRIPTION
 - 1.3.1 Load and Sizing Calculations
 - 1.3.2 OET Design Criteria
 - 1.3.2.1 General
 - 1.3.2.2 Classification
 - 1.3.2.3 Rated Capacity and Speeds
- 1.4 SUBMITTALS
- 1.5 QUALITY ASSURANCE
 - 1.5.1 Manufacturer Qualification
 - 1.5.2 Pre-Delivery Inspections
 - 1.5.3 Certificates
 - 1.5.4 Overhead Electric Traveling (OET) Crane(s)
 - 1.5.5 Welding Qualifications and Procedures
 - 1.5.6 Safety Requirements
- 1.6 DELIVERY, STORAGE, AND HANDLING
- 1.7 EXTRA MATERIALS

PART 2 PRODUCTS

- 2.1 MATERIALS
 - 2.1.1 General
 - 2.1.2 Nameplates
 - 2.1.3 Prohibited Use of Asbestos Products
 - 2.1.4 Capacity Plates
 - 2.1.5 Safety Warnings
- 2.2 STRUCTURAL MATERIALS
 - 2.2.1 Bolts, Nuts and Washers
 - 2.2.2 Bridge Girder or Girders
 - 2.2.3 Bridge Rails or Bars
 - 2.2.4 End Ties and Bridge Girder End Connections
 - 2.2.5 Bridge End Trucks
 - 2.2.6 Trolley Frame

- 2.2.7 End Stops and Bumpers
- 2.2.8 Footwalks
- 2.2.9 Runway Rails
- 2.2.10 Operator's Cab
 - 2.2.10.1 Design
 - 2.2.10.2 Cab Construction
- 2.2.11 Additional Provisions for Outside Service
- 2.3 MECHANICAL EQUIPMENT
 - 2.3.1 Variable Frequency Drives
 - 2.3.1.1 Bridge Drives
 - 2.3.1.2 Trolley Drives
 - 2.3.1.3 Micro-Drives
 - 2.3.2 Gearing
 - 2.3.2.1 Gear Reducers
 - 2.3.2.2 Open Gearing
 - 2.3.3 Brakes
 - 2.3.4 Wheels
 - 2.3.5 Bearings
 - 2.3.6 Anti-Drip Provisions
- 2.4 ELECTRICAL COMPONENTS
 - 2.4.1 Explosion Proof Requirements
 - 2.4.2 Control Systems
 - 2.4.2.1 Travel Motion Control System
 - 2.4.2.2 Drive Control System
 - 2.4.3 Power Sources
 - 2.4.3.1 System Supply Voltage
 - 2.4.3.2 Transformers
 - 2.4.4 Motors
 - 2.4.4.1 General Requirements for Motors
 - 2.4.4.2 Bridge and Trolley Drive Motors
 - 2.4.4.3 Motor Enclosures
 - 2.4.4.4 Motor Insulation and Time Rating
 - 2.4.4.5 Bridge and Trolley Motor Insulation and Time Rating
 - 2.4.4.6 Micro-Motors
 - 2.4.5 Electric Brakes
 - 2.4.5.1 Brakes
 - 2.4.5.2 Hoist Brake Time Delay
 - 2.4.5.3 Automatic Stop System
 - 2.4.6 Control System
 - 2.4.6.1 Control Panels
 - 2.4.6.2 Bridge and Trolley Control
 - 2.4.6.3 Drift Point
 - 2.4.7 Cab Control Station
 - 2.4.7.1 General
 - 2.4.7.2 Cab Indications
 - 2.4.7.3 Cab Controls
 - 2.4.7.4 Cab Heating and Ventilating [and Air-Conditioning]
 - 2.4.8 Pendant Control Station
 - 2.4.8.1 General
 - 2.4.8.2 Operating Pushbuttons
 - 2.4.8.3 Light Indicators
 - 2.4.8.4 Pendant Drive Control
 - 2.4.8.5 Transfer of Control Stations
 - 2.4.9 Radio Remote Control, Infrared Remote Control
 - 2.4.9.1 General
 - 2.4.9.2 Transmitter
 - 2.4.10 Protection
 - 2.4.10.1 Main Line Disconnect
 - 2.4.10.2 Isolation Transformer

- 2.4.10.3 Surge Protection
- 2.4.10.4 Circuit Breakers
- 2.4.10.5 Overloads
- 2.4.11 Limit-Switches
 - 2.4.11.1 Bridge and Trolley Travel Limit-Switches
 - 2.4.11.2 Rail Clamp Limit-Switches
- 2.4.12 Wiring
- 2.4.13 Electrification
 - 2.4.13.1 Main Power Electrification
 - 2.4.13.2 Crane Runway Conductors
 - 2.4.13.3 Bridge Span Conductors
 - 2.4.13.4 Pendant Festoon System
 - 2.4.13.5 Pendant Drive System
 - 2.4.13.6 Pendant Retraction System
- 2.4.14 Special Requirements
 - 2.4.14.1 Warning Horn
 - 2.4.14.2 Accessory Power
 - 2.4.14.3 Receptacles
 - 2.4.14.4 Lighting
 - 2.4.14.5 Wind Indication and Alarm
 - 2.4.14.6 Electrically-Driven Oil Pump Alarm
- 2.4.15 Load-Limit System
 - 2.4.15.1 Load-Sensing Electronics
 - 2.4.15.2 Alarm and Indicator Light
- 2.4.16 Fungus Resistance
- 2.5 ELECTROMAGNETIC INTERFERENCE SUPPRESSION
 - 2.5.1 Shielded Cable
 - 2.5.2 EMI/RFI Shielded Boxes
 - 2.5.2.1 General
 - 2.5.2.2 Construction
 - 2.5.2.3 Attenuation
 - 2.5.2.4 Finish
 - 2.5.3 Drum Grounding

PART 3 EXECUTION

- 3.1 EXAMINATION
- 3.2 ERECTION
 - 3.2.1 Shop Assembly
 - 3.2.2 Mechanical Alignment
 - 3.2.3 Electrical Alignment
 - 3.2.4 Welding
 - 3.2.5 Field Painting
- 3.3 ACCEPTANCE TESTING
 - 3.3.1 General
 - 3.3.1.1 Test Sequence
 - 3.3.1.2 Test Data
 - 3.3.1.3 Equipment Monitoring
 - 3.3.2 Trolley Travel
 - 3.3.3 Bridge Travel
 - 3.3.4 Bridge Crane Tests
 - 3.3.4.1 Dynamic Load Tests
 - 3.3.4.2 Trolley and Bridge Loss of Power Test
 - 3.3.5 Overload Tests
 - 3.3.6 Acceleration and Deceleration Tests
 - 3.3.7 Grounding Test
 - 3.3.8 Adjustments and Repairs
- 3.4 SCHEMATIC DIAGRAMS
- 3.5 MANUFACTURER'S FIELD SERVICE REPRESENTATIVE

- 3.6 OPERATION AND MAINTENANCE MANUALS
- 3.7 FIELD TRAINING
- 3.8 FINAL ACCEPTANCE

-- End of Section Table of Contents --

USACE / NAVFAC / AFCEC / NASA UFGS-41 22 13.13 (April 2008)

Preparing Activity: NAVFAC Superseding
UFGS-41 22 15.00 10 (April 2006)

UNIFIED FACILITIES GUIDE SPECIFICATIONS

References are in agreement with UMRL dated April 2017

SECTION 41 22 13.13

BRIDGE CRANES

04/08

NOTE: This guide specification covers the requirements for overhead electric traveling (OET) bridge cranes with capacities greater than 9 tons 10 tons 9072 kg 20,000 pounds, but less than 27 metric tons 30 tons 27,000 kg 60,000 pounds, suitable for [indoor][or outdoor] use in [hazardous][or non-hazardous] environments.

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).

Forward all procurement of crane systems at Naval Shore based activities with rated capacities of 9072 kg (20,000 pounds) or greater, or for use in specialized applications to: Naval Facilities Engineering Command, Navy Crane Center, Building 491, Norfolk Naval Shipyard, Portsmouth, Va., 23709-5000. (See NAVFAC Instruction 11450.1a of 22 January, 1997).

PART 1 GENERAL

NOTE: Use SECTION 41 22 13.14 for BRIDGE CRANES, OVERHEAD ELECTRIC, TOP RUNNING, (under 9 tons 10 tons 9072 kg 20,000 pounds capacity, CMAA 70 - Class

A, B, or C.)

Use SECTION 41 22 13.15 for BRIDGE CRANES, OVERHEAD ELECTRIC, UNDER RUNNING, (under 9 tons 10 tons 9072 kg 20,000 pounds capacity, CMAA 74 - Class A, B, or C.)

Use SECTION 41 22 23.19 for MONORAIL HOISTS (manual, electric, or air-powered.

Types of crane covered, (more than 9.07 tons 10 tons 9072 kg 20000 pounds, but less than 27.2 tons 30 tons 27215 kg 60000 pounds, including:

(1) top-running bridge and trolley, multiple-girder, with CMAA 70 service class of A through E,

(2) top-running bridge/gantry, underhung trolley, single girder, with CMAA 74 service class of moderate, and

(3) underhung bridge/gantry and trolley, single-girder, with CMAA 74 service class of moderate.

Control types and systems may be specified as follows:

1. Remote, Cab, or Pendant Crane Controls or a combination of the three can be provided.

2. Alternating current or dc control systems can be specified.

Crane Terminology: - refer to DEFINITIONS in this specification.

a. Top-running bridge is a bridge which travels on the top surface of rails of a fixed runway structure.

b. Top-running Trolley is a trolley which travels on the top surfaces of rails of the bridge girder(s).

c. Under-running Trolley is a trolley/hoist unit which travels on the bottom flange of the bridge girder.

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 GEAR MANUFACTURERS ASSOCIATION (AGMA)

AGMA ISO 10064-6	(2010A) Code of Inspection Practice - Part 6: Bevel Gear Measurement Methods
AGMA ISO 17485	(2008A; Supplement 2008) Bevel Gears - ISO System of Accuracy (Including Supplement - Tolerance Tables 2008)
ANSI/AGMA 2001	(2004D; R 2010) Fundamental Rating Factors and Calculation Methods for Involute Spur and Helical Gear Teeth
ANSI/AGMA 2011	(2014B) Cylindrical Wormgearing Tolerance and Inspection Methods
ANSI/AGMA 2015-1	(2001A; R 2014) Accuracy Classification System - Tangential Measurements for Cylindrical Gears
ANSI/AGMA 6013	(2006A; R 2011) Standard for Industrial Enclosed Gear Drives
ANSI/AGMA 6113	(2016B) Standard for Industrial Enclosed Gear Drives (Metric Edition)

AMERICAN INSTITUTE OF STEEL CONSTRUCTION (AISC)

AISC 325	(2011) Steel Construction Manual
----------	----------------------------------

AMERICAN SOCIETY OF HEATING, REFRIGERATING AND AIR-CONDITIONING ENGINEERS (ASHRAE)

ASHRAE 90.1 - IP	(2016) Energy Standard for Buildings Except Low-Rise Residential Buildings
ASHRAE 90.1 - SI	(2016) Energy Standard for Buildings Except Low-Rise Residential Buildings

AMERICAN WELDING SOCIETY (AWS)

AWS D1.1/D1.1M	(2015; Errata 1 2015; Errata 2 2016)
----------------	--------------------------------------

Structural Welding Code - Steel

AWS D14.1/D14.1M

(2005) Specification for Welding
Industrial and Mill Cranes and Other
Material Handling Equipment

ASME INTERNATIONAL (ASME)

ASME B30.10

(2014) Hooks

ASME B30.16

(2012) Overhead Hoists (Underhung)

ASME B30.17

(2015) Overhead and Gantry Cranes (Top
Running Bridge, Single Girder, Underhung
Hoists)

ASME B30.2

(2011) Overhead and Gantry Cranes (Top
Running Bridge, Single or Multiple Girder,
Top Running Trolley Hoist)

ASME HST-1

(2012) Performance Standard for Electric
Chain Hoists

ASME HST-4

(2016) Performance Standard for Overhead
Electric Wire Rope Hoists

ASME NOG-1

(2015) Rules for Construction of Overhead
and Gantry Cranes (Top Running Bridge,
Multiple Girder)

ASME NUM-1

(2016) Rules for Construction of Cranes,
Monorails, and Hoists with Bridge or
Trolley or Hoist of the Underhung Type.

ASTM INTERNATIONAL (ASTM)

ASTM A1023/A1023M

(2015) Standard Specification for Stranded
Carbon Steel Wire Ropes for General
Purposes

ASTM A159

(1983; R 2011) Standard Specification for
Automotive Gray Iron Castings

ASTM A275/A275M

(2015) Standard Test Method for Magnetic
Particle Examination of Steel Forgings

ASTM A307

(2014) Standard Specification for Carbon
Steel Bolts and Studs, 60 000 PSI Tensile
Strength

ASTM A325

(2014) Standard Specification for
Structural Bolts, Steel, Heat Treated,
120/105 ksi Minimum Tensile Strength

ASTM A325M

(2014) Standard Specification for
Structural Bolts, Steel, Heat Treated, 830
MPa Minimum Tensile Strength (Metric)

ASTM A490

(2014a) Standard Specification for

	Structural Bolts, Alloy Steel, Heat Treated, 150 ksi Minimum Tensile Strength
ASTM A490M	(2014a) Standard Specification for High-Strength Steel Bolts, Classes 10.9 and 10.9.3, for Structural Steel Joints (Metric)
ASTM A563	(2015) Standard Specification for Carbon and Alloy Steel Nuts
ASTM A563M	(2007; R 2013) Standard Specification for Carbon and Alloy Steel Nuts (Metric)
ASTM A668/A668M	(2016) Standard Specification for Steel Forgings, Carbon and Alloy, for General Industrial Use
ASTM A931	(2008; R 2013) Standard Test Method for Tension Testing of Wire Ropes and Strand
ASTM B438	(2013) Standard Specification for Sintered Bronze Bearings (Oil Impregnated)
ASTM B439	(2008) Standard Specification for Iron-Base Sintered Bearings (Oil-Impregnated)
ASTM B633	(2015) Standard Specification for Electrodeposited Coatings of Zinc on Iron and Steel
ASTM E125	(1963; R 2013) Photographs for Magnetic Particle Indications on Ferrous Castings
ASTM F436	(2011) Hardened Steel Washers
ASTM F436M	(2011) Hardened Steel Washers (Metric)
ASTM F959	(2013) Compressible-Washer-Type Direct Tension Indicators for Use with Structural Fasteners
ASTM F959M	(2013) Compressible-Washer-Type Direct Tension Indicators for Use with Structural Fasteners (Metric)

CRANE MANUFACTURERS ASSOCIATION OF AMERICA (CMAA)

CMAA 70	(2010) Specification for Top Running Bridge and Gantry Type Multiple Girder Electric Overhead Traveling Cranes, No. 70
CMAA 74	(2010) Specifications for Top Running and Under Running Single Girder Electric Overhead Cranes Utilizing Under Running Trolley Hoist, No. 74

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA 250	(2014) Enclosures for Electrical Equipment (1000 Volts Maximum)
NEMA ICS 2	(2000; R 2005; Errata 2008) Industrial Control and Systems Controllers, Contactors, and Overload Relays Rated 600 V
NEMA ICS 3	(2005; R 2010) Medium-Voltage Controllers Rated 2001 to 7200 V AC
NEMA ICS 5	(2000; R 2010) Control Circuit and Pilot Devices
NEMA ICS 6	(1993; R 2011) Industrial Control and Systems: Enclosures
NEMA ICS 8	(2011) Crane and Hoist Controllers
NEMA MG 1	(2016) Motors and Generators

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(2017) National Electrical Code
---------	---------------------------------

SOCIETY FOR PROTECTIVE COATINGS (SSPC)

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

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

29 CFR 1910	Occupational Safety and Health Standards
29 CFR 1910.147	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

UNDERWRITERS LABORATORIES (UL)

UL 1004-1	(2012; Reprint Jun 2016) UL Standard for Safety Rotating Electrical Machines - General Requirements
UL 1449	(2014; Reprint Mar 2016) UL Standard for Safety Surge Protective Devices
UL 489	(2016) UL Standard for Safety Molded-Case Circuit Breakers, Molded-Case Switches and Circuit-Breaker Enclosures
UL 50	(2015) UL Standard for Safety Enclosures for Electrical Equipment, Non-Environmental Considerations

1.2 DEFINITIONS

- a. Crane Bridge: That part of an overhead crane system consisting of girder(s), end trucks, end ties, walkway, and drive mechanism which carries the trolley(s) and travels along the runway rails parallel to the runway.
- b. Crane Runway: The track system along which the crane operates horizontally, including track hangar rods, track connection devices, and runway structural supports.
- c. Dead Loads: The loads on a structure which remain in a fixed position relative to the structure.
- d. Girder: The principal horizontal beam of the crane bridge. It is supported by the crane end trucks. Normally the crane trolley mounted hoist is suspended from the girder below the crane.
- e. Live Load: A load which moves relative to the structure under consideration.
- f. Pendant: A control for a hoist and/or a crane. The pendant hangs from the hoist or the crane by a cable at a height that is easy for the operator to reach.
- g. Rated Load: For the purpose of this specification the rated load is defined as the maximum working load suspended under the load hook. Load block and wire ropes, conforming to ASTM A1023/A1023M and ASTM A931 are not included in the rated load.
- h. 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 should have been published or copyrighted prior to the issue date of this solicitation bearing a document identification number or bulletin number.
- i. Top Running Crane: An electric overhead traveling crane that runs on rails on top of support beams. The load is supported by the entire cross-section of the beam.
- j. Trolley Mounted Hoist: A combined unit consisting of a wheeled trolley that provides horizontal motion along the bridge girder, and a hoist suspended from the trolley, that provides lifting and lowering of a freely suspended load.
- k. Under running (Underhung) Crane: An electric overhead traveling crane that is supported by crane end trucks suspended below the crane runway. The load is supported by hanging from the lower flange of a beam.

1.3 SYSTEM DESCRIPTION

The requirements for the crane runway and rail supporting structures are specified in Section 05 12 00 STRUCTURAL STEEL.

1.3.1 Load and Sizing Calculations

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

Submit complete list of equipment and materials, including manufacturer's descriptive data and technical literature, performance charts and curves, catalog cuts, and installation instructions. Submit calculations verifying the sizing of the bridge girder, end trucks and travel drives. [Include seismic analysis of bridge girder and end trucks.]

1.3.2 OET Design Criteria

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

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

1.3.2.1 General

**NOTE: Add number of cranes, building name and crane
rated load capacity (tonnage)(pounds).**

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

1.3.2.2 Classification

**NOTE: The CMAA 74 specification covers top running
and under running single girder electric traveling
cranes utilizing an under running trolley hoist,
with a CMAA 70 Duty Class rating of A, B, or C.
Refer to NFPA 70 for environmental requirements.
Make a selection from the following CMAA 70 service
classifications:**

**Class A (Standby or Infrequent Service): This
service covers cranes which may be used in
installations such as powerhouses, public utilities,
turbine rooms, motor rooms and transformer stations**

where precise handling of equipment at slow speeds with long, idle periods between lifts are required. Capacity loads may be handled for initial installation of equipment and for infrequent maintenance.

Class B (Light Service): This service covers cranes which may be used in repair shops, light assembly operations, service buildings, light warehousing, etc., where service requirements are light and the speed is slow. Loads may vary from no load to occasional full rated loads with 2 to 5 lifts per hour, averaging 3 m (10 feet) per lift.

Class C (Moderate Service): This service covers cranes which may be used in machine shops of paper mill machine rooms, etc., where service requirements are moderate. In this type of service the crane will handle loads which average 50 percent of the rated capacity with 5 to 10 lifts per hour, averaging 4.5 m (15 feet), not over 50 percent of the lift at rated capacity.

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

Class E (Severe Service): This type of service requires a crane capable of handling loads approaching rated capacity throughout its life. Applications may include magnet, bucket, magnet/bucket combination cranes for scrap yards, cement mills, lumber mills, fertilizer plants, container handling, etc., with 20 or more lifts per hour at or near the rated capacity.

Class F (Continuous Severe Service): This type of service requires a crane capable of handling loads approaching rated capacity continuously under severe service conditions throughout its life. Applications may include custom designed specialty cranes essential to performing the critical work tasks affecting the total production facility. These cranes must provide the highest reliability with special attention to ease of maintenance features.

Provide crane designed and constructed to [CMAA 70 Class [____], [____] service] [CMAA 74 [Duty Class A][Duty Class B][Duty Class C] service] requirements for operation in [indoor] [outdoor] [hazardous]

[non-hazardous] environment with [multiple girder hoist system][electric chain hoist conforming to ASME HST-1][electric wire rope hoist conforming to ASME HST-4].

1.3.2.3 Rated Capacity and Speeds

NOTE: Select rated speed under full load for the main hoist, auxiliary hoist (if specified) bridge and trolley from the following: (Speeds are in meters per second (feet per minute)). In the following tabulations, the slow speeds apply to Class A and B service, the medium speeds to Class C and D service, and the fast speeds to Class E service. Speeds are in millimeters per second or feet per minute.

Loads are stated in tons, and pounds per NAVFAC P-307.

1. FLOOR OPERATED INDUSTRIAL CRANES (meters per second)										
RATED		HOIST			TROLLEY			BRIDGE		
LOAD tons-pounds		Slow	Medium	Fast	Slow	Medium	Fast	Slow	Medium	Fast
4.5	9,000	0.10	0.15	0.25	0.25	0.38	0.51	0.51	0.76	0.89
9	18,000	0.08	0.13	0.18	0.25	0.38	0.51	0.52	0.76	0.89
14	28,000	0.08	0.10	0.13	0.25	0.38	0.51	0.51	0.76	0.89
18	36,000	0.08	0.10	0.13	0.25	0.38	0.51	0.51	0.76	0.89
23	46,000	0.05	0.10	0.13	0.25	0.38	0.51	0.38	0.51	0.76
27	54,000	0.05	0.08	0.13	0.25	0.38	0.51	0.38	0.51	0.76

1. FLOOR OPERATED INDUSTRIAL CRANES (feet per minute)										
RATED		HOIST			TROLLEY			BRIDGE		
LOAD tons-pounds		Slow	Medium	Fast	Slow	Medium	Fast	Slow	Medium	Fast
5	10,000	20	30	50	50	75	100	100	150	175
10	20,000	15	25	35	50	75	100	100	150	175
15	30,000	15	20	25	50	75	100	100	150	175
20	40,000	15	20	25	50	75	100	100	150	175

1. FLOOR OPERATED INDUSTRIAL CRANES (feet per minute)										
RATED		HOIST			TROLLEY			BRIDGE		
LOAD tons-pounds		Slow	Medium	Fast	Slow	Medium	Fast	Slow	Medium	Fast
25	50,000	10	20	25	50	75	100	75	100	150
30	60,000	10	15	25	50	75	100	75	100	150

2. CAB OPERATED INDUSTRIAL CRANES (meters per second)										
RATED		HOIST			TROLLEY			BRIDGE		
LOAD tons-pounds		Slow	Medium	Fast	Slow	Medium	Fast	Slow	Medium	Fast
9	18,000	0.15	0.30	0.46	0.64	0.76	1.02	1.02	1.52	2.03
14	28,000	0.15	0.23	0.30	0.64	0.76	1.02	1.02	1.52	2.03
18	36,000	0.10	0.15	0.20	0.84	0.76	1.02	1.02	1.52	2.03
23	46,000	0.08	0.13	0.15	0.51	0.76	1.02	1.02	1.52	2.03
27	54,000	0.08	0.13	0.15	0.51	0.76	1.02	1.02	1.52	1.78

2. CAB OPERATED INDUSTRIAL CRANES (feet per minute)										
RATED		HOIST			TROLLEY			BRIDGE		
LOAD tons-pounds		Slow	Medium	Fast	Slow	Medium	Fast	Slow	Medium	Fast
10	20,000	30	60	90	125	150	200	200	300	400
15	30,000	30	45	60	125	150	200	200	300	400
20	40,000	20	30	40	125	150	200	200	300	400
25	50,000	15	25	30	100	150	200	200	300	400
30	60,000	15	25	30	100	150	200	200	250	350

Auxiliary [monorail hoist][multiple girder hoist] may be specified in Section 41 22 23.19 MONORAIL HOISTS for handling light loads (typically 10 to 30 percent of main hoist rated load) at 2 to 4 times the main hoist speed. Specify Variable Frequency AC (VFAC) drives if precise handling and position are required. VFAC drives are normally capable of driving the crane at 5 mm/s (1 fpm) or less. Delete reference to VFAC drives and auxiliary hoist if not applicable.

Micro-drives are included here only for replacement purposes of older equipment. Micro-drives are considered obsolete by current industry standards. Delete micro-drive and columns from the table if not applicable.

Provide crane with rated capacity of [_____] metric tons tons kg pounds.[
Provide auxiliary hoist with [_____] metric tons tons kg pounds capacity.]
Lower load block or assembly of hook, swivel bearing sheaves, pins and
frame suspended by the hoisting ropes are not considered part of the rated
capacity. Rated speeds (in meters/second fpm) for the hoist,[hoist
micro-drive, gantry micro-drive, trolley micro-drive,], bridge and trolley
at the rated load are as follows:

Rated Speeds [meters per second] [feet per minute]			
Description	Minimum	Maximum	[Micro-drive]
Main Hoist	[_____]	[_____]	[_____].]
[Auxiliary Hoist]	[_____]	[_____]	[_____].]
Trolley	[_____]	[_____]	[_____].]
Gantry	[_____]	[_____]	[_____].]

1.4 SUBMITTALS

NOTE: Review Submittal Description (SD) definitions in Section 01 33 00 SUBMITTAL PROCEDURES and edit the following list to reflect only the submittals required for the project.

The Guide Specification technical editors have designated 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 submittals requiring Government approval on Army projects, a code of up to three characters within the submittal tags may be used following the "G" designation to indicate the approving authority. Codes for Army projects using the Resident Management System (RMS) are: "AE" for Architect-Engineer; "DO" for District Office (Engineering Division or other organization in the District Office); "AO" for Area Office; "RO" for Resident Office; and "PO" for Project Office. Codes following the "G" typically are not used for Navy, Air Force, and NASA projects.

Use the "S" classification only in SD-11 Closeout Submittals. The "S" following a submittal item indicates that the submittal is required for the Sustainability eNotebook to fulfill federally mandated sustainable requirements in accordance with Section 01 33 29 SUSTAINABILITY REPORTING.

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

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for [Contractor Quality Control approval.] [information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government.] Submittals with an "S" are for inclusion in the Sustainability eNotebook, in conformance to Section 01 33 29 SUSTAINABILITY REPORTING. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Overhead Electric Traveling (OET) Crane(s); G[, [_____]]

Crane runway system; G[, [_____]]

Complete schematic wiring diagram; G[, [_____]]

Description of operation.

SD-03 Product Data

OET Design Criteria; G[, [_____]]

Overhead Electric Traveling (OET) Crane(s); G[, [_____]]

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

Festoon System; G[, [_____]]

Runway Electrification System; G[, [_____]]

Variable Frequency Drives; G[, [_____]]

Bumpers; G[, [_____]]

End Stops; G[, [_____]]

[Spare Parts; G[, [_____]]]

Framed Instructions; G[, [_____]]

Nameplates; G[, [_____]]

Including all information called for in NFPA 70, Section 430.7.

Cab Control Station; G[, [_____]]

Pendant Control Station; G[, [____]]

Operator's Cab; G[, [____]]

Overloads; G[, [____]]

Limit Switches; G[, [____]]

SD-06 Test Reports

Acceptance Testing; G[, [____]]

Hook Assembly; G[, [____]]

Including Hook Proof Test and Hook and Nut non-destructive Test Report.

SD-07 Certificates

Overload Test Certificate; G[, [____]]

No Hazardous Material; G[, [____]]

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

Crane Runway System; G[, [____]]

Certificate of Compliance; G[, [____]]

Including listed Standards.

Wire Ropes; G[, [____]]

Including Manufacturer's Certificate of Breaking Strength.

SD-10 Operation and Maintenance Data

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

1.5 QUALITY ASSURANCE

1.5.1 Manufacturer Qualification

Overhead Electric Traveling (OET) Crane(s) shall be designed and manufactured by a company with a minimum of 10 years of specialized experience in designing and manufacturing the type of overhead crane required to meet requirements of the Contract Documents.

1.5.2 Pre-Delivery Inspections

Contractor is responsible for performance of quality control inspections, testing and documentation of steel castings, hook assembly and nuclear safety as follows. Submit all crane test data recorded on appropriate test record forms suitable for retention for the life of the crane. Visually inspect and test load-carrying steel castings ASTM A668/A668M using the magnetic-particle inspection method per ASTM A275/A275M. Reference allowable degree of discontinuities to ASTM E125, and relationship to service loads and stresses, critical configuration, location and type. Methods of repairing the discontinuities is subject to review by the

Contracting Officer.

1.5.3 Certificates

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

- a. stating that No Hazardous Material is contained within system or components.
- b. stating that the system is safe to perform a Loss of Power Test
- c. stating that the Crane Runway System conforms to the requirements as specified herein and as specified in Section 05 12 00 STRUCTURAL STEEL.
- d. Certificate of Compliance with listed Standards.

1.5.4 Overhead Electric Traveling (OET) Crane(s)

- a. Submit shop drawings showing the general arrangement of all components in plan, elevation, and end views; hook approaches on all four sides, clearances and principal dimensions, assemblies of hoist, trolley and bridge drives, and complete schematic wiring diagram with description of operation, and Runway Electrification System. Include weights of components and maximum bridge wheel loads and spacing.
- b. Shop drawing quality shall be equivalent to the contract drawings accompanying this solicitation.
- c. Provide integral schedule of crane components on each drawing. Provide maximum wheel loads (without impact) and spacing imparted to the crane runway system track beams. Indicate the crane speeds along the runway, the trolley speeds along the bridge girder, and the multiple girder hoist lifting speeds; all speeds indicated are speeds with hoist loaded with rated crane capacity load.

[1.5.5 Welding Qualifications and Procedures

Perform welding in accordance with qualified procedures using AWS D14.1/D14.1M as modified. Written welding procedures shall specify the Contractor's standard dimensional tolerances for deviation from camber and sweep and not exceed those specified in AWS D14.1/D14.1M. Perform all welding indoors. Qualify welders and welding operators in accordance with AWS D1.1/D1.1M or AWS D14.1/D14.1M. Allowable stress values shall comply with CMAA 70.

]1.5.6 Safety Requirements

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 bridge crane certification. Delete this paragraph if the crane is not required to handle nuclear materials.

Comply with the mandatory and advisory safety requirements of ASME B30.2,

ASME B30.10, ASME B30.16, ASME HST-1, ASME HST-4, NFPA 70, 29 CFR 1910, 29 CFR 1910.179, and 29 CFR 1910.306. Nuclear certification, testing, and rules of construction shall be in accordance with 29 CFR 1910.147, and [ASME NOG-1 top running type cranes][ASME NUM-1 for underhung type cranes]. Submit analysis and test reports to Contracting Officer for approval.

1.6 DELIVERY, STORAGE, AND HANDLING

Protect all delivered and stored equipment from the weather, humidity, temperature variations, dirt and dust, and other contaminants.

1.7 EXTRA MATERIALS

NOTE: The extent to which spare parts are stocked is an economic judgment determined by the user. The impact of downtime expense must be weighed versus the prompt availability and amount of cost allocated to spare parts. Power plant cranes, and similar use cranes receive severe service during the plant construction period, and normal wearing parts should be maintained at the project site.

Submit spare parts data for each different item of material and equipment specified and/or as recommended by the manufacturer, after approval of the detail drawings and not later than [_____] months prior to the date of beneficial occupancy. Include in data a complete list of parts and supplies, with current unit prices and source of supply.[Furnish and deliver one set of manufacturer's recommended spare parts to the site. Suitably package the spare parts for long-term protection and storage. Legibly label the packaging to identify the spare parts. Also include a list of the furnished spare parts in the Maintenance manual.]

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.

2.1.2 Nameplates

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

2.1.3 Prohibited Use of Asbestos Products

Provide materials and products, required for designing and manufacturing cranes, which do not contain asbestos.

2.1.4 Capacity Plates

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

2.1.5 Safety Warnings

Affix labels in a readable position to each lift block or control pendant in accordance with ASME B30.16, ASME B30.2 and ASME B30.17. Submit safety warnings, diagrams and other framed instructions suitably framed and protected for display as indicated by the Contracting Officer as follows:

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

2.2 STRUCTURAL MATERIALS

2.2.1 Bolts, Nuts and Washers

High-strength bolted connections shall be SAE Grade 5 bolts with corresponding lockwashers, ASTM F436M ASTM F436, nuts ASTM A563M ASTM A563, etc., conforming to requirements of AISC 325 bolts. Bolts, nuts and washers ASTM F959M ASTM F959 shall conform to ASTM A325M ASTM A325 bolts or ASTM A307. Galvanized bolts are not acceptable. Do not use ASTM A490M ASTM A490 bolts.

2.2.2 Bridge Girder or Girders

**NOTE: Specify welded structural steel box sections
for multiple girder cranes Class C, D, or E with a
capacity greater than 18 metric tons (20 tons) 16330
kg (36,000 pounds) or a span greater than 12 m (40
feet).**

Provide [welded structural steel box section] [wide flange beam, standard I-Beam, reinforced beam or section fabricated from rolled plates and shapes] bridge girders.

2.2.3 Bridge Rails or Bars

**NOTE: Remove this paragraph for underhung cranes
and cranes having a capacity less than 18 metric
tons (20 tons) 16330 kg (36,000 pounds) (many crane
manufacturers do not need or want rails or bars).**

Trolley runway rails, crane girders and other sections shall be straight and true. When loaded with motor driven cranes the deflection of rails shall not exceed 1/800 of the span. Calculate the deflection with the worst case of two loaded bridge cranes located adjacent each other. Make all rail joints flush and true without misalignment of running tread and design to minimize vibration. The gap between adjacent rail ends and the vertical misalignment of running treads shall not exceed 1.588 mm 0.0625 inch. Level the bridge rail to a plus-or-minus 3 mm 1/8 inch at all rail support joints. Fasten bridge rail to [top cover plate] [wide flange] or centered on flange or offset near web plate for welded box sections, complete with welded clips. Bolt bridge rail joints using standard joint bars. Stagger rail joints. Provide a positive stop at bridge rail ends to prevent creep.

2.2.4 End Ties and Bridge Girder End Connections

**NOTE: Specify end ties for cranes with more than 4
wheels. Specify welded structural steel box
sections for multiple-girder cranes Class C, D, or E
with a capacity greater than 18 metric tons (20 tons)
16330 kg (36,000 pounds) or a span greater than 12
m (40 feet).**

Use welded steel box sections for end ties. Provide full depth diaphragms at girder connections and jacking points. Provide horizontal gusset plates at the elevation of top and bottom end tie flanges for connection to girder ends. Make end connections with high-strength bolts. Use body-bound bolts fitted in drilled and reamed holes to maintain the crane square.

2.2.5 Bridge End Trucks

Provide [rotating][fixed axle] type end trucks fabricated of structural tubes or from structural steel to provide a rigid box section structure. Provide jacking pads for removal of wheel assemblies.

[2.2.6 Trolley Frame

**NOTE: Trolley frame is applicable only to multiple
girder cranes.**

Provide trolley frame consisting of two structural steel side frames or trucks welded together with one or more structural steel load girts to form a one-piece unit. Provide pads for the use of jacks or wedges when changing truck wheels. Make all trolley yokes and load bars of drop forged, cast or rolled steel.

12.2.7 End Stops and Bumpers

NOTE: Rubber bumpers dry out with time. Hydraulic type bumpers are more expensive. Using the words shock-absorbing allows the manufacturer to choose. Rubber like materials are not acceptable as an option.

Fit crane runways and bridge girders with structural steel end stops. Fit bridge end trucks and trolley frames with shock-absorbing, [spring] [or] [hydraulic] type bumpers capable of decelerating and stopping the bridge and/or trolley within the limits stated by OSHA and MHI CMAA. Provide trolley end stops of sufficient strength to withstand the impact of a fully loaded trolley moving at 50 percent of maximum rated travel speed. When two bridge cranes are on the same runway, one crane shall be fitted with shock-absorbing bumpers on each end of each end-truck, and the other crane shall have shock-absorbing bumpers as per above on one end only of each end-truck which is the opposite end of the adjacent crane. Fit the other end of the end-truck with a structural steel stop to engage the bumpers of the adjacent crane. Provide bridge bumper stops as specified in Section 05 12 00 STRUCTURAL STEEL. Locate stops to permit maximum bridge and trolley travel.

12.2.8 Footwalks

NOTE: Delete the following paragraph if double-girder cranes are not required. Provide footwalk fall protection with guard rails or static line with safety belts.

Set the location and construction of footwalks conforming to ASME B30.2. A full-length structural platform is required on the driver's side of the bridge. Provide checkered steel flooring for platform, double member handrail and a suitable toe-guard, with 760 mm 30 inch clearance in front of control equipment. Minimum 380 mm 15 inch clearance is required in front of bridge machinery. [To give access to the opposite side of the trolley, bridge conductors, or other equipment, mount a footwalk twice the length of the trolley on the opposite side of the crane. Provide a cross-over footwalk over an end tie between the two girder footwalks.] Mate the drive side footwalk with the crane access platform. The length of the drive side footwalk shall be [adequate to provide access to the trolley and provide sufficient room for mounting control cabinets][along the entire length of the [bridge][gantry]]. Provide safety handrails for footwalks.

12.2.9 Runway Rails

Provide runway rail size as specified in Section 05 12 00 STRUCTURAL STEEL.

12.2.10 Operator's Cab

NOTE: Applicable if a cab is specified, otherwise delete paragraph. Specify enclosed cab for outdoor use. Open cab may be used indoors. Enclosed cabs can be provided with a heating and/or air

conditioning unit according to environmental conditions. Specify the location of cab and the direction the operator should face.

[2.2.10.1 Design

NOTE: Select ASME B30.2 only with CMAA 70. ASME B30.2 is not compatible with CMAA 74.

Design and construct operator's cab in accordance with [CMAA 70] [CMAA 74] [and ASME B30.2]. Locate cab access to facilitate entry and exit by crane operator. Provide space near cab entrance for storage of a carbon-dioxide, dry chemical, or equivalent hand fire extinguisher.

] [2.2.10.2 Cab Construction

Provide [fixed cab mounted on bridge] [trolley mounted cab] of the [enclosed] [open] type for [outdoor] [indoor] use, and designed to provide a clear view of the operating floor and hook for operator. Provide cab with a suitable [heating] [heating and air conditioning] unit. Locate cab on the [_____] of the [bridge] [trolley] with the operator facing [_____].

]] [2.2.11 Additional Provisions for Outside Service

NOTE: This paragraph is applicable for outdoor cranes only.

Seal weld structural members on outdoor cranes. Provide crane bridges with parking brakes which will sufficiently hold the crane against a wind pressure of 244 Pa 5 psf for in-service conditions. Provide crane bridges with manually-operated pin locks at each rail, designed to securely anchor the crane against a wind pressure of 1.5 kPa 30 psf for out-of-service conditions.

] 2.3 MECHANICAL EQUIPMENT

2.3.1 Variable Frequency Drives

2.3.1.1 Bridge Drives

NOTE: If the span is less than 12 m (40 feet) and the application is CMAA Class "A" or "B", then A-1 drive may be included as an option. A-1 and A-4 drives are only referenced in CMAA 70 and if selected, delete the reference to CMAA 74.

Provide [either the A-1 or] [A-4] bridge drive arrangement as specified in [CMAA 70] or [CMAA 74], consisting of a single electric motor mechanically connected through gear reduction and drive shafts to the drive wheels or separate drive motors at each end of bridge. Acceleration and deceleration shall meet the requirements specified in this section. Gears shall conform to applicable AGMA standards. Gear reducers shall be oil tight and fully

enclosed with pressure or splash type lubrication. Bridge-travel limit-switches are optional.

2.3.1.2 Trolley Drives

Provide complete trolley drive arrangement with a minimum of two wheels driven by an integral electric motor. Provide drive mechanism which runs in totally enclosed oil bath. Limit switches are optional for drive mechanism. Provide acceleration and deceleration controls meeting the requirements specified in this section.

[2.3.1.3 Micro-Drives

NOTE: Current industry standards use Variable Frequency Alternating Current Drives (VFAC) in lieu of micro-drive motors. The following paragraph is included in this section for instances where the micro-drive motors will not be replaced with newer VFAC drives. If micro-drives are not to be used, delete this paragraph.

Include those motions where a micro-drive is required. If micro-drive is not specified, delete these paragraphs. Micro-drives are generally required when slow speeds are required for an extended amount of time. If precision movement is required for limited time for final positioning of loads, use adjustable frequency or dc variable voltage crane controls instead of micro-drives.

Provide the following crane motions with a separate micro-drive: [main hoist], [auxiliary hoist], [trolley drive] [and] [gantry drive]. The micro-drives are used to precisely position loads. Provide each micro-drive with an electric motor, gear reducer, magnetic coupling clutch and necessary controls. Connect the output shaft of the reducer to an extension of the primary drive high-speed shafting with a magnetic coupling clutch. Coupling shall normally be disengaged and become engaged only if the micro-drive is required. Provide electrical clutch components, required for proper operation, conforming to the requirements specified in paragraph ELECTRICAL COMPONENTS. Provide magnetic coupling type clutches which engage and disengage the micro-drives from the high speed shafts of the main drive arrangement. Engage the clutch by electromagnet and release by springs. Provide clutch ratings not less than 150 percent of the micro-motor rated torque as amplified by the intervening gearing. Clutch enclosures shall facilitate easy access for wear inspection of the friction elements and visual examination of the clutch assemblies.

]2.3.2 Gearing

Provide enclosed gear reducers type gearing. Gears and pinions shall be spur, helical, or herringbone type only, and be forged, cast or rolled steel. Open-type gearing is not acceptable, except for final drives. Provide gears and pinions with adequate strength and durability for the crane service class and manufactured to ANSI/AGMA 2001 Quality Class 6 or better precision per [AGMA ISO 10064-6] [AGMA ISO 17485] [ANSI/AGMA 2011] [ANSI/AGMA 2015-1].

2.3.2.1 Gear Reducers

Provide gear reducers which are [standard items of manufacturers regularly engaged in the design and manufacture of gear reducers for Class D and G cranes][or][integral components of standard hoists or hoist/trolley units of manufacturers regularly engaged in the design and manufacture of hoists or hoist/trolley units for Class A, B or C cranes]. Provide gear reducers designed, manufactured and rated in accordance with ANSI/AGMA 6113 ANSI/AGMA 6013 (for trolley drives only), as applicable. Except for final reduction, provide the gear reduction units with fully enclosed in oil-tight housing. Design gearing to AGMA standards and to operate in an oil bath. Operation shall be smooth and quiet.

2.3.2.2 Open Gearing

Provide gears and pinions possessing adequate strength and durability for the crane service class and manufactured to ANSI/AGMA 2001 quality class 6 or better precision per [AGMA ISO 10064-6] [AGMA ISO 17485] [ANSI/AGMA 2011] [ANSI/AGMA 2015-1]. Enclose open gears with safety guard removable covers over openings for inspection and access for grease lubrication.

2.3.3 Brakes

- a. In addition to the requirements of CMAA 70, provide shoe, disc, or conical type brakes with thermal capacity suitable for class and service specified in this section. Shoe, disc, and conical brakes shall be spring-set and electrically-released by a continuously rated direct acting magnet. Provide brakes which are self-aligning and easily adjusted for torque setting and lining wear. Brake lining material shall be asbestos free. Provide cast iron brake wheels conforming to ASTM A159 or the manufacturer's standard high-strength ductile cast-iron brake wheels, provided that the material exhibits wear characteristics in the form of powdered wear particles and is resistant to heat-checking. Disc brakes shall be totally enclosed and have multiple discs with stationary releasing magnets. Provide brake torque easily adjustable over a 2:1 torque range.
- b. [Provide bridge braking system with a spring-applied and electrically-released single shoe, disc, or conical brake for each bridge drive motor.] Provide braking system which automatically sets when controls are released or power is interrupted. Make provisions to facilitate easy brake adjustment. Provide brakes with a torque rating of at least 50 percent of bridge drive motor rated torque.

2.3.4 Wheels

**NOTE: Include the second sentence for CMAA 70 class
D and E, cranes; otherwise delete. Include the
requirement for trolley wheels only for multiple
girder cranes.**

Provide wheels manufactured of rolled or forged steel.[Wheel treads and flanges shall be rim toughened to between 320 and 370 Brinell hardness number.] Provide double-flanged [Bridge] [Bridge and trolley] wheels. Trolley and bridge wheels shall have straight treads. Equip wheels with self-aligning double-row spherical roller-bearings of capacity as recommended by bearing manufacturer for design load of trolley or bridge.

2.3.5 Bearings

NOTE: Equalizer sheaves compensate for unequal length, stretch of the hoisting, and swinging of the load block.

All bearings, except those subject to a small rocker motion, shall be anti-friction type. Provide a means for lubrication for bearings not considered lifetime lubricated by the manufacturer. Equip equalizer sheaves with sintered oil-impregnated type bushings in accordance with ASTM B438 or ASTM B439.

2.3.6 Anti-Drip Provisions

Design cranes to preclude leakage of lubricants onto the lifted loads, floor, or external grounds. Fit all equipment and components which cannot be made leak-proof with suitable drip pans. Drip pans shall be manufactured of steel and designed to permit removal of collected lubricant.

2.4 ELECTRICAL COMPONENTS

[2.4.1 Explosion Proof Requirements

NOTE: Delete this paragraph if explosion proofing is not part of design criteria. Define hazardous classification and evaluate Contractor's proposal for electrical equipment. Show location of the hazardous areas.

Equipment and wiring in locations indicated shall conform to NFPA 70 for Class [I] [II] [III], Division [1] [2] hazardous locations. Provide equipment suitable for [Group [____]] [operating temperature of [____] degrees C degrees F]. Provide wiring and equipment in locations indicated of the classes, groups, divisions, and suitable for the operating temperature as specified.

]2.4.2 Control Systems

Provide a separate controller for each motor; however, use a duplex controller two motor bridge drives. Provide overload protection in conformance with the requirements of [NEMA ICS 2][NEMA ICS 3]. Mechanically and electrically interlock contactors that are used for starting, stopping, and reversing.

2.4.2.1 Travel Motion Control System

Provide AC inverter duty, totally enclosed non-ventilated (TENV), squirrel cage induction type bridge and trolley drive motors. All motors shall have 60 minute duty rating minimum. Provide Class H insulation with Class B temperature rise.

2.4.2.2 Drive Control System

Provide static reversing, adjustable frequency controllers for the

[trolley] [and bridge] infinitely variable electric drives. Provide dynamic braking. Provide two step infinitely variable speed control for the bridge and trolley functions, controlled via pendant pushbuttons. The trolley, and bridge brakes shall set after associated controller decelerates motor to a controlled stop. Size the bridge and trolley controllers to provide sufficient starting torque to initiate motion of that crane drive mechanism from standstill with 0 to 131.25 percent of rated load on the hook and not produce any hook rollback. Drive motors shall run smoothly, without torque pulsations at the lowest speed, and be energized at a frequency not exceeding 60 HZ.

2.4.3 Power Sources

2.4.3.1 System Supply Voltage

Design cranes to be operated from a [_____] volt, [three-phase, 60 Hz, alternating current] [direct current] system power source. Design energy isolating devices for such machine or equipment to accept a lockout device in accordance with NFPA 70.

2.4.3.2 Transformers

NOTE: This paragraph is applicable to ac power supplies only.

Provide dry type transformers and carry full load continuously at rated voltage and frequency without exceeding an average temperature rise of 115 degrees C above an ambient temperature of 40 degrees C. Provide transformer with totally enclosed case finished with manufacturer's standard coating system. Fully encapsulate transformers, except for those specifically designed for use as an isolation transformer for static power conversion units.

2.4.4 Motors

NOTE: Motor heaters are desirable for outdoor cranes, unheated warehouse service cranes, or any other condensing high-humidity application, but specify heaters only if an integral component of the hoist and motor manufacturer. Select a motor from the following types and coordinate with the desired control type.

Select industrial motors for CMAA 70, Class A, B, C and D cranes, as follows:

- a. For critical load handling, self-excited alternator with electrical load brakes or emergency dynamic braking is preferred.
- b. Select crane type motors for ac motors.
- c. Select 800 Series dc mill type motors or dc industrial motors for dc motors.
- d. If crane and/or industrial type motors are

specified, select NEMA MG 1.

Select mill motors for CMAA 70, Class E cranes, as follows:

- a. If 800 Series dc mill type motors are specified, select AISE Std No. 1.
- b. Select dc motor type (squirrel cage, wound rotor) for the appropriate control system.
- c. Select dc series wound motors for dc constant potential control.
- d. Select dc shunt wound for dc variable voltage control.
- e. Select ac motor (squirrel cage, wound rotor) for the appropriate control system.

2.4.4.1 General Requirements for Motors

- a. Provide motors designed specifically for crane and hoist duty. Provide drain holes at low points near each end. Provide inspection and service covers with gaskets. Hardware shall be corrosion-resistant. Provide motors conforming to the requirements of NFPA 70, [NEMA MG 1] and UL 1004-1.
- b. [Motor heaters shall energize when mainline contactor is de-energized, and water heaters de-energize when mainline contactor is de-energized. Provide motors 15 kW 20 HP and larger with a suitable heater to prevent condensation during long periods of inactivity. Motor heater shall be an integral component of the hoist and motor manufacturer.]
- c. Provide one embedded thermal sensitive device in hoist motor windings. Device and associated circuitry shall serve as an alarm activating an amber signal or pilot light visible to control stations when motor temperatures become excessive. Establish set point below the Class B insulation temperature limit. Thermal-sensitive device and associated circuits shall be self-restoring (automatic reset). Two-speed, two-winding motors with a solid-state control are not allowed for creep-speed use.

2.4.4.2 Bridge and Trolley Drive Motors

Provide [ac crane type] [dc industrial type] [800 Series dc mill type] [[single-speed; single-winding] [two-speed; two-winding]] [NEMA design B squirrel cage ac type rated] [wound rotor ac induction type] [ac type designed for ac adjustable frequency operation] [dc series wound type] [dc shunt-wound type] bridge and trolley drive motors.

2.4.4.3 Motor Enclosures

NOTE: Applicable to 1 or 2 speed ac magnetic control of ac squirrel cage motor. If it is not desirable to have the motor immediately reverse direction, include sentence on plugging to allow the

motor to stop prior to reversing direction. If excessive load swing cannot be tolerated during the start of the bridge or trolley, include sentence on reduced voltage starting.

a. Select drip-proof enclosure for indoor usage, except in a hazardous atmosphere.

b. Select totally enclosed nonventilated enclosure for outdoor use and indoor use in a hazardous atmosphere.

c. Select totally enclosed fan cooled enclosure for motors operating at rated speed for long periods.

d. Select forced ventilated enclosure for Class E service.

Provide motor enclosures that are [totally enclosed, non-ventilated (TENV)] [totally enclosed, fan cooled (TEFC)] [totally enclosed, air-over frame (TEAO)] [drip-proof] [drip-proof forced ventilation] and conform to NEMA 250.

2.4.4.4 Motor Insulation and Time Rating

NOTE: For bridge and trolley motors, select Class F or H insulation based on rated temperature rise of 105 (Class F)/125 (Class H) degrees C by resistance above a 40 degree C ambient for CMAA Class A, B, C cranes and CMAA 74 cranes with ac or dc magnetic control and electrical control braking.

For bridge and trolley motors, select Class F insulation for HMI Duty Class H1, H2, and H3 hoists and CMAA 70 Class A, B, C cranes and CMAA 74 cranes with ac or dc magnetic control.

For all motors, select Class F or H insulation with a rated temperature rise of 105 (Class F)/125 (Class H) degrees C by resistance above a 40 degree C ambient for CMAA 70 Class A, B, C and CMAA 74 cranes with ac or dc static controls.

For all motors, select Class F or H insulation based on a rated temperature rise of 105 (Class F)/125 (Class H) degrees C by resistance above a 40 degree C ambient for CMAA 70 Class D and E cranes.

Delete frame size selection if not needed for the project.

2.4.4.5 Bridge and Trolley Motor Insulation and Time Rating

Provide bridge and trolley drive motors with an insulation which has a [Class F] [Class H] rating based on [105] [125] degrees C [220] [258] degrees F motor temperature rise above 40 degrees C 103 degrees F ambient with frame size selection based on continuous rating.

[2.4.4.6 Micro-Motors

NOTE: Current industry standards use Variable Frequency Alternating Current Drives (VFAC) in lieu of micro-drive motors. The following paragraph is included in this section for instances where the micro-drive motors will not be replaced with newer VFAC drives. If micro-drives are not to be used, delete this paragraph.

Micro-motors for bridge [and trolley] drives shall be [direct current industrial type, shunt wound motors] [industrial type, single-speed; single-winding; ac squirrel cage motor] and conform to the requirements of NEMA MG 1. Provide totally enclosed micro-motor, fan cooled (TEFC), with Class F or H insulation. Motor voltage rating shall comply with system supply voltage rating specified.

]2.4.5 Electric Brakes

[2.4.5.1 Brakes

NOTE: Delete this paragraph if hydraulic braking system is not required.

If electric brakes are used, provide a drift point so the brakes will release after the motor is de-energized, thereby allowing the motion to coast and reduce swing of the load. A drift point can also allow the trolley to center itself over the load before actually starting to lift.

For pendant control cranes and cab controlled cranes where hydraulic braking is not desired, select spring-applied electrically-released brakes.

For cab operated cranes, specify electric-hydraulic brakes for bridge or trolley brakes except in the case of constant speed/speed regulated (at a particular controller setting) type controls.

Limit electric-hydraulic brakes to ac magnetic or secondary saturable reactor and dc magnetic controls for ac wound rotor motors and dc series/compound wound motors respectively. Limit electric-hydraulic brakes to bridge brakes on bridge mounted cabs and trolley brakes for trolley mounted cabs.

Do not specify electric-hydraulic brakes for the following:

- a. Single and multi-speed magnetic control of squirrel cage motors.
- b. Alternating current adjustable frequency control of squirrel cage motors.

c. Direct current variable voltage control of shunt wound ac motors.

- a. Electric-hydraulic [bridge] [trolley] brakes shall be dc shunt magnet type equipped with hydraulic actuators manually-operated with a foot-operated master control unit in the operator's cab, and electrically released with the operation of the mainline contactor POWER-OFF pushbutton or power failure.
- b. Provide remote control bleeders operable by pushbutton and foot pedal except for power-assisted brake systems. Remote control bleeders shall be complete with pushbutton clearly labeled and located in operator's cab where the operator can easily depress the pushbutton and pump the brake simultaneously. In lieu of the combination electric-hydraulic brakes, separate hydraulic and electric brakes may be provided. Design hydraulic brake system to ensure equal pressure at each brake cylinder.

]2.4.5.2 Hoist Brake Time Delay

NOTE: Delete this paragraph if one brake is specified.

Provide one of the hoist holding brakes with a time-delay setting (from 1 to 3 seconds). The time-delay shall be initiated upon releasing the control pushbutton or returning the master switch to OFF. Operation of mainline POWER-OFF pushbutton or power failure shall result in each hoist brake's setting without any time-delay.

]2.4.5.3 Automatic Stop System

Provide fail-safe spring set electrically-controlled brakes when power is interrupted. Brakes shall be released with a mainline contactor POWER-OFF pushbutton or a master switch for the associated drive. Brakes shall automatically stop when there is a power failure. Design electric system to be mechanically released. Provide enclosures for electrical-controlled brake components conforming to NEMA ICS 6 Type [____], and NEMA ICS 8. Provide direct current shunt magnetic shoe brakes with an electrical forcing circuit for rapid release of brake. Each shunt coil brake shall be circuited for both conductors to open simultaneously when the brake is de-energized.

2.4.6 Control System

Provide a separate controller for each motor; a duplex type for 2-motor bridge drives and a quadraplex type for 4-motor bridge drives on ac central cranes. When 2-motor bridge drives are furnished and dc magnetic control is required, provide dc series-connected motors. When 4-motor bridge drives are furnished and dc magnetic control is required, provide dc series-parallel connected motors. Provide overload protection conforming to NEMA ICS 2 and NFPA 70. When contactors are used for starting, stopping and reversing, contactors shall be mechanically and electrically interlocked.

2.4.6.1 Control Panels

NOTE: Control panel heaters are desirable for outdoor cranes, unheated warehouse service cranes or any other condensing high-humidity application.

Alternating current or dc static crane control for outdoor cranes need thermostatically-controlled panel heaters for outdoor panels or any other application which is colder than 0 degrees C. Alternating current or dc static crane control may need both thermostatic control and mainline contactor control.

Fabricate control panels of solid sheet steel designed and constructed to conform to requirements of NEMA ICS 6 Type [_____]. [Provide thermostatically-controlled heaters to keep control enclosure temperatures at or above 0 degrees C 32 degrees F in each static crane control panel.] [Control panel heaters shall be energized when mainline contactor is de-energized, and be de-energized when mainline contactor is energized to prevent anti-condensation.] Hinge and equip control panel doors with gaskets and fitted with key-lock handle design, complete with a single key to open all locks.

2.4.6.2 Bridge and Trolley Control

NOTE: Select a bridge and trolley control from following paragraph a through f and coordinate with paragraph Motor Enclosures.

- [a. [Provide bridge and trolley main control systems with [one] [two] speeds in each direction with an electrically-operated, full-magnetic, across-the-line reversing type starter.] [Use centrifugal switches in control circuit to prevent the plugging of trolley or bridge drive motors; arrange each switch to set the associated drive's brake while attempts are made to plug.] [Provide the [bridge] [and] [trolley] main control system with reduced voltage starting for all speed points.]]
- [b. Provide ac magnetic control, five-speed, reversing, plugging type bridge and trolley main control systems.]
- [c. Provide ac static stepless secondary saturable reactor bridge and trolley main control systems.[Provide control with continuously-adjustable speed from minimum to full speed. Minimum speed with zero hook load shall not exceed 15 percent of full-rated speed.][Provide control with speed regulation of 15 percent or less from no-load to full-load at all speed settings.]]
- [d. Provide dc magnetic control type, five-speed, reversing, plugging type bridge and trolley main control systems.]
- [e. Provide dc stepless, speed-regulated, adjustable-voltage control with dc shunt-wound motors for bridge and trolley main control systems. Provide continuous-speed adjustment control from minimum speed (2 percent at no hook load) to full speed. Provide automatic-regenerative

braking for speed reduction and slow down before brake setting.
Provide a minimum 50-to-1 speed range.]

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

2.4.6.3 Drift Point

NOTE: Provide bridge and trolley directions normally oriented to main compass headings.

Select method of festoon suspension. For multiple girder cranes select underneath footwalk and for single girder cranes select auxiliary girder. If a hoist thermal sensor is specified, include requirement for yellow pilot light. If a VFAC drive is specified, include the sentence, "A 2-position [____]."

Pendant handles are required only if pendant is in an explosion area. Monorail cranes do not require an independent track for pendants.

Provide a trolley and bridge main control systems with a drift point between OFF and first speed control point in each direction or have a separate pushbutton.

[2.4.7 Cab Control Station

NOTE: Delete this and the following two paragraphs if a cab is not required.

2.4.7.1 General

NOTE: Provide bridge and trolley directions normally oriented to main compass headings. If stepped speeds and/or drift point are specified, include the applicable requirements in this paragraph. Delete auxiliary hoist switch if not necessary for the project.

Accomplish crane control by a [bridge-mounted] [trolley-mounted] cab control. Provide spring-return to "OFF" for master switch operating handles, with [distinct drift point detents,] [distinct speed-point intents] and OFF position latching. Provide NEMA Type 1 master switch enclosures. Provide POWER-OFF pushbutton with a red mushroom head and a green or black POWER-ON pushbutton. Provide the following cab master switches:

- a. Main Hoist - up/down.
- [b. Aux Hoist - up/down.]
- c. Bridge - [_____] [_____].
- d. Trolley - [_____] [_____].
- e. POWER-OFF.
- f. POWER-ON.

2.4.7.2 Cab Indications

NOTE: If hoist thermal sensor is specified, include requirement for amber light. Voltmeter applicable to dc control systems only. If rail clamps are specified, include sentence regarding rail clamp operation and indication. If flood lighting is specified, include requirement for toggle switch.

Provide amber pilot lights to indicate excessive hoist motor temperature. Provide a white pilot light to indicate that power is available on load side of crane disconnect switch. Provide a blue pilot light to indicate that the main contactor is energized. [Supply a minus 300 to plus 300 Vdc voltmeter to monitor the main rectifier output voltage, and provide a selector switch to select the voltage to be monitored.] [Provide a red pilot light to indicate the rail clamps are set.] [Provide a single-toggle switch to operate crane floodlights.] [Provide a single green pilot to indicate all VFAC drive clutches are engaged.]

[2.4.7.3 Cab Controls

NOTE: Delete this paragraph if combination controls (cab and pendant or cab and radio control) are not used. If it is desirable to raise the pendant out of the way, include the last sentence. Otherwise, delete.

Provide cab with a 2-position key-operated switch to allow transfer of control from cab to [pendant] [radio control] station and a red pilot light mounted in cab to indicate that the control has been transferred to other station. Selection of one operating station shall lock out the controls of other stations.[Also provide a 2-position switch to raise and lower the pendant station.]

]2.4.7.4 Cab Heating and Ventilating [and Air-Conditioning]

NOTE: If heating or air conditioning of the cab is required, edit this paragraph to specify design requirements; otherwise delete this paragraph. Refer to UFC 3-400-02, "Design: Engineering Weather Data" ambient temperatures for cab heating and air conditioning.

Provide thermally-insulated cab with [air-conditioner][and electric heater]. Provide a filter unit to pressurize the cab with filtered outside

air. Provide air filter which is a standard commercial type capable of removing airborne dust and locate it where it can be readily cleaned or changed. Provide adjustable thermostat to control [air conditioner][with][heater]. Provide a unit meeting the Energy Efficient requirements of ASHRAE 90.1 - SI ASHRAE 90.1 - IP. Maintain the cab interior at 18 degrees C 65 degrees F in winter with [_____] degrees C F ambient temperature and [_____] degrees C F in summer with [_____] degrees C F dry bulb and [_____] degrees C F wet-bulb ambient temperatures. Provide corrosion-resistant material or protection against corrosion for all other hardware and components. Mount motor compressor assembly on vibration isolators.

]2.4.8 Pendant Control Station

NOTE: Delete the following paragraphs if pendant control is not specified.

If pendant control is not specified, delete paragraphs. If the crane is higher than 18 m (60 feet) above the operating floor and the span is greater than 15 m (50 feet), consider including a pendant drive for ease of movement of the pendant if it is not towed by the trolley; otherwise delete this paragraph. Pendant drive speed should be the same as the trolley.

[2.4.8.1 General

Provide NEMA Type [1] [3R] [7] [9] [12] pendant control station. Hold physical size of pendant to a minimum. Provide a separate cable of corrosion-resistant 3.2 mm 1/8 inch wire. Attach pendant station to [underside of crane bridge footwalk] [an auxiliary girder] and hang vertically with bottom of pendant at 1 m 40 inches above floor. Do not support weight of pendant by control cable.

]2.4.8.2 Operating Pushbuttons

NOTE: Specify requirements for auxiliary hoist pushbutton in Section 41 22 23.19 MONORAIL HOISTS.

Provide bridge and trolley directions normally oriented to main compass headings. Select method of festoon suspension: For multiple girder cranes select underneath footwalk and for single-girder cranes select auxiliary girder. If a hoist thermal sensor is specified, include requirement for yellow pilot light.

Provide heavy-duty, dust-and-oil-tight type operating pushbuttons with distinctly-felt operating positions which meet requirements of NEMA ICS 2. Pendant control buttons shall be momentary pushbuttons. Provide recessed type pushbuttons (except the POWER-OFF button) to avoid accidental operation. Make diameter of buttons a size which will make operation possible with a thumb while holding the pendant with same hand. Provide nameplates adjacent to each pushbutton. Provide barriers on pendant between various pushbutton functions, except on elements mounted in

junction box. In a multi-speed application, dual-position pushbuttons shall have a definite click-detent position for each speed. Design and manufacture pushbuttons not to hang up in control case. Pendant shall include a separate set of pushbuttons for each motion and for POWER-ON POWER-OFF. Provide the following pushbuttons:

POWER-OFF.
POWER-ON.
Hoist-up.
Hoist-down.
[Gantry]-[____].
[Gantry]-[____].
Trolley-[____].
Trolley-[____].

2.4.8.3 Light Indicators

NOTE: Coordinate requirement for pilot lights and selector switches. Delete VFAC drive if not applicable.

Provide pilot lights meeting heavy-duty requirements of NEMA ICS 5. Provide one [red][amber] pilot light to indicate excessive hoist motor temperature on pendant station. Provide a blue pilot light to indicate that the main contactor is energized, and a white pilot light to indicate that power is available on the load side of crane disconnect switch. Provide a bright red mushroom head for the POWER-OFF pushbutton. Provide a 2-position selector switch to select between normal and VFAC drive. Provide a single green pilot light to indicate all [VFAC drive] functions are engaged.

[2.4.8.4 Pendant Drive Control

NOTE: If the crane is higher than 18 meters (60 feet) above the operating floor and the span is greater than 15 meters (50 feet), consider including a pendant drive for ease of movement of the pendant if it is not towed by the trolley; otherwise delete this paragraph. Pendant drive speed should be the same as the trolley.

Provide a 3-position momentary contact spring-return to OFF toggle switch to control the motorized trolley for pendant.

]2.4.8.5 Transfer of Control Stations

Provide pendant with a green pilot light to indicate that control has been transferred to pendant station from cab with key lock-out.

]2.4.9 Radio Remote Control, Infrared Remote Control

NOTE: Include this and the following paragraph if radio remote control or infrared remote control is desired; otherwise delete.

2.4.9.1 General

Equip crane with a complete digital radio remote-control system to permit full control of crane from a portable wireless transmitter. Provide a system which is the use-proven product of a manufacturer regularly engaged in design and manufacture of crane radio remote-control systems. Provide a "fail-safe" designed system so that the failure of any component or loss of signal will cause all crane motors to stop. The system shall permit complete, independent and simultaneous operation of all crane functions. System frequency shall comply with [FCC Part 15 - (unlicensed frequencies)] [be in the 72MHz-76MHz band]. Include transfer relays in receiver if crane is also cab or pendant controlled.

2.4.9.2 Transmitter

NOTE: Provide bridge and trolley directions normally oriented to main compass headings. Coordinate transmitter requirement for auxiliary hoist control in Section 41 22 23.19 MONORAIL HOISTS if auxiliary hoist is used.

Provide portable transmitter complete with an adjustable belt or harness. Crane motion switches shall spring-return to OFF. Provide transmitter with two spare batteries and battery charger to permit continuous operation. Provide a key-lock with the key removable in the OFF position only to control transmitter operation. Provide a blue signal light mounted on crane visible from floor to indicate the main contactor is energized. Make POWER-OFF toggle-switch bright red. Provide the transmitter with the following controls:

Hoist-up/down.
Bridge-[____].
Trolley-[____].
POWER-ON.
POWER-OFF.

]2.4.10 Protection

2.4.10.1 Main Line Disconnect

Provide a main line disconnect consisting of a combination circuit breaker (50,000 AIC) and non-reversing starter, starter without overloads (mainline contactor) in NEMA Type [____] enclosure. Control circuit of mainline disconnect shall cause all crane motions to stop upon mainline undervoltage, overload, control circuit fuse failure, or operation of POWER OFF pushbutton. Equip mainline disconnect with energy isolating devices designed to accept lockout devices.

2.4.10.2 Isolation Transformer

NOTE: Specify an isolation transformer and surge protection to protect electronics from external faults. Recommended for dc static control systems. Applicable to ac power supplied systems only.

Provide an SCR drive type isolation transformer specifically designed for cranes, with a continuous rating which will exceed that required of the sum of rated full-load full-speed KVA of hoist plus 50 percent of rated full-load full-speed KVA of trolley and bridge motors plus the rated KVA of controls. Multiply the total KVA by 1.05 (efficiency factor). Connect the isolation transformer to the load side of mainline disconnect of the transformer. Supply crane dc static control electric power distributed on the crane through this isolation transformer.

2.4.10.3 Surge Protection

Provide surge suppressors meeting the requirements of UL 1449. Provide three metal oxide varistors on the line side of each SCR drive isolation transformer to provide transient over-voltage protection.

2.4.10.4 Circuit Breakers

Provide circuit breakers meeting the requirements of UL 489.

2.4.10.5 Overloads

**NOTE: Select applicable overload protection based
on control circuit type.**

[Alternating current circuit overload relays shall be of the ambient compensated, automatic reset, inverse time type located in all phases individual motor circuits. Arrange overload relays to de-energize the associated motor on an overload condition.] [Provide an automatically reset inverse time-trip running overload relay for each dc motor circuit. Provide an automatically reset instantaneous trip overload relay in each dc motor circuit or for a pair of series-connected motors. Arrange overload relays to de-energize the associated motor on an overload condition.] [Alternating current adjustable frequency-control motor overload-protection shall be electronic and protected by inverse time and current versus output frequency which will allow less current for a given amount of running time when frequency (speed) is lower than rated.] [Provide electronic direct current variable voltage control motor overload-protection.]

2.4.11 Limit-Switches

**NOTE: Current industry standards require limits to
remove power instantly from the motors and brakes
via the control system.**

**Delete reference to micro-drive control system if
not applicable.**

Provide heavy-duty quick-break double-pole double-throw type gear limit switches conforming to NEMA ICS 2. The geared limit-switch interruption of a motion in one direction shall not prevent the opposite motion. Geared limit-switches shall reset automatically. Provide NEMA Type [1] [4] limit switch housings. Limit-switches shall interrupt power to the primary [and micro-drive]control systems.

2.4.11.1 Bridge and Trolley Travel Limit-Switches

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

[2.4.11.2 Rail Clamp Limit-Switches

**NOTE: Include paragraph for outdoor cranes;
otherwise delete. Delete reference to VFAC drive
when not applicable.**

When rail clamps are set, furnish each rail clamp with a limit-switch designed to interrupt the primary [and VFAC drive]control circuits to bridge drive. Provide a red pilot light at control station to indicate the rail clamps are set.

]2.4.12 Wiring

Provide wiring complying with Article 610 of NFPA 70. Number or tag wires at connection points. Make all splices in boxes or panels on terminals boards or standoff insulators. Base motor loop, branch circuit and brake conductor selection on NFPA 70 for 90 degrees C 184 degrees F conductor rating on indoor cranes, and for 75 degrees C 154 degrees F conductor rating on outdoor cranes. Conductors in the vicinity of resistors and conductors connected to resistors shall be [Type 5RML][_____].

2.4.13 Electrification

2.4.13.1 Main Power Electrification

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

2.4.13.2 Crane Runway Conductors

NOTE: Select covered conductor bar system for:

a. Indoor non-hazardous service
b. Outdoor non-corrosive environment

Select festoon system for:

a. Indoor - hazardous service
b. Outdoor - corrosive (marine) environment

[Provide covered conductor bar type crane runway conductor system designed and manufactured to meet UL requirements. Provide rigid or flexible

self-closing type protective cover designed to cover all live conductors and shaped to prevent accidental contact with conductors. Provide heavy-duty sliding shoe type collectors compatible with the electrification system. Provide two tandem designed collector heads for each conductor rail to provide redundancy.] [Provide festooned type crane runway conductor system consisting of a support rail, cables, junction boxes, cable cars and accessories. Hardware shall be corrosion-resistant or protected against corrosion. Festoon storage area shall not restrict the crane travel at the ends of runway.]

2.4.13.3 Bridge Span Conductors

Provide [festooned type consisting of a support rail, electrical cables, junction boxes, cable cars and accessories] [rigid conductor/collector type located within enclosure] bridge span conductor system. Cable loops shall not drop below the hook high position. Provide corrosion resistant outdoor crane bridge festoon system hardware.

[2.4.13.4 Pendant Festoon System

NOTE: The pendant festoon system is an option to the Designer.

Provide pendant festoon system consisting of a support rail, cables, junction boxes, cable cars and accessories. Cable loops shall not drop below the hook high position. Provide pendant control car with NEMA Type [1] [3R] [12] junction box. Pendant festoon shall be [towed by trolley] [independent of trolley motion]. Provide corrosion resistant outdoor crane pendant festoon system hardware.

]2.4.13.5 Pendant Drive System

Provide pendant festoon system with a motor-drive system capable of driving the pendant control car at [_____] m/s fpm. Control of pendant motor drive shall be from the pendant.

]2.4.13.6 Pendant Retraction System

NOTE: Select method of pendant retraction if specified; otherwise delete paragraph.

[Provide pendant control car with an electric-powered cable reel so that the pendant station will retract fully.] [Provide a wire-rope hoist to hoist the pendant station. Pendant and pendant drop-cable shall be retractable to approximately 1/3 of drop cable length.] Control retraction system from cab.

]2.4.14 Special Requirements

2.4.14.1 Warning Horn

NOTE: Delete last sentence if not applicable to project.

Provide a solid-state electronic warning horn on the crane. Accompany any bridge or trolley motion by a continuous series of alternating tones.[The warning horn shall not sound when the crane is in the VFAC drive mode.]

2.4.14.2 Accessory Power

NOTE: If lighting, motor or control cabinet heaters or receptacles are specified, include the following paragraph if 460 volt ac is the power source. Select the components requiring power.

Use three-phase 208Y/120 volt ac power supplied via a circuit breaker and isolation transformer from the line side of the main line disconnect for [lighting,] [heaters,] [and accessory circuits] on the crane. Provide the circuit breaker with a NEMA Type [1] [3R] [12] enclosure. The enclosure shall have provisions to lock the breaker in the OFF position. Provide each circuit breaker pole with individual thermal and magnetic trip elements and the enclosure cover with a button for mechanically tripping the circuit breaker. Supply three-phase 480 volt delta primary and 208Y/120 volt wye secondary general lighting transformer from the accessory circuit breaker and feed a 208Y/120 volt UL listed circuit breaker panelboard and a heater circuit breaker/combination starter. The panelboard shall supply branch circuits for utilization of various accessories such as [receptacles,] [lighting] [panel internal lighting] [motor heaters and control enclosure which meets NEMA requirements]. Provide transformer and panelboard with the same NEMA classification as the circuit breaker.

2.4.14.3 Receptacles

NOTE: Specify receptacles for multiple girder cranes. Specify ground fault protection for outside cranes. Delete requirement for receptacle in cab when not applicable.

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

2.4.14.4 Lighting

NOTE: Specify lighting for outdoor cranes or in dimly lighted areas.

Provide control panels with a 120-volt lamp fixture with an unbreakable lens and switch. Provide floodlights to illuminate the work area under the

crane and drum area on crane, controlled from crane control station. Provide metal halide industrial floodlight luminaries. Totally enclose each floodlight, vapor-tight design, gasketed and provided with a heat-resistant and impact-resistant glass lens. Space and attach floodlights to underside of crane to provide uniform lighting.

[2.4.14.5 Wind Indication and Alarm

NOTE: Specify location of wind alarm station for outdoor cranes, normally mounted near center of the bridge. Provide location of cutout. Delete paragraph if not applicable.

Provide a wind-indicating device with an adjustable alarm trip point. Provide alarm trip with time-delay for wind gusts. Adjustable trip shall actuate an oscillating blue light and bell mounted near [_____]. Provide ability to cut off bell alarm from the [pendant station] [cab].

]2.4.14.6 Electrically-Driven Oil Pump Alarm

NOTE: Delete this paragraph if equipment does not include an oil-pump.

Provide electrically -driven lubricating pump complete with an audible alarm and red light for indication of pump malfunction. Make location of alarm the factory standard location.

]2.4.15 Load-Limit System

NOTE: Specify load sensing if loads approaching the capacity of the crane are to be lifted routinely.

Provide a load-limit visual/audible system for the main hoist to inform the operator that the preset load has been exceeded. The load-limit system shall consist of a load-cell, load-sensing electronics, overload indicator lights, overload alarm bell and alarm cut-out switch. Mount load cell to receive the load from equalizing sheave pin or upper block sheave pin. Provide adjustable alarm setpoint.

2.4.15.1 Load-Sensing Electronics

Provide NEMA Type [1] [3R] [12] enclosures for load sensing electronics. Provide adjustable alarm setpoint.

2.4.15.2 Alarm and Indicator Light

Provide an overload alarm light to indicate a load greater than the preset maximum. Overload alarm shall be indicated with a red light and clearly labeled "OVERLOAD". Also provide a bell to indicate when an overload condition exists. Make provisions to turn off the bell from [pendant station] [cab] [_____].

2.4.16 Fungus Resistance

**NOTE: Specify fungus resistance for cranes in
marine or humid environments.**

Coat electrical connections such as terminal connections, circuit connections, components and circuit elements with fungus-resistant varnish. Do not treat components and elements which are inherently inert to fungi or hermetically sealed. Do not treat elements whose operation will be adversely affected with the application of varnish.

2.5 ELECTROMAGNETIC INTERFERENCE SUPPRESSION

**NOTE: Specify EMI suppression if electro-magnetic
interference from the crane may be a problem to
sensitive electronics in the work area.**

2.5.1 Shielded Cable

Provide shielded type pendant and festooned cables of braided tinned-copper. Ground each cable shielding with a single connection to equipment grounding conductor.

2.5.2 EMI/RFI Shielded Boxes

2.5.2.1 General

Boxes designed to house electronic and electrical control equipment, instruments, metering equipment, etc., in installations where electromagnetic compatibility and/or system security is required shall protect interior components from stray radio frequency (RF) fields and contain RF signals produced by interior components.

2.5.2.2 Construction

Design Electromagnetic Interference/Radio Frequency Interference (EMI/RFI) shielded boxes to meet UL 50 Type 12 and Type 13. Construct the shielded boxes of [1.519] [1.897] mm [16] [14] gauge steel with seams continuously welded and ground smooth, without holes and knockouts. Cover gasket shall be a combination of woven plated steel mesh and oil-resistant gasket which will provide an EMI/RFI seal as well as an oil-tight, dust-tight and water-tight seal between cover and body. Attach gasket to cover with oil-resistant adhesive. Provide stainless steel cover clamps and screws which are quick and easy to operate on three sides of hinged cover for positive clamping.

2.5.2.3 Attenuation

Design EMI/RFI shielded boxes to provide maximum shielding of electric and magnetic components of radiated RF energy. Provide RF filters to suppress conducted radio frequency in cables and conductors. Provide shielded boxes with attenuation greater than 60 db at 14.5 KHz to greater than 100 db at 1 MHz for magnetic fields and greater than 100 db from 14.5 KHz to 430 MHz for electric fields.

2.5.2.4 Finish

Provide zinc-plated EMI/RFI shielded boxes in accordance with ASTM B633 SC3/Type II to provide corrosion-resistant conductive surfaces for gasket contact area and conduit entries. The finish coat shall match the crane finish.

[2.5.3 Drum Grounding

**NOTE: A grounding drum is required for non-sparking
environment only (general nuclear or explosive).**

Provide a copper ring/collector assembly to ground each drum. Provide electrically-bonded ring to drum. Collector shall be stationary and connected to equipment grounding conductor system with a No. 8 AWG copper wire.

]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, and submit a letter describing the results of this verification, including discrepancies, to the Contracting Officer and crane manufacturer. 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 ERECTION

Perform the entire crane erection in accordance with manufacturer's instructions under the full-time supervision of the manufacturer's representative. Provide a written certificate from crane manufacturer indicating the crane is erected in accordance with manufacturer's recommendations before testing the completed installation.

3.2.1 Shop Assembly

Shop assemble major crane components as completely as possible. Match mark disassembled parts and tag electrical connections after complete no-load shop testing. Protect all parts and equipment at site from weather, damage, abuse and loss of identification. Erection procedures shall ensure that the crane is erected without initial stresses, forced or improvised fits, misalignments, nicks of high-strength structural steel components, stress-raising welds and rough burrs. Clean and repaint damaged surfaces after crane is erected. Provide all necessary grease and oil of approved quality and grade for the initial servicing and field test.

3.2.2 Mechanical Alignment

Align motors, couplings, brakes, gear boxes and drive components when reinstalled in accordance with manufacturer's instructions.

3.2.3 Electrical Alignment

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

3.2.4 Welding

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

3.2.5 Field Painting

**NOTE: The last sentence will only be required if
the bridge crane is in an explosion proof area.**

Painting required for surfaces not otherwise specified, and finish painting of items only primed at the facility, shall conform to SSPC SP 6/NACE No.3 and as specified in Section 09 90 00 PAINTS AND COATINGS. Paint bridge crane including bridge, trolley, hoist and all attached items in accordance with the manufacturer's standard practice. The complete crane shall be of one color. Paint bridge rail, supports and bracing in accordance with Section 09 90 00 PAINTS AND COATINGS. **Do not paint** items such as surfaces in contact with the rail wheels, wheel tread, hooks, wire rope, surfaces on the electrical collector bars in contact with the collector shoes and nameplates.[Coordinate the requirements of explosion proof cables with cable manufacturer.]

3.3 ACCEPTANCE TESTING

3.3.1 General

**NOTE: This paragraph applies to new construction
only. Specify the test weights required. The
weights normally required are the rated load, 125
percent of the rated load and 10 percent of the
rated load (for the grounding and the
acceleration/deceleration test).**

Provide all personnel necessary to conduct the required testing, including but not limited to, crane operators, riggers, rigging gear and test weights. Perform testing in the presence of Contracting Officer. Notify the Contracting Officer [_____] days prior to testing operations. Operate

all equipment and make all necessary corrections and adjustments prior to the testing operations witnessed by Contracting Officer. A representative of the Contractor responsible for procuring and installing hoist equipment shall be present to direct the field testing. Test loads shall be compact and permit a minimum of 50 percent of vertical lift. Use test loads which are minus 0 percent to plus 5 percent of the required weight, and verified prior to testing. Test weights required are [____], [____], and [____] kg [____], [____], and [____] pounds. Do not perform operational testing until after building interior has been painted. Furnish [three] [____] copies of all test reports to Contracting Officer.

3.3.1.1 Test Sequence

Test crane in accordance with applicable paragraphs of this procedure in the sequence provided.

3.3.1.2 Test Data

Record operating and startup current measurements for coils, hoist, trolley, and bridge motors using the appropriate instrumentation. Record speed measurements as required by facility evaluation tests (normally at 100 percent load). Compare recorded values with design specifications or manufacturer's recommended values. Justify abnormal differences in the remarks and perform appropriate adjustments. Note any high temperatures or abnormal operation of any equipment or machinery, investigate and correct. Record hoist, trolley and bridge speeds during each test cycle.

3.3.1.3 Equipment Monitoring

Monitor improper operation or poor condition of safety devices, electrical components, mechanical equipment and structural assemblies during the load test. Report defects observed to be critical during the testing period immediately to the Contracting Officer and suspend the testing operations until the defects are corrected. During each load test and immediately following each load test, make the following inspections:

- a. Inspect for evidence of bending, warping, permanent deformation, cracking or malfunction of structural components.
- b. Inspect for evidence of slippage in wire rope sockets and fittings.
- c. Check for overheating in brake operation; check for proper stopping. Test all safety devices including emergency stop switches and POWER-OFF pushbuttons and inspect separately to verify proper operation of the brakes. When provided, inspect all safety accessories including warning horn, lighting, gauges, warning lights and accuracy of wind indicating device and alarm.
- d. Check for abnormal noise or vibration and overheating in machinery drive components.
- e. Check wire rope sheaves and drum spooling for proper reeving and operation, freedom of movement, abnormal noise or vibration.
- f. Check electrical drive components for proper operation, freedom from chatter, noise, overheating, and lockout/tag-out devices for energy isolation.
- g. Inspect gears for abnormal wear patterns, damage, or inadequate

lubrication.

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

[3.3.2 Trolley Travel

NOTE: Delete references to VFAC drive when not applicable.

Operate trolley the full distance of bridge rails exercising all primary drive [and VFAC drive]speed controls in each direction. Verify brake operation in each direction. In slow speed [or VFAC drive,]trolley bumpers shall contact trolley stops located on the bridge girders. In slow speed, test the proper operation (interrupt power, automatic reset) of the trolley limit-switches at both limits of trolley motion.

]3.3.3 Bridge Travel

NOTE: Delete references to VFAC drive when not applicable.

Operate bridge in each direction the full distance of runway exercising all primary drive [and VFAC drive]speed controls. Verify brake operation in each direction. [In slow speed the proper operation (interrupt power, automatic reset) of the bridge, test limit-switches at both limits of bridge motion.] In slow speed [or VFAC drive]the crane bridge bumpers shall contact the runway rail stops.

3.3.4 Bridge Crane Tests

3.3.4.1 Dynamic Load Tests

- a. Trolley Dynamic Load Test: While operating the trolley the full distance of bridge rails in each direction with test load on the hook (one cycle), test proper functioning of all primary drive and VFAC drive speed control points and proper brake action.
- b. Bridge Dynamic Load Test: With test load on hook, operate bridge for the full length of runway in both directions with trolley at each extreme end of bridge. Verify proper functioning of all primary drive and VFAC drive speed control points and brake action. Binding of the bridge end trucks indicates a malfunction requiring adjustment.

3.3.4.2 Trolley and Bridge Loss of Power Test

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

3.3.5 Overload Tests

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

3.3.6 Acceleration and Deceleration Tests

Test the acceleration and deceleration of bridge and trolley with approximately 10 percent of rated load at lowest possible location of hook. Operate bridge and trolley to run up to high speed and then stop without jarring or swinging the load.

3.3.7 Grounding Test

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

3.3.8 Adjustments and Repairs

Perform adjustments and repairs under the direction of the Contracting Officer at no additional cost to the Government, until satisfactory conditions are maintained, and contract compliance is affected. After adjustments are made to assure correct functioning of the components, repeat pertinent testing.

3.4 SCHEMATIC DIAGRAMS

Store schematic diagrams for equipment where indicated on drawings.

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 [six] [_____] copies of operation and [six] [_____] copies of maintenance manuals for the equipment furnished. One complete set prior to performance testing and the remainder upon acceptance. Operation manuals shall detail the step-by-step procedures required for system startup, operation and shutdown. 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, possible breakdowns and repairs, and troubleshooting guides. Also include piping and equipment layout 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

Conduct a training course for the operating staff. 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 [_____]. Give Contracting Officer at least 2 weeks advance notice of field training.

3.8 FINAL ACCEPTANCE

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

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

-- End of Section --