
 USACE / NAVFAC / AFCEC / NASA UFGS-41 22 23.19 (April 2008)

 Preparing Activity: NAVFAC Superseding
 UFGS-41 22 23.19 10 (April 2006)
 UFGS-41 22 03.13 20 (April 2006)
 UFGS-41 22 03.16 20 (April 2006)
 UFGS-41 22 03.19 20 (April 2006)

UNIFIED FACILITIES GUIDE SPECIFICATIONS

References are in agreement with UML dated October 2017

SECTION TABLE OF CONTENTS

DIVISION 41 - MATERIAL PROCESSING AND HANDLING EQUIPMENT

SECTION 41 22 23.19

MONORAIL HOISTS

04/08

PART 1 GENERAL

- 1.1 REFERENCES
- 1.2 SYSTEM DESCRIPTION
 - 1.2.1 Design Data: Structural Design Calculations
 - 1.2.2 Design Requirements
 - 1.2.2.1 Track Welding
 - 1.2.2.2 Trade Coordination
- 1.3 SUBMITTALS
- 1.4 QUALITY ASSURANCE
 - 1.4.1 Certificates: [Load Chain][Wire Rope]
 - 1.4.2 Pre-Erection Inspection
- 1.5 DELIVERY, STORAGE, AND HANDLING
 - 1.5.1 Delivery and Storage
 - 1.5.2 Handling
- 1.6 MAINTENANCE

PART 2 PRODUCTS

- 2.1 IDENTIFICATION PLATES
- 2.2 OVERHEAD MONORAIL SYSTEM
 - 2.2.1 Capacity and Speed
 - 2.2.2 Material and Design Requirements
 - 2.2.3 Safety
- 2.3 MONORAIL TRACK SYSTEM
 - 2.3.1 Quick Shutoff
 - 2.3.2 Track Beam System
 - 2.3.3 Track Suspension System
- 2.4 MANUAL HOIST
- 2.5 [ELECTRIC]WIRE ROPE HOIST
 - 2.5.1 Hoisting Ropes
 - 2.5.2 Sheaves
 - 2.5.3 Drum

- 2.6 ELECTRIC CHAIN HOIST
- 2.7 AIR POWERED WIRE ROPE HOIST
 - 2.7.1 Hoist Wire Rope
 - 2.7.2 Sheaves
 - 2.7.3 Drum
- 2.8 AIR POWERED CHAIN HOIST
- 2.9 TROLLEY
- 2.10 MOTORS
 - 2.10.1 Trolley Motors
 - 2.10.2 Hoist Motors
 - 2.10.3 Adjustable Frequency Drive Controls
 - 2.10.3.1 Trolley Electric Drive
 - 2.10.3.2 Hoist Electric Drive
 - 2.10.3.3 Electric Drive Speed Control
 - 2.10.3.4 Dynamic Braking
- 2.11 CONTROLS
- 2.12 LIMIT SWITCHES
- 2.13 BRAKES
 - 2.13.1 Hoist Load Brake
 - 2.13.2 Air Hoist Brake
 - 2.13.3 Spring Applied Hoist Brake
 - 2.13.4 Trolley Brake
- 2.14 LOAD BLOCK AND HOOK
 - 2.14.1 Non-Destructive Testing
 - 2.14.2 Hook and Hook Nut Magnetic Particle Inspections
- 2.15 BEARINGS
- 2.16 ELECTRIFICATION
- 2.17 PAINTING SYSTEM

PART 3 EXECUTION

- 3.1 ERECTION AND INSTALLATION
- 3.2 ERECTION SERVICES
- 3.3 FIELD QUALITY CONTROL
 - 3.3.1 Post-Erection Inspection
 - 3.3.2 Operational Tests
 - 3.3.3 Test Data
 - 3.3.4 Hook Tram Measurement
 - 3.3.5 No-Load Test
 - 3.3.6 125 percent Rated Load Test
 - 3.3.7 Rated Load Speed Test
- 3.4 MONORAIL FIELD TEST PROCEDURES
 - 3.4.1 General Instructions
 - 3.4.2 Equipment Monitoring
 - 3.4.3 Hooks
 - 3.4.4 Preparing For Load Testing
 - 3.4.5 Precautions During Load Testing
 - 3.4.6 Testing
 - 3.4.6.1 No Load Test
 - 3.4.6.2 Hoist Load Testing
 - 3.4.6.3 100 Percent of Rated Capacity (plus 0 percent, minus 5 percent) Load Test
 - 3.4.6.4 125 Percent of Rated Capacity (plus 5 percent, minus 0 percent) Load Test

-- End of Section Table of Contents --

```

*****
USACE / NAVFAC / AFCEC / NASA          UFGS-41 22 23.19 (April 2008)
-----
Preparing Activity:  NAVFAC             Superseding
                                         UFGS-41 22 23.19 10 (April 2006)
                                         UFGS-41 22 03.13 20 (April 2006)
                                         UFGS-41 22 03.16 20 (April 2006)
                                         UFGS-41 22 03.19 20 (April 2006)

```

UNIFIED FACILITIES GUIDE SPECIFICATIONS

References are in agreement with UMRL dated October 2017

SECTION 41 22 23.19

MONORAIL HOISTS 04/08

NOTE: This guide specification covers the requirements for monorail hoists with manual, electric, or air powered lifting chains or wire rope; with or without manual, electric or air powered trolleys and other accessories.

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).

NOTE: TO DOWNLOAD UFGS GRAPHICS

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

PART 1 GENERAL

NOTE: This guide specification is not to be used for monorail systems that operate in hazardous areas as defined in the National Electrical Code, or for nonstandard monorail systems that handle hot metals, ordnance, or fissionable materials.

NOTE: Forward all procurement of monorail systems at Naval Shore based activities with rated capacities of 20,000 lbs or greater, or for use in specialized applications, to:

Naval Facilities Engineering Command,
Navy Crane Center, Building 491,
Norfolk Naval Shipyard,
Portsmouth, Virginia, 23709-5000.

(See NAVFAC Instruction 11450.1a, 22 January 1997.)

NOTE: Show the following information on the project drawings:

1. Sketch of monorail hoist, hook, and trolley system, including data.
2. Runway track system.
3. Electrical junction box location (including mounting height).

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 WELDING SOCIETY (AWS)

AWS D1.1/D1.1M (2015; Errata 1 2015; Errata 2 2016)
Structural Welding Code - Steel

ASME INTERNATIONAL (ASME)

ASME B30.11 (2010) Monorails and Underhung Cranes -
Safety Standard for Cableways, Cranes,

Derricks, Hoists, Hooks, Jacks, and Slings

ASME B30.16	(2017) Overhead Underhung and Stationary Hoists
ASME HST-1	(2012) Performance Standard for Electric Chain Hoists
ASME HST-2	(2014) Performance Standard for Hand Chain Manually Operated Chain Hoists
ASME HST-3	(2017) Performance Standard for Lever Hoists
ASME HST-4	(2016) Performance Standard for Overhead Electric Wire Rope Hoists
ASME HST-5	(2014) Performance Standard for Air Chain Hoists
ASME HST-6	(2015) Performance Standard for Air Wire Rope Hoists

ASTM INTERNATIONAL (ASTM)

ASTM A1023/A1023M	(2015) Standard Specification for Stranded Carbon Steel Wire Ropes for General Purposes
ASTM A275/A275M	(2015) Standard Test Method for Magnetic Particle Examination of Steel Forgings
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 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 E543	(2015) Standard Practice for Agencies Performing Non-Destructive Testing
ASTM E709	(2015) Standard Guide for Magnetic Particle Examination
ASTM F436	(2011) Hardened Steel Washers
ASTM F959/F959M	(2017) Standard Specification for Compressible-Washer-Type Direct Tension Indicators for Use with Structural Fasteners, Inch and Metric Series

CRANE MANUFACTURERS ASSOCIATION OF AMERICA (CMAA)

CMAA 74 (2010) Specifications for Top Running and Under Running Single Girder Electric Overhead Cranes Utilizing Under Running Trolley Hoist, No. 74

MATERIAL HANDLING INDUSTRY OF AMERICA (MHI)

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

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

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA ESPG (2009-2010) Electrical Standards and Product Guide (ESPG)

NEMA ICS 8 (2011) Crane and Hoist Controllers

NEMA MG 1 (2016; SUPP 2016) Motors and Generators

NEMA MG 2 (2014) Safety Standard for Construction and Guide for Selection, Installation and Use of Electric Motors and Generators

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70 (2017; ERTA 1-2 2017; TIA 17-1; TIA 17-2; TIA 17-3) National Electrical Code

RESEARCH COUNCIL ON STRUCTURAL CONNECTIONS (RCSC)

RCSC S348 (2009) RCSC Specification for Structural Joints Using ASTM A325 or A490 Bolts

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

29 CFR 1910.179 Overhead and Gantry Cranes

1.2 SYSTEM DESCRIPTION

NOTE: Standard hoists capacities are 1, 5, and 10 metric tons tons 907, 4536, and 9072 kg 2000, 10,000, and 20,000 pounds.

Select the appropriate reference in the following paragraph to coincide with the equipment selected as follows:

ASME HST-1 for electrical chain hoists
ASME HST-2 for hand operated chain hoists
ASME HST-3 for lever operated manual chain hoists
ASME HST-4 for overhead electric wire rope hoists
ASME HST-5 for air chain hoists
ASME HST-6 for air wire rope hoists

The above stated references each include separate
appendices for marine and DoD applications.

Provide a monorail system with [manual hoist][electric powered
hoist][air-powered] and [plain type (hand operated)][hand chain
operated][electric powered][trolley] complete, tested and ready for
operation. Monorail, hoist,[trolley,] equipment, materials, installation,
examination, inspection, and workmanship shall conform to the applicable
requirements of NFPA 70, ASME B30.11, ASME B30.16,[ASME HST-1,][ASME HST-2,][
ASME HST-3,][ASME HST-4],[ASME HST-5,][ASME HST-6,] MHI MH27.1[and
MHI MH27.2], as modified and supplemented by this specification. Reference
in these publications to the "authority having jurisdiction" means the
"Contracting Officer."

[1.2.1 Design Data: Structural Design Calculations

Submit structural design calculations verifying the size of structural
members, structural supports (fittings, rods, brackets, and components),
and lifting beams for the track beam system. Include stress and loading
diagrams. Submit calculations with monorail drawings. Submit additional
product data for commercially procured items, including as a minimum, the
following items:

- Festoon System
- Runway Electrification System
- Variable Frequency Drives
- Bumpers
- End Stops

]1.2.2 Design Requirements

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

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

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

Submit shop drawings showing crane capacity, hook envelope, and the general arrangement of the track beam system, including curves and switches, clearances, principal dimensions, details of structural connections, and all component details. Include complete schematic wiring diagram with description of operation. Manufacturer's catalog data will suffice for items of standard manufacturer.

1.2.2.1 Track Welding

[Welding new sections of monorail track to existing shall conform to AWS D1.1/D1.1M.]

1.2.2.2 Trade Coordination

The Contractor is responsible for the coordination of his work with the work of all trades involved and as it relates to the building structure. Verify all building dimensions that relate to fabrication of the monorail system, and notify the Contracting Officer of any discrepancy prior to ordering the monorail.

]1.3 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

Monorail system, including attachments to existing building structure; G[, [____]]
Complete schematic wiring diagram with description of operation; G[, [____]]

SD-03 Product Data

Monorail Track System; G[, [____]]
[Manual Hoist; G[, [____]]]
[Electric Wire Rope Hoist; G[, [____]]]
[Electric Chain Hoist; G[, [____]]]
[Air Powered Wire Rope Hoist; G[, [____]]]
[AIR POWERED CHAIN HOIST; G[, [____]]]
[Trolley; G[, [____]]]
[Pendant Pushbutton Station; G[, [____]]]
[Licensed Radio Remote Control System; G[, [____]]]
[Unlicensed Radio Remote Control System; G[, [____]]]
Hook Proof Test; G[, [____]]
Festoon System; G[, [____]]
Runway Electrification System; G[, [____]]
Variable Frequency Drives; G[, [____]]
Bumpers; G[, [____]]
End Stops; G[, [____]]
Manufacturer's Published Tables

Manufacturer's descriptive data and technical literature, performance charts and curves, catalog cuts, and installation instructions, and parts list.

SD-05 Design Data

Structural Design calculations; G[, [____]]
Structural and Load Capacity calculations; G[, [____]]

Load and sizing calculations as specified.

SD-06 Test Reports

125 percent Rated Load test
No-Load Test
Post-Erection Inspection
Operational Tests
Rated Load Speed Test
[Wire Rope Breaking Strength

][Load Chain Proof Test
] Hook NDT Report
Hook Tram Measurement

Tests and inspections reports. Magnetic particle inspection of hook and hook nut results.

SD-07 Certificates

[Compliance with all listed Standards
Semi-Annual Overload/Safe for Testing
Hazardous Material]
Brake Settings
Runway Straightness/Levelness
Loss of Power Test
Hook Proof Test

SD-10 Operation and Maintenance Data

Monorail with hoist system, all components, Data Package 3; G[,
[_____]]

Submit Data Package 3 as specified in Section 01 78 23 OPERATION AND MAINTENANCE DATA.

1.4 QUALITY ASSURANCE

1.4.1 Certificates: [Load Chain][Wire Rope]

- [a. Certification of minimum Load Chain Proof Test, clearly indicating load chain breaking strength for each hoist, and clearly identified for traceability. Submit factory certification of load chain rated capacity.]
- [a. Certification of minimum wire rope breaking strength for each hoist, with traceable identification for each hoist installed. Where applicable, submit factory certification of the wire rope rated capacity.]
- b. Certification that the hoist, hook, and trolley system contains no hazardous material, asbestos, cadmium, lead, elemental mercury, or PCBs.
- c. Semi-Annual Overload/Safe for Testing certification that the hoist, hook, and trolley system is safe to test on a semi-annual overload basis with a test load of 131.25 percent of rated capacity with no detrimental effects.
- d. Certification that testing may be performed in which hoist, hook, and trolley system is subjected to a Loss of Power Test during operation with no detrimental effects.
- e. Certification that the hoist, hook, and trolley system design and fabrication is in compliance with all listed standards.
- f. Hook Proof Test certification that the hoist hook was subjected to a minimum static load of 200 percent of rated capacity for at least 10 minutes without deformation.
- g. Runway Straightness/Levelness certification that the straightness,

levelness, and elevation of the monorail system meet MH27.1 requirements.

- h. Certification of brake settings, including the allowable range of adjustment for hoist and trolley brakes and the initial setting of each.

1.4.2 Pre-Erection Inspection

Before erection, the Contractor[and the manufacturer's representative] shall[jointly] inspect the monorail and hoist systems and components at the job site to determine compliance with specifications and manufacturer's data and shop drawings as approved. Notify the Contracting Officer [_____] days before the inspection.

1.5 DELIVERY, STORAGE, AND HANDLING

1.5.1 Delivery and Storage

Inspect materials delivered to site for damage; unload and store with minimum handling. Store materials on-site in enclosures or under protective coverings. Protect materials not suitable for outdoor storage to prevent damage or corrosion during periods of inclement weather, including subfreezing temperatures, precipitation, and high winds. Store materials susceptible to deterioration by direct sunlight under cover and avoid damage due to high temperatures. Do not store materials directly on ground. When special precautions are required, prominently and legibly stencil instructions for such precautions on outside of equipment or its crating.

1.5.2 Handling

Handle materials in such a manner as to ensure delivery to final location in undamaged condition. Make repairs to damaged materials at no cost to Government.

1.6 MAINTENANCE

Submit Monorail with hoist system, all components, Data Package 3 for the entire monorail system in accordance with Section 01 78 23 OPERATION AND MAINTENANCE DATA.

PART 2 PRODUCTS

2.1 IDENTIFICATION PLATES

Provide manufacturer installed identification plates of non-corrosive metal showing, in clearly legible permanent lettering, the manufacturer's name, model number, capacity rating in pounds, and other essential information. Also provide monorail track beam identification plates showing the capacity of the system, in pounds, legible from the floor and from either side of the monorail track beam.

2.2 OVERHEAD MONORAIL SYSTEM

NOTE: Plain type (hand operated) trolleys are recommended where trolley motion is infrequent or the distance is short, providing good load spotting ability and use for hoists of 3 metric ton (3 ton)

capacity and under. Plain type trolleys are not recommended for hoists of 3 metric ton (3 ton) capacity and greater, or for tracks higher than 6 m (20 feet) above the floor level. Motor operated trolleys are recommended where the operating frequency, travel distance, rated load, or beam elevation makes other types of trolleys impractical.

This specification is written for a single monorail system and hoist. Edit the following paragraphs to reflect number, types, capacities of monorail track systems, hoists, trolleys, etc.

Off the shelf monorail systems consist of MH27.1 Patented Track Systems and MH27.2 Enclosed Track Systems. MH27.1 systems feature exposed running flanges and trolley wheels and systems can have equivalent center loads in excess of 150 tons. MH27.2 systems feature enclosed running surfaces where trolley wheels are fully covered by the track and systems have rated capacities typically less than 4000 lbs

When there is one hoist on one monorail system, the monorail system capacity and the hoist capacity must be compatible. When there is more than one hoist on the monorail system, the capacity of the monorail system must be capable of carrying the total sum of the system hoists individual rated capacity with the following exception:

1. There are positive monorail track beam stops to restrict the approach of the hoists.
2. Calculations indicate that at the point of closest approach of the hoists, with rated capacity load on the hoists, the monorail track beam and monorail support points (and appurtenances) are not loaded in excess of the load condition imposed by any one hoist with rated load in any location.

Should conditions 1 and 2 exist, then the capacity of the monorail system must be equal to the capacity of the highest rated individual hoist in the monorail track system. Do not specify a monorail system of greater capacity than required as this will increase the system cost.

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

Do not specify a longer lift range than required as this will increase the building height and hoist cost.

Provide overhead monorail system conforming to [MHI MH27.1, Duty Class C][MHI MH27.2, Frequent Usage (Heavy Service)], for [indoor][outdoor] service, with [an electrical chain hoist][a hand operated chain hoist][a lever operated manual chain hoist][an overhead electric wire rope hoist][an air chain hoist][an air wire rope hoist] mounted on a movable trolley. Provide [plain type (hand operated)][hand chain operated][motor operated] trolley. The hoist and trolley shall meet the design requirements specified in [ASME HST-1, Duty Class H3][ASME HST-2][ASME HST-3][ASME HST-4, Duty Class H3][ASME HST-5, Duty Class A4][ASME HST-6, Duty Class A4].

2.2.1 Capacity and Speed

Provide monorail system with a minimum rated capacity of [_____] metric tons tons pounds. The hook lift capacity and speed shall be the manufacturer's standard within the limits specified above. [The hook lift maximum height limit is [_____] m feet above the finished floor, and at its lowest point [_____] m feet [below][above] the finished floor.]

2.2.2 Material and Design Requirements

Monorail hoist system shall include the following design requirements:

- a. Powered hoists shall include a brake and a controlled braking means, and an overload limiting device.
- b. Directional contactors shall include electrical and mechanical interlocks. Design the mainline contactor, along with the power-off/power-on circuitry to remove power from the drive motors, brakes and control circuit. The control circuit shall not operate unless a power-on button is depressed.
- c. Overcurrent protection for the control circuit and control circuit transformer; fuse or circuit breaker protection for branch circuit short circuit and ground fault protection; and overload protection for each motor, motor controller, and branch circuit conductor shall all conform to the NFPA 70.
- d. Provide safety (drop) lugs or a functional equivalent on the trolley frame to prevent derailment in the event of wheel failure.
- e. The hoist and trolley shall be capable of [general service][protected indoor][all weather outdoor (-18 to 38 degrees C 0 to 100 degrees F)] working conditions.
- f. Provide monorail system operating on [____ psi tool air][____ Volts ____ Hz] power supply.
- g. Provide a non-resettable hour meter, connected across the main line contactor, readable from the exterior of the main control panel, to indicate the elapsed number of hours the crane is energized.

2.2.3 Safety

Comply with the mandatory and advisory safety requirements of ASME B30.11, ASME B30.16, and 29 CFR 1910.179. The Contractor is responsible for checking the proper operation and condition of safety devices, electrical components, mechanical equipment, and structural assemblies prior to installation. Immediately report any observed defective components and

replace. Submit structural and load capacity calculations verifying a design safety factor of [5 to 1][_____] to ultimate strength of weakest material (steel) used for any track suspension device or support which is not a standard cataloged product of the [beam][system] manufacturer.

2.3 MONORAIL TRACK SYSTEM

Track system shall conform to [MHI MH27.1][MHI MH27.2][, except as modified and supplemented in this section,] for powered hoists. Provide patented track beam sections fabricated by a manufacturer regularly engaged in production of this type of beam. The maximum allowable vertical and lateral deflection shall conform to CMAA 74, with the hoist(s) at rated load(s) and at any location(s). Rail separation at joints shall not exceed 1.59 mm 1/16 inch.

2.3.1 Quick Shutoff

Provide electrical disconnect and/or quick shutoff type air supply valve, readily accessible from the floor, and located within proximity to the monorail system.

2.3.2 Track Beam System

Provide the track beam system with trolley stops at all open end locations. The stops shall retain the hoist on the track. Stops shall contact the wrap-around type trolley frame.

2.3.3 Track Suspension System

NOTE: Flexible suspension is preferred if there is adequate headroom to install it.

Use of tension monitoring washers is not mandatory and will increase project cost if used for all structural joints. Choose the appropriate materials for construction of joints per AISC requirement(s) for joint manufacture with approved materials.

Provide [flexible][rigid] type monorail suspension. Design and installation of the monorail track beam suspension system is the responsibility of the Contractor. Support monorail track system using only the structural members indicated on the drawings.[Provide additional supports as required to carry lateral and longitudinal monorail track system loads to the structural members shown.][Additional material supports shall conform to the material requirements contained in Section 05 12 00 STRUCTURAL STEEL.]

- a. Suspend the monorail track beam with the [beam][system] manufacturer's standard cataloged suspension products. Submit manufacturer's published tables verifying the sizing of any track beam and suspension system.
- b. Make bolted connections to supporting structure, excluding hanger rods, with ASTM A325M ASTM A325 bolts, ASTM A563M ASTM A563 nuts, and ASTM F959/F959M load indicator washers[, or ASTM F436 hardened washers]. ASTM A325M ASTM A325 bolts shall be fully pre-tensioned in accordance with RCSC S348.

[2.4 MANUAL HOIST

Provide manual hoist and trolley, ASME HST-2, ASME HST-3, trolley suspension. Provide trolley and wheels suitable for operation on the steel monorail track beam provided, having not less than four wheels.

] [2.5 [ELECTRIC] WIRE ROPE HOIST

2.5.1 Hoisting Ropes

Provide the following:

- a. Rope lengths sufficient to maintain a minimum of two full wraps of rope at the dead end(s) of the drum, with the block in its lowest indicated position.
- b. Hoisting ropes shall conform to ASTM A1023/A1023M, improved or extra improved plow steel, regular lay, uncoated, 6 by 37 class construction, with an independent wire rope core. Provide proof of wire rope breaking strength test report.

**NOTE: ASME HST-4 applies only to electrically
powered wire rope hoists. Delete item "c" and "d"
for non-electric monorails.**

[c. Conform to ASME HST-4, Class H3, except as modified herein. All hoists shall be double reeved.]

[d. Wedge socket end connections or aluminum swages are not permitted.]

2.5.2 Sheaves

Provide steel or ductile cast iron sheaves. Pitch diameter of running sheaves shall not be less than 16 times the rope diameter. Pitch diameter of non running sheaves shall not be less than 12 times the rope diameter. Contact surfaces of sheaves shall be unpainted.

2.5.3 Drum

Provide steel or ductile cast iron drum. Pitch diameter of the drum shall not be less than 18 times the rope diameter. A minimum of two dead wraps of the hoisting rope shall remain on each anchorage when the hook is in its extreme low position. Contact surfaces of drums shall be unpainted.

] [2.6 ELECTRIC CHAIN HOIST

Electric chain hoist shall conform to ASME HST-1, Class H3 and NEMA ICS 8, NEMA MG 2, and NEMA ESPG except as modified herein. Provide load chain proof test results.

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

] [2.7 AIR POWERED WIRE ROPE HOIST

Apply 2 metric ton ton design criteria to hoists of 2 metric ton ton, or less, rated lifting capacity. Hoists of 2, 5, 10, and higher metric ton ton

rated capacity, shall be equipped with an automatic mechanical load lowering brake.

2.7.1 Hoist Wire Rope

Provide sufficient rope lengths to maintain a minimum of two full wraps of rope at the dead end(s) of the drum, with the block in its lowest indicated position. Wedge socket end connections or aluminum swages are not permitted.

2.7.2 Sheaves

Provide steel or ductile cast iron sheaves. Pitch diameter of running sheaves shall not be less than 16 times the rope diameter. Pitch diameter of non running sheaves shall not be less than 12 times the rope diameter. Contact surfaces of sheaves shall be unpainted.

2.7.3 Drum

Provide steel or ductile cast iron drum. Pitch diameter of the drum shall not be less than 18 times the rope diameter. A minimum of two dead wraps of the hoisting rope shall remain on each anchorage when the hook is in its extreme low position. Contact surfaces of drums shall be unpainted.

]2.8 AIR POWERED CHAIN HOIST

Air powered chain hoist shall conform to ASME HST-5. Equip chain hoists of 3 m 10 foot lift or more with a load chain bucket.

]2.9 TROLLEY

Provide a [manual][geared manual][air motor powered] trolley drive designed to operate from [[_____] track beam section][the track beam section furnished under this contract]. Where two or more hoists are located on the same monorail beam, the trolleys shall be equipped with rubber bumper devices designed to prevent contact of any part or parts of the hoists.

2.10 MOTORS

**NOTE: "Inverter duty" and "encoder" requirements
for motors within the following paragraph are
necessary only when specifying "Adjustable Frequency
Drive Controls".**

Motors shall conform to NEMA MG 1. All motors shall be minimum 60 minute duty rating. Motor insulation shall be Class H with a Class B temperature rise. Equip all motors with thermal trip type over-temperature protection.[Maximum motor speed shall not exceed 1800 RPM.][Provide [single][two] speed magnetic control for the hoist[and trolley].]

2.10.1 Trolley Motors

Trolley drive motor shall be AC [inverter duty,]totally enclosed non-ventilated (TENV), squirrel cage induction type.[Provide reduced voltage starting, acceleration and deceleration for the trolley drive.]

2.10.2 Hoist Motors

Provide AC [inverter duty,]totally enclosed non-ventilated (TENV), squirrel cage induction type hoist motor[s].

[2.10.3 Adjustable Frequency Drive Controls

2.10.3.1 Trolley Electric Drive

Provide static reversing, adjustable frequency controllers.

2.10.3.2 Hoist Electric Drive

Provide a static reversing, adjustable frequency, speed regulated, closed loop flux vector controller with encoder feedback. The hoist drive shall ensure that adequate motor torque is available to suspend the load before the brakes are released. For a hoist with one brake, two independent drive outputs energizing separate brake contactors, whose contacts are in series with the brake coil, are required to release the brake; or an additional separate brake contactor independent of the drive whose contact is in series with the drive controlled brake contactor. For hoists with two brakes, connect the secondary brake to a different output from the primary brake.

2.10.3.3 Electric Drive Speed Control

Each electric drive shall be infinitely variable. Provide speed control of the three step infinitely variable type for the hoist function, and two step infinitely variable type for the trolley function, controlled via [pendant pushbuttons][radio controlled unit].

2.10.3.4 Dynamic Braking

Provide dynamic braking for both hoist and trolley electric drives. The hoist and trolley brakes shall set after the associated controller decelerates motor to a controlled stop. Size the hoist and trolley controllers to provide sufficient starting torque to initiate motion of that drive mechanism from standstill with 0 to 131.25 percent of rated load on the hook and not produce any rollback. The hoist controller shall enable the drive motor to develop full torque continuously at zero speed. Drive motors shall run smoothly, without torque pulsations at the lowest speed and be energized at a frequency not exceeding 60 HZ for the trolley, and 120 HZ for the hoist drive, with less than full capacity on the hook.

]2.11 CONTROLS

NOTE: If selecting radio controls, a determination must be made on whether a licensed or unlicensed frequency will be used. Most activities choose a licensed portable transmitter since it is less susceptible to interference. The range of licensed portable transmitters operating on Government exclusive and Government shared frequencies is less than 1000 feet.

Some activities choose a non-licensed portable transmitter due to time constraints in obtaining a license and the dearth of frequencies available in

the Government exclusive bands. The range of non-licensed portable transmitters operating in non-Government exclusive frequencies is at least 200 feet.

For licensed radio control systems, Form DD1494, "Application for Equipment Frequency Allocation" must be approved by the Naval Electromagnetic Spectrum Center (NAVEMSCEN), prior to obtaining a specific frequency from the frequency coordinator.

Form DD1494, frequency allocation and assignments for non-licensed systems must be submitted to NAVEMSCEN for information.

Provide control of electric hoist[and trolley] from a [pendant pushbutton station][Licensed Radio Remote Control System][Unlicensed Radio Remote Control System]. Arrange pushbuttons in accordance with ASME B30.11 recommendations.[If provided, locate pushbutton station [1.2 m 4 feet] [_____] above the finished floor.][Control pendant shall extend [_____] below the underside of the track beam.]

2.12 LIMIT SWITCHES

Equip hoists with adjustable upper and lower limit switches for wire rope or limit stops for chain to prevent over-travel in both the raising and lowering directions. Equip electric wire rope hoist with a secondary upper limit switch, wired independently of the directional contactors and of the primary limit switch, so that activation results in the removal of power from the motor and brake. Use a three position spring return bypass key switch. In one direction the bypass keyswitch shall allow resetting of the secondary upper limit switch prior to resuming operation. During resetting of the secondary limit, the hoist shall operate in the lowering direction only. In the other direction, the keyed bypass switch shall allow bypassing of the primary upper limit switch to allow the secondary limit switch to be tested on a periodic basis.

2.13 BRAKES

NOTE: Specify trolley brake for motor operated trolley. Select "100 percent" for outdoor monorails and "50 percent" for indoor monorails.

2.13.1 Hoist Load Brake

Provide hoist load brake that is capable of stopping and holding a 131.25 percent test load. If dynamic braking is not included, provide a hoist mechanical load brake that is capable of stopping and holding a 131.25 percent test load. If the hoist has more than one brake, each brake shall independently stop and hold 131.25 percent of rated capacity.

2.13.2 Air Hoist Brake

Air hoists shall be provided with a braking means that prevents the lowering of the load in the event of a loss of air supply and can stop and hold 131.25 percent of rated capacity.

2.13.3 Spring Applied Hoist Brake

Provide spring applied hoist brake, electrically released, and capable of being adjusted to 50 percent of its full rating. Provide the hoist brake with a manual lever type, self return to ON, release mechanism so that it may be partially released by hand and the lifted load allowed to gradually descend by gravity and brake friction. Screw type, maintained OFF, release mechanisms are not permitted. Mount the brake on the end of the motor opposite the gear case. Design shall permit easy access for inspection and adjustment.

2.13.4 Trolley Brake

Provide trolley with either a non-coasting worm drive or with an electro mechanical brake that is spring applied, electrically released. Trolley brake shall have a torque rating equal to or greater than 50 percent of the drive motor rated torque and be adjustable from 85 percent to 100 percent of its torque rating. Equip trolley brake with a manual release. Design to permit easy access for wear, inspection and setting.

2.14 LOAD BLOCK AND HOOK

**NOTE: A minimum throat opening may be required to
accommodate special slings or other devices. Verify
with user.**

Provide safety hook fitted with self-closing, spring loaded steel safety latch, and with hook nuts keyed to hook shanks by means of a setscrew installed in a plane parallel to the longitudinal axis of the hook shank, or by any other similar easily removable securing device. Provide unpainted hook and hook nut, permanently marked with an identification number. Clearly mark the hook and hook nut with a unique identification number corresponding to the number used in non-destructive test (NDT) reports.

2.14.1 Non-Destructive Testing

The following requirements apply:

- a. The Hook NDT Report supplier shall provide a letter certifying that the requirements of ASTM E543 are met.
- b. The NDT supplier shall develop, and submit for review, procedures, including technique sheets specific to the types, shapes, and sizes of the parts being examined (e.g., shank hook, eye hook, duplex hook, eye bar nut). For the magnetic particle method, the procedures shall adequately describe the orientation of the hook or nut, or pin with the magnetizing equipment.
- c. These procedures shall be reviewed by a Level III examiner who is independent of the NDT supplier and is certified in the applicable NDT method.

2.14.2 Hook and Hook Nut Magnetic Particle Inspections

The hook and hook nut shall be magnetic-particle inspected in compliance

with ASTM E709 over the entire area in accordance with ASTM A275/A275M, with the following restrictions: Do not use DC yokes (including switchable AC/DC yokes used in the DC mode) and permanent magnet yokes. Do not use automatic powder blowers or any other form of forced air other than from a hand-held bulb for the application or removal of dry magnetic particles. Remove arc strikes. Equipment ammeters shall have an accuracy of plus or minus 5 percent of full scale (equipment ammeter accuracy other than that stated is acceptable provided the MT procedure states that a magnetic field indicator is used to establish and verify adequate field strength for the aspects of the inspection). The acceptance standard is no linear indications greater than 1.59 mm 1/16 inch.

2.15 BEARINGS

All bearings except those subject to a small rocker motion shall be anti-friction type. Provide a means for lubrication for bearings not considered to be lifetime lubricated by the manufacturer.

2.16 ELECTRIFICATION

**NOTE: Festooned type electrification is preferred
for short travel distances. Continuous conductors
are recommended for enclosed safety bar
electrification where runway conditions permit.**

Provide runway electrification of the [flat festooned type][enclosed safety bar type with four[continuous] copper conductors]. Provide electrical work for the monorail system in accordance with NFPA 70 [and Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM].

2.17 PAINTING SYSTEM

**NOTE: Specify blast cleaning, zinc primer, and
epoxy finish coat for outdoor monorail systems. For
a corrosive atmosphere, specify appropriate
protective requirements.**

[Provide manufacturer's standard painting [brilliant yellow][or shop painting]of components.][Comply with the requirements specified in Section 23 03 00.00 20 BASIC MECHANICAL MATERIALS AND METHODS.] Provide a primer and a finish coat. Blast clean all components prior to painting. Primer shall be inorganic zinc type.[Provide epoxy finish coat formulated for marine environments.] Paint coats shall be smooth and even, free of runs, sags, orange peel, or other defects.

PART 3 EXECUTION

3.1 ERECTION AND INSTALLATION

Erect and install the monorail system, complete in accordance with the approved submittals and in condition to perform the operational and acceptance tests.

3.2 ERECTION SERVICES

Provide supervisory erection services from the monorail system manufacturer.

3.3 FIELD QUALITY CONTROL

3.3.1 Post-Erection Inspection

After erection, the Contractor, the Contracting Officer, and a representative of the activity [crane] maintaining organization, shall jointly inspect the monorail and hoist systems and components to determine compliance with specifications and approved submittals. Notify the Contracting Officer [_____] days before the inspection. A list of deficient items, including a determination of criticality will be provided to the Contractor for corrective action. Outstanding items shall be noted for correction during the inspection. Items considered critical (load bearing, load controlling, or operational safety devices) shall be corrected prior to further testing. Upon correction, provide a report of the inspection indicating the monorail system is considered ready for operational tests.

3.3.2 Operational Tests

NOTE: Determine if Government test loads are available. If not, test loads will be provided by the Contractor.

- a. After erection and inspection, test the monorail system, hoist, and trolley as specified herein. Test the systems in service to determine that each component of the system operates as specified, is properly installed and adjusted, and is free from defects in material, manufacturing, installation, and workmanship. Rectify all deficiencies disclosed by testing and retest the system or component to prove the monorail system is operational.
- b. Furnish[loads for testing,] operating personnel, instruments, and all other necessary apparatus. [The Contracting Officer will furnish to the Contractor loads for testing. Receive and transport the loads from a location not more than [_____] km miles from the job site and return them to that location after the tests have been completed.]

NOTE: For NAVFAC LANT, add the following bracketed sentences.

- c. Furnish test loads, operating personnel, instruments, and other apparatus as necessary to conduct field tests on hoist and monorail. Perform test and final adjustments of the equipment under the supervision of the Contracting Officer, and a representative of the activity crane maintaining organization.

3.3.3 Test Data

Record test data on appropriate test record forms suitable for retention for the life of the monorail system. Record operating and startup current

measurements for electrical equipment (motors and coils) using appropriate instrumentation (i.e., clamp-on ammeters). Compare recorded values with design specifications or manufacturer's recommended values. Abnormal differences (i.e., greater than 10 percent from manufacturer's or design values) shall be justified or appropriate adjustments performed. In addition, note any high temperatures or abnormal operation of any equipment or machinery, investigate and correct. Record hoist[and trolley] speeds during each test cycle.

3.3.4 Hook Tram Measurement

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

3.3.5 No-Load Test

- a. Hoist: Raise the load hook the full operating lift distance and verify satisfactory operation of hoist, upper limit switches, lower limit switch, and the hoisting and lowering speeds. [Operate the hoist at low and high speed in both directions.]
- b. Trolley: Operate trolley assembly the full length of the monorail in both directions.[Operate trolley at low and high speed in each direction.] Verify satisfactory operation and verify trolley speed. [Operate all rail switches.]

3.3.6 125 percent Rated Load Test

NOTE: Load Brake Test, if equipped, and Loss of Power Test (items c. and d. below) will be performed at low speed for two speed hoists. These tests are not required for manually powered hoists.

125 Percent (plus 5 percent minus 0) of rated capacity

- a. Hoist Static Test: Raise test load approximately 300 mm one foot above the floor and hold for 10 minutes. Observe load lowering that may occur which indicates malfunction of hoisting component or brake. Lower the test load to the floor until the hoist line is slack.
- b. Hoist Dynamic Test: Raise the test load to approximately 1.5 m 5 feet above the floor[using both speed points in the process]. Lower the load back to the floor[using both speed points]. Stop the test load at least once while lowering[at high speed] and observe proper brake operation. Wait 5 minutes, then repeat the above cycle.
- [c. Load Brake Test (if equipped): Raise test load approximately 1.5 m 5 feet. With the hoist controller in the neutral position, release the holding brake. The load brake must hold the test load. Again with the holding brake in the released position, start the test load down[at low speed] and return the controller to off position as the test load lowers. The load brake must stop and hold the test load. If the load brake does not stop the test load, but prevents the test load from

accelerating, activities will contact the OEM or activity engineering organization to ensure that the load brake is operating as designed.]

- [d. Loss of Power Test: Raise the test load approximately 1 m 3 feet and while lowering test load[at low speed], cut main power to hoist. The load must stop.]
- e. Trolley Test: With test load hoisted to a height of 300 mm one foot above the floor, operate trolley the full distance of the monorail in both directions[using both speed points in the process]. Observe for any malfunctioning of the trolley assembly and monorail system.
[Operate all rail switches.]

3.3.7 Rated Load Speed Test

**NOTE: These tests are not required for manually
powered hoists**

With the hoist loaded to rated capacity, raise and lower the load verifying that the hoisting and lowering speeds are provided as specified.[With the hoist loaded to rated capacity, operate trolley along the monorail beam verifying that the trolley speed is provided as specified. Further, verify that the trolley stops in each direction within a distance (in meters feet) equal to 10 percent of rated capacity high speed (in meters per minute feet per minute) when initially traveling at high speed and carrying the rated capacity load.] Record voltage, amperage, hoisting and lowering speeds,[trolley travel speed,] and motor speed for each motor.

3.4 MONORAIL FIELD TEST PROCEDURES

 NOTE: Use this paragraph For NAVFAC projects.

 NOTE: The following document may be included in
 NASA, Air Force, and Army projects subject to agency
 and/or Contracting Officer approval. This document
 should be included in all NAVFAC Monorail Hoist
 projects.

MONORAIL FIELD TEST PROCEDURES	
Supported Command:	Date of Inspection:
	Contract No.:
Names and Titles of Participating Government, Supported Command, and Contractor Representatives:	

3.4.1 General Instructions

The crane and supporting structure shall be tested in accordance with the applicable paragraphs of this guide. Assure that all components and features that affect load bearing, load controlling, or operational safety devices of the cranes are properly tested. Perform all the tests described below along with any other tests required to verify that the crane meets the contract requirements including any contract modifications. The sequence of testing is at the option of the contractor's test director except that the no-load test shall be performed first. Develop data sheets for tests that require data recording. Include in the data sheets the expected results along with the allowable tolerance in accordance with the requirements of the specification. Determine the tools, meters, measuring devices, etc. that are required to perform the test and have them available at the site. When measuring currents less than 5 amps, a 10-amp series type amp meter is recommended instead of an amp probe or use of the drive monitoring display. All equipment shall be calibrated

3.4.2 Equipment Monitoring

During the load test, check for the proper operation and condition of safety devices, electrical components, mechanical equipment, and structural

assemblies. Immediately report any observed defects critical to continuing testing to the contractor's test director, who shall suspend the testing until the deficiency is corrected.

3.4.3 Hooks

Record hook serial number. Measure the hook for hook throat spread before load testing. Install two tram points on hook throat. Measure the distance between these tram points (plus or minus 0.4 mm 1/64 inch). Record this base dimension. Check operation of safety latches.

Load Hook Unique Identification Number _____

Load Hook Nut Unique Identification Number _____

Load Hook Throat Measurement - Before Load Testing _____

Load Hook Safety Latches SAT_____ UNSAT_____ NA_____

3.4.4 Preparing For Load Testing

- a. Select a safe test area and clear all traffic, unauthorized personnel, and equipment from test area. This test area shall be roped off or otherwise secured to prevent entry of unauthorized personnel and equipment.
- b. All rigging used in crane load testing shall conform to applicable OSHA regulations and ASME standards for inspection and testing. Note that test loads INCLUDE the weight of rigging used to connect them to the load block.

3.4.5 Precautions During Load Testing

- a. Observe extreme caution at all times.
- b. Personnel shall remain clear of suspended loads and areas where they could be struck in the event of component failure.
- c. Raise test load only to a height sufficient to perform the test.

3.4.6 Testing

Inspection Codes: SAT = Satisfactory, UNSAT = Unsatisfactory, NA=Not applicable

3.4.6.1 No Load Test

Pendant Control

From the pendant station energize the main line contactor by activating the **START** button.

a. Power On SAT_____ UNSAT_____ NA_____

De-energize the crane by activating the **E-STOP** button.

b. E-Stop SAT_____ UNSAT_____ NA_____

c) Power Off SAT_____ UNSAT_____ NA_____

From the pendant controller check all the function of the crane. Verify that the motions match the button labels and the directions of operation are correct.

d. Main Hoist Up	SAT_____	UNSAT_____	NA_____
e) Main Hoist Down	SAT_____	UNSAT_____	NA_____
f. Trolley North/West	SAT_____	UNSAT_____	NA_____
g. Trolley South/East	SAT_____	UNSAT_____	NA_____
h. Indicator Lights (Power On, Power Available, etc.)	SAT_____	UNSAT_____	NA_____

Motor Controls

Hoist controls shall be tested to verify that sequencing and timing are in accordance with the requirements of the specification.

Record the following:

Nameplate:

Actual:

a. Disconnect Switch Voltage	_____Volts	_____Volts
b. Current (High Speed) Up	_____Amps	_____Amps
c. Voltage (High Speed) Up	_____Volts	_____Volts

Note: The current and voltage will be measured at the disconnect switch.

d. Current (High Speed) Down	_____Amps	_____Amps
e. Voltage (High Speed) Down	_____Volts	_____Volts

Note: The current and voltage will be measured at the floor disconnect switch.

Hoist Speeds: Measure hoist speed in m/min FPM at fast speed in each direction.

	<i>Actual</i>	<i>Required</i>
a. Up (High Speed, No Load)	_____ m/min FPM	_____ m/min FPM
b. Down (High Speed, No Load)	_____ m/min FPM	_____ m/min FPM

Measure hoist speed in FPM at slow speed in each direction.

c. Up (Slow Speed)	_____ m/min FPM	_____ m/min FPM
d. Down (Slow Speed)	_____ m/min FPM	_____ m/min FPM

Note: Full speed tolerance is 10 percent. Rated high speed is 2.1 m/min 7 fpm with fast speed switch in the OFF position.

Test **Trolley Controls** to verify that sequencing and timing are in accordance with the requirements of the specification.

Record the following:

Nameplate:

Actual:

- | | | |
|------------------------------------|------------|------------|
| a. Disconnect Switch Voltage | _____Volts | _____Volts |
| b. Current (High Speed) North/East | _____Amps | _____Amps |
| c. Voltage (High Speed) North/East | _____Volts | _____Volts |
| d. Current (High Speed) South/West | _____Amps | _____Amps |
| e. Voltage (High Speed) South/West | _____Volts | _____Volts |

Note: The current and voltage will be measured at the floor disconnect switch.

Measure **trolley speed in FPM** high speed in each direction.

- | | Actual | Required |
|----------------------------|-----------------|-----------------|
| a. North/East (High Speed) | _____ m/min FPM | _____ m/min FPM |
| b. South/West (High Speed) | _____ m/min FPM | _____ m/min FPM |

Measure **trolley speed in FPM** slow speed in each direction.

- | | | |
|----------------------------|-----------------|-----------------|
| c. North/East (Slow Speed) | _____ m/min FPM | _____ m/min FPM |
| d. South/West (Slow Speed) | _____ m/min FPM | _____ m/min FPM |

Note: Full Speed tolerance is 10 percent.

Bumper Stops: At slow speed, contact the trolley bumpers with the bumper stops. Verify satisfactory performance of the bumpers, and the alignment of the bumpers with stops.

SAT_____ UNSAT_____ NA_____

Limit Switches

Test all limit switches to determine that they function and that all associated functions occur in accordance with specifications.

Hoist Upper Geared Limit Switch (Primary)

Raise the hoist. Slowly raise the hoist into the upper-gear limit switch and verify that the hoist stops after the limit switch is tripped and the hook is only capable of lowering. Ensure that the runout distance at full speed is greater than the distance to the weighted upper limit by gradually increasing hoist control lever travel to achieve full hoist speed and verify that the weighted limit is not tripped when the geared limit is engaged at this "full speed." If the hoist is equipped with a slow down function, verify that the hoist speed decreases to 25 percent (plus or minus 10 percent) of the full rated speed before entering the primary limit switch.

- | | | | |
|--|----------|------------|---------|
| a. Hoist in slow speed
approaching Upper-Geared
Limit Switch | SAT_____ | UNSAT_____ | NA_____ |
|--|----------|------------|---------|

- | | | | |
|---|----------|------------|---------|
| b. Hoist Upper Geared Limit Switch | SAT_____ | UNSAT_____ | NA_____ |
| c. Hoist can lower only | SAT_____ | UNSAT_____ | NA_____ |
| d. Hoist slows before primary limit
(if slow down enabled) | SAT_____ | UNSAT_____ | NA_____ |

Hoist Upper Limit Switch (Secondary)

Using the geared limit switch by-pass key switch, by-pass the hoist upper-geared limit switch and continue slowly raising the hoist. Once the switch is tripped, verify that the hoist motion stops and hoist drive is inoperable.

- | | | | |
|--|----------|------------|---------|
| a. Hoist in slow speed approaching
Upper Limit Switch | SAT_____ | UNSAT_____ | NA_____ |
| b. Hoist Upper Limit Switch | SAT_____ | UNSAT_____ | NA_____ |
| c. Hoist drive inoperable | SAT_____ | UNSAT_____ | NA_____ |

Using the hoist reset key switch, reset the hoist drive and verify that the hoist is only operable in down direction until the upper limit switch is deactivated.

- | | | | |
|-------------------------|----------|------------|---------|
| d. Hoist Up inoperable | SAT_____ | UNSAT_____ | NA_____ |
| e. Hoist can lower only | SAT_____ | UNSAT_____ | NA_____ |

Hoist Lower Geared Limit Switch

Lower the hoist. Slowly lower the hook into geared lower limit switch. When the limit switch is tripped, verify that the hoist motion stops. Verify hoisting up capability for lower limit switch.

- | | | | |
|---|----------|------------|---------|
| a. Hoist in slow speed approaching
Lower Geared Limit Switch | SAT_____ | UNSAT_____ | NA_____ |
| b. Hoist Lower Geared Limit Switch | SAT_____ | UNSAT_____ | NA_____ |
| c. Hoist up capability | SAT_____ | UNSAT_____ | NA_____ |

Warning Devices and Lights

Crane Status Lights

Verify that White status light illuminates when power is available to crane.

- | | | | |
|--------------------|----------|------------|---------|
| White Status Light | SAT_____ | UNSAT_____ | NA_____ |
|--------------------|----------|------------|---------|

Verify that Blue status light illuminates when power to crane is on (main contactor energized).

- | | | | |
|-------------------|----------|------------|---------|
| Blue Status Light | SAT_____ | UNSAT_____ | NA_____ |
|-------------------|----------|------------|---------|

3.4.6.2 Hoist Load Testing

50 Percent of Rated Capacity (plus 5 percent, minus 0 percent) Load Test

Dynamic Load Test.

Record the actual certified weight, including rigging, that will be used: _____Lbs.

- a. Place 50 percent (plus 5 percent, minus 0 percent) of rated load on the hook.
- b. Start at ground level and hoist up to 300 mm one foot below upper limit using the full range of speeds.
- c. Hoist down to 300 mm one foot above ground level using full range of speeds.
- d. Measure and record the motor current, voltage, and hook speed in FPM at maximum speed in both directions.

Record the following:

Nameplate:

Actual:

- | | | |
|------------------------------|------------|------------|
| a. Current (High Speed) Up | _____Amps | _____Amps |
| b. Voltage (High Speed) Up | _____Volts | _____Volts |
| c. Current (High Speed) Down | _____Amps | _____Amps |
| d. Voltage (High Speed) Down | _____Volts | _____Volts |

Note: The current and voltage will be measured at the floor disconnect switch.

Measure hoist speed in FPM at **fast speed** in each direction.

- | Hoist | Actual | Required |
|----------------------|-----------------|-----------------|
| a. Up (High Speed) | _____ m/min FPM | _____ m/min FPM |
| b. Down (High Speed) | _____ m/min FPM | _____ m/min FPM |

Measure hoist speed in FPM at **slow speed** in each direction.

- | | | |
|----------------------|-----------------|-----------------|
| a. Up (Slow Speed) | _____ m/min FPM | _____ m/min FPM |
| b. Down (Slow Speed) | _____ m/min FPM | _____ m/min FPM |

Note: Speed tolerance is 10 percent

3.4.6.3 100 Percent of Rated Capacity (plus 0 percent, minus 5 percent)
Load Test

A. Dynamic Load Test.

Record the actual weight of the certified weight, including rigging gear that will be used:_____ Kg Lbs.

1. Trolley loss of power test

Raise the test load approximately midway between the trolley and any permanent obstructions on the operating floor. Starting at a safe distance from walls or other obstructions, attain a slow speed of trolley travel. While maintaining a safe distance from obstructions, disconnect the main power source to simulate a power failure. Restart trolley travel and allow the drive to reach an intermediate speed. Repeat the simulated power failure. Restart trolley travel and allow the drive to reach maximum operating speed. Repeat the simulated power failure. Verify that the trolley stops and that the brake sets properly at all speeds.

SAT_____ UNSAT_____ NA_____

2. Hoist loss of power test at rated load

Raise the test load a minimal distance. Lower the test load at slow speed. Disconnect the main power source and return the controller to the neutral position to simulate a power failure. Restart hoist in a downward direction and allow the drive to reach an intermediate speed. Repeat the simulated power failure. Restart hoist in a downward direction and allow the drive to reach maximum operating speed. Repeat the simulated power failure. Verify that the hoist stops and that the brake sets properly to bring the test load to a stop at all speeds.

SAT_____ UNSAT_____ NA_____

3. Hoist Maximum Speed Test at rated load

Measure and record the motor current, voltage, and hook speed in meters per minute FPM at maximum speed in both directions. Stop the load during hoisting and lowering to verify that brake stops and holds the load.

Record the following:

Nameplate:

Actual:

a. Current (High Speed) Up	_____Amps	_____Amps
b. Voltage (High Speed) Up	_____Volts	_____Volts
c. Current (High Speed) Down	_____Amps	_____Amps
d. Voltage (High Speed) Down	_____Volts	_____Volts

Note: The current and voltage will be measured at the floor disconnect switch.

Measure hoist speed in FPM at **fast speed** in each direction.

<i>Hoist</i>	<i>Actual</i>	<i>Required</i>
a. Up (High Speed)	_____ m/min FPM	_____ m/min FPM
b. Down (High Speed)	_____ m/min FPM	_____ m/min FPM

Measure hoist speed in FPM at **slow speed** in each direction.

a. Up (Slow Speed)	_____ m/min FPM	_____ m/min FPM
b. Down (Slow Speed)	_____ m/min FPM	_____ m/min FPM

Note: Speed tolerance is 10 percent

4. **Maximum Runway Deflection**

Measure the maximum runway deflection with the trolley centered between vertical supports and 100 percent (plus 5 percent, minus 0 percent) of rated load on the hook. Repeat the measurement for each segment of runway and record the maximum value. The vertical and lateral deflection must not be greater than the values stated in CMAA 74.

_____Max deflection _____Unsupported Distance at Max deflection
_____Allowable Deflection (1/450 of unsupported distance)
SAT_____ UNSAT_____ NA_____

5. **Rollback Check**

Check rollback. With the load approximately 600 mm 2 feet above the ground, engage the hoist up controller to the slowest hoist position. Verify that the motor turns in raise direction only.

SAT_____ UNSAT_____ NA_____

B. **Trolley Functionality Test.**

- 1.a. Operate the trolley the full distance of the runway in both directions. Verify that the brake operates properly. Measure and record the distance required to come to a full stop from rated speed.

_____Stopping distance

1.b. Measure and record the motor current, voltage, and hook speed in FPM at maximum speed in both directions.

Record the following:

Nameplate:

Actual:

- a. Current (High Speed) North/East _____ Amps _____ Amps
- b. Voltage (High Speed) North/East _____ Volts _____ Volts
- c. Current (High Speed) South/West _____ Amps _____ Amps
- d. Voltage (High Speed) South/West _____ Volts _____ Volts

Note: The current and voltage will be measured at the floor disconnect switch.

Measure Trolley speed in meters per minute FPM **high speed** in each direction.

- a. North/East (High Speed) _____ m/min FPM _____ m/min FPM
- b. South/West (High Speed) _____ m/min FPM _____ m/min FPM

Measure trolley speed in meters per minute FPM at **slow speed** in each direction.

- c. North/East (Slow Speed) _____ m/min FPM _____ m/min FPM
- d. South/West (Slow Speed) _____ m/min FPM _____ m/min FPM

Note: Speed tolerance is 10 percent

3.4.6.4 125 Percent of Rated Capacity (plus 5 percent, minus 0 percent)
Load Test

A. Dynamic Load Test

Record the actual weight of the certified weight, including rigging, that will be used: _____ Kg Lbs.

1. Control and Brake Stop Test

Place 125percent (plus 5 percent, minus 0 percent) of rated load on the hook. Raise and lower test load on each controller point and visually observe smooth control between points. Stop the load during hoisting and lowering to verify that the brake stops and holds the load.

SAT_____ UNSAT_____ NA_____

2. Hoist loss of power test

Raise the test load a minimal distance. Lower the test load at slow speed. Disconnect the main power source and return the controller to the neutral position to simulate a power failure. Verify that the hoist stops and that the brake sets properly to bring the test load to a stop.

NOTE: This test is designed to also verify proper operation of dynamic load brakes including eddy current brakes and regenerative braking.

SAT_____ UNSAT_____ NA_____

B. Hoist Brake(s) Test

Raise the test load approximately 300 mm 1 foot and hold for 10 minutes. If more than one brake on the hoist, manually open the secondary brake during the primary brake test. Rotate load and hook to check for smooth bearing operation. Observe for noticeable lowering of test load that may occur which will indicate the malfunction of hoisting components or brakes. If more than one brake on the hoist, close the secondary brake and manually open the primary brake. Repeat the 10 minute test.

SAT_____ UNSAT_____ NA_____

C. Trolley Test

Operate the trolley the full distance of the bridge in both directions (if clear trolley space is available). Verify smooth control and proper brake operation.

SAT_____ UNSAT_____ NA_____

Comments:

-- End of Section --