

1. GENERAL

1.1 References

- .1 American Welding Society (AWS).
 - .1 AWS D1.1/D1.1M (2012; Errata 2011) Structural Welding Code – Steel.
- .2 ASME International (ASME).
 - .1 ASME B30.11 (2010) Monorails and Underhung Cranes – Safety Standard for Cableways, Cranes, Derricks, Hoists, Hooks, Jacks and Slings.
 - .2 ASME B30.16 (2012) Overhead Hoists (Underhung).
- .3 ASTM International (ASTM)
 - .1 ASTM A275/A275M (2008; R 2013) Standard Test Method for Magnetic Particle Examination of Steel Forgings.
 - .2 ASTM A325 (2010) Standard Specification for Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength.
 - .3 ASTM A325M (2013) Standard Specification for Structural Bolts, Steel, Heat Treated, 830 MPa Minimum tensile Strength (Metric).
 - .4 ASTM A563 (2007a) Standard Specification for Carbon and Alloy Steel Nuts.
 - .5 ASTM A563M (2007) Standard specification for Carbon and Alloy Steel Nuts (Metric).
 - .6 ASTM E543 (2013) Standard Practice for Agencies Performing Non-Destructive Testing.
 - .7 ASTM E709 (2008) Standard Guide for Magnetic Particle Examination.
 - .8 ASTM F436 (2011) Hardened Steel Washers.
 - .9 ASTM F959 (2013) Compressible-Washer-Type Direct Tension Indicators for Use with Structural Fasteners.
 - .10 ASTM F959M (2013) Compressible-Washer-Type Direct Tension Indicators for Use with Structural Fasteners (Metric).
- .4 Material Handling Industry of America Inc. (MHIA)
 - .1 MHI MH27.1 (2009) Specifications for Underhung Cranes and Monorail Systems.
- .5 Research Council on Structural Connections (RCSC)
 - .1 RCSC S348 (2004) RCSC Specification for Structural Joints Using ASTM A325 or A490 Bolts.
- .6 U.S. National Archives and Records Administration (NARA)

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- .1 29 CFR 1910.179 Overhead and Gantry Cranes.

1.2 System Description

- .1 Provide a monorail system with manual hoist and plain type (hand operated) trolley complete, tested and ready for operation. Monorail, hoist, trolley, equipment, materials, installation, examination, inspection and workmanship shall conform to the applicable requirements of ASME B30.11, ASME B30.16, ASME HST-2, MHI MH27.1 and MHI MH27.2, as modified and supplemented by this specification.
 - .1 Design Data: Structural Design Calculations
 - .1 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 for commercially procured items, including as a minimum, the following items:
 - .1 Bumpers
 - .2 End Stops
 - .2 Design Requirements
 - .1 Submit shop drawing 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. Manufacturer's catalog data will suffice for items of standard manufacturer. Refer to Structural drawings for general arrangement.

1.3 Submittals

- .1 Provide submittals in accordance with Section E4 – Shop Drawings.
- .2 Shop Drawings
 - .1 Monorail system, including attachments to structure.
- .3 Product Data
 - .1 Monorail Track System
 - .2 Manual Hoist
 - .3 Trolley
 - .4 Hook Proof Test
 - .5 Bumpers
 - .6 End Stops
 - .7 Manufacturer's Published Tables

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- .8 Manufacturer's descriptive data and technical literature, performance charts and curves, catalog cuts, and installation instructions, and parts list.
 - .9 Identification plates
 - .4 Design Data
 - .1 Structural Design Calculations.
 - .2 Structural and Load Capacity Calculations.
 - .5 Test Reports
 - .1 125 Percent Rated Load Test
 - .2 No-Load Test
 - .3 Post-Erection Inspection
 - .4 Operational Tests
 - .5 Load Chain Proof Test
 - .6 Hook NDT Report
 - .7 Tests and inspections reports. Magnetic particle inspection of hook and hook nut results.
 - .6 Certificates
 - .1 Compliance with all listed Standards.
 - .2 Semi-Annual Overload/Safe for Testing.
 - .3 Hazardous Material.
 - .4 Brake Settings.
 - .5 Runway Straightness/Levelness.
 - .6 Hook Proof Test.
 - .7 Operation and Maintenance Data
 - .1 Monorail with hoist system, all components, data package.
 - .2 Submit Closeout Data Package per Section 01 78 00 - Closeout Submittals.

1.4 Quality Assurance

- .1 Certificates: (Load Chain)

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- .1 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.
 - .2 Certification that the hoist, hook, and trolley system contains no hazardous material, asbestos, cadmium, lead, elemental mercury, or PCB's.
 - .3 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.
 - .4 Certification that the hoist, hook, and trolley system design and fabrication is in compliance with all listed standards.
 - .5 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.
 - .6 Runway Straightness/Levelness certification that the straightness, levelness, and elevation of the monorail system meet MH27.1 requirements.
 - .7 Certification of brake settings, including the allowable range of adjustment for hoist and trolley brakes and the initial setting of each.
- .2 Pre-Erection Inspection
 - .1 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 Contract Administrator 3 days before the inspection.

1.5 Delivery, Storage and Handling

- .1 Delivery and Storage
 - .1 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.
- .2 Handling
 - .1 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 the City.

1.6 Maintenance

- .1 Submit Monorail with hoist system, all components, Data Package for the entire monorail system in accordance with Section 01 78 00 - Closeout Submittals.

2. PRODUCTS

2.1 Identification Plates

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

2.2 Overhead Monorail System

- .1 Provide overhead monorail system conforming to MHI MH27.1, Duty Class C, for outdoor service, with a hand operated chain hoist mounted on a movable trolley. Provide plain type (hand operated) trolley. The hoist and trolley shall meet the design requirements specified in ASME HST-2, Duty Class H3.
 - .1 Capacity and Speed
 - .1 Provide monorail system with a minimum rated capacity of 1500 kilograms. The hook lift capacity and speed shall be the manufacturer's standard within the limits specified above. The hook lift maximum height limit is 4.5 m above the intermediate floor, and at its lowest point 6.75 m below the intermediate floor.
 - .2 Material and Design Requirements
 - .1 Monorail hoist system shall include the following design requirements:
 - .1 Provide safety (drop) lugs or a functional equivalent on the trolley frame to prevent derailment in the event of wheel failure.
 - .2 The hoists and trolley shall be capable of general service all weather outdoor (-18 to 38 degrees c) working conditions.
 - .3 Safety
 - .1 Comply with the mandatory and advisory safety requirements of ASME B30.11 and ASME B30.16. The Contractor is responsible for checking the proper operation and condition of safety devices, 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 used for any track suspension device or support which is not a standard cataloged product of the manufacturer.

2.3 Monorail Track System

- .1 Track system shall conform to MHI MH27.1 except as modified and supplemented in this section. 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 Track Beam System

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- .1 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 Track Suspension System

- .1 Provide 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.

- .1 Suspend the monorail track beam with the manufacturer's standard cataloged suspension products. Submit manufacturer's published tables verifying the sizing of any track beam and suspension system.

- .2 Make bolted connections to supporting structure, excluding hanger rods, with ASTM A325M, ASTM A325 bolts, ASTM A563M, ASTM A563 nuts, and ASTM F959M ASTM F959 load indicator washers, or ASTM F436 hardened washers. ASTM A325M ASTM A325 bolts shall be fully pre-tensioned in accordance with RCSC S348.

- .3 Attach the system to concrete slab using cast-in studs or anchors, ensuring adequate embedment to accommodate loads. Chemical anchors are not acceptable.

2.4 Manual Hoist

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

2.5 Trolley

- .1 Provide a manual trolley designed to operate from the track beam section furnished under this contract.

2.6 Brakes

- .1 Hoist Load Brake

- .1 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.

2.7 Load Block and Hook

- .1 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.

.1 Non-Destructive Testing

.1 The following requirements apply:

- .1 The Hook NDT Report supplier shall provide a letter certifying that the requirements of ASTM E543 are met.
- .2 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 (eg. 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.
- .3 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 Hook and Hook Nut Magnetic Particle Inspections

- .1 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.

2.8 Bearings

- .1 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.

2.9 Painting System

- .1 Provide manufacturer's standard painting (brilliant yellow) of components. 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.

3. EXECUTION

3.1 Erection and Installation

- .1 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

- .1 Provide supervisory erection services from the monorail system manufacturer.

3.3 Field Quality Control

.1 Post-Erection Inspection

- .1 After erection, the Contractor, the Contract Administrator, and a representative of the manufacturer shall jointly inspect the monorail and hoist systems and components to determine compliance with specifications and accepted submittals. Notify the Contract Administrator 3 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.

.2 Operational Tests

- .1 After erection and inspection, test the monorail system, hoist, and trolley as specified herein. Test the system 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.
- .2 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 Contract Administrator.

.3 Test Data

- .1 Record test data on appropriate test record forms suitable for retention for the life of the monorail system. Compare recorded values with design specifications or manufacturer's recommended values. Abnormal differences (ie. 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.

.4 Hook Tram Measurement

- .1 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). 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.

.5 No-Load Test

- .1 Hoist: raise the load hook the full operating lift distance and verify satisfactory operation of hoist.
- .2 Trolley: operate trolley assembly the full length of the monorail in both directions. Verify satisfactory operation (operate all rail switches).

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- .6 125 Percent Rated Load Test - 125 Percent (plus 5 percent minus 0) of rated capacity.
- .1 Hoist Static Test: raise test load approximately 300 mm 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.
 - .2 Hoist Dynamic Test: raise the test load to approximately 1.5 m above the floor. Lower the load back to the floor. Stop the test load at least once while lowering and observe proper brake operation. Wait 5 minutes, then repeat the above cycle.
 - .3 Trolley Test: with test load hoisted to a height of 300 mm above the floor, operate trolley the full distance of the monorail in both directions. Observe for any malfunctioning of the trolley assembly and monorail system. Operate all rail switches.

END OF SECTION