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UNIFIED FACILITIES GUIDE SPECIFICATIONS

References are NOT in agreement with UMRL
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SECTION 14920S

MONORAIL SYSTEMS

12/05

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UNIFIED FACILITIES GUIDE SPECIFICATIONS

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SECTION 14920S

MONORAIL SYSTEMS
12/05

****
NOTE: Delete, revise, or add to the text in this section to cover project requirements. Notes are for designer information and will not appear in the final project specification.

This section covers manually operated, electric and air-operated hoists, 1/4-ton to 5-ton 227 to 4536 kilogram capacity.

Drawings must indicate where the hoist or rail is to be supported, location, capacity, power source (air or electric), headroom and lift requirements, size of trolley rail or beam, switches, and special conditions of mounting.

Drawings must schedule each hoist separately and completely when multiple hoists of different types, capacity, power source, and operating characteristics are required.

Painting is specified in Section 09970S COATINGS FOR STEEL.

These hoists are not suitable for partial or full vacuum chambers without additional specification input.

Hoist manufacturer's data and specifications must be reviewed to aid in developing specific job requirements and to avoid the possibility of specifying improper combinations.

Recommended changes to a UFGS should be submitted as a Criteria Change Request (CCR).

Use of electronic communication is encouraged.
****

PART 1 GENERAL

1.1 REFERENCES

****

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

Use the Reference Wizard's Check Reference feature when you add a 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 BEARING MANUFACTURERS ASSOCIATION (ABMA)

ABMA 11	(1990; R 2000) Load Ratings and Fatigue Life for Roller Bearings
ABMA 9	(1990; R 2000) Load Ratings and Fatigue Life for Ball Bearings

AMERICAN GEAR MANUFACTURERS ASSOCIATION (AGMA)

AGMA 250.04	(1981) Lubrication of Industrial Enclosed Gear Drives

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI B18.22.1	(1975; R 2003) Plain Washers
ANSI B18.22M	(1981; R 2000) Metric Plain Washers
ANSI C80.1	(1994; R 1995) Rigid Steel Conduit - Zinc Coated

AMERICAN WELDING SOCIETY (AWS)

AWS A5.1	(2003) Specification for Carbon Steel Electrodes for Shielded Metal Arc Welding
AWS D1.1/D1.1M	(2004) Structural Welding Code-Steel

ASTM INTERNATIONAL (ASTM)

ASTM A 307	(2004) Standard Specification for Carbon Steel Bolts and Studs, 60 000 psi Tensile Strength
ASTM A 36/A 36M	(2004) Standard Specification for Carbon Structural Steel
ASTM A 366/A 366M	(1997e1) Standard Specification for Steel, Sheet, Carbon, Cold-Rolled, Commercial Quality
ASTM A 591/A 591M	(1998) Standard Specification for Steel Sheet, Electrolytic Zinc-Coated, for Light Coating (Weight) Mass Applications
ASTM B 633	(1998e1) Standard Specification for Electrodeposited Coatings of Zinc on Iron and Steel
ASTM B 766	(2003) Standard Specification for Electrodeposited Coatings of Cadmium
ASTM D 635	(2003) Standard Test Method for Rate of Burning and/or Extent and Time of Burning of Self-Supporting Plastics in a Horizontal Position
ASTM F 568M	(2004) Standard Specification for Carbon and Alloy Steel Externally Threaded Metric Fasteners

MONORAIL MANUFACTURERS ASSOCIATION (MMA)

MMA MH27.1	(2003) Underhung Cranes and Monorail Systems

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA 250	(2003) Enclosures for Electrical Equipment (1000 Volts Maximum)
NEMA BU 1	(1999) Busways
NEMA KS 1	(2001) Enclosed and Miscellaneous Distribution Equipment Switches (600 Volts Maximum)

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(2005) National Electrical Code 2005 Edition

UNDERWRITERS LABORATORIES (UL)

UL 50	(2003) UL Standard for Safety - Enclosures for Electrical Equipment

UL 674	(2003) UL Standard for Safety Electric Motors and Generators for Use in Hazardous (Classified) Locations
UL 857	(2002) UL Standard for Safety Busways and Associated Fittings
UL Elec Const Dir	(2003) Electrical Construction Equipment Directory

U.S. DEPARTMENT OF DEFENSE (DOD)

MS MIL-H-2813	(1994b) Hoists, Chain and Wire Rope, Pneumatic
MS MIL-H-904	(Rev H; Am 2) Hoists, Chain, Hand Operated, Hook and Trolley Suspension

U.S. GENERAL SERVICES ADMINISTRATION (GSA)

FED-STD 595	(1994b) Colors Used in Government Procurement
FS FF-B-171	(Rev A; Am 1) Bearings, Ball, Annular (General Purpose)
FS FF-B-185	(Am 4) Bearings, Roller, Cylindrical; and Bearings, Roller, Self and Aligning
FS RR-C-271	(1995d) Chains and Attachments, Welded and Weldless
FS RR-W-410	(2002e) Wire Rope and Strand
FS ZZ-H-500	(Rev C) Hose, Rubber, and Hose Assemblies, Rubber: Pneumatic (Yarn or Fabric Reinforced)

1.2 SUBMITTALS

****

NOTE: Review Submittal Description (SD) definitions in Section 01330 SUBMITTAL PROCEDURES and edit the following list to reflect only the submittals required for the project. Submittals should be kept to the minimum required for adequate quality control.

A “G” following a submittal item indicates that the submittal requires Government approval. Some submittals are already marked with a “G”. Only delete an existing “G” if the submittal item is not complex and can be reviewed through the Contractor’s Quality Control system. Only add a “G” 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.

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.][for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government.] Submit the following in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Fabrication Drawings shall be submitted for monorail and hoist systems in accordance with the paragraph entitled, "General Requirements," of this section.

Installation Drawings shall be submitted for monorail and hoist systems in accordance with the paragraph entitled, "Installation of Monorail Track," of this section.

SD-03 Product Data

Manufacturer's catalog data shall be submitted for the following items:

Load Chain
Hand Chain
Chain Wheels
Chain Container
Wire Rope
Rope Drum
Load Block and Sheaves
Hook Assembly
Gear Assembly
Bearings
Lubrication
Frame and Housing
Paint Materials
Electric Hoist
Hand-Operated Hoists
Air Hoists
Trolleys
Monorail Track

SD-04 Samples

A Preproduction Sample Hoist shall be submitted in accordance

with paragraph entitled, "General," of this section.

SD-06 Test Reports

The following test reports shall be submitted for the monorail electrification system in accordance with the paragraph entitled, "Testing," of this section.

Continuity Tests
Insulation Tests

SD-07 Certificates

Certificates for monorail and hoist systems shall be submitted in accordance with paragraph entitled, "Certificates," of this section.

SD-08 Manufacturer's Instructions

Manufacturer's Instructions shall be submitted in accordance with paragraph entitled, "Installation of Monorail Track," of this section.

1.3 DEFINITIONS

Capacity shall mean the rated load in kilogram, or metric ton of 1,000 kilogram pounds, or tons of 2,000 pounds each, specified by the manufacturer for the hoist and marked plainly on the hoist and loadblock so as to be clearly legible. In determining the applied load, handling devices shall be included.

Hoisting speed shall mean the velocity in meter per second feet per minute (fpm) at which the hoist will lift the rated load. Actual lifting speed shall be within plus or minus 10 percent of the manufacturer's rating.

Rated lift shall mean the distance between the upper and lower elevations of travel of the load block.

Headroom shall be measured with the load hook in the highest position with full load; it is the distance between the saddle of the load hook and the following points:

Bottom of the beam when S-shape runways are used

Top of the bottom flange for all flat, wheel-bearing flange surfaces

Minimum radius shall mean the smallest radius to the centerline of the beam or track on which the trolley will operate properly.

Trolley speed shall mean the velocity in fpm at which a motordriven trolley with hoist will travel carrying the rated load on level track; actual speed shall be within plus or minus 10 percent of the manufacturer's rating.

1.4 WELDING

****

NOTE: If Section 05090S WELDING, STRUCTURAL is not included in the project specification, applicable requirements therefrom should be inserted and the

following paragraph deleted.
****

[Section 05090S WELDING, STRUCTURAL applies to work specified in this section.]

[Welding shall conform to AWS D1.1/D1.1M.]

1.5 FIELD MEASUREMENTS

Field measurements shall be taken prior to preparation of shop drawings and fabrication.

1.6 DELIVERY AND STORAGE

Hoist components and accessories shall be delivered and stored in their original unbroken containers in a dry, weathertight, ventilated structure.

Structural-steel members, trolley beams, and accessories that are stored at the project site shall be stored off the ground on platforms, skids, or other support and protected from the weather.

Materials shall be kept free from dirt, grease, and other foreign matter and shall be protected from moisture, dampness, and corrosion.

1.7 HOIST CHARACTERISTICS

[Hoist shall be a gear chain hoist, hand operated, of type, suspension, lift, and operating characteristics specified.]

[Hoist shall be an electric chain hoist of type, class, control, suspension, lift, and operating characteristics specified.]

[Hoist shall be an electric wire-rope hoist of type, class, control, suspension, lift, and operating characteristics specified.]

[Hoist shall be a chain air hoist of class, suspension, lift, and operating characteristics specified.]

[Hoist shall be a wire-rope air hoist of suspension, lift, and operating characteristics specified.]

Each hoist shall have the capacity, lift-height, suspension, power source, and operating characteristics indicated and as follows:

Hoist capacity shall be [_____] metric ton [_____] tons.

Each hoist shall have the capacity indicated.

****
NOTE: Drawings must indicate special lifting requirements, for example, loads lowered from one elevation into pits or through floor openings to an intermediate or lower level.
****

Hoist shall be a standard lift with a minimum lift of [_____] meter [_____] feet.

Each hoist shall have the minimum height of lift indicated.

****
NOTE: Select type of suspension.
****

[Hoist shall be the hook-suspension type.]

[Hoist shall be the lug-suspension type, mounted on a plain, hand-propelled trolley. Trolley and track are specified in paragraphs "Trolleys" and "Monorail Track," respectively.]

[Hoist shall be the lug-suspension type, mounted on a geared hand-chain-propelled trolley. Trolley and track are specified in paragraphs "Trolleys" and "Monorail Track," respectively.]

[Hoist shall be the lug-suspension type mounted on an electric-motor-driven trolley. Trolley and track are specified in paragraphs "Trolleys" and "Monorail Track," respectively.]

[Hoist shall be tractor mounted with a motor-driven tractor-trolley unit. Trolley and track are specified in paragraphs "Trolleys" and "Monorail Track," respectively.]

****
NOTE: Select headroom requirements.
****

Hoist and suspension shall be the [standard] [minimum] headroom type.

Each hoist shall be standard headroom or minimum headroom type as indicated.

****
NOTE: The following paragraph must be included.
****

Components of the hoist shall be designed and constructed for safety of operation and durability of components. Replacement parts shall be interchangeable and readily accessible.

1.8 ACCEPTANCE PROVISIONS

1.8.1 General

A Preproduction Sample Hoist of each specified type shall be provided immediately after the award of the contract and prior to submission of complete units for final acceptance. Sample hoist shall be inspected to determine conformance with this specification. Approval of the sample shall not relieve the Contractor of his obligation to supply equipment conforming to this specification. No changes or deviations from the preproduction sample hoist will be acceptable without written approval.

Hoists of each type specified shall be factory load tested for static overload and tests as specified. Hoists shall be subjected to continuous-operating tests and dynamic-overload tests. Installed hoists shall also be tested. Certificates of compliance shall be presented with factory test results.

Hoists and accessories shall be free of manufacturing defects, abrasions, and damage. Chains shall conform to MS MIL-H-904.

Moving parts of each hoist shall be factory lubricated. Enclosed gear trains shall have a full charge of lubricant.

1.8.2 Static-Overload Test

Hoist shall support a static load of 125 percent of the rated capacity for not less than 5 minutes. Load shall be suspended with the load chain or wire rope extended to the limit of the specified lift. No breakage or permanent distortion of the hoist parts shall occur during or after this test.

1.8.3 Continuous-Operating Tests

Hoists of each specified type shall be subjected to continuous operating-cycle tests.

Hand hoists shall receive a 5,000-cycle test. One operating cycle shall consist of lifting and lowering the rated load through a distance of 1220 millimeter 4 feet. Hoists shall be operated at a speed of approximately 30 revolutions per minute of the hand chain wheel with a 6-second pause between each change in the direction of operation. Operation of the sample hoist for this test shall be accomplished by means of power-operated equipment.

[Single] [Two]-speed electric hoists shall be tested for 2 hours at 20 operating cycles per hour. One operating cycle shall consist of lifting and lowering the rated capacity load as follows:

[Lift for 20 seconds with two intermediate stops for a total of three hoisting starts. Pause for 40 seconds. Lower for 20 seconds with two intermediate stops for a total of three lowering starts. Pause for 40 seconds. Repeat cycle.]

[Lift for 10 seconds at slow speed and 10 seconds at high speed for a total of 20 seconds with one intermediate start for a total of two hoisting starts. Pause for 60 seconds. Lower for 10 seconds at slow speed and 10 seconds at high speed for a total of 20 seconds with one intermediate lowering start for a total of two lowering starts. Pause for 60 seconds. Repeat cycle.]

Temperature curves shall be plotted for various parts of electric hoist motors and the results shall be submitted as specified in "Certificates of Compliance."

Air hoists shall be tested for 2 hours at 20 operating cycles per hour. One operating cycle shall consist of raising and lowering the rated capacity load as follows:

Lift for 20 seconds at varying speeds between creep and maximum with two intermediate stops for a total of three hoisting starts. Pause for 40 seconds. Lower for 20 seconds at varying speeds between creep and maximum, with two intermediate stops for a total of three lowering starts. Pause for not less than 40 seconds. Repeat cycle.

****

NOTE: The following paragraphs must be included.

****

Hoists shall not drift or slip after stopping when the power supply is cut off, and shall raise and lower the rated load without jerk or hesitation. Load shall remain suspended when the power source is shut off and shall not lower without application of power. When released, controls shall return, without sticking, to the closed position.

After completion of the tests, motors, gears, bearings, chain, wire rope, sprockets, and other wearing parts shall be examined for excessive wear. Excessive wear is defined as that which is sufficient to impair safe operation of the hoist.

1.8.4 Dynamic Overload Test

Each hoist delivered to the project site shall be subjected to a dynamic overload test of 125 percent of the rated capacity.

Required test weights will be provided by the Government.

Contractor shall provide labor and transportation as required to pick up and transport weights to the test area and to return test weights to storage area (not over [_____] kilometer [_____] miles round trip).

Hoist shall be loaded to 125 percent of rated capacity and operated by hoisting and lowering a minimum of 600 millimeter 24 inches. Trolley type hoists shall be operated back and forth over a section of suitable track, 2500 or more millimeter 8 or more feet in length with the 125 percent load in suspension. This test shall be performed 15 times at the highest rate of speed of which the operator is capable. Hoists shall operate satisfactorily without evidence of permanent distortion or damage to any part, drift at stationary suspended elevation, and dropping or override when lowering. Notice shall be taken of the condition of thrust washers (worm-gear hoists) and friction brakes (spur-geared hoists) after this test. Excessive wear of these parts shall be cause for rejection.

1.8.5 Monorail Electrification System Factory Tests

Factory tests on monorail electrification systems and associated fittings shall be made in accordance with the applicable provisions of the referenced standards.

Temperature, mechanical, and dielectric tests shall be in accordance with UL 857. Voltage-drop and short-circuit tests shall be in accordance with Part 3, "Testing Standards," of NEMA BU 1.

Routine tests shall include dielectric tests on monorail electrification system. Certification of dielectric tests shall be submitted and shall show compliance with the referenced standard.

Certified copies of previous tests on identical monorail electrification systems under actual conditions shall be submitted for voltage-drop and short-circuit tests.

1.9 GENERAL REQUIREMENTS

Fabrication Drawings shall be submitted for monorail and hoist systems consisting of fabrication and assembly details to be performed in the factory.

1.10 CERTIFICATES

The following Certificates shall be submitted:

Certification that each hoist, hoist trolley and track, and hoist control has been factory tested for rated load capacity and operation; and that each hoist complies with the requirements specified

Certification that a sample hoist of each type specified has been factory tested for the tests specified in paragraph entitled, "Acceptance Provisions."

Certified results of thermal monitoring of motor components during tests

Certification that electric hoists, trolleys, wiring, contact conductors, controls, overcurrent protection, and grounding conform to NFPA 70, and to UL standards. Label or listing with reexamination by the UL will be accepted as evidence that the materials conform to this requirement and to NFPA 70.

PART 2 PRODUCTS

2.1 LOAD CHAIN

****

NOTE: Select required chain type. Delete inapplicable paragraph heading and following paragraphs if chain hoists are not required.

****

Load chain shall be steel roller chain conforming to FS RR-C-271, Type III. Pins, bushings, rollers, and side bars shall be carbon or alloy steel suitable for hoist use and of sufficient hardness and strength to withstand the tests specified in MS MIL-H-904.

Chain shall be a cadmium-plated, resistance-welded, heat-treated alloy steel link chain conforming to FS RR-C-271, Type I, Grade C, Class 1 or 2. Chain shall be designed for hoist service and shall be of sufficient section, hardness and strength to meet Specification requirements and to withstand the tests specified in MS MIL-H-904.

Noncorroding, nonsparking roller load chain or link load chain shall be AISI Series 300 chrome-nickel alloy corrosion-resistant steel chain designed for hoist service and of sufficient section, hardness, and strength to meet specification requirements and to withstand the tests specified in MS MIL-H-904.

Load chain shall have a safety factor of not less than 5, based on the minimum ultimate strength of the material.

2.2 HAND CHAIN

Hand chain shall be endless coil, welded-link, cadmium-plated, proof-coil steel chain conforming to FS RR-C-271, Grade C, Class 4.

****

NOTE: Delete following paragraph if not required.

****

Noncorroding, nonsparking hand chain shall be endless coil link type, fabricated from AISI Series 300 chrome-nickel alloy corrosion-resistant steel or suitable bronze alloy.

2.3 LOAD-CHAIN WHEELS

Load-chain wheels and roller chain sprockets and shafts shall be manufactured from steel or heat-treated nodular cast iron. Wheels shall be pocket or sprocket type, accurately shaped to fit the links of the load chain or to accommodate roller chain. Chain shall operate freely and smoothly over load wheels without binding or jamming.

Load-chain shaft may be integral with or rigidly connected to the load chain wheel. Welding of the wheel to the shaft will not be permitted.

Load chain shall be provided with surface-hardened, heat-treated steel guides that surround the load wheel and which will prevent wedging or jamming regardless of angle of pull.

2.4 HAND-CHAIN WHEELS

Hand-chain wheels shall be manufactured from steel, malleable iron, high-strength cast iron, or aluminum alloy. Wheels shall have accurately shaped pockets to receive hand chain. Wheel shall be equipped with a chain guide that will permit operation of the hand chain from an angle of 10 degrees from either side of the chain wheel without slipping or jumping the wheel rim.

2.5 CHAIN CONTAINER

****

NOTE: These containers receive the idle load chain and prevent the chain from interfering with the load and marking finished surfaces.

****

A chain container shall be provided for each chain hoist. Container shall be a factory finished all-welded commercial quality sheet steel conforming to ASTM A 366/A 366M, not less than 1.897 millimeter 0.0747-inch thickness.

Design of chain container shall maintain the headroom and clearance requirements of the hoist and shall not interfere with the operation of the load chain or load chain wheel.

Paint finish shall match finish of hoist.

2.6 WIRE ROPE

****

NOTE: Delete paragraph heading and following paragraphs if wire rope hoists are not required.

****

Wire rope for standard applications shall be extra flexible, preformed, improved plow steel, 6 by 37 fiber core sealed construction wire conforming to FS RR-W-410, Type I, Class 3.

Wire rope for single line application shall be preformed, improved plow

steel 18 by 7, fiber core, nonrotating wire conforming to FS RR-W-410, Type IV, Class 2.

Wire rope for noncorroding, nonsparking hoist application shall be preformed AISI Type 304, 18-8 corrosion-resistant steel, 6 by 19, bright finish, conforming to FS RR-W-410, Type I, Class 2.

****
NOTE: Following paragraphs must be included.
****

Wire rope shall be anchored to drum or dead end. Anchoring shall be of captive type, easily detached for changing and repair.

Wire rope shall have a factor of safety of not less than 5, based on the minimum ultimate tensile strength of the material.

2.7 ROPE DRUM

Wire rope drum shall be hardened steel or special grade alloy ductile iron. Minimum diameter of the drum shall be 20 times the diameter of the hoisting rope for hoists with a capacity of 900 kilogram 2,000 pounds or less and 24 times the diameter of the hoisting rope for hoists over 900 kilogram 2,000-pound capacity. Drum shall have accurate, machine-cut grooves, cut to full depth of wire rope diameter, with rounded corners of dimension as required for the specified lift. In addition, the drum shall have not less than two complete turns of rope around it when the hook is in its lowest position. Groove diameter and pitch centers shall be 0.794 millimeter 1/32 inch greater than diameter of rope. Drum shall be flanged at each end and shall have enclosed tops and sides to preclude cable binding and jamming.

****
NOTE: It is important that the following paragraph be included if hoist has a lift of 30 feet 9 meter or more or if the load must be exactly centered to pass through pit openings or through limited dimension openings.
****

Cable reeving shall be arranged for double reeving. Hook shall remain centered under the drum at all times.

2.8 LOAD BLOCK AND SHEAVES

Cable load block shall be an enclosed, safety type that will shroud the sheave and protect the operator. Sheave assembly shall be mounted on a steel axle and carried on sealed, prelubricated antifriction bearings.

Wire rope sheaves shall be machine-grooved, hardened steel or cast iron with chilled groove surfaces. Pitch diameter for running sheaves shall be not less than 18 times the diameter of the wire rope, and the diameter of the idler and equalizer sheaves shall be not less than 16 times the diameter of the rope used.

2.9 HOOK ASSEMBLY

****
NOTE: Select hook material for standard application or for nonsparking, noncorrosive uses.

****

Hooks and hook swivels shall be heat-treated alloy steel forgings. Yokes, crossheads, and bars shall be of suitable strength steel or cast iron.

Load blocks and hook assembly shall be the nonsparking, noncorroding type, fabricated of AISI Type 304, 18-8 chrome-nickel corrosion-resistant steel; or they shall be a bronze alloy of suitable strength and section for the rated capacity load.

Hook assembly for electric- or air-operated hoists shall be carried on antifriction bearings to permit free swivel under rated capacity load without twisting load chain or wire.

Hook assembly for hand-operated hoists shall be carried on plain bronze bearings or on antifriction bearings to permit free swivel under rated capacity load without twisting load chain.

****
NOTE: The following paragraphs must be included.
****

Each hook shall have a spring-loaded safety latch.

Each hook assembly shall include a machined and threaded shaft and swivel locknut with an effective locking device to prevent nut from backing off.

2.10 GEAR ASSEMBLY

Gears shall be spur, helical, spiral, or bevel type, accurately machined, and conforming to AGMA standards for this type of service.

Gear shafts shall be manufactured from high carbon-steel or alloy steel, machined and ground for accurate fit, and splined for fitting to the mating gear.

Gear train assembly shall be totally enclosed in the hoist frame casting and shall operate in a sealed oil bath. Frame casting shall be provided with lubrication fittings and inspection ports.

2.11 BEARINGS

Bearings in the hoist mechanism of electric- or air-powered hoists shall be antifriction bearings, either needle-type roller bearings or end- and radial-thrust ball bearings operating in an oil bath.

Bearings in the hoist mechanism of hand hoists shall be sealed, permanently lubricated ball or roller antifriction bearings, and plain self-lubricating, lead bronze bearings with provision for type of thrust imposed by the specific duty load.

Sprocket bearings, motor bearings, and load-block bearings shall be prelubricated factory sealed bearings.

Antifriction bearings shall conform to FS FF-B-171, Grade 00, for ball bearings and to FS FF-B-185, Grade 00, for roller bearings. Minimum bearing life rating shall be 3,000 hours as defined by ABMA 9, or ABMA 11, as applicable.

2.12 LUBRICATION

Adequate lubrication shall be provided for moving parts of the hoist and trolley and for filling, draining, and checking the level of the lubricant.

Lubricant shall be designed for use in an ambient temperature of minus 12 to plus 43 degrees C 10 to 110 degrees F.

Hoist reduction gearing, load brake, and trolley wheel gears with electric motor drive shall operate in an oil bath.

Lubrication and mechanism housing shall prevent leaking and lubricant from coming into contact with electrical motors and equipment.

Lubricant shall conform to AGMA 250.04.

2.13 FRAME AND HOUSING

Operating parts of the hoist shall be mounted and enclosed in a sealed, factory-painted metal frame of malleable iron, cast steel, welded steel, or aluminum.

Welded or bolted frames shall carry loads on the fabricated pieces. Welds or bolts shall be used only to hold the fabricated parts in position.

2.14 PAINT FINISH

Paint materials shall meet references standards within this section.

Each hoist, lift block hook, and accessory shall receive a factory-applied paint finish.

Painting shall be in accordance with Section 09970S COATINGS FOR STEEL Coating System No. 2.

2.15 HAND-OPERATED HOISTS

****

NOTE: Delete paragraph heading and following paragraphs if this type hoist is not required.

Hand hoists must be considered for application where slow lift speed, infrequent use, portability, and manual operation is acceptable.

****

2.15.1 General

Hand-operated hoists shall be a spur- or helical-gear-type chain hoist with load brake and shall conform to MS MIL-H-904.

Load carrying parts of the hoist shall be designed so that the calculated static stress of the material, based on rated capacity, shall not exceed 25 percent of the assumed average theoretical ultimate strength of the material.

Hoist shall be factory lubricated and shall be complete and ready for operation.

2.15.2 Hoist Description

Hoist shall be of capacity, lift, suspension, headroom, and materials as specified.

****
NOTE: Select noncorrosive, nonsparking characteristics of hoist.
****

Hoist shall be equipped with a noncorroding, nonsparking hand and load chain and hook assembly.

Hoist shall be standard type, with no corrosion- or spark-resistant hand-and load-chain requirement.

Each hoist shall be noncorroding, nonsparking type or standard type, as indicated.

****
NOTE: Select weight class of hoist.
****

Hoist shall be [standard weight] [lightweight] and shall conform to MS MIL-H-904, weight of Class 1 or Class 2.

****
NOTE: Select type of load chain.
****

Load chain shall be [roller chain] [link chain] of materials specified.

****
NOTE: Following paragraph must be included.
****

Hand chain, hoisting mechanism, and gear mechanism shall be as specified.

2.15.3 Load Brake

Load brake shall be an automatic mechanical type that will prevent lowering of load unless manual power is applied to the load chain.

2.16 ELECTRIC HOIST

****
NOTE: Delete paragraph heading and following paragraphs if this type hoist is not required.
****

Electric hoist, wiring, contact conductors, controls, overcurrent protection, and grounding shall conform to NFPA 70, and to the applicable UL standards and specified requirements.

Electric hoist shall be of capacity, lift, type, suspension, headroom, and materials specified. Each unit shall be factory wired and ready for operation.

Load-carrying parts of the hoist shall be designed so that the calculated

static stress of the material, based on the rated capacity, will not exceed 20 percent of the average theoretical strength of the material.

Each hoist shall be factory lubricated and shall be complete and ready for operation with the specified controls and accessories.

2.16.1 Electric Chain Hoist

****
NOTE: Delete paragraph heading and following paragraphs if this type hoist is not required.
****

Electric chain hoist shall be equipped with a noncorroding, nonsparking chain and hook assembly.

Electric chain hoist shall be equipped with a standard chain and hook assembly as specified, with no corrosion- or spark-resistant requirements.

Each hoist shall be equipped with standard chain and hook assembly or with a noncorroding, nonsparking chain and hook assembly as indicated on the drawings.

****
NOTE: Select type of load chain.
****

Load chain shall be [roller] [link] chain, of materials specified.

2.16.2 Electric Wire-Rope Hoists

****
NOTE: Delete paragraph heading and following paragraphs if this type hoist is not required.
****

Electric wire-rope hoists shall be equipped with a noncorroding, nonsparking wire-rope and hook assembly.

Electric wire-rope hoists shall be equipped with the specified standard wire-rope and hook assembly with no corroding or sparking requirements.

Each electric wire-rope hoist shall be equipped with standard wire-rope and hook assembly or with a noncorroding, nonsparking wire-rope and hook assembly as indicated on the drawings.

2.16.3 Hoist Speed and Horsepower wattage Rating

Each chain and wire-rope electric hoist shall be of hoist speed and horsepower wattage rating as follows:

****
NOTE: Select hoist speed.

Consult manufacturer's data to correlate speed with type of hoist and required motor size.
****

Hoist speed shall be approximately [_____] meter per second [_____] fpm.

Hoist speed shall be two-speed, as indicated and scheduled. Slow speed of two-speed hoist shall be one-third full speed.

****
NOTE: Select motor size.
****

Hoist motor shall be power rated at [_____] watts [_____] horsepower, [_____]-phase, [_____]-hertz.

Hoist motor shall be of wattage horsepower as recommended by manufacturer for capacity and lift speed of hoist.

Each hoist shall be of the wattage horsepower as indicated and as scheduled.

2.16.4 Hoist Motors

****
NOTE: When possible the use of sealed bearings is encouraged. One of the major causes of bearing failures is over lubrication and lubrication contamination. Using sealed bearings helps to eliminate this failure mode.
****

Hoist motor shall be a high-starting torque, high-slip, 30-minute time rated, reversible electric motor specifically designed for hoist duty and capable of operation at the specified duty class, capacity, and speed. Voltage, phase, and frequency requirements shall be as indicated.

2.16.5 Motor Type

****
NOTE: Select motor type.
****

Hoist motors shall be totally enclosed, nonventilated type, certified for 30-minute, time-rated operation at full identification plate power output in an ambient temperature of 40 degrees C 104 degrees F.

****
NOTE: Verify explosion-proof class and group with the current edition of UL 674.
****

Hoist motors, where indicated, shall be explosionproof motors, certified for 30-minute, time-rated operation at full identification plate power output in an ambient temperature of 40 degrees C 104 degrees F. Enclosure shall be fitted with a UL-approved drain and breather and shall be certified and labeled in accordance with UL 674, Class 1, Groups C and D. Each hoist motor speed shall be indicated.

2.16.6 Motor Bearings

****
NOTE: When possible the use of sealed bearings is encouraged. One of the major causes of bearing

failures is over lubrication and lubrication contamination. Using sealed bearings helps to eliminate this failure mode.

****

Motor bearings shall be heavy-duty ball or roller antifriction type with full provision for the type of thrust imposed by the specific duty load. Bearings shall have a minimum 90-percent bearing rating of 3,000 hours as defined by ABMA 9 or ABMA 11 as applicable.

Bearings in motors power rated at 370 watts 1/2 horsepower or larger shall be prelubricated and equipped with lubrication service fittings and with provision for automatic positive relief of lubrication pressure, accomplished by either built-in relief devices or automatic ball-and-spring relief fittings at the bottom of the bearing housing. Pressure relief shall be to the outside of the housing. Lubrication fittings shall be fitted with color-coded plastic or metal dust caps.

Bearings in any motor lubricated at the factory for extended duty periods shall be so identified with labels or tags. Tag shall state that the motor shall not be lubricated for a given number of operating hours.

2.16.7 Motor Controller

****

NOTE: Ability to open and/or remove access covers is required for maintenance activities. In addition, access may be required to inspect this device while circuits are energized (for example, using infrared imaging). Minimum distances to energized circuits is specified in OSHA Standards Part 1910.333 (Electrical - Safety-Related work practices). OSHA Standards are available on the internet.

****

Motor controller shall be a reversing-type magnetic starter with thermal-overload protection, molded case circuit breaker, and low-voltage transformer, operated by a pushbutton control station. Controller and control station shall be mechanically or electrically interlocked to preclude possibility of operating opposing control circuits simultaneously.

Contactor fingers shall be adjustable and shall have renewable tips.

Transformer shall reduce the control-circuit voltage to 120 volts alternating current (ac) or to 24 volts ac.

Motor controller shall be mounted in a gasketed cast-metal or sheet-metal enclosure with hinged door conforming to the requirements of UL 50.

****

NOTE: Select enclosure type. Drawings must list class and group for NEMA Type 7 enclosures. Refer to NFPA 70, article 500.

****

Motor controller enclosure shall be NEMA 250, [Type 1 - general purpose.] [Type 3 - dusttight, raintight, and sleet-ice-resistant.] [Type 7 - hazardous; location, class, and group as indicated] [Type 12 - industrial

use, dusttight, and driptight].

2.16.8 Pushbutton Control Station

Each hoist shall have a pendant-mounted conductor cable and pushbutton station with a strain-reliever chain or cable permanently attached to the hoist frame and integral with the pendant conductor cable.

Control station shall be a full-guarded, momentary-contact, pushbutton type with each button clearly marked to indicate its function. A separate button or a single button providing steps for each speed of multispeed hoists or trolleys shall be provided. Pushbuttons shall return to the off position when pressure is released by operator.

Pushbutton station shall be grounded to the hoist. Strain reliever chain or cable shall not be used as a grounding circuit.

2.16.9 Limit Switches

Adjustable upper-limit switch shall be provided to prevent overtravel of the hook or load block in the hoisting direction. Limit switch shall be arranged to stop the hoist motor and apply the motor brake before reaching the uppermost safe limit of travel. In case of hook overtravel, the motor shall be automatically and momentarily reversed.

Adjustable lower-limit switch shall be provided to stop the hoist motor and apply the motor brake when the load hook reaches a predetermined lower limit.

2.16.10 Wiring

Each hoist shall be completely wired by the manufacturer in accordance with NEC and UL standards. Exposed flexible wiring from controller housing to hoist and trolley motors shall be Type SO, flexible, neoprene, oil-resistant cable.

2.16.11 Load Brake

Load brake shall be a totally enclosed, automatic, mechanical-type brake with a hardened-steel, Weston-type ratchet and pawl mechanism that will hold the capacity load of the hoist at any point when the motor is stopped.

2.16.12 Motor Brake

Motor brake shall be an externally adjustable, electrically-operated shoe or multiplefriction disk brake that shall apply automatically when the power is off.

Motor brake shall be capable of holding the capacity load of the hoist at any point independent of the load brake in addition to stopping and safely holding 125 percent of the rated load from any operating speed. Brake shall hold a static load equal to 150 percent of the rated capacity of the hoist.

2.17 AIR HOISTS

****

NOTE: Air hoists must be considered for applications where flammable fluids and gases are

present, where high heat conditions are prevalent, and where air supply is readily available.

Air hoists are generally more expensive than electric hoists except when the application requires a nonsparking type.

****

2.17.1 General

Air hoists shall conform to MS MIL-H-2813, except where amended, and to particular requirements specified.

Hoist shall be designed for operation with air pressure supplies of 550 to 620 kilopascal 80 to 90 pounds per square inch (psi).

2.17.2 Weight Class

[Air hoists of 454 kilogram 1/2-ton capacity and greater shall be steel, conventional weight.]

[Air hoists of 227 kilogram 1/4-ton capacity shall be steel or aluminum alloy, lightweight.]

2.17.3 Air-Operated Chain Hoists

****

NOTE: Delete paragraph heading and following paragraphs if this type hoist is not required.

****

Air-operated chain hoists shall be equipped with a noncorroding, nonsparking chain and hook assembly.

Air-operated chain hoists shall be standard chain and hook assembly as specified.

Each hoist shall be noncorroding, nonsparking type or standard type as indicated.

****

NOTE: Select type of load chain.

****

Load chain shall be [roller] [link] chain, of materials as specified.

2.17.4 Air-Operated Wire-Rope Hoists

****

NOTE: Select noncorrosive, nonsparking requirements of hoist.

****

Hoist shall be equipped with a noncorroding, nonsparking wire-rope and hook assembly.

Hoist shall be standard wire-rope and hook assembly.

Each hoist shall be noncorroding, nonsparking type or standard type as

indicated.

2.17.5 Lift Speed

Hoists shall be designed for low-hoisting and lowering-speed application at the specified lift and for accurate load positioning. Hoist speeds shall not exceed the following:

****
NOTE: Fill in capacity, hoist type and lift speed.
****

CAPACITY IN KILOGRAM	HOIST TYPE	MAX. LIFT SPEED, MPS
Chain		
Wire		

CAPACITY IN TONS	HOIST TYPE	MAX. LIFT SPEED, FPM
Chain		
Wire		

A tolerance of plus or minus 1.52 meter per second 5 fpm is acceptable.

2.17.6 Air Motors

****
NOTE: Select motor type.

Piston-type air motors must be used where slow-speed, high-torque, heavy-duty, accurate load positioning and control is required and where minimum servicing is desired.

Vane-type air motors must be considered for high-speed applications at moderate torque. Vane-type motors are less expensive than piston type and normally require more maintenance.
****

Air motors shall be totally enclosed, nonventilated, axial or radial, piston, geared type. Unit shall be high-torque, reversible motor design with renewable and interchangeable cylinders, renewable crank-pin bushings, and counterbalanced crankshaft.

Air motor shall be totally enclosed, nonventilated gear-reduction rotary vane type. Unit shall be reversible motor design with removable, renewable vanes and antifriction bearings on rotating or oscillating parts. Motor shall include an adjustable rate-of-descent device.

2.17.7 Controls

****
NOTE: Select required type of control. Pull-chain control is least expensive and will provide precise

control.

Pendant control must be considered for combined air hoist and air trolley drive control, control is precise.

****

Hoist motor shall be controlled by a pull-chain throttle arranged for single-hand control.

Hoist motor shall be controlled by a lever-operated, pendant throttle. Pendant throttle shall include a strain reliever chain or cable permanently attached to the hoist frame and the pendant throttle.

2.17.8 Limit Stop Valves

Adjustable, automatic, upper- and lower-limit stop valves shall be provided to prevent overtravel of the hook in either direction.

Limit stop valves shall act to return the control to neutral and to cut off air supply.

2.17.9 Fittings and Accessories

Each air hoist shall include a swivel-type air inlet, a muffler, an air line filter and oiler, speed couplers and connectors, and the required air hose and fittings between hoist, motor, and air supply source and between hoist, motor, and controller.

Swivel-type air inlets shall be capable of not less than 180 degrees rotation.

Muffler shall be a heavy-duty, removable, pressed-steel device, chain attached to the hoist or motor.

Air filter and oiler shall be a cast-bronze, combination assembly with removable glass bowls and adjustable oil feed. Unit shall have a 64-micrometer bronze screen air filter. Unit shall deliver not more than a 34 kilopascal 5-psi pressure drop when supplying maximum required air.

Speed couplers and connectors shall be cadmium-plated steel fittings not less than 10 millimeter 3/8-inch national pipe thread size, with corrosion-resistant steel valves.

Air hose shall be braided rubber hose conforming to FS ZZ-H-500. Hose shall be sized to deliver, at the air motor, an ample volume of air at not less than 140 kilopascal 80 psi to operate the air hoist and trolley at the specified maximum lift speed and travel speed, with rated capacity load. Hose shall be not less than 20 millimeter 3/4-inch diameter.

Air hose shall be fitted with couplers and connectors and be the length required for equipment indicated.

2.18 TROLLEYS

****

NOTE: Delete paragraph heading and following paragraphs if trolley suspension is not required.

Drawings must indicate location, size, and details of track and must indicate lift heights and trolley types where more than one hoist is required.

****

Each trolley assembly shall be factory painted, designed specifically for use with the specified hoist, and shall be furnished by the hoist manufacturer. Paint finish shall be the same type and quality specified for the hoist.

Paint finish for exposed surfaces shall be Color No. 12246 of FED-STD 595.

Each trolley assembly shall have not less than four wheels. Sufficient wheels shall be provided to properly distribute the load. Load on a wheel shall not exceed 544 DW kilogram (1,200 DW pounds) 1,200 DW pounds where D equals the diameter of the wheel in millimeter inches and W equals the width of the rail head or the nominal length of bearing on the tread.

Wheels shall be single-flange type manufactured from forged alloy steel with machined, hardened treads and flanges, or high-strength cast or nodular iron with machined flanges and treads, chill-hardened not less than as applicable. Bearings shall be provided with fittings for pressure lubrication.

Side plates shall be fabricated from structural-quality rolled-steel plate milled to the required profile with integral bosses where necessary to support equalizing pins; side plates shall be fitted with steel end bumpers.

Equalizing pins and axles shall be heat-treated alloy steel, machined and finish ground to the required size.

Gears shall be cut from heat-treated alloy steel accurately machined into spur, helical, and pinion gears, conforming to AGMA requirements.

Drive pinions shall be carburized alloy steel, malleable iron, or bronze, with cut or cast teeth, conforming to AGMA requirements.

Hand-chain wheel of geared trolleys shall be manufactured from steel, malleable iron, high-strength cast iron, or aluminum alloy, with accurately shaped pockets to receive hand chain and with guides that will permit operation of the hand chain from an angle of 10 degrees from either side of the chain wheel without slipping or jumping the wheel rim.

****

NOTE: Select required type of chain.

****

Hand chain shall be endless-coil, welded-link, cadmium-plated, proof-coil steel chain conforming to FS RR-C-271, Type 1, Grade C, Class 4.

Noncorroding, nonsparking hand chain shall be endless-coil, link-type, fabricated from AISI Type 304 corrosion-resistant steel or suitable bronze or aluminum alloy.

Hand-chain reach distance shall be standard length for specified lift height of hoist and shall reach approximately 760 millimeter 30 inches above the operating floor.

Plain trolleys and geared, manual-drive trolleys shall have suitable,

quick-acting, steel track clamps. Clamps shall be adjustable for wear and shall not injure track flanges. They shall function satisfactorily on curved and straight track and shall be capable of withstanding a pull equivalent to one-third the rated capacity of the hoist when executed parallel to the track.

Safety hangers or lugs shall be steel and shall be integral with, or fastened to, each hoist frame or to trolley frame. They shall ride free above the bottom flange of the beam. Hanger shall be of sufficient capacity to hold the hoist, fully loaded, in the I-beam in case of wheel or axle failure.

Safety factor of each part of trolley assembly shall be not less than 5, based on the ultimate strength of the material used.

2.19 TROLLEY TYPE

2.19.1 Plain Trolley

Plain trolley assembly shall comply with MS MIL-H-904 and the requirements specified.

2.19.2 Geared Manual Drive Trolley

Geared, manual-drive trolley shall conform to MS MIL-H-904 and the requirements specified.

Trolleys shall have gears provided on not less than two wheels to permit propelling the hoist along the rail by a gear mechanism operated by a hand chain and wheel.

2.19.3 Electric-Motor-Driven Trolleys

Electric trolleys, wiring, contact conductors, controls, overcurrent protection, and grounding shall conform to NFPA 70, and to the specified requirements.

****

NOTE: Select type of drive. Geared-trolley type must be considered for standard applications and for any capacity loading.

Tractor-drive types are individual power units and are desirable for motorizing hoists with plain trolley suspension and for negotiating smaller radius turns and switches than generally possible with geared types. Tractive force developed is independent of the load and can be increased or decreased by adjusting the spring tension of the drive wheel

****

Trolley shall be an electric-motor-driven geared type conforming to NFPA 70, the specified general trolley requirements, and the requirements specified.

Trolley drive shall be an electric-motor-driven, tractor type conforming to the specified general trolley requirements. Motor shall drive through a totally enclosed gear train to an adjustable-tension, spring-loaded, rubber-tired, drive wheel. Trolley wheels shall be the flangeless type,

carried on the specified type of antifriction bearings. Tractor frame shall include two guide rollers on each side of the frame, carried on sealed, permanently lubricated antifriction bearings.

****
NOTE: Following paragraphs must be included.
****

Trolley motor shall be a single-speed, totally enclosed, nonventilated, high-starting-torque, 30-minute time-rated, reversible, electric motor specifically designed for monorail trolley operation at an ambient temperature of 40 degrees C 104 degrees F.

Trolley motor shall be power rated at 370 watts 1/2 horsepower minimum, 3-phase, 60-hertz, squirrel-cage induction motor conforming to the requirements for hoist motors as specified.

Motor controller shall be a reversing-type, magnetic starter with overload protection and a low-voltage transformer operated by means of a full-guarded, momentary-contact, pushbutton, pendant control station.

****
NOTE: Delete following paragraph if a combined push-button control for hoist and trolley drive is not required.
****

Pushbutton control station shall be integrated with the pendant pushbutton control of the hoist.

****
NOTE: Delete following paragraphs if brake is not required.
****

Trolley unit shall have an automatic, adjustable, solenoid-operated, electric brake designed for trolley application. Brake shall apply and release smoothly during starts and stops to minimize pendulum action of the load. Braking torque shall be not more than 50 percent of motor torque and shall match motor torque characteristics.

****
NOTE: Select trolley speed in feet per minute meter per second. In general, standard hoists with a capacity of 6,000 pounds 2722 kilogram or less have a trolley speed range of 65 to 150 feet per minute 19.81 to 45.72 meter per second. Hoists with a capacity of 10,000 pounds 4536 kilogram have a speed range of 50 to 150 feet per minute 15.24 to 45.72 meter per second.
****

Trolley speed shall be not more than [15.24] [22.86] [30.48] [45.72] meter per second [50] [75] [100] [150] fpm.

2.19.4 Electric Cable Reel

****
NOTE: Delete paragraph if cable reel is not

required. Reel must be considered for installations where hoist travel does not justify an electric conductor system.

****

Cable reel shall be an automatic rewind assembly with 3- or 4-wire No. 14 or No. 12 AWG Type SO cable. Reel shall have a replaceable spring motor with adjustable tension and sufficient takeup for the entire cable length. Main shaft shall be carried on permanently lubricated antifriction bearings. Unit shall include a four-pole bronze brush and collector ring assembly, wired into a safety terminal block. Unit shall be listed in the UL Elec Const Dir. Each reel shall include a guide roller cable outlet and cable length as follows:

Cable length shall be [_____] millimeter [_____] feet.

Cable reel assembly shall include a swivel mount base that will permit the indicated turn in either direction.

2.19.5 Electric Trolley Accessories

The following items of accessory equipment shall be provided:

a. One pair of trolley travel limit switches for each unit.

b. One 4600 millimeter 15-foot length of standard power supply cord, NEC Type SO cable.

2.19.6 Monorail Electrification System

****

NOTE: Drawings must indicate track layout, clearances, curves and switches; location of power source; number of hoists to be used and horsepower power rating and full load rating of each; the horsepower wattage, load rating, and maximum travel speed of trolley motors.

****

Monorail electrification system for power distribution from the source of supply to mobile tap-off devices shall consist of an approved, three-wire safety contact conductor system of a type listed in the UL Elec Const Dir for the quality of materials and type of service.

System shall be complete with straight and curved conductors; insulating conductor covers; insulators; splices and splice covers; end caps; support brackets and fasteners; current collectors; expansion, isolation, and power-interrupting sections; disconnect switch; and conduit and wiring to source of supply.

****

NOTE: Select type of metal conductor as required by ampere load.

****

Conductor shall be modular 3000 millimeter 10-foot length, galvanized-steel bars, channels, or angles; or may be solid or formed, hollow galvanized steel, figure-8 profile, of sufficient cross section to meet the specified amperage and voltage requirements.

Conductors shall be modular, 3000 millimeter 10-foot length, solid copper bars, channels, or angles; or may be solid or formed, hollow copper, figure-8 profile, of sufficient cross section to meet the specified amperage and voltage requirements.

****
NOTE: Select heat capacity type of conductor cover.
****

Insulating conductor covers and splice covers shall be standard temperature rigid polyvinylchloride extrusions, nonburning, when tested in accordance with ASTM D 635. Covers shall be electric insulation grade with an operating temperature of not less than 66 degrees C 150 degrees F.

Insulating conductor covers and splice covers shall be medium temperature rigid polyvinylchloride extrusion, nonburning, when tested in accordance with ASTM D 635. Covers shall be electric insulation grade with an operating temperature of not less than 102 degrees C 215 degrees F.

****
NOTE: The following paragraphs must be included.
****

Insulating conductor cover and splice covers shall be an integrally colored, high-visibility safety color of sufficient thickness to effectively insulate the conductor.

Conductors shall be mechanically and electrically joined with splices. Conductor splices and power feed sections shall be metal bars, formed metal angles, or metal pins, all fabricated of the same metal as specified for conductors. Bar or angle splices shall be secured with not less than two bolt-and-nut fasteners on each side of the splice. Pin splices shall be secured with an approved clamp connection with not less than four bolt or screw fasteners. Power feed sections shall be clamped or bolted to conductors as required for the type of conductor and ampere load capacity.

Support brackets, hanger clamps, and fasteners shall be steel with electrogalvanized finish conforming to ASTM A 591/A 591M, Class C, or an electrodeposited cadmium finish conforming to ASTM B 766. Brackets shall be spaced at a maximum of 1525 millimeter 5 feet on center for straight sections and 915 millimeter 3 feet on center for curves.

Current collector assembly shall consist of a shoe-type current collector and case, mounted on a swiveling, articulated trolley arm. Assembly shall be dead-front construction of ample current-carrying capacity for the specified equipment. Exposed parts of current collectors shall be grounded and of corrosion-resistant material.

Shoe collector shall be a spring-loaded, sliding contact type with a shoe of hard copper alloy or sintered copper graphite. Shoe shall be mounted in an insulating case of phenolic or urea compound of suitable temperature and insulation quality. Each collector shall be fitted with the required length of extra flexible No. 10 AWG copper conductor Type SO neoprene cable.

Current collector assembly shall be designed to operate through gaps, around curves, and through switches and shall be self-centering. System shall include expansion sections for every 45.72 meter 150 feet using galvanized-steel conductors and every 30.48 meter 100 feet for systems

using copper conductors.

Conductors shall be accurately aligned to ensure positive electrical contact between the collector and the conductor.

Continuous-current thermal rating of conductor shall not exceed 60 degrees C 140 degrees F based on an ambient temperature of 30 degrees C 86 degrees F.

Line-to-line voltage drop shall not exceed 2 volts per 30480 millimeter 100 feet of length with distributed loading at 90 percent power factor.

Short-circuit current rating of conductors shall be not less than 10,000 amperes.

Feed-in boxes for the attachment of feeder conductors to monorail conductor shall consist of bus tap connections without overcurrent protection in a protective enclosure.

Enclosures shall be formed from carbon steel sheet of commercial quality with thickness of metal and box dimensions in accordance with UL 857. Seams and joints shall be closed and reinforced with flanges formed of the same material from which the box is made. Box shall be provided with a screwed-on cover plate. Enclosures shall be zinc coated after fabrication with Type SC3 minimum thickness of coating in accordance with ASTM B 633.

Disconnect switch shall be a surface-mounted, heavy-duty, single-throw, air-break, enclosed type conforming to NEMA KS 1 as indicated and as follows:

Disconnect switch shall be [fuse] [nonfused].

****
NOTE: Drawings must indicate class and group for NEMA 7 enclosures. Refer to NFPA 70, article 500.
****

Enclosure shall be NEMA 250, [Type 1, - general purpose] [Type 3, - dusttight, raintight, and sleet/ice-resistant] [Type 7, - hazardous location, class and group as indicated] [Type 12, - industrial use, dusttight, and driptight].

****
NOTE: The following paragraph must be included.
****

Enclosure shall be installed with centerline 1675 millimeter 66 inches above the finished floor and in the approximate center of the monorail.

Conduit between monorail feeder enclosures and disconnect switches and fixed control stations shall be zinc-coated rigid-steel conduit, couplings, elbows, bends, and nipples conforming to ANSI C80.1. Zinc coating shall be an electrodeposited coating conforming to ASTM B 633.

Building wire for use in conduits, raceways, and wireways in wet or dry locations shall be single conductor, 600-volt, heat- and moisture-resistant Type RHW or THW with a maximum temperature rating of 75 degrees C 167 degrees F, or cross-linked thermosetting, polyethylene insulation with a temperature rating of 90 degrees C 194 degrees F.

2.20 AIR-MOTOR TROLLEYS

2.20.1 Drive Type

****
NOTE: Select drive type.

Geared type must be considered for standard applications where side room requirements are not critical and when radius curves are not minimum. This type is available in special low headroom types.

Tractor drive types are individual power units and are desirable for motorizing hoists with plain trolley suspension and for negotiating smaller radius turns than generally possible with geared types. Tractive force developed is independent of the load and can be increased or decreased by adjusting the spring tension of the drive wheel.
****

Trolley shall be an air-motor drive geared type conforming to the specified general trolley characteristics and the requirements as specified.

Trolley drive shall be an air-motor-driven tractor type conforming to the specified general trolley characteristics and the requirements as specified. Motor shall transmit drive through a totally enclosed gear train to an adjustable tension, spring-loaded, rubber-tired drive wheel. Trolley wheels shall be flangeless type carried on the specified type of antifriction bearings.

Tractor frame shall include two guide rollers on each side of the frame, carried on sealed, permanently lubricated, antifriction bearings.

****
NOTE: Following paragraph must be included.
****

Trolley motor shall be a totally enclosed, nonventilated, radial, piston type or rotary-vane type, reversible air motor of sufficient wattage horsepower to propel the trolley and rated capacity load at the specified speed.

****
NOTE: Select type of control.
****

Trolley motor shall be controlled by a pull chain throttle arranged for single-hand control.

Trolley motor shall be controlled by a lever-operated, pendant throttle. Throttle shall include a strain-reliever chain or cable permanently attached to the trolley frame and to the pendant throttle. Strain-reliever chain or cable shall not be used as a grounding circuit.

Trolley motor controller shall be integrated with the air hoist lever operating pendant control throttles to form a two-motor pendant throttle.

****

NOTE: Delete following paragraph if brake is not required.

****

Mechanically operated or pneumatically operated torsion brake, friction disc or shoe type, designed for air-motor trolley application shall be provided. Brake shall be interlocked with controller and shall apply and release gradually and smoothly during starts and stops to minimize pendulum action of the load. Braking torque shall be not more than 50 percent of motor torque and shall match motor torque characteristics.

****

NOTE: Select maximum trolley speed in feet per minute meter per second.

****

Trolley travel speed shall be not less than [18.29] [24.38] [30.48] meter per second at 552 kilopascal [60] [80] [100] fpm at 80 psi.

2.20.2 Fittings and Accessories

Each air-motor-driven trolley shall include a swivel-type air inlet, a muffler, an air line filter and oiler, speed couplers and connectors, and the required air hose, hose trolleys, and fittings between the trolley motor and air supply source and between trolley motor and controller.

Swivel-type air inlet shall be capable of not less than 180-degree rotation with no leaks at joints.

Muffler shall be a heavy duty, removable, formed steel or iron casting, chain-attached to the motor.

Air filter and oiler shall be a cast-bronze, combination assembly with removable glass bowls and adjustable oil feed. Unit shall have a removable 64-micrometer bronze filter. Assembly shall deliver air at not less than 40 liter per second 85 cubic feet per minute to the motor.

Speed couplers and connectors shall be cadmium-plated-steel fittings not less than 3/8 national pipe thread size, with corrosion-resistant steel valves.

Air hose shall be braided rubber air hose conforming to FS ZZ-H-500, size as required for equipment and fitted with couplers and connectors in length as follows:

One length [7620] [15240] millimeter [25] [50] feet of air hose

One length 30480 millimeter 100 feet of air hose and hose trolley

Length of hose as required by equipment indicated

2.20.3 Hose Trolley

****

NOTE: Drawings must indicate length of hose run.

****

Hose trolleys shall be two-wheel carrier type. Wheels shall be single-flanged type conforming to specified general trolley characteristics

and carried on sealed, permanently lubricated, antifriction bearings. Trolley frame shall be adjustable for flange width and height of I-beam track. Hose clip shall be adjustable spring steel designed to carry not less than two air hoses.

A sufficient number of hose trolleys shall be provided to allow a spacing of not more than 2440 millimeter 8 feet on center when fully extended at the maximum trolley run.

2.21 MONORAIL TRACK

****
NOTE: Drawings must indicate location and size of beam, radius of turns, suspension method, and fittings.
****

2.21.1 General

Monorail track, splice plates, and hangers shall be painted, hot-rolled structural steel I-beam and wide-flange shapes and plates conforming to ASTM A 36/A 36M, of size and weight as required for the specified hoist.

Track shall be designed with a minimum safety factor of 5. Deflection of track shall not exceed 1/450 of the span, as determined by total load of trolley, track, hoist, and full capacity load.

Track curve radii shall permit smooth trolley operation without binding. Flanges shall be smoothly curved and without deformation.

Necessary clamps, hanger rods, hangers, track splice plates, end stops, fasteners, and fittings shall be provided as required for a complete system.

Web-type splice plates or other suitable couplings shall be installed at track joints to provide flush and level connections, with maximum gap between adjacent ends at load carrying ends not exceeding 1.5 millimeter; 4.7 millimeter 1/16 inch; 3/16 inch at switches. Splice fasteners shall be regular hexagon or special, flat-head fasteners.

Safety stops capable of withstanding the impact of a fully loaded hoist and trolley shall be provided.

Fittings with means for not less than 25 millimeter 1-inch vertical adjustment of the track for level erection shall be provided, with provision for additional adjustment after the system has been in operation.

2.21.2 Fasteners

Unfinished threaded fasteners shall consist of regular hexagon-head carbon steel bolts and nuts and special flathead bolts and nuts conforming to ASTM F 568M, Class 4.8 or above ASTM A 307, Grade A. Washers shall be plain carbon steel conforming to ANSI B18.22M ANSI B18.22.1, Type B.

2.21.3 Electrodes for Manual Shielded Metal Arc Welding

Electrodes shall meet the requirements of AWS D1.1/D1.1M and shall be covered mild steel electrodes conforming to AWS A5.1, Series E60 and Series E70.

2.21.4 Paint Finish

Finished monorail shall be inspected after erection, and fasteners, welds, abrasions, and handling marks shall be painted in the finish color. Brackets and hangers of the monorail electrification system shall be painted in the finish color of the monorail track.

PART 3 EXECUTION

3.1 INSTALLATION OF MONORAIL TRACK

Manufacturer's Instructions shall include details of installation, operation, maintenance, and repair of monorail and hoist systems. Repair section shall contain replacement part numbers for the entire assembly.

Installation Drawings shall indicate loadings and structural support for the hoist assembly, location and size of beam or track, power source, location of controls, headroom, clearance, and lift requirements. Drawings shall also indicate capacity, weights, dimensions, hoisting rope or chain, shafts, bearings, drums, blocks, reeving, motor description and characteristics, limit switches, controller and brakes, trolley speed, safety factor of hoist and trolley, wiring, and nonsparking, noncorroding qualities when applicable.

Monorail tracks shall be installed in accordance with the applicable requirements of MMA MH27.1, "Specification for Underhung Cranes and Monorail Systems."

Tracks shall be accurately assembled to the lines and elevations indicated. Fastening of splices shall be performed after the abutting surfaces have been brought completely in contact.

Connections shall be bolted or welded connections.

Splices will be permitted only when indicated. Erection bolts used in welded construction may be tightened securely and left in place when they form no interference to trolley operation. If erection bolts are removed, the holes shall be plug welded and ground smooth.

Monorail track shall be installed plumb and level to a tolerance of not more than 25 millimeter in 30480 millimeter 1 inch in 100 feet from the indicated elevation. Track shall be free of burrs, kinks, and deformation. Curves shall be smooth and even with no kinks or sharp bends.

Track flanges shall be smooth and level. Welded joints and connections shall be ground smooth and offer no obstruction to trolley-wheel movement.

3.2 ON-SITE MONORAIL ELECTRIFICATION SYSTEM TESTS

Monorail electrification system shall be given continuity tests and insulation tests after the installation has been completed but before equipment is energized.

Contractor shall provide necessary test equipment, labor, and personnel to perform the tests as specified. Insulation testing instruments shall consist essentially of a direct-reading ohmmeter and a motor-driven direct current (dc) generator. Continuity tests shall be conducted using a dc device with bell or buzzer.

Monorail electrification system equipment shall be completely isolated from all extraneous electrical connections. Substation and switchboard feeder breakers, circuit breakers in panelboards, and other disconnecting devices shall be used to isolate the equipment under test.

Insulation tests on 480-volt, monorail equipment shall be conducted using a 1,000-volt, insulation-testing instrument. Readings shall be recorded every minute and until three equal and consecutive readings are obtained. Resistance between phase conductors and between phase conductors and ground shall be not less than 50 megohms.

Insulation tests on monorail equipment 300 volts or less shall be conducted using a 500-volt, insulation-testing instrument. Reading shall be recorded after 1 minute and until the reading is constant for 15 seconds. Resistance between phase conductors and between phase conductors and ground shall be not less than 25 megohms.

Test data shall be recorded and shall include location and identification of busway and megohm readings versus time.

Final acceptance shall depend upon satisfactory performance under test. Monorail electrification system shall not be energized until recorded test data are approved.

-- End of Section --