
USACE / NAVFAC / AFCEA / NASA UFGS-41 22 03.19 20 (April 2006)

Preparing Activity: NAVFAC Replacing without change
 UFGS-14622N (February 2003)

UNIFIED FACILITIES GUIDE SPECIFICATIONS

References are in agreement with UMRL dated 25 June 2004

Latest change indicated by CHG tags.

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SECTION 41 22 03.19 20

MONORAILS WITH ELECTRIC POWERED HOISTS 04/06

NOTE: This guide specification covers the requirements for monorails with electric powered wire rope and chain hoists.

Comments and suggestions on this guide specification are welcome and should be directed to the technical proponent of the specification. A listing of technical proponents, including their organization designation and telephone number, is on the Internet.

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

Use of electronic communication is encouraged.

Brackets are used in the text to indicate designer choices or locations where text must be supplied by the designer.

NOTE: Use this guide specification to specify general purpose monorails that are procured as part of a building construction contract for such applications as machine shops, warehouses, and other areas that do not require specialized weight handling equipment. This specification is not intended to be used for automated monorails. The monorails specified herein will handle loads which average 50 percent of rated capacity with 5 to 10 lifts per hour averaging 5 meters 15 feet with not over 50 percent of the lifts at rated capacity (Class C monorail with Class H3 hoist). This guide specification shall not be used to procure monorails of 10 metric ton ton capacity or greater; monorails that operate in "hazardous locations" as defined in the National Electrical Code; nonstandard monorails; or monorails that handle hot (molten) metals, explosives or fissionable materials. Requirements

for procurement of such monorails and all cranes of
10 metric ton ton capacity or greater shall be
forwarded to Northern Division, Naval Facilities
Engineering Command, 10 Industrial Highway, Mail
Stop 82, Lester, PA 19113-2090, ATTN: Navy Crane
Center, Code 09W (See NAVFAC Instruction 11450.1).

NOTE: TO DOWNLOAD UFGS GRAPHICS

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

NOTE: The following information shall be shown on
the project drawings:

1. Sketch UFGS-14622N-1, including data.
2. Runway track system.
3. Electrical junction box location (including
mounting height).

PART 1 GENERAL

1.1 REFERENCES

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

Use the Reference Wizard's Check Reference feature
when you add a RID outside of the Section's
Reference Article to automatically place the
reference in the Reference Article. Also use the
Reference Wizard's Check Reference feature to update
the issue dates.

References not used in the text will automatically
be deleted from this section of the project
specification when you choose to reconcile
references in the publish print process.

The publications listed below form a part of this specification to the
extent referenced. The publications are referred to within the text by the
basic designation only.

AMERICAN INSTITUTE OF STEEL CONSTRUCTION (AISC)

AISC 348

(2000) Structural Joints Using ASTM A325
or A490 Bolts

ASME INTERNATIONAL (ASME)

ASME B30.11	(1998) Monorails and Underhung Cranes
ASME B30.16	(2003) Overhead Hoists (Underhung)
ASME HST-1	(1999; R 2004) Electric Chain Hoists
ASME HST-4	(1999; R 2004) Overhead Electric Wire Rope Hoists

ASTM INTERNATIONAL (ASTM)

ASTM A 275/A 275M	(2003) Magnetic Particle Examination of Steel Forgings
ASTM A 325	(2004b) Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength
ASTM A 325M	(2004b) Structural Bolts, Steel, Heat Treated, 830 Mpa Minimum Tensile Strength (Metric)
ASTM A 563	(2004a) Carbon and Alloy Steel Nuts
ASTM A 563M	(2004) Carbon and Alloy Steel Nuts (Metric)
ASTM F 959	(2004) Compressible-Washer-Type Direct Tension Indicators for Use with Structural Fasteners
ASTM F 959M	(2002) Compressible-Washer-Type Direct Tension Indicators for Use with Structural Fasteners (Metric)

MONORAIL MANUFACTURERS ASSOCIATION (MMA)

MMA MH27.1	(2003) Underhung Cranes and Monorail Systems
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NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA MG 1	(2003; R 2004) Motors and Generators
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NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(2005) National Electrical Code
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U.S. GENERAL SERVICES ADMINISTRATION (GSA)

FS RR-W-410	(Rev E) Wire Rope and Strand
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U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

29 CFR 1910.179	Overhead and Gantry Cranes
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1.2 SYSTEM DESCRIPTION

Provide a monorail system with electric powered hoist[s] and [plain type (hand operated)] [hand chain operated] [electric powered] trolley[s], complete, tested and ready for operation. Monorails, hoist[s], trolley[s], equipment, materials, installation, examination, inspection, and workmanship shall be in accordance with the applicable requirements of NFPA 70, ASME B30.11, ASME B30.16, ASME HST-1, ASME HST-4, and MMA MH27.1, with modifications specified herein. Reference in these publications to the "authority having jurisdiction" shall be interpreted to mean the "Contracting Officer."

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. 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.] The following shall be submitted in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Monorail system; G

SD-03 Product Data

Monorail track system including [switches,] suspension system and other components; G

Electric wire rope hoist; G

Electric chain hoist; G

Trolley; G

Pendant pushbutton station; G

Electrification; G

SD-05 Design Data

Load and sizing calculations; G

SD-06 Test Reports

Wire rope breaking strength test; G

Load chain proof test; G

Hook and hook nut magnetic particle inspection; G

Post-erection inspection; G

Operational tests; G

Hook test; G

No-load test; G

Load test; G

Rated load speed test; G

SD-07 Certificates

Bolts; G

Nuts; G

Washers; G

Painting system; G

Overload test certificate; G

SD-10 Operation and Maintenance Data

Overhead monorail system, Data Package 3; G

Submit in accordance with Section 01 78 23 OPERATION AND MAINTENANCE DATA.

1.4 DELIVERY, STORAGE, AND HANDLING

1.4.1 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 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.

1.4.2 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.

1.5 QUALITY ASSURANCE

1.5.1 Certificates: [Overload Test Certificate](#)

Submit a statement that the monorail system can be periodically load tested to 125 percent (plus 5 minus 0) of rated load.

1.5.2 Drawings: [Monorail System](#)

Show the general arrangement of all components, clearances and principal dimensions, assemblies of hoist, trolley, track, track suspension system, and electrical schematic drawings.

1.5.3 Design Data: [Load and Sizing Calculations](#)

Submit calculations verifying the sizing of any track, track suspension device and additional supports which are not the monorail system manufacturer's standard cataloged product.

PART 2 PRODUCTS

2.1 [OVERHEAD MONORAIL SYSTEM](#)

NOTE: Plain type (hand operated) trolleys are recommended where trolley motion is infrequent or the distance is short. Plain type trolleys are not recommended for hoists of 3 metric ton ton capacity and greater, or for tracks higher than 6 m 20 feet above the floor level. Hand chain operated trolleys are recommended where trolley motion is infrequent or the distance is short. They provide good load spotting ability and can be used for hoists of 5 metric ton ton capacity and under. Motor operated trolleys are recommended where the operating frequency, travel distance, rated load, or beam elevation makes other types of trolleys impractical.

 NOTE: 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.

Provide overhead monorail system conforming to MMA MH27.1, Class C, for [indoor] [outdoor] service, with an electric wire rope or chain hoist mounted on a movable trolley. Trolley shall be [plain type (hand operated)] [hand chain operated] [motor operated]. Monorail system shall operate on [_____] volts AC, 60 Hz, [single] [three] phase power source.

2.1.1 Capacity

The monorail system shall have a minimum rated capacity of [_____] metric tons tons ([_____] kg pounds.) Mark the hoist capacity in kg pounds on both sides of the hoist or load block.

2.1.2 Speeds

 NOTE: Slow full-load operating speeds invariably provide improved load control and increased productivity. The full-load speeds enclosed in brackets are recommended for most applications. However, should other speeds be required, the following guidelines are provided:

1. Hoist: See Tables 1 and 2 below.
2. Trolley: 250 mm/s 50 fpm is recommended for one speed motorized trolleys. For longer travel distances a two speed trolley with a high speed of 500 mm/s 100 fpm is normally sufficient. In any case, travel speed should not exceed the maximum speed that the floor walking, pendant control operator can comfortably negotiate in a work area, approximately 750 mm/s 150 fpm.

TABLE 1: TYPICAL WIRE ROPE HOIST LIFT RANGES AND RATED LIFTING SPEEDS

Rated Load (metric tons)	Hoist Lift Range (m)	Hoist Lifting High Speed Range (mm/s)
1/2	3 to 30	50 to 300
1	3 to 30	50 to 300
2	3 to 25	50 to 200
3	3 to 25	50 to 175
5	3 to 20	50 to 175

TABLE 1: TYPICAL WIRE ROPE HOIST LIFT RANGES AND RATED LIFTING SPEEDS

Rated Load	Hoist Lift	Hoist Lifting High
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TABLE 1: TYPICAL WIRE ROPE HOIST LIFT RANGES AND RATED LIFTING SPEEDS

(tons)	Range (ft)	Speed Range (fpm)
1/2	10 to 100	10 to 60
1	10 to 100	10 to 60
2	10 to 84	10 to 40
3	10 to 84	10 to 35
5	10 to 56	10 to 35

TABLE 2: TYPICAL CHAIN HOIST LIFT RANGES AND RATED LIFTING SPEEDS

Rated Load (metric tons)	Hoist Lift Range (m)	Hoist Lifting High Speed Range (mm/s)
1/8	3 to 6	80 to 320
1/4	3 to 6	80 to 320
1/2	3 to 6	35 to 320
1	3 to 6	35 to 300
1 1/2	3 to 6	35 to 300
2	3 to 6	20 to 200
3	3 to 6	20 to 200
4	3 to 6	20 to 125
5	3 to 6	20 to 125

TABLE 2: TYPICAL CHAIN HOIST LIFT RANGES AND RATED LIFTING SPEEDS

Rated Load (tons)	Hoist Lift Range (ft)	Hoist Lifting High Speed Range (FPM)
1/8	10 to 20	16 to 64
1/4	10 to 20	16 to 64
1/2	10 to 20	7 to 64
1	10 to 20	7 to 60
1 1/2	10 to 20	7 to 60
2	10 to 20	4 to 40
3	10 to 20	4 to 40
4	10 to 20	4 to 24
5	10 to 20	4 to 24

The hoist shall [have two operating speeds and shall] be capable of hoisting and lowering the rated load at a [high] speed of [100 mm/s] [20 feet per minute (fpm)] [_____]. [The trolley shall [have two operating speeds and shall] be capable of moving the rated load at a [high] speed of [250] [500] [_____] mm/s [50] [100] [_____] fpm.] [Low speed(s) shall be one quarter to one third of high speed(s).] Actual speed(s) shall be within plus or minus 15 percent of those specified.

2.1.3 Material Limitations

Shafts, keys, couplings, sprockets, and chains shall be steel. All gears shall be steel except for worm gears, which shall be bronze or steel. Cast iron and aluminum used to support components of the hoist power

transmission train shall be ductile.

2.1.4 Safety

Comply with the mandatory and advisory safety requirements of ASME B30.11, ASME B30.16, and 29 CFR 1910.179.

2.2 MONORAIL TRACK SYSTEM

MMA MH27.1. Track beams shall be patented track sections fabricated by a manufacturer regularly engaged in production of this type of beam.

2.2.1 Track Suspension System

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

Monorail suspension shall be [flexible] [rigid] type. Make bolted connections to supporting structure, excluding hanger rods, with ASTM A 325M ASTM A 325 bolts, ASTM A 563M ASTM A 563 nuts, and ASTM F 959M ASTM F 959 load indicator washers. ASTM A 325M ASTM A 325 bolts shall be fully pre-tensioned in accordance with AISC 348. Support monorail track system from the structural members shown. Provide additional supports as required to carry monorail track system loads to the structural members shown. Materials for additional supports shall conform to the material requirements contained in Section 05 12 00 STRUCTURAL STEEL.

2.3 ELECTRIC WIRE ROPE HOIST

NOTE: Specify double reeved hoist if true vertical
lift is required.

ASME HST-4, Class H3, except as modified herein. [Hoist shall be double reeved.]

2.3.1 Hoisting Ropes

FS RR-W-410, 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.

2.3.2 Sheaves

Sheaves shall be steel or ductile cast iron. 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.

2.3.3 Drum

Drum shall be steel or ductile cast iron. Pitch diameter of the drum shall not be less than 18 times the rope diameter. Not less than two dead wraps of the hoisting rope shall remain on each anchorage when the hook is in its extreme low position.

2.4 ELECTRIC CHAIN HOIST

ASME HST-1, Class H3, except as modified herein. Provide load chain proof test.

2.5 TROLLEY

Trolley shall meet all applicable requirements of MMA MH27.1, ASME HST-1 and ASME HST-4. Trolley shall have elastomeric bumpers to engage runway stops.

2.6 MOTORS

NOTE: Single speed motors are sufficient for slow operating speeds. When two-speed motors are specified, the slow speed will be 1/3 to 1/4 of the rated speed. Squirrel cage motors normally have a high acceleration/deceleration rate. Specifying reduced voltage starting, acceleration, and deceleration for the trolley (see article below entitled "CONTROLS") will reduce this rate and improve load spotting and handling ability.

NEMA MG 1. Hoist [and trolley] motor[s] shall be [single] [two] speed AC squirrel cage induction type. [Trolley motor shall be [single] [two] speed AC squirrel cage induction type.] Motor insulation shall be Class B minimum. Provide totally enclosed non-ventilated (TENV) motor enclosures. Maximum motor speed shall not exceed 1800 RPM.

2.7 CONTROLS

Provide [single] [two] speed magnetic control for the hoist [and trolley]. [Provide [single] [two] speed magnetic controls for the trolley.] [Provide reduced voltage starting, acceleration and deceleration for the trolley drive.]

2.8 LIMIT SWITCHES

Provide upper and lower limit switches which de-energize the hoist motor.

2.9 BRAKES

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

Provide hoist with an electro-mechanical holding brake and a mechanical load brake, each capable of holding 130 percent of the rated hoist capacity. Hoist holding brake shall be capable of being released to test the load brake. [Provide trolley with an electro-mechanical brake. Provide trolley brake with a minimum torque rating of [100] [50] percent of the drive motor rated torque. Trolley brake torque shall be adjustable down to 85 percent of its torque rating.]

2.10 LOAD BLOCK AND HOOK

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

Construct load blocks of steel. Provide forged steel, swivel type hook, with hook nut keyed to hook shank by means of a setscrew installed in a plane parallel to the longitudinal axis of the hook shank, or other similar easily removable securing device. [Hook throat opening shall not be less than [_____] mm inches.] Provide hook with spring loaded steel safety latch for closing the hook throat opening. The hook and hook nut shall be unpainted. Permanently mark hook and hook nut with an identification number.

2.10.1 Hook and Hook Nut Magnetic Particle Inspection

Magnetic particle inspect the hook and nut over the entire area in accordance with **ASTM A 275/A 275M**. Acceptance standard shall be no defects. A defect is defined as a linear indication that is greater than **3 mm 1/8 inch** long whose length is equal to or greater than three times its width.

2.11 BEARINGS

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

2.12 PENDANT PUSHBUTTON STATION

Hoist [and trolley] shall be controlled from a pendant pushbutton station. Arrange pushbuttons in accordance with **ASME B30.11** recommendations. Locate station **[1.2 m] [4 feet]** [_____] above the finished floor.

2.13 ELECTRIFICATION

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

Runway electrification shall be 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].

2.14 IDENTIFICATION PLATES

Provide identification plates of noncorrosive metal with clearly legible permanent lettering giving the manufacturer's name, model number, capacity in pounds, and other essential information or identification.

2.15 PAINTING SYSTEM

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

[Painting shall be manufacturers standard.] Provide a primer and a finish coat. [Blast clean all components prior to painting. Primer shall be inorganic zinc type. The finish coat shall be an epoxy 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 and the Contracting Officer shall jointly inspect the monorail and hoist systems and components to determine compliance with specifications and approved submittals. The Contractor shall notify the Contracting Officer [_____] days before the inspection. 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 must be provided by the Contractor.

After erection and inspection, test the 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, manufacturer, installation, and workmanship. Rectify all deficiencies disclosed by testing and retest the system or component to prove the monorail system is operational. The Contractor shall furnish [loads for testing,] operating personnel, instruments, and all other necessary apparatus. [The Contracting Officer will furnish loads for testing; the Contractor shall receive and transport the loads from a location not more than [_____] km miles from the job site and shall return them to that location after the tests have been completed.]

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, high temperatures or abnormal operation of any equipment or machinery shall be noted, investigated, and corrected. Record hoist [and trolley] speeds during each test cycle.

3.3.4 Hook Test

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 by more than 5 percent from the base measurement shall be 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 switch, 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 Load Test

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

- a. Hoist Static Test: Raise test load approximately one foot above the floor and hold for 10 minutes. Observe load lowering that may occur which will indicate 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.

**NOTE: Load Brake Test and Loss of Power Test shall
be performed at low speed for two speed hoists.**

- c. Load Brake Test: Raise test load approximately 1.5 m 5 feet. With the hoist controller in the neutral position, release the holding brake. The load brake should 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 should prevent the test load from accelerating. NOTE: It is not necessary for the load brake to halt the downward motion of the test load.

- 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. Load should 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

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 feet) equal to 10 percent of rated capacity high speed (in feet per minute) when initially travelling 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.

-- End of Section --