****

USACE / NAVFAC / AFCEC / NASA	**UFGS-41 22 13.33 (May 2010)**

Preparing Activity: NAVFAC	**Superseding**
	UFGS-41 22 13.33 (April 2008)
	UFGS 41 22 23.23 20 (April 2006)

UNIFIED FACILITIES GUIDE SPECIFICATIONS

References are in agreement with UMRL dated January 2021

****

SECTION TABLE OF CONTENTS

DIVISION 41 - MATERIAL PROCESSING AND HANDLING EQUIPMENT

SECTION 41 22 13.33

PORTAL CRANE TRACK INSTALLATION

05/10

PART 1 GENERAL

1.1 REFERENCES
1.2 SUBMITTALS
1.3 QUALITY ASSURANCE
1.3.1 Welder, Welding Method, and Welder Qualification
1.3.2 Certifications Required
1.4 DELIVERY, STORAGE, AND HANDLING
1.5 EXISTING CONDITIONS

PART 2 PRODUCTS

2.1 RAIL MATERIALS
2.1.1 Crane Rail
2.1.1.1 Rail Section Weight and Hardness
2.1.1.2 Metallurgical Composition
2.1.2 Joint Bars
2.1.3 Track Bolts, Nuts, and Washers
2.1.4 Rail Clips
2.1.5 Weldable, Adjustable Rail Clips
2.1.6 Impact Pads
2.1.7 Electrodes
2.2 CRANE TRACK FITTINGS
2.2.1 Four-Rail Portal Crane Track Systems
2.2.2 Two-Rail Portal Crane Track Systems
2.2.2.1 Cast Manganese Steel Double-Tongue Switch Points
2.2.2.2 Cast Manganese Steel Rigid Ramp-Type Frogs
2.2.2.3 Cast Manganese Steel Turntable Frogs
2.2.2.4 Fabricated Double-Tongue Switch Points
2.2.2.5 Fabricated Rigid Ramp-Type Frogs
2.2.2.6 Fabricated Turntable Frogs
2.2.2.7 Manually-Operated Switch Throw Mechanisms and Housings
2.2.2.8 Power-Operated Switch Throw Mechanism
2.3 DRAINAGE LINES FOR FITTINGS
2.4 FOUNDATION MATERIALS

2.4.1 Base Plates
2.4.2 Anchor Bolts
2.4.3 Nonmetallic Nonshrink Grout
2.4.4 Epoxy Grout
2.4.5 Portland Cement Concrete
2.5 STANDARD GAGE RAILROAD TRACK
2.6 OIL FOR TRACK FIXTURES

PART 3 EXECUTION

3.1 WORKMANSHIP
3.2 INSTALLATION OF CRANE TRACK AND FITTINGS
3.2.1 Crane Rails
3.2.2 Welded Crane Rail Joints
3.2.2.1 Thermite Method
3.2.2.2 Manual Shielded-Arc Welding Method
3.2.2.3 Electrical Flash-Butt Method
3.2.3 Bolted Rail Joints
3.2.3.1 Joint Bars
3.2.3.2 Compromise Joints
3.2.4 Anchor Bolts
3.2.5 Base Plates
3.2.6 Crane Track Fittings
3.2.6.1 Crane Switches
3.2.6.2 Rigid Frogs
3.2.6.3 Turntable Frogs
3.2.7 Standard Gage Railroad Tracks
3.2.8 Oiling Track Fixtures
3.2.9 Concrete
3.3 CLEANUP
3.4 FIELD QUALITY CONTROL
3.4.1 Test for Grout
3.4.2 Visual Inspection
3.4.3 Ultrasonic Inspection of Welded Rail Joints
3.4.4 Load Test
3.4.5 Throw Mechanism Operational Test
3.4.6 Retesting
3.4.7 Record Drawing Survey

-- End of Section Table of Contents --

****

USACE / NAVFAC / AFCEC / NASA	**UFGS-41 22 13.33 (May 2010)**

Preparing Activity: NAVFAC	**Superseding**
	UFGS-41 22 13.33 (April 2008)
	UFGS 41 22 23.23 20 (April 2006)

UNIFIED FACILITIES GUIDE SPECIFICATIONS

References are in agreement with UMRL dated January 2021

****

SECTION 41 22 13.33

PORTAL CRANE TRACK INSTALLATION
05/10

****

NOTE: This guide specification covers the requirements for procurement, installation and testing of portal crane trackage.

Adhere to UFC 1-300-02 Unified Facilities Guide Specifications (UFGS) Format Standard when editing this guide specification or preparing new project specification sections. Edit this guide specification for project specific requirements by adding, deleting, or revising text. For bracketed items, choose applicable item(s) or insert appropriate information.

Remove information and requirements not required in respective project, whether or not brackets are present.

Comments, suggestions and recommended changes for this guide specification are welcome and should be submitted as a Criteria Change Request (CCR).

****

****

NOTE: Use this specification in conjunction with the following NAVFAC Standard Drawings that form part of MIL-DTL-82020 and MIL-DTL-29229 and following Definitive Drawings and UFC 4-860-02N, "Design: Trackage ." These are available in inch-pound units only.

NAVFAC NO./TITLE

1404353 "Definitive Drawing - Fabricated Portal Crane Track Switch Throw Linkage"

1404354 "Definitive Drawing - Portal Crane Track Switch Power Mechanism"

1404355 "Definitive Drawing - Portal Crane Track Turntable Frog Power Mechanism"

Crane track material, especially fittings, frequently require long lead time to become available to the Contractor. Ensure that the lead time required for material specified in this guide specification is considered when project construction time is established.

****

****

NOTE: TO DOWNLOAD UFGS GRAPHICS

Go to http://www.wbdg.org/ffc/dod/unified-facilities-guide-specifications-ufgs/for

****

****

NOTE: Show the following information on the project drawings:

1. Existing material to be reused, if required

2. Crane rail system type

3. Crane wheel type

4. Rail curvature geometry

5. Switch throw mechanism

6. Utility line connections for power operated switch throw mechanism

7. Drainage for track fittings and switch throw mechanism housings

8. Rail alignment and gage

9. Rail joint connection types

10. Welding method at each welded joint

11. Sketch No. 41 22 13.33-1 and Sketch No. 41 22 13.33-2

Scheduling restraints which impact on the Contractor's time or cost to perform the work, station operations affected by the Contractor's work, and station operations which may affect the performance of the Contractor's work should be addressed in Section 01 30 00 ADMINISTRATIVE REQUIREMENTS. The following is a sample paragraph which may be used in Section 01 30 00 ADMINISTRATIVE REQUIREMENTS, paragraph "Special Scheduling Requirements."

INTERFACE WITH TRACK OPERATIONS: Schedule work to minimize interference to crane, (train,) and vehicular traffic operations. Crane and/or train

operations will be scheduled to minimize interruptions to Contractor's work. However, critical materials must be transported as necessary. When it is required to transport critical material over trackage where Contractor is working, or to utilize portal cranes in work areas, Government will notify Contractor at least 5 calendar days, or as required, in advance so that he may schedule his work accordingly. If necessary, work scheduling for the entire project will be discussed during the pre-construction conference and present a proposed work schedule not later than 5 calendar days (or as required) after the pre-construction conference.
****

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 Reference Identifier (RID) outside of the Section's Reference Article to automatically place the reference in the Reference Article. Also use the Reference Wizard's Check Reference feature to update the issue dates.

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

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

AMERICAN RAILWAY ENGINEERING AND MAINTENANCE-OF-WAY ASSOCIATION (AREMA)

AREMA Eng Man	(2017) Manual for Railway Engineering
AREMA Track Plans	(2008) Portfolio of Trackwork Plans

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

ASME B18.2.1	(2012; Errata 2013) Square and Hex Bolts and Screws (Inch Series)
ASME B18.2.2	(2015) Nuts for General Applications: Machine Screw Nuts, Hex, Square, Hex Flange, and Coupling Nuts (Inch Series)

AMERICAN WELDING SOCIETY (AWS)

AWS D1.1/D1.1M	(2020) Structural Welding Code - Steel

ASTM INTERNATIONAL (ASTM)

ASTM A1	(2000; R 2018) Standard Specification for Carbon Steel Tee Rails
ASTM A36/A36M	(2019) Standard Specification for Carbon Structural Steel
ASTM A49	(2012; R 2019) Standard Specification for Heat Treated Carbon Steel Joint Bars, Microalloyed Joint Bars and Forged Carbon Steel Compromise Joint Bars
ASTM A53/A53M	(2020) Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
ASTM A128/A128M	(1993; R 2017) Standard Specification for Steel Castings, Austenitic Manganese
ASTM A183	(2014; R 2020) Standard Specification for Carbon Steel Track Bolts and Nuts
ASTM A283/A283M	(2013) Standard Specification for Low and Intermediate Tensile Strength Carbon Steel Plates
ASTM A325	(2014) Standard Specification for Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength
ASTM A325M	(2014) Standard Specification for Structural Bolts, Steel, Heat Treated, 830 MPa Minimum Tensile Strength (Metric)
ASTM C109/C109M	(2020b) Standard Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 2-in. or (50-mm) Cube Specimens)
ASTM C144	(2018) Standard Specification for Aggregate for Masonry Mortar
ASTM C157/C157M	(2017) Standard Test Method for Length Change of Hardened Hydraulic-Cement Mortar and Concrete
ASTM D1763	(2000; R 2013) Epoxy Resins

U.S. DEPARTMENT OF DEFENSE (DOD)

MIL-DTL-29229	(Rev B, Notice 1) Switches and Frogs, Track, Fabricated, for Portal Cranes

MIL-DTL-82020	(1997; Rev C; Notice 1; CANC Notice 2) Switches and Frogs, Track, Cast Manganese Steel, for Portal Cranes
MIL-STD-1699	(1992; Rev B) Nondestructive Evaluation of Butt Welds in Crane and Railroad Rails

1.2 SUBMITTALS

****

NOTE: Review Submittal Description (SD) definitions in Section 01 33 00 SUBMITTAL PROCEDURES and edit the following list, and corresponding submittal items in the text, to reflect only the submittals required for the project. The Guide Specification technical editors have classified those items that require Government approval, due to their complexity or criticality, with a "G". Generally, other submittal items can be reviewed by the Contractor's Quality Control System. Only add a "G" to an item if the submittal is sufficiently important or complex in context of the project.

For Army projects, fill in the empty brackets following the "G" classification, with a code of up to three characters 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.

The "S" classification indicates submittals required as proof of compliance for sustainability Guiding Principles Validation or Third Party Certification and as described in Section 01 33 00 SUBMITTAL PROCEDURES.

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" or "S" classification. Submittals not having a "G" or "S" classification are [for Contractor Quality Control approval.][for information only. When used, a code following the "G" classification identifies the office that will review the submittal for the Government.] Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

[Crane track fittings; G[, [_____]]]

[Switch throw mechanisms and housings; G[, [_____]]]

[Drainage lines connections; G[, [_____]]]

[Weldable, adjustable rail clips; G[, [_____]]]

[Impact pads; G[, [_____]]]

SD-03 Product Data

Rail materials; G[, [_____]]

joint bars and methods of installation; G[, [_____]]

Rail clips; G[, [_____]]

Anchor bolts; G[, [_____]]

Grout; G[, [_____]]

Drainage lines; materials, pipe, and fittings; G[, [_____]]

SD-06 Test Reports

Test for grout; G[, [_____]]

Visual inspection; G[, [_____]]

Ultrasonic inspection of welded rail joints; G[, [_____]]

Load test; G; G[, [_____]]

Throw mechanism operational test; G[, [_____]]

Retesting; G[, [_____]]

SD-07 Certificates

Standard railway fittings; G[, [_____]]

Base plates; G[, [_____]]

Grout; G[, [_____]]

Aggregate materials; G[, [_____]]

Welding method; G[, [_____]]

Welder qualification; G[, [_____]]

1.3 QUALITY ASSURANCE

1.3.1 Welder, Welding Method, and Welder Qualification

a. Manual Shielded-Arc Welding Method: AWS D1.1/D1.1M, submit certification for each welder stating the type of welding and positions qualified for, the code and procedure qualified under, date qualified, and the firm and individual certifying the qualification tests.

b. Thermite Welding Method: Welder qualification requirements for

thermite welding method are defined in Section 34 11 19.00 20 WELDING CRANE AND RAILROAD RAIL - THERMITE METHOD.

1.3.2 Certifications Required

Submit certifications for standard railway fittings as outlined in AREA Manual and for base plates, grout, and aggregate materials used in crane track support in accordance with requirements specified herein.

1.4 DELIVERY, STORAGE, AND HANDLING

Deliver assembled items, and other materials to the job site in an undamaged condition. Handle and store materials to protect against damage before and after delivery. [Prevent distortion of double-tongue switches in transit and storage.]

1.5 EXISTING CONDITIONS

****
NOTE: An additional description of existing conditions may be included in this paragraph. If there is doubt as to foundation location, provide for confirmation by the Contractor. A description of any special conditions, such as any required salvage or reuse of existing crane track components or fittings, may be included in this paragraph.
****

****
NOTE: When existing crane rail trackage is to be removed, use Section 34 11 00 RAILROAD TRACK AND ACCESSORIES, subparts 1.2 38 through 1.2.46 as applicable, or the EFD regional guide specification for removal work. Provide specific requirements for removal of crane rail trackage material. When existing materials are to be reused, list materials here and indicate quantities on project drawings. The designer must determine the appropriateness of reusing existing materials. When it is determined that existing materials to be reused require reconditioning, identify the materials and include reconditioning requirements at the end of Part 2.

This "NOTE" applies to Parts 2 and 3.
****

Confirm existing rail, rail fittings, foundations, and utility locations by means of a field survey. Do not prepare drawings before the completion of field survey and measurements.

Submit details for [casting] [and] [fabrication] of fittings. Include complete dimensioning, alignment data, shop instructions, and a material list indicating description and quantity of components and fasteners for each fitting. Submit drawings for each individual fitting which is adequate to determine the conformance of fittings with project drawings and as provided for herein. Show details of drainage connections from fittings and housings to drain pipes.

Do not manufacture materials until drawings have been approved.

PART 2 PRODUCTS

2.1 RAIL MATERIALS

Provide new track material [except for existing material approved for reuse. Perform removal work as specified in Section 34 11 00 RAILROAD TRACK AND ACCESSORIES. The following material is existing and may be reused: [_____]].

2.1.1 Crane Rail

2.1.1.1 Rail Section Weight and Hardness

****

NOTE: Requirements for minimum length of closure rail sections do not apply to stub rail sections provided as part of fabricated crane rail fittings.

****

****

NOTE: All references in this section to rail section specify per yard (135-CR) crane rail. The 135-CR section is the most common for new and replacement portal crane track. In some work, rail sections other than 135-CR may be required for crane use. These include heavier rail section or, for connection to older existing installations, use of 60 kilogram 132 pound or other railroad rail may be specified. Make changes where rail sections are required that are different than the 135-CR.

This also applies to subparts 2.1.4 through 2.1.6, and 2.2.1.

****

AREMA Eng Man and ASTM A1. Rails must be [664] [_____] kg per meter [135] [_____] pounds per yard in weight and be control-cooled, [fully heat-treated,] [321 to 388] [250 minimum] Brinell hardness carbon steel referred to herein as [135-CR] [_____]. Crane rail hardness must not exceed crane wheel Brinell hardness of [388] [_____]. Provide standard 12 m 39 foot rail lengths except for closure rails. Provide closure rails in one or two sections as long as practical, but in no case less than 4 m 13 feet long.

2.1.1.2 Metallurgical Composition

Provide steel crane rail with chemical composition within the following limits:

a. Carbon, percent 0.67 to 0.82

b. Manganese, percent 0.60 to 1.00

c. Phosphorus, percent 0.04 maximum

d. Silicon, percent 0.10 to 0.23

e. Sulfur, percent 0.04 maximum

2.1.2 Joint Bars

ASTM A49 and AREMA Eng Man, Chapter 4. Provide heat-treated carbon steel six-hole joint bars sized to fit the rail section.

2.1.3 Track Bolts, Nuts, and Washers

AREMA Eng Man, Chapter 4. Provide track bolts not less than 23 mm one inch in diameter.

2.1.4 Rail Clips

****
NOTE: Rail clips should be used on curves for lateral support. If rail clips are not used provide some form of lateral restraint.
****

Provide single clips and holders designed for tight fit and sized to match [135-CR] [_____] crane rail section.

2.1.5 [Weldable, Adjustable Rail Clips

****
NOTE: Rail clips should be used on curves for lateral support. If rail clips are not used provide some form of lateral restraint.
****

****
NOTE: Use weldable, adjustable rail clips if the rail will not be permanently anchored in the pavement. Adjustable rail clips are normally used on overhead electric traveling cranes.
****

Provide weldable, adjustable rail clips sized for [135-CR] [_____] crane rail section. Provide rail clips made by a manufacturer currently manufacturing crane rail clips. Rail clips shall be forged steel which can be welded directly to structural steel. Rail clip bolts must conform to ASTM A325M ASTM A325. Provide rail clips designed for a side thrust of [_____] kg [_____] pounds. Provide rail clips designed to allow rail removal without the removal of the welded portion of the rail clip.

]2.1.6 [Impact Pads

****
NOTE: Use impact pads where there will be a large number of crane movements or where vibration could cause excessive wear on the crane or rail.
****

Provide impact pads sized for [135-CR] [_____] crane rail section. Provide pads which are impervious to water, oil, fuels, grease and ultraviolet rays. Provide pads with vulcanized reinforcing and encapsulated in synthetic rubber. The required properties are:

a. Shore hardness: [75 to 85] [_____] to [_____] degrees

b. Thickness (minimum): [6] [_____] mm [1/4] [_____] inch

c. Ultimate tensile strength (minimum): [17] [_____] MPa [2500] [_____]

pounds per square inch

d. Reduction in load per square mm inch (minimum): [30] [_____] percent

e. Temperature range: Minus 7 to 100 degrees C 20 to 212 degrees F

f. Wheel Load: [_____] kg [_____] pounds

g. Crane rail bending stress (maximum): 75 percent of allowable bending

The pads must meet the required properties for a minimum of 1,000,000 wheel passes at the maximum permissible wheel load.

]2.1.7 Electrodes

****

NOTE: Welded rail joints are preferred for crane rail except at connections between rail and rail fittings such as switches and frogs where bolted joints are recommended. Indicate on the drawings each joint type (bolted and/or welded). Accomplish welded connections between carbon steel rail and rail fittings fabricated from carbon steel, using either of the methods identified in paragraph "Welded Crane Rail Joints." Determine the welding method(s) to be used and show on project drawings location of each welding method. Welded connections between carbon steel rail and cast manganese steel are not recommended. However, if the activity requires a dissimilar metal welded connection such as this, the cast manganese stub rail end section must be prepared for welding in accordance with Sketch NFGS-14606-1. Use the manual shielded arc welding method in accordance with paragraph "Manual Shielded-arc Welding Method" and electrodes in accordance with paragraph "Electrodes" . Thermite method is not acceptable for welding dissimilar metal.

****

Provide AWS low-hydrogen, high-tensile E 14018 or E 14016 electrodes. Utilize electrodes of the smallest practical diameter worked at the lowest compatible current. Coating on low-hydrogen type electrodes must be thoroughly dry when the electrode is used. Use electrodes taken from hermetically sealed packages within one hour of the time the package is opened. Dry electrodes not used within this one hour period and electrodes taken from nonhermetically sealed packages for at least one hour between 370 and 430 degrees C 700 and 800 degrees F before use. Store dried electrodes at temperatures between 110 and 200 degrees C 225 and 400 degrees F until used, or if not stored and not used within one hour after this drying is completed,re-dry before use. [Do not use electrodes which have been wet.] [Hard surfacing rod used on top 3 mm 1/8 inch of railheads must be alloy with the following composition:

a. Carbon, percent 0.4 to 0.6

b. Manganese, percent 4.0

c. Chromium, percent 18.0 to 21.0

d. Nickel, percent 9.0 to 10.5

e. Molybdium, percent 1.2

f. Iron, base

Heat railhead to a minimum temperature of 260 degrees C 500 degrees F for a distance of 200 mm 8 inches on each side of the joint before welding overlay.]

2.2 CRANE TRACK FITTINGS

****

NOTE: Two types of crane rail fittings are available:

1. Manganese Steel Castings: Most existing crane track fittings are of this type, which has a superior ability to withstand wear. These castings are, however, costly when custom-manufactured, and require long lead time to order.

2. Fabricated (Build-up) Fittings: Fabricated crane track switches and frogs are alternatives to the conventional cast fittings. They consist of stock rails and a number of steel plates bolted and/or welded together into the required configuration. Due to the use of standard components, many machine shops are capable of producing fabricated fittings, thus reducing cost and lead time. Fabricated fittings are, however, heavier and less wear-resistant than cast fittings.

Military standards as listed in this guide specification are available for both types of fittings and paragraphs are provided for both types. Delete paragraphs referring to inapplicable types of fittings. For further information on use of cast and fabricated fittings contact:

Commander
Atlantic Division
Naval Facilities Engineering Command
Code 15C2
Bldg. N-26, Room 234
Norfolk, VA 23511-6287

****

Provide configuration and geometry of fittings as indicated and as specified herein. Substitutions will not be accepted. Fittings include [switches] [and] [frogs] for use with crane wheels indicated.

2.2.1 Four-Rail Portal Crane Track Systems

****

NOTE: There are two types of portal crane trackage systems in use in the Naval Shore Establishment:

1. Four-Rail System: This system consists of two standard gage (railroad) tracks. The cranes for this system are equipped with single-flanged wheels. Switches and frogs are of the standard railroad type except for some small frog angles, where turntable frogs may be required. For details of two- and four-rail system applications, see UFC 4-860-02N. This guide specification may be used for either two-rail or four-rail crane track systems by deletion of inapplicable paragraphs describing the use of specific types of switches and frogs. For four-rail systems, additional references based on Section 34 11 00 RAILROAD TRACK AND ACCESSORIES for Standard Gage Railroad Track may be used.

2. Two-Rail System: The cranes for this system are equipped with double-flanged wheels. Special double-tongue switchpoints and ramp-type frogs are required for this system. Turntable frogs may also be required for small frog angles.

****

Crane track switches and frogs for use with single-flanged wheels shall conform to applicable requirements of the AREMA Eng Man and AREMA Track Plans, with the following limitations:

a. Provide fittings for use with [135-CR] [_____] crane rail section.

[b. Provide turntable frogs.]

2.2.2 Two-Rail Portal Crane Track Systems

Crane track switches and frogs for use with double-flanged wheels must be special fittings meeting the following requirements:

2.2.2.1 Cast Manganese Steel Double-Tongue Switch Points

****

NOTE: If deviation from the military specification is necessary, include the phrase, "except as specified in paragraph entitled "_____." Either specify the deviations in the appropriate paragraph or list together in a new paragraph.This NOTE applies to subparts 2.2.2.1 through 2.2.2.6

****

MIL-DTL-82020 [, except as specified in paragraph [_____],] for use with double-flanged wheels. Provide manganese steel castings conforming to ASTM A128/A128M. [Provide double-tongue switch points with rail curvature geometry indicated. Variations will not be accepted.] [Confirm switch point dimensions by preparation of full-size patterns before molds for castings are made.] [Provide switch points for use in a single crane track turnout in matched pairs.]

2.2.2.2 Cast Manganese Steel Rigid Ramp-Type Frogs

MIL-DTL-82020 [, except as specified in paragraph [_____],] for use with double-flanged crane [and railroad] wheels. Provide manganese steel castings conforming to ASTM A128/A128M. [Provide rigid frogs with frog angle and rail curvature geometry indicated. Variations will not be accepted.] [Cast half-crossings at the intersection of a crane rail and a

standard gage railroad track as an integral one- or two-piece unit.]

2.2.2.3 Cast Manganese Steel Turntable Frogs
MIL-DTL-82020 [, except as specified in paragraph [_____],] for use with double-flanged crane [and railroad] wheels. Provide manganese steel castings conforming to ASTM A128/A128M. [Provide turntable frogs with frog angle and rail curvature geometry indicated. Variations will not be accepted.]

2.2.2.4 Fabricated Double-Tongue Switch Points
MIL-DTL-29229 [, except as specified in paragraph [_____],] for use with double-flanged wheels. [Provide double-tongue switch points with rail curvature geometry indicated. Variations will not be accepted.] [Confirm switch point dimensions by preparation of full-size patterns before fabrication is commenced.] [Provide switch points for use in a single crane track turnout in matched pairs.]

2.2.2.5 Fabricated Rigid Ramp-Type Frogs
MIL-DTL-29229 [, except as specified in paragraph [_____],] for use with double-flanged crane [and railroad] wheels. [Provide rigid frogs with frog angle and rail curvature geometry indicated. Variations will not be accepted.]

2.2.2.6 Fabricated Turntable Frogs
MIL-DTL-29229 [, except as specified in paragraph [_____],] for use with double-flanged crane [and railroad] wheels. [Provide turntable frogs with frog angle and rail curvature geometry indicated. Variations will not be accepted.]

2.2.2.7 Manually-Operated Switch Throw Mechanisms and Housings

****

NOTE: Manually-operated switch throw mechanisms and housings are commercially available items preferably supplied and pre-tested by the switch manufacturer whenever possible. NAVFAC Definitive Drawing No. 1404353, "Portal Crane Track Switch Throw Linkage," contains definitive details for a manually operated throw mechanism but may not be similar to commercially available units. If paragraph entitled "Power-Operated Switch Throw Mechanism" is used, then paragraph entitled "Manually-Operated Switch Throw Mechanisms and Housings" must be used.

The power throw mechanism utilizes a hydraulic linear actuator of a manufacturer's standard design employing an electric or air-driven motor pump. NAVFAC Definitive Drawing No. 1404354 "Portal Crane Track Switch Power Mechanism" and 1404355 "Portal Crane Track Turntable Frog Power Mechanism" contain definitive details for the layout of a power-operated switch throw mechanism but may not be similar to commercially available designs. The minimum performance characteristics for the NAVFAC Definitive Design power throw mechanisms are as follows:

<u>Turntable Frog</u>:

Stroke: 300 mm 12 inches

Speed: 20 mm/s 3/4 inches per second

Force: 5 kN 1200 pounds working: 70 kN 16,000 pounds maximum

<u>Switch Points</u>:

Stroke: 250 mm 10 inches

Speed: 20 mm/s 3/4 inches per second

Force: 13 kN 3000 pounds working: 187 kN 42,000 pounds maximum

Satisfactory commercially available power throw mechanisms for certain site specific crane rail switches have recently been installed at:

Puget Sound, Naval Shipyard, Bremerton, Washington

The Public Works Departments at that activity may be able to provide additional information pertaining to these units. If paragraph "Power-Operated Switch Throw Mechanism," is used, then paragraph "Manually-Operated Switch Throw Mechanisms and Housings," must be used.

****

a. Provide switch points in a single crane track turnout (including turnouts containing shared railroad tracks) to operate simultaneously by a single throw mechanism.

b. Provide each switch with a manually operated throw mechanism. [Provide switch throw as indicated.] [Provide switch throw designed and fabricated by the manufacturer of the switch point.] Base the design on a [bell crank] [lever] operator principle so that the switch can be readily and easily operated by one person without causing damage to the linkage or component parts.

c. Provide throw mechanism to automatically lock into place at the end of the throw in both operating positions.

d. Provide throw handles which indicate the position of the switch, easily accessible, and visible to the crane operator

e. [Provide visible indicators capable of being seen by the crane operator to indicate position of switch.]

f. Provide throw mechanism of a heavy-duty type for specific use with double-flange wheel crane rail fittings.

g. Provide linkage oriented 90 degrees to the switch tongue.

h. All component parts must be readily accessible to allow for inspection, cleaning, maintenance and easy removal and replacement of parts.

i. Provide turn buckles of the open type to permit inspection to ensure engagement of ends of threaded rods.

j. Provide rods and throw linkage components adequately sized and laterally supported to prevent bending and buckling during operation.

k. Provide box housing frames bolted to base plates and equipped with heavy-duty cover plates designed to fit neatly over the housing frame.

l. [When an unequal throw is required for crane track switch points, achieve throw using mechanical bar linkage and not by use of lost motion spring action.]

m. [Lost motion utilizing a spring system action may be employed to facilitate the operation of a railroad switch used in conjunction with the throw of a crane rail switch.]

2.2.2.8 [Power-Operated Switch Throw Mechanism

****

NOTE: If deviation from the military specification is necessary, include the phrase, "except as specified in paragraph entitled "_____." Either specify the deviations in the appropriate paragraph or list together in a new paragraph.

Manually-operated switch throw mechanisms and housings are commercially available items and should be supplied and pre-tested by the switch manufacturer whenever possible. NAVFAC Definitive Drawing No. 1404353, "Portal Crane Track Switch Throw Linkage," contains definitive details for a manually operated throw mechanism but may not be similar to commercially available units. If paragraph entitled "Power-Operated Switch Throw Mechanism" is used, then paragraph entitled "Manually-Operated Switch Throw Mechanisms and Housings" must be used.

****

Provide power-operated switch throw mechanism with all the features specified for the manually operated switch, except remove the throw handle mechanism (and retain at the site for backup operation) and allow the switch operation to be accomplished with the aid of a hydraulic linear actuator driven by [compressed air] [electric] power. Provide utility line connections to the power unit as indicated. Minimum performance characteristics for [turntable frog] [switch point] are as follows:

a. Stroke: [_____] mm [_____] inches

b. Speed: [_____] mm/s [_____] inches per second

c. Force: [_____] N working [_____] pounds

[d. [_____] N [_____] pounds maximum]

]2.3 DRAINAGE LINES FOR FITTINGS

Provide storm water drains for [turntable frogs,] [double-tongue switch

points,] [_____] and [throw mechanism housings] to prevent ponding of water therein. Provide 100 mm 4 inch diameter steel drainage pipe lines conforming to ASTM A53/A53M to drain the fittings and housings as indicated. Slope pipes not less than 2 percent.

2.4 FOUNDATION MATERIALS

2.4.1 Base Plates

ASTM A36/A36M or ASTM A283/A283M. [Provide continuously welded plates, except where existing crane rail base covers the joint between the plates.] [Stagger rail joints and base plate joints.] Shape plates to conform to the configuration of rail curvature and to each special fitting. Minimum width of plates under rails must be 300 mm 12 inches. Minimum length of plates must be 1200 mm 4 feet and maximum length 3000 mm 10 feet. Minimum edge distance for holes as indicated. Provide [28] [_____] mm [1 1/8] [_____] inch diameter anchor bolt holes, field or shop fabricated. Provide grouting holes 50 mm 2 inches in diameter in plates wider than 900 mm 3 feet. Center grout holes, spaced approximately 600 mm 2 feet apart, and locate so as not to interfere with the proper function of the plate.

2.4.2 Anchor Bolts

ASTM A183, square head [25] [_____] mm 1 [_____] inchdiameter steel. Provide each bolt with two finished hexagon nuts and one spring washer. Provide bolt threads conforming to ASME B18.2.1, and nuts and threads to ASME B18.2.2. [For bolts fastened to existing grade beams determine lengths in the field after the elevation of the concrete support beams has been determined and the finished profile grade from the drawings has been taken into consideration.] [Minimum length of anchor bolt is [_____] mm [_____] inches.]

2.4.3 Nonmetallic Nonshrink Grout

Provide grout under base plates as indicated. Provide high early strength, nonshrink, nonmetallic grout, with components passing the No. 4 sieve and proportioned so as to provide a 3-day compressive strength of not less than [28] [45] MPa [4,000] [6,500] psi as determined by ASTM C109/C109M, an expansion-to-original length ratio of 0.018 to 0.020 as determined by ASTM C157/C157M. As an option, commercial premixed grout may be used if it meets the strength, workability, nonshrink, and nonmetallic requirements herein specified. When the depth of grouting exceeds 25 mm one inch, the addition of crushed stone, 6 to 10 mm 1/4 inch to 3/8 inch maximum size, to the grout mixture will be allowed. The ratio of grout to crushed stone by weight must be maximum 2:1 or as specified in the manufacturer's instructions. After installation, cure the nonshrink grout a minimum of 3 days in accordance with the curing requirements as recommended by the manufacturer.

2.4.4 Epoxy Grout

ASTM D1763, two component, Grade 1. Provide epoxy grout for cored anchor bolt holes in existing concrete grade beams. Aggregates for epoxy grout must conform to ASTM C144.

2.4.5 Portland Cement Concrete

Provide concrete for flangeways, [grade beams] and [encasements]

conforming to Section 03 30 00 CAST-IN-PLACE CONCRETE.

2.5 STANDARD GAGE RAILROAD TRACK

****

NOTE: Use Section 34 11 00 RAILROAD TRACK AND ACCESSORIES and AREMA Eng Man and PTWP for standard gage railroad track intersecting with crane tracks. Provide specification for guardrails as required opposite rigid frogs for use by standard gage wheels. Where guardrail flangeway is for use by crane wheels, provide adequate flangeway width or flare. For a railroad in dual gage with crane track, add references as required for half ties or rail on grade beam foundation.

****

In accordance with Section 34 11 00 RAILROAD TRACK AND ACCESSORIES.

2.6 OIL FOR TRACK FIXTURES

Meet the following requirements:

a. Flash point, minimum: 57 degrees C 135 degrees F.

b. Asphalt, 100 penetration, minimum 45 percent viscosity, saybolt Universal: 54 degrees C 130 degrees F, 240 to 350 seconds

PART 3 EXECUTION

3.1 WORKMANSHIP

Handle fittings, rails, and accessories to avoid kinking or other damage. Maintain tracks in proper grade, alignment, curvature, and gage.

3.2 INSTALLATION OF CRANE TRACK AND FITTINGS

3.2.1 Crane Rails

Install crane rails to the alignment indicated. Install rails atop continuous steel base plates with anchor bolts and rail clips. Do not bend rail in the field, but preform rail to the required radii in a plant prior to installation. [Assemble the entire curved layout with all pieces match-marked.] Completely lay out and mark in the field and have approved by the Contracting Officer before any portion of crane rail alignment is installed. Tolerances are as follows:

a. Horizontal alignment: Place rails within plus or minus 6 mm 1/4 inch of the designed rail centerline alignment indicated.

b. Crane track gage: Provide track gage between railheads within plus or minus 12 mm 1/2 inch of the design gage indicated. Crane rail gage is measured from centerline of rail to centerline of rail.

c. Vertical alignment: Place top of rails within plus or minus 3 mm 1/8 inch of the designed rail elevation indicated.

d. Cross-level elevation: Elevation differences between rails must not exceed 3 mm 1/8 inch.

****

NOTE: Regarding the text below, use Section 34 11 00 RAILROAD TRACK AND ACCESSORIES and AREMA Eng Man and PTWP for standard gage railroad track intersecting with crane tracks. Provide specification for guardrails as required opposite rigid frogs for use by standard gage wheels. Where guardrail flangeway is for use by crane wheels, provide adequate flangeway width or flare. For a railroad in dual gage with crane track, add references as required for half ties or rail on grade beam foundation.

****

e. Where the crane rail also serves as one rail of a standard gage railroad track, gage the railroad rail from the crane rail based on standard gage requirements in accordance with Section 34 11 00 RAILROAD TRACK AND ACCESSORIES.

3.2.2 Welded Crane Rail Joints

****

NOTE: Welded rail joints are preferred for crane rail except at connections between rail and rail fittings such as switches and frogs where bolted joints are recommended. The project drawings must indicate each joint type (bolted and/or welded). Welded connections between carbon steel rail and rail fittings fabricated from carbon steel, if desired, may be accomplished using either of the methods identified in paragraph "Welded Crane Rail Joints." Determine the welding method(s) to be used and show location of each welding method on project drawings. Welded connections between carbon steel rail and cast manganese steel are not recommended. However, if the activity requires a dissimilar metal welded connection such as this, the cast manganese stub rail end section must be prepared for welding in accordance with Sketch 14606-1. Use the manual shielded arc welding method in accordance with paragraph "Manual Shielded-arc Welding Method" and electrodes in accordance with paragraph "Electrodes". Thermite method is not acceptable for welding dissimilar metal.

****

Weld crane rail joints [, except those joints at fittings]. The welding together of rails which have been bored for bolted joints is not permitted. Clean rails of foreign substances prior to welding. [Welded compromise joints must be by the thermite method.] Align and weld rail in accordance with the recommendations and specifications of the manufacturer and supplier of the particular welding process used. Do not weld when the rail temperature is lower than that recommended for the welding method used. Use the following method[s].

3.2.2.1 Thermite Method

In accordance with Section 34 11 19.00 20 WELDING CRANE AND RAILROAD RAIL - THERMITE METHOD.

3.2.2.2 Manual Shielded-Arc Welding Method

AWS D1.1/D1.1M and the following:

****

NOTE: Regarding the text below, when manual shielded-arc welding method is specified, prepare rail ends in accordance with Sketch No. NFGS-41 22 13.33-1. Show sketch information on the project drawings.

****

a. Prepare rail end as indicated and as specified herein. Bevel ends of the rails at approximately 35 degrees full bevel on the head, 35 degrees double bevel on the web, and 35 degrees full bevel on the upper side of the base. Retain a narrow "nose" of approximately 2 mm 1/16 inch of original rail-end face across the base and up the web, following beveling operation, to permit proper alignment of rail ends. When beveling with a torch, first preheat each rail end to 260 degrees C 500 degrees F. After torch cutting, grind off scale and oxides. Grind level faces only after preheating. Use proper grinding wheel and speed to avoid grinding "burns" or formation of "hard spots" from localized overheating.

b. Align the beveled rail ends, allowing approximately 3 mm 1/8-inch root clearance, and place a copper shim under the joint opening. Clamp the rails during the welding with up to 6 mm 1/4 inch vertical camber (ends high) in 1200 mm 4 feet, centered over the joint to compensate for contracting distortion.

c. Preheat the joint area to approximately 260 degrees C 500 degrees F for a distance of 150 to 200 mm 6 to 8 inchesson each side of the joint using a suitable heat source, such as an oxy-acetylene or propane torch.

d. Initiate arc welding of the joint immediately after preheating in the following sequence: base, web, and head. Weld alternately on both sides of base and web. Do not entrap foreign material, such as slag, in the weld. Grind, chip, or arc-air the root of the initial weld to sound metal before welding is started from the second side. Maintain a 260 degrees C 500 degree F to moderately higher interpass temperature. Proceed with welding until the joint is completed and sufficient metal has been deposited to permit grinding to finish contour in the head area. Provide slight reinforcement of the web and top of the base areas.

e. Postheat the joint area to approximately 370 degrees C 700 degrees F immediately after the welding operation, using the same technique for preheating. After postheating, protect the weld area against rain and snow and cool as slowly as possible by covering with an insulating blanket.

f. Grind the excess deposited weld metal from sides and top of rail head using heavy-duty grinder. Heat area of the weld to at least 290 degrees C 550 degrees F before and during grinding. Grind the area smooth, finishing to within plus or minus 0.5 mm 0.020 inch of original contour. Use proper grinding wheel, speed, and rate of metal removal to avoid grinding "burns" or formation of "hard spots" from

localized overheating. Prevent grinding cracks.

g. Measure temperatures specified by temperature pencils.

3.2.2.3 Electrical Flash-Butt Method

Welding process must conform to applicable provisions of Chapter 4 of AREMA Eng Man.

3.2.3 Bolted Rail Joints

****

NOTE: Welded rail joints are preferred for crane rail except at connections between rail and rail fittings such as switches and frogs where bolted joints are recommended. Indicate on project drawings each joint type (bolted and/or welded). Welded connections between carbon steel rail and rail fittings fabricated from carbon steel, if desired, may be accomplished using either of the methods identified in paragraph "Welded Crane Rail Joints." Determine the welding method(s) to be used and show location of each welding method on drawings. Welded connections between carbon steel rail and cast manganese steel are not recommended. However, if the activity requires a dissimilar metal welded connection such as this, prepare the cast manganese stub rail end section for welding in accordance with Sketch 14606-1. Use the manual shielded arc welding method in accordance with paragraph "Manual Shielded-Arc Welding Method" and electrodes in accordance with paragraph "Electrodes". Thermite method is not acceptable for welding dissimilar metal.

****

[Provide bolted joints at rail connectors.] [Provide bolted rail joints to connect crane rail to crane rail fittings.] Bolted joints will be permitted for connection of crane rail fittings to intersecting railroad rail not for use by cranes. Chamfer rail head at joints in accordance with AREMA Eng Man.

3.2.3.1 Joint Bars

Install joint bars with the full number of bolts, nuts and washers. After track has been tested as provided for herein and before flangeway concrete is poured, check and tighten bolts. The openings between railheads must not deviate more than 3 mm 1/8 inch from the opening recommended for a given temperature. Vertical or horizontal mismatch at joints must not exceed 2 mm 1/16 inch. Joints must conform to applicable AREMA Eng Man. Tighten joint bar bolts to a tension no less than the proof load given in ASTM A183. Perform tightening with a properly calibrated wrench[or by turn of the nut method].

3.2.3.2 Compromise Joints

Provide bolted [and welded] compromise joints for connection of adjoining rails or fittings of differing cross sections. Make joints by means of either cast or fabricated compromise bars or welded transition rails.

Provide step chairs, as required, at joints of rails of differing height. Provide compromise joints with proper allowance for rail wear. The offset of compromise joints or of either surface or gage alignment must not exceed 3 mm 1/8 inch. Rails at compromise joints of rails for double-flanged wheels must have the centerlines of the rails in alignment and provide a smooth surface along the top of rails. Grind edges of the wider of the two rail heads smooth over a minimum transition length of 450 mm 18 inches. Heat area to be ground to at least 290 degrees C 550 degrees F before and during grinding. Clad welding is not permitted to achieve transitions for compromise joints. [Align compromise joints of rails for single-flange wheels only along top and gage side of rails.] [Use thermite method to weld compromise joints.]

3.2.4 Anchor Bolts

Provide pairs of anchor bolts for connection of rail clips and crane rails to base plate and supporting grade beam. At crane track fittings, provide separate groups of anchor bolts for connection of fittings to base plate and to supporting grade beam. [Install anchor bolts with epoxy grout specified herein into 50 mm 2 inch diameter holes drilled into existing concrete rail support beams.] [Cast anchor bolts into new concrete grade beams.] Tighten anchor bolt nuts to snug tight using the effort of an ordinary man with a 6'-0" spud wrench. Perform tightening with properly calibrated wrenches [or by turn of nut method]. Make longitudinal spacing as indicated.

3.2.5 Base Plates

****

NOTE: Install base plates in accordance with Sketch No. NFGS-41 22 13.33-2. The sketch is based on 61 kilogram 135 pound crane rail and should be modified as required to reflect actual size of crane rail to be installed. Show sketch information on the project drawings.

****

Install as indicated and as specified herein. Install 25 mm 1 inch thick base plates to support rail, switches, frogs, and throw mechanism housings. Shape base plates, as necessary, under [switches] [and] [frogs]. Furnish plates with anchor bolt holes located and drilled in field or shop fabricated; use as template for setting anchor bolts. Do not enlarge bolt holes in the field. Do not torch, cut holes. Provide finished plate free of bows, bends, and lips, and cleaned of grease and oil. After installation of rail, vertically align base plates to within plus or minus 3 mm 1/8 inch of the profile grade elevation indicated by adjustment of base leveling nut and washer underneath plates. After installation, check to ensure proper grade and alignment of the base plates and install temporary hold-down nuts before grouting with nonshrink grout. After grout has hardened, and with rail clips, crane rail, and fittings in place, tighten anchor bolt nuts to snug tight using the effort of an ordinary man with a 6'-0" spud wrench.

3.2.6 Crane Track Fittings

3.2.6.1 Crane Switches

Install fittings and throw mechanisms atop steel base plates and align vertically by means of leveling nuts as indicated. Connect switch points

to adjacent rails by means of [bolted] [welded] joints. [Secure the nuts of bolted joints in place with a cotter pin through the bolt.] Install throw mechanisms complete in housings as indicated. Mechanisms must operate smoothly and reliably and hold the switchpoints in position securely, against motion of crane wheels.

3.2.6.2 Rigid Frogs

Install crane track rigid frogs atop steel base plates and align vertically be means of leveling nuts as indicated. Connect to adjacent crane rails [and railroad rails] by means of [bolted] [welded] joints.

3.2.6.3 Turntable Frogs

Install frog [and throw mechanism] atop steel base plates and align vertically by means of leveling nuts as indicated. Connect fittings to adjacent rails by means of [bolted] [welded] joints. Install throw arm complete in housings as indicated. Mechanism must operate smoothly and reliably, and hold the turntable in position securely, against motion of crane wheels.

3.2.7 Standard Gage Railroad Tracks

Install in accordance with Section 34 11 00 RAILROAD TRACK AND ACCESSORIES.

3.2.8 Oiling Track Fixtures

Swab [track bolts,] [switch points,] [throw mechanisms,] and [joint bars] with oil specified.

3.2.9 Concrete

Install concrete for flangeways [, grade beams] and [encasements] in accordance with Section 03 30 00 CAST-IN-PLACE CONCRETE.

3.3 CLEANUP

Upon completion of the work, clear job site of equipment, surplus material, and debris. [Dispose of such material [off Government property] [at the site indicated].] [Disposal is as required in Section 01 57 19 TEMPORARY ENVIRONMENTAL CONTROLS.]

3.4 FIELD QUALITY CONTROL

3.4.1 Test for Grout

Verify nonmetallic, nonshrink grout strength during placement of grout at daily intervals by molding and testing standard cubes of samples taken at the job site. Take three test cubes each day for grout placed that day. Mold and cure test specimens in accordance with ASTM C109/C109M. Furnish necessary labor, materials, and facilities for molding the samples and for handling and storing the cubes at the site of the work. Transport cubes to the laboratory not sooner than 24 hours after molding. Test specimens for compressive strength in accordance with ASTM C109/C109M. Grout strength test evaluation is the average of the strengths of specimens tested at 3 days.

3.4.2 Visual Inspection

Inspect rail fittings thoroughly. Inspect for defects that might hinder satisfactory operation. [Inspect bolted joints for loose bolts and smooth transitions between rails of different sections.] Inspect each welded joint thoroughly after removal of the mold and grinding of excess metal. Correct or replace welds containing surface cracking, slag inclusion, gas pockets, and lack of fusion. Method of correction must be approved by the Contracting Officer.

3.4.3 Ultrasonic Inspection of Welded Rail Joints

[The Government will inspect each weld ultrasonically following the visual inspection.] Perform ultrasonic inspection and testing of each weld in accordance with MIL-STD-1699. Correct or replace defective welds. Clean rails at testing locations as directed by Contracting Officer. The method of correction must be approved by Contracting Officer.

3.4.4 Load Test

Load test of trackage will be performed by the Government prior to work on concrete flangeways, encasements, and pavement. The load test is to be performed after completion of track work, but before rails are covered by concrete flangeways and encasements. The load test for crane trackage consists of a portal crane supporting a load designated by the Contracting Officer traversing new track work. The crane must operate without difficulty, without binding of crane wheel flanges, or without visible rail deflection. Vertical movement of the ends of crane [switches] [and] [turntable frogs] must not exceed 3 mm 1/8 inch during the passage of any crane. Correct or replace defective welded rail joints, rail, and fittings. Correct the causes of excess deflections, and retighten anchor bolts loosened under crane wheel loading.

3.4.5 Throw Mechanism Operational Test

Test throw mechanisms for effectiveness, security, integrity, and reliability in accordance with the operational requirements of the mechanical and electrical sections of the specifications.

3.4.6 Retesting

Retest corrected and replaced items.

3.4.7 Record Drawing Survey

****

NOTE: A Record Drawing survey may be required where alignment of crane rails, gage reduction, or orientation of fittings is expected to be critical or problematic. The survey may be performed by Contractor, Government, or independent surveyor.

****

****

NOTE: Include bracketed (last) sentence if Contractor is to perform record drawing survey.

****

At completion of crane track replacement work, and before start of work on

concrete flangeways, encasements, and paving, [perform] a record drawing survey of crane track alignment [will be performed by Contracting Officer. Notify Contracting Officer [_____] calendar days in advance of the availability of the crane trackage for conducting the survey. Execution of the survey will require [_____] days for completion]. Deviation of record drawing horizontal crane rail alignment in excess of tolerances specified herein will constitute grounds for rejection of the work. Surveys, in addition to the initial survey made necessary by nonconforming work, are at Contractor's expense. [Provide two sets of full-size contract drawings marked-up to show record drawing conditions. The requirements for these surveys are in addition to the requirements of Division 1 for quality control.]

-- End of Section --