
USACE / NAVFAC / AFCEA UFGS-05652N (September 1999)

Preparing Activity: NAVFAC Replacing without revision
NFGS of same number and date

UNIFIED FACILITIES GUIDE SPECIFICATIONS

References are in agreement with UMRL dated 22 December 2004

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SECTION 05652

WELDING CRANE AND RAILROAD RAIL - THERMITE METHOD 09/99

NOTE: This guide specification covers the
requirements for welding of crane rail and railroad
rail by a thermite process.

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

1. Location of welds.

PART 1 GENERAL

1.1 REFERENCES

NOTE: Issue (date) of references included in
project specifications need not be more current than
provided by the latest guide specification. Use of
SpecsIntact automated reference checking is
recommended for projects based on older guide
specifications.

The publications listed below form a part of this specification to the

extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN WELDING SOCIETY (AWS)

AWS D1.1/D1.1M (2004) Structural Welding Code - Steel

ASTM INTERNATIONAL (ASTM)

ASTM E 10 (2001e1) Brinell Hardness of Metallic Materials

ASTM E 110 (1982; R 2002) Indentation Hardness of Metallic Materials by Portable Hardness Testers

U.S. DEPARTMENT OF DEFENSE (DOD)

MIL-STD-1699 (Rev B) Nondestructive Evaluation of Butt Welds in Crane and Railroad Rails

1.2 SUBMITTALS

NOTE: Submittals must be limited to those necessary for adequate quality control. The importance of an item in the project should be one of the primary factors in determining if a submittal for the item should be required.

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 projects.

Submittal items not designated with a "G" are considered as being for information only for Army projects and for Contractor Quality Control approval for Navy 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 01330 SUBMITTAL PROCEDURES:

SD-04 Samples

- [Operator qualification welds]
- Procedure qualification welds

SD-06 Test Reports

- Ultrasonic tests
- Hardness tests

SD-07 Certificates

- Rails
- Welder's qualification
- Welding procedure
- [Cold weather welding procedures]
- [Wet weather welding procedures]
- Rail correction method
- Rail preparation

SD-08 Manufacturer's Instructions

- Thermite kit

SD-11 Closeout Submittals

- Welded joint records
- Submit as required by paragraph entitled "Joint Records."

1.3 QUALITY ASSURANCE

NOTE: Thermite welding processes and kits have been developed by the following companies. There may be other processes available. This Guide Specification has been prepared with the processes of these manufacturers in mind. If another manufacturer's product is available in the vicinity of the activity at which the work is to be performed, modify this Guide Specification as necessary.

1. U.S. Orgotherm Inc., Lakehurst, NJ 08733,
Telephone: (201) 657-5781

2. Boutet Proces, Du-Wel Steel Products Co., 360
Scott Street, Elk Grove Village, IL 60007,
Telephone: (312) 439-3630

Use only qualified procedures and personnel. Procedures and personnel previously qualified in accordance with this specification shall not require requalification, provided qualifications have not lapsed and qualification records are available.

1.3.1 Operator Qualification

The Contractor shall notify the Contracting Officer in writing one week prior to making qualification welds. Operators shall qualify by welding one acceptable rail joint in accordance with a qualified procedure. This qualification may be accomplished either prior to production welding or on the first joints to be welded at the work site. If welding operator qualification is conducted at the work site, perform no further welding until the qualification weldments have been accepted by visual inspection and ultrasonic tests. Written approval of the acceptability of the welded joint shall be obtained from the Contracting Officer prior to continuing with welding. Welding operator's qualification shall be effective from the test date and will remain in effect for a period of one year.

1.3.2 Acceptable Welds

Shall be those welds that meet the visual inspection and ultrasonic test requirements of MIL-STD-1699. Welds selected for testing for Brinell Hardness shall meet the requirements of ASTM E 10 and paragraph entitled "Hardness Test."

1.3.3 Procedure Qualification

1.3.3.1 Written Procedure

Prepare for the welding process to be used. The procedure shall include the information specified in paragraph entitled "Submittals," as well as any particulars of the process deemed pertinent to the successful completion of the welds.

1.3.3.2 Manufacturer's Procedure

No separate qualification is necessary for various rail weights, although in order to be qualified for a specific rail weight or cross section, the procedure shall include fit-up requirements and other features unique to the rail weight or cross section of the rails to be welded.

1.3.3.3 Welding Procedure Qualification

- a. Provide welding procedure qualification records acceptable to the Contracting Officer as proof of previous qualification under this specification. The records shall include the information specified in paragraph entitled "Submittals," as well as any particulars of the process deemed pertinent to the successful completion of the welds.
- b. Welding procedure not previously qualified under this specification may be qualified by providing four consecutive acceptable welded rail joints. An acceptable weld is defined as a

weld which has been visually inspected and ultrasonically tested and has been found acceptable in accordance with MIL-STD-1699 and ASTM E 10. This qualification may be accomplished either by shop fabrication of the joints or on the first four joints welded at the work site. If procedure qualification is accomplished at the work site, perform no further welding until the qualification weldments have been accepted by visual inspection and ultrasonic tests. Obtain written approval of the acceptability of the four welded joints from the Contracting Officer prior to continuing with welding.

- c. Ambient temperature: Welding procedure shall be considered qualified for use at an ambient temperature of 10 degrees C 50 degrees F and above regardless of ambient temperature during welding of qualification assemblies. No welding shall be conducted below 10 degrees C 50 degrees F without a specifically qualified procedure. Procedures qualified for use at ambient temperatures less than 10 degrees C 50 degrees F shall be qualified by welding test assemblies in accordance with the procedure qualification requirements of this specification at the desired minimum ambient temperature plus or minus one degree C 5 degrees F. Procedures thus qualified shall be considered acceptable for use at the minimum qualified ambient temperature and above.
- d. Wet weather welding: Perform welding only during dry weather. No welding will normally be permitted on wet, showery and inclement days. However, if means are provided to protect the work and work area, welding may be performed during other than dry weather, if approved by the Contracting Officer. Welding in confined spaces shall comply with AWS D1.1/D1.1M to assure adequate ventilation for personnel safety.

1.3.4 Required Data

Submit thermite kit manufacturer's instructions and recommendations covering rail end preheat treatment, thermite ignition, mold removal, and finishing.

1.3.5 Welding Procedure

- a. Thermite kit manufacturer's name and kit size or designation
- b. Thermite kit batch numbers and manufacturing date
- c. Welding procedure designation (name, number)
- d. Size of rail section being joined and type of rail
- e. Test assembly identification number
- f. Results of nondestructive testing of qualifications assemblies
- g. Date of qualification (test date)

1.3.6 Required Qualification Welds

Submit operator qualification welds in accordance with paragraph entitled "Operator Qualification." Submit procedure qualification welds in

accordance with paragraph entitled "Welding Procedure Qualifications." Include results of ultrasonic test and hardness tests. Welders certification or procedure qualification may be substituted, pursuant to paragraph entitled "Quality Assurance."

1.4 DELIVERY AND STORAGE

Deliver materials in the manufacturer's original unbroken packages or containers plainly labeled with the manufacturer's name and brand.

1.4.1 Receipt Inspection of All Thermite Weld Kits

Shall consist of a visual inspection of the weld kit package for freedom from damage and the recording of the thermite weld mix batch number and manufacturing date. Do not use kits which have been manufactured more than 2 years before the date of use or show signs of having been wet.

1.4.2 Material Control

Store materials in the original package and keep dry at all times until used.

PART 2 PRODUCTS

2.1 MATERIALS

Provide in kit form including preformed mold, thermite powder, wicking cord, luting material, and all necessary materials and accessories needed to provide one welded rail joint per kit. Molds shall be factory-made, moisture free, and of nonhygroscopic material.

PART 3 EXECUTION

3.1 SEQUENCE OF OPERATION

Perform work in strict accordance with the qualified procedure.

3.1.1 Rail Preparation

Cut rails which are battered, cracked or notched, or which contain bolt holes so that these irregularities are removed. Rail surface shall be free of grease, dirt, loose oxide, and moisture on the face of and for approximately 125 mm 5 inches from the joint to be welded. Clean rail ends by grinding or wire brushing. Use a torch to remove grease, oil, or moisture in accordance with procedures in thermite manufacturers instructions. Rail cutting, when necessary, shall be by the saw-cut method. Remove all burrs, rolled-over edges, and loose oxide before applying the mold. No flame cutting of rails is permitted. If the space between the mold and the rail is unusually large on used or relayer rails, fill this gap with a piece of wicking cord before luting or packing.

3.1.2 Rail Alignment

Separate rail ends as recommended by the welding process manufacturer. Align rails as to both surface and gage, and raise the rails at the joint to compensate for the greater thermal contraction that occurs in the rail head during cooling relative to the web and base regions. Measure the amount of joint elevation with a 900 mm 36 inch long straightedge centered at the joint. The correct elevation is obtained when 2 mm 1/16 inch

separates the top of the rail head and bottom surface of the straightedge at both ends.

3.1.3 Placing of Molds

Attach the molds to the rails, centered over the joint, and seal the molds to the rail with luting material according the welding kit manufacturer's instructions. Handle the luting material, a mixture of clay and sand, so that none is introduced into the weld chamber. Align so that the centerline of the mold coincides with the centerline of the gap. Install the tapping plug or discs in the crucible and pour in the prescribed amount of thermite mixture.

3.1.4 Preheating Rail Ends

In accordance with the manufacturer's instructions and recommendations.

3.1.5 Ignition of Thermite

Follow manufacturer's instructions and recommendations.

3.1.6 Mold Removal

Follow manufacturer's instructions.

3.1.7 Finishing

Follow manufacturer's instructions and recommendations. No finishing is required on the web and base of rail. Perform final grinding when the weld and rail have cooled to ambient temperature. Under no circumstances shall a cutting torch be used to remove excess weld metal.

3.1.8 Joint Records

Provide a record of the date and location of each weld made. The record shall also include the rail type, size, thermite kit manufacturer's name, and thermite weld portion batch number. Also, provide a record of the nondestructive test date and acceptance date.

3.2 INSPECTION AND TESTING

3.2.1 Visual Inspection

Each welded joint by shall be inspected by the Contractor after removal of the mold and grinding or removal of excess metal. The inspector shall pay particular attention to surface cracking, lack of fusion and other surface irregularities. The Contractor shall correct or replace all defective welds at no additional cost to the Government. The method of correction shall be approved by the Contracting Officer.

3.2.2 Nondestructive Inspection

Inspect each welded joint by ultrasonic tests using the method of inspection and acceptance as prescribed in MIL-STD-1699. The Contractor shall correct or replace all defective welds at no additional cost to the Government. The method of correction shall be approved by the Contracting Officer. All repairs to defective welds shall be ultrasonically inspected by the Contractor using the method of inspection and acceptance as prescribed in MIL-STD-1699.

3.2.3 Hardness Tests

Perform Brinell hardness test in accordance with ASTM E 10 and ASTM E 110. The Brinell Hardness Number (BHN) of the weld and for the rail for a distance of 150 mm 6 inches on each side of the joint shall be greater than 250. In the heat-affected zone (a distance not greater than 25 mm one inch to each side of the joint) the BHN may be up to 20 points lower except for the top of the rail, which shall be not less than 250. Check hardness on at least 10 percent of all welds. Tests shall be performed on randomly selected welds or as directed by the Contracting Officer.

-- End of Section --