

SECTION 20720

THERMITE RAIL WELDING

PART 1 - GENERAL

1.01 DESCRIPTION

- A. Section includes specifications for welding rails together by the Thermite process at the project site for the purpose of joining rail strings and for other in-track welds.
- B. Refer to Section 20400, Track Construction; Section 20150, Rail, and Section 20710, Flash Butt Rail Welding, for additional requirements for thermite welds.

1.02 REFERENCE STANDARDS

- A. American Railway Engineering and Maintenance of Way Association (AREMA):
 - 1. Manual for Railway Engineering (Manual), Volume 1, Chapter 4, Rail
- B. American Society for Testing and Materials (ASTM International):
 - 1. E164 Standard Practice for Ultrasonic Contact Examination of Weldments
 - 2. E709 Standard Guide for Magnetic Particle Examination
- C. Federal Railroad Administration (FRA):
 - 1. CFR 49 Part 213 - Track Safety Standards

1.03 SUBMITTALS

- A. Submit detailed procedure specification of the step-by-step methods to be employed in making the welds for Engineer's approval. Include complete description of each of the following items, as applicable:
 - 1. Manufacturer's trade name for the welding process.
 - 2. Method used for cutting and cleaning the rail ends. Refer to Section 20400, Track Construction, for allowable means of cutting rail.
 - 3. Minimum and maximum allowable gap between rail ends prior to welding.
 - 4. Methods used for cleaning multiple-use crucibles and removing moisture, and the procedures for tracking the number of welds made. If single-use crucibles are used, the above mentioned procedure will not be required.
 - 5. Method used for preheating, including time and temperature.

6. Method used for removing the upset metal and finishing the weld to the final contour, including a description of special tools and equipment.
 7. Quality control procedures to be followed.
- B. Submit welder qualifications and certification from weld-kit manufacturer for Engineer's approval.

1.04 DELIVERABLES

- A. Prepare welding testing record in a form acceptable to the Engineer. Submit signed original form to the Engineer within 14 days of completion of the weld testing.
- B. Submit a weld record for each weld indicating weld number, location, rail temperature, date and time of weld, and name of welder within 72 hours of completing the weld.

1.05 QUALITY ASSURANCE

- A. Perform welding under the direct supervision of an experienced welding supervisor or foreman. Welding supervisors and foremen shall be familiar with FRA parts 213.119, 213.305, 213.341 and 213.343.
- B. Welders shall be certified by weld kit manufacturer
- C. Verify that weld kits have not expired.
- D. Test weld prior to allowing revenue train traffic over.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Handle weld kits with care from receipt to installation to ensure high quality welds.
- B. Identify weld kits by brand name in the original Manufacturer's container. Store weld kits in a moisture-proof container.
- C. Use weld kits prior to the expiration date. Remove expired weld kits from Owner's property.

PART 2 - PRODUCTS

2.01 RAIL WELDING KITS

- A. The following rail welding kits are approved.
1. Calorite, limited or standard preheat, by Calorite Inc.
 2. Boutet, distributed by Esco.

3. Orgo-Thermit, by Orgo-Thermit, Inc.

PART 3 - EXECUTION

3.01 GENERAL

- A. Perform welding in accordance with the requirements of the AREMA Manual, Chapter 4, Section 3.13, Specification for the Quality Assurance of Thermitic Welding of Rail and Section 3.11, Specifications for Fabrication of Continuous Welded Rail, except as modified or amended by this Section.
- B. Weld second hand rail according to the requirements of the AREMA Manual, Chapter 4, Section 3.12, Inspection and Classification of Secondhand Rail for Welding, for Class 1 Rail.
- C. Position weld in the crib between two ties. Do not place weld on a tie. Field welds are not permitted in road crossings.
- D. Weld compromise joints using in track thermitic welds for compromise joints.
- E. Do not weld in rain, or other inclement weather without adequate protection from the elements.

3.02 END PREPARATION

- A. Clean the rails to be welded of grease, oil, dirt, loose scale, and moisture to a minimum of 6 inches back from the rail ends, including the railhead surface. Use a wire brush to completely remove dirt and loose oxide, and use oxygen-acetylene torch to remove grease, oil and moisture.
- B. Align the rail ends using a rail beam specifically designed for this purpose or a 36-inch straight edge.
- C. Use a power grinder with an abrasive wheel to remove scale, rust, burrs, lipped metal and mill brands which would interfere with the fit of the mold for two (2) inches on each side of the ends. Rail ends shall show no steel defects, dents, or porosity before welding.
- D. Cut rail square using approved rail saws.
- E. Field welds shall be no closer than 8 inches from any existing bolt hole.

3.03 GAP

- A. The minimum and maximum spacing between rail ends shall be as specified by the rail welding kit manufacturer and the approved procedure specification. Wide gap welds will not be permitted unless approved by the Engineer.

3.04 ALIGNMENT

- A. Properly gap and align the ends of the rails to be welded to produce a weld which shall conform to the alignment tolerances below. Hold the rail gap and alignment without change during the complete welding cycle.
 - 1. Alignment of rail shall be done on the head, web, and base of the rail.
 - 2. Vertical alignment shall provide for a flat running surface. Any difference of height of the rails shall be in the base.
 - 3. Horizontal alignment shall be done in such a manner that any difference in the width of heads of rails shall occur on the field side.
 - 4. Maximum horizontal offsets: 1/25 inches in the head and/or 1/8 inches in the base.
 - 5. Surface Misalignment Tolerances:
 - a. Maximum combined vertical offset and crown camber: 1/25 inches per foot at 600 degrees F.
 - b. Maximum combined vertical offset and dip camber: 1/10 inches per foot at 600 degrees F.
 - 6. Gage Misalignment Tolerance: Maximum combined horizontal offset and horizontal kink camber is 1/25 inches per foot at 600 degrees F.

3.05 THERMITE WELD PREHEATING

- A. Preheat the rail ends prior to welding to the temperature and for the time specified in the approved welding procedure specification to ensure full fusion of the weld metal to the rail ends without cracking of the rail or weld. Engineer will reject welds that were made without the rail first properly preheated in accordance with the manufacturer's recommendations.

3.06 THERMITE WELD COOLING

- A. Leave the molds in place, after tapping for a sufficient time to permit complete solidification of the molten metal, in order to allow proper slow cooling in order to prevent cracking and to provide a complete weld with proper hardness and ductility.

3.07 WELD FINISHING AND TOLERANCES

- A. Bring welded joints in the finished track to a true surface and align by means of an approved grinding or planning machine (shear). Use a hand grinder for the final smoothing and for areas not accessible to a track grinder. Perform finish grinding with an approved grinder operated by a skilled workman. Take care to grind evenly and leave the joints in a satisfactory condition. Finishing shall eliminate all cracks. Complete the completed weld by mechanically controlled grinding in conformance with the following requirements:

1. Tolerances: A finishing deviation of not more than plus or minus 1/100 inches of parent section of the rail will be allowed.
2. Welds produced by welding kits which are specially designed to produce reinforced welds need not be ground in the fishing area except as necessary to remove fins, burrs, cracks, etc.

3.08 WELD QUALITY

- A. Each completed weld shall have full penetration and complete fusion and be entirely free of cracks or fissures.

3.09 WELD NUMBERING

- A. Semi-permanently mark a sequential weld number, rail temperature, and date on the rail immediately adjacent to the weld using a quality paint marker at the time the weld is made.
- B. Number the welds sequentially in the order in which they are made.
- C. Obtain the initial weld number from the Engineer.
- D. When defective welds are replaced, assign a new sequential number by adding a letter to the defective weld number (e.g. defective weld 109 would be replaced by 109A).

3.10 FIELD QUALITY CONTROL AND TESTING

- A. Visually inspect all welds at the time of welding and during the grinding operation.
- B. Prior to completion of welding operation, visually inspect all welds to verify the base riser break off area has been smoothed.
- C. Visually inspect and check welds in accordance with approved procedures to ensure there are no surface defects such as cracks and to verify that the welds conform to the alignment and finishing tolerances specified in this Section.
- D. Each completed field weld shall be marked with the date, name of welder, air temperature, and rail temperature or with date, name, and "free weld" for welds not used to control CWR thermal adjustment.
- E. Verify that each completed weld has full penetration and complete fusion and is entirely free of cracks or fissures.
- F. Perform the following tests on all welds. All testing shall be performed by a qualified Independent Testing Agency (ITA) hired by the Contractor. Refer to Section 01400, Quality Control and Assurance. The testing agency shall provide test results directly to the Engineer.
 1. Ultrasonic testing shall be performed after the weld has been ground and finished to specified tolerances. Ultrasonic testing shall be

performed in accordance with ASTM E164. Equipment used shall be capable of detecting a 3/64-inch discontinuity, 6-1/2 inches below the top of rail.

- G. The weld quality, finishing and alignment requirements specified in this Section shall also apply as requirements of acceptance.
- H. Perform testing of welds in active tracks within 96 hours after placing the track back in service. Perform testing of welds in other tracks prior to placing the track in service. Replace unacceptable welds in accordance the requirements of this Section.
- I. The Engineer may randomly select any welds to be retested at any time within the period of the Contract. Such testing shall be performed by Contractor-hired ITA.

3.11 REPLACEMENT OF DEFECTIVE WELDS

- A. Welds made outside of the track which the Engineer determines to be unacceptable prior to rail installation shall be cut out, rails pulled together to the indicated rail gap, and re-welded.
- B. Cut unacceptable welds and replace with a section of rail and 2 new welds. The minimum length of the new rail used shall be 15 feet.
- C. Saw cuts shall be made at least 6 inches from the centerline of the faulty weld. In-track welds shall be made in accordance with the requirements specified in this Section.
- D. Ultrasonically test the replacement welds as specified in this Section.
- E. Install joint bars on defective welds in active track immediately upon completion of testing, and under no circumstances later than 8 hours after testing in accordance with Section 20120, Track Appurtenances and Other Track Material, and comply with FRA Standards Part 213.

3.12 CLEAN UP

- A. Inspect areas where welding operation performed. Collect and dispose any remaining scrap sections of cropped rail daily after completion of welding operation.

ATTACHMENT FOLLOWS

**ATTACHMENT 20720
RECORD OF FIELD WELD**

INSTALLATION _____ WELDER'S NAME _____ WELD NUMBER _____
 RAILROAD _____
 FINAL INSTALLED LOCATION _____ TRACK _____ RAIL WEIGHT _____ STATIONING _____ RAIL L. R. (Circle)
 _____ FACING UPSTATION _____
 DATE _____ TIME _____ AM PM (Circle) COMPLETE WELD (YES/NO) circle one

AIR TEMPERATURE _____ °F. WEATHER _____
 RAIL TEMPERATURE _____ °F. PRE-HEAT TIME _____
 WELD KIT MANUFACTURER _____ WELD INGOT # _____
 RAIL GAP (NEAREST 1/16 INCH) _____ RAIL CUT REQUIRED? YES NO (Circle)

BACK RAIL
 MANUFACTURER _____ RELAY RAIL? YES NO (Circle)
 YEAR/MONTH ROLLED _____ HEAT NUMBER _____

AHEAD RAIL
 MANUFACTURER _____ RELAY RAIL? YES NO (Circle)
 YEAR/MONTH ROLLED _____ HEAT NUMBER _____

REMARKS _____

ULTRASONIC TEST DATE AND RESULTS _____
 KIT MFG. REPRESENTATIVE PRESENT _____ WELDING FOREMAN _____
 (Initial) (Signed)

PCJPB'S
 REPRESENTATIVE PRESENT _____ RECORDER _____
 (Initial) (Signed)

END OF ATTACHMENT

END OF SECTION

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