SECTION 34 11 25

RUNNING RAIL

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Running Rail.

B. Pressure Flash Butt Rail Welding.

C. Thermite Rail Welding.

D. Insulated Rail Joints.

1.02 RELATED SECTIONS

A. Refer to Section 34 05 17 - Common Work Results for Trackway, for related requirements.

1.03 MEASUREMENT AND PAYMENT

A. General: Rail, rail welds, and insulated rail joints will not be measured separately for payment. All costs in connection therewith will be considered as included in the applicable Contract lump sum price or the Contract unit price per linear foot for trackwork of the different types indicated as listed in the bid item in the Bid Schedule of the Bid Form.

1.04 REFERENCES

A. American Railway Engineering and Maintenance of Way Association (AREMA):

AREMA Manual.

B. American Society for Nondestructive Testing (ASNT):

ASNT-TC-1A	Recommended Practice

C. American Society for Testing and Materials (ASTM):

1. ASTM E10	Standard Test Method for Brinell Hardness of Metallic Materials.
2. ASTM E18	Standard Test Methods for Rockwell Hardness and Rockwell Superficial Hardness of Metallic Materials.
3. ASTM E164	Standard Practice for Ultrasonic Contact Examination of Weldments.
4. ASTM E709	Standard Guide for Magnetic Particle Examination.

1.05 SUBMITTALS

A. Refer to Section 01 33 00 - Submittal Procedures, and Section 01 33 23 - Shop Drawings, Product Data, and Samples, for submittal requirements and procedures.

B. Refer to Section 34 05 17 - Common Work Results for Trackway, for additional submittal requirements.

C. Provide additional submittals as required herein.

1.06 RUNNING RAIL

A. Only 119RE rail, as shown in the AREMA Manual, shall be used.

B. Product Data, and Test Program Plan. Submit the following for review and approval by the Engineer, prior to rail production in accordance with the approved schedule.

1. Steel manufacture process description for making and casting or teaming the steel.

2. Hydrogen elimination process description for hydrogen elimination.

3. Heat treatment process description for heat treatment of the heat-treated rail, if to be supplied, including the brinell hardness that will be attained also, proof of the heat-treated rail's ability to consistently meet AREMA rail welding requirements.

4. Alloy rail chemical composition of the alloy rail, if to be supplied, including the brinell hardness that will be attained. Also, proof of the alloy rail's ability to consistently meet AREMA rail welding requirements.

5. Production records and production test results. Submit the following for review and approval by the engineer at the time of each shipment.

6. Rail test and inspection results for each test and inspection specified by AREMA and herein.

7. Mill certificate containing at least the following data.

   a. Rail section and type.

   b. Heat number.

   c. Number of pieces in each heat.

   d. Chemical analysis.

   e. List of all Brinell hardness readings.

   f. Macroetch test results.

   g. Ultrasonic test results.

   h. Submit a storage procedure covering, as a minimum, the following subjects for storage of running rail at manufacturer's facility:

1) Permanent color marking with different color per type of rail and delivery location.

2) Plan layout of storage area, the number of layers of rails, and segregation of rails by type of rail.

3) Foundation details, materials, and spacing. Confirm adequacy of ground to support the rail stacks.

4) Handling methods in and out of storage, including crane and details of lifting rig.

5) Environmental conditions.

6) Security of stored materials.

7) Inventory control procedures.

1.07 RAIL QUALITY ASSURANCE AND CONTROL

A. Except for modifications, amplifications, deletions, and additions indicated herein, provide running rail in accordance with the requirements of AREMA.

1. Where AREMA states “purchaser” this shall be taken to mean the District.

2. Rail used for the manufacture of special trackwork shall meet the tolerance requirements of the special trackwork manufacturers(s).

B. The Contractor shall establish, implement, and maintain a detailed Quality Plan in conformance with applicable requirements of Section 01 43 00 - Quality Assurance, and Section 01 45 00 - Quality Control.

C. Qualification of Testing Personnel

1. Personnel performing tests and inspections shall be qualified for such work by virtue of prior experience or training.

2. Personnel performing nondestructive testing shall be qualified and certified in accordance with SNT-TC-1A. Only persons certified for NDT Level I and working under a NDT Level II person or persons certified for NDT Level II shall perform nondestructive testing.

D. Testing Equipment. Testing equipment shall be in good operating condition, of adequate capacity and range, and accurately calibrated. Testing equipment calibration shall be certified and traceable to recognized national standards such as the National Institute of Standards and Technology.

E. Test Program Plan

1. A test program plan shall be prepared identifying the approach for accomplishing each of the specified rail inspections and tests. A detailed narrative shall be prepared for each test and inspection specified herein, describing the test set-up; equipment, and instrumentation that will be used; procedure to be implemented; and the anticipated,

as well as, acceptable test results. Drawings showing the relationship of the rail and all significant components of the test equipment shall be included, as necessary, to describe the test set-up and procedure. Pertinent testing drawings included in standard specifications may be referenced in lieu of actual drawings. The test program plan shall include the test sequencing.

2. Equipment specifications, and calibration methods for all testing equipment used to perform rail testing and inspection shall be included in the test program plan. The plan shall indicate the calibration certificates that will be submitted with the test reports.

3. Identity, and qualifications of personnel who will perform rail testing and inspection shall be included in the test program plan. Also include certification records for personnel who will perform nondestructive testing.

4. The test plan shall include a description of the testing facilities and a layout of the test equipment that will permit the efficient performance of the testing.

5. The plan shall include the proposed format for reporting test data.

6. The projected schedule for test procedure submittals, test executions, and test results reports submittals shall be included in the test program plan.

7. After approval of the test program plan, any proposed changes shall be approved by the Engineer prior to implementing the change.

F. Test Report

1. A report of test results of each test shall be submitted which includes rail section, rail type, heat number, test name, identity of test sample, test procedure references, specified requirements, actual test results, nonconformances if any, and interpretation of the results. The format for the test report shall be arranged so that the data is presented in an orderly manner.

2. The rail mill's standard, computer-generated, test reports may be used upon approval by the Engineer. Such reports shall be supplemented, as required, to provide all information, and test and inspection results specified herein.

3. Copies of calibration certificates shall be submitted with the initial test reports. If test equipment is recalibrated while work is being performed on the Contract, calibration certificates shall be submitted for the recalibrated test equipment with the test reports of the first tests performed after recalibration. In lieu of submitting calibration certificates, the manufacturer may maintain the certificates at its facilities available to the Engineer at all times during the performance of the Contract and for a three-year retention period thereafter.

G. The Engineer shall be notified in writing not less than 7 days in advance of dates scheduled for any tests or inspections. The Engineer retains the right to witness the tests.

1.08 PRESSURE FLASH BUTT RAIL WELDING

A. Quality Assurance:

1. When aligning rails in the welding machine, the Contractor, with the prior approval of the Engineer, may pre-determine the gage side and allow differences in width of head to occur on the field side, in accordance with AREMA. The pre-determined gage side shall be marked with red paint 12 inches from each end of the CWR string.

2. The finishing deviation of the rail head running surface and gage face shall be revised to not more than plus 0.020 inch to minus 0.0 inch of the parent section.

3. Each completed weld shall have complete fusion for the entire cross section, and shall be entirely free of cracks.

4. The rail head surface hardness of the weld and heat affected zone shall be as required by AREMA.

B. Qualification of Welding Procedure

1. Prepare a detailed pressure flash butt rail welding procedure specification for the Engineer's approval, describing the step-by-step machine operations and procedures to be employed in making the welds for all rail types and metallurgies to be welded. A complete description of at least the following items and any other essential characteristics shall be included:

   a. Manufacturer and model of the welding machine.

   b. Power source and capacity.

   c. Plan of the welding layout, showing rail feed handling facilities, the welding line and all stations, and the equipment to move the completed strings to the stockpile.

   d. The CWR stockpile detail and configuration, including support to avoid bending the rail or overloading the soil.

   e. Rail cutting equipment and rail end surface preparation.

   f. Platen motion for flashing and upset, voltage and current, and how these relate to welding time.

   g. Forces applied to clamp the rail ends and to upset the rails.

   h. Post weld heating or quenching procedures to meet the hardness requirements for the type of rail.

   i. Weld trimming, grinding, and finishing.

   j. Procedure for defective weld cut-out and rewelding.

   k. Recording equipment, calibration, operation, and final report format.

l. Names and qualifications of key operating personnel.

2. The Contractor shall qualify the procedure specification at each pressure flash butt rail welding location and for each machine operator in accordance with the following requirements prior to production welding:

a. Make three sample welds of each weld type to be used in the work (standard to standard, special to special, and standard to special). Use weld machine operating variables proposed for production welding; and confirm the values on brush recorder charts or equivalent and qualification records.

b. Qualification Program

1) Inspect all welds in accordance with the requirements of herein.

2) Perform non-destructive ultrasonic testing and magnetic particle testing on each weld in accordance with the requirements herein. Testing shall be performed immediately after the completion of the weld at the location the weld was made.

3) Perform the surface hardness testing on each weld in accordance with the requirements herein.

4) Perform internal metallurgical evaluation on one accepted weld of each type in accordance with the requirements of herein.

5) Prepare a qualification report with the inspection and testing data, and evaluation of the data, and a final definition of the welding machine variables, including the quenching/ tempering procedures.

C. Re-qualification

1. Re-qualification is required for fixed welding plants, if the welding machine is moved, if any of the operating variables of the procedure specification are changed

2. Re-qualification is required for fixed and portable welding plants if two consecutive welds or re-welds are rejected. For portable in track welding, re-qualification is required if:

D. Weld Inspection and Testing

1. All weld qualification and production inspection and testing shall be performed by a qualified independent testing service employed by and at the expense of the Contractor. The testing service and their testing program and procedures will be subject to approval of the Engineer.

2. Submit copy of the Contractor's agreement with the testing service to the Engineer for approval. The agreement shall specify that the testing service is directly responsible to the Engineer; that all subsequent communication between the Testing Services and the Contractor regarding the work under this Contract shall be through the Engineer; and that the agreement shall run for the duration of the Contract and can be terminated only by the Engineer.

3. The testing service shall certify whether or not each weld meets the quality criteria immediately following its inspection, and shall promptly indicate acceptance or rejection marking the tested weld. Written reports shall be submitted to the Engineer within five working days of testing a weld. The Engineer will forward copies to the Contractor.

4. Personnel performing non-destructive examination (NDE) under this specification shall be certified as Level II in accordance with ASNT-TC-1A for the NDE methods they are to perform.

5. The testing service shall prepare written procedures for all inspections and testing for approval by the Engineer prior to the start of Work. Include a description of the proposed procedure, materials, equipment, safety requirements, and report format.

E. Pressure flash butt rail welding Weld Testing

1. The weld shall be visually inspected in accordance with approved procedures to check for surface defects such as cracks and to determine conformance with the alignment and finishing tolerances specified herein.

2. Acceptance Criteria

a. Weld quality shall be in accordance with the requirements herein.

b. Alignment and finishing shall be in accordance with the requirements of AREMA, as modified herein.

3. Ultrasonic Testing (UT)

a. Ultrasonic (external pulsating) testing of all welds shall be performed in accordance with ASTM E164.

b. Calibration

1) A section of rail shall be used as the calibration standard.

2) Side drilled holes of 1/16 inch diameter shall be used as calibration reflectors for angle beam testing the head of the rail weld. These holes shall be place at 1/4T, 1/2T, and 3/4T and shall be used to construct a Distance Amplitude Curve (DAC). (T is the thickness of the head along the centerline from the top of the head through the head and web fillet.)

3) Notches shall be used as calibration reflectors for angle beam testing of the web and the base. The notches may be buttress (square) or U type. A notch shall be placed on both sides of the web section of the weld and shall be used to construct a DAC. The notch depth shall be 10 percent of the thickness of the web; plus 10 percent minus 20 percent of required notch depth. Notches shall be at least 1 inch in length and 1/8 to 1/4 inch in width.

c. Testing Procedures

1) The transducer and wedge combination shall produce an angle of 70 degrees plus or minus 2 degrees in the test material for the web and base and 45 degrees plus or minus 2 degrees in the head of the rail. The transducer crystal shall be at least 1/2 inch square. Other angles may be used to further evaluate indications. Transducer frequency shall be 2.25 through 5 MHZ.

2) Scanning shall be at 6db above the primary reference level. The rail weld shall be scanned from the top of the head, side of the head, the web, and the top of the base. Scanning shall be accomplished from both sides of the same face of the weld. The scanning pattern shall allow sound to be passed through the entire volume of the weld. When testing rail configurations other than Tee Rail, scanning patterns shall be developed, in each case, to allow the entire cross section of the weld to be tested.

3) The primary reference level to be used when testing the head section of the rail is the gain setting used to construct the DAC from the side-drilled holes. The gain setting used to construct a three point DAC from the notches shall be the primary reference level when testing the web and base sections of the rail weld.

d. Welds showing a response at any level that is identified as a crack or lack of fusion will not be acceptable.

e. Each weld examined shall be recorded on a report form that includes, as a minimum, the following information.

1) Weld number.

2) Technique sketch.

3) Type of equipment, size of transducer, frequency and angle.

4) Calibration data.

5) Equipment identification information (serial numbers).

6) Defect description - depth, location, size, character.

7) Accepted or rejected.

8) Name of operator and certification level.

9) Date of inspection.

4. Magnetic Particle Testing (MT)

a. The Magnetic particle testing of all welds shall be longitudinal magnetization by the dry powder method in accordance with ASTM E709.

The magnetizing equipment shall be either an encircling coil or electro-magnetic yoke meeting the following requirements:

1) DC lift capacity of 40 lbs. and/or:

2) AC lift capacity of 10 lbs. at the maximum pole spacing.

b. Test all weld surfaces including the underside of the rail base.

c. Linear indications are unacceptable.

5. Metallurgical Evaluation

a. Cut each weld sample three inches on each side of the weld and then vertically section each specimen at the longitudinal center line of the rail. Perform the following tests:

1) Macroetch and photograph to show fusion line and heat affected zone.

2) Rockwell "C" hardness shall be measured in accordance with ASTM E18 on the vertical section in the head, web, and base at 1/8 inch intervals through the heat affected zone.

b. Acceptance Criteria

1) The heat affected zone shall be symmetrical about the centerline of the weld.

2) The hardness values converted to Brinell shall conform to requirements herein, and shall be symmetrical about the centerline of the weld.

6. Surface Hardness

a. Test Brinell hardness in accordance with the requirements of ASTM E10.

b. Measure Brinell hardness on the rail head along the top centerline and on the gage surface at the centerline of weld and at 1/2 inch increments each way across the heat affected zones to base metal.

c. Conform with requirements herein.

1.09 THERMITE RAIL WELDING

A. Each thermite rail weld requires a Change Order, approved by the District, in advance of installation, except as specifically provided in the Contract Documents.

1. Poor planning, scheduling, improper rail layouts, field changes or weld failures are unacceptable reasons for exceptions.

2. If a defective thermite rail weld is found, then it shall be replaced using a single thermite rail weld or electric-flash butt welding.

3. If the installation of a short rail is required to replace a defective thermite rail weld, then at least one end of that rail shall be welded using the electric-flash butt welding process. In addition, the replacement weld(s) shall comply with the weld location restrictions provided in this Section.

B. When the Contractor determines thermite rail weld locations, the specific restrictions to thermite rail weld use provided in the Design Criteria shall be observed along with the additional weld location restrictions provided in this Section.

C. Weld Alignment and surface misalignment shall be in accordance with the quality requirements herein for pressure flash butt rail welds.

D. Field weld quality shall meet all of the requirements of AREMA, as modified herein.

E. Finishing Tolerances: Top, side of rail head, web and base, plus 0.010 inch to minus 0 inch of the parent rail section.

F. The rail head hardness of the weld and heat affected zone shall be in accordance with AREMA requirements.

G. Prepare and submit a detailed procedure specification for the Engineer's approval, covering step-by-step procedures to be employed in making field thermite welds for all rail types and metallurgies to be welded. A complete description of at least the following items and any other essential characteristics shall be included.

1. Manufacturer's trade name for welding process.

2. Method used for cutting and cleaning of rail ends.

3. Minimum and maximum gap between rail ends.

4. Method and equipment to be used for maintaining rail gap and alignment during welding.

5. Method and equipment to be used for placing, aligning, and holding the molds during welding.

6. Method used for preheating, including minimum time and minimum temperature.

7. Tapping procedure, including minimum time required to cool weld under the mold insulation.

8. Method used for removing gates and risers and finishing weld suitable for radiographic inspection, including a description of special tools and equipment.

9. Marking standards for kit and materials for the rail size, and types of rail and types of field welds.

H. Qualification of Procedure Specification

1. Qualify the above specification procedure by preparing and testing two qualification test welds for each of the three combinations of rail weld types (standard to standard, special to special, and standard to special) prior to beginning production

welding. If different field weld gap type or compromise kits are to be used, then each type must be separately qualified under this procedure. The qualification test welds shall be performed in conformance with the procedure specification above, on short lengths of 119 RE rail out of track, and in the presence of the Engineer. One weld shall be made with minimum gap and one with maximum gap.

2. The qualification test welds shall be inspected and tested in accordance with the following requirements.

   a. Visual Weld Inspection.

   b. Magnetic Particle Testing.

   c. Ultrasonic Weld Testing.

   d. Metallurgical Evaluation.

   e. Surface Hardness.

   f. Weld alignment.

   g. Finish tolerances.

3. The testing service shall prepare and submit a report of all inspections and tests with evaluation and acceptance or rejection for approval of the Engineer.

4. The procedure specification will be considered qualified if all tests and inspections meet or exceed the acceptance requirements. If any test or inspection is failed, the Contractor shall submit and qualify a revised procedure specification in accordance with the requirements herein.

5. Production field welding shall not begin until a procedure specification is qualified in accordance with the requirements specified herein.

6. Re-qualification is required if any of the items herein are changed or if more than two consecutive welds or re-welds are rejected.

I. Qualification of Welding Crew

1. Prior to production welding, each crew, including the foreman or supervisor of that crew, shall prepare a qualification weld in each weld type and rail size at the expense of the Contractor. The weld shall be prepared in accordance with the approved procedure specification and will be witnessed by the Engineer.

2. Qualification weld shall be inspected and tested in accordance with the following requirements.

   a. Visual Weld Inspection.

   b. Magnetic Particle Testing.

   c. Ultrasonic Weld Testing.

d. Metallurgical Evaluation.

e. Surface Hardness.

f. Weld alignment.

g. Finish tolerances.

3. The test record shall contain names of the crew members, including the foreman or supervisor of that crew, who performed the qualification weld, briefly describing their duties. The test records shall also show results of inspection and testing. Performance qualification records shall be submitted to the Engineer at least 14 calendar days before starting production welding. Production welding shall not start until qualification test welding records have received the Engineer written approval.

4. Re-qualification is required if any of the items herein are changed or if more than two consecutive welds or re-welds are rejected.

J. Weld Inspection And Testing

1. All field weld qualification and production inspection and testing shall be carried out by a qualified independent testing service at the expense of the Contractor. The testing service and their testing program and procedures shall be subject to approval of the Engineer.

2. The Contractor shall submit a copy of its agreement with the testing service to the Engineer for approval. The agreement shall specify that the testing service is directly responsible to the Engineer, that all subsequent communication between the testing service and the Contractor, regarding the work under this Contract, shall be through the Engineer, and that the agreement shall run for the duration of the Contract and can be terminated only by the Engineer.

3. The testing service shall certify whether or not each weld meets the quality criteria immediately following its inspection, and shall indicate promptly acceptance or rejection marking the tested weld. Written reports shall be submitted to the Engineer within five working days of testing a weld. The Engineer will forward copies to the Contractor.

4. Personnel performing non-destructive examination (NDE) under this specification shall be certified as Level II in accordance with ASNT-TC-1A for the NDE methods they are to perform.

5. The testing service shall prepare written procedures for all inspections and testing for approval by the Engineer prior to the start of Work. Include a description of the proposed procedure, materials, equipment, safety requirements, and report format.

K. The weld shall be visually inspected in accordance with approved procedures to check for surface defects such as cracks and to determine conformance with the alignment and finishing tolerances herein.

L. Acceptance Criteria

1. Weld Quality shall be in accordance with the requirements herein.

2. Alignment shall be in accordance with the requirements herein.

3. Finishing shall be in accordance with the requirements herein.

M. Magnetic Particle Testing (MT)

1. Magnetic particle testing shall be by the dry powder method in accordance with ASTM designation E709. The magnetizing equipment shall be an electro-magnetic yoke meeting the following requirements.

   a. DC lift capacity of 40 lbs.; and

   b. AC lift capacity of 10 lbs. at the maximum pole spacing.

2. Test all weld surfaces except the underside of the rail base. Magnetization shall be in two directions on each inspected surface.

3. Acceptance Criteria

   a. Only indications greater than 1/16 inch are relevant.

   b. Linear indications that have a length more than three times the width.

   c. Relevant linear indications are unacceptable.

N. Ultrasonic Testing (UT)

1. Ultrasonic (external pulsating) testing of field welds shall be performed in accordance with ASTM E164.

2. Calibration

   a. A section of welded rail at least 12 inches in length with the thermite weld in the center shall be used as the calibration standard. (The side drilled holes and notches shall be located adjacent to the thermite weld material).

   b. Side drilled holes of 3/32 inch in diameter shall be used as calibration reflectors for angle beam testing the head of the rail weld. These holes shall be placed at 1/4T, 1/2T, and 3/4T and shall be used to construct a Distance Amplitude Curve (DAC). (T is the thickness of the head along the centerline from the top of the head through the head and web fillet.)

   c. Notches shall be employed as calibration reflectors for angle beam testing of the web and the base. The notches may be buttress (square) or U type. A notch shall be placed on both sides of the web section of the weld and shall be used to construct a DAC. The notch depth shall be 10 percent of the thickness of the web; plus 10 percent, minus 20 percent of required notch depth. Notches shall be at least one inch in length and 1/8 to 1/4 inch in width.

   d. The sound beam shall pass through the thermite weld during calibration.

3. Testing Procedures

a. The transducer and wedge combination shall produce an angle of 70 degrees, plus or minus 2 degrees in the test material for the web and base, and 45 degrees plus or minus 2 degrees in the head of the rail. The transducer crystal shall be at least 1/2 inch square. Other angles may be used to further evaluate indications. Transducer frequency shall be in the range of 2.25 through 5 MHZ.

b. Scanning shall be at 6db above the primary reference level. The rail weld shall be scanned from the top of the head, side of the head, the web, and the top of the base. Scanning shall be accomplished from both sides of the same face of the weld. The scanning pattern shall allow sound to be passed through the entire volume of the weld.

c. The primary reference level to be used when testing the head section of the rail is the gain setting used to construct the DAC from the side drilled holes. The gain setting used to construct a three point DAC from the notches shall be the primary reference level when testing the web and base sections of the rail weld.

4. Acceptance Criteria

a. Welds showing a response at any level that is identified as a crack, shrinkage, or lack of fusion will not be acceptable.

b. Welds showing a response that is less than 50 percent of the primary reference level will be acceptable.

c. Welds showing a response greater than 50 percent, but which do not exceed the primary reference level, are acceptable, providing that all of the following requirements apply.

1) The defects are evaluated as slag or porosity.

2) The largest defect does not exceed 0.180 inch in its largest dimension.

3) The total of the defects do not exceed 0.09 square inch.

4) The sum of the greatest dimension of defects in a line does not exceed 3/8 inch and individual defects are separated by 1/8 inch or more.

d. Welds showing a response that exceeds the primary reference level will not be acceptable.

5. Each weld examined shall be recorded on a report form that includes as a minimum the following information.

a. Weld number

b. Technique sketch

c. Type of equipment - size of transducer - frequency – angle

d. Calibration data

e. Equipment identification information (serial numbers)

f. Defect description - depth, location, size, character

g. Accepted or rejected

h. Name of operator and certification level

i. Date of inspection

O. Metallurgical Evaluation

1. Cut each weld sample 3 inches on each side of the weld, and then vertically section each specimen to the longitudinal center line of the rail for the following tests.

a. Macroetch and photograph to show fusion line and heat affected zone.

b. Rockwell "C" hardness shall be measured along the center line of head, web, and base at 1/8 inch intervals through the heat affected zone. Each completed weld shall have complete fusion for the entire cross section, and shall be entirely free of cracks.

2. Acceptance Criteria

a. The heat affected zone shall be symmetrical about the centerline of the weld.

b. The hardness values converted to Brinell shall conform to the requirements herein, and shall be symmetrical about the centerline of the weld.

P. Surface Hardness

1. Test Brinell Hardness in accordance with the requirements of ASTM E10.

2. Measure Brinell hardness on the rail head along the top centerline and on the gage surface at the centerline of weld and at 1/2 inch increments each way across the heat affected zones to base metal.

3. Conform with requirements herein.

1.10 INSULATED RAIL JOINTS

A. Definitions

1. Bonded Insulated Joint: A rail joint that electrically isolates joined rails and is permanently glued or bonded to the rails.

2. Bonded Insulated Joint Plug: A section of rail including a bonded insulated rail joint that has been assembled by the manufacturer, prior to shipment to the construction site.

3. Field Bonded Insulated Joint: A bonded insulated joint assembled in the field by the Contractor.

4. Temporary Insulated Joint: An insulated rail joint temporarily installed to electrically isolate the Contractor's work area from the District's existing operating system to provide protection from stray currents.

B. All design qualification and production testing shall be performed by an approved independent laboratory that is staffed, equipped, and experienced to perform the specified tests, approved by the Engineer, in advance of any testing.

C. Insulated joint tolerances shall comply with the following requirements.

1. Fishing Height: Within plus or minus 1/64 inch of the dimension shown on the approved Drawings.

2. Straightness: All portions of the joint bars adjacent to the rail shall be straight within a tolerance of plus or minus 1/32 inch, measured with a 36-inch straight edge.

3. Rail End Squareness: Variation in squareness of not more than 1/32 inch.

4. Alignment Tolerances

a. Alignment: Alignment of rail shall be performed on the head of the rail, as follows.

1) Vertical alignment shall provide for a flat running surface. Any difference of height of the rails shall be in the base.

2) Horizontal alignment shall be accomplished in such a manner that any differences in the width of heads of rail shall occur on the field side.

b. Surface Misalignment Tolerance

1) Combined vertical offset and crown camber shall not exceed 0.040 inch per foot.

2) Combined vertical offset and dip camber shall not exceed 0.010 inch per foot.

c. Combined horizontal offset and horizontal kink chamber shall not exceed 0.040 inch per foot at ambient temperature.

5. The end posts on insulated rail joints shall not be less than 3 inches of a tie, direct fixation pad, or rail fastener.

D. Installation procedure and bolt tension shall be as specified by the product manufacturer.

E. Furnish bonded insulated rail joints complete with bars, 3/8 inch end posts, bushings, pin bolts, collars, and adhesive as recommended by the manufacturer.

F. Rail ends at bonded insulated rail joints shall be end hardened in accordance with the AREMA Manual, Supplementary Requirements Sl, End Hardening, and as required herein.

G. Field-bonded insulated joints are not allowed.

H. Following approval of the Shop Drawings and installation procedure by the Engineer, test three bonded insulated joints as specified herein. The Engineer may accept certification from an independent testing laboratory that similar joints have passed an equivalent testing program in lieu of the testing program specified herein, if test was performed within 6 months of the submittal date.

I. Longitudinal Compression Test

1. Test Preparation

a. Assemble one bonded insulated rail joint complete, on two pieces of 119 RE rail each 2 feet long.

b. Saw joint the assembly in half where rails are butted together, at right angles to centroid of the rail.

c. Ensure that sawing does not overheat and damage the bonding adhesive.

d. Affix a device that will confine the reaction at the sawn end to the face of the joint bars when a compressive load is applied at the centroid of the rail at the opposite end.

2. Test Method

a. Apply test loads in increments of 25,000 pounds, maintaining each increment until longitudinal deflection of the rail ceases before increasing the load to the next increment.

b. Increase the load in increments until a total load of 650,000 pounds is attained or failure occurs.

c. At each increment of loading, measure and record the load, and the differential movement of rail and joint bars, to the nearest 0.001 inch.

3. Acceptance Criteria

a. There shall be no indication of slippage of the rail joint before the total test load reaches 650,000 pounds.

b. The difference between original position of the joint bar and the rail and the final position thereof after the final test load has been released shall be not more than 1/32 inch.

J. Rolling Loading Test

1. Test Preparation: Mount the second bonded insulated rail joint on a 33-inch stroke rolling load test machine and support on 36-inch centers; center the joint as indicated in Figure 5.

2. Test Method: Apply a 44,000 pound load on the rail for 2,000,000 cycles. Measure and record the deflection at rail centerline to the nearest 0.001 inch when the wheel load is over points A and B for every 500,000 cycles.

3. Alternative Test Methods: Alternative test methods may be submitted, which develop equivalent bending moments throughout the length of the joint bar, for approval by the Engineer.

4. Acceptance Criteria After 2,000,000 Cycles

a. There shall be no evidence of failure by bending of bonded insulated rail joint.

b. Deflection exhibited by bonded insulated rail joint shall not exceed 0.065 inch.

K. Electrical Resistance Test

1. Test Method: Fully assemble a third bonded insulated rail joint in accordance with manufacturer's recommendation on two lengths of 119 RE rail, one 24 inches in length, the other 42 inches in length, for an electrical resistance test. During the fabrication, maintain a gap of 3/16 inch between the rail ends with the end post. Support both rails on an electrically non-conducting material.

2. Acceptance Criteria: The acceptance criteria for the 500 V dc Megger Test and the 2.2 kV ac Hypot Test shall be as follows: The minimum resistance for the 500 V dc Megger Test shall be 100 megohms. The joint shall not show any indication of failure when the test is performed.

L. Bonded Insulated Joint Qualification Failure: Failure of the proposed design to satisfy the requirements of the specified tests shall require redesign of the bonded insulated joint to correct the cause of such failure and retesting.

M. Approval

1. All qualification tests conducted on bonded insulated joints shall be successfully completed to the written approval of the Engineer prior to fabrication of any bonded insulated joint.

2. The Engineer may accept Certificates of Compliance that bonded insulated joints of identical design have successfully completed these tests, if test was performed within 6 months of submittal date.

N. Temporary Insulated Rail Joints

1. Temporary insulated rail joints shall be installed as indicated on the Contract Drawings.

2. Bolt Holes

a. Bolt holes shall be drilled in accordance with herein specified requirements.

b. Drill only the two holes furthest from each rail end for a total of four holes. Omit track bolts on the holes closest to the rail ends.

3. Before assembly, all contact metal surfaces shall be painted with insulating enamel as specified in the Contract Specifications.

4. Remove temporary insulated rail joints and field weld as required. Field welding shall meet all herein specified requirements.

5. The remaining unused bolt holes at temporary insulated joint locations shall remain in track provided they meet all other herein specified requirements.

6. All temporary insulated rail joints shall be removed prior to the completion of the project and the execution of any retentions.

1.11 PACKAGING, LOADING, SHIPPING, AND HANDLING

A. Rail

1. Bumping and striking the rail during handling or laying will not be permitted. Nicked or gouged rail shall be rejected or repaired as determined by the Engineer.

2. Continuous welded rail shall be unloaded and placed on ties or structures with rollers or other devices approved by the Engineer, which shall prevent damage to the rail, ties, and structure. The bottom of the rail, fastener assemblies, and all bearing surfaces shall be broom cleaned before rail is laid.

3. Rail shall not be covered in dirt and not be submersed in water. Rail damaged by mishandling or allowed to corrode, shall be replaced at no additional cost to the District.

B. Insulated Rail Joints

1. All containers shall be clearly marked with the following: identification of item contained, manufacturer's name, shipping date, number of pieces, designation, and gross weight.

2. Handle all fasteners in a manner that will prevent damage during packaging, loading and transporting.

3. Pack insulated rail joints separately in units convenient for handling. Assemblies shall be packed in weatherproof wooden, plastic or metal containers, banded on pallets for forklift handling.

4. All Insulated Rail Joint shipments shall be adequately prepared to preclude damage during shipment.

PART 2 - PRODUCTS

2.01 DISTRICT-FURNISHED MATERIALS

A. Refer to Section 01 64 13 - District-Furnished Materials and Equipment, of the Contract Specifications for description and quantity of District-furnished materials.

2.02 CONTRACTOR-FURNISHED MATERIALS

A. All products, tools, materials, equipment and labor required to complete all aspects of the work shall be furnished by the Contractor.

2.03 RUNNING RAIL

A. Provide only new 119 RE rail section conforming with the dimensional requirements provided in AREMA.

B. Rail Types

1. Use fully heat-treated carbon steel tee rail, surface heat-treated carbon steel tee rail, on-line-hardened carbon steel tee rail, or high-strength alloy steel tee rail, with a minimum hardness of 365 BHN, with the supplied rail not varying more than ±10 BHN, but in no case less than 365 BHN. All rail shall be the same rail type and metallurgy throughout.

2. All rail shall be capable of being electric flash butt welded and thermite welded in accordance with AREMA rail welding requirements using standard materials, equipment and techniques. Rail shall be able to consistently meet AREMA rail welding requirements when electric flash butt and thermite welding to other rail types and metallurgies.

C. All rail shall be manufactured in accordance with AREMA, except as provided herein.

D. Rail Lengths

1. Standard rail lengths shall be 70 to 83 feet, when corrected to a temperature of 60 degrees F.

2. Short rails, as short as 39 feet, shall not exceed 25 percent of the total net tonnage accepted for each rail type. The use of short rails shall be limited to the manufacture of special trackwork, insulated rail joint plugs, sidings, yards, spurs and storage tracks. Short rails shall not be used in main line tracks.

E. Furnish rails with blank rail ends, unless otherwise specified in the Contract Specifications.

F. Stamp and brand rails in accordance with the AREMA.

G. Rail Cutting Cut rails square and clean by means of rail saws, or abrasive cutting wheels. Torch cutting is prohibited.

H. Rail shall be roller-straightened.

I. Rails failing to meet the requirements of these Specifications shall be reworked, retreated, cut-back or rejected in accordance with the AREMA, as modified herein.

2.04 PRESSURE FLASH BUTT RAIL WELDING

A. All welds shall be made with electric flash butt welding machines capable of producing welds that meet the quality requirements specified herein, and the following requirements.

1. The welding machine shall have the capacity to forge the rail weld to full refusal.

2. Automatic recording equipment shall be used to monitor and record the significant welding parameters, including the following information.

   a. Voltage.

   b. Current impulses.

   c. Platen movement during flashing and forging.

3. Equipment and procedures required to quench rail to conform with the hardness requirements and post heating if necessary to avoid excessive hardness of any rail.

4. Equipment to shear excess flash close to the shape of 119 RE rail.

2.05 THERMITE RAIL WELD KITS

A. Provide a kit of materials, equipment, tools, and procedures that are qualified as provided herein, and conform with the following requirements.

1. Use factory made preformed molds.

2. Use external preheat prior to welding.

3. Use an alignment jig to set and maintain horizontal and vertical alignment during welding.

4. Use a rail puller/expander to set and maintain the proper rail gap when joining CWR strings.

5. Provide positive identification on each kit of the rail size and type, and the expiration date of the material's shelf life.

2.06 INSULATED RAIL JOINTS

A. Provide Allegheny or Portec bonded toeless insulated rail joints or equal for insulated joint plugs, designed for 6 bolts, using huck bolts, with 3/8 inch end post components.

B. For temporary insulated rail joints provide Allegheny or Portec toeless poly insulated rail joints, designed for 6 track bolts, including track bolts, track bolt plates and 3/8 inch end post components or equal. All nuts shall be located on the field side. Fiberglass insulation shall not be used.

2.07 GENERAL PRODUCTION

A. Production of rail, rail welds and insulated rail joints prior to the Engineer's review and approval is prohibited.

B. Manufacture all rail, rail welds and insulated rail joints materials using the same methods used to produce qualification test pieces.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Install rail, rail welds and insulated rail joints in accordance with the respective manufacturer's recommended installation instructions and procedures and as provided, except as modified herein.

B. Install rail, rail welds and insulated rail joints in accordance with the requirements of Section 34 05 17 - Common Work Results for Trackway.

3.02 RAIL

A. Install rail as provided by AREMA, except as modified herein.

B. Cut rails square and clean by means of rail saws or abrasive cutting wheels. Torch cutting is prohibited.

C. Rail branding at reinforcing bar locations and within 1 foot 8 inches of rail ends at joint locations shall be ground smooth. All excess material at rail ends shall be ground off with no resulting beveling.

D. Rail Drilling:

1. Drill the ends of rails where standard rail joints are to be installed as indicated. Rail drilling shall conform to the requirements specified herein, for hole size, location, method, and quality. Each drilled rail end shall have three holes to accommodate a 36-inch, six-hole joint bar. Punching of holes in the rail is prohibited.

2. Rail with drilled ends shall be beveled in accordance with the AREMA.

3. All holes drilled in the rail shall be drilled using an automatic feed rail drill in accordance with the rail drill manufacturer’s operating instructions.

4. All holes drilled in the rail, greater than 1/2 inch in diameter, shall be drilled using a broach type bit. Dull broaches or bits shall not be used.

5. Rail/cutting surface interface shall be flooded with a cutting fluid adequate to prevent over heating of the rail. Holes not properly drilled or if bluing of the rail or cuttings occurs shall be rejected.

6. Rail drilling shall be performed so as not to cause mechanical or metallurgical damage to the rail.

7. Holes drilled in the rail shall be circular, perpendicular to the web of the rail, and drilled to the proper dimension.

8. Except for rail joints as otherwise required, all holes shall be drilled through the neutral axis of the rail (3.124 inches above the bottom of the base for 119 RE rail, 2.980 inches above the bottom of the base for 115 RE rail, and 2.540 inches above the bottom of the base for 90 RA-A rail).

9. Where rail is drilled to allow for bolt to pass through the rail, the size of the hole shall be between 1/8 inch and 1/16 larger than the diameter of the bolt to be used, unless otherwise required.

10. Except as provided herein, the diameter of all holes drilled in the rail shall be plus or minus 1/16 inch of the proper dimension.

11. The variation in location of holes drilled in the rail shall be plus or minus 1/16 inch.

12. Entrance and exit sides of all holes drilled in the rail shall be chamfered 1/32 inch (plus or minus 1/64 inch) at a 45 degree angle (plus or minus 5 degrees).

13. No part of holes drilled in the rail shall be closer than 1 inch to rail welds.

14. No part of holes drilled in the rail shall be closer than 5 inches to another hole.

15. Rail that has unnecessary or improperly drilled holes, or locations where train control or traction power bonds are removed or no longer used shall be replaced at no additional cost to the District.

16. Rail drilling for bonding, within special trackwork, shall be performed at the special trackwork manufacturers facility.

E. Replacement Rails:

1. The minimum rail length used as replacement shall be 15 feet and shall be installed to minimize the number of welds and/or rail joints.

2. All repairs shall meet all requirements specified herein.

F. CWR:

1. Construct CWR only using the flash-but pressure welding process, thermit rail welding of running rail is not permitted.

3.03 PRESSURE FLASH BUTT RAIL WELDING

A. All rails in a string shall be positioned with the rail heat numbers on the same side.

B. All welding shall be performed by an operator trained and certified by the manufacturer of the welding equipment.

C. The Contractor shall make suitable notations on the charts to identify each weld and reweld; lead rail heat number, rail letter and ingot number; welding machine and string number for each CWR string. Corresponding string numbers shall be painted on the gage side of the web on the lead rail for each CWR string with aluminum paint. Upon daily completion of the work, the Recorder Charts shall be suitably identified by the Contractor and submitted to the Engineer for permanent record.

D. If the gage side of a CWR string is pre-determined as required herein, the gage side shall be marked with red paint 12 inches from each end.

E. Rail Cutting: All rail cutting shall be square and clean by means of rail saws or abrasive cutting disks. When cutting out a defective weld, remove the heat affected zone on both sides of the weld. Oxy-fuel flame cutting is prohibited.

F. Air quenching is permitted when welding special rails to meet the hardness requirements herein specified.

G. No rail drilling is permitted for handling CWR.

H. Both ends of each CWR string shall be marked with weather-resistant paint at least 12 inches from the rail end with the following information:

1. String number
2. Length
3. Type of rail
4. Pre-determined gage side

I. Prepare and submit the following daily reports and records:

1. Figure 1 - CWR String Report
2. Figure 2 - Rail Identification Tally
3. Welding Machine Recorder Charts

J. Production Inspection and Testing

1. Inspect every rail end in accordance with the new rail tolerances specified herein, and for any surface or interior defect on the rail end.
2. Non-conforming rail ends shall be cut back until acceptable, at no additional cost to the District.
3. Inspect every weld in accordance with the requirements herein.
4. Compare recorder charts of production welds with the qualification chart. Reject welds where the production welding variables are not within the qualified range.
5. UT and MT Test every weld in accordance with the requirements herein.
6. Rejected welds shall be cut out, rewelded, and retested at no additional cost to the District.

3.04 THERMITE RAIL WELDING

A. All welding shall be performed under the direct supervision of a qualified and experienced welding foreman or supervisor. In addition, a manufacturer's representative, experienced in thermite welding, shall be present at the job site and shall witness the performance of at least the first 10 acceptable thermite field welds.

B. The rails to be welded shall be cleaned of all grease, oil, dirt, loose scale, and moisture to a minimum of six inches back from the rail ends, including all of the rail surface, by use of a wire brush, to completely remove all dirt and loose oxide, and by use of oxy-fuel torch to a minimum temperature of 250 degrees F to remove any grease, oil, or moisture. The face of the rail ends shall be aligned and arranged at right angles and cut by using a power-actuated saw, or abrasive rail cutting machine, and further cleaned to remove all scale and rust by use of a power actuated grinder with abrasive wheel for two inches on each side of the weld. Rail ends shall show no steel defects, dents, or porosity before welding.

C. The minimum and maximum gap shall be in accordance with the qualified procedure specification for the type of thermite weld being made, and as provided by the equipment manufacturer. The measurements shall be made with go or no-go gauges made of the specified dimensions for the thermite process used. The gap shall be adjusted if under the minimum or over the maximum specified gap.

D. The ends of the rails to be welded shall be properly gapped and aligned to produce a weld that will conform to the specified alignment tolerances. The rail gap and alignment shall be held by a hydraulic rail puller/expander and alignment jig without change during the complete field welding cycle.

E. No holes will be permitted within 36 inches of the ends of the rail to be welded.

F. The rail ends shall be preheated, prior to welding, to a sufficient temperature, and for sufficient time, to ensure full fusion of the weld metal to the rail ends without cracking of the rail or weld.

G. The molds shall be left in place after tapping for sufficient time to permit complete solidification of the molten metal and proper slow cooling to prevent cracking and provide a complete weld with proper hardness and ductility.

H. The weld shall be finished with a rail mounted rail head grinder specifically designed for the work. The balance of the rail section shall be finished with a hand-held grinder as required to remove notches, gouges, visible cracks and other defects. All grinding shall blend to the parent rail section and shall not overheat the steel. Heavy grinding shall be completed while the steel is still hot from welding. Weld reinforcement shall be contoured smoothly to the parent metal to facilitate the performance and interpretation of non-destructive examination.

I. Welding shall not be performed during rain, drizzle, or other inclement weather.

J. During the setting up and actual welding, other work that would in any way move, vibrate, or otherwise interfere with the welding outcome shall be prohibited. Necessary precautions shall be taken to prevent disturbing the weld immediately after the pour when working adjacent to a grade crossing.

K. Protect thermite kit materials from damage and environmental exposure. Store materials under temperature and humidity conditions as recommended by the manufacturer. Do not use materials or molds whose packaging is wet or damaged.

L. Perform cutting of rails as follows

1. Cut rails so that field welds are midway between cross ties or rail fasteners.

2. Cut rails square and clean by using rail saws or abrasive cutting disks only. Do not flame cut rails. A deviation from square of more than 1/32 of an inch will not be accepted.

3. After cutting, all edges of the cut shall be lightly ground with a hand-held grinder to remove any burrs or fins resulting from the saw cut.

M. Each weld shall be given a number in sequence as the welding progresses. The number shall be painted two inches from the finished weld on the field side of the rail. Defective welds that are replaced shall be given a new sequential "R" number. This number shall be recorded in the field welding records. For example, FW 12-R1 is the first reweld of field weld number 12.

N. Field welding records shall be provided by the Contractor. The field welding records shall be continuously maintained to record details of all field welding as follows.

1. Daily for each filed weld performed – Figure 3.

a. This exhibit shall be signed and dated by the contractors Forman present during the welding and the inspector/tester.

b. This exhibit shall be maintained on a daily basis, and shall be available for inspection by the Engineer.

2. Within 30 days of acceptance of trackwork – Figure 4.

a. This exhibit shall be maintained on a daily basis, and shall be available for inspection by the Engineer.

b. This exhibit shall include all field welds performed, including those rejected. The reason for rejection shall be noted. Rewelds shall also be noted.

O. Inspect and test welds after the rails have cooled to ambient temperature, and the rail puller and alignment jig are removed.

P. Each weld shall be visually inspected for surface defects such as cracks and inspected in accordance with the requirements herein.

Q. Test each weld in accordance with the requirements herein for Magnetic Particle Testing.

R. Test each weld in accordance with the requirements herein for Ultrasonic Weld Testing.

S. Test each weld in accordance with the requirements herein, Surface Hardness, except test only on the field side of the rail head.

T. Measure each weld for alignment and surface finish as provided herein.

U. Welds rejected during inspection and testing shall be cut out and rewelded if possible, or replaced with at least 15-foot rail welded in its place in accordance with these Specifications.

V. Locate field welds, including those for insulated joint plugs, so that they do not occur at the following locations, including after thermal rail adjustment.

1. Open Track Construction and Track with Restraining Rails.

    a. Within 8 feet of a field weld in the opposite rail.

    b. Within 15 feet of a field weld in the same rail.

    c. Within 36 inches of a pressure flash butt weld or bolt hole.

    d. Within 15 feet from the center of any bolted joint.

    e. On ballasted track within 100 feet of a change of track construction, including ballasted deck structures.

    f. On direct fixation track within 39 feet of a change of track construction.

    g. Within 6 inches of a tie, direct fixation pad, or rail fastener.

2. Special Trackwork Construction

    a. Within 15 feet of a field weld in the same rail.

    b. Within 36 inches of a pressure flash butt weld or bolt hole.

    c. Within 15 feet from the center of any bolted joint.

    d. Within 6 inches of a tie, direct fixation pad, or rail fastener.

3.05 INSULATED RAIL JOINTS

A. Only factory bonded insulated rail joint, performed by the manufacturer, shall be used.

B. Insulated Joint Plug Lengths

1. Bonded insulated rail joint plugs shall be no shorter than 15 feet 0 inch long.

2. The shortest segment of rail within bonded insulated rail joint plugs for standard track shall be no shorter than 7 feet 6 inches long.

C. Insulated Joint Plugs shall be manufactured using the correct rail type for the location installed.

D. Any insulated rail joints shall be replaced at no additional cost to the District.

E. All failed insulated rail joints shall meet all requirements herein.

F. Insulated Joint Location:

1. Insulated joints shall be located such that the end post is no closer than 3 inches from the nearest tie or rail fastener, including after rail adjustment.

2. Insulated joints not meeting the requirements specified herein will be rejected. The Contractor shall replace all rejected insulated joints at no additional cost to the District. Repaired insulated joints shall meet all herein specified requirements.

3.06 BONDED INSULATED RAIL JOINT MEGGER TESTING

A. At the worksite immediately prior to welding bonded insulated rail plugs to the adjacent rails, perform the following procedure to detect faulty insulated joints. The procedure will detect rail-to-rail shorts and rail-to-joint bar shorts. This test is required in addition to all other required herein.

1. The procedure uses a megohm meter to test rail-to-joint bar impedance and, in some cases, rail-to-rail impedance. The procedure also uses a current injection method for insulated joints where the associated track layout electrically shorts around the joint. The current injection method will check rail-to-rail impedance and isolate which half of an insulated joint bar is shorted to the rail in these areas. The following information specifies the equipment needed, the test procedure, and entering information on the Data Sheet.

2. Equipment

   a. Megohm meter, 250 V or 500 V range;

   b. Frequency-sensitive voltmeter;

   c. Signal generator and leads to attach to rails;

   d. Inductive pick-up coil; and

   e. Jumper that will attach to railhead.

3. Procedure

   a. Insulation shall be tested between each rail and the insulated joint assembly using the megohm meter as follows

      1) Connect one meter lead to the insulated joint assembly under test by contacting one of the huck bolt collars. Connect the other lead to a second huck bolt collar on the same joint under test. Crank the meter. A zero reading indicates that good contact has been made and that the test circuit is continuous.

      2) Leave one lead attached to the joint assembly huck bolt collar and attach the other lead to one rail section (north or south of the joint). Crank the instrument and record the meter indication in the appropriate place on the data sheet. A reading greater than 5 M is acceptable.

      3) Repeat Step 2) for the second rail section on the other side of the insulated joint.

      4) Connect meter leads to rails on either side of insulated joint. Repeat Step 2).

      5) If any of the tests fails, perform the following steps

a) Connect signal generator and Frequency-Sensitive Voltmeter (FSVM).

b) Connect jumper to rails on either side of IJ, shorting out IJ.

c) Set Signal Generator to 12 kHz, plus or minus 2 kHz and 100 mA (minus 20 mA, plus 50 mA) as measured by FSVM.

d) If current exceeds 10 percent of Step c), joint fails and is not repaired but replaced, and the replacement joint is tested.

e) Connect jumper to huck pin on insulated joint bar and to south running rail between IJ and FSVM. If current exceeds 10 percent of Step 3), joint fails and is not repaired but replaced, and the replacement joint is tested.

f) Move jumper on running rail to other rail. Repeat Step e).

B. Care shall be exercised in unloading and handling material to prevent breaking or bending or in any way damaging the material. Materials shall not be dropped or thrown from cars, but shall be lifted or skidded to the ground or other surface.

C. Minimum Acceptable Resistance 100 megohms prior to installation.

3.07 INSULATED RAIL JOINT HARMON TESTING

A. Perform the following test on bonded insulated rail plugs and bolted insulated rail joints. This test shall be performed immediately after rail welding and thermal rail adjustment and prior to the installation of all traction power negative return power bonding. If the rail is thermally readjusted, all traction power ground return cable shall be removed, prior to testing. This test is required in addition to all others required herein.

B. All testing shall be preformed with the adjacent rail and insulated rail joint dry.

C. Testing shall be performed using a Harmon 1501A Insulated Joint Checker (IJC) operated according to the Harmon 1501A IJC Instruction Manual. Other test equipment with equivalent range and accuracy may be used, with advance written approval of the Engineer.

D. All test equipment requiring calibration shall be listed on the appropriate Test Data Form (TDF), showing calibration due date. Out-of-date test equipment for calibration shall not be used.

E. Test Method:

1. Prior to performing the test record the track, location and rail on the TDF.

2. Check that the insulated rail joint is properly installed, the end post is no within 3 inches of a tie or fastener and is designed for the rail size for which it is installed.

3. Set the FUNCTION SELECTOR SWITCH to the BART position and place the POWER SWITCH to the ON position. The meter should read between 10 and 14

volts. If the meter does not read between 10 and 14 volts, replace batteries or test instrument.

4. Set the FUNCTION SELECTOR SWITCH to the CAL position. Adjust the CALIBRATION ADJ. Knob for a meter reading of 15.

5. Place the POWER SWITCH to the OFF position.

6. Prior to connecting the leads to the rail, sand the rail to bright metal, where test lead connection are to be made.

7. Connect the leads of the Harmon 1501A to the rail, one on each side of the insulated rail joint. Ensure lead connections are tight and make good contact with the running rails.

8. Data evaluation shall consist of comparing the results on the TDF with the requirements of the location being tested.

9. Acceptance shall be based upon the criterion provided by the Engineer.

3.08. UNNECESSARY INSULATED RAIL JOINTS

A. Abandoned Insulated Rail Joints or Insulated Rail Joints that are no longer necessary, located within the limits of the Contract or changes to the Contract, shall be removed at no additional cost to the District.

B. Unnecessary Insulated Rail Joints shall not be electrically bonded and shall be removed.

C. The removal of unnecessary Insulated Rail Joints shall meet all herein specified requirements.

END OF SECTION 34 11 25

FIGURE 1 - CWR STRING REPORT

DATE:_____

CONTRACT NO:_____ LOCATION:_____

WELDING CO:_____ SHIFT_____

RAIL SECTION:_____ EXTENSION:_____

STRING NO:_____

STRING LENGTH:_____Lineal Feet

TOTAL PIECES OF RAIL IN STRING:_____ CONSISTING OF THE FOLLOWING LENGTHS:_____

LENGTH OF CUTOUTS:_____

NO. OF ACCEPTED WELDS:_____

NO. OF REWELDS:_____

TOTAL NO. OF WELDS:_____

STRAIGHTNESS INSPECTOR:_____

MAGNETIC PARTICLE INSPECTOR:_____

ULTRASONIC INSPECTOR:_____

CONTRACTOR WELDING SUPERVISOR:_____

FIGURE 2 - RAIL IDENTIFICATION TALLY

STRING NO:

ITEM	RAISED CHARACTERS	STAMPED CHARACTERS	LENGTH	WELD	REWELD
1					
2					
3					
4					
5					
6					
7					
8					
9					
10					
11					
12					
13					
14					
15					
16					
17					
18					
19					
20					
21					
22					
23					
24					
25					
26					
27					
28					
29					
30					
		TOTAL LENGTH:			

FIGURE 3 - THERMIT RAIL FIELD WELD RECORD

CONTRACT NUMBER	RAIL FIELD WELD NUMBER

THERMIT RAIL FIELD WELD DATA					
ITEM	**DESCRIPTION**	**COMPLETED INFORMATION**			
1	DATE				
2	TIME				
3	TRACK				
4	LOCATION				
5	RAIL (LEFT or RIGHT)				
6	RAIL TYPE(S)				
7	CONTRACTORS FOREMAN				
8	QUALIFIED WELDER				
9	MANUFACTURER'S REPRESENTATIVE (if present)				
10	WEATHER				
11	RAIL TEMPERATURE				
12	WELD BRAND NAME				
13	RAIL PULLER OR HEATER	YES:		NO:	
14	GAP BEFORE PULING/HEATING				
15	GAP WHEN WELDING				
INSPECTION AND TESTING DATA					
	DESCRIPTION	**COMPLETED INFORMATION**			
16	INSPECTION DATE				
17	INSPECTION TIME				
18	INSPECTORS NAME				
19	INSPECTORS COMPANY				
20	INSPECTION RESULT	ACCEPT:		REJECT:	
21	IF REJECT, INSPECTORS COMMENTS:				
22	TEST DATE				
23	TEST TIME				
24	TESTORS NAME				
25	TESTING COMPANY				
26	TESTING RESULTS	ACCEPT:		REJECT:	
27	IF REJECT, TESTORS COMMENTS:				

CONTRACTORS FOREMAN: _____ **DATE:** _____

INSPECTOR: _____ **DATE:** _____

TESTOR: _____ **DATE:** _____

FIGURE 4 – THERMIT RAIL FIELD WELD SUMMARY RECORD

DISTRICT CONTRACT NUMBER _____ PAGE _____ OF _____ PAGES

	WELD NUMBER		RAIL	LOCATION	NOTES
1					
2					
3					
4					
5					
6					
7					
8					
9					
10					
11					
12					
13					
14					
15					
16					
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20					

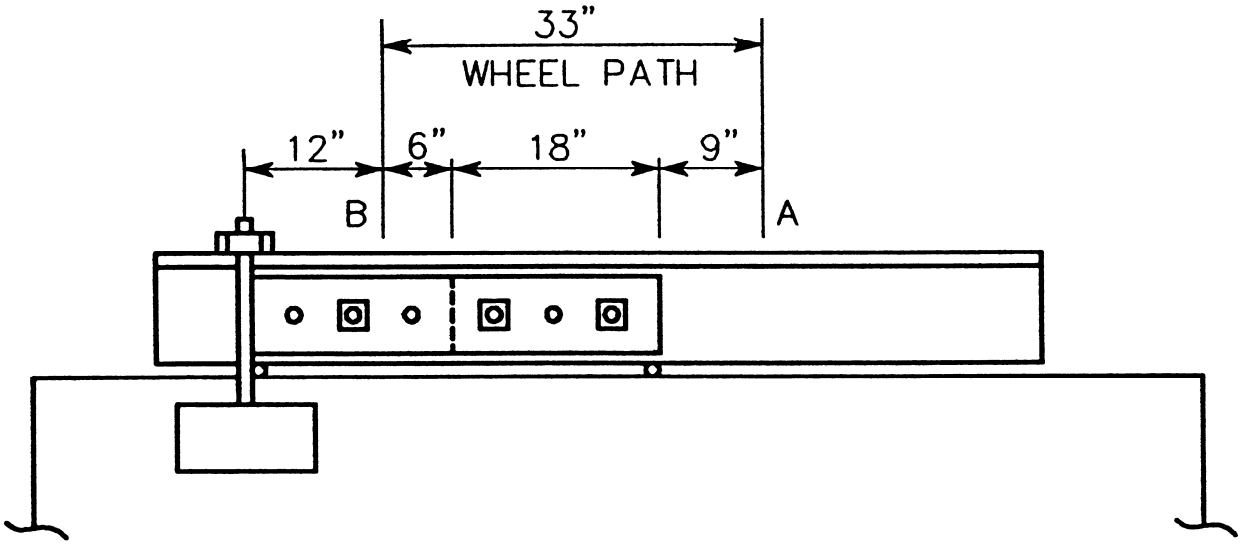

FIGURE 5 - INSULATED RAIL JOINT ROLLING LOAD TEST