

# THE AMERICAN RAILWAY ENGINEERING AND MAINTENANCE OF WAY ASSOCIATION

**Committee:** 4 (Rail), **Subcommittee:** 6 (Joint Bars, Insulated Joints, Track Bolts, Spring Washers)

**Letter Ballot Number:** 04-21-06

**Assignment:** None

**Explanation of Ballot:**

This ballot was a result of general review of Section 3.8. During the Spring 2021 meeting it was noted that rail end hardening is referenced in this Section which is no longer a recommended practice. This reference will be removed.

**Reason:** Bring Section up to date with current recommended practices.

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### 3.8.1 SCOPE (1996)

These specifications cover the design, materials, fabrication and in-plant testing of bonded insulated rail joints.

### 3.8.2 ENGINEERING DRAWINGS (1996)

The manufacturer shall submit to the purchaser, for approval, drawings showing the material description, dimensions, fabrication tolerances and assembly methods where required.

### 3.8.3 INSPECTION (1996)

- a. The purchaser's authorized representatives shall have free entry to the manufacturer's plant to inspect the processing and testing of all bonded insulated joints and/or their components. The manufacturer shall provide test specimens to satisfy the purchaser that the bonded insulated joints and/or their components are being supplied in accordance with this specification. Results of all required qualification tests, acceptance tests and production inspections shall be made available to the purchaser prior to shipment unless otherwise stated by the purchaser.
- b. The manufacturer shall provide the purchaser with necessary copies of his quality assurance manual, for the purchaser's review and approval. Upon request, the manufacturer shall provide the purchaser with access to documentation of the active use and findings of the quality assurance procedures.

### 3.8.4 MATERIALS (2020)

#### 3.8.4.1 General

All bonded insulated joints and/or components shall be new and conform to the requirements specified herein unless otherwise specified by the purchaser. All materials shall conform to the dimensional requirements for the rail section specified by the purchaser.

#### 3.8.4.2 Full Contact Joint Bars

Joint bars for bonded insulated joints shall conform to the configuration of the rail section specified by the purchaser with allowances being made for the insulating material to be used and shall be fabricated from material which meets or exceeds the mechanical properties and workmanship requirements of the current AREMA "Specification for Quenched Carbon Steel Joint Bars, Microalloyed Joint Bars and Forged Compromise Joint Bars" except as noted below. The fishing height of the joint bar with insulation shall be controlled to within +0 inch to - 1/32 inch of the rail section specified. The contact surface of the joint bars adjacent to the rail shall be smooth and straight within a tolerance of  $\pm 1/32$  inch using a 36 inch straight edge. No branding or other raised surfaces shall be permitted on the contact surfaces. All holes shall be deburred, to a minimum 1/32 inch and conform to the size, tolerances and locations specified by the purchaser.

#### 3.8.4.3 Rail

When prefabricated bonded insulated joints are ordered, and rail is furnished by the manufacturer, the rail used in fabricating the bonded insulated joints shall conform to the chemical composition, mechanical

<sup>1</sup> References, Vol. 97, p. 43.

properties, and workmanship requirements of the current [Section 2.1, Specifications for Steel Rails](#) or the appropriate rail specification indicated by the purchaser. The use of high-strength rails for bonded insulated joints is recommended. The rail shall be saw cut with a variation in end squareness of not more than 1/32 inch. The lengths and drilling of each rail shall be as specified by the purchaser. All burrs from sawing and drill shall be removed. Where so specified by purchaser, rail holes and rail ends may also be chamfered per the railroad specification. Adjacent sawed ends of the rail shall be joined by bonded insulated joint bars. All raised letters, numerals, etc. within the joint area shall be removed by grinding, to conform to the existing rail section prior to joint assembly. **Although not recommended, should standard rail be specified by the purchaser, end hardening is recommended and shall be in accordance with Section 2.1, Specifications for Steel Rails, Paragraph 2.1.17.1.**

### 3.8.4.4 Insulating Materials

All insulation materials shall have electrical characteristics such that completed joints will meet or exceed the dielectric requirements of the AREMA Communications and Signals Manual, Part 8.5.1. and the Electrical Tests specified in Part 8.5.1. End post size shall be as specified by the purchaser with a thickness tolerance of  $\pm 1/32$  inch.

### 3.8.4.5 Fasteners

The bonded insulated joint shall be designed to be joined together with an adhesive and bolted together with one of the two following methods; bolted together with the required number of high-strength bolts of a diameter to be specified by the purchaser or with a swaged pin connection of the appropriate number and diameter. Every other fastener shall be reversed with the nut or collar on the opposite side of the rail, unless otherwise specified by the purchaser. The bolts, nuts, pins, collars and washers, if required shall conform to the chemical and mechanical requirements of ASTM Specification A490 or A325, A354 or SAE Grade 8 as applicable, and have Class 2A and 2B thread fits.

### 3.8.4.6 Adhesive

The structural adhesive used as the bonding agent shall produce a minimum lap shear strength of 3,500 psi at 75 degrees F as per test prescribed in ASTM D-1002 (metal to metal). Adhesive shall be capable of meeting the above requirements for a period of one year from date of manufacture when stored as specified by the manufacturer. A corrosion inhibitor shall be included in the adhesive formulation.

## 3.8.5 WORKMANSHIP (2020)

### 3.8.5.1 General

The glue-bonded insulated joint is an assembly of insulating materials, steel and adhesive. Its design is for these dissimilar materials to perform as a homogeneous product. To accomplish this, care must be taken to ensure that quality control procedures are used and that no voids exist in the joint area.

### 3.8.5.2 Contact Surfaces

The steel contact surfaces of the bars and rail shall be cleaned to bright metal by an approved method such as sand blasting or metallic grit blasting. All grit and other residues must be removed from the steel contact surfaces to be bonded.

### 3.8.5.3 Adhesive

Enough adhesive must be used to completely cover the entire contact surfaces of the joint bars and rail and allow some excess adhesive to be squeezed out along the entire perimeter of the joint, when the joint is assembled. Any excess adhesive should be dressed around the perimeter of the joint bars and used to seal the edges of the bolt or swaged fastener heads and nuts or collars. The assembled joint shall be cured in accordance with the manufacturer's recommendations.

### 3.8.5.4 Rail Ends and Bolt Holes

Sharp edges and burrs shall be removed by grinding. The bolt holes shall be free of sharp edges, burrs, loose scale (where so specified), shavings and other foreign matter.

### 3.8.5.5 Fastener Torque

Fasteners must be tightened to the required torque, following manufacturer's suggested sequence and procedures and those of the purchaser. Fastener torque does not apply to swaged fasteners.

## 3.8.6 DIMENSIONAL TOLERANCE (2020)

### 3.8.6.1 Overall Straightness

Assembled joints shall not deviate from a straight line by more than the tolerances provided in [Table 4-3-15](#). The deviation from a straight line must be reasonably uniform. Kinks are unacceptable except as provided in [Article 3.8.6.2.c](#).

**Table 4-3-15. Tolerances for Assembled Joints**

Length of Rail and Joint	10'-20'	>20'– 30'	>30' – 40'
Maximum mid-ordinate from a straight line for either side sweep or upsweep	3/16"	1/4"	3/8"

For assembled joints of lengths greater than 40', tolerance shall be as agreed upon between purchaser and manufacturer.

### 3.8.6.2 Joint Area

- The vertical alignment of the assembled joint shall be level, within a tolerance of .060 inch on a projected plane, as measured with a 36 inch straight edge. Dip shall not be permitted. See [Figure 4-3-16](#) and [Figure 4-3-17](#).
- The horizontal alignment of the assembled joint shall be straight, within a tolerance of 0.040 inch as measured with a 36 inch straight edge. See [Figure 4-3-18](#).
- Vertical offset between the two rail ends shall not exceed 0.030 inch. Horizontal offset (kink) shall not exceed 0.020 inch.

## 3.8.7 QUALIFICATION TESTING (2020)

### 3.8.7.1 General

- Three bonded insulated joints shall be tested by the material components manufacturer as follows: two bonded insulated joints shall be tested as specified in [Article 3.8.7.2](#) and the remaining bonded insulated joint shall be tested first in accordance with [Article 3.8.7.3](#) then subjected to a test as specified in [Article 3.8.7.4](#). After completion of the rolling load test, the joint shall be resubjected to the electrical resistance test.
- Qualification testing shall not commence until the engineering drawings are approved by the purchaser. For each design and/or material change, the material components manufacturer shall be required to

perform these qualification tests only on a one-time basis unless otherwise agreed upon by both the manufacturer and the purchaser.

- c. If the bonded insulated joint being purchased has been previously qualified, the manufacturer shall provide access to the test results to subsequent purchasers. If the manufacturer makes any changes in the materials or the design, the manufacturer shall requalify the new joint through the testing prescribed herein before production is resumed.

**3.8.7.2 Longitudinal Compression Test (For Qualification Only)**

a. Two bonded insulated joints, with 36 inches long joint bars, shall be assembled per manufacturer’s recommendations. Two pieces of rail of the prescribed rail section, each 2 feet long, shall be utilized for each joint. Each joint assembly shall then be sawed in half where the rails are butted together. The sawing shall be done in a manner which will prevent overheating and damage to the bonding agent, and the cut shall be perpendicular to the centerline of the top of the rail with a tolerance of ±1 degree. The sawn ends of the bars at one end of the test piece, and the end of the rail at the other, shall have fair bearing in the test machine to ensure that the loading and reaction are through the centroid of the rail, and parallel to its axis.

b. Load shall be applied parallel to the running surface of the rail in increments of 25,000 pounds. Each load increment shall be maintained constant until the longitudinal deflection of the rail ceases before increasing the load by the next increment.

. The load shall be increased in these increments until a total load of 650,000 lb is attained for rail weights of 132lb or greater, or failure occurs. For rails less than 132lb, a total load of 600,000 lb shall be used. At each increment of loading, the load and differential movement of the rail and joint bars, measured to 0.001 inch, shall be recorded. If an alternate method of performing this test is used, it shall be submitted to the purchaser for prior approval. The loads indicated in this test are for an 18 inch half joint.

c. The acceptance criterion for the longitudinal compression test shall be as follows: At no time shall any of the bonded insulated joints show any indication of slippage during or before the total prescribed load for the rail section involved is applied to the joint. At the completion of the test, after the load on the rail has been released, the relative position of the rail and joint bar shall be within 0.020 inch of its original value.

**3.8.7.3 Electrical Resistance Test**

**3.8.7.3.1 General**

A rail joint shall be fully assembled in accordance with manufacturer’s recommendations on two lengths of rail for an electrical resistance test. The dry rail and joint assembly shall be supported on dry nonelectrical conducting material.

**3.8.7.3.2 Megohmmeter Test (For Qualification and In-plant Acceptance)**

Apply 500 volts, D.C. rail to rail and each rail to one bar, each test for a duration of five (5) seconds according to either of the following:

- a. Method 1: Measure the actual current flow (I) through the joint to the nearest 0.1 microampere and record. Calculate the resistance (R) using the formula:

$$R(\text{ohms}) = \frac{500 \text{ (volts)}}{I(\text{amps})} \text{ where } 1 \text{ megohm} = 1,000,000 \text{ ohms, or}$$

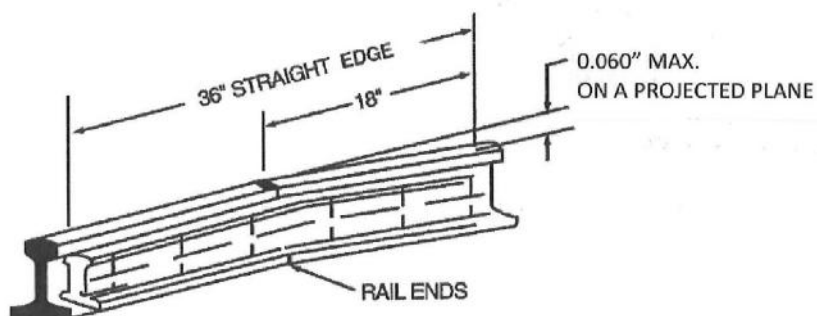


Figure 4-3-16. Elevation of Joint Showing Misalignment Tolerance in Vertical Alignment per Article 3.8.6.2

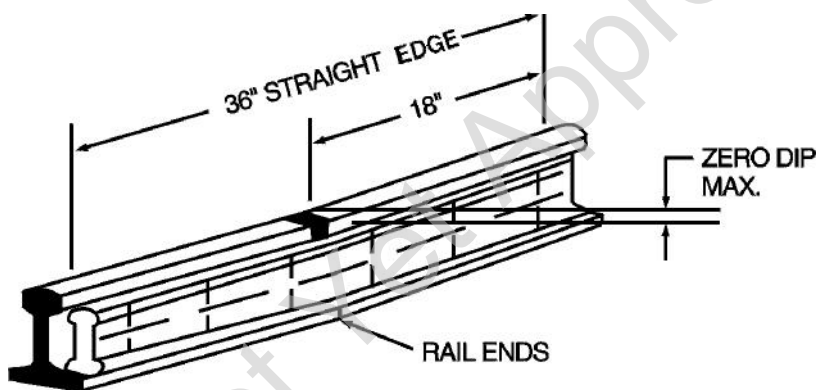


Figure 4-3-17. Elevation of Joint Showing Misalignment Tolerance in Vertical Alignment per Article 3.8.6.2

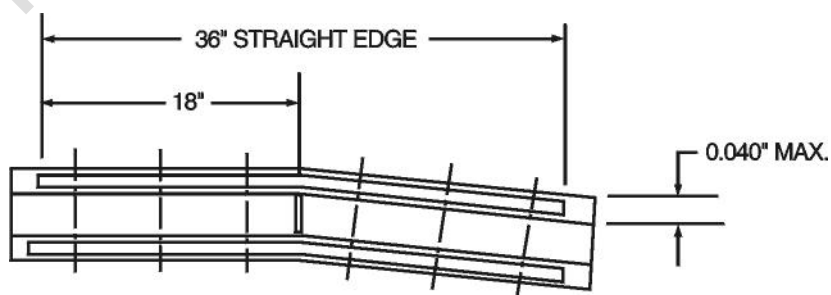


Figure 4-3-18. Plan View of Joint Showing Misalignment Tolerance in Horizontal Alignment per Article 3.8.6.2

- b. Method 2: Use a megohmmeter that reads directly in megohms (resistance).

The acceptance criterion for these tests shall be a minimum resistance of ten (10) megohms.

**3.8.7.3.3 High Potential Test (Qualification only, and for spot checks as specified by the customer.)**

Apply 3000 volts, 60 Hz, A.C. RMS, rail to rail which shall be held for a duration of not less than 60 seconds, or as specified by purchaser.

The acceptance criterion shall be that there shall be no flashover or puncture through the insulation which is evident by the failure to maintain voltage through the time stipulated.

**3.8.7.4 Rolling Load Test (For Qualification Only)**

The bonded joint shall be mounted on a 33 inch stroke rolling load test machine and supported on 36 inch centers with the joint centered between supports.

- a. A wheel load of 44,000 lb shall be applied to the rail. The stroke shall have a range of 33 inches, centered as shown on [Figure 4-3-19](#). The load on the rail shall be applied for 2,000,000 cycles and the deflection of the rail at the centerline of rail shall be measured and recorded when the wheel load is over both points A and B for every 500,000 cycles and recorded to the nearest 0.001 inch.
- b. An alternative method of testing the joint is allowed as shown below:

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### ALTERNATIVE ROLLING LOAD TEST

(Duplicates bending moments of reciprocating-wheel 33" Stroke Rolling Load Test.)

Test joint or weld is supported on 36-inch centers with the joint or weld centered between rail base supports, as shown in Figure 1. Diameter of support pins is two inches, unless otherwise specified. Repeated loads are applied by two electronically-controlled, servo-hydraulic actuators. Loads are applied alternately to the rail head at P1 and P2. Each load varies, unless otherwise specified, from 500 pounds to 44,000 pounds in the approximate shape of a sine curve. One load cycle consists of one application of P1, then P2. A complete test consists of two million load cycles. When requested, rail deflection at point "A" is measured to the nearest 0.001 inch before the test and after every 500,000 cycles.

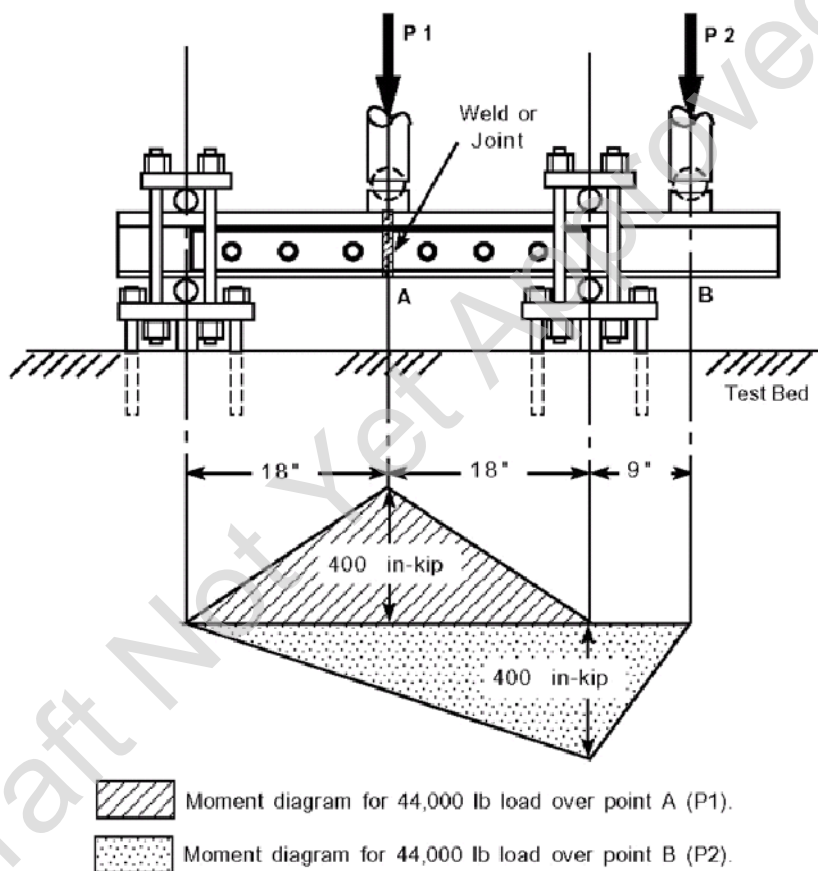


Figure 1- LOADING ARRANGEMENT AND BENDING MOMENT DIAGRAM

#### 3.8.7.5 Acceptance Criteria

At all times the deflection of the bonded insulated joint shall not exceed 0.065 inch.

#### 3.8.8 ACCEPTANCE (1996)

To be accepted, all prefabricated bonded insulated joints and bonded insulated joint materials must fulfill all of the requirements of this specification.



### **3.8.9 PACKAGING AND HANDLING (1996)**

- a. The proposed method of packaging, handling and loading for all items shall be submitted to the purchaser for approval before production is begun.
- b. Prefabricated bonded insulated joints shall be handled and loaded in a manner that will not damage the insulated joint or the rail.

### **3.8.10 MARKING (1996)**

- a. Date of manufacture, name of manufacturer, rail section and metallurgy shall be marked on the joint such that it will remain during the life of the joint.
- b. Rail shall be marked with paint as to length of finished plug, and color coded as to metallurgy. Colors to be as agreed upon between purchaser and manufacturer.

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