SECTION 3.4 SPECIFICATIONS FOR QUENCHED CARBON-STEEL JOINT BARS, MICROALLOYED JOINT BARS, AND FORGED COMPROMISE JOINT BARS[1]

— 2009 —

3.4.1 SCOPE (1994)

These specifications cover quenched carbon steel joint bars, microalloyed joint bars, and forged compromise joint bars for general use in standard railroad tracks.

3.4.2 MANUFACTURE (2005)

a. Melting Practice – The steel shall be made by any of the following processes: open hearth, basic oxygen, or electric furnace.

b. The steel shall be cast by a continuous process, or by other methods agreed upon by the purchaser and the manufacturer.

c. Heating and Quenching – Quenched carbon steel joint bars and forged compromise joint bars shall be uniformly heated for punching, slotting, shaping and forging, and subsequently quenched. Maximum depth of decarburized layer of forged bars shall not exceed 0.040 inch.

d. Microalloyed joint bars shall be produced from hot rolled steel sections. Bars shall be sheared or sawed cold, and holes shall be drilled. No reheating and quenching is required.

3.4.3 CHEMICAL COMPOSITION (2005)

3.4.3.1 Composition

a. The chemical composition of the quenched carbon-steel joint bars and forged compromise joint bars, determined as prescribed in Paragraph 3.4.3.2.a, shall be within the limits shown in Table 4-3-2.

b. Finished material representing the heat may be product tested. The product analysis shall be within the limits for product analyses specified in Table 4-3-2.

c. The chemical composition of the microalloyed joint bars shall be agreed upon by the purchaser and the manufacturer. Microalloying shall be accomplished with columbium, vanadium, and nitrogen, or combinations thereof.

3.4.3.2 Heat or Cast Analysis

a. Separate analysis shall be made from test samples representing one of the first and one of the last three continuously cast blooms, preferably taken during the pouring of the heat. Determinations may be made chemically or spectrographically. Any portion of the heat meeting the chemical analysis requirements of Table 4-3-2 may be applied. Additionally, any material meeting the product analysis limits shown in Table 4-3-2 may be applied against the customer's order after testing such material.

b. The first heat analysis shall be recorded as the official analysis, but the purchaser shall have access to all chemical analysis determinations.

---

[1] Adopted, Vol. 37, 1936, pp. 436, 994; Reference, Vol. 25, 1924, pp. 406, 1283; Vol. 52, 1951, pp. 598, 824; Vol. 54, 1953, pp. 1178, 1413; Vol. 58, 1957, pp. 963, 1248; Vol. 63, 1962, pp. 501, 768; Vol. 64, 1963, pp. 499, 690; Vol. 68, 1967, p. 408; Vol. 70, 1969, p. 197; Vol. 87, 1986, p. 80; Vol. 94, p. 70.

Table 4-3-2. Chemical Composition

Element	Chemical Analysis Weight Percent	Product Analysis Weight Percent Allowance Beyond Limits of Specified Chemical Analysis	
		Under Minimum Limit	Over Minimum Limit
Carbon	0.35 to 0.60	0.040	0.040
Manganese	1.20 max	0.060	0.060
Phosphorus	0.040 max	N/A	0.008
Sulfur	0.050 max	N/A	0.008

c. Upon request by the purchaser, samples shall be furnished to verify the analysis as determined in paragraph a.

3.4.4 TENSILE PROPERTIES (1993)

a. The material shall conform to the following requirements as to tensile properties:

Tensile strength, minimum psi	100,000
Yield point, minimum psi	70,000
Elongation in 2″, minimum percent	12
Reduction of area, minimum percent	25

b. The yield point shall be determined by the drop of the beam or halt in the gage of the testing machine operated at a cross-head speed not to exceed 1/8 inch per minimum. The tensile strength shall be determined at a speed of head not to exceed 1**2** inches per minimum.

3.4.5 BENDING PROPERTIES (2006)

3.4.5.1 Small Specimen Bend Test

The bend test specimen specified in Paragraph 3.4.6 shall stand being bent cold through 90 degrees without cracking on the outside of the bent portion around a pin the diameter of which is not greater than three times the thickness of the specimen.

3.4.5.2 Full Section Bend Test

If preferred by the manufacturer and approved by the purchaser, the following bend test may be substituted for or performed in addition to that described in Article 3.4.5.1. A complete finished bar shall stand being bent cold through 45 degrees without cracking on the outside of the bent portion around a pin the diameter of which is not greater than three times the greatest thickness of the section. The test fixture used shall bend the bar laterally about its center, with the outside surface of the bar being placed on the opposite side from the bending pin.

3.4.6 TEST SPECIMENS (2005)

Tension and bend test specimens shall be taken from the middle of the head at the center of the finished bars. Tension test specimens shall be machined to the form and dimensions shown in Figure 4-3-10. Bend test specimens may be **1/2** inch square in section or rectangular in section with two parallel faces as rolled and with corners rounded to a radius not over 1/16 inch.

The gage length, parallel section and fillets shall be as shown in Figure 4-3-10. Tests shall be conducted in accordance with ASTM A49

NOTE: The ends of the tension test specimens shall be of a shape to fit the testing machine and to ensure axial loading.

3.4.7 NUMBER OF TESTS (1993)

a. One tension test and one bend test shall be made from each lot of 1,000 bars or fraction thereof, but not less than one test for each heat on each day on which quenched carbon steel bars are heated and quenched, or on which microalloyed joint bars are sheared or sawed.

b. If any test specimen shows defective machining or develops flaws it may be discarded and another specimen substituted.

c. If the percentage of elongation of any tension test specimen is less than specified in Article 3.4.4 and any part of the fracture is more than **3/4** inch from the center of the gage length, as indicated by scribe scratches marked on the specimen before testing, a retest of additional specimen shall be allowed as per Article 3.4.8.

3.4.8 RETESTS (1993)

a. If any tensile property of any tension test specimen is less than that specified, and any part of the fracture is outside the middle third of the gage length, as indicated by scribe scratches marked on the specimen before testing, a retest shall be allowed.

b. If the results of an original tension specimen fail to meet the specified minimum requirements and are within 2000 psi of the required tensile strength, within 1000 psi of the required yield point, or within two percentage units of the required elongation, a retest shall be permitted on two random specimens for each original tension specimen failure from the lot. If all results of these retest specimens meet the specified requirements, the lot shall be accepted.

c. If a bend test fails for reasons other than mechanical reasons or flaws in the specimen as described in paragraph d and e, a retest shall be permitted on two random specimens from the same lot. If the results of both test specimens meet the specified requirements, the lot shall be accepted. The retest shall be performed on test specimens that are at air temperature but not less than 60 degrees F.

d. If any test specimen fails because of mechanical reasons such as failure of testing equipment or improper specimen preparation, it may be discarded and another specimen taken.

e. If any test specimen develops flaws, it may be discarded and another specimen of the same size bar from the same lot substituted.

f. For quenched joint bars – If the results of the mechanical tests of any test lot (retests included) do not conform to the requirements specified, the manufacturer may retreat such lot not more than twice, in which case two additional tension tests and two additional bend tests shall be made from such lot, all of which shall conform to the requirements specified.

3.4.9 WORKMANSHIP (1993)

The bars shall be smoothly rolled, or forged, true to template and shall accurately fit the rails for which they are intended and shall provide a true alignment of the gage and running surfaces of the two rails being connected. (Head easement is recommended per Figure 4-3-7, View C) The bars shall be either sheared or sawed to length, and the punching or drilling, and slotting shall conform to the dimensions specified by the purchaser. A variation of ±1/32 inch from the specified size of holes, or ±1/16 inch from the specified location of holes, and of ±**1/8** inch from the specified length of joint bar will be permitted.

Any variation from a straight line in a vertical plane shall be such as will make the bars high in the center. The camber in either plane shall not exceed 1/32 inch in 24 inch bars and 1/16 inch in 36 inch bars.

3.4.10 FINISH (1993)

The material shall be free from injurious defects and shall have a workmanlike finish.

3.4.11 MARKING AND STAMPING (2009)

a. The name or brand of the manufacturer, the rail section designation, and the year of the manufacture shall be either hot stamped on the side of each of the bars or rolled in raised letters and figures on the side of each of the bars. All non-applicable rail section markings shall be removed in a permanent non-damaging manner.

b. For quenched bars, a serial number representing the heat shall be hot stamped on the outside of the web of each bar, near one end.

c. Each compromise joint bar shall also have the rail sections shown at each end along with the word "Gage" or "Out" to indicate on which side of the rail the bar is to be used. (If the compromise joint bars are interchangeable, the words gage and out will be omitted.)

3.4.12 INSPECTION (1993)

The inspector representing the purchaser shall have free entry, at all times while work on the contract of the purchaser is being performed, to all parts of the manufacturer's works which concern the manufacture of the material ordered. The manufacturer shall afford the inspector, without charge, all reasonable facilities to satisfy him that the material is being furnished in accordance with these specifications. All tests (except check analyses) and inspection shall be made at the place of manufacture prior to shipment, unless otherwise specified, and shall be so conducted as not to interfere unnecessarily with the operation of the works.

3.4.13 REJECTION (1993)

a. Material failing to meet the requirements of these specifications will be rejected.

b. Unless otherwise specified, any rejection based on tests made in accordance with Paragraph 3.4.3.1b shall be reported to the manufacturer within five working days from the receipt of samples by the purchaser.

c. Material that shows injurious defects subsequent to its acceptance at the manufacturer's works will be rejected, and the manufacturer shall be notified.

3.4.14 REHEARING (1993)

Samples tested in accordance with Paragraph 3.4.3.1.b that represent rejected material shall be preserved for two weeks from the date of the test report. In case of dissatisfaction with the results of the tests, the manufacturer may request a rehearing within that time.