Designation: A49 – 12 (Reapproved 2019)

Standard Specification for Heat-Treated Carbon Steel Joint Bars, Microalloyed Joint Bars, and Forged Carbon Steel Compromise Joint Bars[1]

This standard is issued under the fixed designation A49; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

This standard has been approved for use by agencies of the U.S. Department of Defense.

1. Scope

1.1 This specification covers heat-treated carbon steel joint bars, microalloyed joint bars, and forged compromise joint bars for general use in standard railroad track.

1.2 The joint bars may be used for the production of insulated joints.

1.3 The values stated in inch-pound units are to be regarded as standard. The values given in parentheses are mathematical conversions to SI units that are provided for information only and are not considered standard.

1.4 *This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the Development of International Standards, Guides and Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.*

2. Referenced Documents

2.1 *ASTM Standards:*[2]

A29/A29M Specification for General Requirements for Steel Bars, Carbon and Alloy, Hot-Wrought

A370 Test Methods and Definitions for Mechanical Testing of Steel Products

A700 Guide for Packaging, Marking, and Loading Methods for Steel Products for Shipment

2.2 *AREMA Publications:*[3]

AREMA Manual for Railway Engineering

3. Ordering Information

3.1 Orders for joint bars under this specification shall include the following information as appropriate:

3.1.1 *Quantity*—number of pairs of bars,

3.1.2 *Type*—design or type bar along with section designation and weight of rails being joined,

3.1.3 *Dimension*—overall length,

3.1.4 *Punching*—type (elliptical, oval, round, or combinations), size, number, location, spacing and elevation of punched holes, with dimensional drawing if necessary,

3.1.5 *Head Easement*—if required, and

3.1.6 *Certification and Test Report Requirements* (see 12.1).

4. Manufacture

4.1 The steel shall be made by one or both of the following processes: basic-oxygen or electric-furnace.

4.1.1 The steel may be cast by a continuous process, or in ingots.

4.2 *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 in.

4.3 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.

5. Chemical Requirements

5.1 The chemical composition of the quenched carbon-steel joint bars and forged compromise joint bars determined as prescribed in 5.3 shall be within the limits shown in Table 1.

5.2 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.

5.3 *Heat or Cast Analysis*—Separate analysis shall be made from test samples representing one of the first three and one of the last three ingots or continuously cast blooms preferably taken during the pouring of the heat. Determinations may be made chemically or spectrographically. Any portion of the heat

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[2] For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

[3] Available from American Railway Engineering and Maintenance-of-Way Association (AREMA), 4501 Forbes Blvd., Suite 130, Lanham, MD 20706, https://www.arema.org.

TABLE 1 Chemical Requirements

Element	Composition, %
Carbon	0.35–0.60
Manganese, max	1.20
Phosphorus, max	0.04
Sulfur, max	0.050

TABLE 2 Product Analyses

Allowance Beyond Limits of Specified Chemical Analysis		
	Percent under min limit	Percent over max limit
Carbon	0.04	0.04
Manganese	0.06	0.06
Phosphorus	. . .	0.008
Sulfur	. . .	0.008

TABLE 3 Tensile Requirements

	ksi	MPa
Tensile strength, min	100	690
Yield point or yield strength, minimum[A]	70	485
Elongation in 2 in. or 50 mm, min, %	12	
Reduction in area, min, %	25	

[A] Determination by either the 0.2 % offset method or the 0.5 % extension-under-load method.

meeting the chemical analysis requirements of Table 1 may be applied. The first heat analysis shall be recorded as the official heat analysis, but the purchaser shall have access to all ladle analyses. Additionally, any material meeting the product analysis limits shown in Table 2 may be applied after testing such material in accordance with Specification A29/A29M.

5.4 *Product Analysis*—When ladle tests are not available, finished material representing the heat may be product tested. The product analysis allowance beyond the limits of the specified ladle analysis shall be within the limits for product analyses specified in Table 2.

5.4.1 An analysis may be made by the purchaser from a sample taken from a finished joint bar representing each heat or cast. The chemical composition thus determined shall conform to the requirements in Table 2.

6. Tensile Requirements

6.1 *Properties:*

6.1.1 The material as represented by a tension test specimen shall conform to the tensile properties prescribed in Table 3.

6.1.2 The yield point prescribed in Table 3 may be determined by the drop of the beam or halt of the gage of the testing machine, or by use of dividers. Where a definite yield point is not exhibited, the yield strength method defined in 6.1.3 shall be used.

6.1.3 The yield strength prescribed in Table 3 shall be determined by a strain gage or extensometer reading to 0.0002 in. (0.005 mm). Yield strength may be defined as the stress at 0.5 % total strain under load or as the stress at 0.2 % offset. The method described in Test Methods and Definitions A370 shall be followed. After the yield point has been passed, the extensometer may then be removed and the test continued to determine the tensile strength.

6.2 *Test Specimens*—The tension test specimen shall be taken from the middle of the head at the center of a finished joint bar, and shall be machined to the form and dimensions for a standard round tension test specimen with 2-in., or 50-mm gage length as described in Test Methods and Definitions A370.

6.3 *Number of Tests*—One tension test shall be made from each lot of 1000 bars or less, but not less than one test from each heat or cast on each day in which bars are heated and quenched. For microalloyed bars, one tension test shall be made from each heat or cast.

6.4 *Retests:*

6.4.1 If the results of the tension test of any test lot for quenched bars do not conform to the specified requirements, the manufacturer may retreat such lot not more than twice, in which case two additional tension tests shall be made from such lot, and both shall conform to the requirements specified in Table 3.

6.4.2 If the results of the tension test for microalloyed bars do not conform to the specified requirements, a retest may be made on two random samples from the heat or cast, and both shall conform to the requirements specified in Table 3.

6.4.3 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.

7. Bending Requirements

7.1 *Properties:*

7.1.1 The material as represented by a bend test specimen shall conform to the bend properties prescribed below.

7.1.2 The bend test 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. If preferred the manufacturer may get approval by the purchaser to substitute a full section bar. It 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.

7.2 *Test Specimens*—The bend test specimen shall be taken from the middle of the head at the center of a finished joint bar, and shall be machined to ½ in. square in section or rectangular in section with two parallel faces as rolled and with corners rounded to a radius not over 1/16 in.

7.3 *Number of Tests*—One bend test shall be made from each lot of 1000 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 micro alloyed joint bars are sheared or sawed.

7.4 *Retests*—If a bend test fails 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.