Designation: A 911/A 911M – 05

Standard Specification for Uncoated, Stress-Relieved Steel Bars for Prestressed Concrete Railroad Ties[1]

This standard is issued under the fixed designation A 911/A 911M; 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.

1. Scope*

1.1 This specification covers uncoated stress-relieved steel bars for use in prestressed concrete railroad ties.

1.2 Supplement I describes low-relaxation bars and relaxation testing for that product. Low-relaxation bars shall be furnished when specifically ordered, and may be furnished in place of regular bars if mutually agreed to by the purchaser and manufacturer.

1.3 This specification is applicable for orders in either inch-pounds units (as Specification A 911) or in SI units (as Specification A 911M).

1.4 The values stated in either inch-pound units or SI units are to be regarded separately as standards. Within the text, the SI units are shown in brackets. The values stated in each system are not exact equivalents; therefore, each system must be used independently of the other. Combining values from the two systems may result in nonconformance with the specification.

2. Referenced Documents

2.1 *ASTM Standards:* [2]

A 370 Test Methods and Definitions for Mechanical Testing of Steel Products

E 328 Methods for Stress-Relaxation Tests for Materials and Structures

2.2 *Federal Standard:*

Fed. Std. No. 123 Marking for Shipments (Civil Agencies)[3]

2.3 *Military Standards:*

MIL-STD-129 Marking for Shipment and Storage[3]

MIL-STD-163 Steel Mill Products Preparation for Shipment and Storage[3]

3. Terminology

3.1 *Definitions of Terms Specific to This Standard:*

3.1.1 *lot*, *n*—all the coils of bars of the same nominal bar size contained on an individual shipping release or shipping order, from the same cast or heat of steel.

4. Ordering Information

4.1 It shall be the responsibility of the purchaser to specify all requirements that are necessary for bars ordered to this specification. Such requirements shall include, but are not limited to, the following:

4.1.1 Quantity (weight) [mass],

4.1.2 Name of material (uncoated, stress-relieved bars for prestressed concrete railroad ties),

4.1.3 Diameter of bar (inches) [millimetres],

4.1.4 Packaging,

4.1.5 ASTM designation and year of issue, and

4.1.6 Special requirements, if any.

NOTE 1—A typical ordering description is as follows: 100 tons [90 t] uncoated, stress-relieved steel bars for prestressed concrete railroad ties, 0.394-in. [10-mm] diameter bars in 6.5-ft [2.0-m] diameter coils to ASTM A XXX – [A XXXM –].

5. Manufacture

5.1 The bars shall be made from properly identified heats of steel made by the electric-furnace, the open-hearth, or the basic oxygen process.

5.2 After hot-rolling, the bars shall be cold-drawn and finally stress-relieved by induction heat treatment to produce the desired mechanical properties and then coiled.

6. *Chemical Requirements* Chemical Requirements

6.1 An analysis of each heat of steel shall be made by the manufacturer from test samples taken during the pouring of each heat.

6.2 The analysis of the steel shall conform to the chemical requirements specified in Table 1.

[1] This specification is under the jurisdiction of ASTM Committee A01 on Steel, Stainless Steel, and Related Alloys and is the direct responsibility of Subcommittee A01.05 on Steel Reinforcement.

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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 Standardization Documents Order Desk, Bldg. 4 Section D, 700 Robbins Ave., Philadelphia, PA 19111-5094, Attn: NPODS.

***A Summary of Changes section appears at the end of this standard.**

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TABLE 1 Chemical Requirements

Element	Composition, %
Carbon	0.70–0.90[A]
Silicon	0.10–0.35
Manganese	0.50–0.90[B]
Chromium, max	0.15
Phosphorus, max	0.030
Sulphur, max	0.035
Copper, max	0.30

[A]Carbon in any one lot shall not vary more than 0.13 %.
[B]Manganese in any one lot shall not vary more than 0.30 %.

7. Mechanical Requirements

7.1 *Test Method*—Tests shall be made in accordance with Test Methods and Definitions A 370, including Annex A4, using full-size bar specimens taken from either end of the coil of the finished product.

7.2 *Tensile Strength*—The minimum tensile strength of the finished bar, as represented by test specimens, shall conform to the requirements prescribed in Table 2.

7.3 *Yield Strength*—Yield strength shall be measured at 1 % extension under load. The load at this extension is recorded as yield strength and shall meet the requirements of Table 2.

7.4 *Elongation*—The total elongation after rupture shall not be less than 6.0 % and shall be measured in a gage length of 4 in. [100 mm].

7.5 *Wrapping Test*—Bars shall withstand being wound around a mandrel with a diameter of five times the bar diameter without cracking or other surface defects occurring on the outside of the bent portion. The bar shall be bent around the mandrel 1½ turns beginning with a 90° bend.

8. Dimensions and Permissible Variations

8.1 The size of the finished bar shall be expressed as the nominal diameter of the bar in decimals of an inch [millimeter]. The required initial diameters before cold-drawing, and the final diameters after cold-drawing shall be as follows:

Initial Diameter	Final Diameter
0.591 in. [15 mm]	0.370 in. [9.4 mm]
0.614 in. [15.6 mm]	0.394 in. [10 mm]
0.654 in. [16.6 mm]	0.413 in. [10.5 mm]

8.2 *Permissible Variations in Diameter*:

8.2.1 All bars shall conform to a size tolerance of ±0.002 in. [±0.05 mm] from the nominal diameter.

8.3 *Out of Round*—The difference between the largest and smallest diameter, measured at the same section, shall not be greater than 0.002 in. [0.04 mm].

9. Workmanship, Finish, and Appearance

9.1 *Joints*:

TABLE 2 Mechanical Requirements

Yield strength, min	200 ksi [1375 MPa]
Tensile strength, min	228 ksi [1570 MPa]
Ratio of yield strength to tensile strength, max	0.95
Elongation after rupture in a gage length of 4 in. [100 mm], min	6.0 %
Reduction of area, min	30.0 %

TABLE 3 Relaxation Requirements

f_{pi}/f_{pu}[A]	Max Stress Losses after 1000 h, %
0.50	1.0
0.60	1.0
0.70	2.5
0.80	5.0

[A]f_{pi} = initial prestress load, and
f_{pu} = specified minimum tensile strength.

9.1.1 There shall be no welds or joints in the finished bar. Any welds or joints made during manufacture to promote continuity of operations shall be removed.

9.2 The finished bar shall be uniform in diameter in conformance with Section 8 and shall be free of imperfections not consistent with good commercial practice.

9.3 *Straightness*—After uncoiling, there shall be no residual out of line deformation greater than 0.4 in. [10 mm] in a length of 40 in. [1000 mm].

10. Sampling

10.1 Test specimens taken from either end of the coil are permitted. Any specimen found to contain a joint shall be discarded and a new specimen obtained.

11. Number of Tests

11.1 One test specimen each for the tensile test and the wrapping test shall be taken for each 10 coils or fraction thereof in a lot.

12. Inspection

12.1 The purchaser shall be allowed to request that a representative inspect or witness the inspection and testing of the material prior to shipment. Such agreement shall be made by the purchaser and manufacturer as part of the purchase contract.

12.2 When such inspection or witness of inspection and testing is agreed upon, the purchaser's representative shall be afforded reasonable access to facilities to assure that the material meets the requirements of this specification. Inspection and tests shall be conducted so as to avoid unnecessary interference with the manufacturer's operations.

13. Rejection and Rehearing

13.1 Failure of any test specimen to comply with the requirements of this specification shall constitute grounds for rejection of the lot represented by the specimen.

13.2 The manufacturer shall be allowed to resubmit the lot for inspection by testing a sample from each reel and sorting out nonconforming material.

13.3 In the event that testing of any individual sample results in a reasonable doubt as to the ability of the bar to satisfy any requirement of this specification, two additional tests shall be made on samples of bar from the same reel, and if failure occurs in either of these tests, the represented coil shall be rejected.

14. Certification

14.1 In the event that outside inspection is waived, a manufacturer's certification that the material has been tested in

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accordance with and meets the requirements of this specification shall be the basis of acceptance of the material.

14.2 The manufacturer shall, when requested in the order, furnish a representative load-elongation curve for each size shipped.

14.3 A material test report, certificate of inspection, or similar document printed from or used in electronic form from an electronic data interchange (EDI) transmission shall be regarded as having the same validity as a counterpart printed in the certifier's facility. The content of the EDI transmitted document must meet the requirements of the invoked ASTM standard(s) and conform to any existing EDI agreement between the purchaser and the supplier. Notwithstanding the absence of a signature, the organization submitting the EDI transmission is responsible for the content of the report.

NOTE 2—The industry definition as invoked here is: EDI is the computer-to-computer exchange of business information in a standard format such as ANSI ASC X12.

15. Product Marking and Packaging

15.1 The bars shall be furnished in coils having a minimum core diameter of 6.5 ft [2.0 m], for bars of 0.370 in. [9.4 mm] diameter and a minimum core diameter of 8.0 ft [2.4 m] for bars of 0.394 in. [10 mm] and 0.413 [10.5 mm] diameter, unless otherwise specified by the purchaser. Lengths of coils shall be as agreed upon at the time of purchase. Each coil shall be identified with two strong tags securely attached showing the length, size, grade, ASTM designation, and the name or mark of the manufacturer.

15.2 Low-relaxation bars produced in accordance with the requirements of Supplement I shall be specially identified.

15.3 *For Government Procurement Only*— When specified in the contract or order, and for direct procurement by or direct shipment to the United States government, material shall be preserved, packaged, and packed in accordance with the requirements of MIL-STD-163. The applicable levels shall be as specified in the contract. Marking for shipment of such material shall be in accordance with Fed. Std. No. 123 for use by civil agencies and MIL-STD-129 for use by military agencies.

16. Transportation and Storage

16.1 The bars shall be well-protected using good commercial practice against mechanical injury and contamination in shipping as mutually agreed upon by the purchaser and manufacturer at the time of purchase. The coils shall not be exposed to weather during transportation or storage. Storage areas shall be free from aggressive elements such as chlorides, nitrates, fertilizers, acids, or other deleterious materials. Corrosion preventing coatings shall be allowed to be used to afford protection against corrosion, but assurance shall be made that the corrosion inhibitor can be removed with suitable solvents by the purchaser. Steel with rust, which can be removed with a soft, dry rag, shall not be cause for rejection. Steel with pitted rust shall be subject to rejection.

17. Keywords

17.1 prestressed concrete; railroad ties; steel bars, stress-relieved

SUPPLEMENTARY REQUIREMENTS

I. LOW-RELAXATION BARS

S1 Scope

S1.1 This supplement delineates only those details that are peculiar to low-relaxation bars, and to the methods of relaxation testing related to bars having properties generally as described in Specification A 911/A 911M.

S2 Test Method

S2.1 Low-relaxation bars shall be tested as prescribed in Method E 328.

S3 Relaxation Properties

S3.1 Low-relaxation bars shall meet the mechanical property requirements of this specification, with the added requirements listed in Table 3.

S4 Yield Strength

S4.1 Yield strength of low-relaxation bars, as described in 7.3, shall not be less than 90 % of the specified minimum breaking strength of the bar.

S5 Conditions of Relaxation Test

S5.1 If required, relaxation evidence shall be provided from the manufacturer's records of tests on similarly dimensioned bars.

S5.2 The temperature of the test specimen shall be maintained at 68 ± 3.5°F [20 ± 2°C].

S5.3 The test specimen shall not be subjected to loading prior to the relaxation test.

S5.4 The initial load shall be applied uniformly over a period of not less than 3 min and not more than 5 min, and the gage length shall be maintained constant; load relaxation readings shall commence 1 min after application of the total load.

S5.5 Overstressing of the test specimen during the loading operation shall not be permitted.

S5.6 It is desirable to have a test gage length of at least 60 times the nominal diameter. If this gage length cannot be used due to limitations in the capacity of the extensometer or testing machine, a shorter gage length may be used. The minimum allowable gage length is 40 times the nominal diameter.

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SUMMARY OF CHANGES

Committee A01 has identified the location of selected changes to this standard since the last issue (A 911/A 911M–99) that may impact the use of this standard.

(1) Revised 10.1 to enhance the wording.

(2) Revised S5.2, S5.3 and S5.5 for consistency.

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