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American Association State Highway and Transportation Officials Standard AASHTO No.: M 204

Standard Specification for Uncoated Stress-Relieved Steel Wire for Prestressed Concrete[1]

This standard is issued under the fixed designation A 421/A 421M; 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 Department of Defense.

1. Scope*

1.1 This specification covers two types of uncoated stress-relieved round high-carbon steel wire commonly used in prestressed linear concrete construction, as follows:

1.1.1 *Type BA* wire is used for applications in which cold-end deformation is used for anchoring purposes (Button Anchorage), and

1.1.2 *Type WA* wire is used for application in which the ends are anchored by wedges, and no cold-end deformation of the wire is involved (Wedge Anchorage).

1.2 Supplement I describes low relaxation wire and relaxation testing for that product.

1.3 The values stated in either inch-pound or SI units are to be regarded as standard. Within the text, the inch-pound units are shown in parentheses. The values stated in each system are not exact equivalents; therefore, each system shall be used independently of the other, without combining values in any way.

2. Referenced Documents

2.1 *ASTM Standards:*[2]

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

E 30 Test Methods for Chemical Analysis of Steel, Cast Iron, Open-Hearth Iron, and Wrought Iron[3]

E 328 Test Methods for Stess Relaxation Tests for Materials and Structures

2.2 *Military Standards:*

MIL-STD-129 Marking for Shipment and Storage[4]

MIL-STD-163 Steel Mill Products, Preparation for Shipment and Storage[4]

2.3 *Federal Standard:*

Fed. Std. No. 123 Marking for Shipments (Civil Agencies)[4]

3. Ordering Information

~~3.1Orders for stress-relieved wire under this specification should include the following information:~~

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

3.1.1 Quantity (kg [lb]),

3.1.2 Diameter,

3.1.3 Type of anchorage (BA or WA),

3.1.4 Packaging,

3.1.5 ASTM designation and date of issue, and

3.1.6 Special requirements, if any.

NOTE 1—A typical ordering description is as follows: 10 000 kg of 6.35-mm diameter wire, Type BA in approximately 450 kg 1.5-m diameter coils

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[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* ~~, Vol 01.03.~~volume information, refer to the standard's Document Summary page on the ASTM website.

~~[3] Discontinued. See *1995 Annual Book of ASTM Standards* , Vol 03.05.~~

[3] Withdrawn.

~~[4] Annual Book of ASTM Standards, Vol 03.01.~~

[4] 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.**

to ASTM A 421/A 421M– _____(22 000 lb 0.250-in. diameter wire, Type BA in approximately 1000 lb 60-in. diameter coils to ASTM A 421/A 421M–_____).

4. Manufacture

4.1 *Process*—The steel shall be made by the basic-oxygen, open-hearth, or electric-furnace process.

4.2 *Internal Soundness*—A sufficient discard shall be made to ensure freedom from injurious piping and undue segregation.

4.3 *Wire*—The wire shall be cold-drawn to size and suitably stress relieved after cold drawing by a continuous heat treatment to produce the prescribed mechanical properties.

5. Physical Requirements

5.1 *Tensile Strength*—The tensile strength of Type BA wire and Type WA wire shall conform to the requirements prescribed in Table 1, and shall be determined as prescribed in Test Methods and Definitions A 370, including Annex A4.

5.2 *Yield Strength*:

5.2.1 The minimum yield strength for all wire, measured by the 1.0 % extension under load method, shall not be less than 85 % of the specified minimum breaking strength.

5.2.2 The extension under load shall be measured by an extensometer calibrated with the smallest division not larger than 0.0001 mm/mm (0.0001 in./in.) of gage length.

5.2.3 The initial load corresponding to the initial stress prescribed in Table 2 shall be applied to the specimen, at which time the extensometer is attached and adjusted to a reading of 0.001 mm/mm (0.001 in./in.) of gage length. The load shall then be increased until the extensometer indicates an extension of 1 %. The load for this extension shall be recorded. The stress corresponding to this load shall meet the requirements for stress at 1 % extension prescribed in Table 2.

5.3 *Elongation*—The total elongation under load of all wire shall not be less than 4.0 % when measured in a gage length of 250 mm (10 in.). The elongation shall be determined by an extensometer which is placed on the test specimen after a load corresponding to the initial stress prescribed in Table 2 ~~is applied. If the fracture takes place outside of the gage length, the elongation value obtained may not be representative of the material. If the elongation so measured meets the minimum requirements specified, no further testing is indicated; but if the elongation is less than the minimum requirements, the test shall be discarded and a retest made.~~ is applied. If the fracture takes place outside of the gage length and the elongation so measured meets the minimum requirements, no further testing shall be required. If the elongation is less than the minimum requirements, the test shall be considered an invalid test and a retest made.

6. Diameter and Permissible Variations

6.1 Wire meeting the requirements of this specification is normally ordered in the diameters shown in Table 1.

6.2 The diameter of the wire shall not vary from the nominal diameter specified by more than ± 0.05 mm (0.002 in.).

6.3 The wire shall not be out-of-round by more than 0.05 mm (0.002 in.).

7. Workmanship and Finish

7.1 *Cast*—A wire sample having a chord length of 1524 mm (60 in.) shall have an offset at the center of the chord of not more than 76 mm (3 in.). This is equivalent to a chord of an arc of a circle not less than 7.6 m (25 ft) in diameter.

7.2 *Type BA Wire*—Type BA wire shall be of suitable quality to permit cold forming of buttons for anchorage. Splitting shall not be considered a cause for rejection if the button anchorage is capable of developing the minimum required tensile strength of the wire.

7.3 The wire shall be free of kinks.

7.4 The wire shall be furnished in firmly tied coils having a minimum inside diameter of 1219 mm (48 in.). Each coil shall be of one continuous length.

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

7.6 The wire shall not be oiled or greased. Slight rusting, provided it is not sufficient to cause pits visible to the naked eye, shall not be cause for rejection.

7.7 Temper colors which result from the stress-relieving operation are considered normal for the finished appearance of this strand.

TABLE 1 Tensile Strength Requirements

Nominal Diameter, mm (in.)	Tensile Strength, min, MPa (psi)	
	Type BA	Type WA
4.88 (0.192)	[A]	1725 (250 000)
4.98 (0.196)	1655 (240 000)	1725 (250 000)
6.35 (0.250)	1655 (240 000)	1655 (240 000)
7.01 (0.276)	1620 (235 000)	1620 (235 000)

[A] This size is not commonly furnished in Type BA wire.