SPECIFICATION FOR STEEL WIRE, PRESSURE VESSEL WINDING

SA-905

(Identical with ASTM Specification A905-93.)

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1. Scope

1.1 This specification covers requirements for a high strength drawn and cold rolled steel wire in two strength classes, with rectangular cross section, and round mill edge. This wire is intended for prestressed vessel and press frame windings.

1.2 The values stated in either inch-pound units or SI (metric) units are to be regarded separately as standards. Within the text and tables, the SI units are shown in parentheses. The values stated in each system are not exact equivalents. Therefore, each system must be used independent of the other. Combining values from the two systems may result in nonconformance with the specification.

2. Referenced Documents

2.1 *ASTM Standards:*

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

A 510 Specification for General Requirements for Wire Rods and Coarse Round Wire, Carbon Steel

A 510M Specification for General Requirements for Wire Rods and Coarse Round Wire, Carbon Steel [Metric]

A 700 Practices for Packaging, Marking, and Loading Methods for Steel Products for Domestic Shipment

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

E 309 Practice for Eddy-Current Examination of Steel Tubular Products Using Magnetic Saturation

2.2 *Military Standard:*

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

2.3 *Federal Standard:*

Fed. Std. No. 123 Marking for Shipment (Civil Agencies)

2.4 *AIAG Standard:*

AIAG B-502.00 Primary Metals Identification Tag Application Standard

3. Ordering Information

3.1 Material furnished under this specification shall conform to the applicable requirements of the current edition of Specification A 510 or A 510M.

3.2 Orders for material under this specification shall include the following information for each ordered item.

3.2.1 Quantity (mass),

3.2.2 Name of material,

3.2.3 Dimensions (see Section 7),

3.2.4 Finish (see Section 8),

3.2.5 Packaging (see Section 11),

3.2.6 Heat analysis report (see 5.2),

3.2.7 Number of certification and test reports required,

3.2.8 ASTM designation and year of issue, and

3.2.9 Supplementary requirements, if any.

4. Material and Manufacture

4.1 The steel shall be produced by any of the following primary processes: (1) basic oxygen, and (2) electric furnace or vacuum induction (VIM). The primary melting may incorporate separate degassing or refining and may be followed by secondary melting by the electrode slag process (ESR) or the vacuum arc remelting process (VAR).

4.1.1 The steel may be ingot cast or continuously cast.

4.2 The finished wire shall be free from detrimental pipe and undue segregation.

4.3 The wire shall be cold drawn or cold rolled, or both, to produce the desired mechanical properties and dimensions after subjecting it to the patenting treatment.

4.4 The width to thickness ratio of the wire cross section shall not exceed 8.

5. Chemical Composition

5.1 The steel shall conform to the requirements for chemical composition prescribed in Table 1.

5.2 *Heat Analysis* — Each heat of steel shall be analyzed by the manufacturer to determine the percentage of elements prescribed in Table 1. This analysis shall be made from a test specimen preferably taken during the pouring of the heat. When requested, this shall be reported to the purchaser and shall conform to the requirements of Table 1.

5.3 *Heat Number Assignment for Sequentially Strand Cast Material* — When heats of the same chemical composition are sequentially strand cast, the heat number assigned to the cast product may remain unchanged until all of the steel in the product is from the following heat.

5.4 *Product Analysis* — An analysis may be made by the purchaser from finished wire representing each heat of steel. The chemical composition thus determined, as to elements required or restricted, shall conform to the product analysis requirements specified in Table 10 of Specification A 510 or A 510M.

5.5 For referee purposes, Methods E 30 shall be used.

6. Mechanical Requirements

6.1 *Tension Test:*

6.1.1 *Requirements*— The material as represented by tension test specimens shall conform to the requirements prescribed in Table 2.

6.1.2 *Number of Tests* — One test specimen shall be taken from each end of every coil.

6.1.3 *Test Method* — The tension test shall be made in accordance with Test Methods A 370, except that the length L for evaluation of the elongation shall be calculated from the following formula:

$$L = 11.3 \sqrt{W \cdot T}$$

where:

W = width of the wire, and
T = thickness of the wire.

The length L shall be used to calculate the permanent elongation. The distance between the gage marks shall be measured to the nearest 0.004 in. (0.1 mm). Determine tensile properties and permanent elongation as described in Test Methods A 370.

6.1.4 *Retest* — If any test specimen exhibits obvious discontinuity, it may be discarded and another specimen substituted.

7. Dimensions and Permissible Variations

7.1 The permissible variations in dimensions of the wire shall be as specified in Table 3, unless otherwise specified in the ordering information.

8. Workmanship, Finish, and Appearance

8.1 The wire shall be free of detrimental surface imperfections, tangles and sharp kinks.

8.2 The wire shall conform to the dimensions, tolerances, and finish specified on the order or drawing. Welds are not permitted.

8.3 When required, non-destructive examination shall be carried out in accordance with Supplementary Requirement S1.

8.4 The wire as received shall be smooth and substantially free from rust. No detrimental die marks or scratches may be present.

9. Inspection

9.1 All tests and inspections shall be made at the place of manufacture unless otherwise agreed upon, and shall not interfere unnecessarily with the manufacturer's operations. The manufacturer shall afford the purchaser's inspector all reasonable facilities necessary to satisfy him that the material is being produced and furnished in accordance with this specification.

10. Certification and Reports

10.1 The manufacturer shall furnish the required number, from the purchase order, of test reports to the purchaser. The following items shall be reported.

10.1.1 Heat number,

10.1.2 Heat chemical analysis,

10.1.3 Result of test of tensile properties,

10.1.4 Reports of non-destructive tests, if required (S.1), and

10.1.5 ASTM specification number, year of issue and revision letter, if any.

11. Packaging, Marking, and Loading for Shipment

11.1 The coil, reel or spool mass, dimensions, and the method of packaging shall be agreed upon between the manufacturer and purchaser.

11.2 The size of the wire, purchaser's order number, ASTM specification number, and name or mark of the manufacturer shall be marked on a tag securely attached to each coil, reel, or spool of wire.

11.3 Unless otherwise specified in the purchaser's order, packaging, marking, and loading for shipments shall be in accordance with those procedures recommended by Practices A 700.

11.4 *For Government Procurement* — Packaging, packing, and marking of material for military procurement shall be in accordance with the requirements of MIL-STD-163, Level A, Level C, or commercial as specified in the contract or purchase order. Marking for shipment of material for civil agencies shall be in accordance with Fed. Std. No. 123.

11.5 *Bar Coding* — In addition to the previously-stated identification requirements, bar coding is acceptable as a supplementary identification method. Bar coding should be consistent with AIAG Standard 02.00, Primary Metals Identification Tag Application. The bar code may be applied to a substantially affixed tag.

12. Keywords

12.1 pressure vessel; winding; wire

TABLE 1
CHEMICAL REQUIREMENTS

Element	Composition %
Carbon	0.80–0.95
Manganese	0.30–0.60
Phosphorus	0.025
Sulphur, max	0.020
Silicon	0.10–0.30

TABLE 2
TENSILE REQUIREMENTS

Thickness[A] in. (mm)	Tensile Strength min, ksi (MPa)		Yield Strength min, ksi (MPa)		Elongation min, %	
	Class 1	Class 2	Class 1	Class 2	Class 1	Class 2
0.020 (051)	296 (2045)	268 (1850)	260 (1795)	232 (1600)	4.0	5.0
0.030 (0.76)	290 (2000)	262 (1810)	255 (1760)	226 (1560)	4.0	5.0
0.040 (1.02)	285 (1965)	256 (1770)	250 (1725)	221 (1525)	4.0	5.0
0.051 (1.30)	280 (1930)	250 (1725)	243 (1680)	214 (1480)	4.0	5.0
0.059 (1.50)	275 (1900)	246 (1700)	239 (1650)	210 (1450)	4.0	5.0

[A] Tensile requirement values for intermediate thickness may be interpolated.

TABLE 3
PERMISSIBLE VARIATIONS IN DIMENSIONS

Thickness in. (mm)	Permissible Variation, ± in. (mm)
0.02 to 0.03 (0.51 to 0.76), incl	0.0004 (0.01)
Over 0.03 to 0.04 (0.76 to 1.02), incl	0.0008 (0.02)
Over 0.04 to 0.06 (1.02 to 1.52), incl	0.0012 (0.03)
Width in. (mm)	**Permissible Variation, ± in. (mm)**
0.08 to 0.16 (2.03 to 4.06), incl	0.0016 (0.04)
Over 0.16 to 0.24 (4.06 to 6.10), incl	0.0024 (0.06)
Over 0.24 to 0.48 (6.10 to 12.2), incl	0.0040 (0.10)

SUPPLEMENTARY REQUIREMENTS

Supplementary requirements to this specification shall only apply to a product specification when specified by the purchaser in his inquiry, contract or order. Details of the supplementary requirements shall be agreed upon in writing between the manufacturer and purchaser.

S1. Surface Examination

S1.1 The surface of the wire shall be examined by the eddy current method in accordance with Practice E 309. The acceptance criteria shall be mutually agreed upon by the purchaser and manufacturer.