Designation: A 905 – 04

Standard Specification for Steel Wire, Pressure Vessel Winding[1]

This standard is issued under the fixed designation A 905; 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 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:* [2]

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

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[4]

2.3 *Federal Standard:*

Fed. Std. No. 123 Marking for Shipment (Civil Agencies)[6]

2.4 *AIAG Standard:*

AIAGB-5 02.00 Primary Metals Identification Tag Application Standard[5]

3. Ordering Information

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

3.1.1 Quantity (mass),

3.1.2 Name of material,

3.1.3 Dimensions (see Section 7),

3.1.4 Finish (see Section 8),

3.1.5 Packaging (see Section 11),

3.1.6 Cast or heat analysis report (see Section 5),

3.1.7 Number of certification or test reports required (see Section 10),

3.1.8 ASTM designation and year of issue, and

3.1.9 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

[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 A01.03 on Steel Rod and Wire.

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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] Withdrawn.

[4] Available from Standardization Documents Order Desk, DODSSP, Bldg. 4, Section D, 700 Robbins Ave., Philadelphia, PA 19111-5098

[5] Available from Automotive Industry Action Group (AIAG), 26200 Lahser Rd., Suite 200, Southfield, MI 48034.

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

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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

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 *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.

5.4 For referee purposes, Test 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 and Definitions 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 and Definitions A 370.

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

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.

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 The manufacturer shall afford the purchaser's inspector all reasonable facilities to satisfy him that the material is being produced and furnished in accordance with this specification. All tests and inspections may be made at the place of manufacture prior to shipment and shall be so conducted as to not interfere unnecessarily with the operation of the work.

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.

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)

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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

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.

SUMMARY OF CHANGES

Committee A01 has identified the location of selected changes to this standard since the last issue, A 905 – 93 (1998), that may impact the use of this standard. (Approved Sept. 1, 2004.)

(*1*) Revised Section 3 to use mandatory language.
(*2*) Deleted 5.3.
(*3*) Revised 9.1.

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