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AEROSPACE MATERIAL SPECIFICATION

AMS 5115F
Superseding AMS 5115E

Issued 3-1-42
Revised 7-1-83

CARBON STEEL WIRE
Valve Spring Quality
0.60 - 0.75C
Hardened and Tempered

UNS G10700

1. SCOPE:

1.1 Form: This specification covers a carbon steel in the form of wire supplied as coils of wire or as finished springs.

1.2 Application: Primarily for springs, such as valve springs, subject to moderate stresses and requiring good fatigue properties.

2. APPLICABLE DOCUMENTS: The following publications form a part of this specification to the extent specified herein. The latest issue of Aerospace Material Specifications (AMS) shall apply. The applicable issue of other documents shall be as specified in AMS 2350.

2.1 SAE Publications: Available from SAE, 400 Commonwealth Drive, Warrendale, PA 15096.

2.1.1 Aerospace Material Specifications:

AMS 2259 - Chemical Check Analysis Limits, Wrought Low-Alloy and Carbon Steels
AMS 2350 - Standards and Test Methods
AMS 2370 - Quality Assurance Sampling of Carbon and Low-Alloy Steels, Wrought Products Except Forgings and Forging Stock
AMS 2430 - Shot Peening
AMS 2640 - Magnetic Particle Inspection

2.2 ASTM Publications: Available from American Society for Testing and Materials, 1916 Race Street, Philadelphia, PA 19103.

ASTM A370 - Mechanical Testing of Steel Products
ASTM E350 - Chemical Analysis of Carbon Steel, Low-Alloy Steel, Silicon Electrical Steel, Ingot Iron, and Wrought Iron

2.3 U.S. Government Publications: Available from Commanding Officer, Naval Publications and Forms Center, 5801 Tabor Avenue, Philadelphia, PA 19120.

2.3.1 Federal Standards:

Federal Test Method Standard No. 151 - Metals; Test Methods

2.3.2 Military Standards:

MIL-STD-163 - Steel Mill Products, Preparation for Shipment and Storage
MIL-STD-794 - Parts and Equipment, Procedures for Packaging and Packing of

3. TECHNICAL REQUIREMENTS:

3.1 Composition: Shall conform to the following percentages by weight, determined by wet chemical methods in accordance with ASTM E350, by spectrographic methods in accordance with Federal Test Method Standard No. 151, Method 112, or by other analytical methods approved by purchaser:

	min	max
Carbon	0.60 -	0.75
Manganese	0.50 -	0.90
Silicon	0.10 -	0.30
Phosphorus	--	0.025
Sulfur	--	0.030

3.1.1 Check Analysis: Composition variations shall meet the applicable requirements of AMS 2259.

3.2 Condition: The product shall be supplied in the following condition:

3.2.1 Wire: Cold drawn, hardened, and tempered.

3.2.2 Springs: Stress relieved, after coiling, by heating to 725° - 750°F (385° - 400°C), holding at heat for not less than 1 hr, and cooling in air. When permitted by purchaser, other stress relieving treatments may be used.

3.3 Properties: The product shall conform to the following requirements:

3.3.1 Wire:

3.3.1.1 Tensile Properties: Shall be as shown in Table I, determined in accordance with ASTM A370:

TABLE I

Nominal Diameter Inch	Tensile Strength, psi	Reduction of Area %, min
0.093 to 0.120, incl	210,000 - 230,000	45
Over 0.120 to 0.148, incl	205,000 - 225,000	45
Over 0.148 to 0.192, incl	200,000 - 220,000	45
Over 0.192 to 0.250, incl	195,000 - 215,000	45

TABLE I (SI)

Nominal Diameter Millimetres	Tensile Strength, MPa	Reduction of Area %, min
2.30 to 3.00, incl	1450 - 1585	45
Over 3.00 to 3.70, incl	1415 - 1550	45
Over 3.70 to 4.80, incl	1380 - 1515	45
Over 4.80 to 6.25, incl	1345 - 1480	45

3.3.1.1.1 Square wire shall have tensile strength within the limits specified in Table I; the reduction of area requirement does not apply.

3.3.1.1.2 Tensile property requirements for wire under 0.093 in. (2.30 mm) or over 0.250 in. (6.25 mm) in nominal diameter shall be as agreed upon by purchaser and vendor.

3.3.1.2 Twist: A sample of wire, approximately 10 in. (250 mm) long, twisted 7 turns forward and then reversed until failure shall show a square break normal to the axis of the wire without splits or cracks.

3.3.1.3 Decarburization: The surface of the wire shall exhibit no ferritic area when transverse sections of the wire are mounted, micro-etched, and examined at 100X magnification.

3.3.1.4 Etching: Visual examination, at 7 - 10X magnification, of surfaces of sections of wire, etched in hot hydrochloric acid (1:1) at 160° - 180°F (70° - 80°C) for sufficient time to remove approximately 1% of the nominal diameter or thickness of the wire, shall show no evidence of pits, cracks, laps, injurious die marks, torn surfaces, or other imperfections detrimental to usage in springs. Coils from which defective samples are taken shall be subject to rejection; if 25% or more of the coils from a lot are rejected, the entire lot shall be rejected.

3.3.2 Springs: Shall have properties as agreed upon by purchaser and vendor.

3.3.2.1 Shot Peening: When specified, springs shall be peened in accordance with AMS 2430 to obtain uniform coverage of the entire surface of each spring. Shot size and peening intensity shall be as agreed upon by purchaser and vendor.

3.4 Quality:

3.4.1 Wire: Shall, as received by purchaser, be uniform in quality and condition, sound, smooth, and free from seams, pits, nicks, scratches, and other imperfections detrimental to usage of the wire.

3.4.2 Finished Springs:

3.4.2.1 The surface of finished springs shall be uniform and free from pits, nicks, scratches, and marks due to grinding, drawing, or coiling, and from other imperfections detrimental to performance of the springs.

3.4.2.2 Each spring shall be subjected to magnetic particle inspection in accordance with AMS 2640. The inspection procedure and standards for acceptance shall be as agreed upon by purchaser and vendor.

3.5 Tolerances: Unless otherwise specified, tolerances shall conform to the following:

3.5.1 Diameter: Shall be as shown in Table II.

TABLE II

Nominal Diameter Inch	Tolerance, Inch plus and minus
0.093 to 0.148, incl	0.001
Over 0.148 to 0.177, incl	0.0015
Over 0.177 to 0.250, incl	0.002

TABLE II (SI)

Nominal Diameter Millimetres	Tolerance, Millimetre plus and minus
2.30 to 3.70, incl	0.02
Over 3.70 to 4.50, incl	0.038
Over 4.50 to 6.25, incl	0.05

3.5.2 Round wire shall not be out-of-round by more than one-half the total tolerance specified for diameter in Table II.

4. QUALITY ASSURANCE PROVISIONS:

4.1 Responsibility for Inspection: The vendor of the product shall supply all Ø samples for vendor's tests and shall be responsible for performing all required tests. Results of such tests shall be reported to the purchaser as required by 4.5. Purchaser reserves the right to sample and to perform any confirmatory testing deemed necessary to ensure that the product conforms to the requirements of this specification.

4.2 Classification of Tests:

4.2.1 Acceptance Tests: Tests to determine conformance to all technical Ø requirements of this specification are classified as acceptance tests and shall be performed on each heat or lot as applicable.

4.2.2 Preproduction Tests: Tests of springs to determine conformance to all applicable technical requirements of this specification are classified as Ø preproduction tests and shall be performed prior to or on the first-article shipment of a spring to a purchaser, when a change in material or processing, or both, requires reapproval as in 4.4.2, and when purchaser deems confirmatory testing to be required.

4.2.2.1 For direct U.S. Military procurement of springs, substantiating test data and, when requested, preproduction test material shall be submitted to the cognizant agency as directed by the procuring activity, the contracting officer, or the request for procurement.

4.3 Sampling: Shall be in accordance with the following; a lot of wire shall be all wire of the same nominal diameter produced in one continuous run from a single heat of steel, hardened and tempered in the same heat treat batch, and presented for vendor's inspection at one time; a lot of springs shall be all springs of the same part number produced from one lot of wire and presented for vendor's inspection at one time:

4.3.1 Wire: AMS 2370 and the following:

4.3.1.1 Twist and Decarburization: One specimen from each coil.

4.3.1.2 Etching: One specimen from each end of each coil.

4.3.2 Springs: As agreed upon by purchaser and vendor.

4.4 Approval:

4.4.1 Sample springs shall be approved by purchaser before springs for Ø production use are supplied, unless such approval be waived by purchaser. Results of tests on production springs shall be essentially equivalent to those on the approved sample springs.

4.4.2 Vendor shall use materials, manufacturing procedures, processes, and methods of inspection for production springs which are essentially the same as those used on the approved sample springs. If necessary to make Ø any change in materials, manufacturing procedures, or processes, vendor shall submit for reapproval a statement of the proposed changes in material or processing, or both, and, when requested, sample springs. Production springs incorporating the revised operations shall not be shipped prior to receipt of reapproval.

4.5 Reports:

4.5.1 The vendor of wire shall furnish with each shipment three copies of a report showing the results of tests for chemical composition of each heat and for tensile properties of each lot and stating that the wire conforms to the other technical requirements of this specification. This report shall include the purchase order number, heat number, AMS 5115F, size, and quantity from each heat.

4.5.2 The vendor of finished or semi-finished parts shall furnish with each shipment three copies of a report showing the purchase order number, AMS 5115F, contractor or other direct supplier of wire, part number, and quantity. When wire for making parts is produced or purchased by the parts vendor, that vendor shall inspect each lot of wire to determine conformance to the requirements of this specification and shall include in the report either a statement that the wire conforms or copies of laboratory reports showing the results of tests to determine conformance.

4.6 Resampling and Retesting: Shall be in accordance with AMS 2370.

5. PREPARATION FOR DELIVERY:

5.1 Identification: The product shall be identified as follows:

5.1.1 Wire: Coils or reels of wire shall each be identified by a durable tag marked with the purchase order number, AMS 5115F, heat number, nominal size, quantity, and manufacturer's identification. Straight lengths shall be bundled or boxed and shall have attached to each bundle or box a durable tag marked with the same information.

5.1.2 Springs: Each spring shall, when size permits, be marked with the wire coil number and part number on one end. On compression springs, marking shall appear on the chamfer or ground face of the dead coil. If springs are too small to be marked individually, part numbers shall appear on containers.

5.2 Protective Treatment:

5.2.1 Wire: Wire shall be coated with a suitable corrosion-preventive compound prior to shipment.