



# AEROSPACE MATERIAL

Society of Automotive Engineers, Inc.  
400 COMMONWEALTH DRIVE, WARRENDALE, PA. 15096

## AMS 5115D

Superseding 5115C

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### CARBON STEEL WIRE

Valve Spring Quality

0.60 - 0.75C

#### 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 Society of Automotive Engineers, Inc., 400 Commonwealth Drive, Warrendale, Pennsylvania 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, Pennsylvania 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 Government Publications: Available from Commanding Officer, Naval Publications and Forms Center, 5801 Tabor Avenue, Philadelphia, Pennsylvania 19120.

2.3.1 Federal Standards: Federal Test Method Standard No. 151 - Metals; Test Methods

#### 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 approved analytical methods:

|            | min  | max   |
|------------|------|-------|
| Carbon     | 0.60 | 0.75  |
| Manganese  | 0.50 | 0.90  |
| Silicon    | 0.12 | 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° - 398.9°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<br>Inch  | Tensile Strength, psi | Reduction of Area<br>%, 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<br>Millimetres | Tensile Strength, MPa | Reduction of Area<br>%, min |
|---------------------------------|-----------------------|-----------------------------|
| 2.36 to 3.05, incl              | 1448 - 1586           | 45                          |
| Over 3.05 to 3.76, incl         | 1413 - 1551           | 45                          |
| Over 3.76 to 4.88, incl         | 1379 - 1517           | 45                          |
| Over 4.88 to 6.35, incl         | 1345 - 1482           | 45                          |

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

3.3.1.2 Tensile properties of wire less than 0.093 in. (2.36 mm) or over 0.250 in. (6.35 mm) in nominal diameter shall be as agreed upon by purchaser and vendor.

3.3.1.3 Twist: A sample of wire, approximately 10 in. (254 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.

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

3.3.1.5 Etching: Visual examination, at 7 - 10 diameters magnification, of surfaces of sections of wire, etched in hot hydrochloric acid (1:1) at 160° - 180°F (71.1° - 82.2°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 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.

Ø 3.3.2 Springs: Shall have properties 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 be uniform in quality and condition, clean, sound, smooth, and free from seams, pits, nicks, scratches, and other imperfections detrimental to fabrication or to performance of springs.

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<br>Inch  | Tolerance, Inch<br>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<br>Millimetres | Tolerance, Millimetre<br>plus and minus |
|---------------------------------|-----------------------------------------|
| 2.36 to 3.76, incl              | 0.03                                    |
| Over 3.76 to 4.50, incl         | 0.038                                   |
| Over 4.50 to 6.35, 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 samples 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 perform such confirmatory testing as he deems necessary to assure that the product conforms to the requirement of this specification.

4.2 Classification of Tests: Tests to determine conformance to all technical requirements of this specification are classified as acceptance or routine control tests.

4.3 Sampling: Shall be in accordance with the following:

4.3.1 Wire: AMS 2370 and the following:

Ø 4.3.1.1 Twist and Decarburization: One specimen from each coil.

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

Ø 4.3.2 Springs: As agreed upon by purchaser and vendor.

#### 4.4 Approval:

4.4.1 Springs shall be approved by purchaser before springs for production use are supplied, unless  
Ø such approval be waived.

4.4.2 Vendor shall use the same manufacturing procedures, processes, and methods of inspection for  
Ø production springs as for approved sample springs. If necessary to make any change in materials, manufacturing procedures, or processes, vendor shall submit for reapproval a statement of the proposed changes in processing and, when requested, sample revised springs. No production springs incorporating the revised operations shall 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 of the results of tests  
Ø for chemical composition of each heat in the shipment and for tensile properties of each size from each heat and a statement that the wire conforms to the other technical requirements of this specification. This report shall include the purchase order number, heat number, material specification number and its revision letter, size, and quantity from each heat.

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

Ø 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  
Ø order number, AMS 5115D, heat number, nominal size, quantity, and manufacturer's identification. Straight lengths shall be bundled or boxed and shall have attached to each container a durable tag marked as above.

5.1.2 Springs: Each spring shall, when size permits, be marked with the wire coil number and part num-  
Ø ber 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:

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

5.2.2 Finished Springs: Springs shall be protected during shipment and storage by a suitable corrosion-preventive compound which is readily removable by washing in hydrocarbon solvents.