Society of Automotive Engineers, Inc.
TWO PENNSYLVANIA PLAZA, NEW YORK, N.Y. 10001

AEROSPACE MATERIAL SPECIFICATION

AMS 7301C
Superseding AMS 7301B

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STEEL SPRINGS, HIGHLY STRESSED
0.95Cr - 0.2V (0.48 - 0.53C) (SAE 6150)

1. SCOPE:

1.1 Form: This specification covers low-alloy steel springs made of annealed round wire heat treated after forming.

1.2 Application: Primarily valve springs, clutch springs, and other highly stressed springs on which a case is required as assurance that surfaces will not be decarburized. Hardness of these springs is very high and use is recommended only after careful consideration.

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., Two Pennsylvania Plaza, New York, New York 10001.

2.1.1 Aerospace Material Specifications:

AMS 2259 - Chemical Check Analysis Limits, Wrought Low Alloy and Carbon Steel
AMS 2301 - Aircraft Quality Steel Cleanliness, Magnetic Particle Inspection Procedure
AMS 2350 - Standards and Test Methods
AMS 2370 - Quality Assurance Sampling of Carbon and Low Alloy Steels, Wrought Products Except Forgings
AMS 2640 - Magnetic Particle Inspection

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

ASTM E18 - Rockwell Hardness and Rockwell Superficial Hardness of Metallic Materials
ASTM E112 - Estimating Average Grain Size of Metals
ASTM E290 - Semi-Guided Bend Test for Ductility of Metallic Materials
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: Wire from which springs are made 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	0.48	0.53
Manganese	0.70	0.90
Silicon	0.20	0.35
Phosphorus	--	0.025
Sulfur	--	0.025
Chromium	0.80	1.10
Vanadium	0.15	--
Nickel	--	0.25
Molybdenum	--	0.06
Copper	--	0.35

3.1.1 Check Analysis: Composition variations shall meet the requirements of AMS 2259, paragraph titled "Low Alloy Steels".

3.2 Condition: Hardened and tempered after forming.

3.3 Fabrication:

3.3.1 Springs shall be formed on automatic spring-winding equipment.

3.3.2 When specified, ends of springs shall be ground flat.

3.3.3 Metal shall not be removed from any active coil. Special care shall be exercised during removal of burrs from spring ends to assure that this requirement is met.

3.3.4 Springs shall be heat treated by carburizing, cyaniding, or carbonitriding above the transformation range of the steel, quenching, and tempering. All possible care shall be exercised during heat treatment to prevent surface and internal cracking.

3.3.5 After heat treatment, springs shall be uniformly blasted all over, with grit of suitable size, for such time and in such manner as will produce springs which are satisfactorily cleaned and on which the surface effect is not lower than that agreed upon by purchaser and vendor.

3.3.6 Grit blasted springs shall subsequently be uniformly blasted, preferably in automatic equipment, with sand of suitable size, for sufficient time to produce smooth surfaces.

3.4 Properties:

3.4.1 Hardness: Core hardness of finished springs shall be 65 - 69 HR30N, or equivalent, determined in accordance with ASTM E18.

3.4.2 Grain Size: Shall be 5 or finer, ASTM E112, McQuaid-Ehn test.

3.4.3 Case Depth: Shall be 0.001 - 0.005 in. (0.02 - 0.13 mm) on finished springs, determined on a cross section mounted, polished, etched in Nital for sufficient time to develop a well-defined microstructure, and examined at 100X magnification.

3.4.4 Decarburization: Springs shall be free from partial and complete decarburization, determined as in 3.4.3. Examination for decarburization may be made on the same specimens on which case depth was determined.

3.4.5 Magnetic Particle Inspection: Springs shall be subject to magnetic particle inspection in accordance with AMS 2640; the method of inspection and standards for acceptance shall be as agreed upon by purchaser and vendor.

3.4.6 Bending: Specimens cut from finished springs shall, as evidence of the presence of case, fracture before the angle of bend reaches 180 deg (3.14 rad). Bend shall be made in accordance with ASTM E290 around a diameter equal to twice the nominal diameter of the wire with OD of spring on inside of bend. Sections of springs, or specimens of the wire processed in the same manner as springs, shall, as evidence of ductility of the springs, withstand, without cracking, bending at room temperature through an angle, measured under load, of 5 deg (0.087 rad). Bend shall be made as above.

3.5 Quality: Steel shall be aircraft quality conforming to AMS 2301. Wire from which springs are made and the finished springs shall be uniform in quality and condition, clean, sound, and free from foreign materials and from internal and external imperfections detrimental to fabrication, appearance, or performance of springs.

4. QUALITY ASSURANCE PROVISIONS:

4.1 Responsibility for Inspection: The vendor of springs 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 springs conform to the requirements 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.

4.3.2 Springs:

4.3.2.1 Composition: Not required.

4.3.2.2 Hardness: Three springs from each lot (See 8.1).

4.3.2.3 Grain Size: Two springs from each lot.

4.3.2.4 Case Depth, Decarburization, and Bending: One spring from each lot, or one section of wire from each lot processed with the springs it represents.

4.3.2.5 Magnetic Particle Inspection: As specified by purchaser.

4.4 Approval:

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

4.4.2 Vendor shall use the same manufacturing procedures, processes, and methods of inspection for production springs as for approved sample springs. If any change is necessary in manufacturing procedures or processes which could affect quality or properties of the springs, vendor shall submit for reapproval a statement of the revised operations and, when requested, sample springs. No production springs incorporating the revised operations shall be shipped prior to receipt of reapproval.