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400 Commonwealth Dr., Warrendale, PA 15096

AEROSPACE MATERIAL SPECIFICATION

Submitted for recognition as an American National Standard

AMS 7301E

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Superseding AMS 7301D

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

UNS G61500

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 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 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 and Forging Stock
AMS 2640 - Magnetic Particle Inspection

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

ASTM E18 - Rockwell Hardness and Rockwell Superficial Hardness of Metallic Materials
ASTM E112 - Determining Average Grain Size
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 U.S. Government Publications: Available from Commanding Officer, Naval Publications and Forms Center, 5801 Tabor Avenue, Philadelphia, PA 19120.

2.3.1 Military Standards:

MIL-STD-794 - Parts and Equipment, Procedures for Packaging and Packing of

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 or by spectrographic or other analytical methods approved by purchaser:

	min	max
Carbon	0.48	0.53
Manganese	0.70	0.90
Silicon	0.15	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 applicable requirements of AMS 2259.

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 ensure 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: Springs shall conform to the following requirements:

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, determined in accordance with ASTM E112.

3.4.3 Case Depth: Shall be 0.001 - 0.005 in. (0.02 - 0.12 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 subjected 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 Specimens cut from finished springs shall, as evidence of the presence of case, fracture before the angle of bend reaches 180 degrees. 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 degrees. Bend shall be made as above.

3.5 Quality:

3.5.1 Steel shall be aircraft quality conforming to AMS 2301.

3.5.2 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 imperfections detrimental to usage of the springs.

4. QUALITY ASSURANCE PROVISIONS:

4.1 Responsibility for Inspection: The vendor of springs shall supply all 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 springs conform to the requirements of this specification.

4.2 Classification of Tests:

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

4.2.2 Preproduction Tests: Tests of springs to determine conformance to all technical requirements of this specification are classified as 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, 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, substantiating test data and, when requested, preproduction springs 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 shall be all wire of the same nominal diameter produced in one continuous run from a single heat of steel and presented for vendor's inspection at one time or shall be all springs of the same part number produced from a single lot of wire, hardened and tempered in the same heat treat batch, and presented for vendor's inspection at one time:

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.

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.