

AEROSPACE MATERIAL SPECIFICATION

Submitted for recognition as an American National Standard



AMS 7301F

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Superseding AMS 7301E

(R)

Steel, Highly-Stressed Springs
0.95Cr - 0.20V (0.48 - 0.53C) (SAE 6150)
Case Hardened

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:

These springs have been used typically for valve springs, clutch springs, and other highly-stressed springs on which a hardened case is required as assurance that surfaces will not be decarburized, but usage is not limited to such applications. 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 SAE publications shall apply. The applicable issue of other publications shall be the issue in effect on the date of the purchase order.

2.1 SAE Publications:

Available from SAE, 400 Commonwealth Drive, Warrendale, PA 15096-0001.

AMS 2259	Chemical Check Analysis Limits, Wrought Low-Alloy and Carbon Steels
AMS 2301	Cleanliness, Aircraft Quality Steel, Magnetic Particle Inspection Procedure
MAM 2301	Cleanliness, Aircraft Quality Steel, Magnetic Particle Inspection Procedure, Metric (SI) Measurement
AMS 2370	Quality Assurance Sampling and Testing of Carbon and Low-Alloy Steel Wrought Products and Forging Stock

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2.2 ASTM Publications:

Available from ASTM, 100 Barr Harbor Drive, West Conshohocken, PA 19428-2959.

ASTM E 18 Rockwell Hardness and Rockwell Superficial Hardness of Metallic Materials

ASTM E 112 Determining the Average Grain Size

ASTM E 290 Semi-Guided Bend Test for Ductility of Metallic Materials

ASTM E 350 Chemical Analysis of Carbon Steel, Low-Alloy Steel, Silicon Electrical Steel, Ingot Iron, and Wrought Iron

ASTM E 1444 Magnetic Particle Examination

3. TECHNICAL REQUIREMENTS:

3.1 Wire Composition:

Shall conform to the percentages by weight shown in Table 1, determined by wet chemical methods in accordance with ASTM E 350, by spectrochemical methods, or by other analytical methods acceptable to purchaser.

TABLE 1 - Composition

Element	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 of Springs:

Hardened and tempered after forming.

3.3 Fabrication of Springs:

- 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.
- 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 deeper 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 springs shall be 65 to 69 HR30N, or equivalent (See 8.2), determined in accordance with ASTM E 18.
- 3.4.2 Average Grain Size: Shall be ASTM No. 5 or finer, determined in accordance with ASTM E 112.
- 3.4.3 Case Depth: Shall be 0.001 to 0.005 inch (0.03 to 0.13 mm) on 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 Bending:
 - 3.4.5.1 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 E 290 around a diameter equal to twice the nominal diameter of the wire with OD of spring on inside of bend.

3.4.5.2 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 described in 3.4.5.1.

3.5 Quality:

Wire and finished springs shall be uniform in quality and condition, clean, sound and free from foreign materials and from imperfections detrimental to usage of the wire and springs.

3.5.1 Steel shall be aircraft quality conforming to AMS 2301 or MAM 2301.

3.5.2 Springs shall be subjected to magnetic particle inspection in accordance with ASTM E 1444. The method of inspection and standards for acceptance shall be as agreed upon by purchaser and vendor.

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 the performance of all required tests. Purchaser reserves the right to sample and to perform any confirmatory testing deemed necessary to ensure that the springs conform to the specified requirements.

4.2 Classification of Tests:

4.2.1 Acceptance Tests: Composition (3.1) on each heat, hardness (3.4.1), average grain size (3.4.2), case depth (3.4.3), decarburization (3.4.4), bending (3.4.5), and magnetic particle inspection (3.5.2) are acceptance tests and shall be performed on each heat of wire and/or on each lot of springs.

4.2.2 Preproduction Tests: All technical requirements are 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 and/or processing requires reapproval as in 4.4.2, and when purchaser deems confirmatory testing to be required.

4.3 Sampling and Testing:

Shall be as follows: 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: In accordance with 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 Average 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 Sample springs shall be approved by purchaser before springs for production use are supplied, unless such approval be waived by purchaser.

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

4.5 Reports:

The vendor of the product shall furnish with each shipment a report showing the results of tests for chemical composition, hardness, average grain size, case depth and bending of each heat or lot as applicable and stating that the springs conform to the other technical requirements. This report shall include the purchase order number, heat and lot numbers, AMS 7301F, part number, and quantity.

4.6 Resampling and Retesting:

If any specimen used in the above tests fails to meet specified requirements, disposition of the springs may be based on the results of testing three additional specimens for each original nonconforming specimen. Failure of any retest specimen to meet specified requirements shall be cause for rejection of the springs represented. Results of all tests shall be reported.

5. PREPARATION FOR DELIVERY:

5.1 Identification:

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.