AEROSPACE MATERIAL SPECIFICATION

AMS7301™	REV. J

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Superseding AMS7301H

Steel, Highly-Stressed Springs
0.95Cr - 0.20V (0.48 - 0.53C) (SAE 6150)
Case Hardened
(Composition similar to UNS G61500)

RATIONALE

AMS7301J has been stabilized as mature technology.

STABILIZED NOTICE

AMS7301J has been declared "STABILIZED" by SAE AMS Carbon and Low Alloy Steels Committee E. This document will no longer be updated and may no longer represent standard industry practice. This document was stabilized because this document contains mature technology that is not expected to change and thus no further revisions are anticipated. Previously this document was reaffirmed non-current. The last technical update of this document occurred in December 2003. Users of this document should refer to the cognizant engineering organization for disposition of any issues with reports/certifications to this specification; including exceptions listed on the certification.

NOTE: In many cases, the purchaser may represent a sub tier supplier and not the cognizant engineering organization.

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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 issue of the following documents in effect on the date of the purchase order forms a part of this specification to the extent specified herein. The supplier may work to a subsequent revision of a document unless a specific document issue is specified. When the referenced document has been canceled and no superseding document has been specified, the last published issue of that document shall apply.

2.1 SAE Publications:

Available from SAE, 400 Commonwealth Drive, Warrendale, PA 15096-0001 or www.sae.org.

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

2.2 ASTM Publications:

Available from ASTM, 100 Barr Harbor Drive, West Conshohocken, PA 19428-2959 or www.astm.org.

ASTM E 18 Rockwell Hardness and Rockwell Superficial Hardness of Metallic Materials
ASTM E 112 Determining Average Grain Size
ASTM E 290 Bend Testing of Material for Ductility
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 a minimum of 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. The bend shall be made in accordance with ASTM E 290 around a diameter equal to twice the nominal diameter of the wire with the OD of the spring on the inside of the 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.

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) and frequency-severity cleanliness rating (3.5.1) are acceptance tests and shall be performed on each heat, and 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), and magnetic particle inspection (3.5.2) are acceptance tests and shall be performed on each lot of wire and/or 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.