GM	WORLDWIDE ENGINEERING STANDARDS	Material Specification	GMW17163

Chrome Silicon Steel – Wire and Springs

1 Scope

This specification details the material characteristics of three grades of oil hardened and tempered chrome silicon round steel wire used in the manufacture of springs for both static and dynamic applications involving moderately elevated temperature and medium-to-high stress. Spring manufacturing and performance requirements are also included. Note that Grade A is no longer applicable to this standard.

1.1 Material Description. Unless otherwise specified, the wire shall be drawn, austenitized, oil quenched and tempered to conform to the mechanical property limits shown in Table A1. The three grades are distinguished by their respective limits for decarburization and seam depth and by the range of mechanical properties shown in Table A1. A reference of replaced/comparable grades is given in Section 9.

1.1.1 Grade B. Exhibits the lowest range of mechanical properties, and is the only Grade of wire with two Classes of temper condition (hardness) for finished springs.

1.1.2 Grade C. Decarburization limits are more restrictive than B.

1.1.3 Grade D. Allowable seam depth is shallowest of the three Grades. Most restrictive decarburization limits and generally highest yield strength of the three grades.

1.2 Symbols. Not applicable.

1.3 Applicability. Applications include but are not limited to oil pump relief springs, compression springs used in tensioner assemblies, piston pin retaining clips, and automatic transmission valve body control springs and shifting piston return springs.

1.4 Remarks. When specifying one of the material Grades it is recommended that a tensile strength and/or equivalent hardness be referenced on the Engineering drawing. The words “Class 1” or “Class 2” should be used with Grade B wire to designate spring hardness.

2 References

Note: Only the latest approved standards are applicable unless otherwise specified.

2.1 External Standards/Specifications.

None

2.2 GM Standards/Specifications.

GMW3059

3 Requirements

3.1 Chemical Requirements. Steel furnished to this specification shall conform to one of the following composition limits (percentage by weight) depending on the Grade being specified in Table 1.

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Table 1: Composition Limits for Each Grade

	Grade B	Grade C	Grade D
Carbon	0.51 to 0.59	0.50 to 0.60	0.50 to 0.60
Manganese	0.60 to 0.80	0.50 to 0.90	0.50 to 0.90
Phosphorus	0.035 max.	0.025 max.	0.025 max.
Sulfur	0 040 max.	0.020 max.	0.020 max.
Silicon	1.20 to 1.60	1.20 to 1.60	1.20 to 1.60
Chromium	0.60 to 0.80	0.50 to 0.80	0.50 to 0.80

max. = maximum

3.2 Wire Mechanical Properties. Tensile properties vary with wire diameter and shall meet the limits detailed in Table A1. Any specimen breaking in the grips shall be discarded and a new specimen tested if the specified mechanical properties are not achieved.

3.3 Wrap Test (Grades B, C). Wire through 4.0 mm diameter shall wind (as a close wound helix) on itself as an arbor (or an arbor equal to the wire diameter) and wire over 4.0 mm through 8.0 mm inclusive shall wind on an arbor twice its diameter without breaking or checking the surface. The wrap test on wires over 8.0 mm diameter is not applicable.

3.4 Torsion Test (Grade D). The torsion test shall be carried out on a test piece of wire 300 mm in length. The test piece shall be clamped in the devices in such a manner that its longitudinal axis is aligned to the axis of the clamping heads and remains straight during the test under a force corresponding to 1% of the maximal force (F_m). One clamping head is turned at a uniform speed of rotation, not exceeding the following maximum speeds.

The maximum speed for carrying out the torsion test shall be:

- For diameter < 1.00 mm 60 turns/minute
- 1.00 mm ≤ d < 3.00 mm 30 turns/minute
- 3.00 mm ≤ d 15 turns/minute

The test piece is first twisted in one direction – the number of twists for 0.70 < d ≤ 1.00 is 6, 1.00 < d ≤ 1.60 is 5, 1.60 < d ≤ 4.50 is 4, 4.50 < d ≤ 6.00 is 3 – and is then twisted in the other direction until fracture. The fracture of the torsion test piece shall be smooth and perpendicular to the wire axis. The rupture shall show no longitudinal cracks.

3.5 Metallurgical Properties.

3.5.1 Wire Surface Condition. The wire as-received shall be smooth and free from rust, scale, die marks, deep scratches, slivers seams, laps, pits or cracks which would affect fabrication or properties of the finished parts. The surface of the wire shall be examined after etching in a solution of equal parts of chemically pure hydrochloric acid and water at a temperature of 70 °C to 80 °C for a sufficient length of time to remove approximately one percent of the diameter of the wire. Unless otherwise specified, seams shall not exceed the smaller of the two limits for each Grade detailed in Table 2 when measured on a transverse section.

Table 2: Allowable Seam Depth for Each Grade [Note 1]

Grade B	Grade C	Grade D
0.015 x d	0.015 x d	0.013 x d

Note 1: d = wire diameter.

3.5.2 Microstructure. A longitudinal section shall show a fine homogeneous tempered martensitic structure. Decarburization shall be determined on a polished and nital etched transverse section of wire by examining the entire periphery at 100x magnification, measuring the worst area present, but not measuring decarburization directly associated with a seam or other surface defect. The allowable depth of surface decarburization for each Grade is as listed in Table 3 as a percentage of the wire diameter (d).

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