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SAE J157 DEC88

Oil Tempered Chromium — Silicon Alloy Steel Wire and Springs

SAE Recommended Practice
Reaffirmed December 1988

Submitted for Recognition as an American National Standard

SAE The Engineering Society For Advancing Mobility Land Sea Air and Space ®
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MATERIALS PRACTICE

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SAE J157

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OIL TEMPERED CHROMIUM - SILICON ALLOY STEEL WIRE AND SPRINGS

1. SCOPE:

This SAE Recommended Practice covers the mechanical and chemical requirements of oil tempered chromium silicon alloy steel wire used for the manufacture of springs requiring resistance to set when used at moderately elevated temperatures. It also covers the basic material and processing requirements of springs fabricated from this wire.

2. MANUFACTURE AND WORKMANSHIP:

The steel shall be made by the electric furnace, open hearth, or basic oxygen process. Sufficient discard shall be made to insure freedom from all pipe and undue segregation. The wire shall be properly drawn, austenitized, oil quenched, and tempered to produce the specified mechanical properties.

The wire shall be uniform in quality and in temper and shall not be wavy or crooked. It shall be homogeneous and free from injurious imperfections caused in its manufacture, whether such imperfections are apparent at the time of receiving inspection or while the wire is processed by the spring manufacturer. Each coil shall be one continuous length of wire, properly coiled and firmly tied.

3. CHEMICAL COMPOSITION:

The steel shall conform to the chemical composition[1] as follows:

Carbon	0.51 - 0.59%
Manganese	0.60 - 0.80%
Phosphorus	0.035% max
Sulfur	0.040% max
Silicon	1.20 - 1.60%
Chromium	0.60 - 0.80%

4. MECHANICAL PROPERTIES: The tensile strength of the wire shall conform to the requirements in Table 1 for the various sizes. Hardness ranges indicated in Table 1 apply to finished springs and are subject to normal variations found in standard hardness testing procedures.

On Rockwell C, normal variations are considered ±1 point RC or equivalent by conversions.

5. PERMISSIBLE VARIATIONS IN DIMENSIONS:

The diameter of the wire shall not vary from that specified by more than the following:

Diameter, in	Permissible Variations, ±in	Permissible Out of Round, in
0.032 - 0.072 incl	0.0010	0.0010
Over 0.072 - 0.438 incl	0.0020	0.0020

6. WRAP TEST:

Wire 0.162 in and smaller in diameter shall wind on itself without breaking or cracking the surface. Larger diameter wire, up to and including 0.312 in, shall wind without breaking or cracking the surface on a mandrel twice the wire diameter. The wrap test on wires over 0.312 in diameter is not applicable.

[1]For permissible variations from specified ranges and limits for steel, refer to SAE J409.

TABLE 1

Wire Diameter, in	Tensile Strength 10^3 psi		Hardness		Reduction of Area[a] min %
	Min	Max	Min	Max	
			R 15N		
0.032	300	325	88.5	90.0	b
0.041	298	323	88.5	90.0	b
0.054	292	317	88.0	89.5	b
			R 45N		
0.062	290	315	59.5	63.0	b
0.080	285	310	59.0	62.0	b
0.092	280	305	58.5	61.5	45
0.120	275	300	57.5	61.0	45
			RC		
0.135	270	295	51.5	54.0	45
0.162	265	290	51.0	53.5	40
0.177	260	285	50.5	53.0	40
0.192	260	283	50.5	53.0	40
0.218	255	278	50.0	52.5	40
0.250	250	275	50.0	52.5	40
0.312	245	270	49.0	52.0	40
0.375	240	265	48.5	51.5	40
0.438	235	260	48.0	51.0	40

Values for intermediate sizes may be interpolated.

[a]The reduction of area values are for as-received wire. These values may be decreased by 5 points when tested immediately after tempering.

[b]Reduction of area does not apply to wire under 0.092 inch in diameter.

7. MICROSTRUCTURE:

A longitudinal section shall show a fine homogeneous tempered martensitic structure. Decarburization shall be determined by etching a polished transverse section of wire in nital and examining the entire periphery at 100X magnification, measuring the worst area present, but not measuring decarburization which is directly associated with a seam or other surface defect. Depth of carbon free decarburization shall not exceed 0.5% of the wire diameter.

Combined depth of carbon free and partial decarburization shall not exceed 2% of the wire diameter on all sizes of wire.

8. SURFACE CONDITION:

The surface of the wire shall be smooth and free from rust, scale, die marks, deep scratches, slivers, seams, laps, pits, or cracks which would affect the fabrication of the finished parts. Unless otherwise specified by the purchaser, seams shall not exceed 3.5% of the wire diameter or 0.010 in, whichever is the smaller as measured on a transverse section.

9. FINISHED PARTS:

Springs coiled from this wire shall be stress relieved immediately after coiling for a minimum of 30 min at heat unless otherwise agreed upon between purchaser and supplier. The temperature used will be the maximum which will leave the original hardness of the wire essentially unchanged. Typical temperatures are 650-800°F.

It should be recognized that in certain applications, such as some torsional or extension springs, lower than typical stress relieving temperatures may be used. Hardness of springs shall be measured on a suitable ground flat on wire sizes of 0.062 in and larger or on ground mounted sections for wire sizes less than 0.062 inch. The hardness scale and values shall conform to the requirements of Table 1 for the respective wire diameters.

The surface conditions on the finished parts shall be as described for the wire, except certain instances where shot peening might be used. In addition, there shall be no excessive coiling marks, nicks, or gouges which would impair the serviceability of the parts.

When springs are shot peened, the surface appearance will be altered. Because of a resulting decrease in the spring resistance to relaxation, shot peening is permitted only when agreed upon by the purchaser. After shot peening, the springs shall be stress relieved at 400-475°F for a minimum of 30 min at heat.

RATIONALE:

Not applicable.

RELATIONSHIP OF SAE STANDARD TO ISO STANDARD:

Not applicable.

REFERENCE SECTION:

SAE J409 DEC88, Product Analysis - Permissible Variations from Specified Chemical Analysis of a Heat or Cast of Steel

APPLICATION:

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COMMITTEE COMPOSITION:

DEVELOPED BY SAE DIVISION 17 - SPRING WIRE:

E. H. Judd, Barnes Grp., Inc., Associated Spring Co., Livonia, MI - Chairman

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