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SAE J271 DEC88

**Special Quality High
Tensile, Hard Drawn
Mechanical Spring
Wire and Springs**

SAE Recommended Practice
Reaffirmed December 1988

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**SPECIAL QUALITY HIGH TENSILE,
HARD DRAWN MECHANICAL
SPRING WIRE AND SPRINGS**

1. SCOPE:

This recommended practice covers the mechanical and chemical requirements of special quality high tensile, hard drawn carbon steel spring wire with restricted size tolerances. This material is used where such restricted dimensional requirements are necessary for the manufacture of highly stressed mechanical springs and wire forms. It is generally employed for applications subject to static loads or infrequent stress repetitions. This recommended practice also covers basic materials and processing requirements of springs and forms fabricated therefrom.

2. MANUFACTURE AND WORKMANSHIP:

The steel shall be made by electric furnace, open hearth, or basic oxygen process. Sufficient discard must be made to insure freedom from pipe and undue segregation. Rolling practice shall be controlled to insure that the finished wire shall have no seams greater than 3.5% of the wire diameter or 0.010 in (0.25 mm), whichever is the smaller, as measured on a transverse section.

Using either properly patented or uniformly control cooled rods, the wire shall be cold drawn to produce the specified mechanical properties. The wire shall be uniform in quality, not kinked or improperly cast. To test for cast, one or more convolutions of wire shall be cut from the coil and placed on a flat surface. The wire shall lay substantially flat on itself and not show a wavy condition. Each finished coil shall be one continuous length of wire, properly coiled and firmly tied. Welds prior to cold drawing are permitted.

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3. CHEMICAL COMPOSITION:

The steel shall conform to the following chemical composition (percent by weight):

Carbon ^a	0.70 - 1.00
Manganese ^a	0.20 - 1.30
Phosphorus	0.040 max
Sulfur	0.040 max
Silicon	0.10 - 0.30

NOTE: For permissible variations from specified chemical ranges and limits for steel, refer to SAE J409.

^aCarbon in any one lot shall not vary more than 0.20% and Manganese not more than 0.30%. Normally, lower Mn is used for the smaller size wire, and higher Mn is used for the larger sizes.

4. MECHANICAL PROPERTIES:

The tensile properties of the wire shall conform to the requirements shown in Table 1 by sizes.

TABLE 1 - Tensile Properties

Wire Dia		Tensile Strength ^a			
		Min		Max	
in	mm	ksi	MPa	ksi	MPa
0.020	0.508	350	2415	387	2670
0.023	0.584	346	2385	381	2630
0.026	0.660	337	2325	373	2570
0.029	0.737	332	2290	367	2530
0.032	0.813	327	2255	361	2490
0.035	0.889	325	2245	359	2480
0.041	1.041	314	2165	348	2400
0.048	1.219	306	2110	339	2335
0.054	1.377	301	2075	332	2290
0.062	1.575	295	2035	325	2245
0.072	1.829	287	1980	317	2185
0.080	2.032	282	1945	312	2150
0.092	2.337	276	1905	305	2100
0.106	2.692	269	1855	297	2050
0.120	3.048	263	1815	291	2005
0.135	3.429	258	1780	285	1965
0.148	3.760	253	1745	280	1930
0.162	4.115	249	1715	275	1895
0.177	4.496	245	1690	270	1860
0.192	4.877	241	1660	267	1840
0.207	5.258	238	1640	264	1820
0.225	5.715	235	1620	260	1795
0.250	6.350	230	1585	255	1760
0.312	7.925	217	1495	242	1670
0.375	9.525	210	1450	235	1620
0.438	11.125	206	1420	231	1590
0.500	12.700	195	1345	220	1515
0.531	13.487	190	1310	210	1450

^aTensile strength for intermediate sizes shall be interpolated.

5. PERMISSIBLE VARIATIONS IN DIMENSIONS:

The diameter of the wire shall not vary from that specified by more than shown in Table 2.

TABLE 2 - Permissible Variations

Diameters		Permissible Variations		Permissible Out-of-Round	
in	mm	±in	±mm	in	mm
0.020 to 0.026 incl	0.51 to 0.66 incl	0.0003	0.008	0.0003	0.008
Over 0.026 to 0.063 incl	Over 0.66 to 1.60 incl	0.0005	0.013	0.0005	0.013
Over 0.063 to 0.207 incl	Over 1.60 to 5.26 incl	0.0010	0.025	0.0010	0.025
Over 0.207 to 0.375 incl	Over 5.26 to 9.52 incl	0.0020	0.05	0.0020	0.05
Over 0.375	Over 9.52	0.0030	0.08	0.0030	0.08

6. WRAP TEST REQUIREMENTS:

Wire shall withstand winding (at least five turns closely wound) without fracture over an arbor of diameter as indicated below. The test shall be conducted on wire prior to stress relieving.

Wire Dia, in (mm)	Mandrel Size
0.020 to 0.162 (0.51 to 4.11) incl	2X dia
Over 0.162 to 0.312 (4.11 to 7.92) incl	4X dia
Over 0.312 (7.92)	Wrap test not applicable

7. 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 of their serviceability.

8. FINISHED PARTS:

1. The surface of the finished springs shall be as described for the wire. In addition, there shall be no excessive coiling marks, nicks, or gouges which would impair the serviceability of the parts.
2. Unless otherwise agreed upon by purchaser and supplier, tension and compression springs coiled from this wire shall be stress relieved for a minimum of 30 min at heat. The normal temperature range is 450-550°F (232-288°C).
3. Electroplating of parts made from special quality high strength, hard drawn wire is not recommended because of susceptibility to hydrogen embrittlement. If plating is necessary, parts should be heated at a temperature of not less than 350°F (177°C) for a minimum of 2 h immediately after plating. Other temperatures and times may be necessary.

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RATIONALE:

Not applicable.

RELATIONSHIP OF SAE STANDARD TO ISO STANDARD:

Not applicable.

APPLICATION:

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REFERENCE SECTION:

SAE J409 JUN84, Product Analysis - Permissible Variations from Specified Chemical Analysis of a Heat or Cast of Steel

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