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SAE J132 DEC88

Oil Tempered Chromium-Vanadium Valve Spring Quality 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®
400 COMMONWEALTH DRIVE, WARRENDALE, PA 15096

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MATERIALS PRACTICE

SAE J132

Issued October 1969
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Reaffirming J132 APR74

OIL TEMPERED CHROMIUM-VANADIUM VALVE SPRING QUALITY WIRE AND SPRINGS

1. SCOPE:

This SAE Recommended Practice covers the mechanical and chemical requirements of oil tempered chromium-vanadium valve spring quality wire used for the manufacture of engine valve springs and other springs used at moderately elevated temperatures and requiring high fatigue properties. It also covers the basic material and processing requirements of spring 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 being processed by the user. Each coil shall be one continuous length of wire properly coiled and firmly tied. Welds in coils are not permitted.

3. CHEMICAL COMPOSITION:

The steel shall conform to the following chemical composition[1] (percentage by weight):

Carbon	0.48-0.53
Manganese	0.70-0.90
Phosphorus	0.020 max
Sulfur	0.035 max
Silicon	0.20-0.35
Chromium	0.80-1.10
Vanadium	0.15 min

4. MECHANICAL PROPERTIES:

The tensile properties of the wire shall conform to the requirements in Table 1 for the various sizes.

5. PERMISSIBLE VARIATIONS IN DIMENSIONS:

The diameter of the wire, prior to forming springs, shall not vary from that specified by more than the values in Table 2.

6. WRAP TEST:

Wire 0.162 in and smaller in diameter shall wind on itself as a mandrel without breaking or cracking the surface. Larger diameter wire, up to and including 0.312 in, shall wind without breaking or cracking of the surface when wound on a mandrel twice the diameter of the wire. The wrap test is not applicable to wire over 0.312 in 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 the tempered wire in nital and examining the entire periphery at 100X magnification, measuring the worst area present. Inspection at 100X magnification shall show no completely decarburized (carbon free) areas and partial decarburization shall not exceed a depth of 0.001 in on wire 0.192 in and smaller or 0.0015 in on wire larger than 0.192 in. See SAE J419.

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

TABLE 1 - Tensile Properties

Wire Diameter, in	Tensile Strength, 10^3 psi		Hardness[a]		Reduction of Area,[b] Min, %
	Min	Max	Min	Max	
			Rockwell 15N		
0.020	300	325	88.5	89.7	N/A[c]
0.031	290	315	88.0	89.3	N/A[c]
0.041	280	305	87.5	88.8	N/A[c]
0.054	270	295	86.9	88.3	N/A[c]
			Rockwell 45N		
0.062	265	290	57.9	61.4	N/A[c]
0.080	255	275	56.4	59.4	N/A[c]
0.106	245	265	55.0	57.9	45
			Rockwell C		
0.135	235	255	48	51	45
0.162	225	245	47	50	40
0.192	220	240	46	49	40
0.244	210	230	45	48	40
0.283	205	225	44	47	40
0.312	203	223	43	47	40
0.375	200	220	43	46	40
0.438	195	215	42	45	40
0.500	190	210	41	45	40

Values for intermediate sizes may be interpolated.

[a]Hardness ranges indicated apply to finished springs and are subject to normal variations found in standard hardness testing procedures.

[b]The 45 and 40% minimum values are for as received wire. These values may be decreased by five points when tested immediately after tempering.

[c]N/A--Reduction of area does not apply to wire under 0.106 in in diameter.

TABLE 2 - Permissible Variations

Diameter, in	Permissible Plus Variations in	Permissible Out of Round, ±in
0.020 to 0.075 incl	0.0008	0.0008
Over 0.075 to 0.148 incl	0.0010	0.0010
Over 0.148 to 0.375 incl	0.0015	0.0015
Over 0.375 to 0.500 incl	0.0020	0.0020

8. SURFACE CONDITIONS:

The surface of the wire specimens shall be examined after etching in a solution of equal parts of hydrochloric acid and water at a temperature of 165-175°F for a sufficient time to remove approximately 1% of the wire diameter. This examination shall be made using a binocular microscope at a magnification not to exceed 10X. The surface of the wire shall be free from imperfections such as seams, pits, die marks, scratches, and other defects tending to impair the fatigue value of the springs.

9. SPECIAL SURFACE INSPECTION:

When specified, the entire length of every coil used by engine valve spring manufacturers shall be inspected for surface imperfections with a magnetic and/or eddy current defect analyzer or equivalent. Springs made from wire containing surface defects 0.002 in deep and greater must be rejected.

10. FINISHED PARTS:

1. Coiling marks or nicks which flatten but do not gouge the specified wire diameter by more than 1% or that would not impair the serviceability of the parts are permitted..

2. Springs coiled from this wire shall be stress relieved for a minimum of 30 min at heat unless otherwise agreed upon by purchaser and supplier. Normally the temperature used will be the maximum which will leave the original hardness of the wire essentially unchanged. Typical temperatures are 700-800°F.

3. Hardness of springs shall be measured on suitable ground flats for wire sizes 0.062 in and larger, or on ground mounted sections for wire sizes of less than 0.062 in. Hardness values shall conform to Table 1.

4. When specified, valve and other high fatigue requirement springs shall be shot peened to a minimum of 90% coverage on the inside diameter of the springs (reference SAE HS 84). After shot peening the springs shall be stress relieved at a temperature of 400-475°F.

RATIONALE:

Not applicable.

RELATIONSHIP OF SAE STANDARD TO ISO STANDARD:

Not applicable.

REFERENCE SECTION:

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

SAE J419 DEC83, Methods of Measuring Decarburization

SAE HS 84, Manual on Shot Peening

APPLICATION:

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COMMITTEE COMPOSITION:

DEVELOPED BY THE SAE DIVISION 17 - SPRING WIRE:

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