

HARD DRAWN CARBON STEEL VALVE SPRING QUALITY WIRE AND SPRINGS

Foreword—This Document has not changed other than to put it into the new SAE Technical Standards Board Format.

1. Scope—This SAE Recommended Practice covers the mechanical and chemical requirements of the best quality hard drawn carbon steel spring wire used for the manufacture of engine valve springs and other springs requiring high fatigue properties. It also covers the basic material and processing requirements of springs fabricated from this wire.

2. References

2.1 Applicable Publications—The following publications form a part of the specification to the extent specified herein. Unless otherwise indicated the latest revision of SAE publications shall apply.

2.1.1 SAE PUBLICATIONS—Available from SAE, 400 Commonwealth Drive, Warrendale, PA 15096-0001.

SAE J409 JUN94—Product Analysis—Permissible Variations from Specified Chemical Analysis of a Heat or Cast of Steel

SAE HS 84—Manual on Shot Peening

3. Manufacture And Workmanship—The steel shall be made by the electric furnace, open hearth, or basic oxygen process. Sufficient discard must be made to insure freedom from all pipe and undue segregation. The material shall be properly patented or control cooled and cold drawn to produce the specified mechanical properties. The wire shall be uniform in quality and shall not be kinked, wavy, or crooked. It shall be 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.

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SAE J172 Reaffirmed DEC88

4. **Chemical Composition**—The steel shall conform to the chemical composition¹ as follows:

Carbon	0.60–0.75% ⁽¹⁾
Manganese	0.60–0.90% ¹
Phosphorus	0.025% max
Sulfur	0.030% max
Silicon	0.15–0.30%

1. Carbon and manganese may be varied from the above specified ranges, by the manufacturer, by agreement with the purchaser, provided the mechanical properties specified are maintained.

5. **Mechanical Properties**—The tensile properties of the wire shall conform to the requirements in Table 1 for the various sizes.

TABLE 1—

Wire Diameter, in	Tensile Strength, 10 ³ psi		Reduction of Area, Min, %
	Min	Max	
Over 0.092 to 0.128 incl	235	255	40
Over 0.128 to 0.162 incl	230	250	40
Over 0.162 to 0.192 incl	225	245	40
Over 0.192 to 0.225 incl	220	240	40
Over 0.225 to 0.250 incl	215	235	40

6. **Permissible Variations In Dimensions**—The diameter of the wire shall not vary from that specified by more than the dimensions specified in Table 2.

TABLE 2—

Diameter, in	Permissible Variations, ±in	Permissible Out of Round, in
Over 0.092 to 0.148 incl	0.0010	0.0010
Over 0.148 to 0.177 incl	0.0015	0.0015
Over 0.177 to 0.250 incl	0.0020	0.0020

7. **Microstructure**—Decarburization shall be determined by etching a polished transverse section of the wire in nital and examining the entire periphery at 100X magnification, measuring the worst area present. Inspection shall show no completely decarburized (carbon free) areas. 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 inch.

8. **Surface Conditions**—The surface of the as-received wire specimens, which have been stress relieved at approximately 800 °F for 1/2 h, 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.

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