

## STANDARDS ASSOCIATION OF AUSTRALIA.

Headquarters :

Science House, Gloucester and Essex Streets, Sydney.

AUSTRALIAN STANDARD SPECIFICATION FOR AIRCRAFT MATERIAL  
(Emergency Series)CHROMIUM-VANADIUM STEEL WIRE FOR  
VALVE SPRINGS

Section I. Wire.

Section II. Valve Springs.

*This standard forms one of a series prepared by the Standards Association of Australia at the request of Departments of the Commonwealth Government for use in relation to the supply of materials required for defence purposes. In appropriate cases these specifications will be reviewed for inclusion in the normal series of Australian standards.*

## SECTION I.

## Wire.

## 1. Chemical Composition.

(a) The chemical composition of the wire shall be :

Carbon	...	...	...	...	0.45 to 0.55%
Manganese	...	...	...	...	0.60 to 0.90%
Phosphorus	...	...	...	...	0.04% maximum
Sulphur	...	...	...	...	0.04% „
Chromium	...	...	...	...	0.80 to 1.10%
Vanadium	...	...	...	...	0.15 to 0.25%
Silicon	...	...	...	...	0.30% maximum

(b) The complete analysis of every cast or consignment of steel from which the wires are made shall be supplied by the wire-maker.

2. Process. The steel shall be made by the electric furnace process.

3. Inspection of Blooms. Every bloom shall be inspected at both ends, and any showing signs of pipe shall be rejected or cut back to sound metal. One of the top end blooms so passed shall be examined by sulphur-printing or deep etching, and if any harmful segregation is noticed, all the top end blooms in the heat shall be similarly examined.

## 4. Manufacture.

(a) All surface defects in the blooms or billets which might produce defects in the rods or wires made therefrom shall be removed by rough machining, chipping, grinding or scarfing.

(b) The rods from which the wires are made shall be ground all over at some stage during the manufacture of the wire.

## 5. Condition.

(a) The wire shall be delivered in the uniformly annealed condition or, if so required, shall be cold drawn a sufficient amount after annealing to meet the purchaser's spring coiling requirements.

(b) The carbides shall be finely divided and uniformly distributed.

6. Freedom from Defects. The surface of the wire shall be smooth and free from imperfections such as seams, cracks, pits, nicks, scratches, grinding or drawing marks, or other defects.

**7. Deep Etch Test.** Test pieces at least 2 in. long shall be cut from each end of each coil and boiled for ten minutes in a solution containing 50 parts concentrated hydrochloric acid and 50 parts water. The test pieces shall not show signs of any defects.

**8. Margins of Manufacture.**

(a) The permissible variations in diameter of the wire shall be as follows:

Diameter in.	Tolerance in.
0.250 to 0.178 incl. ... ..	± 0.0015
0.177 to 0.093 incl. ... ..	± 0.001
Under 0.093 ... ..	± 0.0005

(b) The wire shall not be out of round by more than one-half the total tolerance specified above.

**9. Selection and Preparation of Mechanical Test Samples.**

(a) Coils of wire of the same gauge and from the same cast of steel shall be grouped into parcels of not more than 1 cwt. One coil shall be selected from each parcel, from which:

(i) one test sample of sufficient length shall be cut for the tensile and reverse torsion tests. These test samples shall be hardened and tempered to give the mechanical properties specified in Clause 10 (a) and (b).

Details of the heat-treatment given shall be supplied by the wire-maker.

(ii) one bend test sample shall be cut from each end of the selected coil for the single bend test specified in Clause 10 (c).

(b) All test samples shall be marked in such a way as will positively identify them with the parcel of material they represent.

**10. Mechanical Tests.** Test pieces selected and prepared in accordance with Clause 9 shall comply with the following tests:

(a) *Tensile Test.* The ultimate tensile strength shall be:  
not less than 95 tons per sq. in.

(b) *Reverse Torsion Test.* A twisting test shall be made on a straight specimen of the wire held between clamps separated by a distance equal to 50 times the wire diameter. The test shall be made by twisting the wire one complete turn to the left, then reverse twisting two turns from this position, again reverse two turns, this procedure being repeated until failure. The temperature of the wire while twisting shall not exceed the boiling point of water. The wire shall withstand a minimum of 25 turns.

(c) *Single Bend Test.* The wire, in the "as delivered" condition, shall withstand being closely wrapped at least one turn around a mandrel equal in diameter to the diameter of the wire, without showing signs of cracking.

**11. Microscopical Test.** A sample for microscopical examination shall be selected from one coil from each parcel as defined in Clause 9 (a), and shall show no evidence of decarburisation.

**12. Re-tests and Rejection of Material.**

(a) If any test piece fails to meet the requirements of Clause 10:

(i) the manufacturer may withdraw the parcel represented by the test piece, or

(ii) two further coils from the same parcel may be selected for test, one coil of which shall be the original coil selected unless that coil has been withdrawn by the manufacturer; if any test sample prepared from these coils fails to meet the requirements of Clause 10, the parcel shall be rejected.

(b) Any wire may be rejected for faults in manufacture, notwithstanding that it has been passed previously for chemical composition and physical properties.

**13. Protection against Corrosion.** The wires shall, unless otherwise specified on the order, be protected against corrosion by an approved method.

**14. Identification.** To each coil shall be securely attached a durable tag bearing such marks as will ensure identification of the material with this specification, with the cast and heat-treatment batch numbers and with the manufacturer.

**SECTION II.**

**Valve Springs.**

**15. Material.** The valve springs shall be made from wire which has been inspected and passed as complying with Section I of this specification.

**16. Details.** The details of all springs shall comply with the requirements as shown on the drawings.

**17. Freedom from Defects.**

(a) The surface of finished springs shall be uniform and free from imperfections such as pits, nicks, scratches, marks due to grinding, drawing or coiling, and from all other defects which would be detrimental to the serviceability of the springs.

(b) Representative springs may be subjected to deep acid etching as specified in Clause 7, and shall show after etching a uniform surface without defects.

#### 18. Heat-Treatment.

- (a) (i) The springs shall be hardened and tempered to give the mechanical properties specified in Clause 20 (a) and (b), unless otherwise specified on the drawing.
- (ii) Details of the heat-treatment given shall be supplied by the spring-maker.
- (iii) No spring shall be re-hardened more than twice.
- (b) The springs shall be heat-treated without excessive scaling or decarburising, and shall have a smooth finish when cleaned.
- (c) Springs shall be given a set after heat-treatment to prevent any change under normal loading in operation.

#### 19. Selection and Preparation of Mechanical Test Samples.

- (a) Coils of wire of the same gauge and from the same cast of steel shall be grouped into parcels of not more than 1 cwt.
- (b) One test sample shall be selected, of sufficient length to permit of one tensile and one reverse bend test being carried out on each parcel of wire. The test sample shall be heat-treated with the first batch of springs from each parcel.
- (c) All test samples shall be marked in such a way as will positively identify them with the parcel of material they represent.

**20. Mechanical Tests.** Test pieces selected and prepared in accordance with Clause 19 shall comply with the following tests:

- (a) *Tensile Test.* Unless otherwise specified on the drawing, the ultimate tensile strength shall be:

not less than 95 tons per sq. in.

(b) *Reverse Bend Test.* One end of each test piece shall be fixed in a vice between suitable formers, the inner edges of which are rounded to a radius equal to three times the diameter of the test piece. The projecting end of the test piece shall then be bent at right angles to the fixed end, first to one side and then to the other, until the test piece breaks. Each test piece shall withstand without cracking three bends through 180°, the first bend through 90° not being counted.

**21. Microscopical Test.** Representative springs for microscopical examination shall be selected, and shall show no evidence of decarburisation. A microscopical test may be required from each heat of springs.

**22. Hardness.** Unless otherwise specified, the hardness number of the wire in each spring tested shall be between 430 and 470 Diamond Pyramid (Rockwell C-43 and C-46), or equivalent on the scale of the method adopted.

#### 23. Magnetic Inspection.

(a) Each spring shall be subjected to magnetic inspection by an approved method in which the wire of the spring is magnetised circumferentially. All springs shall be completely demagnetised on completion of the inspection.

(b) Springs showing cracks, seams, non-metallic inclusions or any defects which would be detrimental to their strength and serviceability shall be rejected.

**24. Re-tests.** If any test piece fails to meet the requirements of Clause 20, the manufacturer may:

- (i) withdraw the batch of springs represented by the test piece, or
- (ii) re-heat-treat the entire batch and re-submit it for inspection and testing.

**25. Protection against Corrosion.** The finished springs shall, unless otherwise specified on the order, be protected against corrosion by an approved method.

#### 26. Identification.

(a) On one end of each spring shall be etched such marks as will ensure identification of the spring with the coil of wire from which it was made.

(b) If the springs are too small to be marked individually, the containers shall be marked in such a way as will ensure identification of the springs with the coils of wire from which they were made.

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This specification, prepared by the Special Committee on Aircraft Materials and Components, was approved on behalf of the Council of the Association on 20th May, 1943.

#### NOTE.

In order to keep abreast of progress in the industries concerned, Australian standards are subject to periodical review. Suggestions for improvement, addressed to the Headquarters of the Association, will be welcomed.