

STANDARDS ASSOCIATION OF AUSTRALIA.

Headquarters :
Science House, Gloucester and Essex Streets, Sydney.

AUSTRALIAN STANDARD SPECIFICATION FOR AIRCRAFT MATERIAL
(Emergency Series)

SYNTHETIC RUBBER HOSE, PETROL AND
OIL RESISTANT
(Low Pressure)

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.

SCOPE.

1. **Scope.** This specification applies to fabric-reinforced synthetic rubber hose for use in fuel and oil systems in aircraft. The hose is intended for use in short lengths only.

MATERIALS.

2. **Materials.** The materials used in the construction of the hose shall comply with the following requirements :

- (a) *Rubber.* The rubber shall be made by a synthetic process, and shall be of a type which is not liable to change its characteristics, under the low temperature liable to be met in service, to an extent that would adversely affect the serviceability of the hose.¹
- (b) *Fabric.* The fabric shall be cotton canvas weighing not less than 6 oz. per sq. yd. The strength of the fabric as determined by the method described in Appendix A. shall be not less than 55 lb. per in. width in both the warp and weft directions.

Before incorporation in the hose the fabric shall be impregnated with rubber in such a manner that in the finished hose adjacent plies of fabric will be separated by a thin layer of rubber.

CONSTRUCTION.

3. **Dimensions.** The purchaser shall state in the order the nominal inside diameter and wall thickness of the hose required. The actual inside diameter and wall thickness at any point shall conform to the nominal dimensions within the tolerances specified in Table II.

Hoses of less than $\frac{1}{2}$ in. nominal internal diameter may be ordered in lengths up to 6 ft., and hoses $\frac{1}{2}$ in. nominal internal diameter and larger in lengths up to 3 ft.

4. **Construction.** The hose shall consist of an inner lining of rubber covered by a number of plies of rubberised fabric, which in turn shall be covered by an outer layer of rubber, the whole being vulcanised together.

5. **Manufacture.** The inner lining shall be seamless in all hose of nominal internal diameter up to and including 2 in. In hose of nominal internal diameter exceeding 2 in. the lining may be made from sheet, and if so made shall be formed of at least two whole turns of the sheet. The thickness of the lining shall be as specified in Table I.

The rubberised fabric shall be wrapped longitudinally over the inner lining on the bias. The number of turns of fabric shall be as specified in Table I. The outer edge of the fabric shall overlap the inner edge by not less than $\frac{3}{16}$ in. nor more than $\frac{3}{8}$ in. in hose of nominal internal diameter up to and including $\frac{5}{8}$ in., and by not less than $\frac{1}{4}$ in. nor more than $\frac{1}{2}$ in. in hose of nominal internal diameter exceeding $\frac{5}{8}$ in.

¹ Consideration is being given to the development of a test to check this property of the rubber, for inclusion in the specification at a later date.

The thickness of the outer layer of rubber shall be as specified in Table I. The colour of the outer layer shall be black.

A narrow identification strip, coloured red and yellow, extending the full length of the hose, shall be applied to the outer layer of rubber.

6. Quality and Finish. The hose shall be of uniform quality throughout its length and shall be free from porosity and other defects.

The inner lining shall be smooth and free from foreign matter.

The impression left on the outer surface by the fine fabric used for wrapping the hose before vulcanising will be considered satisfactory, but a corrugated surface will not be acceptable.

The hose ends shall be cut clean and square and shall be entirely free from frayed edges of fabric.

7. Marking and Packing.

(a) Each length of hose shall be marked with the manufacturer's batch number. A manufacturer's batch shall comprise all the hose made from the same lot or lots of rubber mixture for the inner lining and the outer layer and the same roll or piece of rubberised fabric.

(b) Hose of the same batch, having the same nominal internal diameter and wall thickness, shall be packed in lots of not more than 50 lengths. Each package shall be marked with the following information :

- (i) the number of this specification (A.S. No. (E)D.2002),
- (ii) the manufacturer's name or distinguishing mark,
- (iii) the nominal internal diameter and wall thickness,
- (iv) the inspector's stamp.

TESTS.

8. Test Samples.

(a) A test sample 24 in. long shall be taken from the first length of hose made from each lot or lots of rubber mixture for testing in accordance with the provisions of Clause 9 (b), (c), (d) and (e).

(b) A test sample 12 in. long shall be selected at random from each size of hose in each manufacturer's batch for testing in accordance with the provisions of Clause 9 (f).

9. Tests. The following tests shall be carried out to the satisfaction of the inspector :

(a) The hardness of the rubber in the finished hose shall be determined on lengths selected at random by the inspector. The determinations shall be made by the method described in British Standard No. 903—1940, Methods of Testing Vulcanised Rubber, and the hardness values so obtained shall be not lower than 35 nor higher than 75.^{2, 3}

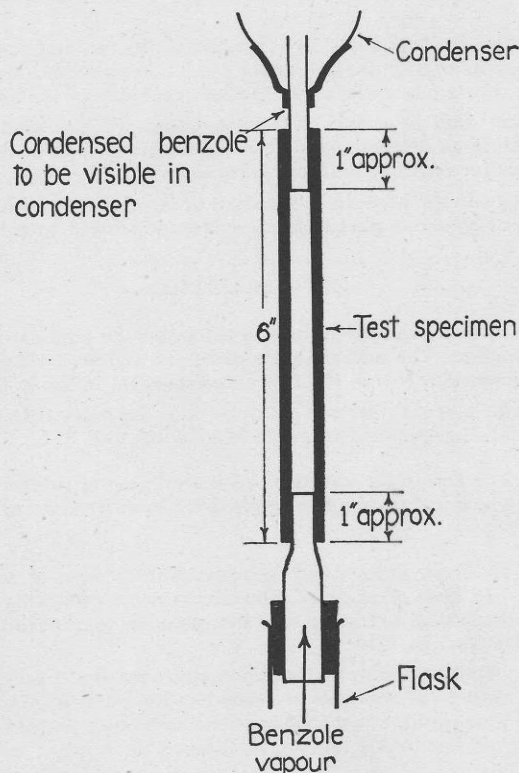


Fig. 1. Method of Determining Resistance to Benzole.

² For works testing, the hardness of the rubber may be determined by the Shore Durometer. The hardness numbers given by the Shore Type A. Durometer approximately equivalent to the B.S. hardness numbers specified herein, are given for assistance in this connection.

³ The approximately equivalent Shore hardness numbers are 80 and 60 respectively.

(b) A specimen of the hose 6 in. long shall be refluxed with benzole complying with the latest issue of B.S. No. D.10, as shown in Fig. 1, for one hour. The apparatus shall then be filled with cold benzole and allowed to stand for 24 hours. Alternatively, the end of the specimen shall be plugged and the hose filled with cold benzole and allowed to stand for 24 hours. At the end of this period the specimen shall be removed and immediately examined. The diameter of the bore as determined by projection or by means of rod gauges or calipers shall not differ from the original by more than 20% for hose of nominal internal diameter up to and including $\frac{1}{4}$ in., nor by more than 15% for hose of nominal diameter exceeding $\frac{1}{4}$ in.

The rubber shall show no tendency to separate from the fabric and shall not be friable. These requirements shall be checked by cutting the hose at two or more sections.

(c) A specimen of the hose 3 in. long shall be immersed for five hours in mineral lubricating oil (summer grade) complying with the latest issue of British Ministry of Aircraft Production Specification No. D.T.D. 109, at a temperature of 150°C. On removal from the oil the surface of the specimen shall not be tacky or show any signs of decomposition. The separation of the marking strip shall not be cause for rejection.

The B.S. hardness number of the rubber shall be not higher than 135.⁴

(d) A specimen of the hose 3 in. long shall be heated to and maintained at a temperature of 100°C. for 48 hours. At the end of this period the specimen shall be allowed to stand and cool for 24 hours.

Six rings, each $\frac{3}{8}$ in. wide, shall be cut from the test specimen, care being taken that the cut edges are not torn. The end pieces of the original specimen shall be discarded. Each ring shall be cut longitudinally at a different point on the circumference relative to the original hose for each ring and pressed flat in a vice over a plate $\frac{1}{8}$ in. thick with its edges rounded with a radius of $\frac{1}{16}$ in., in such a manner that the inner lining of the rubber is on the outside of the bend. (See Fig. 2.) The pressure of the vice shall be sufficient to keep the ring flat, but without more than very slight compression of the rubber. The specimens shall be kept in this position for five minutes and then examined visually. They shall show no tendency to crack.

The B.S. hardness number of the rubber shall be not lower than 35.⁵

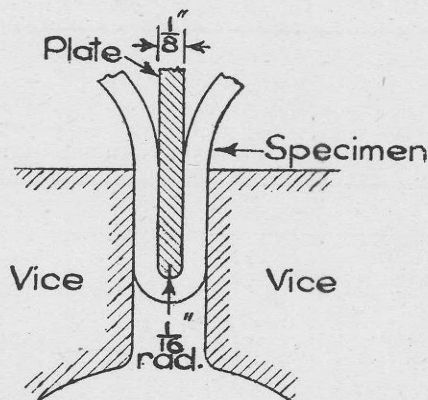


Fig. 2.

(e) A specimen of the hose 12 in. long shall be subjected to the appropriate internal pressure specified in Table III, and shall show no signs of failure or separation of the rubber from the fabric.

The test pressure shall be applied gradually and shall be maintained at the specified value for five minutes.

10. Re-tests. Should a specimen fail to pass the test applied to it, the inspector shall select two further specimens from the same batch and shall test them in the same manner. Should either of these further specimens fail, the whole batch shall be rejected, or alternatively, two further samples shall be selected at random from the batch and tested in accordance with the provisions of Clause 9. Should either of these samples fail, the whole batch shall be rejected.

APPENDIX A.

Method of Determining the Strength of the Fabric.

The inspector shall select a sample the full width of the fabric and 11 in. long from at least one web of each warper's beam, where it can be shown that the consignment can be correlated with the warper's beam; otherwise a sample shall be selected from each roll or piece at the inspector's discretion.

Six specimens shall be cut from the test sample, three in the direction of the warp and three in the direction of the weft. No two specimens cut in the same direction shall contain the same longitudinal threads.

⁴ The approximately equivalent Shore hardness number is 40.

⁵ The approximately equivalent Shore hardness number is 80.

The specimens shall be cut $2\frac{1}{2}$ in. wide and the width then reduced to 2 in. by fraying off approximately the same number of yarns from each side.

The specimens shall be exposed for at least 48 hours in an atmosphere having a relative humidity of $65\% \pm 2\%$ and a temperature of $70^\circ\text{F.} \pm 5^\circ$. They shall then be placed evenly in the jaws of a suitable testing machine and the breaking strength determined.

The tests shall preferably be carried out in an atmosphere having the same temperature and humidity conditions as those obtaining in the conditioning chamber. When this is not possible, the tests shall be completed within 2 min. of removing the specimens from the conditioning chamber.

The rate of traverse of the moving jaw of the machine shall be uniform and shall be 18 in. per min. The length of unstretched fabric between the jaws shall be 7 in.

The breaking strength in the warp and in the weft shall be the averages of the three warp and three weft specimens respectively, and shall be expressed in terms of pounds per inch width.

If a specimen slips in the jaws, or breaks in or at the jaws, or if for any other reason attributable to faulty operation the result falls markedly below the strength required, the result shall be discarded and another specimen containing the same longitudinal threads shall be taken, and the result of this break included in the average.

TABLE I.

No. of Plies of Fabric.	Wall Thickness.	Thickness of Inner Lining.	Thickness of Outer Layer of Rubber.
	in.	in.	in.
2	$\frac{1}{8}$ to $\frac{3}{16}$	$\frac{3}{32}$ min.	$\frac{1}{32}$ min.
3	$\frac{3}{16}$ to $\frac{1}{4}$	$\frac{1}{16}$ "	$\frac{1}{32}$ "
4	$\frac{3}{16}$ to $\frac{3}{32}$	$\frac{1}{16}$ "	$\frac{1}{32}$ "
5	$\frac{1}{4}$ to $\frac{5}{16}$	$\frac{1}{16}$ "	$\frac{1}{32}$ "

TABLE II.

Permissible Tolerances on Nominal Dimensions.

Dimension.	Tolerance.
Internal Diameter :	in.
Up to and including $\frac{5}{8}$ in.	$\pm \frac{1}{64}$
Over $\frac{5}{8}$ in.	$+\frac{1}{64}$ $-\frac{1}{32}$
Wall Thickness :	
$\frac{1}{8}$ in. up to and including $\frac{3}{8}$ in.	$+\frac{1}{64}$ -0
Over $\frac{3}{8}$ in. up to and including $\frac{5}{16}$ in.	$+\frac{1}{32}$ -0
Length :	
Up to and including 12 in.	$\pm \frac{1}{16}$
Over 12 in.	$\pm \frac{1}{4}$

TABLE III.

Test Pressures.

Wall Thickness.	Up to and incl. $\frac{3}{4}$ in. Internal Diameter.	Over $\frac{3}{4}$ in. up to and incl. $1\frac{1}{2}$ in. Internal Diameter.	Over $1\frac{1}{2}$ in. Internal Diameter.
	lb. per sq. in.	lb. per sq. in.	lb. per sq. in.
$\frac{1}{8}$ in. up to and incl. $\frac{5}{32}$ in.	200	150	106
Over $\frac{5}{32}$ in. up to but not incl. $\frac{1}{4}$ in.	300	200	125
$\frac{1}{4}$ in. up to but not incl. $\frac{3}{16}$ in.	400	250	150
$\frac{3}{16}$ in.	500	300	175

For the purposes of this specification the term "Inspector" shall be interpreted in the manner directed by the Australian Airworthiness Authority concerned.

This specification, prepared by the Special Committee on Aircraft Materials and Components, was approved on behalf of the Council of the Association on 12th 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.