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SPECIFICATION FOR ELECTRICALLY BONDED AIRCRAFT FUELLING RUBBER HOSE

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MANAK BHAVAN, 9 BAHADUR SHAH ZAFAR MARG
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SPECIFICATION FOR ELECTRICALLY BONDED AIRCRAFT FUELLING RUBBER HOSE

0. FOREWORD

0.1 This Indian Standard was adopted by the Indian Standards Institution on 8 June 1970, after the draft finalized by the Rubber Products Sectional Committee had been approved by the Chemical Division Council.

0.2 This hose is primarily intended for fuelling aircraft on the ground with petroleum fuels having an aromatic hydrocarbon content not exceeding 30 percent by volume at ambient air temperature within the range −25 to +55°C and working pressure up to 10·0 kgf/cm². It may also be used for defuelling purposes, but a different type of embedded hose or hose with internal wire helix may be necessary for high speed defuelling.

0.3 The demand is also growing for hose suitable for a maximum working pressure of 17·5 kgf/cm². This type of hose will also be included in the standard in due course.

0.4 In the formulation of this standard considerable assistance has been derived from draft ISO Recommendation No. 1825 ' Aircraft refuelling hose (bonded) '.

0.5 This standard contains clauses **3.3.3**, **4.2** and **6.1** which call for agreement between the purchaser and the supplier.

0.6 For the purpose of deciding whether a particular requirement of this standard is complied with, the final value, observed or calculated expressing the result of a test or analysis, shall be rounded off in accordance with IS : 2-1960*. The number of significant places retained in the rounded off value should be the same as that of the specified value in the standard.

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1. SCOPE

1.1 This standard prescribes the requirements, methods of sampling and test for electrically bonded aircraft fuelling rubber hose, non-collapsible type,

*Rules for rounding off numerical values (*revised*).

reinforced with woven or braided textile material or plies of cord, and built on mandrels and suitable for working pressure up to 10·0 kgf/cm².

2. TERMINOLOGY

2.1 For the purpose of this standard, the definitions given in 2 of IS : 443-1963* shall apply.

3. REQUIREMENTS

3.1 Materials

3.1.1 *Lining* — The lining shall consist of a rubber compound resistant to petroleum fuels.

3.1.2 *Reinforcement* — The textile reinforcement shall consist of natural or synthetic fibre.

NOTE — For reinforcement with cotton textile, *see* IS : 4388-1967†.

3.1.3 *Cover* — The cover shall consist of a suitable rubber compound.

3.2 Construction

3.2.1 *Lining* — The lining shall be reasonably uniform in thickness and free from air blisters, porosity and splits. It shall be seamless and smooth in the bore.

3.2.2 *Reinforcement* — The reinforcement shall consist of plies of natural or synthetic yarn or plies of cord or woven plies of natural or man-made fibre suitably rubberized on both sides with a compound resistant to petroleum fuel. The yarn reinforcement shall be so impregnated with a suitable rubber compound that a distinct layer of rubber is formed between each ply. The reinforcement of woven plies shall be applied on bias at approximately 45° angle. The finishing end of the last ply shall overlap the start of the first ply by minimum of 6 mm.

3.2.2.1 Not fewer than two low-resistant electrical bonding wire shall all be provided between or incorporated in the reinforcement plies and arranged in such a manner that reliable electrical continuity is maintained along the length of the hose in service and possibility of fracture of the strands is minimized. If the hose is supplied without couplings, those bonding wires shall protrude at least 40 mm at each end of the hose and shall be folded into the hose bore. Where the hose is supplied fitted with couplings, the bonding wires shall be anchored to the couplings in a manner which shall ensure reliable electrical continuity throughout the life of the hose.

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*Methods of sampling and test for rubber hoses (*revised*).

†Specification for cotton fabrics for reinforcement of rubber hoses.

3.2.3 *Cover* — The cover shall be of compounded synthetic rubber and shall be resistant to abrasion, weather (outdoor exposure) and petroleum fuel. It shall be reasonably uniform and free from air blisters, porosity and splits. The cover may have cloth-marked finish and the whole shall be consolidated by wrapping and uniformly vulcanized to give good adhesion between the reinforcement plies and the rubber lining of the cover.

3.3 Dimensions and Tolerances

3.3.1 *Bore Sizes* — The nominal bore size of the hose when measured according to the method prescribed in **9.2** of IS : 443-1963* shall be 25, 31·5, 38, 50, 63 and 75 mm. The tolerance on the nominal bore size specified shall be as given in Table 1.

3.3.2 *Thickness of Lining and Cover* — The Thickness of lining and cover for all the hoses, when determined according to **8** of IS : 443-1963*, shall be not less than 1·5 mm at any point.

3.3.3 *Length* — The length shall be as specified by the purchaser. Splicing or joining of hoses shall not be permitted in lengths of 18 metres or less. In lengths over 18 metres, joining shall only be permitted by agreement between the purchaser and the supplier.

3.3.3.1 The tolerance on standard or any specified lenght shall be ± 1 percent.

3.3.4 *Weight of Hose* — The weight of hose shall be not greater than the values shown in Table 1.

TABLE 1 TOLERANCE ON BORE SIZES AND MAXIMUM WEIGHT OF ELECTRICALLY BONDED AIRCRAFT FUELLING RUBBER HOSE

(*Clauses* 3.3.1 *and* 3.3.4)

Nominal Bore Size of Hose	Tolerance on Bore Size	Weight
(1)	(2)	(3)
mm	mm	g/m
25	± 1·25	1 120
31·5	± 1·50	1 400
38	± 1·50	1 660
50	± 1·50	2 050
63	± 1·50	3 265
75	± 2·00	4 100

*Methods of sampling and test for rubber hoses (*revised*).

3.4 Tensile Strength and Elongation at Break of Lining and Cover of Finished Hose — The tensile strength and elongation at break of the rubber used for lining and cover of the hose when tested according to the method prescribed in **4** of IS : 443-1963* shall be as prescribed below:

Characteristics	*Requirements*	
	Lining	*Cover*
Tensile strength, kgf/cm², *Min*	70	70
Elongation at break, percent, *Min*	250	300

3.5 Accelerated Ageing-Test Requirement — After ageing at 100± 1°C for 72 hours, the rubber used for the lining and cover of the hose shall not vary by more than ±25 percent for tensile strength, and $^{+10}_{-45}$ percent for elongation at break of the corresponding values obtained before ageing, when tested according to **4** of IS : 443-1963*.

3.6 Adhesion — The adhesion shall be such that the rate of separation does not exceed 25 mm per minute under a load of 5 kg as indicated below:

a) Between braids or plies,

b) Between lining and braid or ply, and

c) Between cover and braid or ply.

3.7 Swelling in Fuel — When representative samples of rubber of lining and cover of the hose are subjected to swelling at 40±1°C for 48 hours, the volume shall not increase by more than 25 percent for lining and 75 percent for cover, when tested according to the method prescribed in **13** of IS : 443-1963*.

3.8 Fuel Soluble Matter — The rubber lining, when tested according to the method prescribed in Appendix A, shall not have fuel soluble matter more than 3 percent by weight.

3.9 Low Temperature Flexibility — The lining and cover when tested according to the methodp rescribed in Appendix B, shall show no cracking at −26±1°C.

3.10 Flexibility of Hose — The flexibility of hose shall be such that, when empty, it shall be capable of being coiled round a test drum of external diameter as given in Table 2 without suffering structural damage. After uncoiling, it shall show no permanent deformation or loss of electrical continuity.

*Methods of sampling and test for rubber hoses (*revised*).

TABLE 2 NOMINAL EXTERNAL DIAMETER OF DRUM FOR FLEXIBILITY TEST

(*Clause* 3.10)

All dimensions in millimetres.

Nominal Internal Bore of Hose	External Diameter of Drum
25	230
31·5	280
38	360
50	430
63	460
75	460

NOTE — Diameter of service reeling drums are given in Appendix C for guidance.

3.10.1 If the empty hose is bent until an obvious kink is formed and then released, it shall suffer no structural damage or loss of electrical continuity.

3.11 Resistance to Vacuum — The adhesion between layers of the hose shall be such that the hose is capable of withstanding for 10 minutes an internal vacuum of 500 mm of mercury without suffering structural damage or permanent deformation.

3.12 Hydraulic Test Requirements

3.12.1 *Proof-Test on Hose Lengths* — Each manufactured length of hose, if supplied without couplings, shall be subjected to an internal pressure 1·5 times that of the working pressure applied at a rate of 0·75 to 1·5 kgf/cm² per second. The proof pressure shall be maintained for 5 minutes, then reduced at the same rate to 3·5 kgf/cm² and shall be maintained for a further 2 minutes. During the test the hose shall show no signs of leakage or other failure including breakdown in electrical continuity.

3.12.1.1 The test medium shall be water. This water shall be completely removed from the hose after testing and the electrical continuity shall be retested.

3.13 Bursting Pressure — Representative samples having a minimum length of 63 cm clear of test fittings, cut from hose of approximately 100 cm long, shall be subjected to a hydraulic pressure, built up at a rate of 0·75 to 1·5 kgf/cm² per second until the hose bursts. The test medium shall be water and the bursting pressure, when tested according to the method prescribed in **12** of IS : 443-1963*, shall not be less than 40 kgf/cm².

*Methods of sampling and test for rubber hoses (*revised*).

3.14 Electrical Bounding — During and after subjection to the flexibility tests specified in **3.9** and to the hydraulic tests specified in **3.12**, electrical continuity of each hose shall be maintained from end to end.

NOTE — A suitable method of determining electrical continuity is by the use of a 4·5-V battery and 3·5-V, 0·3-A test bulb. A dimly lighted bulb is sufficient to indicate satisfactory continuity.

4. MARKING AND PACKING

4.1 Each length of wrapped hose shall be indelibly marked adjacent to each end with:

a) the manufacturer's name or trade-mark and hose denomination; and

b) the month and year of manufacture, if required by the purchaser.

4.1.1 For long length moulded hose, the above markings shall be made at intervals of 10 metres.

4.1.2 Each length of hose may also be marked with the ISI Certification Mark.

NOTE — The use of the ISI Certification Mark is governed by the provisions of the *Indian Standards Institution (Certification Marks) Act*, and the Rules and Regulations made thereunder. Presence of this mark on products covered by an Indian Standard conveys the assurance that they have been produced to comply with the requirements of that standard, under a well-defined system of inspection, testing and quality control during production. This system, which is devised and supervised by ISI and operated by the producer, has the further safeguard that the products as actually marketed are continuously checked by ISI for conformity to the standard. Details of conditions, under which a licence for the use of the ISI Certification Mark may be granted to manufacturers or processors, may be obtained from the Indian Standards Institution.

4.2 The material shall be packed as agreed to between the purchaser and the supplier.

5. SAMPLING

5.1 For the purpose of ascertaining conformity of the hose in a consignment to this specification, the scale of sampling and the criteria for conformity shall be as prescribed in **3** of IS : 443-1963*.

6. TESTS

6.1 Unless otherwise agreed to between the purchaser and the supplier, all tests shall be carried out within three months from the date of receipt of the material by the purchaser.

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*Methods of sampling and test for rubber hoses (*revised*).

APPENDIX A

(*Clause* 3.8)

METHOD FOR DETERMINATION OF FUEL SOLUBLE MATTER

A-1. PROCEDURE

A-1.1 Cut the same sample into pieces approximately 3 mm^2 and extract 5 g of the comminuted sample with 100 ml of a mixture of 30 parts by volume of pure toluene and 70 parts by volume of pure iso-octane in a glass flask for 96 hours at 40± 1°C, suitable precautions being taken to prevent loss by evaporation. Filter the contents, while still hot, into a hemispherical glass dish of suitable size, washing both the residue in the flask and the filter with a further quantity of the solvent mixture. Evaporate the contents of the dish on a boiling water bath and heat the residue in a ventilated air-oven for 2 hours at 150± 3°C. Carry out a blank determination on the solvent mixture and correct the result as necessary.

NOTE — If fuel soluble determination is made on a sample of lining taken from the hose, buff to remove any adhering reinforcement fabric before comminuting.

A-2. CALCULATION

A-2.1 Calculate the weight of residual fuel-soluble matter as a percentage of the original weight of the test portion.

APPENDIX B

(*Clause* 3.9)

LOW TEMPERATURE FLEXIBILITY

B-1. PROCEDURE

B-1.1 Fix a test piece 150 × 25 × 3 mm in two grips so that it lies in one plane with 125 mm exposed between the grips and then reduce the distance between the grips by 1·0 mm. Place the clamped test piece in a Dawar vessel of suitable size, containing industrial methylated spirit at −26°C so that the test piece is completely immersed. Maintain the temperature at −26 ± 1°C for 30 minutes by careful addition of pieces of solid carbon dioxide and then reduce the distance between the grips by 25 mm in 20 seconds by moving one grip directly towards the other and in the same plane. Examine the test piece for cracks.

APPENDIX C

(*Clause* 3.10, and *Table* 2)

DIAMETERS OF SERVICE REELING DRUMS

C-1. Minimum outside diameters of reeling drums used in service are given in Table 3.

TABLE 3 MINIMUM OUTSIDE DIAMETER OF REELING DRUM

All dimensions in millimetres.

Sl No.	Nominal Bore Size of Hose	Outside Diameter of Reeling Drum, *Min*
(1)	(2)	(3)
i)	25	305
ii)	31·5	380
iii)	38	460
iv)	50	560
v)	63	610
vi)	75	610