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IS 636 (1988): Non-percolating flexible fire fighting delivery hose [PCD 13: Rubber and Rubber Products]



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“Knowledge is such a treasure which cannot be stolen”

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Indian Standard

**SPECIFICATION FOR
NON-PERCOLATING FLEXIBLE FIRE
FIGHTING DELIVERY HOSE**

(Third Revision)

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NEW DELHI 110002

Indian Standard

SPECIFICATION FOR NON-PERCOLATING FLEXIBLE FIRE FIGHTING DELIVERY HOSE (*Third Revision*)

0. FOREWORD

0.1 This Indian Standard (Third Revision) was adopted by the Bureau of Indian Standards on 10 July 1988, after the draft finalized by the Rubber Products Sectional Committee had been approved by the Petroleum, Coal and Related Products Division Council.

0.2 This standard was originally published in 1958 and subsequently revised in 1962 and in 1979. In the second revision, categorization based on construction was removed and the specification made performance-oriented with classification under two types, depending on differences in the requirements. The Rubber Products Committee took cognizance of the continuous improvement achieved in the quality of fire hoses and felt that uniformly high quality should be preferred for all fire fighting applications to provide durability and reliability. The Committee, therefore, decided to have only two types of fire hoses in this standard. Type A is the rubber lined or rubberized fabric lined with or without elastomeric coating/covering. Type B is the improved quality, outer elastomeric coated/covered fire hose which would take care of the more rigorous operational uses and changing fire fighting environment. Type 2 hose of 1979 edition has been covered under Type A of this third revision.

0.3 In this revision, the requirements of mass and coil diameter have been modified while the requirements for tensile strength and elongation at break of lining, flexibility and friction loss have been deleted.

0.3.1 In the second revision, need for inclusion of abrasion and heat resistance test was felt but in the absence of adequate data, they were not included. These requirements have now been included. Further, requirements for water pick up, moisture absorption, ozone resistance and oil resistance test have been included for Type B hoses.

0.3.2 In this third revision, tests have been classified as type, acceptance and routine tests, depending upon the criticality and time factor, to facilitate speedy acceptance of lots.

0.4 In the preparation of this standard, guidance has been derived from BS 6391 : 1983 'Non-percolating lay flat delivery hoses and hose assemblies for fire fighting purposes', issued by the British Standards Institution (BSI).

0.5 This standard contains clauses 3.1.1, 5.3 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 results 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 this standard.

*Rules for rounding off numerical values (revised).

1. SCOPE

1.1 This standard prescribes the requirements and methods of sampling and test for non-percolating flexible fire fighting delivery hose of sizes 38, 50, 63 and 70 mm.

2. TERMINOLOGY

2.0 For the purpose of this standard, the definitions given in various parts of IS : 7503* and the following shall apply.

*Glossary of terms used in rubber industry.

2.1 Type Tests — Tests carried out to prove conformity with the specification. These are intended to prove the general qualities and raw materials of a given type of fire hose.

2.2 Acceptance Tests — Tests carried out on samples taken from a lot for the purpose of acceptance of the lot.

2.3 Routine Tests — Tests carried out at manufacturer's works on each fire hose to check the requirements which are likely to vary during production.

3. TYPES

3.1 Hoses shall be of the following two types.

3.1.1 Type A — Normal fire hoses, rubber lined or rubberized fabric lined, woven-jacketed with or without elastomeric coating/covering for application under normal fire conditions.

3.1.2 Type B — Hose to which an elastomeric outer coating or covering has been applied or incorporated as reinforcement to give the hoses very low absorption of liquids such as oils, greases, acids and alkalis, etc, and has high resistance to abrasion and direct heat.

4. TESTS

4.1 Classification of Tests

4.1.1 Type Tests — The following shall constitute the type tests:

- a) Workmanship (*see* 5.1.1.1),
- b) Rotproofing (*see* 5.1.1.2),
- c) Internal diameter (*see* 5.2),
- d) Mass (*see* 5.4),
- e) Coil diameter (*see* 5.5),
- f) Hydrostatic burst pressure (*see* 5.6),
- g) Hydrostatic proof pressure (*see* 5.7),
- h) Kink test (*see* 5.8),
- j) Change in length (*see* 5.9),
- k) Change in diameter (*see* 5.10),
- m) Adhesion (*see* 5.11.1),
- n) Accelerated ageing (*see* 5.11.2),
- p) Abrasion resistance (*see* 5.12),
- q) Water pick up/moisture absorption (for Type B only) (*see* 5.13),
- r) Heat resistance (*see* 5.14),
- s) Oil resistance (for Type B only) (*see* 5.15), and
- t) Ozone resistance (for Type B only) (*see* 5.16).

4.1.1.1 Criteria for approval — Three samples from three different lots shall be submitted for testing. The testing authority shall issue a type approval certificate if the hoses are found to comply with the requirements of tests given in 4.1.1.

In case of failure in one or more type tests, the testing authority may call for fresh samples not exceeding twice the number of original samples and subject them to the test(s) in which the failure occurred. If in the repeat test(s) no failure occurs, the tests may be considered to have been satisfied.

4.1.2 Acceptance Tests — The following shall constitute the acceptance tests:

- a) Workmanship (*see* 5.1.1.1),
- b) Internal diameter (*see* 5.2),

- c) Length (*see* 5.3),
- d) Mass (*see* 5.4),
- e) Coil diameter (*see* 5.5),
- f) Hydrostatic burst pressure (*see* 5.6),
- g) Kink test (*see* 5.8),
- h) Change in length (*see* 5.9),
- j) Change in diameter (*see* 5.10),
- k) Adhesion (*see* 5.11.1),
- m) Abrasion resistance (*see* 5.12),
- n) Water pick up/moisture absorption (for Type B only) (*see* 5.13), and
- p) Heat resistance (*see* 5.14).

4.1.2.1 A recommended sampling plan for determining the acceptability or otherwise of a lot, is given in Appendix A.

4.1.3 Routine Tests

- a) Internal diameter (*see* 5.2), and
- b) Hydrostatic proof pressure (*see* 5.7).

5. REQUIREMENTS

5.1 General

5.1.1 The hose shall be constructed from a circular woven jacket having a waterproof rubber lining or rubberized fabric lining on the inside, facing the waterway and with or without elastomeric coating/covering (Type A) and with elastomeric coating/covering (Type B). The jacket shall be seamless and compactly woven from good quality cotton yarn or from yarn made from suitable synthetic fibre of polyamide or polyester type of good quality or from their combinations. Fire hose with outer coating/covering shall be manufactured using synthetic yarn only.

5.1.1.1 Workmanship — The jacket shall be practically free from dirt, knots, lumps, irregularities of the yarn and other visible defects.

5.1.1.2 Rotproofing — If cotton yarn is used in the construction of jacket, this shall be treated with pentachlorophenyl laurate (PCPL) to the extent of 1.5 percent minimum by mass as determined by the method described in Appendix C of IS : 11662-1986*. This test is to be carried out on the jacket either before or after lining.

NOTE — Other rotproofing materials may also be used provided when tested by pure culture, mixed culture, *Aspergillus niger* and soil burial methods prescribed in IS : 1389-1984† shall conform to the requirements stipulated against each method.

5.1.1.3 Inner lining shall either be of rubber or rubberized fabric and shall be generally smooth and practically free from pitting and other imperfections.

*Preservative treatments for textiles.

†Methods of testing cotton fabrics for resistance to attack by micro-organism (*first revision*).

5.1.1.4 Externally applied elastomeric coating or covering of the reinforcement, if present, shall be generally smooth and practically free from pitting and other imperfections.

5.2 Internal Diameter — The internal diameter of the hose shall be measured by a suitable conical plug gauge and shall conform to the specified diameter with a tolerance of plus 2 and minus 0.0 mm.

5.3 Length — Unless specified otherwise, the standard length shall be 30 metres. Unless otherwise specified, a tolerance of ± 2 percent shall be permitted on the length prescribed for the hose by the purchaser but the total of all lengths of hose supplied shall be not less than the total quantity specified by the purchaser.

5.4 Mass — The average mass of hose per metre of 5-metre length shall be not more than that prescribed in Table 1. For the determination of mass, sample of the hose shall be conditioned at $27 \pm 2^\circ\text{C}$ and 65 ± 5 percent relative humidity for a period of at least 48 hours and then shall be weighed under the same conditions.

TABLE 1 MAXIMUM MASS OF THE HOSE

| SIZE (1) | MASS OF HOSE PER METRE LENGTH, Max | |
|-------------|------------------------------------|---------------|
| | Type A (2) | Type B (3) |
| mm | g | g |
| 38 | 275 | 320 |
| 50 | 350 | 425 |
| 63 | 425 | 500 |
| 70 | 480 | 600 |

5.5 Coil Diameter (Machine Coiled) — For 30 m length of dry hose without couplings, the coil diameter shall not exceed 45 cm for Type A and 55 cm for Type B.

5.6 Hydrostatic Burst Pressure Test — A test length of hose, one metre clear of fittings when subjected to an internal hydraulic pressure in accordance with 8.2 of IS : 443-1975*, increasing it at the rate not exceeding 1 MPa (10.2 kgf/cm^2) per minute shall not burst or show leakage before a pressure of 3.5 MPa (35.7 kgf/cm^2) is reached.

5.7 Hydrostatic Proof Pressure Test — Each hose length shall be subjected to an internal hydraulic pressure of 2.1 MPa (21.4 kgf/cm^2) in accordance with 8.3 of IS : 443-1975* increasing the pressure at the rate of not exceeding 1 MPa (10.2 kgf/cm^2) per minute and maintaining it for one minute. Within this one minute, the hose shall not develop any leakage or sweating nor any thread in the jacket shall break.

5.8 Kink Test — Connect a 3 metre length of hose to a suitable hydraulic pump. Blank the free end of hose pipe with a suitable coupling

having arrangement to bleed out entrapped air with the help of suitable stop cock or pet cock. Fill the hose with water and raise the pressure to 70 kPa (0.7 kgf/cm^2). Allow all air to escape through stop cock by raising the free end of the hose and again rebuild the pressure to 70 kPa. Now kink the hose through 180° at approximately 50 cm from the free end by tying the hose back against itself as close to the fitting as practicable. Increase the pressure at a rate not exceeding 1 MPa (10.2 kgf/cm^2) per minute to 2.1 MPa (21.4 kgf/cm^2). When maximum pressure has been attained, retain it for 30 seconds, release the pressure, examine it for sign of leakage and damage. There shall be no sign of leakage or rupture and no thread in the jacket shall break.

5.9 Change in Length — The increase in length shall not exceed 6 percent when measured in accordance with 5.9.1.

5.9.1 Connect the hose to a suitable pump and raise the pressure to 70 kPa (0.7 kgf/cm^2) ensuring that all the entrapped air has been bled out and mark two points not less than 100 cm apart, then raise the pressure to 1 MPa (10.2 kgf/cm^2) and maintain for minimum 2 minutes, and measure the distance between the two markings again.

5.10 Change in Diameter — When subjected to a pressure of 1 MPa (10.2 kgf/cm^2) in accordance with 5.9.1, the increase in diameter shall not be more than 10 percent.

5.11 Requirements for Rubber Lining and the Outer Coating

5.11.1 Adhesion — When tested according to the method described in Appendix B, the rate of separation of the lining and the jacket, and for Type B hoses, the rate of separation of the cover and the jacket shall not exceed 25 mm/min.

5.11.2 Accelerated Ageing Test — Four numbers of test hose pieces each of 1 metre length, shall be conditioned for 120 h at $27 \pm 2^\circ\text{C}$ and 65 ± 5 percent relative humidity and shall then be aged for 336 h at $70 \pm 2^\circ\text{C}$. After ageing, there shall be no tackiness on the surface of lining or the surface of the cover. Three numbers of aged test pieces each of 1 metre length shall then be subjected to burst pressure test in accordance with the method described in IS : 443-1975* and shall meet the requirements given in 5.6. The remaining length of hose shall be used for an adhesion test in accordance with the method described in Appendix B using a load of 2 kg for the lining and 3.5 kg for the cover. Rate of separation of the lining and the jacket, and for Type B hoses, the rate of separation of the cover and the jacket shall not exceed 25 mm/min.

*Methods of sampling and test for rubber hose (second revision).

*Methods of sampling and test for rubber hose (second revision).

5.12 Abrasion Resistance — When determined by the method described in Appendix C, the average number of cycles completed before bursting for five test pieces shall not be less than 100 for Type A and 200 for Type B.

5.13 Water Pick Up/Moisture Absorption (for Type B Only) — When determined by the method described in Appendix D, the amount of water absorbed shall not exceed 0.02 kg/m².

NOTE — Moisture absorption resistance to fire hoses is related to their ability for acid alkali resistance.

5.14 Heat Resistance — When tested by the method described in Appendix E, none of the test samples shall burst at less than 8 seconds of the application of hot cube for Type A and 20 seconds for Type B.

5.15 Oil Resistance Test (for Type B Only) — A test piece measuring 1 metre in length shall be marked around the circumference at a distance of 60 mm from each end. The test piece shall be kept immersed in an oil bath for 70 hours containing oil No. 3 specified in IS : 3400 (Part 6)-1983* and maintained at $50 \pm 2^\circ\text{C}$ in such a manner that the both ends are so clamped that the marks are in level with the surface of oil and the remaining entire length of the test piece within the marks remains completely immersed in oil. At the end of this period, the test piece shall be taken out in such a manner that the portions beyond the marks do not come in contact with the oil. The length shall be laid horizontally and the central fully immersed portion of the hose shall be visually examined for any swelling of rubber, weathering and cracking in the rubber lining.

Test pieces taken from the central (fully immersed) portion of the hose shall then be subjected to an adhesion test in accordance with the method described in Appendix B and shall meet the requirements as given in 5.11.1 (for both lining and cover).

5.16 Ozone Resistance (for Type B Only) — When tested by the method prescribed in Appendix F, the lining and cover of the hose shall neither develop cracking nor crazing, that is, fine

*Methods of test for vulcanized rubbers : Part 6 Resistance to liquids (first revision).

flaws visible when seen under X2 magnification, except at the cut edges of the hose.

6 PACKING AND MARKING

6.1 Packing — The hoses may be dusted with French chalk (see IS : 380-1978*) on the inside and also outside, in case of coated/covered hoses if required by the purchaser and shall be packed and delivered in specified lengths in neat, clean and dry condition in polyethylene bags.

6.2 Marking — Beginning at a point not less than one metre from each end, each length of hose shall be marked with clear and indelible letters at least 20 mm in height indicating:

- Type of the hose,
- Size of the hose,
- Length of the hose,
- Manufacturer's name or trade-mark or both, and
- Month and year of manufacture.

6.2.1 Each length of hose may also be marked with the Standard Mark.

NOTE — The use of the Standard Mark is governed by the provisions of the Bureau of Indian Standards Act 1986 and the Rules and Regulations made thereunder. The Standard 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 which is devised and supervised by BIS and operated by the producer. Standard marked products are also continuously checked by BIS for conformity to that standard as a further safeguard. Details of conditions under which a licence for the use of the Standard Mark may be granted to manufacturers or producers may be obtained from the Bureau of Indian Standards.

7. TIME LAPSE BETWEEN RECEIPT OF MATERIAL AND TESTING

7.1 For all test purposes, the minimum time between vulcanization and testing shall be 16 h.

7.1.1 For product tests, whenever possible, the time lapse between vulcanization and testing should not exceed 4 months. In other cases, tests shall be made within 2 months from the receipt of the product by the consumer.

*Specification for French chalk, technical (second revision).

APPENDIX A

(Clause 4.1.2.1)

SAMPLING OF FIRE FIGHTING HOSES

A-0. GENERAL

A-0.1 The object of testing hoses by the purchaser is to ensure conformity to the specification whereas testing by the manufacturer during production is to ensure the conformity by reducing the quality fluctuations to the minimum and thus ensure the conformity of the lot to the specified requirements. A useful guidance can

be obtained from IS : 397 (Part 1)-1972* and IS : 397 (Part 2)-1985* for the purpose of ensuring the homogeneity of the lot.

*Method for statistical quality control during production:

Part 1 Control charts for variables (first revision).

Part 2 Control chart for attributes and count of defects (second revision).

A-1. SCALE OF SAMPLING

A-1.1 Lot — In a single consignment, all the lengths of fire fighting hoses of same type, size and produced under similar conditions of manufacture, that is, from single batch of raw material or from components obtained from single source of production or undergoing a single curing process, shall be separated to constitute a lot.

A-1.2 For ascertaining the conformity of the material in the lot to the requirements of the specification, tests shall be carried out on the samples taken from each lot separately.

A-1.3 The number of lengths of hoses to be selected from each lot, for this purpose, shall depend on the size of the lot and shall be in accordance with Table 2.

TABLE 2 SCALE OF SAMPLING

| LOT SIZE (IN LENGTHS) | SAMPLE SIZE FOR VISUAL AND DIMEN- SIONAL REQUIRE- MENTS | PERMISSI- BLE No. OF DEFECTIVE LENGTHS | SUB- SAMPLE SIZE |
|----------------------------|--|--|------------------------|
| (1) | (2) | (3) | (4) |
| Up to 100 | 20 | 1 | 1 |
| 101 to 300 | 32 | 2 | 1 |
| 301 to 500 | 50 | 3 | 1 |
| 501 and above | 80 | 5 | 2 |

A-1.3.1 The required number of lengths of hoses shall be selected at random from the lot. In order to ensure the randomness of selection, procedure given in IS : 4905-1968* may be followed.

*Methods for random sampling.

A-2. NUMBER OF TESTS AND CRITERIA FOR CONFORMITY

A-2.1 The lengths of hose selected according to col 1 and 2 of Table 2 shall be examined for visual and dimensional requirements given in 5.1.1, 5.1.1.1, 5.2, 5.3, 5.4 and 5.5 of the specification. A length of hose failing in any one or more of these requirements shall be considered as defective. The lot shall be considered as satisfying these requirements if the number of defectives found in the sample is less than or equal to the corresponding permissible number of defectives given in col 3 of Table 2.

A-2.2 The lot having been found satisfactory according to **A-2.1** shall be subjected to destructive tests given in 5.6, 5.8, 5.9, 5.10, 5.11.1, 5.12, 5.13 (for Type B only) and 5.14. For this purpose, the number of lengths of hoses given in col 4 of Table 2 shall be selected from the lot. These may be selected from those already tested according to **A-2.1** and found satisfactory. The test specimens of requisite dimensions shall be cut from each sample hose thus selected.

A-2.2.1 The lot shall be considered as conforming to the requirements of these characteristics if all the lengths of hoses subjected to various destructive tests satisfy the relevant specification requirements.

NOTE — In case cutting up of the test pieces for any tests from a length of hose is found to be uneconomical or impracticable, the required number of test pieces may be produced by the same process by which the hoses in the lot have been manufactured and supplied separately along with the lot.

A-2.3 The lot shall be declared as conforming to the requirements of the specification if **A-2.1** and **A-2.2** are satisfied.

APPENDIX B

(Clauses 5.11.1, 5.11.2 and 5.15)

METHOD OF TEST FOR DETERMINATION OF ADHESION STRENGTH

B-1. TEST PIECE

B-1.1 The test piece shall be a cylindrical section of the hose, 25.0 ± 0.5 mm long, cut perpendicular to the axis of the hose with a sharp tool.

B-2. APPARATUS

B-2.1 Mandrel — It is snug fit in the test piece with a central shaft.

NOTE — The material of mandrel may be teak wood and that of central shaft may be stainless steel.

B-2.2 Means of Supporting the Mandrel — So that it may rotate in an essentially friction-free manner on its shaft.

B-2.3 Means of Applying a Load to the Test Piece — These shall incorporate a grip for attachment to the lining or cover and spring for supporting weights and to serve as a cushion so as to protect the test piece from receiving jerks and impulses.

A typical layout of the test apparatus is given in Fig. 1.

B-3. PROCEDURE

B-3.1 Lining/Reinforcement Adhesion — Turn the test piece inside out, to expose the lining, and separate the lining and reinforcement

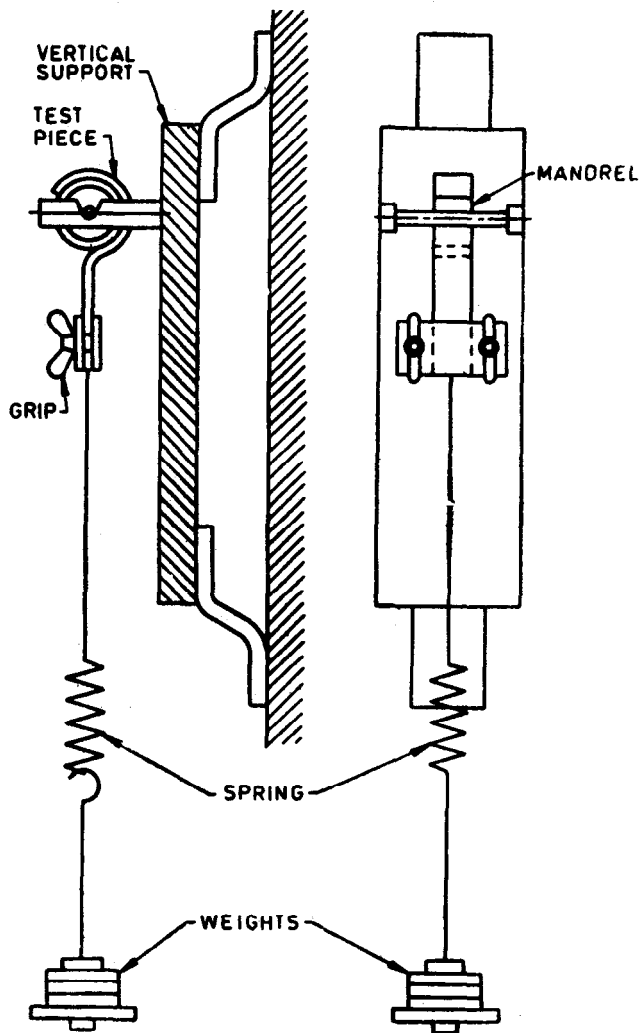


FIG. 1 TYPICAL APPARATUS FOR THE ADHESION TEST

just sufficient to enable the grip to be attached. Slide the test piece on to the mandrel and insert in the apparatus. Attach the grip together with weights to give a total mass of 2.5 kg and then measure the length of lining separated after 1 minute.

B-3.2 Cover/Reinforcement Adhesion — For Type B hoses, repeat the procedure described in B-3.1 using a separate test piece but test the cover adhesion without reversing the test piece and apply a total mass of 4.5 kg.

B-4. TEST REPORT

B-4.1 The test report shall include the following information:

- The date of test;
- All details necessary for the complete identification of the hose under test; and
- The length of separation, if any, after 1 minute.

APPENDIX C

(Clause 5.12)

ABRASION RESISTANCE TEST

C-0. OUTLINE OF THE METHOD

C-0.1 In this test, capability of the hose to withstand the rough usage to ground which it is bound to be subjected to during fire operation is tested. The hose may be dragged on rough surfaces or bent where it comes in contact with building corners or where the first length from pump delivery touches the ground and is subjected to continuous chafing due to vibration of pump.

C-1. APPARATUS

C-1.1 For determining a realistic value of abrasion resistance of the hose, a special apparatus is used as described in C-1.2. The average

number of cycles completed before the test piece bursts is to be termed as abrasion resistance cycles. Five test pieces shall be taken for such tests and the average number of cycles determined.

C-1.2 Test Apparatus — A test apparatus shall be fabricated comprising the following:

- A constant and uninterrupted source of hydrostatic pressure with water as test medium, capable of maintaining a steady pressure of 0.7 MPa or 700 kPa (7 kgf/cm²) in the test piece and provisions to bleed out entrapped air.
- A machine for abrading the test piece with a reciprocating movement. A typical

lay out of the tests apparatus is given in Fig. 2.

- c) Abrasive material fixed on the test apparatus. The abrasive material shall be a strip 25 mm wide and 300 ± 5 mm long; grit 50 'X' weight, glue bonded aluminium oxide cloth in accordance with IS : 715 (Part 2)-1976*. A new abrading strip shall be used for each test.
- d) An electric air blower to blow away the abraded fluff.

*Specification for coated abrasives : Part 2 Special and mechanized applications (*third revision*).

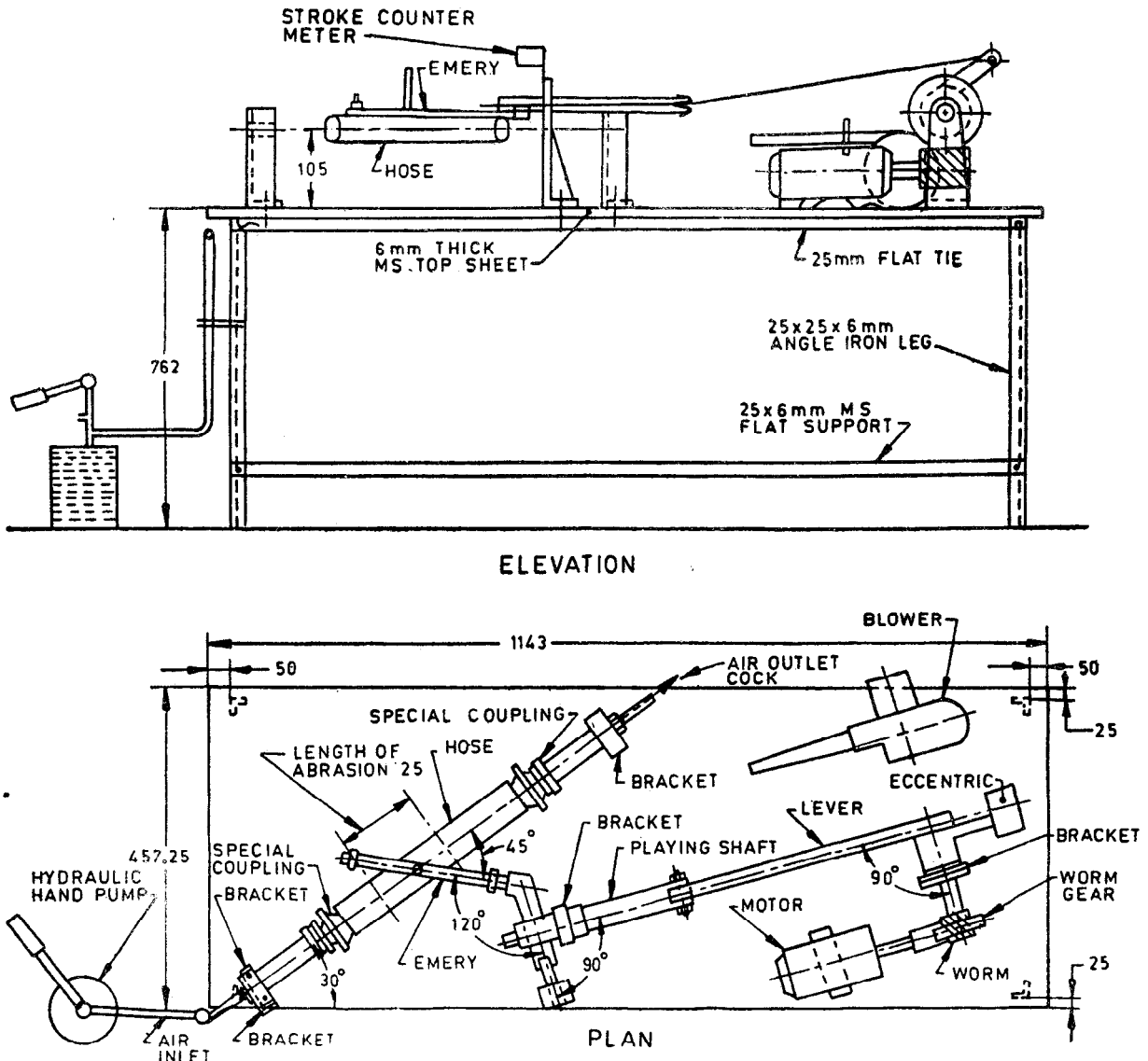
C-2. TEST SPECIMENS

C-2.1 Test Piece — Cut pieces of 35 cm length of hose.

C-2.2 Number of Test Pieces — Three test pieces shall be subjected to abrasion resistance test.

C-3. PROCEDURE

C-3.1 The abrading strip shall be mounted in a carrier and shall be set at an angle of 45° to the horizontal axis of the test piece and at an angle of 20° to the direction of reciprocating action of the test machine. The apparatus shall be adjusted to give a frequency of 50 to 60 cycles



All dimensions in millimetres.

FIG. 1 GENERAL ARRANGEMENT OF ABRASION TESTING MACHINE (NTS)

(double strokes) of reciprocating movement per minute. The length of each single stroke shall be adjusted to 230 mm. The machine shall exert a downward force of 1.58 kgf (15.5 N) on the test piece.

C-3.2 Connect the test piece to the pressure source by suitable means.

C-3.3 Fill up the test piece with water at a low pressure to expel all air. Apply a pressure of 0.7 MPa (700 kPa) raised gradually. Test piece should be horizontal as any curved fixing may lead to lower values/results.

Care shall be exercised to ensure that the hose test piece is fixed on the bed of the machine in such a manner that the free end may stretch fully, and maintain this pressure of 700 kPa for minimum two minutes before starting the abrasion. Care shall also be exercised to ensure that the abrading strip does not abrade the hose

test piece at the lap joint otherwise false results will be obtained on the much higher side.

C-3.4 Switch on the air blower and start the test machine. Record the number of cycles completed until the test piece bursts. The recording of cycles should be done by a metering device such as stroke counter and it should be switched off as soon as the hose bursts.

C-3.5 Repeat the test with a new abrading strip fixed on the machine, and a new test piece, three times.

C-3.6 Take the average value for three test pieces.

C-3.7 Remove any dirt or debris from the plane of abrasion by using an ordinary air blower working at a low pressure of 100 kPa and the nozzle fixed to some firm object, directing the air jet at an angle from a distance not exceeding 300 mm

APPENDIX D

(Clause 5.13)

METHODS OF TEST FOR MOISTURE ABSORPTION

D-1. TEST PIECE

D-1.1 The test piece shall be 600 mm length of hose marked around the circumference at distance of 50 mm from each end.

D-2. APPARATUS

D-2.1 Forced circulation air oven capable of being controlled at $50 \pm 1^\circ\text{C}$.

D-2.2 Water bath, filled with distilled water, capable of being controlled at $20 \pm 5^\circ\text{C}$.

D-3. CONDITIONING

D-3.1 Condition the test piece in the oven at $50 \pm 1^\circ\text{C}$ for 3 hours, immediately prior

to testing.

D-4. PROCEDURE

D-4.1 Weigh the conditioned test piece to an accuracy of 0.1 g. Fold the test piece inside the marks so that the ends are vertical. Place the test piece in the water bath, maintained at $20 \pm 5^\circ\text{C}$, and clamp the ends of the piece so that the marks are in level with the surface of the water and the entire length of test piece within the marks is immersed. After a period of 6 hours, remove the test piece from the water, wipe the surface dry with an absorbent cloth and allow it to dry by hanging vertically at $27 \pm 2^\circ\text{C}$ for 2 hours and then weigh.

APPENDIX E

(Clause 5.14)

METHODS OF TEST FOR HEAT RESISTANCE

E-1. TEST PIECE

E-1.1 Each test piece shall be 1 metre length of hose freshly cut from the lot offered for inspection. There shall be 5 number of test pieces for this test.

E-2. APPARATUS

E-2.0 The following test apparatus is required.

E-2.1 Laboratory furnace capable of being controlled at $600^{+10}_{-0}^\circ\text{C}$.

E-2.2 A number of steel cubes of uniform size each side being of 13.0 ± 0.1 mm.

E-2.3 Source of steady hydrostatic pressure with water as the test medium. The pressure shall be maintained at 0.7 MPa (7 kgf/cm²) in the test piece without any variation in the pressure.

E-2.4 A stop watch with a least count of 0.2 seconds.

E-2.5 A pair of steel tongs of size 30 cm.

E-2.6 A stout guard made of steel wire mesh to protect the person(s) conducting the test against any injury.

E-3. TEST PROCEDURE

E-3.1 Place the steel cubes in the furnace at $600 \pm 10^\circ\text{C}$ and maintain this temperature for at least 30 minutes immediately before use.

E-3.2 Connect the hose test piece to the pressure source and fill the test piece with water at a low pressure not exceeding 70 kPa to expel all the air from inside the test piece with the help of a pet cock. Place the test piece horizontally on some hard smooth surface like RCC or metal table. Put the free end of the test piece inside the guard. Apply the water pressure gradually raising it up to 0.7 MPa.

E-3.3 Take out the heated steel cube from the furnace with the help of an iron tong as quickly as possible (maximum time lapse 2 seconds) and place it immediately on top of the test piece. The steel cube shall be held in position by means of light wire support. Record the time elapsed from the time of placing the steel cube on the test piece until the test piece bursts. Repeat the test for all the 5 test pieces. Burst shall not occur within 8 seconds of the application of the steel cube on any of the test pieces for Type A and 20 seconds for Type B.

Care shall be exercised to ensure that the hot cube is not placed on lap joint otherwise false results will be obtained on much higher side. For each test, only new mild steel cubes free from rust, carbon particles and loose flakes shall be used.

NOTE — In case of polymeric coated hoses, the hot cube has a tendency to slip down due to quick melting of the polymer coating. So the cube must be held in position by means of light wire support.

APPENDIX F

(Clause 5.16)

METHOD OF TEST FOR OZONE RESISTANCE

F-1. TEST PIECE

F-1.1 The test piece shall be a 150 mm length of hose.

F-2. APPARATUS

F-2.1 As described in 3 of IS : 3400 (Part XX)-1977*.

F-3. CONDITIONING

F-3.1 Condition the test piece at $27 \pm 2^\circ\text{C}$ in a substantially ozone free atmosphere in the dark for 38 hours immediately prior to testing.

F-4. PROCEDURE

F-4.1 Lining — Turn the test piece inside out to expose the lining. If it is not possible to turn the test piece inside out, slit it lengthwise and reverse it to expose the lining. Form the test piece into a securely held tight coil and then

expose it in the ozone cabinet to an ozone concentration of 50 ± 5 parts per hundred million by volume (pphm) at $50 \pm 2^\circ\text{C}$ for 96 h. After exposure, examine the test piece with a lens of X 2 magnification for any signs of cracking or crazing.

F-4.2 Cover — Expose a separate, tightly coiled test piece which has not been reversed, in the ozone cabinet to an ozone concentration of 50 ± 5 pphm at $50 \pm 2^\circ\text{C}$ for 96 h and then examine the test piece as described in **F-4.1**.

F-5. TEST REPORT

F-5.1 The test report shall include the following information:

- The date of test,
- All details necessary for the complete identification of hose under test, and
- The nature and location of any cracking or crazing observed.

*Methods of test for vulcanized rubbers : Part XX Resistance to ozone.

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