भारतीय मानक

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Indian Standard

SOLVENT CEMENT FOR USE WITH UNPLASTICIZED POLYVINYL CHLORIDE PLASTIC PIPE AND FITTINGS — SPECIFICATION

UDC 621·643·42 [678·743·22·042]

BUREAU OF INDIAN STANDARDS
MANAK BHAVAN, 9 BAHADUR SHAH ZAFAR MARG
NEW DELHI 110002

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Price Group 4

FOREWORD

This Indian Standard has been adopted by the Bureau of Indian Standards, after the draft finalized by the Adhesives Sectional Committee, had been approved by the Petroleum, Coal and Related Products Division Council.

Solvent cements consist of essentially a solution of vinyl chloride homo-polymer or co-polymer dissolved in organic solvent. These solvent cements can be used for joining unplasticized PVC pressure pipes complying with the requirements of IS 4985 : 1988 'Specification for unplasticized PVC pipes for potable water supplies (*second revision*)'. A recommended procedure for joining PVC pipes and fittings is given in IS 7634 (Part 3) : 1975 'Code of practice for plastic pipe work for potable water supplies : Part 3 Laying and jointing of UPVC pipes'.

Information regarding the selection of solvent cement of right quality is given in Annex D of this standard for guidance only.

Solvent cement for plastic pipes is made from flammable liquids. It is the responsibility of the manufacturer of the product to give detailed information regarding the use of this product to the users who in turn should establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.

While preparing this standard, considerable assistance has been derived from ASTM D 2564 : 1988 Standard specification for solvent cements for polyvinyl chloride PVC plastic pipe and fittings and BS 4346 Part 3 : 1982 Joints and fittings for use with unplasticized PVC pressure pipes : Part 3 Specification for solvent cement issued by the American Society for Testing and Materials (USA) and British Standards Institution (UK) respectively.

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 'Rules for rounding off numerical values (*revised*)'. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

Indian Standard

SOLVENT CEMENT FOR USE WITH UNPLASTICIZED POLYVINYL CHLORIDE PLASTIC PIPE AND FITTINGS — SPECIFICATION

1 SCOPE

This standard prescribes requirements and methods of sampling and test for solvent cements to be used in joining unplasticized polyvinyl chloride pipe and fittings intended for use in carrying potable water. The pipes may be pressure or non-pressure type.

2 REFERENCES

The following Indian Standards are necessary adjuncts to this standard:

IS No.	*Title*
1070 : 1992	Reagent grade, water (*third revision*)
2267 : 1972	Polystyrene moulding materials (*first revision*)
2828 : 1964	Glossary of terms used in plastic industry
5210 : 1969	High impact polystrene sheet
6746 : 1972	Unsaturated polyester resin system for low pressure fibre reinforced plastics
8543 (Part 4/ Sec 1) : 1984	Methods of testing plastics: Part 4 Short term mechanical properties, Section 1 Determination of tensile properties
9845 : 1986	Methods of analysis for the determination of specific and/or overall migration of constituents of plastics materials and articles intended to come into contact with foodstuffs (*first revision*)
10148 : 1982	Positive list of constituents of polyvinyl chloride and its copolymers for safe use in contact with foodstuffs, pharmaceuticals and drinking water
10151 : 1982	Polyvinyl chloride PVC and its copolymers for its safe use in contact with foodstuffs, pharmaceuticals and drinking water
10500 : 1991	Drinking water

The above-mentioned standards contain provisions which, through reference in this text, constitute provisions of this standard. At the time of publication, the edition, indicated were valid. All standards are subject to revision, and parties to agreements based on this standard are encouraged to investigate the possibility of applying the most recent editions of the standards indicated above.

3 TERMINOLOGY

The definitions given in this standard are in accordance with IS 2828 : 1964.

4 REQUIREMENTS

4.1 The solvent cement shall be a solution of unplasticized polyvinyl chloride moulding or extrusion compound or PVC resin. The requirements for rigid PVC compound are given in Table 1 for information only.

NOTE — Either virgin plastic material or clean rework material generated from solvent cement manufacturer's own product compatible with virgin material shall be used.

4.2 The solvent cement shall be thixotropic and consist substantially of solvents that will swell plasticized PVC polymers and stabilizers. Fillers may be incorporated provided the resulting cement meets all the requirements (*see* **4.3** to **4.12**) of specification.

4.3 The solvent cement shall be capable of application by brush and shall contain no lumps or foreign matter or macroscopic undissolved particles that will adversely affect the ultimate joint strength or chemical resistance of the material.

4.4 The cement shall show no gelation. It shall show no evidence of stratification or separation that cannot be removed by stirring.

4.5 When used under the conditions for which they are designed, non-metallic materials in contact with or likely to come in contact with potable water shall not constitute a toxic hazard, shall not support microbial growth and shall not give rise to unpleasant taste or odour, cloudiness or discoloration of the water.

NOTES

1 Though no specific tests have been prescribed in this standard for measuring the above-mentioned requirements, measurements of relevant organoleptic/physical parameters of drinking water coming in contact with solvent cement shall conform to IS 10500 : 1991 'Drinking water'.

2 Concentrations of chemical substances, leached out from materials in contact with potable water may be determined as per IS 9845 : 1986 Methods of analysis for the determination of specific and/or overall migration of constituents of plastics materials and articles intended to come into contact with foodstuffs (*first revision*). Since toxicity of leaches from materials in contact with water cannot be determined in the absence of suitable test methods, it is advised that IS 10148 : 1982 and IS 10151 : 1982 may be referred for knowledge of approved chemicals for polyvinyl chloride and its copolymers.

4.6 The particular solvent system to be used in the formulation of this solvent cement is not specified, since several adequate solvent system for PVC are known. Solvent systems consisting of blends of tetrahydrofuran and cyclohexanone have been found to be acceptable under the requirements of this specification.

4.7 Vinyl Chloride Polymer Content

The PVC resin content shall be minimum 10 percent by mass when tested in accordance with Annex A.

4.8 Dissolution

The cement shall be capable of dissolving an additional 3 percent by mass of unplasticized PVC granular, powder compound or resin at 27±2°C without evidence of gelation.

4.9 Viscosity

Cements are classified as regular, medium or heavy bodied types, based on their minimum viscosity. The viscosity may be determined as per Annex B.

i) Regular-bodied cement shall have a minimum viscosity of 90 mPa.s;

ii) Medium-bodied cements shall have a minimum viscosity of 500 mPa.s.; and

iii) Heavy-bodied cements shall have a minimum viscosity of 1 600 mPa.s.

4.10 Lap Shear Strength

The minimum average lap shear strength, when tested in accordance with Annex C shall be 1·7 MPa after 2 h curing time, 3·4 MPa after 10 h curing time and 6·2 MPa after 72 h curing time.

4.11 Hydrostatic Burst Strength

The minimum average hydrostatic burst strength test, when tested as per **C-1.2** shall be 2·8 MPa after 2 h curing time.

4.12 Shelf Life

The manufacturer shall declare the shelf life of the product on the container.

5 SAMPLING

5.1 Owing to the possibility of stratification within the resin in the container it is essential that the contents of any container selected for sampling for test purpose shall be mixed thoroughly before the sample is taken.

5.2 Criteria for Conformity — These resin systems shall be deemed to comply with this standard if they comply with all the requirements prescribed in **4.3** to **4.12**.

6 METHODS OF TEST

6.1 Test shall be conducted as prescribed in Annex A to C.

6.2 Quality of Reagents — Unless specified otherwise, pure chemicals and distilled water (*see* IS 1070 : 1992) shall be employed in tests.

7 PACKING AND MARKING

7.1 The material is supplied in suitable containers or tubes in a variety of sizes which allow for a range in the number and size of joints being made during a short period.

7.2 Marking

The containers may be suitably marked with the following information:

a) Indication of source of manufacture;

b) The nominal content by mass or volume;

c) The batch number;

d) The type of material according to viscosity;

e) Safety precautions including handling and distribution of product;

f) Shelf life; and

g) Any statutory requirement of law for use of flammable and toxic materials.

In addition to the above information, it is preferable if the following information is also provided in the leaflet.

a) A list of thermoplastic pipes and sizes for which the material is recommended; and

b) Intended uses and end use applications (examples, potable water, pressure or non-pressure pipes).

7.2.1 The material may also be marked with Standard Mark.

7.3 BIS Certification Marking

The product may also be marked with Standard Mark.

7.3.1 The use of the Standard Mark is governed by the provisions of Bureau of Indian Standards Act, 1986 and the Rules and Regulations made thereunder. The details of conditions under which the licence for the use of Standard Mark may be granted to manufacturers or producess may be obtained from the Bureau of Indian Standards.

Table 1 Requirements for Rigid PVC Compound

(*Clause* 4.1)

Sl No.	Characteristic	Requirement	Methods of Test, Ref to IS No.
(1)	(2)	(3)	(4)
i)	Tensile strength, MPa, *Min*	48·3	8543 (Part 4/Sec 1) : 1984
ii)	Impact strength (Izod), J/m, *Min*	34·7	2267 : 1972
iii)	Modulus of elasticity in tension, MPa, *Min*	2·758	5210 : 1969
iv)	Deflection temperature under load, °C, *Min*	70	6746 : 1972
v)	Chemical resistance	To pass the test	[H_2SO_4 (93 %), 14 days immersion at 55 ± 2°C]
	a) Change in mass		
	Increase, percent by mass, *Max*	5·0	
	Decrease, percent by mass, *Max*	0·1	
	b) Change in flexural yield strength		
	Increase, percent by mass, *Max*	5·0	
	Decrease, percent by mass, *Max*	25·0	
vi)	Resistance to oil change in mass	To pass the test	[ASTM Oil No. 3, 30 days immersion at 27 ± 1°C]
	Increase, percent by mass, *Max*	1·0	
	Decrease, percent by mass, *Max*	1·0	

ANNEX A

(*Clauses* 4.7 *and* 6.1)

METHODS OF TEST FOR PVC RESIN CONTENT IN SOLVENT CEMENT

A-1 QUALITY OF REAGENTS

A-1.1 Unless specified otherwise, pure chemicals and distilled water (*see* IS 1070 : 1992) shall be used in tests.

NOTE — 'Pure chemicals' shall mean chemicals that do not contain impurities which affect the results of analysis.

A-2 DETERMINATION OF SOLVENT CONTENT

A-2.0 Outline of the Method

Solvent is removed from the solvent cement under vacuum to dryness in an oven. Thereafter PVC compound is dissolved in tetrahydrofuran and separated, leaving the inert filler present in the cement.

A-2.1 Apparatus

A-2.1.1 *Ointment Tins* — 30 ml all metal

A-2.1.2 *Vaccum Oven*

A-2.1.3 *Analytical Balance*

A-2.1.4 *Centrifuge*

A-2.2 Procedure

A-2.2.1 Stir the sample thoroughly with a spatula before weighing. Weigh 3·0 to 5·0 g of the sample to the nearest 1 mg into a tared ointment tin, place the tin into the vacuum oven, and heat at 120°C for 45 minutes ± 15 minutes. Discard specimens left in for more than 1 h. Vacuum must be continuously in operation to draw off inflammable solvents and should be maintained at 15 mm Hg minimum. Remove the tin from the oven and place in desiccator until cooled to room temperature. Weigh the tin and dried sample to the nearest 1 mg.

A-2.2.2 After weighing, dissolve most of the dried sample by adding 15 ml of tetrahydrofuran (THF) to the sample in the ointment tin and stirring with a glass rod for 15 minutes, collect the liquid decanted from this step, plus the liquid from the next two steps. Dissolve the remainder with a second addition of 15 ml of THF, followed by a third addition 5 ml of THF to rinse the ointment tin. Centrifuge the entire volume at 20 000 rpm for 15 minutes. Discard the supernatant liquid. Add 15 ml of THF to the tube, mix thoroughly and transfer the tube contents to the ointment tin. Use 2 ml more of THF to wash down the tube and pour into the ointment tin. Evaporate off THF in the vacuum oven at 120°C for 45 minutes. Cool in desiccator and weigh the tin to the nearest 1 mg and calculate the percent of inert filler present in the cement.

A-2.3 Calculation

Percentage of PVC resin is given by

$$\text{Resin, percent} = [(B-A-D)/(C-A)] \times 100$$

where

A = mass of ointment tin;

B = mass of tin and specimen after drying;

C = mass of tin and specimen before drying; and

D = mass of inert filler if present.

ANNEX B

(*Clauses* 4.9 *and* 6.1)

DETERMINATION OF VISCOSITY

B-0 GENERAL

Information on viscosity is usually required to ensure that the adhesive has correct flow characteristic for use. Viscosity of the adhesive is determined by Brookfield viscometer or equivalent. When the viscosity of thixotropic adhesive is measured, at least two measurements shall be taken at two different speeds.

B-1 APPARATUS

Brookfield Viscometer.

B-2 PROCEDURE

Fill the compound in a 250-ml beaker taking care that it remains free from air bubbles. With the use of a viscometer such as Brookfield RVT model, determine viscosity of the material

using Spindles No. 2 and 4 for liquids and T-spindles for pastes. Other viscometers may also be used provided they have been calibrated against Brookfield Viscometer. The temperature of the laboratory should be maintained at 27±1°C. A minimum of 10 readings shall be taken within 15 minutes and at a fixed speed of 20 rev/min (RPM) on the viscometer. The average of these 10 readings shall be taken as the viscosity of the compound. The viscosity shall be reported in mPa.s.

ANNEX C

(*Clauses* 4.10, 4.11 *and* 6.1)

C-1 DETERMINATION OF BOND STRENGTH

C-1.0 Number of Specimen

A minimum of 5 specimens shall be tested for lap shear strength and hydrostatic burst strength.

C-1.1 Lap Shear Strength

Cut 25 mm × 25 mm and 25 mm × 50 mm sections from 6 mm thick sheet made from rigid PVC (*see* Table 2 for quality of rigid plastic sheet). Clean the surfaces to be adhered to with a cloth soaked in methyl ethyl ketone or acetone. Using a 25 mm natural bristle brush apply a thin layer of cement to the complete surface of a 25 mm × 25 mm sheet section and to the centre of 25 mm × 50 mm sheet section. Assemble these sections immediately and rotate the 25 mm × 25 mm section 180° on 25 mm × 50 mm section, within 5 s, using light hand, pressure (approx 2 N).

Place the assembled test specimen on a clean level surface by using 25 mm × 50 mm section as a base. After 30 s, place a 2 kg weight on the test specimen for a period of 3 minutes and then remove.

Store the assembled test specimens at 27±2°C for the specified time and test immediately in a holding fixture as shown in Fig. 1 and 2. The shear speed shall be 1·25 mm/min. Express the results in MPa.

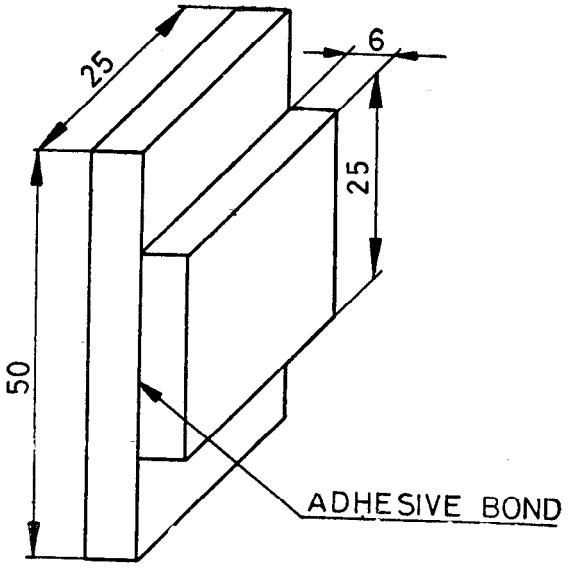
C-1.2 Hydrostatic Burst Strength

Use 51·2 mm (2 inch) PVC pipe and coupling for the test. The minimum socket depth of the coupling shall be 38 mm. The dimensions of the pipe and fitting socket shall be such that the pipe will enter the socket from 1/3 to 2/3 of the full socket depth dry when assembled by hand.

Cut the pipe into 150 mm lengths and join the couplings. The pipe must be fully bottomed in the fitting socket. Close the ends of the test specimens with suitable end closures for pressures testing. Store the specimen at 27 ± 2°C for 2 h ± 5 minutes then test. Increase the internal hydrostatic pressure at a rate of 1·4 MPa/mm ± 10 percent until failure occurs.

C-1.3 Retest

If any failure occurs, the materials may be retested to establish conformity in accordance with agreement between the purchaser and the seller.



All dimensions in millimetres.

FIG. 1 COMPRESSION SHEAR SPECIMEN

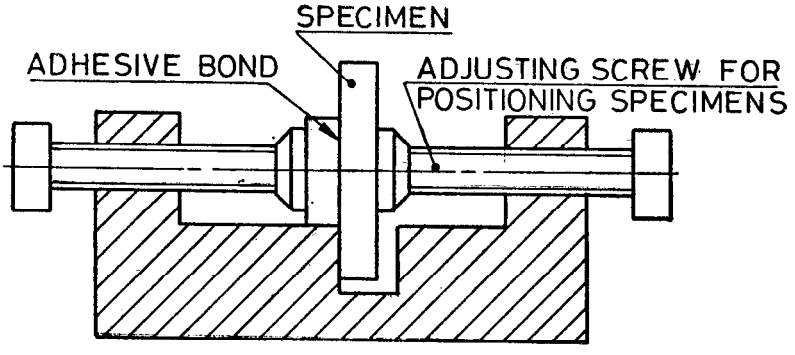


FIG. 2 TYPICAL SPECIMEN HOLDING DEVICE

ANNEX D

(*Foreword*)

GUIDE FOR PVC SOLVENT CEMENT SELECTION

D-1 The successful joining of PVC pipes and fittings larger than 50 mm and all non-interference type joints requires the use of solvent cements that have higher gap-filling properties than the minimum viscosity (90 mPa) cements permitted in this specification. The ability of a solvent cement to fill a gap in a pipe joint can be determined by considering its viscosity and wet-film thickness (Note 1). A guide to the proper selection of a cement for various pipe sizes is given in Table 2 where cements are classified (for purposes of identification) into three types as regular-bodied, medium-bodied, or heavy-bodied, based on minimum wet-film thickness.

D-1.1 Manufacturers' recommendations for pipe size application should be followed, for guidelines shown in the table are general ones. Note that solvent cement properties may vary considerably among manufacturers. There are also situations where joint fits vary for different applications of the same nominal pipe size. In such cases manufacturer's instructions may be followed strictly (Note 2).

Table 2 Guide for Selection of Solvent Cement for Various Pipe Sizes

Pipe Size Range, in mm	Cement Type	Minimum Viscosity (mPa·s)	Wet Film Thickness *Min* (mm)
16 to 50	regular-bodied	90	0·15
51 to 200	medium-bodied	500	0·30
201 and above	heavy-bodied	1 600	0·60

NOTES

1 The wet-film thickness of a solvent cement can be measured by using a Nordson Wet Film Thickness Gauge or equivalent. It is available from Nordson Corp., Amherst, OH 44001, as Nordson No. 79-0015. To use this gauge, dip a short length of 25 mm pipe vertically into the cement at a temperature of approximately 27°C to a depth of 40 to 50 mm for a period of 15 s. Measure the wet-film thickness on the top surface of the pipe with the end of the gauge about 10 mm from the end of the pipe. With a little care and experience the wet cement layer can be readily measured to ± 0·05 mm.

2 Medium-bodied and heavy-bodied cement can generally be used for smaller pipe size than that shown in Table 1 in case manufacturer's instructions say so.

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Revision of Indian Standards

Amendments are issued to standards as the need arises on the basis of comments. Standards are also reviewed periodically; a standard along with amendments is reaffirmed when such review indicates that no changes are needed; if the review indicates that changes are needed, it is taken up for revision. Users of Indian Standards should ascertain that they are in possession of the latest amendments or edition by referring to the latest issue of 'BIS Handbook' and 'Standards Monthly Addition'.

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BUREAU OF INDIAN STANDARDS

Headquarters:
Manak Bhavan, 9 Bahadur Shah Zafar Marg, New Delhi 110002

Telephones : 331 01 31, 331 13 75

Telegrams : Manaksanstha
(Common to all Offices)

Regional Offices :	Telephone
Central : Manak Bhavan, 9 Bahadur Shah Zafar Marg NEW DELHI 110002	331 01 31 331 13 75
Eastern : 1/14 C. I. T. Scheme VIII M, V. I. P. Road, Maniktola CALCUTTA 700054	37 84 99, 37 85 61 37 86 26, 37 86 62
Northern : SCO 335-336, Sector 34-A, CHANDIGARH 160022	60 38 43, 60 20 25,
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AMENDMENT NO. 1 MARCH 2002
TO
IS 14182 : 1994 SOLVENT CEMENT FOR USE WITH UNPLASTICIZED POLYVINYL CHLORIDE PLASTIC PIPE AND FITTINGS — SPECIFICATION

(*Page* 1, *clause* **2**):

a) Insert 'IS 4985 : 2000 Unplasticized PVC pipes for potable water supplies (*third revision*)' at the appropriate place.

b) Delete 'IS 9845 : 1986, IS 10148 : 1982, IS 10151 : 1982 and IS 10500 : 1991'.

(*Page* 2, *clause* **4.5**) — Substitute the following for the existing and delete Notes 1 and 2:

'**4.5** When used for bonding pipes and fittings coming in contact with potable water, the cement, after evaporation of the solvent, shall conform to the requirements, when tested in accordance with relevant Indian Standards, as prescribed in **10.3** of IS 4985'.

(PCD 12)

Reprography Unit, BIS, New Delhi, India