

Specification for

Pressure-sensitive adhesive tapes for electrical insulating purposes

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- Adhesive Tape Manufacturers' Association
- British Paper and Board Industry Federation (PIF)
- British Plastics Federation
- Department of Industry (British Calibration Service)
- Department of Industry (National Physical Laboratory)
- Electrical and Electronic and Insulation Association (BEAMA)
- Glass Textile Association
- Rotating Electrical Machines Association (BEAMA)
- Transmission and Distribution Association (BEAMA)

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Foreword

This revision of BS 3924:1965 has been prepared both to take account of technological improvements and, where appropriate, to implement some international agreements.

Some new materials have been introduced into the standard and some backing materials previously included have been omitted. The system of classification used in the previous edition of BS 3924 is retained, although it differs from International Electrotechnical Commission recommendations.

To comply with international agreements, the electric strength test is now a breakdown strength test instead of a voltage proof test, and the moisture permeability testing of plastics film backed tapes has been replaced by a voltage breakdown test following conditioning in high humidity. A test for flammability has been introduced mainly for PVC tapes. Some changes have been made in the design and the materials of the apparatus suitable for measurement of insulation resistance because the insulation resistance of some more recently developed tapes is too high for accurate measurement using the old apparatus.

The conditioning test temperature and relative humidity (see Appendix A) have been changed to 23 ± 2 °C and 50 ± 5 % r.h.

A British Standard does not purport to include all the necessary provisions of a contract. Users of British Standards are responsible for their correct application.

Compliance with a British Standard does not of itself confer immunity from legal obligations.

Summary of pages

This document comprises a front cover, an inside front cover, pages i and ii, pages 1 to 18, an inside back cover and a back cover.

This standard has been updated (see copyright date) and may have had amendments incorporated. This will be indicated in the amendment table on the inside front cover.

1 Scope

This British Standard specifies requirements for pressure-sensitive adhesive tapes suitable for use as electrical insulation. These tapes are for use where good electrical properties and freedom from liability to cause corrosion are important.

2 References

The titles of the standards publications referred to in this standard are listed on the inside back cover.

3 Classification

For the purposes of this British Standard pressure-sensitive adhesive tapes are classified by:

- a) base (or backing) material;
- b) maximum working temperature;
- c) type of adhesive.

Classification is given in Table 1, in column 1 of which tapes are divided into four broad classes of base materials.

Column 2 lists the tapes by class and type of base material (first and second digits) and maximum working temperature, in °C, of the base (digits following the first oblique). The addition of “/2” denotes that the tape is coated with adhesive on both sides.

Column 3 gives the nature of the adhesive, of which there are currently four basic types in use. The thermoplastic type, Tp, softens on heating and reverts to its original state when cooled; this process may be repeated. A further type of adhesive (Ss) generally has equal or better solvent resistance and softening temperature than thermosetting adhesives without requiring heat treatment. The thermosetting type, Ts, becomes firmer after heating and remains so on cooling; it does not soften appreciably on subsequent reheating. The initial heating of a thermosetting adhesive improves the solvent resistance and raises the softening temperature.

Because of the wide range of temperatures over which they may be used, thermosetting adhesives based on silicone compounds are listed separately as “Si”.

Example

12/105 Ts denotes a class 1 tape (i.e. woven cloth) having a maximum working operating temperature of the base of 105 °C, with a thermosetting adhesive and a base material of woven cellulose acetate cloth.

NOTE The maximum working temperature of the adhesive may be lower than that of the base (or backing) material. The advice of the supplier should be sought if it is intended to use tapes under the following conditions:

- a) thermoplastic tapes, Tp, at a temperature continuously exceeding 60 °C;
- b) thermosetting tapes, Ts, and thermoplastic tapes, Ss, at a temperature continuously exceeding 130 °C;
- c) silicone adhesive, Si, tapes at a temperature exceeding 180 °C.

4 Colour

Where coloured tapes are required, the preferred colours are black, blue, brown, green, red, white and yellow as follows:

PVC: in accordance with the colours specified in BS 6746C;

other coloured tapes: an approximate match to those specified in BS 6746C.

5 Freedom from defects

Each roll shall be reasonably free from telescoping, gapping or other forms of distortion. When unrolled, the tape shall show negligible transference of the adhesive to the backing of the underlying turn, tearing of the base or fraying of the thread.

NOTE Care should be taken not to unwind tapes rapidly at temperatures below 10 °C.

6 Dimensions

The internal diameters of the cores on which the tape is wound shall be either approximately 26 mm or approximately 76.5 mm.

6.2 Width. The preferred widths of tape are 6 mm, 9 mm, 12 mm, 15 mm, 19 mm, 22 mm, 25 mm, 30 mm, 38 mm and 50 mm.

NOTE Other widths are available.

6.2.1 Tolerance. The tolerance on the width shall be ± 1.0 mm for widths up to and including 19 mm and ± 1.5 mm for greater widths.

NOTE Closer tolerances are available on some tapes.

6.2.2 Measurement. The nominal width of the tape shall be measured on a roll by means of a steel rule graduated to 0.5 mm.

6.3 Length. The length of tape on a roll shall be 10 m, 20 m, 25 m, 33 m, 50 m, 55 m, 66 m or multiples of 50 m or 66 m. The actual length shall be not less than the stated length.

6.4 Thickness. The thickness, when measured in accordance with Appendix B, shall be within the limits of ± 15 % of the declared nominal value.

NOTE 1 The usual nominal thicknesses available are shown in Table 1. Other thicknesses may be available.

NOTE 2 Other tolerances may be agreed between the supplier and the purchaser.

Table 1 — Classification

1	2	3	4	5
Class of base materials	Group	Types of adhesive available	Typical base material	Usual nominal thickness available
1. Woven cloth (C)	10/105 (C)	Tp	cotton or viscose	0.26
	10/105 (C)	Ts	cotton or viscose	0.26
	11/105 (Ct)	Tp	treated cotton or viscose	0.35
	12/105 (CA)	Ts	cellulose acetate	0.20, 0.23
	13/180 (G)	Ts	glass	0.14, 0.17
	13/180 (G)	Ss	glass	0.20
	13/180 (G)	Si	glass	0.20
	14/105 (Gt)	Tp	treated glass	0.22
2. Paper (P)	20/105 (Cc)	Tp	crêped paper	0.20
	20/105 (Cc)	Ts	crêped paper	0.14, 0.18, 0.22, 0.28, 0.46
	20/105 (C)	Ts	plain uncrêped paper	0.12
	20/105/2 (C)	Ts	plain uncrêped paper	0.15
	22/105 —	Ts	microcrêped paper	0.15, 0.30, 0.45
3. Plastics (F)	30/90 (PE)	Tp	polyethylene	0.03, 0.10, 0.14, 0.17
	31/90 (PVCp)	Tp	plasticized PVC	0.13, 0.18, 0.21, 0.25
	32/75 (PVC)	Tp	unplasticized PVC	0.06
	34/105 (CA)	Ts	cellulose acetate	0.06, 0.08, 0.10
	35/130 (PE)	Tp	polyethylene	
			terephthalate (PETP)	0.05
	35/130 (PETP)	Ts	PETP	0.02, 0.06, 0.09
	35/130 (PETP)	Si	PETP	0.06
	35/130 (PETP)	Ss	PETP	0.06
	35/130/2 (PETP)	Ts	PETP	0.10
	36/180 (PTFE)	Si	PTFE	0.10, 0.18, 0.30
	37/105 (PP)	Ss	polypropylene	0.05
	38/180 (PI)	Si	polyimide	0.07, 0.09
4. Composite (M)	40/105 —	Ts	plastics backed viscose filament reinforced	0.25
	42/105 —	Ts	plastics backed glass filament reinforced	0.18, 0.20

NOTE Letters in brackets are equivalent IEC classifications.

7 Properties

7.1 Breaking strength and elongation at break. The breaking strength, and elongation if applicable, shall be determined in accordance with Appendix C, and shall be not less than the value given in Table 2.

7.2 Electric breakdown strength

7.2.1 After normal conditioning. When determined in accordance with D.2, the electric breakdown strength shall be not less than the value given in Table 2.

7.2.2 After humid conditioning (only applicable to backings not susceptible to moisture). When determined in accordance with D.3, the electric breakdown strength shall be not less than the value given in Table 2.

7.3 Adhesion

7.3.1 Peel at 180°. The adhesion to steel and, when applicable, to the backing shall be determined in accordance with Appendix E, and shall be not less than the values given in Table 2.

7.3.2 Flagging test. When determined in accordance with Appendix F, the amount unwound shall not exceed 2 mm under the appropriate conditions specified in F.5.

7.4 pH of water extract. When determined in accordance with Appendix H, the pH value of the water extract shall be within the limits given in Table 2.

7.5 Conductivity of water extract. When determined in accordance with Appendix J, the conductivity of the water extract shall not exceed the value given in Table 2.

7.6 Freedom from corrosive sulphur. When tested in accordance with Appendix K, the tape shall be free from corrosive sulphur.

7.7 Insulation resistance. When determined in accordance with Appendix L, the insulation resistance shall be not less than the value given in Table 2.

7.8 Electrolytic corrosion. When requested by the purchaser, and determined in accordance with Appendix M, the corrosion liability factor (CLF) and the standard deviation shall be as agreed between the supplier and the purchaser.

7.9 Resistance to flame propagation. When tested in accordance with Appendix N, the tape is described as falling into one of three categories. In the case of plasticized PVC tapes, only tapes that can be described as being in category 1 or category 2 are deemed to have complied with the requirements of this standard. The test is not normally applied to tapes other than plasticized PVC.

NOTE This test should not be taken as fully representative of the behaviour of the material in service to difference in sample size and the conditions of application.

7.10 Curing properties of thermosetting tapes

7.10.1 *Curing properties (Flagging characteristics).* When tested in accordance with Appendix F, after conditioning as specified in **F.5.2**, the flag shall not exceed 2 mm.

7.10.2 *Bond separation after thermal treatment (adhesive to backing).* The bond separation after thermal treatment shall be tested in accordance with Appendix P. There shall be no complete separation of the bond.

7.11 Flagging test after liquid immersion. When required by the purchaser, the tape shall be tested in accordance with Appendix F, using the agreed liquid. The flag shall not exceed 2 mm, and the tape shall not wrinkle or crack.

8 Packing

The individual rolls of tape shall be packed in such a manner that

- a) they are protected from dust and light;
- b) they can be easily separated;
- c) they are reasonably protected from damage during normal transit conditions;
- d) the cut edges of the rolls are horizontal.

When stored flat on the cut edges, in the original unopened packing, at temperatures between 10 °C and 30 °C and relative humidities between 45 % and 75 %, tapes can be expected to comply with the requirements of this standard for a storage life of 12 months from the date of despatch to the user, or up to the declared expiry date, whichever is the shorter period.

NOTE *Storage life.* Since pressure-sensitive tapes may deteriorate in storage, particularly those with thermosetting adhesive, it is recommended that stored material be used in the date order it is received.

9 Marking

Each unit pack, and each package containing a number of unit packs, shall have the following information clearly and indelibly marked on it:

- a) the number of this British Standard i.e. BS 3924;
- b) the reference of the tape and adhesive type as detailed in Table 1;
- c) the colour (where applicable);
- d) the nominal width and the nominal thickness of the tape.
- e) the nominal length of the tape on each roll;
- f) the number of rolls in the unit pack or larger package;
- g) "This side up" or a similar indication, appropriately positioned, so that the rolls of tape will be lying flat on their cut edges;
- h) the manufacturer or supplier's identification mark and batch number;
- i) the declared expiry data if applicable.

Table 2 — Properties

1	2	3	4	5	6	7	8	9	10	11
Tape reference	Minimum breaking strength		Minimum elongation at break	Minimum electric breakdown strength		Minimum adhesion to		pH of water extract	Maximum conductivity of water extract	Minimum insulation resistance
	Appendix C		Appendix C	After normal conditioning (Appendix D)	After humid conditioning (Appendix D)	Steel (Appendix E)	Backing (Appendix E)	Appendix H	Appendix J	Appendix L
	N/10 mm width	MPa (1 MPa = 1 N/mm ²)	%	kV/mm	kV/mm	N/10 mm width	N/10 mm width		mS/m	MΩ/25 mm
10/105 Tp	50	—	—	8.0	Not applicable ^a	2.0	1.8	5.5 – 8.0	7.5	20
10/105 Ts	50	—	—	8.0		2.7	1.8	5.5 – 8.0	7.5	20
11/105 Tp	50	—	—	4.0		2.0	2.0	5.5 – 8.0	7.5	20
12/105 Ts	50	—	—	11.0		2.8	1.4	5.5 – 8.0	2.5	5 000
13/180 Ts	200	—	—	11.0		2.8	1.4	5.5 – 8.5	5.0	50
13/180 Si	200	—	—	11.0		2.0	1.4	5.5 – 8.5	5.0	50
13/180 Ss	200	—	—	10.0		1.8	0.8	5.5 – 8.5	5.0	50
14/105 Tp	200	—	—	10.0		1.8	1.6	5.5 – 8.5	5.0	500
20/105 Tp	20	—	6	5.0	Not applicable ^a	1.8	b	5.5 – 8.0	5.0	5
20/105 Ts	20	—	6	5.0		2.6	b	5.5 – 8.0	5.0	5
21/105 Ts	60	—	—	8.0		3.5	2.0	5.5 – 8.0	5.0	5
21/105/2 Ts	36	—	—	8.0		2.8	—	5.5 – 8.0	5.0	5
22/105 Ts	50	—	6	5.0		2.6	b	5.5 – 8.0	5.0	5
30/90 Tp	—	10	100	40.0	Not applicable ^a	1.4	1.0	5.5 – 8.0	2.5	100 000
31/90 Tp	—	13	125	40.0		1.8	1.5	5.5 – 8.0	2.5	100 000
32/75 Tp	—	42	15	60.0		1.8	c	5.5 – 8.0	2.5	100 000
34/105 Ts	—	28	10	40.0		2.8	c	5.5 – 8.0	2.5	25 000
35/130 Tp	—	63	50	70.0		2.0	c	5.5 – 8.0	2.5	100 000
35/130 Ts	—	63	50	70.0		3.5	c	5.5 – 8.0	2.5	100 000
35/130 Si	—	49	50	70.0		1.8	c	5.5 – 8.0	5.0	100 000
35/130 Ss	—	63	50	70.0		3.6	c	5.5 – 8.0	2.5	100 000
35/130/2 Ts	—	30	50	45.0		2.8	—	5.5 – 8.0	2.5	100 000
36/180 Si	—	20	75	55.0		1.6	0.2	5.5 – 8.0	5.0	100 000
37/105 Ss	—	50	50	100.0		2.2	c	5.5 – 8.0	2.5	100 000
38/180 Si	—	50	50	60.0		1.8	c	5.5 – 8.0	2.5	100 000
40/105 Ts	320	—	8	20.0	Not applicable	3.2	2.0	5.5 – 8.0	5.0	25 000
42/105 Ts	320	—	4	20.0	Not applicable	3.2	0.5	5.5 – 8.0	5.0	100 000

^a Test not suitable for the material.

^b Test results variable because of the nature of the backing. Flagging test applicable using 12 mm rod (see 7.3.2).

^c Flagging test applicable (see 7.3.2) using 6 mm rod for thicknesses not exceeding 0.08 mm and 12 mm rod for greater thicknesses.