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21 April 2003

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BRITISH STANDARD

BS 3492:1987

Specification for

Road and rail tanker hoses and hose assemblies for petroleum products, including aviation fuels

UDC 621.643.3:629.065:665.7

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British Rubber Manufacturers' Association
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Department of the Environment (Property Services Agency)
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Association of Hydraulic Equipment Manufacturers
British Railways Board
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Engineering Equipment and Materials Users' Association

This British Standard, having been prepared under the direction of the Rubber Standards Committee, was published under the authority of the Board of BSI and comes into effect on
27 February 1987

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First published April 1962
First revision May 1972
Second revision February 1987

The following BSI references relate to the work on this standard:
Committee reference RUM/9
Draft for comment 85/37493 DC

ISBN 0 580 15564 1

Amendments issued since publication

Amd. No.	Date of issue	Comments

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Foreword

This revision of this British Standard has been prepared under the direction of the Rubber Standards Committee and supersedes BS 3492:1972 which is withdrawn. It is one of a series of British Standards for various hoses and hose assemblies for the petroleum industry.

It is important to note that class 1 hoses are suitable for use with aviation fuels, whereas class 2 hoses should not be used for this purpose.

In order to take account of modern technological developments this British Standard is based on performance requirements.

The principal changes from the 1972 edition are as follows.

a) The types have been designated A, AX, B, BX, C, D, E and F to distinguish them from types 1, 2 and 3 in the previous edition.

b) Types AX and BX which are composite hoses have been introduced and so has type F which is a hose with controlled dilation for metered delivery.

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Summary of pages

This document comprises a front cover, an inside front cover, pages i and ii, pages 1 to 6, 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.

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1 Scope

This British Standard specifies requirements for rubber and plastics hoses and hose assemblies for carrying gasoline, kerosene, fuel and lubricating oils, including aviation fuels with an aromatic hydrocarbon content of not more than 50 %, at temperatures up to 80 °C. All types are suitable for use with a vacuum not exceeding 0.5 bar.

Hoses of types A, AX, B, BX, C and D are for service as "dry" hoses, i.e. drained after use.

NOTE 1 For continuous service the manufacturer should be consulted.

NOTE 2 The attention of the purchaser is drawn to clauses **1**, **3** and **8**. From each of these clauses the purchaser should clearly indicate his requirements and intentions to the manufacturer at the time of enquiry or order.

NOTE 3 The titles of the publications referred to in this standard are listed on the inside back cover.

2 Definitions

For the purposes of this British Standard the definitions given in BS 3558 apply, together with the following.

2.1
composite hose

a non-vulcanized hose with construction as specified in **4.2** for types AX and BX

2.2
type approval tests

tests required to obtain type approval

2.3
routine tests

tests carried out on each finished length of hose or hose assembly

3 Types and classes

3.1 Types

Hoses are designated as follows.

Type A Rough bore externally armoured hose principally for gravity discharge with a maximum working pressure of 3 bar.

Type AX Rough bore composite hose principally for gravity discharge with a maximum working pressure of 3 bar.

Type B Rough bore externally armoured hose with a maximum working pressure of 7 bar.

Type BX Rough bore composite hose with a maximum working pressure of 7 bar.

Type C Smooth bore hose with smooth or corrugated exterior principally for gravity discharge with a maximum working pressure of 3 bar.

Type D Smooth bore hose with smooth or corrugated exterior with a maximum working pressure of 7 bar.

Type E Smooth bore reeling hose with a maximum working pressure of 7 bar.

Type F Smooth bore reeling hose of controlled dilation for metered delivery with a maximum working pressure of 7 bar.

3.2 Classes

Types A, AX, B and BX are divided into the following two classes:

class 1 for aviation and other uses;

class 2 for non-aviation use.

4 Construction

4.1 Hoses of types A, B, C, D, E and F shall consist of the following:

a) an internal wire helix (types A and B only);

b) an inner polymeric lining;

c) a reinforcing layer or layers;

d) two or more low resistance electrical bonding wires in hoses not containing a wire helix;

e) an optional embedded helix of wire or other material;

f) a polymeric cover;

g) an externally applied armouring wire (types A and B only).

4.2 Hoses of types AX and BX shall consist of the following:

a) an internal wire helix;

b) a multi-ply wall of thermoplastics films and reinforcing fabrics in proportions that give the required physical properties and provide a complete seal.

NOTE The film content may be built of tubular films.

c) a cover consisting of fabric with an abrasion resistant polymeric coating;

d) an external wire helix.

4.3 The lining of smooth bore hoses of types C, D, E and F shall be free from holes, porosity and other defects when examined visually.

NOTE For hoses of types A, B, C, D, E and F, the lining and cover should be resistant to all petroleum liquids and should cause negligible discoloration of fluids carried by the hose.

4.4 The internal wire used in the construction of class 1 hoses shall be made of aluminium and shall comply with BS 1475, grade 5154A or 5056A.

4.5 Steel wire used for the internal helix shall comply with BS 3592-1, have a tensile strength of not less than 650 N/mm^2 and be galvanized in accordance with the requirements of BS 443.

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4.6 Steel wire used for the embedded helix shall have a tensile strength of not less than 650 N/mm^2 and comply with BS 3592-1.

4.7 The electrical bonding wires shall be of a braided construction, spirally applied and fatigue resistant.

4.8 External armouring wire shall comply with BS 3592-1, have a tensile strength of not less than 650 N/mm^2 and be galvanized in accordance with the requirements of BS 443. The wire shall be secured at each end of the hose or hose assembly.

5 Dimensions and tolerances

5.1 Bore

The bore of the hose shall comply with the nominal dimensions and tolerances given in Table 1 when measured in accordance with BS 5173-101.1.

Table 1 — Nominal bores and tolerances

Types A, AX, B, BX, C and D	Types E and F	Permissible deviations
mm	mm	mm
—	25	± 1.25
32	32	± 1.25
38	38	± 1.5
51	51	± 1.5
63	—	± 1.5
76	—	± 2.0
102	—	± 2.0

5.2 Tolerance on length

When measured in accordance with BS 5173-101.2[1)], the tolerance on length of hoses and hose assemblies shall be ± 1 %.

5.3 Change in length at working pressure

For all types the maximum change in length at working pressure shall be + 10 %, – 5 % when measured in accordance with BS 5173-101.2[1)].

6 Hose mass

The mass of the hose excluding end fittings but including external armouring in the case of types A and B shall not exceed the values given in Table 2.

Table 2 — Maximum mass of hoses

Nominal bore	Maximum mass				
	Types A and AX	Types B and BX	Type C	Type D	Types E and F
mm	kg/m	kg/m	kg/m	kg/m	kg/m
25	—	—	—	—	1.25
32	1.05	1.80	1.35	1.95	1.65
38	1.35	2.10	1.65	2.40	1.85
51	1.85	2.75	2.25	3.00	2.25
63	2.25	3.65	3.00	4.10	—
76	3.00	4.90	3.70	5.20	—
102	4.10	6.70	4.75	8.20	—

7 Pressure requirements

The maximum working pressure, proof pressure and minimum burst pressure of hoses shall be as given in Table 3.

Table 3 — Pressure ratings

Pressure	Types A, AX and C	Types B, BX, D, E and F
	bar	bar
Maximum working	3	7
Proof	4.5	10.5
Minimum burst	12	28

8 End fittings

End fittings shall be attached by wire binding, swaging, band clips or clamps. In all cases they shall be connected to the construction wire or bonding wires to provide electrical continuity. End fittings shall comply with **10.3** and **10.7**. End fittings for class 1 hoses shall be suitable for use with aviation fuels.

9 Physical properties of the cover

9.1 Hoses of types A, B, C, D, E and F

9.1.1 *Resistance to liquids.* When tested in accordance with the volumetric method described in BS 903-A16:1971, using Liquid B, as described in Appendix A of that standard, and immersing for 48 ± 1 h at 40 ± 1 °C, the cover shall have a volume change not greater than 100 %.

9.1.2 *Resistance to ozone.* When tested in accordance with BS 5173-106.3 at a temperature of 40 ± 2 °C for 168 ± 1 h, no cracking shall be visible when viewed at × 2 magnification.

[1)] In preparation.

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9.2 Hoses of types AX and BX

The adhesion between the cover material and its abrasion resistant coating shall be not less than 2.0 kN/m when tested in accordance with BS 3424-7.

10 Performance requirements (type approval tests)

10.1 General

To obtain type approval, **10.2** to **10.14** shall be complied with. The tests described in **10.2**, **10.4** and **10.7** shall be carried out as routine tests except for the burst pressure in **10.2** (see clause **11**).

10.2 Hydrostatic

When tested in accordance with BS 5173-102.1, the hose or hose assembly shall comply with the requirements of Table 3 and shall show no cracks or leaks at proof pressure.

10.3 Electrical continuity after bend test under pressure

When tested in accordance with Appendix A, the hose assembly shall show no sign of failure or loss of electrical continuity.

10.4 Vacuum resistance

When tested in accordance with the appropriate method described in BS 5173-102.9 using a vacuum of 0.5 bar, the hose or hose assembly shall show no signs of damage or failure.

10.5 Adhesion (types A, B, C, D, E and F)

When tested in accordance with the appropriate method described in BS 5173-103.1, the adhesion between lining and reinforcement, between layers of reinforcement and between cover and reinforcement shall be not less than 2.0 kN/m.

NOTE The adhesion is not tested for types AX and BX.

10.6 Fuel resistance

When tested in accordance with Appendix B, the hose shall comply with **10.2** and **10.4**.

10.7 Electrical continuity

When tested in accordance with method 1 of clause **5** of BS 5173-4:1977 the hose or hose assembly shall exhibit satisfactory electrical continuity as described therein.

10.8 Bending test

Using the appropriate method described in BS 5173-103.5, hoses shall be capable of bending to the minimum bend radii shown in Table 4 without damage.

Table 4 — Minimum bend radii

Nominal bore	Types A, AX and C	Types B, BX and D	Types E and F
mm	mm	mm	mm
25	—	—	190
32	130	190	230
38	150	230	280
51	200	310	360
63	260	380	—
76	310	460	—
102	410	560	—

10.9 Low temperature flexibility

When tested in accordance with the appropriate method described in BS 5173-6 at – 25 ± 1 °C and bent to the radius specified in Table 4, the hose shall show no signs of cracking or failure. The same hose shall then be tested at proof pressure as specified in Table 3. If the hose fails the proof pressure test, it shall be deemed to have failed the low temperature flexibility test.

10.10 Crush test (types A, AX, B, BX, C and D)

When tested in accordance with the method described in BS 5173-3 using the force given in Table 5, the outside diameter of the hose under the applied force shall be not less than 80 % of the original outside diameter and after release of the force the diameter shall return to not less than 90 % of the original outside diameter.

Table 5 — Crushing force

Nominal bore	Crushing force
mm	kN
32	0.9
38	1.0
51	1.1
63	1.45
76	1.45
102	1.45

10.11 Reeling test (types E and F)

When tested in accordance with Appendix C, the outside diameter of the coiled hose measured on the major axis shall not show an increase on the original outside diameter of more than 10 %.

10.12 Dilation test (type F)

Using a test piece that has complied with the proof pressure given in Table 3, the dilation of the hose shall not exceed 4 % in volume when tested in accordance with clause **5** of BS 5173-2:1976 at a pressure of 2 bar.

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10.13 Fuel-soluble matter

When tested in accordance with Appendix D, the fuel-soluble matter shall be a maximum of 3 % of the total mass.

10.14 Fuel contamination

When tested in accordance with Appendix E, the increase in residue on evaporation shall be a maximum of 10 mg.

11 Test certificate

For each length of hose or hose assembly the manufacturer shall supply a test certificate giving the results of the tests described in **10.2**, **10.4** and **10.7**.

12 Marking

Each length of hose and hose assembly shall be durably marked with the following information:

a) the manufacturer's name or identification;

b) the number and date of this British Standard[2)] with the type letter and class number as suffixes;

c) the nominal bore;

d) the month and year of manufacture;

e) the maximum working pressure.

NOTE An example is MN/BS 3492:1987–B2/51 mm/9–87/7 bar.

In addition, class 1 hoses shall be marked "suitable for aviation fuels".

[2)] Marking BS 3492:1987 on or in relation to a product is a claim by the manufacturer that the product has been manufactured to the requirements of the standard. The accuracy of such a claim is therefore solely the manufacturer's responsibility. Enquiries as to the availability of third party certification should be addressed to the appropriate certification body.

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Appendix A Bend test under pressure

Apply the proof test pressure hydrostatically as specified in Table 3. Bend the hose 180° around a smooth drum of the appropriate radius given in Table 4 while maintaining the pressure, and return the hose to the straight condition. Repeat the bending and straightening six times. Then, carry out the electrical continuity test as described in **10.7**.

NOTE Suitable safety precautions should be taken while this procedure is being carried out.

Appendix B Fuel resistance test

Fill a length of hose or a hose assembly with Liquid B, as described in Appendix A of BS 903-A16:1971, using the guidelines given in BS 5173-5. Maintain the filled test piece at 40 ± 1 °C for 7 days. Empty the test piece and allow it to drain for 30 min. Then, carry out the proof pressure and vacuum resistance tests described in **10.2** and **10.4**.

Appendix C Reeling test (types E and F only)

Measure the outside diameter of a hose test piece of suitable length in accordance with an appropriate method described in BS 5173-101.1. Securely attach one end of the test piece to a smooth drum of the diameter given in Table 6.

Coil the hose at least once around the drum and secure the other end. After 1 h + 5, – 0 min, measure the major axis of the hose in accordance with BS 5173-101.1 while it is in contact with the drum.

Table 6 — External diameter of drum for reeling test

Nominal internal diameter of hose	Nominal external diameter of test drum
mm	mm
25	300
32	400
38	450
51	500

Appendix D Method for determination of fuel-soluble matter

NOTE 1 This method is broadly in line with clause **5** of BS 5173-5:1977.

Take a sample from the lining of the hose and remove any extraneous fibres. Cut the sample into pieces approximately 3 mm square and extract 5 ± 0.01 g of the comminuted sample with 100 mL of Liquid B, as described in Appendix A of BS 903-A16:1971, in a glass flask for 96 h at 40 ± 1 °C (see note 2). Take suitable precautions to prevent loss by evaporation.

NOTE 2 It is important that precautions to avoid overheating during preparation of the test sample are taken as any degradation of the polymer due to overheating is not estimable and could give a falsely high result.

While the contents is still hot, filter it into a pre-weighed hemispherical glass dish of suitable size. Wash both the residue in the flask and the filter with a further known quantity of the solvent mixture. Evaporate the contents of the dish on a boiling water bath and heat the residue in a ventilated oven for 2 h at 150 ± 3 °C. Calculate the mass of residual fuel-soluble matter as a percentage of the original mass of the test portion.

Appendix E Fuel contamination test

E.1 Procedure

Take a suitable length of hose (not less than 300 mm) and stopper one end with a glass plug. For types A, B, C, E and F hoses the bore should be 31.5 mm. Fill the hose with Liquid B, as described in Appendix A of BS 903-A16:1971, and allow it to stand at room temperature for 3 days. Remove the liquid and examine it in accordance with **E.2**. Then, refill the hose with fresh liquid. Repeat this procedure at daily intervals for a further 4 days. Refill the hose again and allow it to stand for 3 days at 20 ± 5 °C. Visually examine the liquid taken from the hose after the final day in accordance with **E.2** and test it in accordance with **E.3**.

E.2 Visual examination

On removal from the hose the test liquid should appear clear, bright and free from suspended matter after each flushing. Note any change in colour of the test liquid. Carry out a "blank" determination of the residue on evaporation on a sample of the Liquid B mixture, in accordance with **E.3**.

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E.3 Fuel contamination (increase in residue on evaporation)

First determine the residue on evaporation of the "test" and "blank" samples in accordance with BS 4348.

Report the increase in residue on evaporation from that of the blank sample as milligrams of residue per 100 mL of test liquid, using a hose of bore 76 mm for types A, B, C, E and F and a hose of bore 31.5 mm for type D.

When testing hoses having bores other than the reference bores quoted above, adjust the values obtained to give the final result in terms of the relevant reference bore.

Calculate the 76 mm equivalent increase in residue R_e (in mg per 100 mL) from the equation:

$$R_e = \frac{RB}{76}$$

where

R is the measured increase in residue (in mg per 100 mL);

B is the bore of the hose (in mm).

NOTE This is to allow for the fact that the hose surface area/liquid volume ratio is different.

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Publications referred to

BS 443, *Specification for testing zinc coatings on steel wire and for quality requirements.*
BS 903, *Methods of testing vulcanized rubber.*
BS 903-A16, *The resistance of vulcanized rubber to liquids.*
BS 1475, *Wrought aluminium and aluminium alloys for general engineering purposes — wire.*
BS 3424, *Testing coated fabrics.*
BS 3424-7:Method 9, *Method for determination of coating adhesion strength.*
BS 3558, *Glossary of rubber terms.*
BS 3592, *Steel wire for hose reinforcement.*
BS 3592-1, *Specification for coated round and flat steel wire for rubber hose reinforcement.*
BS 4348, *Determination of existent gum in fuels by jet evaporation.*
BS 5173, *Methods of test for hoses.*
BS 5173-2, *Hydraulic pressure tests.*
BS 5173-3, *General physical tests.*
BS 5173-4, *Electrical tests.*
BS 5173-5, *Chemical resistance tests.*
BS 5173-6, *Environmental tests.*
BS 5173, *Methods of test for rubber and plastics hoses and hose assemblies.*
BS 5173-101.1, *Measurement of dimensions (excluding length).*
BS 5173-101.2, *Measurement of length of hoses and hose assemblies*[3)].
BS 5173-102.1, *Hydrostatic tests.*
BS 5173-102.9, *Determination of resistance to vacuum.*
BS 5173-103.1, *Determination of adhesion between components.*
BS 5173-103.5, *Bending tests.*
BS 5173-106.3, *Determination of ozone resistance.*

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