

Metal hose assemblies —

Part 1: Guidance on the construction and use of corrugated hose assemblies

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Foreword

This Part of BS 6501-1 has been prepared by Technical Committee PSE/12. It supersedes BS 6501-1:1991 which is withdrawn. This edition has been produced to compliment BS EN ISO 10380 and its contents are topics that are not covered by BS EN ISO 10380 but were in the 1991 version of BS 6501-1.

BS EN ISO 10380 specifies requirements for the design, manufacture and testing of corrugated metal hose assemblies for general purposes.

This revision of BS 6501-1 gives guidance on the installation and selection of corrugated metal hose assemblies.

A high temperature resistance test for hose assemblies is also included.

BS 6501-2 covers strip-wound hose assemblies.

Corrugated metal hoses assemblies, as part of pipework systems, are used to convey liquids and gases under various pressure and temperature conditions in applications where, because of the need to accept displacement during operation, the use of standard piping materials is precluded. Corrugated hose assemblies may be used also as pipelines for connecting fixed and movable installations during loading/discharge operations.

On account of the materials of its construction, a corrugated hose is electrically conductive and is more suitable for certain duties than a non-metallic hose, particularly where resistance to extremes of temperature, crushing or fire and flame is involved. Corrugated hose assemblies are suitable also for applications involving vacuum or high pressure.

The piping services in which corrugated metal hose assemblies may be used include those for hazardous applications such as high pressure steam, chemicals and gases as well as non-hazardous applications.

Assessed capability. Users of this British Standard are advised to consider the desirability of quality system assessment and registration against the appropriate standard in the BS EN ISO 9000 series by an accredited third-party certification body.

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

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Summary of pages

This document comprises a front cover, an inside front cover, pages i and ii, pages 1 to 25 and a back cover.

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1 Scope

This part of BS 6501 gives guidance on the installation of corrugated metal hose assemblies and on the selection of the method of construction, the flexibility type and the material used for the hose.

This part of BS 6501 is complementary to BS EN ISO 10380.

NOTE 1 Corrugated hose assemblies generally are not suitable for applications involving axial compression or extension.

NOTE 2 Guidance on the selection and application of metal hose assemblies is given in Annex A and Annex B.

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the reference cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

BS EN ISO 7369, *Metal hoses and hose assemblies — Vocabulary*.

BS EN ISO 10380:2003, *Corrugated metal hoses and hose assemblies*.

3 Terms and definitions

For the purposes of this part of BS 6501, the terms and definitions given in BS EN ISO 7369 apply.

4 Guidance on the selection of corrugated hose assemblies

4.1 Materials

Due consideration should be given to the selection of suitable materials for the hose, braid if fitted, and the end fittings. Materials for the manufacture of corrugated metal hose assemblies should be selected on the basis of their suitability for fabrication, e.g. cold forming, welding, as appropriate, and according to the conditions under which they will operate.

NOTE 1 Because of the wide variety that exists in such conditions and the choice of materials available, this standard does not make the choice of materials the subject of compliance by specifying a comprehensive list of materials. BS EN ISO 10380:2003, Table 1, however, lists those materials that are preferred.

Table 1 should be used in conjunction with the requirements of BS EN ISO 10380:2003, 4.2e).

NOTE 2 Further guidance on the selection of materials is given in A.3.1.

4.2 Hose construction

Where concerns exist regarding the environment (see BS EN ISO 10380:2003, 4.1a)) or the product conveyed (see BS EN ISO 10380:2003, 4.2c)) being a potential source of crevice corrosion, construction type X as given in BS EN ISO 10380:2003, 5.5 should be used.

4.3 Temperature related corrosion resistance

The effect of temperature on the corrosion resistance of the assembly should be considered and reference should be made to BS EN ISO 10380:2003, 4.1a), 4.1g) and 4.2c).

NOTE Further guidance on the effect of temperature on corrosion resistance is given in A.3.2.

4.4 Pressure

The effect of pressure variations should be considered.

NOTE Guidance on this topic is given in A.3.3.

4.5 Product velocity

High product velocities should be avoided.

NOTE Limits on product velocities and corrective action are given in A.3.4.

4.6 High temperature resistance

Hose assemblies with welded end fittings may be subjected to the test described in Annex C. At no time during the test may the sample show any signs of leakage.

NOTE The flame test simulates a 1 000 °C flame.

4.7 Flexibility

The requirements given in BS EN ISO 10380:2003, 4.1c) should be used as the basis for the selection of the hose flexibility requirement.

NOTE Further details on flexibility are given in **A.2**.

Annex A (informative)

Selection and installation of corrugated metal hose assemblies

A.1 General

A.1.1 This annex is provided in order to assist the purchaser in the selection of a hose assembly for a specific application, taking into account pressure, temperature and other considerations and to give guidance on hose installation and handling.

A.1.2 A hose assembly has the following four basic uses:

- a) it facilitates movement, e.g. that associated with thermal expansion in piping or with connection to moving components;
- b) it facilitates random motion, e.g. that which occurs in plant transfer hose;
- c) it facilitates ease of connection between non-moving parts and compensates for misalignment, e.g. in gas meter installations;
- d) it greatly reduces the transmission of vibration, e.g. local to pump connections.

A.1.3 The following points should be considered when selecting a hose assembly:

- a) the movement required;
- b) the cyclic life required;
- c) the product to be conveyed by the hose assembly;
- d) the design pressure (see BS EN ISO 10380:2003, **5.3.1**);
- e) the design temperature range (see BS EN ISO 10380:2003, **5.3.2**);
- f) the handling and installation requirements e.g. minimum bend radius and maximum unsupported length;
- g) the environmental conditions;
- h) any special conditions such as pressure fluctuations due to pump surge, valve opening or closing, high product velocity, etc. (see **A.3.4**).

A.2 Hose assembly types

A.2.1 General

Three types of hose flexibility are specified in BS EN ISO 10380:2003. When selecting the cyclic life, it should be borne in mind that the service life of the assembly will be dependent also upon the other parameters listed in **A.1.3**.

A.2.2 Type 1 hose assemblies

BS EN ISO 10380 Type 1 hose is a highly flexible hose designed for demanding applications. However, its test requirements are less demanding than those of BS 6501-1:1991, Type C. A comparison between the requirements of BS 6501-1:1991, Type C and those of BS EN ISO 10380:2003, Type 1 is shown in Table A.1. Where a purchaser requires Type C flexibility, the manufacturer should be consulted.

A.2.3 Type 2 hose assemblies

BS EN ISO 10380:2003 Type 2 hose is a flexible hose designed for typical applications.

A.2.4 Type 3 hose assemblies

BS EN ISO 10380:2003 Type 3 hose is a bendable hose designed for use in static installations in order to overcome problems of misalignment or offset and to facilitate connection.

Type 3 assemblies should be used only for applications where pliability, as opposed to flexibility, is required.

Table A.1 — Comparison between the flexibility requirements of BS 6501-1:1991, Type C and BS EN ISO 10380:2003, Type 1

DN	BS 6501-1, Flexibility Type C		BS EN ISO 10380, Flexibility Type 1	
	Bend radius	Life	Bend radius	Life
4	—	40 000/50 000	100	8 000/10 000
6	100	40 000/50 000	110	8 000/10 000
8	—	40 000/50 000	130	8 000/10 000
10	150	40 000/50 000	150	8 000/10 000
12	200	40 000/50 000	165	8 000/10 000
15	200	40 000/50 000	195	8 000/10 000
20	200	40 000/50 000	225	8 000/10 000
25	200	40 000/50 000	260	8 000/10 000
32	250	40 000/50 000	300	8 000/10 000
40	250	40 000/50 000	340	8 000/10 000
50	350	40 000/50 000	390	8 000/10 000
65	410	40 000/50 000	460	8 000/10 000
80	450	40 000/50 000	660	8 000/10 000
100	560	40 000/50 000	750	8 000/10 000
125	660	40 000/50 000	1 000	8 000/10 000
150	815	40 000/50 000	1 250	8 000/10 000
200	1 015	40 000/50 000	1 600	8 000/10 000
250	1 220	40 000/50 000	2 000	8 000/10 000
300	1 420	40 000/50 000	2 400	8 000/10 000

A.3 Selection of hose assemblies

A.3.1 Materials

It is essential to select a material that has adequate resistance to both product and environment. Where resistance to the environment is the determining factor, the use of an outer sleeve or jacket might be preferable to the selection of more expensive materials for the hose.

Details of internal and external plant cleaning routines should be considered where appropriate.

Guidance on the corrosion resistance of commonly used hose assembly materials is given in BS 6501-1, Table A.2. This table should be read in conjunction with BS EN ISO 10380:2003, Table 1, but not all hose materials and products conveyed are included in the table. The manufacturer should be consulted before materials are selected.

A.3.2 Temperature

Where a hose is required for use at temperatures in excess of 50 °C and in the presence of certain corrosive agents, notably halogens, the possibility of stress corrosion should be considered and a suitable material resistant to this type of failure should be selected. In some applications high temperatures can alternate with lower temperatures with the attendant risk of condensation and corrosion. Details of temperature de-rating factors based on a creep life of 100 000 h are given in BS EN ISO 10380: 2003, Table 3.

A.3.3 Pressure

When selecting the nominal pressure of a hose assembly to be used, consideration should be given to the nature of the pressure to be applied. Where shock or pulsating pressure are likely to occur, the manufacturer should be consulted.

A.3.4 Product velocity

Liquid velocities in excess of 5 m/s and gas velocities in excess of 60 m/s can force the corrugations into resonant vibration resulting in premature failure. Such failure may be prevented by the use of flexible liners. The manufacturer should be consulted in these cases.

A.3.5 Coverings and coatings

It is strongly recommended that synthetic covers and protective coatings should not contain chlorine or sulfur, examples include neoprene, PVC, marking inks and paint.

End fittings that have been galvanized and paints containing zinc should not be used. Other non-ferrous metals, e.g. lead and tin, can cause damage similar to that caused by zinc.

NOTE At temperatures over 450 °C, either under working conditions or as a result of a plant fire, zinc can rapidly penetrate and embrittle austenitic stainless steel and high nickel alloys. For further information, see Guidance Note PM13, from the Health and Safety Executive, *Zinc embrittlement of austenitic stainless steel 3* [1].

A.3.6 Guidance on the choice of materials

A.3.6.1 General

Operating temperature can affect the choice of hose materials from the point of view of resistance to corrosion. Data on fluid compatibility are given in Table A.2. Most service requirements in industry can be met by selecting from the materials listed in Table A.2.

A.3.6.2 Hose materials

A.3.6.2.1 Austenitic stainless steels

A.3.6.2.1.1 ISO 9328-5 type X6CrNiTi 18 10

This material is commonly used where good corrosion resistance and satisfactory mechanical properties over a wide temperature range are required. The material is stabilized and, therefore, is resistant to corrosion problems associated with welding.

A.3.6.2.1.2 ISO 9328-5 type X2CrNiMo 17 12

This material offers improved resistance to pitting corrosion but, since it is a non-stabilized alloy, carbon precipitation can be a problem where carbon steel end fittings are used.

A.3.6.2.1.3 ISO 9328-5 type X2CrNi 18 10

This material is commonly used where good corrosion resistance is required.

A.3.6.2.2 Nickel-based alloys

A.3.6.2.2.1 ISO 6208 number NW 8825

A high nickel alloy resistant to stress corrosion cracking and having good resistance to sulfuric and phosphoric acids.

A.3.6.2.2.2 ISO 6208 number NW 8800

A high nickel alloy resistant to stress corrosion cracking and having very good general corrosion resistance.

A.3.6.2.2.3 ISO 6208 number NW 6600

The alloys included under this designation are immune to stress corrosion cracking and exhibit a good resistance to high temperature oxidation and corrosion.

A.3.6.2.2.4 ISO 6208 number NW 4400

A nickel copper alloy widely used in marine and chemical processing applications and also in applications involving contact with chlorine.

A.3.6.2.3 Copper-based alloys

Copper-based alloys are used mainly in areas where sparking can be a danger and for applications involving contact with sea water flowing at a rate of less than 1m/s. Copper based alloys should not be used where there is a risk of flame impingement.

A.3.6.3 End fitting materials

A.3.6.3.1 End fittings attached by welding

The use of carbon steel end fittings is an acceptable practice but such construction is not advisable for applications where shock or high flexing are involved. Carbon steel end fittings are not suitable for low temperature applications nor for applications where corrosion resistance is required.

A.3.6.3.2 End fittings attached by brazing

It is essential that the joining material selected is compatible with the product to be conveyed and that it has adequate strength at the design temperature.