INTERNATIONAL STANDARD

ISO 10380

First edition
1994-05-01

Corrugated flexible metallic hose and hose assemblies

Tuyaux et tuyauteries métalliques flexibles onduleux

Reference number
ISO 10380:1994(E)

Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

International Standard ISO 10380 was prepared by Technical Committee ISO/TC 5, *Ferrous metal pipes and metallic fittings*, Subcommittee SC 11, *Flexible interlocked and convoluted metallic hoses*.

International Organization for Standardization
Case Postale 56 • CH-1211 Genève 20 • Switzerland

Printed in Switzerland

Corrugated flexible metallic hose and hose assemblies

1 Scope

This International Standard specifies the requirements for the design, manufacture and testing of corrugated metallic hose and hose assemblies.

It also specifies nominal sizes from DN 6 to DN 300, nominal pressures from PN 2,5 to PN 250, two types of construction (see 8.1.2) and two types of flexibility (see 8.1.3) of hose assembly.

The corrugated hose assemblies specified in this International Standard are suitable for the majority of possible applications. They are however not designed for applications involving axial compression or extension, or external pressure.

2 Normative references

The following standards contain provisions which, through reference in this text, constitute provisions of this International Standard. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this International Standard are encouraged to investigate the possibility of applying the most recent editions of the standards indicated below. Members of IEC and ISO maintain registers of currently valid International Standards.

ISO 49:—[1], *Malleable cast iron fittings threaded to ISO 7-1.*

ISO 683-13:1986, *Heat-treatable steels, alloy steels and free-cutting steels — Part 13: Wrought stainless steels.*

ISO 7268:1983, *Pipe components — Definition of nominal pressure.*

ISO 7369:—[2], *Pipework — Flexible metallic hoses — Vocabulary of general terms.*

ISO 8601:1988, *Data elements and interchange formats — Information interchange — Representation of dates and times.*

3 Definitions

For the purposes of this International Standard, the definitions given in ISO 7369 apply.

4 Information to be supplied by the purchaser

The purchaser shall give the manufacturer all relevant information on the use of the assembly.

5 Materials

5.1 Materials for the manufacture of corrugated metallic hose assemblies shall be selected on the basis of their suitability for fabrication, e.g. cold forming, welding, etc. as appropriate, and for the conditions under which they will be used.

For corrugated hose assemblies, the materials used shall be chosen from those listed in table 1.

5.2 If materials other than those listed in table 1 are used, it is essential that this selection be made by agreement between the manufacturer and the user.

1) To be published. (Revision of ISO 49:1983)

2) To be published. (Revision of ISO 7369:1983)

Table 1 — Materials

Materials of construction	Hose	Braid and ferrules	End fittings[1)]
Stainless steel hose assemblies	Austenitic stainless steel of the composition given in ISO 683-13, types 10, 15, 19, 20 and 21	Fully-annealed austenitic stainless steel of the composition given in ISO 683-13, types 10, 11, 15, 19, 20 and 21	Austenitic stainless steel of the composition given in ISO 683-13, types 10, 11, 15, 16, 19, 20 and 21 Carbon steel with a maximum of 0,05 % sulfur and 0,05 % phosphorus
			Copper-based alloy, if formed, deep-drawing quality
Copper-based alloy hose assemblies	Deep-drawing quality phosphor bronze containing a minimum of 95 % copper and 1 % tin	Phosphor bronze containing a minimum of 95 % copper and 1 % tin	Copper-based alloy, if formed, deep-drawing quality

1) The materials specified for end fittings apply only to the parts which are welded or brazed to the hose.

6 Dimensions

6.1 Bore hose

The minimum bore size of a hose shall be at least 98 % of the nominal size as listed in table 2.

6.2 Bend radii

The nominal static and dynamic bend radii of the hose assemblies are given in table 2. Two types of flexibility are identified (see 8.1.3). Hose assemblies shall meet the bend radii requirements of table 2 when tested in accordance with 9.2 and 9.3.

6.3 Overall length

The overall length of a hose assembly shall be the length as ordered to a tolerance of $^{+3}_{-1}$ %.

7 Design

7.1 Pressure

Hose assemblies shall be designed to be in accordance with one of the maximum permissible pressures referred to in table 3, when tested in accordance with clause 9.

It is essential that the maximum service pressure, including surge pressure to which the hose assembly is subjected in service, does not exceed the maximum permissible pressure specified.

Maximum permissible pressures in bars at room temperature are to be selected from the nominal pressures given in table 3.

Table 2 — Nominal size and bend radii

Radii in millimetres

Nominal size	Nominal static bend radius	Nominal dynamic bend radius	
DN	Types 1 and 2	Type 1	Type 2
6	25	110	140
8	32	130	165
10	38	150	190
12 [1)]	45	165	210
15	58	195	250
20	70	225	285
25	85	260	325
32	105	300	380
40	130	340	430
50	160	390	490
65	200	460	580
80	240	520	660
100	290	600	750
125 150 200 250 300	For details refer to the manufacturer		

1) Not listed in ISO 49, which applies to the R10 series.

Table 3 — Maximum permissible pressures

Recommended pressure[1] PN	Limit of use[2] PN	Exceptional cases PN
	2,5	
	6	
10		
16		
20		
	25	
	40	
50		
		65
100		
150		
		200
250		

1) Taken from ISO 7268:1983, series 1.

2) Taken from ISO 7268:1983, series 2.

7.2 Elevated temperature

The method of determining the maximum service pressure for an assembly used at elevated temperature shall be as follows: each hose assembly used at elevated temperature conditions shall be designed to comply with the lowest derating factor given for each component in table 4 (hose, end fitting, braid and method of assembly) at their appropriate design temperature.

NOTE 1 Table 4 is to be used until an appropriate International Standard is prepared.

The design temperature for each component shall take into consideration the maximum temperature it is expected to reach.

The maximum service pressure of the hose assembly at the maximum service temperature is the product of the maximum service pressure at ambient temperature multiplied by the lowest derating factor given in table 4.

The bend radius of assemblies which are flexed at elevated temperature is different from that at room temperature. The manufacturer should be consulted for further details.

7.3 Low temperature

Hose, braid and end fittings manufactured from materials listed in table 1 are suitable for use without derating at temperatures down to – 200 °C, with the exception of carbon steel end fittings for which the minimum temperature is – 20 °C.

7.4 Cyclic lifetime

7.4.1 General

Hose assemblies shall be designed for the nominal static bend radius and one of the two types of nominal dynamic bend radii given in table 2.

7.4.2 Static bend radius

Hose assemblies of DN up to 100 shall have a lifetime of not less than 10 cycles when tested at the nominal static bend radii given in table 2 and in accordance with 9.2.

7.4.3 Dynamic bend radius

Hose assemblies of DN up to 100 shall have an average lifetime of not less than 50 000 cycles when tested at the nominal dynamic bend radii given in table 2 and in accordance with 9.3.

NOTES

2 No requirements are specified for hoses of nominal size larger than DN 100. For such hoses, the cyclic lifetime should be as agreed between the purchaser and the manufacturer.

3 Passing the fatigue test does not imply that the minimum or average cyclic lifetime can be reached in circumstances other than those specified in the test procedure. For applications where fatigue lifetime is important or where high temperatures occur, it is essential that the manufacturer be consulted when establishing the design requirements and that these include a mutually acceptable factor of safety.

4 It should be noted that changing the bend radii will affect the fatigue performance of a hose assembly. As an example, if a type 2 hose assembly is flexed at a type 1 hose bend radii, its fatigue performance will drop to approximately 5 000 cycles.

8 Construction

8.1 Hose

8.1.1 General

The hose may be made from seamless tube, welded tube or strip. Where welded construction is used the hose may be butt- or lap-welded, the weld being either axial or spiral along the length of the hose. Corrugations may be annular or helical.

Table 4 — Temperature derating factors and service temperature limits for hose assemblies built with the materials indicated in table 1

Material of construction		Assembly method	Derating factors																						
			Temperature, °C																						
			– 200	– 150	– 100	– 50	– 20	0	20	50	100	150	200	250	300	350	400	450	500	550	600	650	700	750	800
	ISO 683-13, type 10 (AISI 304 L)[1]		1,0	1,0	1,0	1,0	1,0	1,0	1,0	0,90	0,82	0,73	0,66	0,60	0,56	0,52	0,49	0,47	0,45	0,44	—	—	—	—	—
	ISO 683-13, type 11 (AISI 304)[1]		1,0	1,0	1,0	1,0	1,0	1,0	1,0	0,91	0,81	0,73	0,65	0,61	0,56	0,53	0,50	0,49	0,47	0,46	0,31	0,19	0,10	A	A
	ISO 683-13, type 15 (AISI 321)[1]		1,0	1,0	1,0	1,0	1,0	1,0	1,0	0,95	0,83	0,75	0,69	0,65	0,62	0,59	0,58	0,57	0,56	0,53	0,34	0,19	0,10	0,046	A
	ISO 683-13, type 16 (AISI 347)[1]		A	A	A	A	A	A	1,0	A	A	A	A	A	A	A	A	A	A	—	—	—	—	—	—
	ISO 683-13, type 19 (AISI 316 L)[1]		1,0	1,0	1,0	1,0	1,0	1,0	1,0	0,96	0,83	0,76	0,69	0,65	0,61	0,58	0,56	0,54	0,53	0,52	—	—	—	—	—
	ISO 683-13, type 20 (AISI 316)[1]		1,0	1,0	1,0	1,0	1,0	1,0	1,0	0,94	0,85	0,78	0,72	0,67	0,62	0,59	0,56	0,55	0,54	0,53	0,45	0,26	0,15	0,14	A
	ISO 683-13, type 21 (AISI 316 Ti)[1]		A	A	A	A	A	A	1,0	A	A	A	A	A	A	A	A	A	A	—	—	—	—	—	—
	Carbon steel		—	—	—	—	1,0	1,0	1,0	0,98	0,90	0,89	0,86	0,82	0,76	0,73	0,70	0,41	0,24	—	—	—	—	—	—
	Copper-based alloy		A	A	A	A	A	A	1,0	A	A	A	A	A	—	—	—	—	—	—	—	—	—	—	—
	Phosphor bronze		A	A	A	A	A	A	1,0	A	A	A	A	A	—	—	—	—	—	—	—	—	—	—	—
	Silver brazing	Suitable														—	—	—	—	—	—	—	—	—	—
	Shielded arc weld	Suitable																							

NOTE — "A" : Refer to manufacturer.

1) For information only.

8.1.2 Types of construction

Two types of hose construction are possible, X and Y.

— Type X: seamless annular hose and butt-welded annular hose.

— Type Y: lap-welded annular hose and helical hose either seamless, butt- or lap-welded.

The corrugations shall be of regular form, continuous along the length of the hose, and shall be free from any defects such as scores, dents, cuts or weld variations which might cause premature failure. Where required, a hose may be heat-treated after manufacture.

8.1.3 Types of flexibility

Two types of flexibility are possible, 1 and 2.

— Type 1: corrugated hose of high flexibility.

— Type 2: corrugated hose of moderate flexibility.

See table 2.

8.1.4 Method of hose joining

Where a manufacturer uses hose joints prior to braiding, such joints shall be either butt-welded or edge-welded as shown in figure 1.

8.2 Braid

8.2.1 Where braided, the hose shall be closely covered by wire, either machine-woven around the hose or fitted by hand as a stocking.

8.2.2 For braided hose assemblies to meet the characteristics given in this International Standard, the assembly shall be of such a length that there is at least one complete revolution of braid along the length of the hose.

8.3 Methods of assembly

8.3.1 General

End fittings shall be attached to the hose, by shielded arc welding or by equivalent welding methods or by silver brazing. Welded and brazed joints shall be free from globular deposits, discontinuities, porosity and undercutting, and shall have a regular surface.

8.3.2 Braided assemblies

Care shall be taken to ensure that all braid wires are securely bonded to the end fittings.

8.4 Additional protection

8.4.1 Where required, hose assemblies may be provided with additional external protection to prevent mechanical damage. This shall be provided by either:

— an anti-abrasion protective coil of metallic or non-metallic construction suitable for the operating conditions envisaged, or

— an additional outer sleeve resistant to tear, weathering and abrasion.

8.4.2 Where additional protection affects the minimum bend radii given in table 2, the manufacturer shall notify the purchaser accordingly.

8.4.3 Where a protective coating is used on a stainless steel hose, it shall not contain zinc, lead or tin.

9 Type test

9.1 General

Hose assemblies shall be tested in the form of construction in which they are to be supplied, i.e. with or without hose joints, with or without heat treatment, with or without braid, with or without ferrules, and using the relevant end fitting joining method.

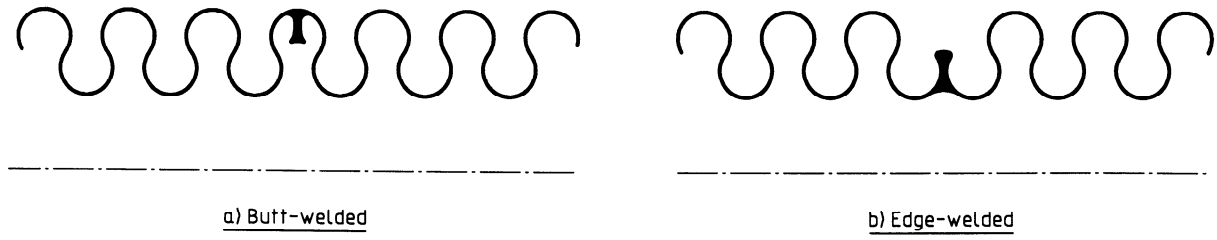

Figure 1 — Details of butt-welded and edge-welded hose joints

Tests shall be carried out at ambient temperature and the test medium shall be water.

Type approval tests shall consist of those given in 9.2 to 9.4.

Prior to these tests, the hoses shall be tested as specified in 10.1.

9.2 Bend test for flexible hose assemblies

For flexible hose assemblies up to and including DN 100, two samples of each nominal size of hose assembly shall be subjected to a bend test in accordance with figure 2. With one hose end rigidly fixed, the other shall be moved in a circular arc around a former having a radius calculated from the nominal static bend radius as given in table 2, until the hose assembly is in intimate contact with the full length of the arc of the former.

One stress cycle comprises one bend and the return movement to the straight position. The test shall consist of the assembly being flexed through 10 cycles without pressure, as indicated in figure 2. The test frequency shall be between 10 cycles/min and 30 cycles/min.

After the test, the assembly shall be subjected to the hydraulic pressure test specified in 10.1.1. There shall be no leakage or substantial change in shape.

9.3 Fatigue test for flexible hose assemblies

For flexible hose assemblies up to and including DN 100, six samples of each nominal size shall be subjected to a fatigue test (see figure 3). The test shall be conducted with the hose at the relevant maximum permissible pressure and with the distance between the axes of the end fittings equal to twice the nominal dynamic bend radius given in table 2.

The hose shall be subjected to repeated flexion at a rate of from 5 cycles/min to 30 cycles/min in a direction parallel with the axis of the hose through a movement of $2x$.

The test shall be conducted using hose assemblies mounted to form a vertical loop as shown in figure 3. The flexible length of the assembly l, shall be given in the following equation:

$$l = 4r + x$$

where

r is the nominal dynamic bend radius;

x is equal to 4 DN or 125 mm, whichever is greater;

DN is the nominal size.

The average number of cycles before failure for a hose assembly shall be not less than 50 000 and the minimum number of cycles for any one hose assembly before failure shall be not less than 40 000.

Failure is defined as leakage of the hose or a permanent change in shape by greater than ± 20 % of the nominal dynamic bend radius. The hose shall not be lubricated prior to or during the test.

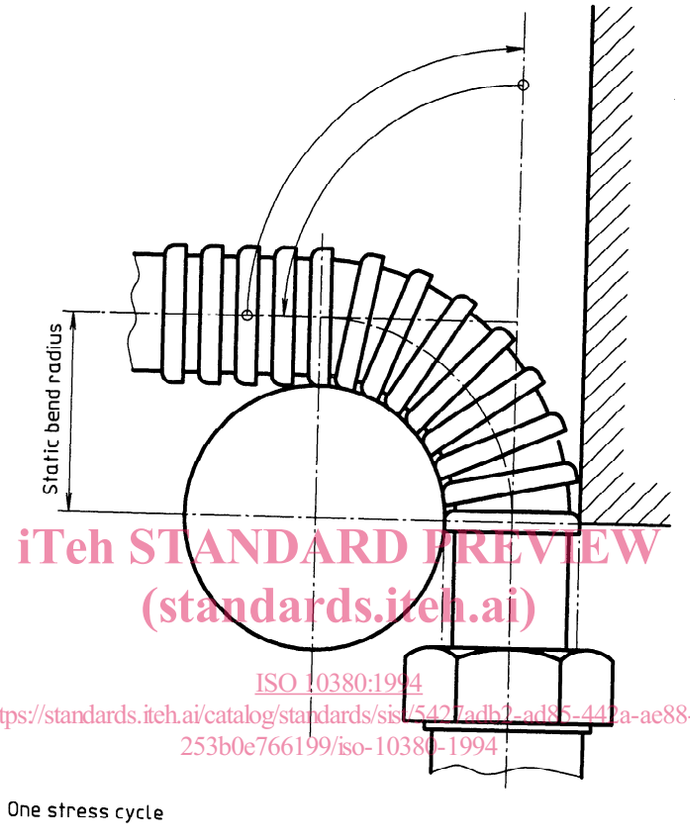

Figure 2 — Bend test for assemblies