International Standard 3949

INTERNATIONAL ORGANIZATION FOR STANDARDIZATION•МЕЖДУНАРОДНАЯ ОРГАНИЗАЦИЯ ПО СТАНДАРТИЗАЦИИ•ORGANISATION INTERNATIONALE DE NORMALISATION

Plastics hoses and hose assemblies — Thermoplastics, textile-reinforced, hydraulic type

Tuyaux et assemblages de tuyaux en plastique — Type hydraulique en thermoplastique à renforcement en fibre textile

First edition — 1980-03-15

UDC 678.06 : 621.643.33 **Ref. No. ISO 3949-1980 (E)**

Descriptors : plastic products, hoses, fluids, thermoplastic resins, specifications, diameters, pressure.

Price based on 7 pages

Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards institutes (ISO member bodies). The work of developing International Standards is carried out through ISO technical committees. Every member body interested in a subject for which a technical committee has been set up 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.

Draft International Standards adopted by the technical committees are circulated to the member bodies for approval before their acceptance as International Standards by the ISO Council.

International Standard ISO 3949 was developed by Technical Committee ISO/TC 45, *Rubber and rubber products*, and was circulated to the member bodies in March 1978.

It has been approved by the member bodies of the following countries :

Australia	Greece	Romania
Austria	Hungary	South Africa, Rep. of
Belgium	India	Spain
Brazil	Ireland	Sri Lanka
Bulgaria	Italy	Sweden
Canada	Korea, Rep. of	Turkey
Czechoslovakia	Mexico	United Kingdom
Egypt, Arab Rep. of	Netherlands	USA
France	New Zealand	USSR

No member body expressed disapproval of the document.

Printed in Switzerland

Plastics hoses and hose assemblies — Thermoplastics, textile-reinforced, hydraulic type

1 Scope and field of application

1.1 This International Standard specifies requirements for two types of thermoplastics hoses with textile reinforcement, the design working pressure ranges for which are indicated in table 2. The hoses are suitable for use with petroleum-, water- and synthetic-based hydraulic fluids within a temperature range of − 40 °C to + 100 °C. Operating temperatures in excess of + 100 °C may materially reduce the life of the hose.

1.2 This International Standard does not include requirements for end fittings. It is limited to the performance of hoses and hose assemblies.

1.3 Annex C gives dimensional details of widely used hoses. These are for information only and do not form part of the specification.

2 References

ISO 1219, *Fluid power systems and components — Graphic symbols.*

ISO 1307, *Rubber hose — Bore sizes, tolerances on length and test pressures.*

ISO 1402, *Rubber hose — Hydrostatic testing.*

ISO 1431, *Vulcanized rubbers — Determination of resistance to ozone cracking under static conditions.*

ISO 1817, *Vulcanized rubbers — Resistance to liquids — Methods of test.*

ISO 2719, *Petroleum products — Determination of flash point — Pensky-Martens closed cup method.*

ISO 2977, *Petroleum products and hydrocarbon solvents — Determination of aniline point and mixed aniline point.*

ISO 3016, *Petroleum oils — Determination of pour point.*

ISO 3448, *Industrial liquid lubricants — ISO viscosity classification.*

3 Material and construction

3.1 The hose shall consist of a seamless thermoplastics lining resistant to hydraulic fluids, with suitable synthetic fibre reinforcement, and a thermoplastics cover resistant to hydraulic fluids and the weather.

3.2 The hose shall be concentric in accordance with the following specification :

The measurement of the wall thickness at different points shall not differ by more than the following values :

Nominal bore	Difference in thickness
Up to and including 6,3 mm	0,8 mm
Over 6,3 mm, up to and including 19 mm	1,0 mm
Over 19 mm	1,3 mm

4 Dimensions

The bore of the hoses shall meet the requirements of table 1.

Table 1 — Nominal bore and tolerances

Values in millimetres

Nominal bore	Permitted range			
	Type 1		Type 2	
	min.	max.	min.	max.
5	4,6	5,2	4,6	5,3
6,3	6,2	6,8	6,2	6,9
8	7,7	8,3	—	—
10	9,3	9,9	9,3	10,0
12,5	12,3	13,2	12,3	13,2
16	15,5	16,5	15,5	16,5
19	18,6	19,8	18,6	19,8
25	25,0	26,2	25,0	26,2

NOTE — ISO 1307 has not been followed for nominal bore or permitted range; the dimensions in table 1 are in accordance with those specified by the Society of Automotive Engineers (USA), which are in wide use in numerous countries throughout the world for thermoplastics hoses.

5 Pressure ratings

5.1 The design working pressure, proof test pressure and minimum burst pressure of the hose shall comply with the requirements of table 2.

5.2 The hoses shall withstand without damage a proof test pressure as shown in table 2 maintained for a period of 1 min by the method specified in ISO 1402.

6 Minimum bend radius and change in length at design working pressure

6.1 The hoses shall be capable of performing at design working pressure when curved to the minimum bend radius given in table 3. A hose shall not be installed for use at the design working pressure if a smaller bend radius is used than shown in table 3.

NOTE — Should any portion of the hose be curved to a radius smaller than the specified minimum bend radius, the performance capability of the hose is reduced.

6.2 The change in length of hoses at the design working pressure shall not be greater than specified in table 3.

NOTE — The minimum bend radius is measured to the inside of the bend.

7 Tolerance on length

7.1 The hose shall be supplied in lengths as specified by the purchaser, subject to a tolerance on the specified length of ± 1 % or ± 3 mm, whichever is the greater.

7.2 When no specific length has been ordered, the percentage of different lengths in any given delivery shall be as follows :

— over 13 m : not less than 65 % of total length;

— over 7,5 m to 13 m : not more than 35 % of total length;

— 1,0 to 7,5 m : not more than 10 % of total length.

No length shall be less than 1 m.

8 Impulse test requirements

8.1 Four unaged test pieces of hose with end fittings shall be tested.

8.2 Means shall be provided for applying a pulsating pressure internally to a hose assembly at a rate of between 0,5 and 1,25 Hz (30 and 75 cycles per minute). A typical schematic hydraulic circuit for the hose test rig is given for guidance in figure 1.

Table 2 — Design working pressure, proof test pressure and minimum burst pressure

Nominal bore	Design working pressure				Proof test pressure				Minimum burst pressure			
	Type 1		Type 2		Type 1		Type 2		Type 1		Type 2	
	bar*	(MPa)	bar	(MPa)	bar	(MPa)	bar	(MPa)	bar	(MPa)	bar	(MPa)
5	205	(20,5)	345	(34,5)	410	(41)	690	(69)	820	(82)	1 380	(138)
6,3	190	(19)	345	(34,5)	380	(38)	690	(69)	760	(76)	1 380	(138)
8	170	(17)	—	—	340	(34)	—	—	680	(68)	—	—
10	155	(15,5)	275	(27,5)	310	(31)	550	(55)	620	(62)	1 100	(110)
12,5	135	(13,5)	240	(24)	270	(27)	480	(48)	540	(54)	960	(96)
16	100	(10)	190	(19)	200	(20)	380	(38)	400	(40)	760	(76)
19	86	(8,6)	155	(15,5)	172	(17,2)	310	(31)	344	(34,4)	620	(62)
25	69	(6,9)	138	(13,8)	138	(13,8)	275	(27,5)	276	(27,6)	550	(55)

* 1 bar = 10^5 N/m^2 = 0,1 MPa

Table 3 — Minimum bend radius — Change in length

Nominal bore	Minimum bend radius	Change in length
mm	mm	%
5	90	± 3
6,3	100	± 3
8	115	± 3
10	125	± 3
12,5	180	± 3
16	205	± 3
19	240	± 3
25	300	± 3

8.3 Each cycle shall comply with the requirements of the pressure impulse cycle (see figure 2) as appropriate.

8.4 The fluid to be used in the test shall be a fully fortified mineral oil of viscosity grade ISO VG 46 (46 mm^2/s* at 40 °C) in accordance with ISO 3448 and having the following characteristics :

		ISO test method
pour point, max.	− 28 °C	ISO 3016
flash point, closed, min.	190 °C	ISO 2719
aniline point	100 ± 10 °C	ISO 2977

Other oils may be used by agreement between the interested parties.

8.5 The free length of test hose shall be determined as follows :

Bend	Free length
90°	$0{,}5\,\pi\,r + 2\,d$
180°	$\pi\,r + 2\,d$

where r is the minimum bend radius and d is the overall diameter of the hose.

8.6 The test pieces shall be connected to the apparatus and, in the case of hoses up to and including 19 mm nominal bore, they shall be bent through either 90° or 180°. For the latter configuration the fittings shall be parallel and the distance between the two ends of the hose at the fittings shall be twice the minimum bend radius $^{+5}_{0}$ %. Hoses over 19 mm nominal bore shall be bent through 90°.

8.7 Type 1 hose, when tested at 125 % of the design working pressure at a temperature of 93 ± 5 °C using circulating petroleum-based test fluid, shall withstand a minimum of 150 000 impulse cycles without leakage or other malfunction.

Type 2 hose, when tested at 133 % of the design working pressure at a temperature of 93 ± 5 °C using circulating petroleum-based test fluid, shall withstand a minimum of 200 000 impulse cycles without leakage or other malfunction.

Any failures adjacent to the end fittings shall be disregarded, and repeat tests carried out. Failure due to coupling blow-off or rupture adjacent to the fittings (within 25 mm) shall not be interpreted as a true hose burst but as failure due to the fitting attachment, and shall be recorded as such.

9 Cold flexibility

The hose shall be subjected to a temperature of $-40\ ^{0}_{-2}$ °C for 24 h in a straight position. After this time and while still at the specified temperature, the test piece shall be evenly and uniformly bent over a mandrel having a diameter equal to twice the minimum bend radius specified in table 3. Bending shall be accomplished within a period of 10 ± 2 s.

Hoses of less than 25 mm nominal bore shall be bent through 180° over the mandrel, and hoses of 25 mm nominal bore shall be bent through 90° over the mandrel.

After bending, the test piece shall be allowed to warm to room temperature, and shall then be visually examined for cover cracks and subjected to a proof test as described in 5.2. There shall be no cover cracks or leakage.

10 Ozone resistance

When tested in accordance with ISO 1431, no cracking or other deterioration of the cover shall be visible at a magnification of 2 X after exposure for 72 h at 40 ± 2 °C to an ozone concentration of $(0{,}5 \pm 0{,}05) \times 10^{-6}$ (V/V) (0,5 ± 0,05 ppm) using test pieces as detailed in annex A.

11 Oil resistance

The lining and the cover, when tested in accordance with ISO 1817, immersing in oil No. 3 for 72 h at a temperature of 100 °C, shall show no shrinkage greater than 15 % or volume swelling greater than 35 %.

12 Electrical conductivity

Hose other than that with a pin-pricked cover, when tested in accordance with annex B, shall not show a leakage greater than 50 µA when subjected to an applied voltage of 250 kV/m for 5 min.

13 Marking

The hoses shall be marked with information as agreed between the purchaser and the manufacturer.

* 1 mm^2/s = 10^{-6} m^2/s = 1 centistoke (cSt)

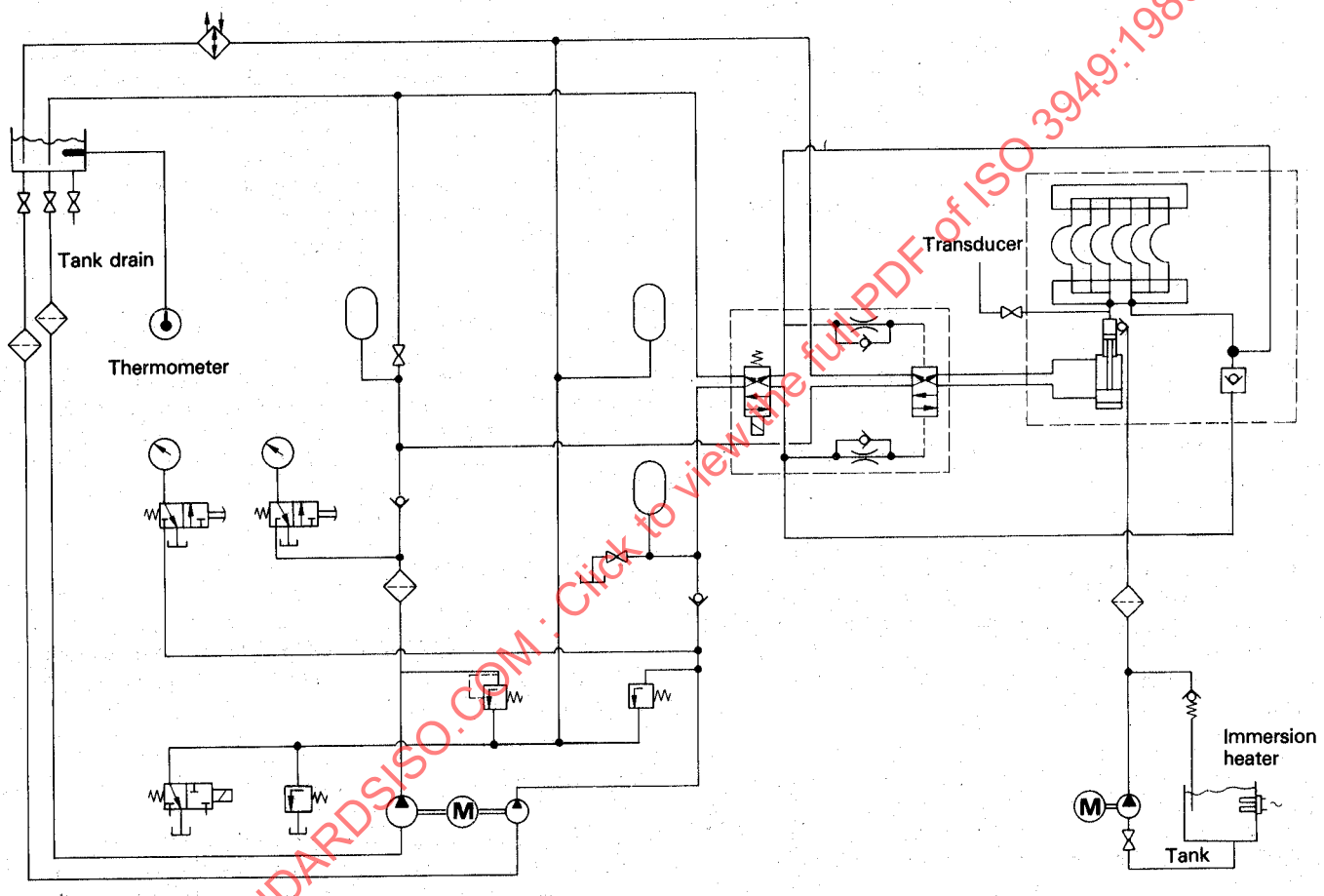

Figure 1 — Typical schematic hydraulic circuit for the hose test rig (see ISO 1219)

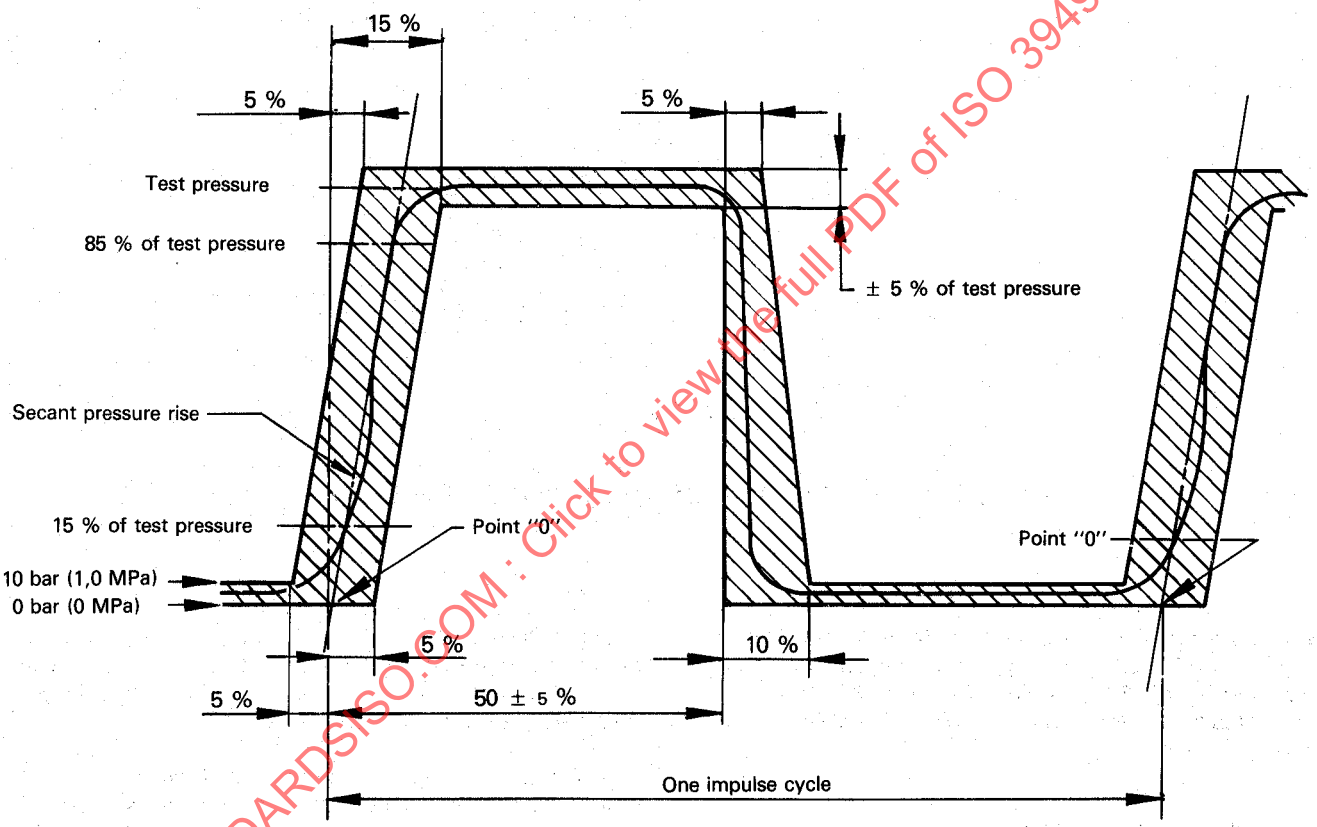

Figure 2 — Pressure impulse cycle

Annex A

Preparation of test pieces for ozone resistance test

A.1 Shape and dimensions

Test pieces shall be rectangular strips 25 mm wide by 95 mm long and having a thickness between 1,9 and 2,5 mm.

A.2 Number of test pieces

Two test pieces shall be tested.

A.3 *Looping of test pieces*

Loop the test piece until its ends meet and then insert the ends between a pair of wooden strips, each of which shall be 25 mm wide and 12 mm thick. Adjust the ends of the test piece so that they are flush with one edge of the strips. Firmly clamp the two wooden strips together.

Test pieces should be at least 6,5 mm apart.

Annex B

Method of test for electrical conductivity

Hose assemblies having a free length of 150 ± 10 mm without fluid, and capped to prevent entry of moisture, shall be exposed to a minimum of 85 % relative humidity at 23 ± 3 °C for a period of 168 h. Surface moisture shall be removed prior to testing.

Conditioned assemblies shall have one end fitting attached to the lead from a source of 50 to 60 Hz sinusoidal, 37,5 kV (rms) electricity. This lead shall be suspended by dry fabric strings so that the hose hangs free, at least 600 mm from any extraneous objects. The lower end of the hose shall be connected to earth through a known resistance between 1 kΩ and 1 MΩ, keeping the resistor near the end of the hose.

A suitable a.c. voltmeter shall be connected across the resistor, using a fully shielded cable with the shielding well earthed. 37,5 kV (equivalent to 250 kV/m) shall be applied to the test piece for 5 min and a current reading taken. Check that the current does not exceed 50 μA.

Annex C

Dimensional details of widely used hoses

(This annex does not form part of the standard.)

Dimensions in millimetres

Nominal bore	Maximum outside diameter	
	Type 1	Type 2
5	10,7	14,6
6,3	13,0	16,8
8	15,0	—
10	17,8	20,3
12,5	21,8	24,6
16	24,6	29,8
19(20)	27,9	33,0
25	36,8	38,6