INTERNATIONAL STANDARD

ISO 5771

Third edition
2008-09-15

Rubber hoses and hose assemblies for transferring anhydrous ammonia — Specification

Tuyaux et flexibles en caoutchouc pour le transfert d'ammoniac anhydre — Spécifications

Reference number
ISO 5771:2008(E)

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Published in Switzerland

Contents

Page

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.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of technical committees is to prepare International Standards. 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.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

ISO 5771 was prepared by Technical Committee ISO/TC 45, *Rubber and rubber products*, Subcommittee SC 1, *Hoses (rubber and plastics)*.

This third edition cancels and replaces the second edition (ISO 5771:1994), which has been technically revised. The main changes are the addition of a concentricity requirement (see 6.3), increases in the lining and cover adhesion requirements (see Table 4) and more detailed cover pin-pricking requirements (see 5.3). It also incorporates the Technical Corrigendum ISO 5771:1994/Cor.1:1995.

Rubber hoses and hose assemblies for transferring anhydrous ammonia — Specification

WARNING — Persons using this International Standard should be familiar with normal laboratory practice. This standard does not purport to address all the safety problems, if any, associated with its use. It is the responsibility of the user to establish appropriate health and safety practices and to ensure compliance with any national regulatory conditions.

CAUTION — All personnel working with anhydrous ammonia and its delivery systems should be familiar with and utilize the necessary safety precautions to minimize the potential for personal injury and property damage. Do not use anhydrous-ammonia hose assemblies at temperatures or pressures above those recommended by the hose manufacturer. Never recouple an anhydrous-ammonia hose. Hoses manufactured to this specification are suitable for use with anhydrous ammonia only.

1 Scope

This International Standard specifies the minimum requirements for rubber hoses used for transferring ammonia, in liquid or in gaseous form, at ambient temperatures from −40 °C up to and including +55 °C. It does not include specifications for end fittings, but is limited to the performance of the hoses and hose assemblies.

2 Normative references

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

ISO 37, *Rubber, vulcanized or thermoplastic — Determination of tensile stress-strain properties*

ISO 188:2007, *Rubber, vulcanized or thermoplastic — Accelerated ageing and heat resistance tests*

ISO 1307, *Rubber and plastics hoses — Hose sizes, minimum and maximum inside diameters, and tolerances on cut-to-length hoses*

ISO 1402, *Rubber and plastics hoses and hose assemblies — Hydrostatic testing*

ISO 4671, *Rubber and plastics hoses and hose assemblies — Methods of measurement of the dimensions of hoses and the lengths of hose assemblies*

ISO 4672:1997, *Rubber and plastics hoses — Sub-ambient temperature flexibility tests*

ISO 7326, *Rubber and plastics hoses — Assessment of ozone resistance under static conditions*

ISO 8033, *Rubber and plastics hoses — Determination of adhesion between components*

ISO 8330, *Rubber and plastics hoses and hose assemblies — Vocabulary*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 8330 apply.

4 Pressure rating

The pressure rating shall comply with the requirements of Table 1.

Table 1 — Pressure requirements

Parameter	Pressure requirements	
	bar	MPa
Maximum working pressure	25	2,5
Proof pressure	63	6,3
Minimum burst pressure	125	12,5

5 Materials and construction

5.1 Lining

The lining shall be of uniform thickness of at least 1,5 mm, measured in accordance with ISO 4671, and free from holes, porosity and other defects. The finished hose lining shall comply with the performance requirements specified in Table 3. The material used shall be resistant to hardening or other deterioration due to the action of ammonia.

5.2 Reinforcement

The reinforcement shall consist of a material not adversely affected by permeating ammonia. It shall be applied evenly and uniformly, and in such a way that the finished hose complies with the relevant performance requirements specified in Table 4.

A suitable material is corrosion-resistant stainless steel.

5.3 Cover

The rubber cover, when used, shall be uniform in quality and thickness and shall be free from injurious defects. It shall comply with the relevant performance requirements specified in Table 3. It shall also be resistant to deterioration due to exposure to ammonia and exposure to the external environment. A gas-tight rubber cover shall be pin-pricked during manufacture to permit the release of any permeating gas during service. The pinholes shall not penetrate the lining and there shall be at least 40 effective pinholes per metre of hose.

5.4 Hose assemblies

Hose assemblies shall be made only from hoses complying with the performance requirements specified in Table 4. Only permanently attached ferrous-metal fittings shall be used. Specific information can be obtained from the hose manufacturer. In addition, guidance can be found in ISO/TR 17784.

6 Dimensions

6.1 Inside diameters and tolerances

When measured in accordance with ISO 4671, inside diameters shall conform to the values and tolerances specified in Table 2.

Table 2 — Nominal size and permitted ID range

Nominal size	Minimum ID mm	Maximum ID mm
12,5	12,1	13,5
16	15,3	16,7
19	18,5	19,9
25	24,6	26,6
31,5	31,0	33,4
38	37,3	39,7
51	49,6	52,0
64	62,3	64,7
76	75,0	77,4

6.2 Outside diameter

Although no required outside diameters, or required tolerances on such diameters, are specified, it is necessary that they be selected by the hose manufacturer to be in keeping with users' needs and to provide complete fitting compatibility, meeting the performance requirements of this specification.

6.3 Concentricity

When determined in accordance with ISO 4671, the concentricity, based on a total indicator reading between the internal diameter and the outside surface of the cover, shall be no greater than 1,0 mm for hoses of internal diameter up to and including 76 mm.

6.4 Tolerances on length

Tolerances on cut lengths shall be as specified in ISO 1307. Recommendations for the lengths of hoses supplied in bulk and for tolerances on the lengths of hose assemblies are given in Annex C.

7 Physical properties

7.1 Rubber compounds

When tested by the methods listed in Table 3, the physical properties of the compounds used for the lining and cover shall conform to the required values.

Tests shall be carried out on test pieces taken either from the hose or from separately vulcanized sheets 2 mm in thickness and vulcanized to the same cure state as production hoses.

Table 3 — Physical properties of the rubber compounds used for the lining and cover

Property	Requirements		Test method
	Lining	Cover	
Minimum tensile strength	7,0 MPa	7,0 MPa	ISO 37 (dumb-bell test pieces)
Minimum elongation at break	250 %	250 %	ISO 37 (dumb-bell test pieces)
Change in tensile strength from original value after oven ageing	—	± 25 %	Age in accordance with ISO 188:2007 for 72 h ± 2 h at 70 °C ± 1 °C using a cell-type oven or a cabinet oven (method A) Test in accordance with ISO 37 (dumb-bell test pieces)
Change in elongation at break from original value after oven ageing	—	± 50 %	Age in accordance with ISO 188:2007 for 72 h ± 2 h at 70 °C ± 1 °C using a cell-type oven or a cabinet oven (method A) Test in accordance with ISO 37 (dumb-bell test pieces)

7.2 Finished hose

When tested by the methods listed in Table 4, the physical properties of the finished hose shall conform to the required values.

Table 4 — Finished-hose performance requirements

Property	Requirement	Method of test
Proof test pressure	63 bar (6,3 MPa)	ISO 1402
Minimum burst pressure	125 bar (12,5 MPa)	ISO 1402
Change in length at maximum working pressure, max.	± 5 % at 25 bar (2,5 MPa)	ISO 1402
Low-temperature flexibility	No breaks or cracks in cover or lining at −40 °C	ISO 4672:1997, method B
Adhesion of the lining, min.[a]	1,75 kN/m	ISO 8033
Adhesion of the reinforcement, min.[a]	1,50 kN/m	ISO 8033
Adhesion of the cover, min.[a]	1,75 kN/m	ISO 8033
Ozone resistance of the cover	No cracks	ISO 7326:2006, method 1, using 100 phm ozone
Ammonia resistance tests:		
ammonia conditioning	No blistering, cracking or leakage	7.3.2
flexing	No blistering, cracking or leakage	7.3.3
minimum burst pressure after conditioning and flexing	125 bar (12,5 MPa)	ISO 1402 and 7.3.4
change in tensile strength of cover after conditioning and flexing, max.	± 20 %	ISO 37 and 7.3.5
change in elongation at break of cover after conditioning and flexing, max.	± 50 %	ISO 37 and 7.3.5

[a] Test pieces for adhesion testing shall be taken from hoses which have been conditioned for 30 days with ammonia as described in 7.3.2.

7.3 Ammonia resistance tests

WARNING — The operator in charge of the test installation and inspection shall ensure compliance with all safety precautions concerning the handling of ammonia.

7.3.1 Test lengths

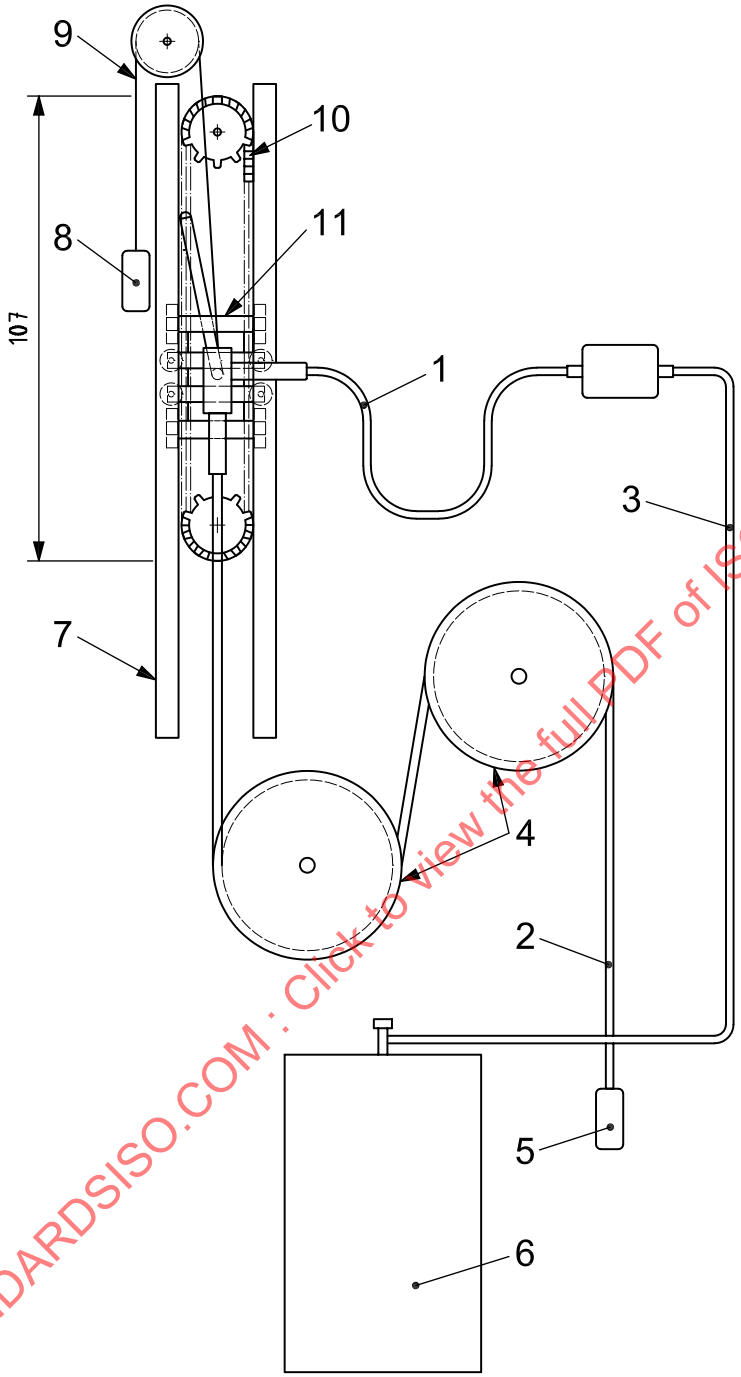
The total length of hose conditioned shall be sufficient to carry out the flexing, burst and physical-property tests in Table 4. The hose length required for flexing (hose B in Figure 1) will depend on the flex unit design and the hose size, but should preferably be from 3 m to 6,2 m. A test piece of length 600 mm is required for the burst test. The length of the feed hose (hose A in Figure 1) shall be 910 mm unless otherwise specified.

7.3.2 Ammonia conditioning

Fill a length or lengths of hose with liquid anhydrous ammonia by connection to a tank and flushing out with ammonia to remove all the air. Seal one end of each length and leave the other end connected to the liquid space of the tank of anhydrous ammonia. Condition the hose for 30 days in this way at standard laboratory temperature. Any valve between the ammonia tank and the hose may be closed, providing it is opened completely at least once each day to fill the hose with liquid anhydrous ammonia. If the hose is closed off by means of stop valves at each end when full of liquid, a hydrostatic relief valve should preferably be provided between the stop valves. Examine the hose each day for visible defects. There shall be no evidence of blistering of the cover or perceptible leakage. Upon completion of the 30 days conditioning, there shall be no evidence of blistering or cracking of the inside bore.

Upon completion of the 30 days conditioning, the adhesion values between all components of the hose shall meet the requirements in Table 4.

Dimensions in centimetres



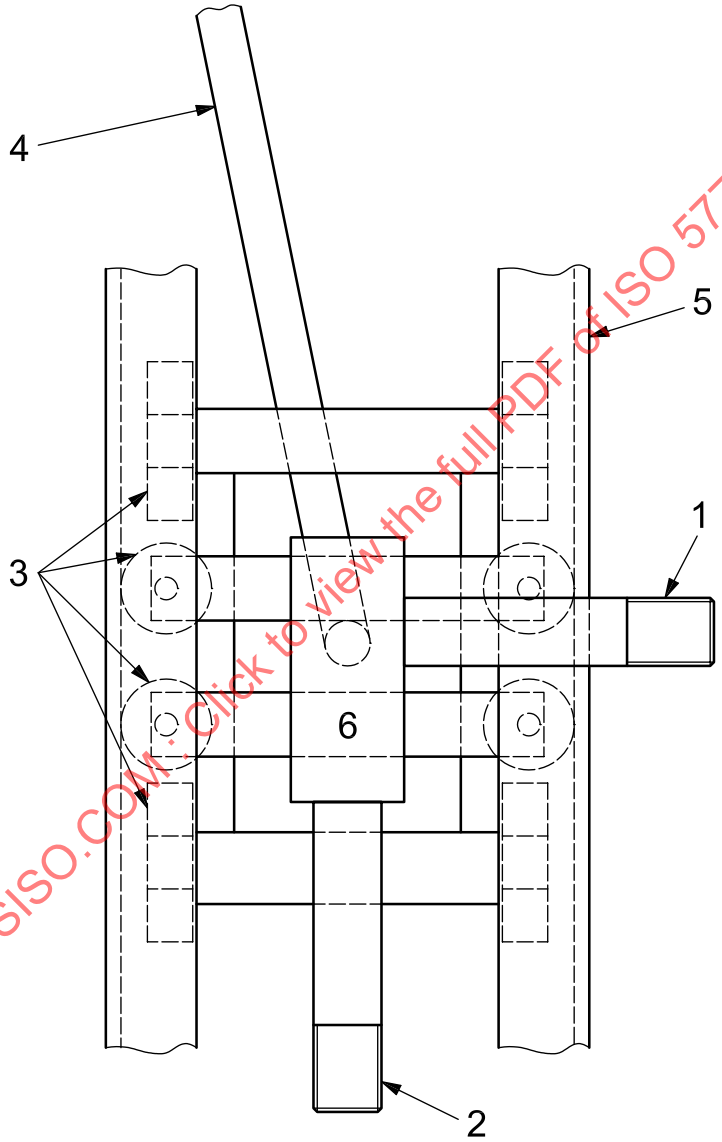
Key

1	hose A	5	weight	9	steel cable
2	hose B	6	water tank	10	chain, driven by electric motor
3	pipe	7	track	11	trolley (see detail in Figure 2)
4	pulleys	8	optional counterweight		

Figure 1 — Typical hose-flexing machine

7.3.3 Flexing of conditioned hose

Place a length of conditioned hose (see 7.3.2) in a flex-testing machine (hose B in Figure 1). Connect one end of the hose to the travelling block (see Figure 2) and pass the free end around two pulleys of the diameters shown in Table 5. Then attach to the free end a weight of just sufficient mass to cause the hose to conform to the circumference of the pulleys. This hose shall be long enough to prevent the weight on the free end from contacting the nearer of the two pulleys when the hose is pressurized and the travelling block is in the "up" position.



Key

1 connection for hose A
2 connection for hose B
3 ball bearings
4 rod attached to the chain
5 U-shaped track
6 travelling block

Figure 2 — Details of trolley and track

Place a 910 mm length of conditioned hose in the feeder line of the flex-testing machine (hose A in Figure 1). Connect one end to the vertical travelling block as shown in Figure 2 and connect the other end to a water source with pressure of 2,5 MPa.

Flexing shall begin within 6 h to 8 h of completion of the 30 day conditioning period.

Carry out the flexing for 72 h at a rate of approximately 0,13 Hz with a vertical movement of the travelling block of 1 m. Examine the hose each day for visible defects. There shall be no evidence of blistering, cracking or leakage.

Table 5 — Pulley diameters and feeder hose lengths for flexing

Hose size	Pulley diameter mm	Feeder hose length mm
12,5	350 ± 6,0	910
16	350 ± 6,0	910
19	350 ± 6,0	910
25	350 ± 6,0	910
31,5	350 ± 6,0	—[a]
38	460 ± 6,0	—[a]
51	610 ± 6,0	—[a]
64	760 ± 6,0	—[a]
76	920 ± 6,0	—[a]

[a] The test on the feeder hose does not apply to sizes over 25 mm. To conduct flexing on larger sizes, any convenient hose may be used as the feeder hose.

7.3.4 Burst-pressure test on conditioned and flexed hoses

At the conclusion of the flexing period, cut a 600 mm test piece from the middle of hose A and from the middle of hose B and subject each test piece to the hydrostatic burst test specified in ISO 1402. The minimum burst pressure shall be as required in Table 4.

7.3.5 Physical-property tests on conditioned and flexed hoses

Determine the physical properties as required in Table 4 on each flexed test piece in accordance with ISO 37.

8 Hose assembly delivery test and annual in-use test requirements

Hose assemblies shall be tested before delivery and during use in accordance with Table 6.

Table 6 — Delivery and annual proof-pressure testing requirements for hose assemblies

Proof-pressure test on hose assemblies	Requirement	Test method
Before delivery	63 bar (6,3 MPa)	ISO 1402
Annual in-use test	63 bar (6,3 MPa)	ISO 1402
NOTE The delivery test is designed to ensure that each hose assembly delivered meets the minimum proof-pressure requirement and the annual in-use test is designed to ensure that hose assemblies in use continue to meet this requirement.		

9 Frequency of testing

Type tests and routine tests shall be as specified in Annex A.

Type tests are those tests required to confirm that a particular hose design, manufactured by a particular process, meets all the requirements of this International Standard. The tests shall be repeated at maximum intervals of 5 years, or whenever a change in the method of manufacture or materials used occurs. They shall be performed on all sizes, and on all classes and types except those of the same construction and size.

Routine tests are those tests required to be carried out on each length of finished hose prior to dispatch.

Periodic tests are those tests, specified in Annex B, which should preferably be carried out to control the quality of manufacture. The frequencies specified in Annex B are given as a guide only.

Delivery tests are those tests required to be carried out on each hose or hose assembly delivered (see Table 6).

Annual tests are those tests required to be carried out on each hose assembly every 12 months while in use (see Table 6).

10 Marking

The hose shall be marked at least once every 1,5 m with the following information and with such additional information as may be agreed between manufacturer and purchaser:

a) the manufacturer's name or recognized symbol or trademark;

b) the number and year of publication of this International Standard, i.e. ISO 5771:2008;

c) the hose size, e.g. size 12,5;

d) the maximum working pressure, i.e. MWP 25 bar (2,5 MPa);

e) the quarter and last two digits of the year of manufacture, e.g. 3Q08;

f) the words: “Only for use with anhydrous ammonia”.

EXAMPLE MAN/ISO 5771:2008/size 12,5/MWP 25 bar (2,5 MPa)/3Q08/Only for use with anhydrous ammonia.

11 Packaging and storage

Recommendations for packaging and storage of hoses and hose assemblies are given in ISO 8331.

12 Test certificate

A test certificate giving the results of the type tests shall be supplied if requested.

Annex A
(normative)

Type and routine testing of production hoses and hose assemblies

Property	Type tests Frequency (for each hose size and type): at initial product qualification, in the event of product changes after initial qualification and after 5 years	Routine tests Performed on each length of finished hose prior to warehousing or sale
Visual examination	X	X
Dimensions		
Measurement of inside diameter (see Table 2)	X	X
Measurement of concentricity (see 6.3)	X	N/A
Measurement of lining thickness (see 5.1)	X	N/A
Hose tests		
Proof-pressure test (see Table 4)	X	X
Burst-pressure test (see Table 4)	X	N/A
Change in length test (see Table 4)	X	X
Ozone resistance test (see Table 4)	X	N/A
Low-temperature flexibility test (see Table 4)	X	N/A
Adhesion (cover) (see Table 4)	X	N/A
Adhesion (lining) (see Table 4)	X	N/A
Adhesion (reinforcement) (see Table 4)	X	N/A
Minimum tensile strength (lining and cover) (see Table 3)	X	N/A
Minimum elongation at break (lining and cover) (see Table 3)	X	N/A
Ammonia resistance tests (see 7.3 and Table 4)		
Burst-pressure test on both test pieces after conditioning and flexing	X	N/A
Maximum change in tensile strength after conditioning and flexing (lining and cover)	X	N/A
Maximum change in elongation at break after conditioning and flexing (lining and cover)	X	N/A
Accelerated ageing (cover) (see Table 3)		
Change in tensile strength	X	N/A
Change in elongation at break	X	N/A
Hose assembly delivery and annual in-use tests (see Table 6)		
Proof-pressure test prior to delivery and once each year during use	X	X

X = Test shall be carried out.

N/A = Test not applicable.