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Rubber and plastics hoses and hose assemblies, wire- or textile-reinforced, for water jetting or water blasting applications — Specification

Tuyaux et flexibles en caoutchouc et en plastique, à armature textile ou métallique, pour applications à jet d'eau à haute et ultra haute pression — Spécifications

Reference number
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Contents

Page

Foreword

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The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

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For an explanation on the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT) see the following URL: www.iso.org/iso/foreword.html

This document was prepared by Technical Committee ISO/TC 45, *Rubber and rubber products*, Subcommittee SC 1, *Rubber and plastics hoses and hose assemblies*.

Rubber and plastics hoses and hose assemblies, wire- or textile-reinforced, for water jetting or water blasting applications — Specification

1 Scope

This document specifies requirements for nine classes of reinforced hydraulic hoses and hose assemblies of nominal sizes ranging from 5 to 25. Each class has a single maximum working pressure. Such hoses and hose assemblies are intended to be used with very high-pressure water jetting and water blasting machines.

This document also reviews all the significant hazards, hazardous situations and events relevant to the equipment in the scope, when it is used as intended and under conditions of misuse which are reasonably foreseeable by the manufacturer.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements 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 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 6803, *Rubber or plastics hoses and hose assemblies — Hydraulic-pressure impulse test without flexing*

ISO 7326:2016, *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*

ISO 10619-1, *Rubber and plastics hoses and tubing — Measurement of flexibility and stiffness — Part 1: Bending tests at ambient temperature*

ISO 10619-2:2011, *Rubber and plastics hoses and tubing — Measurement of flexibility and stiffness — Part 2: Bending tests at sub-ambient temperatures*

ISO 12100, *Safety of machinery — General principles for design — Risk assessment and risk reduction*

3 Terms and definitions

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

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at http://www.iso.org/obp

— IEC Electropedia: available at http://www.electropedia.org/

4 List of significant hazards

4.1 General

This clause reviews some of the significant hazards, hazardous situations and events, identified by risk assessment as significant for hoses and hose assemblies, as far as they are dealt with in this document, and which require action to eliminate or reduce the risk.

4.2 Hazards due to bursting or leaking of hoses

Hazards can occur when a hose bursts or leaks. The escaping stream of liquid can cause personal injury or property damage. See Figure 1.

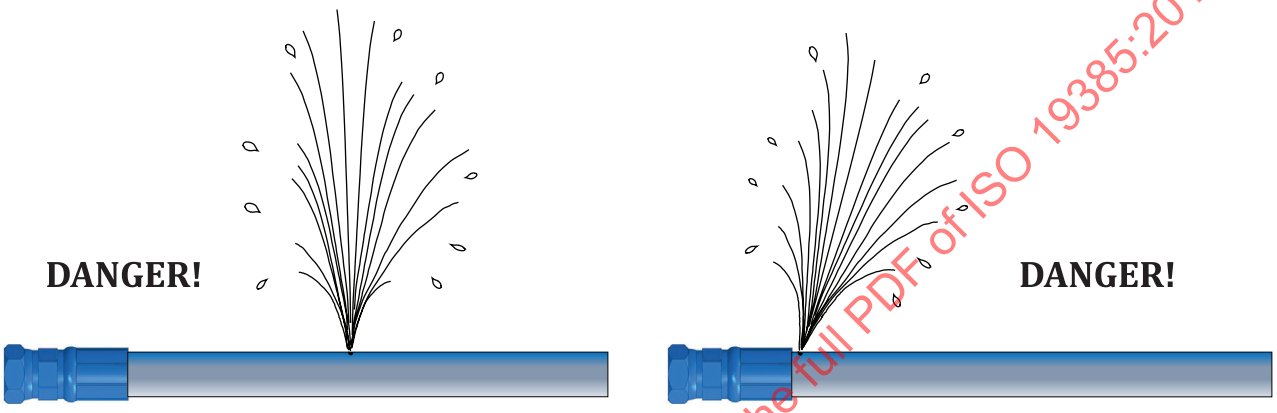


Figure 1 — Hazards due to bursting or leaking of hoses

4.3 Hazards due to failure of connectors

Hazards can occur when a connector fails. The escaping stream of liquid can cause physical damage and also a sudden repositioning of the hose assembly in a dangerous manner (whip). See Figure 2.

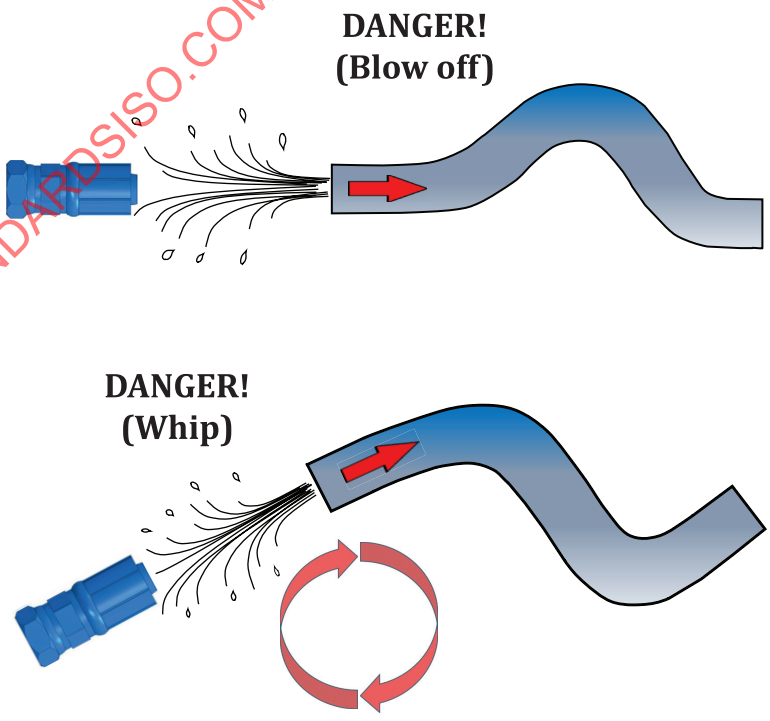


Figure 2 — Hazards due to failure of connectors

4.4 Hazards due to errors by the operator

Hazards can occur if the operator uses incompatible substances or incompatible components. Hazards can also occur if the operator exceeds the limits of use specified by the manufacturer (e.g. too high pressure, too high tensile stress), also pinhole caused by kink may result in a significant injury. See Figure 3.

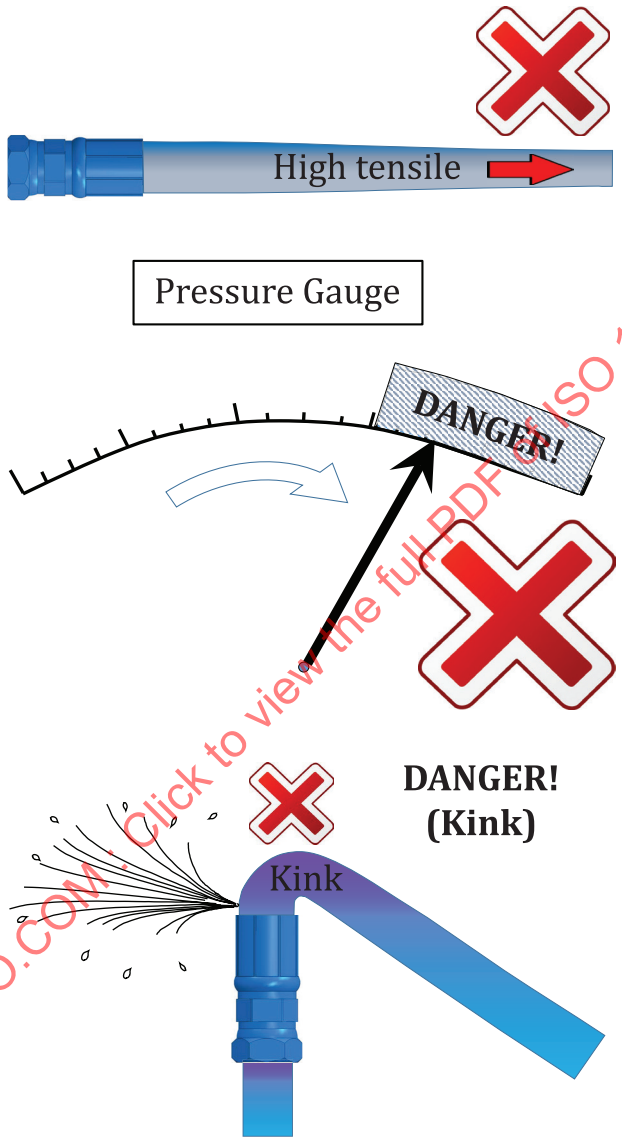


Figure 3 — Hazards due to errors by the operator

4.5 Hazards due to change in length of hose assembly

Hazardous situations occur when there is a sudden change of pressure in the hose assembly causing a change in length resulting in the operators losing their firm hold. See Figure 4.

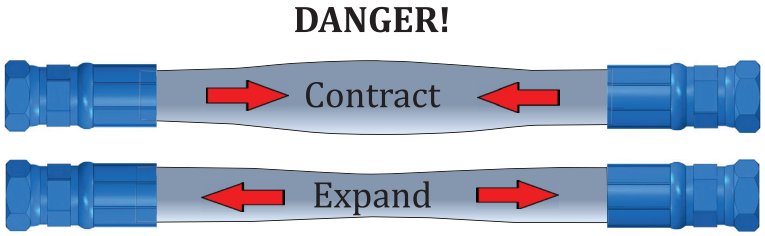


Figure 4 — Hazards due to change in length of hose assembly

5 Safety requirements and/or protective measures

5.1 General

Hoses, hose assemblies and their connectors shall comply with the safety requirements and/or protective measures of this clause. In addition, they shall be designed according to the principles of ISO 12100 for relevant but not significant hazards, which are not dealt with in this document.

Hoses, hose assemblies, and connectors shall feature a certain structure in order to guarantee safe operation when used properly. They must not bear any risks for the operator or for the workplace and its environment.

The design of any connector safety devices shall provide safe operational performance to eliminate any risk or hazard for the operator or their environment. However, improper use of a hose assembly or the connectors may result in hazardous situations and shall be avoided.

Correct assembly of hose assemblies requires specific knowledge and skills and also specific equipment.

5.2 Requirements for compatibility of components

The hoses and connectors combined to hose assemblies shall match each other in terms of structure, composition, and design.

NOTE Hoses of one manufacturer do not necessarily match connectors of another manufacturer.

5.3 Mechanical requirements

All components of a hose assembly as well as the connectors and the hose assembly itself shall not fail under the burst pressure specified by the manufacturer.

5.4 Requirements concerning the maximum working pressure for hose assemblies

For hose assemblies with maximum working pressure up to or equal to 3 000 bar the burst pressure shall be at least 2,5 times the maximum working pressure. For hose assemblies with maximum working pressure above 3 000 bar the burst pressure shall be at least two times the maximum working pressure (see also ISO 7751).

5.5 Thermal requirements

The hose assemblies shall be suitable for operating temperatures above –20 °C and below +70 °C.

5.6 Requirements for loosening connectors

Measures shall be taken against the hazards of unintentional loosening of connectors while the hose assembly is under pressure. One method is a design where the presence of pressure becomes apparent when starting loosening, for example by the use of swivel nuts with at least two axial relief bores.

If sufficient technical measures are not possible, the manufacturer shall provide appropriate warnings and instructions.

5.7 Requirements for connector safety devices

The need for connector safety devices to restrain movement of the hose assembly if the connector fails shall be defined on the basis of an assessment of the related risk, within the limits of the intended use of the machines the hose assemblies are intended for.

In particular, for applications with an input to the drive for the pressure generator exceeding 40 kW or a working pressure exceeding 500 bar the use of connector safety devices is mandatory for any place where significant presence of persons is foreseeable. Where technically not possible (e.g. pipe cleaning) alternative measures shall be considered and where necessary instructions shall be given in the information for use.

The fixing provisions of the connector safety devices shall be designed and constructed for withstanding the foreseeable mechanical constraints.

6 Classification

Nine classes of hose are specified, distinguished by their maximum working pressure, as shown in Table 1. Other pressure classes are acceptable as long as all performance requirements are met.

Table 1 — Classes and nominal sizes

Class	MPa	**70**	**100**	**110**	**125**	**140**	**200**	**250**	**300**	**400**
	bar	**700**	**1 000**	**1 100**	**1250**	**1 400**	**2 000**	**2 500**	**3 000**	**4 000**
Nominal size										
5		X	X	X	X	X	X	X	X	**X**
6,5		X	X	X	X	X	X	X	X	**X**
8		**X**	**X**	**X**	**X**	**X**	**X**	**N/A**	**N/A**	**N/A**
9,5		**X**	**X**	**X**	**X**	**X**	**N/A**	**N/A**	**N/A**	**N/A**
13		X	X	X	X	X	N/A	N/A	N/A	**N/A**
19		X	X	X	X	X	N/A	N/A	N/A	**N/A**
25		X	N/A	N/A	N/A	N/A	N/A	N/A	N/A	**N/A**

X = Applicable N/A = Not applicable

Other nominal sizes are acceptable as long as all performance requirements are met.

7 Materials and construction

7.1 Hoses

Hoses shall consist of a rubber or plastic lining, multiple layers of textile or steel wires and oil, abrasion and weather resistant rubber or plastic cover.

7.2 Hose assemblies

Hose assemblies shall only be manufactured using hose fittings which conform to the requirements of this document.

8 Dimensions and tolerances

8.1 Diameters

When measured in accordance with ISO 4671, the diameters of hoses shall conform to the values given in Table 2.

Table 2 — Diameters of hoses

Class	MPa		70	100	110	125	140	200	250	300	400
	bar		700	1 000	1 100	1 250	1 400	2 000	2 500	3 000	4 000
Nominal size		Inside diameter		Maximum outside diameter of hoses							
		min.	max.	max.	max.	max.	max.	max.	max.	max.	max.	max.
		mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm
5		4,6	5,4	15,0	15,0	16,0	16,0	18,0	20,0	20,0	22,0	22,0
6,5		6,1	7,0	18,0	20,0	20,0	21,0	21,0	22,0	24,0	26,0	26,0
8		7,5	8,5	20,0	23,0	23,0	23,0	23,0	24,0	26,0	N/A	N/A
9,5		9,3	10,1	23,0	26,0	26,0	26,0	26,0	28,0	28,0	N/A	N/A
13		12,3	13,5	28,0	29,0	29,0	31,0	31,0	N/A	N/A	N/A	N/A
19		18,6	19,8	35,0	35,0	38,0	38,0	38,0	N/A	N/A	N/A	N/A
25		25,0	26,4	44,0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

N/A = Not applicable

Other nominal sizes are acceptable as long as all performance requirements are met.

8.2 Concentricity

When measured in accordance with ISO 4671, the concentricity of hoses shall conform to the values given in Table 3.

Table 3 — Concentricity of hoses

Nominal size	Maximum variation in wall thickness	
	between internal diameter and outside diameter	between internal diameter and reinforced diameter
	mm	mm
3 and 6,5	0,8	0,5
Over 6,5 and up to and including 19	1	0,7
Over 19 and up to and including 25	1,3	0,9

9 Performance requirements

9.1 Hydrostatic requirements

The maximum working pressure, proof pressure and minimum burst pressure, according to ISO 1402, are given in Table 4.

Table 4 — Maximum working pressure, proof pressure and minimum burst pressure

Maximum working pressure		Proof pressure		Minimum burst pressure	
MPa	bar	MPa	bar	MPa	bar
70	700	105	1 050	175	1 750
100	1 000	150	1 500	250	2 500
110	1 100	165	1 650	275	2 750
125	1 250	187,5	1 875	312,5	3 125
140	1 400	210	2 100	350	3 500
200	2 000	300	3 000	500	5 000
250	2 500	375	3 750	625	6 250
300	3 000	450	4 500	600	6 000
400	**4 000**	**480**	**4 800**	**800**	**8 000**

9.2 Change in length

When determined in accordance with ISO 1402, the change in length of hoses at the maximum working pressure shall not exceed ± 2 %.

9.3 Minimum bending radius

When determined in accordance with ISO 10619-1, the minimum bend radius shall conform to the values given in Table 5.

When bent to a minimum bend radius given in Table 5 and measured on the inside of the bend, the flatness shall not exceed 10 % of the original outside diameter.

Table 5 — Minimum bending radius

Class	MPa	70	100	110	125	140	200	250	300	400
	bar	700	1 000	1 100	1 250	1 400	2 000	2 500	3 000	4 000
Nominal size										
5		100	100	130	150	180	200	250	450	600
6,5		150	180	200	230	250	270	300	480	700
8		180	200	230	250	280	300	350	N/A	N/A
9,5		180	200	230	270	300	320	400	N/A	N/A
13		200	230	250	280	300	N/A	N/A	N/A	N/A
19		220	280	280	300	350	N/A	N/A	N/A	N/A
25		350	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

N/A = Not applicable

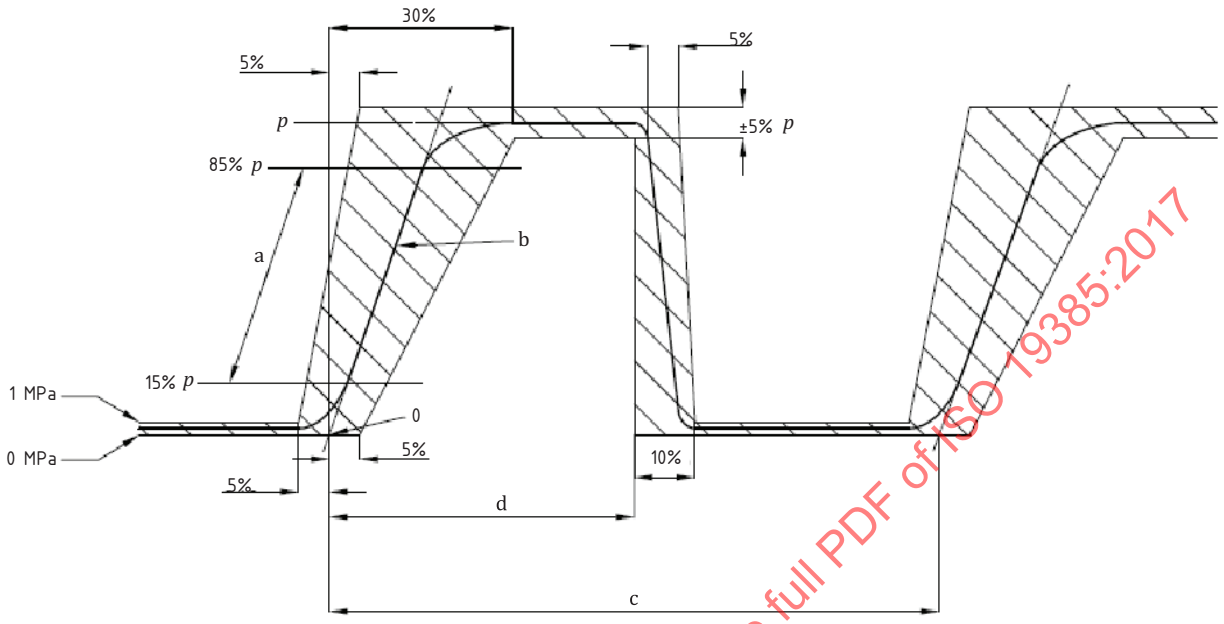
Other nominal sizes are acceptable as long as all performance requirements are met.

9.4 Cold flexibility

When tested in accordance with ISO 10619-2:2011, method B, at the temperature of –20 °C, there shall be no cracking of the lining or cover. The test piece shall not leak or crack when subjected to a proof pressure test in accordance with ISO 1402, after regaining ambient temperature.

9.5 Resistance to impulse

9.5.1 When tested in accordance with ISO 6803, the test fluid temperature shall be 70 °C. The pressure rise shall be contained within the wave form envelope as shown in Figure 5.



Key

p test pressure

a Rate of rise to be determined between these points.

b Secant pressure rise.

c One pulse cycle (0,2 Hz to 0,5 Hz).

d 45 % to 55 % of the cycle.

Figure 5 — Pressure pulse wave

9.5.2 When tested at impulse pressure equal to 100 % of the maximum working pressure, the hose assemblies shall withstand a minimum of 20 000 impulse cycles.

9.5.3 There shall be no leakage or other malfunction before reaching the specified number of cycles.

9.5.4 This test shall be considered a destructive test and the test piece shall be discarded.

9.6 Adhesion between components (only for rubber hoses and hose assemblies)

When tested in accordance with ISO 8033, the adhesion between lining and reinforcement, and between cover and reinforcement shall not be less than 2,0 kN/m.

9.7 Tensile test

The hose assemblies shall withstand a tensile force equivalent to that induced by minimum burst pressure.

9.8 Ozone resistance

When testing the outer cover of hoses in accordance with ISO 7326:2016, method 1 or 2, no cracking or deterioration of the cover shall be visible under ×2 magnification.

9.9 Abrasion test

Abrasion test is to be specified in ISO 20444.[1)]

9.10 Proof pressure hold test

Each hose assembly manufactured shall be subject to a proof pressure hold test in accordance with ISO 1402 for not less than 1 min. The test pressure shall be 1,5 times (above 3 000 bar 1,2 times) the maximum working pressure.

10 Frequency of testing

The minimum frequency of testing shall conform to the schedule given in Annex A.

Type testing is carried out in order to confirm that all the material, construction and test requirements specified in this document have been met by the method of manufacture and the hose design. Type testing shall be repeated at intervals of, at the most, five years, or whenever a change in the method of manufacture or the materials occurs, and shall be performed on the largest-diameter hose of each design in the manufacturer's range for each type.

Routine tests are those tests carried out on each length of finished hose or hose assembly.

Production tests are those tests carried out per batch. Schedule given in Annex B is for guidance only.

11 Marking

11.1 Hoses

Hoses shall be marked permanently and indelibly with at least the following information and the marking shall be repeated every 500 mm or less:

a) the manufacturer's name or identification, e.g. XXX;

b) the reference of this document, i.e. ISO 19385;

c) nominal size, e.g. 13;

d) maximum working pressure in megapascals and in bars, or in either, with units indicated, e.g. 70 MPa (700 bar);

e) quarter and last two digits of year of manufacture, e.g. 2Q17.

For item b), the hose manufacturer shall use the latest edition of this document, otherwise the year of publication shall be included in the marking.

EXAMPLE XXX/ISO 19385/13/70 MPa (700 bar)/2Q17

11.2 Hose assemblies

Hose assemblies shall be marked preferably at the coupling with at least the following information:

a) the manufacturer's name or identification, e.g. XXX;

1) Under preparation.

b) maximum working pressure of the assemblies, in megapascals and in bar, or in either, with units indicated, e.g. 70 MPa (700 bar);

c) month and last two digits of year of assembly, e.g. 02/15.

EXAMPLE XXX/70 MPa (700 bar)/02/15

If the maximum working pressure of the hose assembly is less than the maximum working pressure of the hose, the hose assembly shall be additionally marked or labelled with the safety sign ISO 7010–W001 (see Figure 6) together with the maximum working pressure of the hose assembly.

NOTE Possible information carriers for hose assemblies are shrink sleeves, embossing sleeves, revenue stamps, etc.

Figure 6 — General warning sign according to ISO 7010

12 Test report

When requested by the purchaser, the manufacture or supplier will supply a test report representing the purchased product (each length or batch of hoses).

13 Recommendations for packaging and storage

These are given in ISO 8331.

