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**Pipework — Corrugated metal hoses and  
hose assemblies**

*Tuyauteries — Tuyaux et tuyauteries métalliques flexibles onduleux*

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## 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 10380 was prepared by the European Committee for Standardization (CEN) Technical Committee CEN/TC 342, *Metal hoses, hose assemblies, bellows and expansion joints*, in collaboration with ISO Technical Committee TC 5, *Ferrous metal pipes and metallic fittings*, Subcommittee SC 11, *Metal hoses and expansion joints*, in accordance with the Agreement on technical cooperation between ISO and CEN (Vienna Agreement).

This third edition cancels and replaces the second edition (ISO 10380:2003), which has been technically revised.

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## Introduction

It was decided to produce an International Standard under the Vienna Agreement on technical cooperation between ISO and the European Committee for Standardization (CEN) in order to maintain a unique EN ISO document.

The major changes in this revision of this International Standard are the following:

- update of the structure of the International Standard;
- update of the test and performance requirements to reflect the practice of the industry at the time of publication;
- introduction of an evaluation of conformity and a system of certification.

This International Standard is a base standard for corrugated metal hoses and hose assemblies for general purpose.

Corrugated metal hoses and metal hose assemblies conforming to all aspects of this International Standard are considered to be designed and manufactured to sound engineering practice.

The requirements of this International Standard are of importance to designers, manufacturers, users, suppliers and importers of corrugated metal hoses.

Non-permanent, detachable connections between hoses and fittings are available in the market. Their design is not covered by this International Standard.

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# Pipework — Corrugated metal hoses and hose assemblies

## 1 Scope

This International Standard specifies the minimum requirements for the design, manufacture, testing and installation of corrugated metal hose and metal 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 6208, *Nickel and nickel alloy plate, sheet and strip*

ISO 9328-7, *Steel flat products for pressure purposes — Technical delivery conditions — Part 7: Stainless steels*

ISO 9723, *Nickel and nickel alloy bars*

ISO 9724, *Nickel and nickel alloy wire and drawing stock*

ISO 13585, *Brazing — Qualification test of brazers and brazing operators*

ISO 15614-1, *Specification and qualification of welding procedures for metallic materials — Welding procedure test — Part 1: Arc and gas welding of steels and arc welding of nickel and nickel alloys*

ISO 16143-3, *Stainless steels for general purposes — Part 3: Wire*

EN 287-1, *Qualification test of welders — Fusion welding — Part 1: Steels*

EN 1652, *Copper and copper alloys - Plate, sheet, strip and circles for general purposes*

EN 1779, *Non-destructive testing — Leak testing — Criteria for method and technique selection*

EN 10028-7, *Flat products made of steels for pressure purposes — Part 7: Stainless steels*

EN 10088-1, *Stainless steels — Part 1: List of stainless steels*

EN 10088-3, *Stainless steels — Part 3: Technical delivery conditions for semi-finished products, bars, rods, wire, sections and bright products of corrosion resisting steels for general purposes*

EN 10204, *Metallic products — Types of inspection documents*

EN 13133, *Brazing — Brazer approval*

## 3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

### 3.1

#### **corrugated metal hose**

pressure-tight hose made from tube or from strip, with corrugations, helical or annular to the axis of the hose, made by deforming the metal, its flexibility being obtained by bending the corrugations

NOTE 1 Classified by material, DN, PS at 20° C, bend radius and lifetime.

NOTE 2 In this International Standard, helical is designated “h” and annular is designated “a”.

**3.2**  
**nominal size**  
**DN**

<for components of a pipework system> alphanumeric designation of size comprising the letters DN followed by a dimensionless whole number which is indirectly related to the physical size, in millimetres, of the bore or the outside diameter of the end connections, and is used as a reference

NOTE 1 This defined number does not represent a measurable value and cannot be used for calculation purposes except where specified in the relevant standard.

NOTE 2 Adapted from ISO 6708.

NOTE 3 Adapted from ISO 7369:2004, definition 4.1.5.

**3.3**  
**strand**

group of parallel wires that are woven together to form a single layer of braid

**3.4**  
**braid pitch**

distance measured parallel to the axis of the braid for one complete turn or revolution of a strand

**3.5**  
**braided braid**

braid that is manufactured from previously braided strands

**3.6**  
**metal hose assembly**

assembly of a corrugated metal hose with its end fittings subjected to internal or external pressure

See Figure 1.

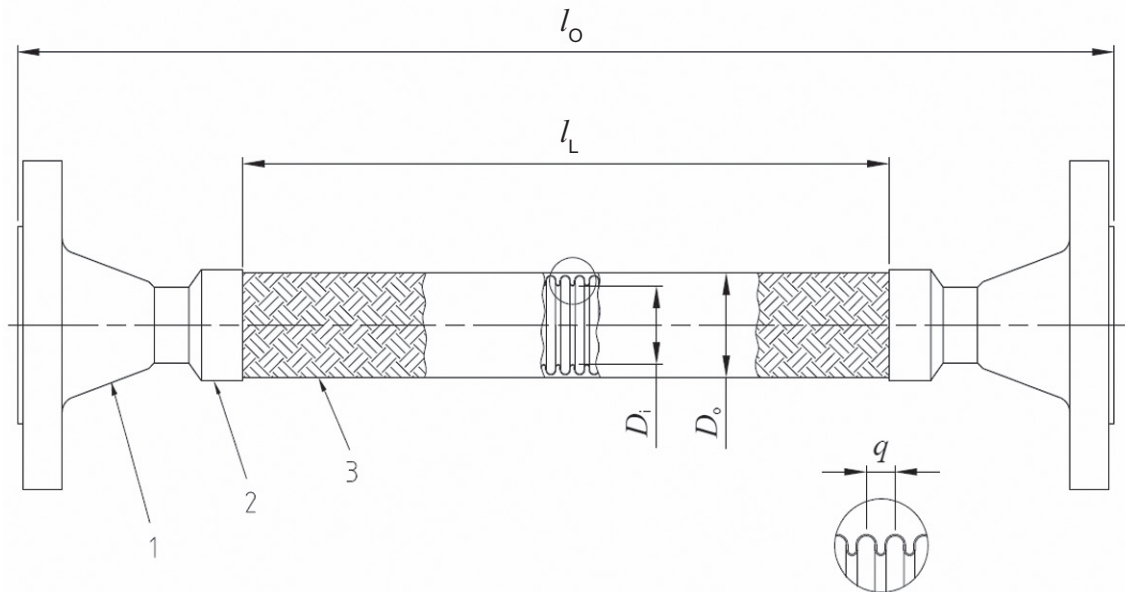
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**Key**

- 1 end fitting
- 2 ferrule
- 3 corrugated metal hose/braid
- $D_i$  internal diameter
- $D_o$  outside diameter
- $l_L$  active live length
- $l_o$  overall length
- $q$  pitch of the hose profile

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**Figure 1 — Metal hose assembly**

**3.7****nominal pressure****PN**

numerical designation which is a convenient rounded number for reference purposes

[ISO 7369:2004, definition 3.3]

NOTE 1 This defined number is a dimensionless number indirectly related to a pressure value in bar(s).

NOTE 2 Adapted from ISO 7268. See EN 1333.

**3.8****maximum allowable pressure****PS**

$p_s$

maximum pressure at the operating temperature for which the hose assembly is designed, as specified by the manufacturer

**3.9****operating temperature****TS**

extreme operating temperature, positive or negative, for which the hose assembly is designed

**3.10**  
**active live length**

$l_L$   
corrugated metal hose length to be taken into account for the design of the hose assemblies subjected to repeated movements

**3.11**  
**type testing**

group of tests to be performed in order to verify that the performance level of the product meets the requirements of a standard

**3.12**  
**qualified procedure**

manufacturing and design process demonstrated by tests and described in detail in process instructions for the specific manufacturing or design

NOTE For products subject to specific quality surveillance systems, such procedures can be qualified by the required authorities or person.

**3.13**  
**third-party conformity assessment activity**

conformity valuation activity that is performed by a person or body independent of the person or organization who/which provides the object, and independent of user interests in that object

NOTE 1 Criteria for the independence of conformity assessment bodies and accreditation bodies are provided in the International Standards and Guides applicable to their activities.

NOTE 2 The first-, second- and third-party descriptors used to characterize conformity assessment activities with respect to a given object are not to be confused with the legal identification of the relevant parties to a contract.

**3.14**  
**certification**

third-party attestation related to products, processes, systems or persons

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NOTE 1 Certification of a management system is sometimes also called registration.

NOTE 2 Certification is applicable to all objects of conformity assessment except for conformity assessment bodies themselves, to which accreditation is applicable.

**3.15**  
**test pressure**

$P_T$   
differential pressure to which the hose assembly or the component is subjected during a test at ambient temperature

NOTE Adapted from ISO 7369:2004, definition 3.8.

**3.16**  
**manufacturer**

producer of corrugated metal hose or producer of corrugated metal hose and metal hose assemblies

**3.17**  
**assembler**

fabricator of metal hose assemblies with corrugated metal hose purchased from manufacturers

## 4 Design requirements

### 4.1 General

Corrugated metal hoses, braided or unbraided, and their assemblies are designed to allow frequent movement or pliability.

These design requirements shall ensure that the construction of corrugated metal hoses, where properly installed and used correctly, under chemical, mechanical and thermal conditions for general use, provide long-term safe operation without degradation.

Corrugated metal hoses are divided into the following four different types (see Table 7) and tested accordingly, as described in Clause 5:

- type 1-50: corrugated metal hoses of high flexibility with high fatigue life;
- type 1-10: corrugated metal hoses of high flexibility with medium fatigue life;
- type 2-10: corrugated metal hoses of average flexibility;
- type 3: corrugated metal hoses where only pliability is required.

Corresponding radii for pliability tests are given in Table 6 and corresponding radii for fatigue tests are given in Table 8.

NOTE 1 The fatigue life of a corrugated metal hose is mainly affected by bend radius, pressure and temperature:

- at a given bend radius, fatigue life increases by lowering the working pressure;
- at a given working pressure, fatigue life increases by increasing the bend radius.

NOTE 2 Passing a test does not imply that the minimum or average fatigue life can be reached in circumstances other than those specified in the test procedure.

NOTE 3 Where a user requires a higher fatigue life than given in this International Standard, the manufacturer can be consulted.

NOTE 4 The installation configuration, such as type of movement, pressure characteristics and environmental condition, have a strong influence on the fatigue life of a corrugated metal hose assembly.

NOTE 5 The lubrication condition of the braid influences the fatigue life of a corrugated metal hose. A reduction of lubrication can occur during assembly, cleaning, transportation, storage or in service conditions.

## 4.2 Nominal sizes, DN

The designation of standard nominal sizes shall be as given in Table 1. The internal diameter of a corrugated metal hose shall not be less than 98 % of its nominal size designation.

**Table 1 — Nominal sizes, DN**

DN
4
6
8
10
12
15
20
25
32
40
50
65
80
100

Table 1 (continued)

DN
125
150
200
250
300

Other nominal sizes can be produced in accordance with the customer's requirements. Their performance (see Clause 5) should be interpolated from the values for the nearest nominal sizes, as given in Table 1.

**4.3 Overall length,  $l_O$**

If not explicitly otherwise specified between the manufacturer and purchaser, the overall length,  $l_O$ , of a metal hose assembly shall be the length as ordered to a tolerance of +3 % and -1 %.

For short hose assemblies, these tolerances do not apply because often a tolerance of one corrugation is necessary, depending on the attachment technology of fittings. On no account shall the overall length be less than 99 % of the length as ordered.

NOTE For minimum overall length of a braided hose assembly, see 4.6.

**4.4 Hose design**

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The corrugated metal hose shall 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 axial or spiral along the length of the hose and in accordance with qualified welding and forming procedures. Corrugations may be annular or helical.

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The corrugation shall be of regular form, continuous and concentric along the length of the hose, and shall be free of defects, such as scores, dents, cuts or weld variations, which can cause premature failure. Where required, a hose can be heat treated after forming.

NOTE Heat treatment influences flexibility, fatigue life and pressure-bearing capacity. It is, therefore, necessary for the manufacturer to provide details on the characteristics affected by this type of treatment.

**4.5 Materials**

Materials for the manufacture of corrugated metal hoses and metal hose assemblies shall be selected on the basis of their suitability for fabrication (cold forming, welding, etc.) and for the conditions under which they shall be used. A list of suitable materials is given in Table 2.

Alternative equivalent European material designations are given in Table A.3.

Table 2 — Materials

Material of construction	Corrugated metal hose	Braid	End fitting <sup>a</sup> and ferrule
Stainless steel hose assemblies	Austenitic stainless steel in accordance with ISO 9328-7, grades X2CrNi19-11, X6CrNiTi18-10, X2CrNiMo17-12-2, X5CrNiMo17-12-2, X6CrNiMoTi17-12-2, X2CrNiMo18-14-3, X1CrNiMoCuN20-18-7 and X1NiCrMoCu25-20-5	Austenitic stainless steel in accordance with ISO 16143-3, grades X2CrNi19-11, X5CrNi18-9, X6CrNiTi18-10, X2CrNiMo17-12-2, X5CrNiMo17-12-2 and X6CrNiMoTi17-12-2	Austenitic stainless steel in accordance with the composition given in ISO 9328-7, grades X2CrNi19-11, X5CrNi18-9, X6CrNiTi18-10, X2CrNiMo17-12-2, X5CrNiMo17-12-2 and X6CrNiMoTi17-12-2  Carbon steel containing a maximum of 0,05 % sulfur and 0,05 % phosphorus <sup>b</sup>  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.
Nickel alloy hose assemblies	Nickel alloy strip in accordance with ISO 6208, grades NiMo16Cr15Fe6W4, NiCu30, NiCr15Fe8, NiCr22Mo9Nb, FeNi32Cr21AlTi and NiFe30Cr21Mo3	Austenitic stainless steel in accordance with ISO 16143-3, grades X2CrNi19-11, X5CrNi18-9, X6CrNiTi18-10, X2CrNiMo17-12-2, X5CrNiMo17-12-2 and X6CrNiMoTi17-12-2  Nickel alloy wire in accordance with ISO 9724, grades NiMo16Cr15Fe6W4, NiCu30, NiCr15Fe8, NiCr22Mo9Nb, FeNi32Cr21AlTi and NiFe30Cr21Mo3	Austenitic stainless steel in accordance with the composition of ISO 9328-7, grades X2CrNi19-11, X5CrNi18-9, X6CrNiTi18-10, X2CrNiMo17-12-2, X5CrNiMo17-12-2 and X6CrNiMoTi17-12-2  Nickel alloy bar in accordance with ISO 9723, grades NiMo16Cr15Fe6W4, NiCu30, NiCr15Fe8, NiCr22Mo9Nb, FeNi32Cr21AlTi and NiFe30Cr21Mo3

<sup>a</sup> The material specified for end fittings applies only to the parts which are welded or brazed to the hose.

<sup>b</sup> Carbon steel shall not be used for ferrules.

#### 4.6 Braiding

Where braided, the corrugated metal hose shall be uniformly covered by wire, either machine-woven around the hose or tightly fitted by hand as a stocking.

Where the braid (see Figure 2) is fitted by hand as a stocking, suitable design and manufacturing measures shall be taken to fit the braid as tightly as possible. However, the performance level of such a braid can still be different from that of a machine-woven braid around the hose. In addition, if machine and hand-fitted braiding are used on the same assembly (double braiding), special care shall be taken regarding the performance of such a combination. Therefore, the performance level shall be verified.

Braid irregularities, such as wire crossings and wire loops, can have an influence on the performance of the product. The manufacturer shall take care to limit such features.

The wires of a strand should all have a similar tension.

The practical burst strength also depends on the method used to attach the braiding to the end fittings and shall be established by burst tests, as described in 5.5.

Braided braid shall be considered appropriate for the large nominal sizes and heavy-duty applications.