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Pipework — Corrugated metal hose assemblies for combustible gas — Performance requirements, testing and marking

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National foreword

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The UK participation in its preparation was entrusted to Technical Committee GSE/42, Gas fittings and connections including metal hose and hose assemblies.

A list of organizations represented on this committee can be obtained on request to its secretary.

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Foreword

This document (EN 16617:2015) has been prepared by Technical Committee CEN/TC 342 “Metal hoses, hose assemblies, bellows and expansion joints”, the secretariat of which is held by SNV.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by October 2015, and conflicting national standards shall be withdrawn at the latest by October 2015.

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1 Scope

This European Standard specifies general requirements for material, design, manufacture, testing, marking and documentation of corrugated metal hose assemblies for gas of diameter up to DN 300 for gases of the 2nd and 3rd families according to EN 437.

This European Standard applies to:

Corrugated metal hose assemblies for gas for the supply of combustible gas and having a maximum operating pressure (MOP) less than or equal to 16 bar.

This European Standard does not apply to:

— corrugated metal hose assemblies for gas for engines including turbines and internal combustion engines as stated by Pressure Equipment Directive 97/23/EC;

— corrugated metal hose assemblies for the connection of domestic appliances using gaseous fuels according to EN 14800;

— corrugated metal hose assemblies for gas buried in earth;

— corrugated metal hose assemblies with non–permanent detachable end fittings;

— stainless steel pliable corrugated tubing kits in buildings for gas with an operating pressure up to 0,5 bar (EN 15266).

Users of this European Standard should take into account national standards and existing code of practice in the country of destination.

2 Normative references

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

EN 437, *Test gases — Test pressures — Appliance categories*

EN 549, *Rubber materials for seals and diaphragms for gas appliances and gas equipment*

EN 682, *Elastomeric Seals — Materials requirements for seals used in pipes and fittings carrying gas and hydrocarbon fluids*

EN 1562, *Founding — Malleable cast irons*

EN 1775:2007, *Gas supply — Gas pipework for buildings — Maximum operating pressure less than or equal to 5 bar - Functional recommendations*

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 10088-3, *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 10242, *Threaded pipe fitting in malleable cast iron*

EN 12163, *Copper and copper alloys — Rod for general purposes*

EN 12166, *Copper and copper alloys — Wire for general purposes*

EN 12168, *Copper and copper alloys — Hollow rod for free machining purposes*

EN 14800, *Corrugated safety metal hose assemblies for the connection of domestic appliances using gaseous fuels*

EN ISO 6708:1995, *Pipework components — Definition and selection of DN (nominal size) (ISO 6708:1995)*

EN ISO 7369:2004, *Pipework — Metal hoses and hose assemblies — Vocabulary (ISO 7369:2004)*

EN ISO 10380:2012, *Pipework — Corrugated metal hoses and hose assemblies (ISO 10380:2012)*

3 Terms and definitions

For the purpose of this document, the following terms and definitions apply:

3.1
corrugated metal hose
pressure-tight hose made from tube or from welded strip with corrugations, helicoidal or annular to the axis of the hose, made by deforming the metal

[SOURCE: EN ISO 7369:2004, 3.1.2]

3.2
braid
tubular woven stocking of metal wires used to provide pressure strength and/or external protection

[SOURCE: EN ISO 7369:2004, 4.1.9]

3.3
end fittings
non-detachable part which is permanently attached to the end of the corrugated metal hose and if relevant to the braid and which ensures a workable connection to the pipe system, so as to ensure that it cannot be detached without destruction or alteration of the corrugated metal gas hose assembly

3.4
corrugated metal gas hose assembly
element of flexible pipe-work consisting of a corrugated metal hose, with braid if required, its end fittings with appropriate gaskets if any and, if required, an external protection

3.5
external protection
outer cover used to protect the corrugated metal hose assembly against environmental and other outside influences

3.6
nominal length
length, including end fittings of the straightened-out hose assembly, unless otherwise specified

[SOURCE: EN ISO 7369:2004, 4.2.1]

3.7
minimum bending radius
radius measured to the centre line of the hose axis at which the corrugated metal gas hose assembly is designed to operate

3.8
gasket
component assuring leak-tightness between two adjacent elements

3.9
gas
second and third family gas which are commonly referred to as natural gases or liquefied petroleum gases (LPG)

[SOURCE: EN 437]

3.10
maximum operating pressure
MOP
maximum pressure for which the corrugated metal gas hose assembly can be operated under working conditions

3.11
DN
(for components of a pipework system) alphanumeric designation of size comprising the letters DN followed by a dimensionless whole number that is indirectly related to the physical size, in millimetres, of the bore, and is used as a reference

Note 1 to entry: This defined number does not represent a measurable value and should not be used for calculation purposes except where specified in the relevant standard.

[SOURCE: EN ISO 6708:1995 and EN ISO 7369:2004, 4.1.5]

4 Design requirements

4.1 General

Corrugated metal hose assemblies for gas, braided or unbraided, are designed to allow frequent movement.

These design requirements shall ensure that the construction of corrugated metal hose assemblies for gas, when properly installed and correctly used, under normal chemical, mechanical and thermal conditions will provide long term safe operation without degradation.

For temperature above 50 °C care shall be taken to apply a derating factors given in EN ISO 10380.

Corrugated metal hose assemblies for gas are classified according to EN ISO 10380:2012, 4.1:

— Type 1-50: corrugated metal hoses of high flexibility with high fatigue life;

— Type 1-10: corrugated metal hoses of high flexibility with standard fatigue life;

— Type 2-10: corrugated metal hoses of normal flexibility.

Corresponding type test radii for Type 1-50, Type 1-10 and Type 2-10 are given in EN ISO 10380:2012, Table 8 (including the notes).

The performance requirements of the tests described in Annex A (normative) shall apply.

4.2 Nominal size (DN)

4.2.1 General

The standard nominal sizes designation shall be as given in EN ISO 10380:2012, 4.2.

4.2.2 Overall length (l_O)

The tolerances of EN ISO 10380:2012, 4.3, shall apply.

The maximum overall length of the corrugated metal hose assemblies for gas is subject to national requirements if any.

4.3 Materials

4.3.1 General

Materials for the manufacture of a corrugated metal hose assembly for gas shall be selected from Table 1 and their related suitability for fabrication, e.g. welding, cold forming, etc, as appropriate and the conditions under which they will be used.

4.3.2 Metal hose, braid, end fittings and ferrules

4.3.2.1 General

The materials used for metal hose, braid, end fittings and ferrules shall be selected from Table 1.

Table 1 — Materials

Materials	Hose		Braid		End fittings [a] and ferrules	
Corrugated metal hose	**Stainless steels according to EN 10028–7**		**Stainless steels according to EN 10088–3**		**Stainless steels according to EN 10088–3**	
	Steel grade	**Steel number**	**Steel grade**	**Steel number**	**Steel grade**	**Steel number**
	X2CrNi 19–11	1.4306	X5CrNi 18–10	1.4301	X5CrNi 18–10	1.4301
	X6CrNiTi 18–10	1.4541	X2CrNi 19–11	1.4306	X2CrNi 19–11	1.4306
	X2CrNiMo 17–12–2	1.4404	X6CrNiTi 18–10	1.4541	X6CrNiTi 18–10	1.4541
	X2CrNiMo 18–14–3	1.4435	X2CrNiMo 17–12–2	1.4404	X2CrNiMo 17–12–2	1.4404
	X5CrNiMo 17–12–2	1.4401	X2CrNiMo 18–14–3	1.4435	X2CrNiMo 18–14–3	1.4435
	X6CrNiMoTi 17–12–2	1.4571	X5CrNiMo 17–12–2	1.4401	X5CrNiMo 17–12–2	1.4401
			X6CrNiMoTi 17–12–2	1.4571	X6CrNiMoTi 17–12–2	1.4571
					Carbon steel containing a maximum of 0,05 % sulfur and 0,05 % phosphorus [b]	
					Copper alloys according to EN 12163 to EN 12168 except for EN 12166 (copper wire)	
					Copper grade	Number
					CuZn39Pb2	CW612N
					CuZn39Pb3	CW614N
					CuZn40Pb2	CW617N
					Malleable cast iron for threaded end fittings according to EN 10242. Material shall be according to EN 1562. Malleable cast iron parts shall be made weldable by multiple tempering. The carbon content of the welding zones shall not exceed 0,3 %.	

[a] The material specified for end fittings applies only to the parts which are welded or brazed to the hose.

[b] Carbon steel shall not be used for ferrules.

4.3.2.2 Corrosion

Where the combination of a corrosive agent (e.g. sulfur) and humidity increases the risk of corrosion, the material shall be selected as a minimum in the corrosion resistance class B as given in Table 2.

Table 2 — Typical classification of materials for corrosion resistance

Corrosion resistance class	Description	Material grade	Examples
A	Basic corrosion resistance	Stainless steels	X2CrNi19–11
B	Good corrosion resistance	Mo-alloyed stainless steels	X2CrNiMo17–12–2
C	Advanced corrosion resistance	Super-alloyed stainless steels	X1CrNiMoCuN20–18–7
D	High corrosion resistance	Ni-based alloys	NiCr22Mo9Nb (NW 6625)

4.3.3 Braid

The requirements of EN ISO 10380:2012, 4.6 shall apply.

4.3.4 Gaskets

Where non-metallic gaskets are used in the hose assembly or to connect to a matching part they shall comply with EN 549 or EN 682.

4.4 Attachment of end fittings to the corrugated metal hose for gas with or without braid

Attachment of the end fittings to the corrugated metal hose with or without braid shall be made by welding or brazing. All joining methods used in the manufacturing of corrugated hose assemblies for gas shall be qualified.

The requirements of EN ISO 10380:2012, 4.15 shall apply.

NOTE Other types of technologies such as form fitting joints completely assembled could be used providing that the fittings are permanently attached.

4.5 External protection

Where necessary, an external protection can be used to protect the corrugated metal hose assembly against environmental and other outside influences.

Where additional external protection affects the bend radii given in EN ISO 10380:2012, Table 6, or negatively influences the dynamic life expectancy of the corrugated metal hose assembly, it shall be specified in the instructions.

Where an external protection is used on a corrugated metal hose assembly, it shall not contain zinc, lead or tin.

If the material of a synthetic cover contains corrosive agents as ingredients, such as sulfur or chlorine, care shall be taken to ensure that such agents are not released during the manufacturing process or in the working conditions.

The external protection shall not contribute to the achievement of a given leakage rate.

4.6 End fittings

Where applicable, the flow direction shall be identified.

The design of the corrugated metal hose assembly for gas shall be such that no torsion can occur during installation and operation. At least one of the end fitting shall be designed with a swivelling connection.

4.7 Electrical conductivity

The requirements of EN ISO 10380:2012, 4.11 shall apply.

4.8 Hose joining

Where a manufacturer uses hose joints in order to increase the hose length, such joints shall be conform to EN ISO 10380:2012, 4.14.

4.9 Flow velocity

Flow velocity shall be considered in the design of a corrugated metal hose assembly for gas.

NOTE High velocities may force the corrugations into resonant vibration resulting in premature failure. Such failure may be prevented by the use of an internal liner or change of the nominal size DN. The critical speed may start from 30 m/s. For higher values it is advised to consult the manufacturer.

4.10 Cleanliness

Hoses and hose assemblies shall be supplied to the purchaser free of water and substantially free of visible residues on inner and outer surfaces.

NOTE 1 Free of visible residues corresponds to less than of 500 mg/m^2.

NOTE 2 A more stringent cleanliness level may be required dependant on the application.

Water used for cleaning procedures shall contain a maximum chlorine level of 0,003 %.

5 Performance requirements and tests

5.1 General

The following tests are designed to establish minimum requirements of corrugated metal hose assemblies for gas (type testing).

The manufacturer shall record all the relevant data and to keep a full documentation of the type testing procedures and corresponding test results for a minimum of 10 years.

The tolerances indicated in the Table 3 shall apply to the tests and the test equipment:

Table 3 — Tolerances

Air pressure	± 5 %;
Ambient temperature	± 5 °C;
Volume	± 5 %;
Time	± 5 %.

5.2 Pressure resistance

5.2.1 Requirements

Each corrugated metal hose assembly for gas with or without braid shall be capable to withstand the test pressure, given in 5.2.2, without any visually recognizable deformations, leakage or other mode of failure.

5.2.2 Test

The test pressure shall be made accordingly to EN ISO 10380:2012, 5.3.

If the test is performed with air or nitrogen under water, the leakage test 5.3 and this pressure resistance test can be combined.

NOTE 1 Attention is drawn to the need to control the chloride content of the water used for hydraulic tests on stainless steel to below 30 mg/l.

NOTE 2 This test can be combined with the elongation test (5.5).

5.3 Leak-tightness

5.3.1 Requirement

Each corrugated metal hose assembly for gas shall be leak-tight when tested in accordance with the methods given in 5.3.2.

A corrugated metal hose assembly for gas shall be deemed tight if the leakage value is equal to or lower than 10^{-3} mbar·l/s.

5.3.2 Test

The leakage test shall be performed with one of the test methods in accordance with EN 1779.

During the leakage test the external protection, if any, shall not contribute to the achievement of the above leakage rate.

The test conditions shall be stated in the test report.

5.4 High temperature resistance

5.4.1 General

If required by national fire regulation the requirements of 5.4.2 apply and high temperature test has to be performed according to 5.4.3.

5.4.2 Requirements

The test is deemed to be passed if the leakage rate of the corrugated metal hose assembly for gas, does not exceed 150 dm^3/h.

When the design of the corrugated metal hose assembly for gas includes one or more gaskets as defined in 3.9, the test shall be performed with the gasket(s).

5.4.3 High temperature test

This test shall be carried out according to EN 1775:2007, Annex A.

5.5 Elongation

5.5.1 Requirement

The permanent elongation of a corrugated metal hose assembly for gas subjected to its test pressure shall not exceed 1 % of the original assembly length after release of the pressure.

When subjected to the test method described in 5.5.2, a corrugated hose assembly for gas shall remain tight when tested in accordance with 5.3

5.5.2 Test

The corrugated metal hose assembly for gas shall be laid in a straight position on a flat surface. It shall then be hydraulically pressurized on one end to 1,5 times its MOP at 20 °C and the pressure held for 1 minfor hoses up to DN 50, 2 min for hoses above DN 50 up and including DN 100 and 3 min for hoses above DN 100.

The pressure is then released and the permanent elongation shall satisfy the requirement of 5.5.1.

5.6 Impact test

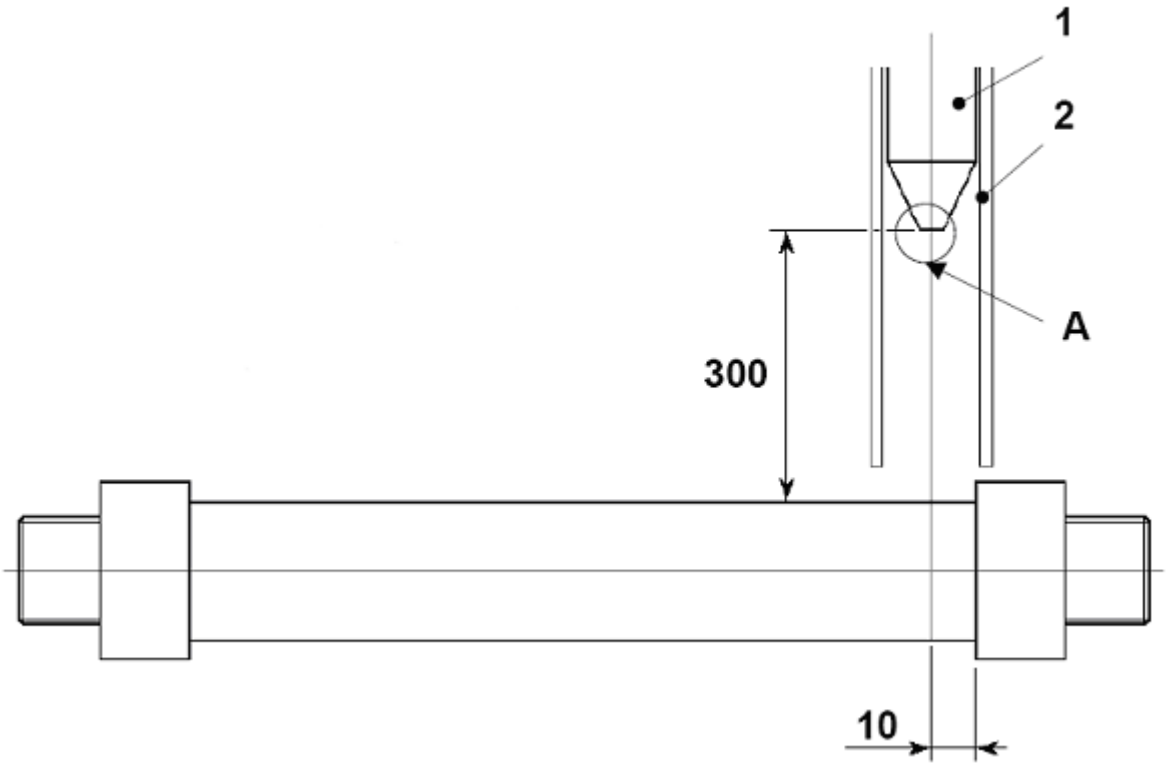
5.6.1 Requirement

When subjected to the test method as described in 5.6.2, a corrugated metal hose assembly for gas shall remain tight when tested in accordance with 5.3.

5.6.2 Test

A striker of a mass of 5 kg as given in detail A, shall be dropped from a height of 300 mm onto the corrugated metal hose for gas, see Figure 1.

The seam of the corrugated metal hose for gas at the point of impact shall be at right angles to the direction of force as viewed along the axis of the corrugated metal hose for gas.



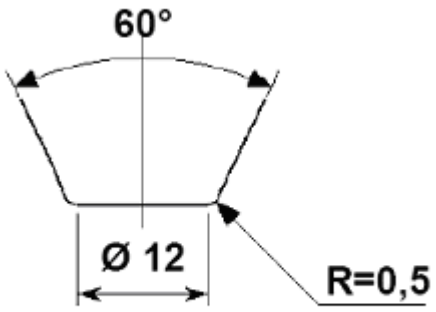
Key

1 striker

2 guide tube with a loose fit

A see detail A

a)



b) Detail A

Figure 1 — Impact test configuration

5.7 Burst pressure test

5.7.1 Requirement

The burst pressure of a corrugated metal hose assembly for gas shall not be less than 4 times the MOP.

For each diameter, the resistance against bursting of a corrugated metal hose assembly for gas is fulfilled if all samples remain tight when tested according to EN ISO 10380:2012, 5.5.

5.7.2 Test

The corrugated metal hoses assemblies for gas, their ends closed by appropriate fittings, fixed on one end, laying straight on a surface shall be hydraulically pressurized to 1,5 times the MOP and such pressure held for 1 min. The pressure then shall be increased gradually in increments over a period of 2 min to 4 times its MOP and the pressure held at this level for an additional minute.

At this pressure the corrugated metal hose assemblies for gas shall not leak and the braid shall not fail.

A deformation of the corrugations shall not be regarded as a failure.

5.8 Pliability and fatigue

Pliability assessment shall be based on tests carried out according to EN ISO 10380:2012, 5.6.

Fatigue assessment shall be based on tests carried out for Type 1-50, Type 1-10 and Type 2-10 according to EN ISO 10380:2012, 5.7.

5.9 Electrical conductivity

Electrical conductivity test of EN ISO 10380:2012, 5.8.shall be carried out.

6 Self-assessment report

Each corrugated metal hose assembly for gas shall be accompanied by a self-assessment report in the language of the country of its intended destination giving all necessary information regarding its safe use together with details of the tightness equipment test that shall be used on the installation and during its lifetime.

7 Installation instruction

The instructions shall detail:

— the method and procedure of how to assemble a corrugated metal hose assembly for gas and how to verify its correct installation;

— the verification of leak-tightness after installation of the a corrugated metal hose assembly for gas and its connecting parts.

The instructions shall in addition give as a minimum the following information:

— trade name of the manufacturer, trademark of the product and the product type (Type 1-50, Type 1-10 or Type 2-10);

— EN number of this European Standard;

— smallest allowable bend radii which are allowed during:

1) installation and

2) usage,

— MOP of the corrugated metal hose assembly for gas;

together with the following warning:

— “Any deterioration or destruction of any part of the corrugated metal hose assembly for gas shall result in the need to replace the complete installed length; alterations to any part of the corrugated metal hose assembly for gas shall mean that it is no longer in conformity with this European Standard”;

— **DO NOT**

“twist or over bend”,

— **DO**

“Install in accordance with existing local and National Regulations as well as best custom and practice.”

“Follow both the installation instructions of the corrugated metal hose manufacturer and of the manufacturer of a corrugated metal hose assembly for gas.”.

NOTE These instructions and warnings can be supplemented by drawings.

8 Designation

The designation for a corrugated metal hose assembly for gas complying with this European Standard shall mention the:

a) reference to this European Standard and date of manufacturing;

b) type of hose (Type 1-50, Type 1-10 or Type 2-10);

c) hose material;

d) nominal size DN;

e) maximum operating pressure (MOP).

EXAMPLE A corrugated metal hose assembly for gas of Type 1–50, of grade 1.4306 for the hose material, of size DN 25 and pressure equal to MOP 16 is designated as follows: “EN 16617:2015 – T1-50 – 1.4306 - DN 25 - MOP 16”

9 Marking

9.1 Permanent marking

A corrugated metal hose assembly for gas shall be permanently marked with the following minimum information:

— the reference to this European Standard;

— the MOP as defined by 3.10;

— the operating temperature in relation with the working conditions;

— the term “gas”;

— the element(s) of traceability.

9.2 Marking on label

Corrugated metal hose assembly for gas shall carry a label giving as a minimum, the following information:

— the reference to this European Standard;

— the name of manufacturer or trademark;

— the trademark of the product (if any);

— the element(s) of traceability as minimum DN, MOP and l_o;

— the designation in accordance with Clause 8.

Additional indications are permitted, as long they do not interfere with the above markings.

10 Packaging

Each corrugated metal hose assembly for gas shall be protected against the ingress of any foreign matter.

The manufacturer shall provide visible recommendations concerning coiling.

Annex A
(normative)

Comparison of the performance tests described by EN ISO 10380 and those of this European Standard

Table A.1 — Comparison of the performance tests described by EN ISO 10380 and those of this European Standard

EN ISO 10380		EN 16617		Specifics for gas use
Leak-tightness	5.2	Leak-tightness	5.3	Leakage rate
Pressure resistance	5.3	Pressure resistance	5.2	Pressure conditions
		High temperature test (If required by national fire regulation)	5.4	EN 1775:2007, Annex A
Elongation	5.4	Elongation	5.5	Pressure conditions
Burst pressure	5.5	Burst pressure	5.7	Pressure conditions
Pliability and fatigue	5.6/5.7	Pliability and fatigue	5.8	Only Type 1–50, Type 1–10 and Type 2–10 are permitted.
		Impact test	5.6	Specific test (mass and height at which the striker is dropped)

Bibliography

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[2] EN 751-1, *Sealing materials for metallic threaded joints in contact with 1st, 2nd and 3rd family gases and hot water — Part 1: Anaerobic jointing compounds*

[3] EN 751-2, *Sealing materials for metallic threaded joints in contact with 1st, 2nd and 3rd family gases and hot water — Part 2: Non-hardening jointing compounds*

[4] EN 751-3, *Sealing materials for metallic threaded joints in contact with 1st, 2nd and 3rd family gases and hot water — Part 3: Unsintered PTFE tapes*

[5] EN 1011-8, *Welding — Recommendations for welding of metallic materials — Part 8: Welding of cast irons*

[6] EN 1092-1, *Flanges and their joints — Circular flanges for pipes, valves, fittings and accessories, PN designated — Part 1: Steel flanges*

[7] EN 1333, *Flanges and their joints — Pipework components — Definition and selection of PN*

[8] EN 1982, *Copper and copper alloys — Ingots and castings*

[9] EN 10025-2, *Hot rolled products of structural steels — Part 2: Technical delivery conditions for non-alloy structural steels*

[10] EN 10087, *Free-cutting steels — Technical delivery conditions for semi-finished products, hot-rolled bars and rods*

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

[12] EN 10204, *Metallic products — Types of inspection documents*

[13] EN 10216-2, *Seamless steel tubes for pressure purposes — Technical delivery conditions — Part 2: Non-alloy and alloy steel tubes with specified elevated temperature properties*

[14] EN 10217-2, *Welded steel tubes for pressure purposes — Technical delivery conditions — Part 2: Electric welded non-alloy and alloy steel tubes with specified elevated temperature properties*

[15] EN 10226-1, *Pipe threads where pressure tight joints are made on the threads — Part 1: Taper external threads and parallel internal threads — Dimensions, tolerances and designation*

[16] EN 10278, *Dimensions and tolerances of bright steel products*

[17] EN 10305-2, *Steel tubes for precision applications - Technical delivery conditions — Part 2: Welded cold drawn tubes*

[18] EN 14585-1, *Corrugated metal hose assemblies for pressure applications — Part 1: Requirements*

[19] CEN/TR 14585-2, *Corrugated metal hose assemblies for pressure applications — Part 2: Guidance on the use of conformity assessment procedures*

[20] EN ISO 228-1, *Pipe threads where pressure-tight joints are not made on the threads — Part 1: Dimensions, tolerances and designation (ISO 228-1)*

[21] EN ISO 14732, *Welding personnel — Qualification testing of welding operators and weld setters for mechanized and automatic welding of metallic materials (ISO 14732)*

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