English translation

AR 215
Datum jjjj-mm-dd
validated Dutch version

Approval requirement 215

Stainless steel press fittings for stainless steel piping systems

kiwa

GASTEC Qa

Trust
Quality
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Foreword

This GASTEC QA (English version) approval requirement has been approved by the Board of Experts product certification GASTEC QA, in which relevant parties in the field of gas related products are represented. This Board of Experts supervises the certification activities and where necessary require the GASTEC QA approval requirement to be revised. All references to Board of Experts in this GASTEC QA approval requirement pertain to the above mentioned Board of Experts.

This GASTEC QA approval requirement will be used by Kiwa Nederland BV in conjunction with the GASTEC QA general requirements and the KIWA regulations for certification.

Approved by Board of Experts : xxx

Accepted by Kiwa Nederland B.V. : xxx

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Contents

1 Introduction

1.1 General

This GASTEC QA approval requirement in combination with the GASTEC QA general requirements include all relevant requirements, which are adhered by Kiwa as the basis for the issue and maintenance of a GASTEC QA certificate for stainless steel press fittings for stainless steel piping systems.

1.2 Scope

This approval requirement specify the requirements for stainless steel press fittings for stainless steel piping systems in the size range 12 mm to 108 mm for the intended use in natural gas systems according to EN 437.

Commented [BW1]: Are we limited to a max? Vibration test cannot be carried out on larger sizes for example

2 Definitions

In this approval requirement, the following terms and definitions are applicable:

Board of Experts: The Board of Experts Gastec QA.

Maximum operating pressure: maximum pressure that a component is capable of withstanding continuously in service under normal operating conditions.

Natural gas: 2nd family gas in accordance with EN 437

3 Product requirements

3.1 Classification

The fittings shall be classified as type 2 fittings for use with medium fuel gas as medium carried.

3.2 Operating temperatures and pressures

The fittings shall comply with the values as outlined in table 1 below:

Operating temperature °C	**Maximum operating pressure for nominal diameters from 6 mm up to and including 108 mm** bar	
	MOP 5	MOP 1
- 20 to + 70	5	1

Table 1: Operating temperatures and pressures for type 2 press fitting

3.3 Materials

3.3.1 Metals

Fitting bodies and tubes shall be made from stainless steel grades alloys shown in the list below or selected from materials specified in EN 10088-1.

When option 2 of EN 10088-2 is specified, then tube and fitting material shall be tested in accordance with EN ISO 3651-2, provided that the fittings manufactured from them meet the functional requirements of this standard.

Material designation			**Standard**
Steel Name		**Steel Number**	
X2 CrNiMo	17-12-2	1.4404	EN 10088-1
X5 CrNiMo	17-12-2	1.4401	EN 10088-1
X6 CrNiMoTi	17-12-2	1.4571	EN 10088-1
G-X5 CrNiMo	19-11-2	1.4408	EN 10213
G-X5 CrNiMoNb	19-11-2	1.4581	EN 10213
X2 CrMoTi	18-2	1.4521	EN 10088-1
NOTE These examples do not constitute an exhaustive list.			

Table 2: Examples of commonly used materials

Other components can be made from metallic or non-metallic materials, provided that they do not prevent the fitting meeting the functional requirements of this standard and do not cause degradation of the connected tube, fitting or sealing element.

3.3.2 Elastomers

Sealing elements for type 2 fittings shall conform to the requirements for elastomeric materials in EN 549 minimum temperature class A2 and table 3 below.

Additional requirement are necessary considering that press fitting design does not allow maintenance and/or substitution of sealing rings after installation. The original sealing ring shall consequently insure a relevant lifetime expectance.

Test procedures
Ozone resistance testing and requirements in accordance with EN 549, 7.8 and 6.2, table 3 Requirement — no cracks
Material identity by TGA Frequency of test – the test shall be carried out at the initial type testing stage to produce the master graph. Further analysis will be made to compare the production to the master graph at a frequency of once per year thereafter.

Table 3 — Sealing elements for type 2 fittings - additional requirements and tests

3.4 Design and manufacture

Press fittings and seals shall be designed to meet the expected lifetime of a building or to the first expected renovation period of the building.

The tightness of the joint, based on actual technical knowledge, is presumed to be capable of maintaining required performance over a period of at least 50 years under the influence of foreseeable actions and normal maintenance to fulfil the essential requirements, if the joint itself is in conformity with the requirements of this standard.

3.4.1 Pressing machine and pressing tools

It is important to use appropriate pressing machine and appropriate pressing tools to ensure that the connection has been made correctly.

3.4.2 Tube abutment

Fittings are usually manufactured with an abutment to limit tube insertion and to retain a loose supporting sleeve, if used. Fittings may be produced for special purposes, particularly useful for repairs, where the fittings do not incorporate abutments, allowing for the fitting to slide along the tube.

3.4.3 Tolerance for the alignment of the fitting ends

The alignment of the ends of the fitting shall be within 2° of the specified axis.

3.4.4 Tube specification

Press fittings produced to this standard are suitable for joining stainless steel tubes to EN 10312 and EN 10217-7 and with wall thicknesses as specified by the manufacturer.

4 Performance requirements & test methods

4.1 General

All sizes of press fittings and each tube material, unless otherwise specified, shall be type tested. Combinations within a test rig are permissible. New fittings can be required for each test.

Fittings declared by the manufacturer being unpressed untight shall comply to requirements as outlined in prEN 10352:2011 paragraph 8.2.3 and Annex N which will be assessed during inspection as part of the FPC system.

The fittings to be tested shall be assembled with the relevant metallic tube, in accordance with the manufacturer's instructions

Tests shall be conducted at a temperature of (23 ± 5) °C unless otherwise stated.

4.2 Leaktightness under internal hydraulic pressure

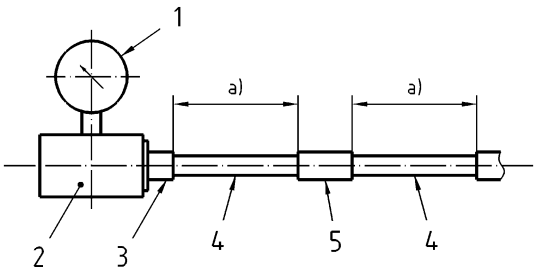
When tested in accordance with the parameters shown in table 4 fittings shall show no signs of leakage.

Free length of tube in the test assembly mm	**Test pressure** bar	**Test duration**	**Number of test pieces per size**	**Test method**
100	24 ± 1	1 h	1	4.2.1 followed by 4.2.2

Table 4: Hydrostatic pressure test parameters

4.2.1 Test method for testing leaktightness of joints with tube under internal hydrostatic pressure

The test piece shall consist of the fitting or fittings to be tested connected to the relevant tube to the minimum length as specified in table 4. The free end of the tube shall be fitted with an end cap to seal off the assembly. The test piece and apparatus shall be arranged as shown schematically in Figure 1.



Key

1) pressure measurement device
2) pressurising pump
3) pump connection
4) tube
5) fitting under test
a) for dimensions see table 4

Figure 1: Arrangement of apparatus for leak tightness under internal hydrostatic pressure

Connect the test pieces to the pressurizing pump and bleed off the air. Progressively and smoothly apply the test pressure and maintain for the duration of the test, all as stated in table 4. Inspect the test joint assemblies for leaks.

4.2.2 Test method for testing leaktightness of joints with metallic tube under internal pneumatic pressure

The test piece shall consist of the fitting or fittings to be tested connected to the relevant tube to a minimum length as specified in table 5. The free end of the tube shall be fitted with an end cap to seal off the assembly.

The test piece and apparatus shall be arranged as shown schematically in Figure 2.

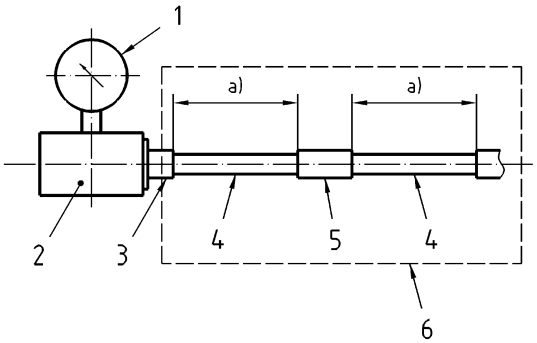


Figure 2 : Arrangement of apparatus for testing sample for leak tightness under internal pneumatic pressure test

Key
1) pressure measurement device
2) pressurizing device
3) pressurized connection
4) tube
5) fitting under test
6) water tank
a) for dimensions, see table 5

Connect the test pieces to the pressurizing device. Apply the first test pressure and maintain for the duration of the test as stated in table 4. Inspect the test press fittings for leaks. Repeat the test at the second and third test pressures stated in table 5.

4.3 Leaktightness under internal pneumatic pressure

When tested in accordance with the parameters shown in table 5 fittings shall show no signs of leakage.

Free length of the tube in the test assembly	**1st test**		**2nd test**		**3rd test**		**Number of test pieces per size**
	pressure	duration	pressure	duration	pressure	duration	
mm	bar	min	mbar	min	mbar	min	
100	1,1 x nominal working pressure	3	110	10	22	10	1

Table 5: Pneumatic pressure test parameters

4.3.1 Test method for testing leaktightness of joints with metallic tube under internal pneumatic pressure

The test piece shall consist of the fitting or fittings to be tested connected to the relevant tube to a minimum length as specified in table 5. The free end of the tube shall be fitted with an end cap to seal off the assembly.

The test piece and apparatus shall be arranged as shown schematically in Figure 2 (see paragraph 4.2.2).

Connect the test pieces to the pressurizing device. Apply the first test pressure and maintain for the duration of the test as stated in table 5. Inspect the test press fittings for leaks. Repeat the test at the second and third test pressures stated in table 5.

4.4 Resistance to pull-out

When tested in accordance with the parameters shown in table 6, the pressed fittings shall withstand the pull-out forces given in table 7 without being separated and shall not leak when subjected to the subsequent hydrostatic pressure test.

Number of test pieces per size	Test method
1	4.4.1 followed by 4.2.1

Table 6: pull-out test parameters

Nominal diameter	Force *F* N
12	600
15	600
18	611
22	913
28	1 478
35	2 310
42	3 326
54	5 497
64	7 721
76,1	10 916
88,9	14 897
108	21 986

Table 7: Tensile forces for pull-out test

For sizes up to and including 15 mm, the force, F, is based on a minimum practical requirement for the separation of joints.

For sizes above 15 mm, the force, F, is calculated from the following equation:

$$F = \frac{\pi \times d_n^2 \times p_D \times S_f}{4}$$

where

F is the force, expressed in newtons (N);

dn is the nominal diameter of the tube in millimetres (mm);

pD is the maximum design pressure of 16 bar, expressed in megapascals (MPa);

Sf is a factor of safety of 1,5.

4.4.1 Test method

The test piece incorporates one fitting assembled with two pieces of tube (see figure 3) and is subjected to an axial tensile loading and held under tension for a period of time, followed by a leak tightness test. Separate combinations shall be assembled for each type of tube for which the fittings are designed.

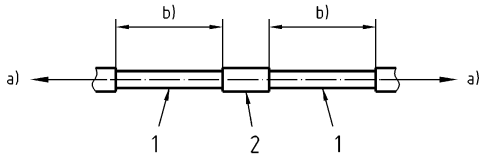


Figure 3 — Arrangement of apparatus for testing sample under pull-out load

Key

1) tube
2) fitting under test
a) for magnitude of test force, see table 7
b) for dimensions, see below

Separate assemblies shall be used for each size and type of fitting. Each piece of tube shall be not less than 100 mm. Secure the test assembly in the apparatus and apply gradually over a period not less than 30 s the force as shown in table 7. Hold the specimen in constant tension for 1 h.

After the tensile load use the same test assemblies for testing the leak tightness under internal hydrostatic pressure (see also 4.2.1). Connect the test pieces to the pressurizing device. Apply the first test pressure and maintain for the duration of the test as stated in table 4. Inspect the test press fittings for leaks.

4.5 Resistance to temperature cycling

When tested in accordance with the parameters shown in table 8, fittings under test shall present at the beginning and at the end of the test no signs of leakage.

Test pressure	Thermal cycles	Free length of pipe in testing assembly	Number of samples for each tested diameter
MOP/ Air	5 cycles consisting of: 111 cycles from - 10 °C to + 50 °C (within 1h30 each) and 1 cycle from - 20 °C to + 50 °C (within 1h30)	200 mm	3

Commented [BW2]: Contrary to prEN10352 with air instead of helium based on current protocols

Table 8: Temperature cycling test parameters for gas installations

4.5.1 Test method

Three samples for each diameter will have to be submitted to this test.

The sample consists of a fitting pressed onto two pipes of stainless steel with a minimum free length of 200mm. Each sample assembly consists of 2 pressed joints (e.g. coupling or elbow). The sample shall be connected to on one side the pressure source and shall be capped on the other side by an end fitting.

Before carrying out the test an initial tightness test shall be carried out. If leakage occurs, connections shall be replaced.

After that the sample is pressurized with air at Maximum Operating Pressure and put in a vacuum chamber which is depressed down to vacuum. After fifteen minutes, air content in the chamber is measured through the mass spectrometer.

For the thermal cycling test, samples are connected to the air pressure source and put under the Maximum Operating Pressure, in a climatic chamber and submitted to the cycles as outlined in the table 8 (see above) and figure 4 below.

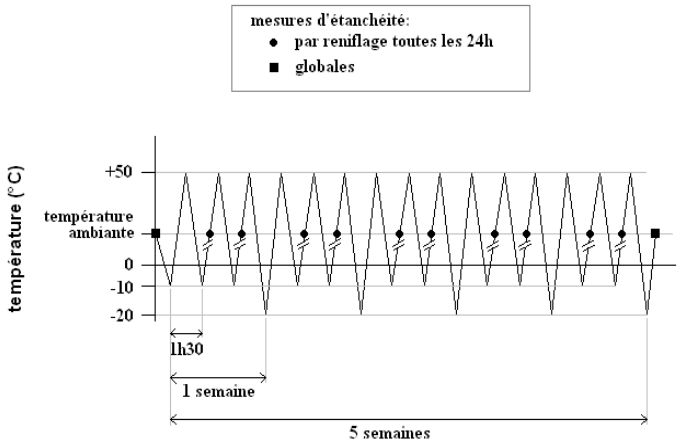


Figure 1 : CYCLAGE THERMIQUE

Figure H.1 — Thermo-cycling frequence

Figure 4: Thermo-cycling frequency

Local leak rate measurement will be carried out at ambient temperature every 24 h throughout the test in order to check no leakage increase occurred.

Temperature cycles are temporarily suspended to allow the measurement. Samples are kept in place and under pressure during measurement. If such a situation arises the fitting concerned should be taken from the climatic chamber in order to perform a global measurement on it. If significant leakage is confirmed, the fitting should be abandoned for testing and the cycles restarted.

Once the cycles have been completed, samples are to be taken from the climatic chamber. The sample is then put in a vacuum chamber and put under air at maximum operating while the chamber is depressed down to vacuum. After 15 minutes, helium content in the chamber is measured through the mass spectrometer.

After testing, the fittings shall show no signs of leakage.

4.6 Resistance to working temperature

When tested in accordance with the parameters shown in table 9 fittings under test shall show no signs of leakage.

Temperature		**Number of pieces per size**	**Free length of tube in test assembly**	**Test method**
hot °C	cold °C		mm	
70 ± 2	- 20 ± 2	1	100	4.6.1 followed by 4.2.2

Table 9: Working temperature test parameters

4.6.1 Test method

An assembly of tubes and fittings is subjected to specified variations of temperature and duration. The test piece shall consist of one or more fittings to be tested connected to the relevant tube to a minimum length as specified in table 9. The free end of the tube shall be fitted with an end cap to seal off the assembly.

The test piece shall be arranged as shown schematically in figure 5.

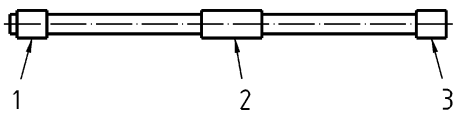


Figure 5: Arrangement of apparatus for testing sample under working temperature

Key
1) pressure connection
2) test fitting
3) end fitting

The assembly is heated to the hot temperature as specified in table 9. The assembly is removed and allowed to cool to room temperature in ambient air, cycle time within 3 hours. This sequence is repeated six times. The assembly is then cooled to the cold temperature specified in table 9 and held for a duration of 24 h, the assembly is then removed and allowed to return to room temperature in ambient air, cycle time 27 hours.

See Figure 6 for cycle times.

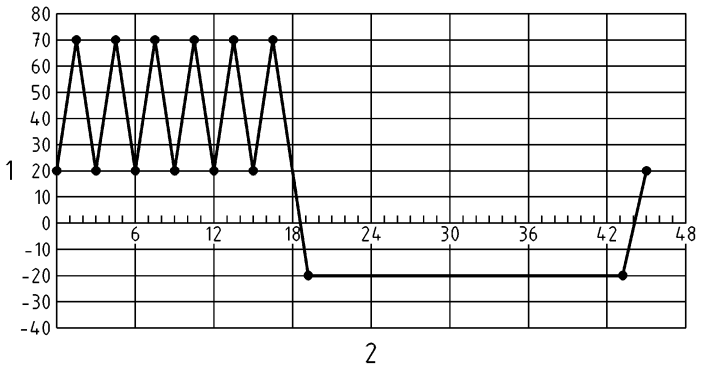


Figure 6: Temperature cycling

Key
1) temperature °C
2) time hours

After the temperature cycling test, a leak tightness test shall be carried out according to paragraph 4.2.2 and table 5.

4.7 Resistance to vibration

When tested in accordance with table 10 fittings shall show no signs of leakage.

Test pressure	Deflection mm	Number of cycles	Frequency of cycles Hz	Number of test pieces per size	Test method
Atmospheric	± 1	1 000 000	20	4	4.7.1 followed by 4.2.2

Table 10: Vibration test parameters

4.7.1 Test method

The test assembly shall consists of four fittings; two 90° elbows, and two straight fittings, arranged as shown in figure 7.

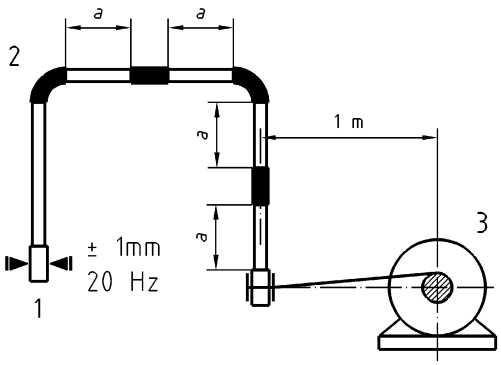


Figure 7: Arrangement of apparatus for testing sample for vibration

Key
1) fixed point and pressurised water connection point
2) test specimen
3) eccentric disk, see H.3.1
a) free pipe segments of 200 mm

The test assembly shall be fitted to the apparatus. The test is then started to complete the number of cycles required as specified in table 10. After completion of the required cycles, a leak tightness test shall be carried out according to paragraph 4.2.2 and table 5.

4.8 Resistance to static flexural strength

When tested in accordance with the parameters shown in table 11, fitting ends shall show no signs of leakage.

Test pressure bar	**Test load**	**Maximum deflection** mm	**Test duration** h	**Number of test pieces per size**	**Test method**
3	see table 12	100	1	1	4.8.1 followed by 4.2.2

Table 11: Static flexural strength test parameters

Nominal diameter	Force *F* N
12	80
15	110
18	140
22	180
28	240
35	310
42	380
54	500
64	600
76,1	720
88,9	850
108	1 040

Table 12: Bending forces

4.8.1 Test method

The test assembly shall consist out of pipe and fitting as shown in figure 8.

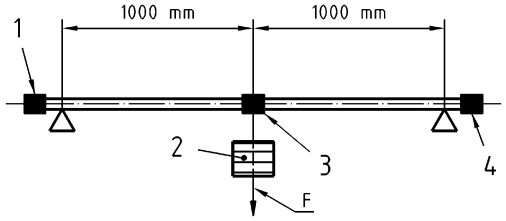


Figure 8: Arrangement of apparatus for testing sample for static flexural strength

Key
1) plug
2) weight
3) fitting
4) supply

Connect the sample to the pressurizing pump and progressively and smoothly apply the test pressure and maintain for the duration of the test all as stated in table 11, then apply the force as stated in table 12.

After this test, a leak tightness test shall be carried out according to paragraph 4.2.2 and table 5.

4.9 Resistance to high temperatures

When tested in accordance with the parameters shown in table 13, each fitting end shall not exceed a leakage rate of 30 dm3/h (nitrogen).

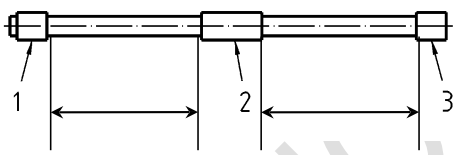
NOTE the manufacturer has to select the pressure for testing according to classification.

Temperature	Pressure		Leakage rate	Test duration
	MOP 5	MOP 1		
°C	bar	bar	dm^3/h	min
650 ± 10	5,0 + 0,5	1,0 + 0,5	30	30

Table 13: High temperature test parameters

4.9.1 Test method

The test assembly shall consist of tube and one fitting as shown in figure 9.



200 mm 200 mm

Figure 9: Arrangement of apparatus for testing sample for high temperature

Key

1) pressurised connection
2) test fitting
3) end stop

Connect the test assembly to the apparatus. Raise the temperature to the value stated in table 13 and maintain for the duration of the test. Pressurize with nitrogen and maintain the pressure for the time period as stated in table 13. The quantity of 'leaked' gas shall be measured in which the maximum leakage shall not exceed the amount specified in table 13 for the duration of the test.

4.10 Resistance to intercristalline corrosion test

The test shall be carried out in accordance with EN ISO 3651-2. Test method is described in paragraph 4.10.1. After carrying out the test, the fittings shall not show any cracks.

4.10.1 Test method

EN ISO 3651-2 specifies a method for the determination of resistance to intercristalline corrosion of stainless steels. The principle of the method, the reagents, materials and apparatus required and the procedure for the selection and preparation of the test pieces, are all in accordance with EN ISO 3651-2.

Test pieces shall be complete fittings incorporating all components and shall be assembled to the tube with the joints made. Fittings shall be tested in accordance with the procedure A stated in EN ISO 3651-2, annex A.

5 Marking, instructions and packaging

5.1 Marking

Each fitting shall be legibly and permanently marked, at the minimum, with the following:

- The name or logo of GASTEC QA quality mark
- Manufacturer's identity symbol
- Nominal diameter
- GT (refers to having been high temperature tested for gas applications) followed by the nominal pressure in bars
- MOP followed by the maximum operating pressure (see note 1)

Additionally there is temporarily marking to be applied for the press fittings:

- bodies shall be color coded yellow (remaining visible after installation)
- seals shall be color coded yellow

NOTE There is no relationship between PN and GT tests but fittings may be supplied with permissible pressure ratings, tested at high temperature, in the following combinations; GT 1/PN 1, GT 1/PN 5 or GT 5/PN 5.

In case the required marking does not fit on the fitting, it may be placed on the smallest packaging.

5.2 Instructions

User instructions shall be available from the manufacturer and shall be provided in the Dutch language.

5.3 Packaging

The product shall be pack in such a way that contamination or damaging is not possible.

6 Quality system requirements

The supplier shall make a risk assessment of the product and production process according to chapter 3.1.1.1 and 3.1.2.1 of the GASTEC QA general requirements. The risk assessments shall be available to Kiwa for review.

7 Summary of tests

This chapter contains a summary of tests to be carried out during:

- The initial product assessment;
- The periodic product verification;

7.1 Test matrix

Description of requirement	Clause	Test within the scope of		
		Initial product assessment	Product verification	
			Verification	Frequency
Product requirements	3			
Classification	3.1	X		
Operating temperatures and pressures	3.2	X		
Materials	3.3	X		
Metals	3.3.1	X		
Elastomers	3.3.2	X		
Design and manufacturer	3.4	X		
Pressing machine and pressing tools	3.4.1	X		
Tube abutment	3.4.2	X		
Tolerance for the alignment of the fitting end	3.4.3	X		
Tube specification	3.4.4	X		
Performance requirements and test methods				
General	4.1	X		
Leak tightness under internal hydraulic pressure	4.2	X		
Leak tightness under internal pneumatic pressure	4.3	X		
Resistance to pull-out	4.4	X		
Resistance to temperature cycling	4.5	X		
Resistance to working temperature	4.6	X		
Resistance to vibration	4.7	X		
Resistance to static flexural strength	4.8	X		
Resistance to high temperatures	4.9	X		
Resistance to intercristalline corrosion	4.10	X		
Marking	5.1	X		
Instructions	5.2	X		
Packaging	5.3	X		

8 List of referenced documents and source

8.1 Standards / normative documents

All normative references in this Approval Requirement refer to the editions of the standards as mentioned in the list below.

EN 437: 2021	Test gases- test pressure – appliance categories
EN 549: 2019	Rubber materials for seals and diaphragms for gas appliances and gas equipment

8.2 Source

Parts of the text of this approval requirement have been based on prEN 10352:2011.