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Refrigerating systems and heat pumps — Qualification of tightness of components and joints

Systèmes de réfrigération et pompes à chaleur — Qualification de l'étanchéité des composants et des joints

Reference number
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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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This document was prepared by the European Committee for Standardization (CEN) Technical Committee CEN/TC 182, *Refrigerating systems, safety and environmental requirements*, in collaboration with ISO Technical Committee TC 86, *Refrigeration and air-conditioning*, Subcommittee SC 1, *Safety and environmental requirements for refrigerating systems*, in accordance with the Agreement on technical cooperation between ISO and CEN (Vienna Agreement).

This second edition cancels and replaces the first edition (ISO 14903:2012), which has been technically revised.

Refrigerating systems and heat pumps — Qualification of tightness of components and joints

1 Scope

This document provides the qualification procedure for type approval of the tightness of hermetically sealed and closed components, joints and parts used in refrigerating systems and heat pumps as described in relevant parts of ISO 5149. The sealed and closed components, joints and parts concerned are, in particular, fittings, bursting discs, flanged or fitted assemblies. The tightness of flexible piping made from non-metallic materials is dealt with in ISO 13971. Metal flexible piping are covered by this document.

The requirements contained in this document are applicable to joints of maximum DN 50 and components of internal volume of maximum 5 l and maximum weight of 50 kg.

This document is intended to characterize their tightness stresses met during their operations, following the fitting procedure specified by the manufacturer, and to specify the minimal list of necessary information to be provided by the supplier of a component to the person in charge of carrying out this procedure.

It specifies the level of tightness of the component, as a whole, and its assembly as specified by its manufacturer.

It applies to the hermetically sealed and closed components, joints and parts used in the refrigerating installations, including those with seals, whatever their material and their design are.

This document specifies additional requirements for mechanical joints that can be recognized as hermetically sealed joints.

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 175, *Plastics — Methods of test for the determination of the effects of immersion in liquid chemicals*

ISO 1817, *Rubber, vulcanized or thermoplastic — Determination of the effect of liquids*

ISO 5149-1, *Refrigerating systems and heat pumps — Safety and environmental requirements — Part 1: Definitions, classification and selection criteria*

ISO 5149-2, *Refrigerating systems and heat pumps — Safety and environmental requirements — Part 2: Design, construction, testing, marking and documentation*

ISO 13971, *Refrigeration systems and heat pumps — Flexible pipe elements, vibration isolators, expansion joints and non-metallic tubes — Requirements and classification*

IEC 60068-2-64, *Environmental testing — Part 2-64: Tests — Test Fh: Vibration, broadband random and guidance*

EN 1593, *Non-destructive testing — Leak testing — Bubble emission techniques*

EN 13185:2001, *Non-destructive testing — Leak testing — Tracer gas method*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 5149-1 and the following apply.

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

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

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

3.1
mass flow rate
Q_m
value of the leak mass flow rate at any point of the component

Note 1 to entry: The mass flow rate is expressed in grams (g) per year.

3.2
volume flow rate
Q
value of the leak volume flow rate at any point of the component

Note 1 to entry: The volume flow rate is expressed in Pascal cubic metres per second ($Pa \cdot m^3/s$).

3.3
hermetically-sealed system
system in which all refrigerant containing parts are made tight by welding, brazing or a similar permanent connection which may include capped valves and capped service ports that allow proper repair or disposal and which have a tested tightness control level of less than 3 g per year under a pressure of at least a quarter of the maximum allowable pressure

Note 1 to entry: Sealed systems as defined in ISO 5149-1 are equal to hermetically-sealed systems.

3.4
product family
group of products that have the same function, technology, and material for each functional part and sealing materials

3.5
closed joint
joint other than hermetically-sealed joints where there is no movement between the sealing surfaces except for service purposes

EXAMPLE Flanged joints.

3.6
closed component
component other than hermetically-sealed components where there is no movement between the sealing surfaces except for service purpose

EXAMPLE Stop valves, service ports, pressure-relief valves.

3.7
hermetically-sealed joint
joint that are made tight by welding, brazing or a similar permanent connection

3.8
hermetically-sealed component
component that are made tight by welding, brazing or a similar permanent connection

3.9
permanent joint
joint which cannot be disconnected except by destructive methods

[SOURCE: Pressure Equipment Directive 2014/68/EU, modified]

3.10
reusable joint
joint made without replacing the sealing material in general procedure

Note 1 to entry: In some cases, the tube is used as sealing material (e.g. flared joint).

3.11
same base material
material belonging to the same group

EXAMPLE Steel group, aluminium and aluminium alloy group or copper group.

Note 1 to entry: Subgroups of these material groups are considered to be same base materials (refer to EN 14276-2).

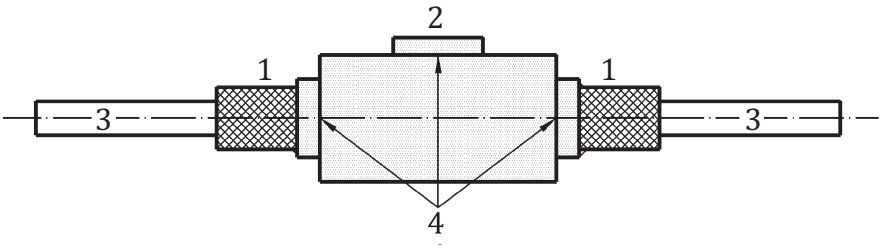
4 Symbols

Symbol	Denomination	Unit
D_K	Percentage deviation of the minimum and maximum torque from the average of the minimum and maximum torque, $(K_{max} - K_{min})/(K_{min} + K_{max})$	—
f	Frequency of vibrations	Hz
K_{ave}	Average torques of the respective joint standard	Nm
K_{max}	Required maximum torques of the respective joint standard, if specified. Otherwise, the maximum torque values supplied by the manufacturer.	Nm
K_{min}	Required minimum torques of the respective joint standard, if specified. Otherwise, the minimum torque values supplied by the manufacturer.	Nm
L	Length of tube	mm
n	Number of cycles in temperature and in pressure (method 1)	—
n_1	Number of cycles in temperature and in pressure (method 2)	—
n_2	Number of cycles in pressure	—
n_3	Number of cycles in vibration	—
n_{total}	Total number of cycles in temperature and in pressure	—
N	Number of samples	—
P	Tightness test pressure	bar
P_{max}	Maximal pressure of cycle	bar
P_{min}	Minimal pressure of cycle	bar
PS	Maximal allowable pressure	bar
P_{set}	Nominal set pressure of the device	bar
Q	Volume flow leakage rate	mbar l/s
Q_m	Mass flow leakage rate	g/a
s	Vibration displacement (peak to peak value)	mm
t_{max}	Maximal temperature of cycle	°C
t_{min}	Minimal temperature of cycle	°C

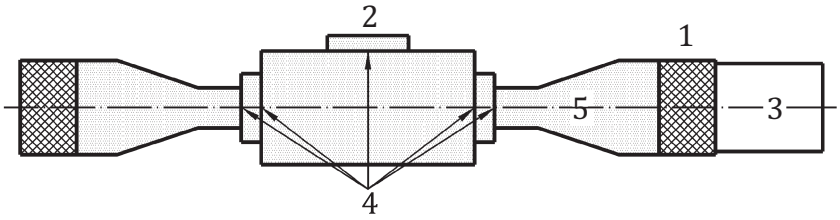
5 Test requirements

The required tests to be applied to component bodies and joint used in refrigerating systems and heat pumps are given in Table 1 and in Table 2.

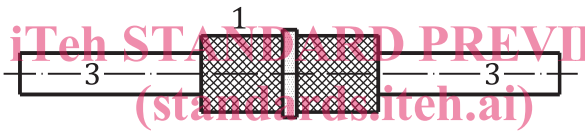
Figure 1 illustrates the principle of a component and a joint and their corresponding requirements in Table 1 or Table 2.



a) According to Table 1



b) According to Table 1



c) According to Table 2

Key

1 joint
2 component body
3 pipe
4 component body joint
5 extension pipe

Figure 1 — Principle: component body-joint

All component types and joints types shall be tested.

When a component may be connected with different types of joints, one of these joints shall be tested with the component according to Table 1. The other possible types of joints shall be tested independently according to Table 2.

Table 1 — Requirements for component bodies

Components (including valves)	**Requirements**							
	Tightness test	**PTV- test** (pressure-temperature-vibration)	**Operation simulation**	**Freezing test**	**Chemical compatibility with materials**	**Vacuum test**	**Additional test for hermetically sealed**	
							Pressure test	**Fatigue test**
Subclause	7.4	7.6	7.7	7.8	7.11	7.10	7.9	7.12
Component bodies having only permanent body joints: brazing and welding Identical base materials	YES	NO	NO	NO	NO	NO	NO	NO
Components having permanent body joints: brazing and welding Different base materials	YES	YES[a]	NO	NO	NO	NO	NO	NO
Component bodies having other permanent body joints (e.g. glue, permanent compression fittings, expansion joints)	YES	YES	NO	YES if operating temperature below 0 °C	YES if non-metallic parts	YES	YES	YES
Component bodies with non-permanent body joints	YES	YES	YES if any external stems, shaft seals or removable or replaceable parts	YES if operating temperature below 0 °C	YES if non-metallic parts	YES	Not applicable	Not applicable
By exception, compressors that comply with the requirements of EN 12693 or IEC 60335-2-34 only need to be subjected to the following test: — joints connecting to other parts of the refrigerating systems; — chemical compatibility test for all gaskets (sight glass, etc.). [a] PTV tests are not required if destructive and non-destructive tests of EN 13134 are carried out. NOTE Other qualifications for this chemical compatibility done according to other standards are equivalent.								

Table 1 *(continued)*

Components (including valves)	**Requirements**							
	Tightness test	**PTV- test** (pressure-temperature-vibration)	**Operation simulation**	**Freezing test**	**Chemical compatibility with materials**	**Vacuum test**	**Additional test for hermetically sealed**	
							Pressure test	**Fatigue test**
Subclause	7.4	7.6	7.7	7.8	7.11	7.10	7.9	7.12
Capped valves and capped service ports for hermetically sealed systems	YES	YES	YES	YES if operating temperature below 0 °C	YES if non-metallic parts	YES	YES	YES
Safety valves	YES	YES	NO	NO	YES if non-metallic parts	Not applicable	Not applicable	Not applicable
Flexible piping	Test according to ISO 13971							
By exception, compressors that comply with the requirements of EN 12693 or IEC 60335-2-34 only need to be subjected to the following test: — joints connecting to other parts of the refrigerating systems; — chemical compatibility test for all gaskets (sight glass, etc.). [a] PTV tests are not required if destructive and non-destructive tests of EN 13134 are carried out. NOTE Other qualifications for this chemical compatibility done according to other standards are equivalent.								

Table 2 — Requirements for the joining of components

Joints and parts	Requirements							
	Tightness test	**PTV- test** (pressure-temperature-vibration)	**Operation simulation**	**Freezing test**	**Chemical compatibility with materials**	**Vacuum test**	**Additional test for hermetically sealed**	
							Pressure test	**Fatigue test**
Subclause	7.4	7.6	7.7	7.8	7.11	7.10	7.9	7.12
Permanent piping joints: brazing and welding Identical base materials	YES	NO	NO	NO	NO	NO	NO	NO
Permanent piping joints: brazing and welding Different base materials	YES	YES	NO	NO	NO	NO	NO	NO
Other permanent piping joints (e.g. glue, permanent compression fittings, expansion joints)	YES	YES	NO	YES	YES	YES	YES	YES
Non-permanent piping joints	YES	YES	YES	YES	YES, if sealing material	YES	Not applicable	Not applicable
Gaskets and sealing	NO	NO	NO	NO	YES	NO	Not applicable	Not applicable

6 Requirements for hermetically sealed systems

Hermetically-sealed systems shall be constructed with components which have their tightness control level qualified as A1 or A2 as per Table 3 or Table 4. These components and joints shall be submitted to the relevant tests as specified in Tables 1 and 2.

7 Test procedures

7.1 General

The components, joints and part shall pass the tightness test before the other tests are executed. The different tests are shown in Figure 2.

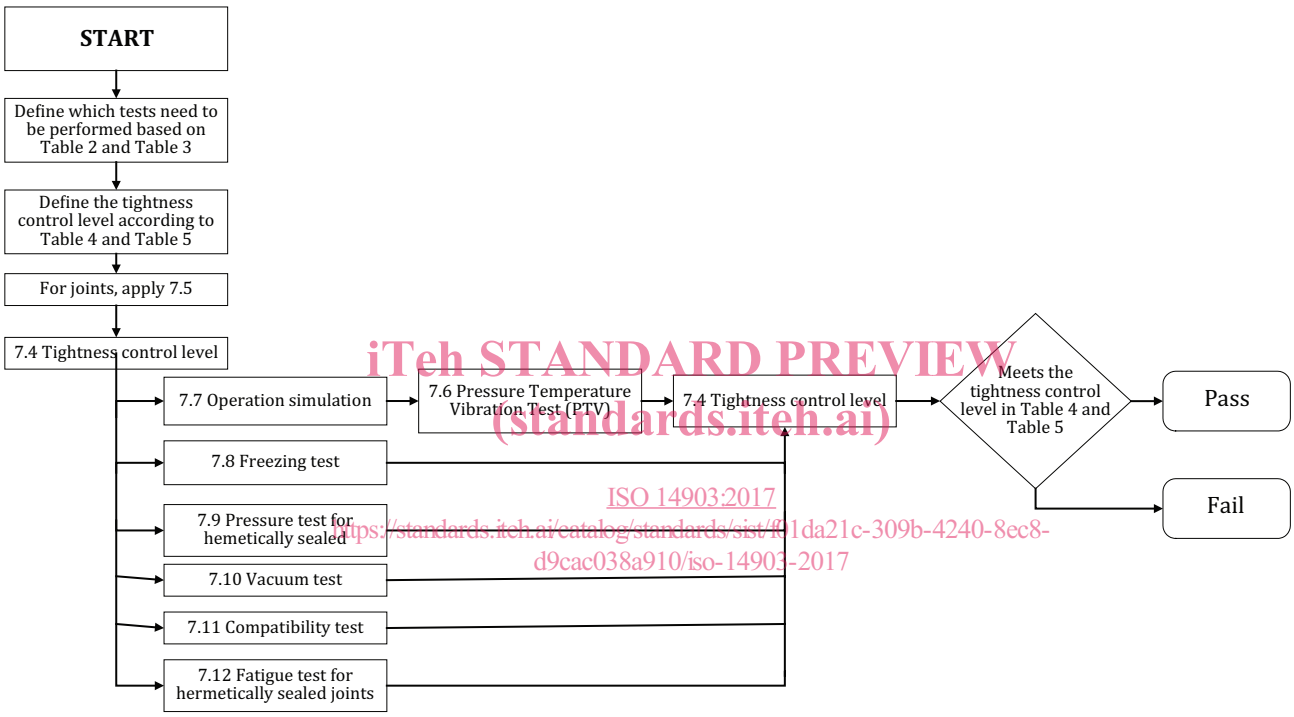


Figure 2 — Test procedure

7.2 Sampling

The largest, the smallest and any random samples in between of the product family shall be submitted to the test as required in Table 1 or Table 2. The samples used for pressure-temperature vibration test (7.6) and for operation simulation (7.7) shall be the same. For each of the other tests (7.8, 7.9, 7.10, 7.11, 7.12), different samples may be used.

7.3 Test temperature

Test temperature (ambient and gas) shall be 15 °C to 35 °C, unless otherwise specified as the test conditions.

7.4 Tightness test

7.4.1 General

The tightness of components and joints shall be tested according to the following test pressures.

For pressure relief devices, P = 0,9 × P_{set} (−2) %;

For all other components and joints the test pressure P shall be defined as: P = PS (2) % (PS = Maximum allowable pressure);

Q ≤ requirements for actual tightness control level A1 – A2 (hermetically-sealed components) or B1 – B2 for all other components.

The maximum required tightness control level are specified for Helium at 10 bar and +20 °C as a reference.

The actual tightness control levels can be calculated (e.g. other test fluids or pressures) by using the stated calculation formulas (Annex A).

The maximum tightness control level depends on the size of the tested component or joint. Tightness control levels are specified in accordance with the joints used in Table 3. These are levels for each individual joint.

Table 3 — Tightness control level according to joints nominal diameter

Joints	DN	Tightness control levels
Hermetically sealed joints	≤ 50	A1
Closed joints	≤ 50	B1

For components, the tightness control level depends on the component internal volume and the type of component as specified in Table 4. These are levels for each individual component.

Table 4 — Tightness control level according to components volume

Components	Component Volume l	Tightness control levels
Hermetically sealed components	0 up to 1,0	A1
	> 1,0	A2
Closed components	0 up to 2,0	B1
Closed components	> 2,0 up to 5,0	B2

The manufacturer can choose more stringent tightness control level if adequate.

Table 5 — Equivalence of test gas flow according to tightness control levels

Component type	Tightness control level at +20 °C, 10 bar	Helium reference leak $Q_{he\text{-}ref}$ Pa·m³/s	Equivalent air leak $Q_{air\text{-}ref}$ Pa·m³/s	Equivalent iso-butane leak $m_{R\text{-}600a}$ g/a
Hermetically sealed	A1	≤ 7,5 × 10^{-7}	≤ 8 × 10^{-7}	≤ 1,5
	A2	≤ 1 × 10^{-6}	≤ 11 × 10^{-7}	≤ 2,0
Closed	B1	≤ 1 × 10^{-6}	≤ 11 × 10^{-7}	≤ 2,0
	B2	≤ 2 × 10^{-6}	≤ 2,1 × 10^{-6}	≤ 4,0
NOTE The equivalent iso-butane leak is calculated as gas. At +20 °C and 10 bar, iso-butane is in the liquid phase. See R-600a in Table A.1.				

7.4.2 Tightness level control

7.4.2.1 Test method