INTERNATIONAL STANDARD

ISO 15848-1

Second edition
2015-06-01

Industrial valves — Measurement, test and qualification procedures for fugitive emissions —

Part 1:
Classification system and qualification procedures for type testing of valves

Robinetterie industrielle — Mesurage, essais et modes opératoires de qualification pour émissions fugitives —

Partie 1: Système de classification et modes opératoires de qualification pour les essais de type des appareils de robinetterie

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Contents

Page

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.

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).

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. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation on the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the WTO principles in the Technical Barriers to Trade (TBT), see the following URL: Foreword — Supplementary information.

The committee responsible for this document is ISO/TC 153, *Valves*, Subcommittee SC 1, *Design, manufacture, marking and testing*.

This second edition cancels and replaces the first edition (ISO 15848-1:2006) which has been technically revised. The main changes are the following:

— leak rate at the stem seal (Table 1) is expressed in mbar·l·s^{-1} per mm stem diameter;

— flushing method is replaced by accumulation or suck through method to measure leak rate from stem seal with Helium (Annex A);

— leakage is expressed in ppmv; leakage with methane is measured by sniffing;

— for tightness Class AH, leak rate ≤ 1,78·10^{-7} mbar·l·s^{-1}·mm^{-1} (10^{-5} mg·s^{-1}·m^{-1});

— the appropriate leak rate is given for Classes BH and CH;

— addition of Table 3 which gives tightness classes for stem (or shaft) seals with methane;

— there is no correlation intended between the tightness classes when the test fluid is helium (Classes AH, BH, CH) and when the test fluid is methane (Classes AM, BM, CM);

— modification of the number of mechanical cycles for isolating valves;

— addition of Table 4;

— addition of Figures 3, 4, and 5;

— addition of type leak (A.1.3.4, B.1.4.2, B.1.6.1);

— modification of Figure B.2;

— modification of B.1.6.1 on calibration procedures;

— deletion of Figure B.3;

— addition of Table C.1 and modification of Table C.2.

ISO 15848 consists of the following parts, under the general title *Industrial valves — Measurement, test and qualification procedures for fugitive emissions*:

— *Part 1: Classification system and qualification procedures for type testing of valves*

— *Part 2: Production acceptance test of valves*

Introduction

The objective of this part of ISO 15848 is to enable classification of performance of different designs and constructions of valves to reduce fugitive emissions.

This part of ISO 15848 defines type test for evaluation and qualification of valves where fugitive emissions standards are specified.

The procedures of this part of ISO 15848 can only be used with the application of necessary precautions for testing with flammable or inert gas at temperature and under pressure.

Industrial valves — Measurement, test and qualification procedures for fugitive emissions —

Part 1: Classification system and qualification procedures for type testing of valves

1 Scope

This part of ISO 15848 specifies testing procedures for evaluation of external leakage of valve stem seals (or shaft) and body joints of isolating valves and control valves intended for application in volatile air pollutants and hazardous fluids. End connection joints, vacuum application, effects of corrosion, and radiation are excluded from this part of ISO 15848.

This part of ISO 15848 concerns classification system and qualification procedures for type testing of valves.

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.

ISO 5208, *Industrial valves — Pressure testing of metallic valves*

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

3 Terms and definitions

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

3.1
body seals
any seal in pressure containing part except stem (or shaft) seals

3.2
Class
convenient round number used to designate pressure-temperature ratings

Note 1 to entry: It is designated by the word "Class" followed by the appropriate reference number from the following series: Class 125, Class 150, Class 250, Class 300, Class 600, Class 900, Class 1 500, Class 2 500.

3.3
concentration
ratio of test fluid volume to the gas mixture volume measured at the leak source(s) of the test valve

Note 1 to entry: The concentration is expressed in ppmv[1)].

1) Parts per million volume is a unit deprecated by ISO. 1 ppmv = 1 ml/m^3 = 1 cm^3/m^3.

3.4
control valve
power operated device which changes the fluid flow rate in a process control system and which consists of a valve connected to an actuator that is capable of changing the position of a closure member in the valve in response to a signal from the controlling system

3.5
fugitive emission
chemical or mixture of chemicals, in any physical form, which represents an unanticipated or spurious leak from equipment on an industrial site

3.6
leakage
loss of the test fluid through the stem (or shaft) seal or body seal(s) of a test valve under the specified test conditions and which is expressed as a concentration or a leak rate

3.7
leak rate
mass flow rate of the test fluid, expressed in mg·s^{-1} per millimetre of stem diameter through stem seal system or volumic flow rate of the test fluid, expressed in mbar·l·s^{-1} per millimetre of stem diameter through stem seal system

3.8
local leakage
measurement of the test fluid leakage using a probe at the leak source point

3.9
mechanical cycle of control valves
for linear/rotary control valves, test cycles performed at 50 % of stroke/angle with an amplitude of ±10 % of full stroke/angle

3.10
mechanical cycle of isolating valves
motion of a valve obturator moving from fully closed position to fully opened position, and returning to fully closed position

3.11
nominal size
DN
alphanumeric designation of size for components of a pipework system, which is used for reference purposes, comprising the letters DN followed by a dimensionless whole number which is indirectly related to physical size, in millimetres, of the bore or outside diameter of the end connections

Note 1 to entry: The nominal diameter is designated by the letters DN followed by a number from the following series: 10, 15, 20, 25, 32, 40, 50, 65, 80, 100, 125, 150, 200, 250, 300, 350, 400, etc.

Note 2 to entry: The number following the letters DN does not represent a measurable value and should not be used for calculation purposes except where specified in the relevant standard.

Note 3 to entry: Adapted from ISO 6708:1995, definition 2.1.

3.12
nominal pressure
PN
numerical designation relating to pressure, which is a convenient rounded number for reference purposes, comprising the letters PN followed by the appropriate reference number

Note 1 to entry: All equipment of the same nominal size (DN) designated by the same PN number have compatible mating dimensions.

Note 2 to entry: The maximum allowable working pressure depends upon materials, design, and working temperatures and is selected from the pressure/temperature rating tables in the appropriate standards.

Note 3 to entry: The nominal pressure is designated by the letters PN followed by the appropriate reference number from the following series: 2,5, 6, 10, 16, 20, 25, 40, 50, etc.

Note 4 to entry: Adapted from ISO 7268:1983, definition 2.1.

3.13
isolating valve
valve intended for use principally in the closed or open position which can be power actuated or manually operated

3.14
performance class
level of the performance of a test valve

Note 1 to entry: The performance classes are defined in Clause 6.

3.15
room temperature
temperature in the range of −29 °C to +40 °C

3.16
stem
shaft
valve component extending into the valve shell to transmit the linear/rotary motion from the actuating device to the valve obturator

3.17
stem seal
shaft seal
component(s) installed around the valve stem (or shaft) to avoid leakage of internal fluids to atmosphere

3.18
test pressure
pressure used for testing the valve which, unless otherwise specified, is the rated pressure specified at the test temperature and the shell material of a test valve in the relevant standards

3.19
test temperature
fluid temperature selected for the test as measured inside the test valve

Note 1 to entry: The test temperature is given in Table 5.

3.20
thermal cycle
change of the temperature from the room temperature to the specified test temperature and return to the room temperature

3.21
total leakage
collection of leakage of the test fluid at the leak source using an encapsulation method

3.22
type test
a test conducted to establish the performance class of a valve

4 Symbols and abbreviations

M_{alr} predicted maximum leakage

SSA stem (or shaft) seal adjustment

OD_{stem} stem outside diameter

RT room temperature

NOTE The abbreviation SSA corresponds to the abbreviation of “Stem Seal Adjustment”.

5 Type test

5.1 Test conditions

5.1.1 Preparation of a valve to be tested

Only a fully assembled valve shall be used for the test.

A valve shall be selected from standard production at random. The valve shall have been tested and accepted in accordance with ISO 5208 or any other applicable standard and no subsequent protective coating shall have been applied.

Additional seal arrangements to allow the stem sealing system leakage measurement is permitted and shall not affect the sealing performance of the valve.

The test valve interior shall be dried and lubricants (if any) shall be removed. The valve and test equipment shall be clean and free of water, oil, and dust and the packing may be changed prior to the test. If the valve packing is changed prior to the test, it should be done under the supervision of the valve manufacturer.

If a test valve is equipped with a manually adjustable stem (or shaft) seal(s), it shall be initially adjusted according to the manufacturer’s instructions and recorded in the test report as provided in Clause 7.

The valve manufacturer shall select the appropriate actuating device.

5.1.2 Test fluid

The test fluid shall be helium gas of 97 % minimum purity or methane of 97 % minimum purity. The same test fluid shall be used throughout the test.

5.1.3 Test temperature

Valve mechanical cycling is carried out at the room temperature or in the steps of the room temperature and the selected test temperature other than the room temperature (see 5.2.4.1).

The test temperature shall be recorded for each leakage measurement.

5.1.4 Measurement of test valve temperature

The temperature of the test valve shall be measured at three locations, as shown in Figure 1, and recorded in a test report.

a) Measurement at location 1 shall be used to determine the test temperature.

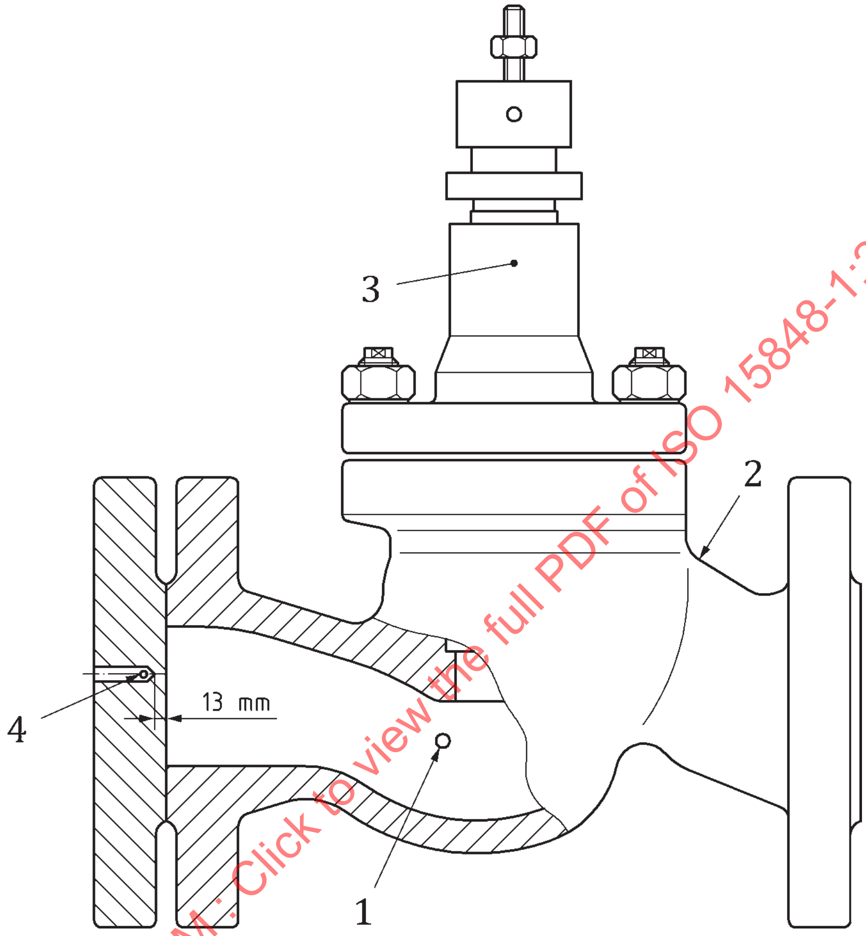
b) Measurement at location 2 is also made for information. Any use of insulation shall be detailed in the test report.

c) Measurement at location 3 is used to determine the external valve temperature adjacent to the stem (or shaft) seal(s) for information.

d) Measurement at location 4 is an option if measurement location 1 is not possible (except in the case where heating elements penetrate the blind flanges).

All temperatures at location 1, 2, and 3 (and 4) shall be stabilized before leakage is measured (see Figures 2 and 3). Temperature at location 3 shall be stabilized for minimum 10 min prior to leakage measurement.

Check if the temperature variation is within ±5 %.



Key

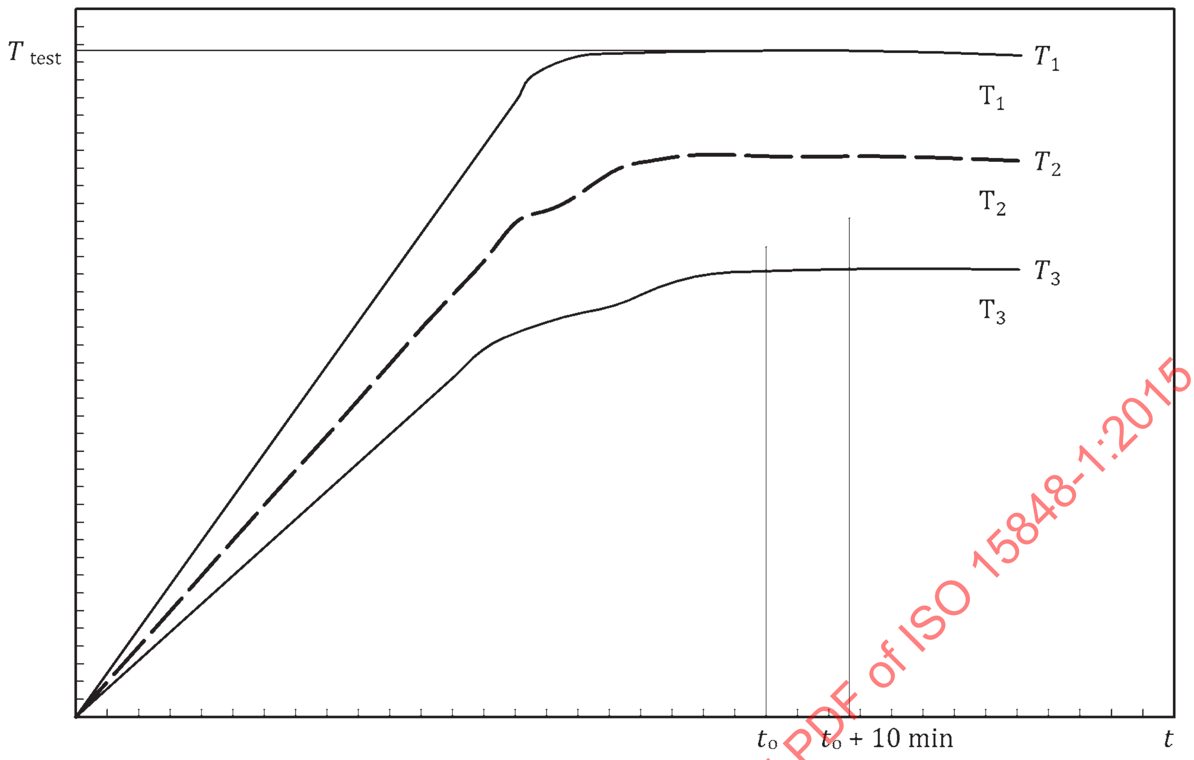
1 location 1: flow path (temperature T_1)

2 location 2: valve body (temperature T_2)

3 location 3: stuffing box (temperature T_3)

4 location 4: optional for flow path (temperature T_1)

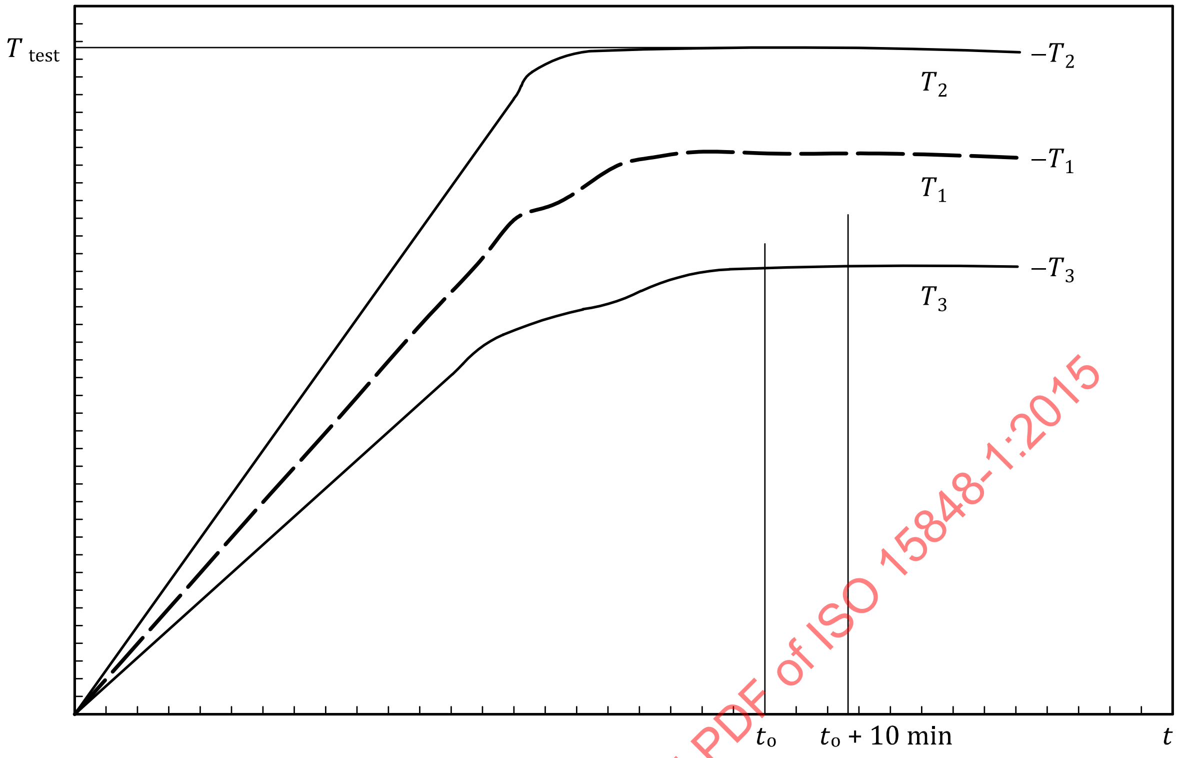
Figure 1 — Measurements of temperature



Key

T_{test}	test temperature, °C
T_1	stabilization temperature at location 1 (flow path)
T_2	stabilization temperature at location 2 (valve body)
T_3	stabilization temperature at location 3 (stuffing box)
t	time
t_0	stabilization of temperature at location 3 (stuffing box)
t_0+ 10 min	start of mechanical cycles

Figure 2 — Stabilization of temperatures (when the valve is internally heated or cooled)



Key

T_{test}	test temperature, °C
T_1	stabilization temperature at location 1 (flow path)
T_2	stabilization temperature at location 2 (valve body)
T_3	stabilization temperature at location 3 (stuffing box)
t	time
t_0	stabilization of temperature at location 3 (stuffing box)
t_0+ 10 min	start of mechanical cycles

Figure 3 — Stabilization of temperatures (when the valve is externally heated or cooled)

5.1.5 Leakage measurement

5.1.5.1 Stem (or shaft) leakage measurement

Leakage shall be measured from a test valve at rest in the partly open position.

The leakage measurement shall be performed

— by the global method (vacuum or bagging) according to the procedures described in Annex A, or

— by the local leakage measurement (sniffing) according to the procedures described in B.2.

5.1.5.2 Body seal leakage measurement

The local leakage shall be measured by sniffing method according to the procedure described in Annex B.

Evaluation of the end connections should be done to ensure that they do not affect the results of the evaluation of the body seals.

5.1.5.3 Leakage-measurement records

All results of leakage measurements shall be recorded in a test report as specified in Clause 7.

5.2 Test procedures

5.2.1 Safety rules

Testing with high pressure gas is potentially hazardous and thus all applicable local safety rules and adequate safety measures shall be followed. If methane (CH_4) is used, the combination of the test pressure and temperature shall be reviewed for possible combustion concerns.

5.2.2 Test equipment

The test equipment shall be appropriately selected to

a) apply and maintain the test pressure within a range of ±5 % of the nominal value,

b) apply valve mechanical cycles,

c) heat or cool the test valve to the selected test temperature and maintain it within a range of ±5 % but not exceeding 15 °C; no mechanical cycling is permitted during temperature change,

d) measure and record time, pressure, temperature, leakage, and duration of a valve mechanical cycle,

e) measure and record actuation forces or torques to operate a test valve, and

f) measure and record the stem sealing system loading, if applicable.

5.2.3 Stem (or shaft) seal adjustment (SSA)

5.2.3.1 Number of stem seal adjustment

Mechanical adjustments of stem (or shaft) sealing system during the type test shall be permitted only once, as shown below, for each of qualification stage done according to Figures 4, 5, and 6, if stem (or shaft) leakage has been measured in excess of the target tightness class selected from Tables 1 to 4.

The maximum retightening force (or torque) to apply shall be determined prior to the type test.

EXAMPLE

— A maximum of one adjustment is accepted for CC1 or CO1.

— A maximum of two adjustments is accepted for CC2 or CO2.

— A maximum of three adjustments is accepted for CC3 or CO3.

5.2.3.2 Test failure after stem seal adjustment

If a stem (or shaft) sealing arrangement fails to achieve the target tightness class, or it is not possible to continue mechanical cycling, the test shall be considered terminated, and the test valve shall be evaluated for qualification of lower tightness and endurance classes, if applicable.

5.2.3.3 Reporting the number of SSA

The total number of stem (or shaft) seal adjustment shall be recorded in the test report and indicated in the designation of the valve classification as “SSA-1”, “SSA-2”, and “SSA-3”.

5.2.4 Test description

5.2.4.1 General

The test description is the following:

a) The test valve shall be mounted on a test rig, according to the instructions given by the manufacturer.

b) The valve mounting shall be principally made with a stem (or shaft) positioned vertical. A valve intended for use in other positions shall be mounted with the stem (or shaft) positioned horizontally.

c) All sealing systems shall have been properly adjusted beforehand, according to the manufacturer's instructions. For valves using packings as a stem seal, the tightening torque of the gland boltings shall be measured and recorded at the beginning of the test and after any stem seal adjustment.

d) The target number and combination of mechanical and thermal cycles shall be selected from the endurance classes specified in Figures 4, 5, and 6.

e) Leakage from the stem (or shaft) seal and from the body seals shall be separately measured. If the valve does not allow such a separate measurement, the total leakage of both stem (or shaft) and body seals shall be measured at the same time according to Annex A and Annex B respectively.

f) Actual methods of mechanical cycles other than those specified in 5.2.4.2 and 5.2.4.3 shall be in accordance with the manufacturer's instructions, and opening, closing, and dwelling time shall be recorded in the test report. Basically, they shall represent the intended operating conditions of a test valve.

g) Valve opening and closing force (or torque) shall be measured and recorded at the start and at the end of the test, following subsequent stem seal adjustments if applicable.

5.2.4.2 Mechanical cycles of isolating valves

Unless otherwise specified by the valve manufacturer, the valve seating force (or torque) required for tightness under a differential pressure of 0,6 MPa (6 bar), air or inert gas shall be used as the minimum force (or torque) for mechanical cycle of a test valve.

Fully back seating a test valve is not required.

5.2.4.3 Mechanical cycles of control valves

The stem motion of linear action valves shall be between 1 mm/s and 5 mm/s. The shaft motion of rotary control valves shall be between 1°/s and 5°/s.

The actuator to operate a test valve shall withstand only the pressure and friction force (or torque) acting on the valve stem, and these values shall be recorded.

NOTE Measurement of friction force (or torque) is principally intended to check the packing friction usually expressed as the dead band.

5.2.4.4 Preliminary tests at the room temperature (test 1)

The tests are carried out as shown below.

a) Pressurize a test valve with the test fluid to the test pressure as specified in a relevant standard.

b) After the test pressure has been stabilized, measure leakages both from the stem (or shaft) seal and from the body seals, in accordance with Annexes A and B, respectively.

c) Record the test result in a test report.

5.2.4.5 Mechanical cycle test at the room temperature (test 2)

The tests are carried out as shown below.

a) Perform mechanical cycles at room temperature while the test valve is kept pressurized.

b) Measure the leakage from the stem (or shaft) seal only, in accordance with Annex A.

c) Record the test result in the test report.

d) Repeat the test in case of Class CO1 and CC1, as indicated in Figures 4 and 6.

5.2.4.6 Static test at the selected test temperature (test 3)

The tests are carried out as shown below.

a) Pressurize a test valve with the test fluid to the test pressure as specified in a relevant standard for the selected test temperature selected from Table 5.

b) After the test pressure has been stabilized, adjust the valve temperature to the selected test temperature, ensuring that the test pressure does not exceed the level specified in the relevant standard.

c) After the valve temperature has been stabilized with an allowance of ±5 % with a maximum of 15 °C, measure the leakage from the stem (or shaft) seal only in accordance with Annex A.

d) Record the test result in the test report.

e) Repeat the test in case of Class CO1 and CC1, as indicated in Figures 4 and 6.

5.2.4.7 Mechanical cycle test at the selected test temperature (test 4)

The tests are carried out as shown below.

a) Perform mechanical cycles at the selected test temperature while the test valve is kept pressurized.

b) Measure the leakage from the stem (or shaft) seal only in accordance with Annex A.

c) Record the test result in a test report.

d) Repeat the test in case of Class CO1 and CC1, as indicated in Figures 4 and 6.

5.2.4.8 Intermediate static test at the room temperature (test 5)

The tests are carried out as shown below.

a) Allow a test valve to return to the room temperature, without artificial cooling (or heating).

b) After the valve temperature has been stabilized, measure the leakage from the stem (or shaft) seal only in accordance with Annex A.

c) Record the test result in a test report.

5.2.4.9 Final test at the room temperature (test 6)

The tests are carried out as shown below.

a) Allow a test valve to return to the room temperature, without artificial measures.

b) After the valve temperature has been stabilized, measure the leakage from the stem (or shaft) seal in accordance with Annex A and from body seals in accordance with Annex B.

c) Record the test results in the test report.

5.2.4.10 Post-test examination

After all the tests have been successfully completed, the test valve shall be disassembled and all sealing components shall be visually examined to record notable wear and any other significant observations for information.

5.2.4.11 Qualification

Tested valves shall be qualified when

— all steps of test procedures have been satisfactorily performed for the target performance class, and

— all leakage measurements are verified equal or lower than the values specified for the target performance class.

6 Performance classes

6.1 Classification criteria

Valve operating conditions and hazards of the line fluid being handled can result in different levels of valve emission performance.

The purpose of Clause 6 is to define classification criteria resulting from the type test.

A performance class is defined by the combination of the following criteria:

a) "tightness class": see Tables 1 and 2 (helium as test fluid), Tables 3 and 4 (methane as test fluid);

b) "endurance class": see Figures 4, 5, and 6;

c) "temperature class": see Table 5.

6.2 Tightness classes

6.2.1 Definition

Tightness classes are defined only for stem (or shaft) sealing systems.

Table 1 — Tightness classes for stem (or shaft) seals with helium

Class	Measured leak rate (mass flow)	Measured leak rate (mass flow)	Measured leak rate (volumic flow)	Remarks
	$mg \cdot s^{-1} \cdot m^{-1}$ stem perimeter (for information)	$mg \cdot s^{-1} \cdot mm^{-1}$ stem diameter through stem seal system	$mbar \cdot l \cdot s^{-1}$ per mm stem diameter through stem seal system	
AH[a]	$\leq 10^{-5}$	$\leq 3,14 \cdot 10^{-8}$	$\leq 1,78 \cdot 10^{-7}$	Typically achieved with bellow seals or equivalent stem (shaft) sealing system for quarter turn valves
BH[b]	$\leq 10^{-4}$	$\leq 3,14 \cdot 10^{-7}$	$\leq 1,78 \cdot 10^{-6}$	Typically achieved with PTFE based packings or elastomeric seals
CH[b]	$\leq 10^{-2}$	$\leq 3,14 \cdot 10^{-5}$	$\leq 1,78 \cdot 10^{-4}$	Typically achieved with flexible graphite based packings

a Measured by the vacuum method as defined in Annex A.

b Measured by the total leak rate measurement method (vacuum or bagging) as defined in Annex A.

Table 2 — Leakage from body seals with helium

Measured leakage ppmv
≤50
NOTE Measured by the sniffing method as defined in Annex B.

Table 3 — Tightness classes for stem (or shaft) seals with methane

Class	Measured leakage (sniffing method as described in Annex B) ppmv
AM	≤50
BM	≤100
CM	≤500

Table 4 — Leakage from body seals with methane

Measured leakage (sniffing method as described in Annex B) ppmv
≤50

6.2.2 Helium as test fluid

When the test fluid is helium, the tightness classes are identified as Class AH, Class BH, and Class CH.

6.2.3 Methane as test fluid

When the test fluid is methane, the tightness classes are identified as Class AM, Class BM, and Class CM.

6.2.4 Correlations

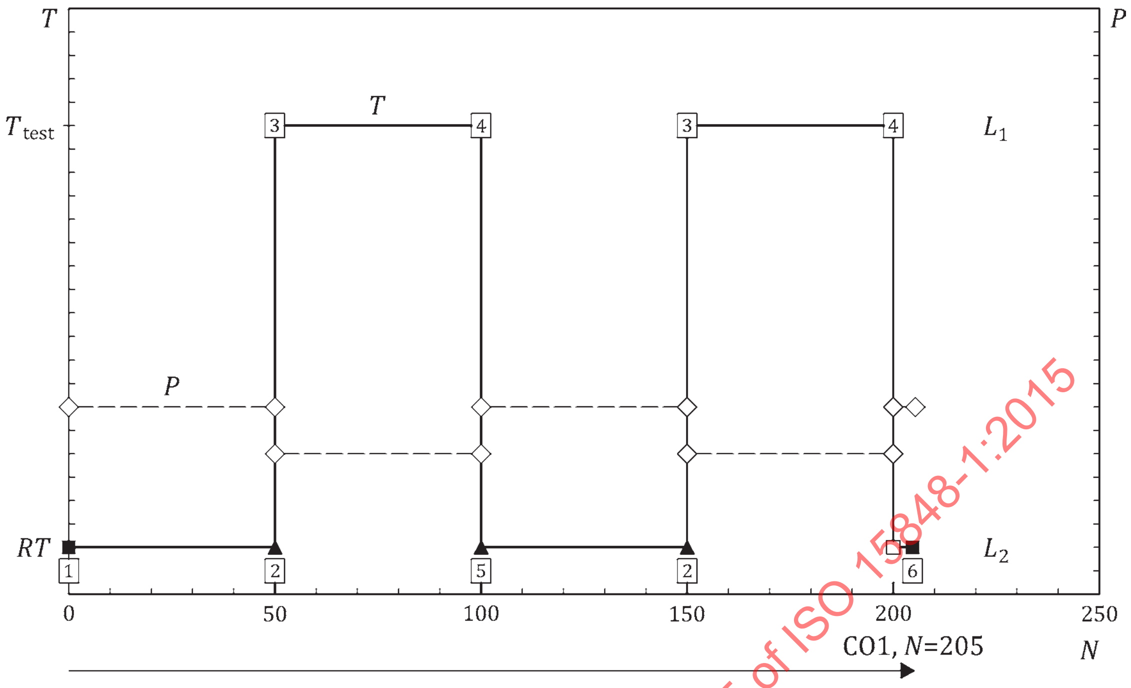
There is no correlation intended between measurements of total leak rate as described in Annex A and local sniffed concentration as described in Annex B.

There is no correlation intended between the tightness classes when the test fluid is helium (Class AH, Class BH, and Class CH) and when the test fluid is methane (Class AM, Class BM, and Class CM).

6.3 Endurance classes

6.3.1 Mechanical-cycle classes for isolating valves

The required minimum number of mechanical cycles for isolating valves shall be 205 cycles (full stroke) with two thermal cycles (a total of 50 cycles at RT, 50 cycles at test temperature, 50 cycles at RT, 50 cycles at test temperature and 5 cycles at RT). This classification stage shall be identified as CO1 (see Figure 4). An extension to classification CO2 shall be accomplished by addition of 1 295 mechanical cycles with one thermal cycle (795 cycles at RT followed by 500 cycles at test temperature). Further extension to CO3, etc. shall be achieved by addition of 1 000 mechanical cycles with one thermal cycle (see Figure 5).



Key

T_{test} test temperature, °C

L_1 measurement of leakage of stem seal

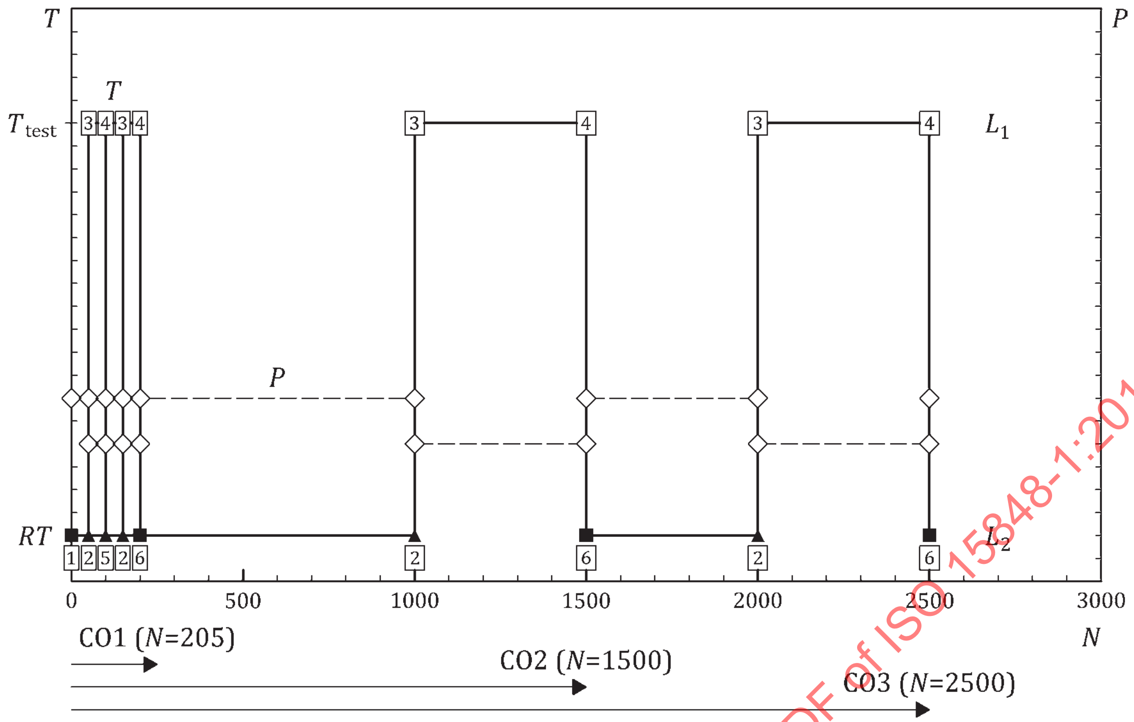
L_2 measurement of leakage of body seal

N number of mechanical cycles

P test fluid pressure

NOTE The numbers 1 to 6 refer to the test sequences test 1 to test 6 as defined in 5.2.4.4 to 5.2.4.9.

Figure 4 — Mechanical-cycle classes for isolating valves (endurance Class CO1)



Key

T_{test} test temperature, °C

L_1 measurement of leakage of stem seal

L_2 measurement of leakage of body seal

N number of mechanical cycles

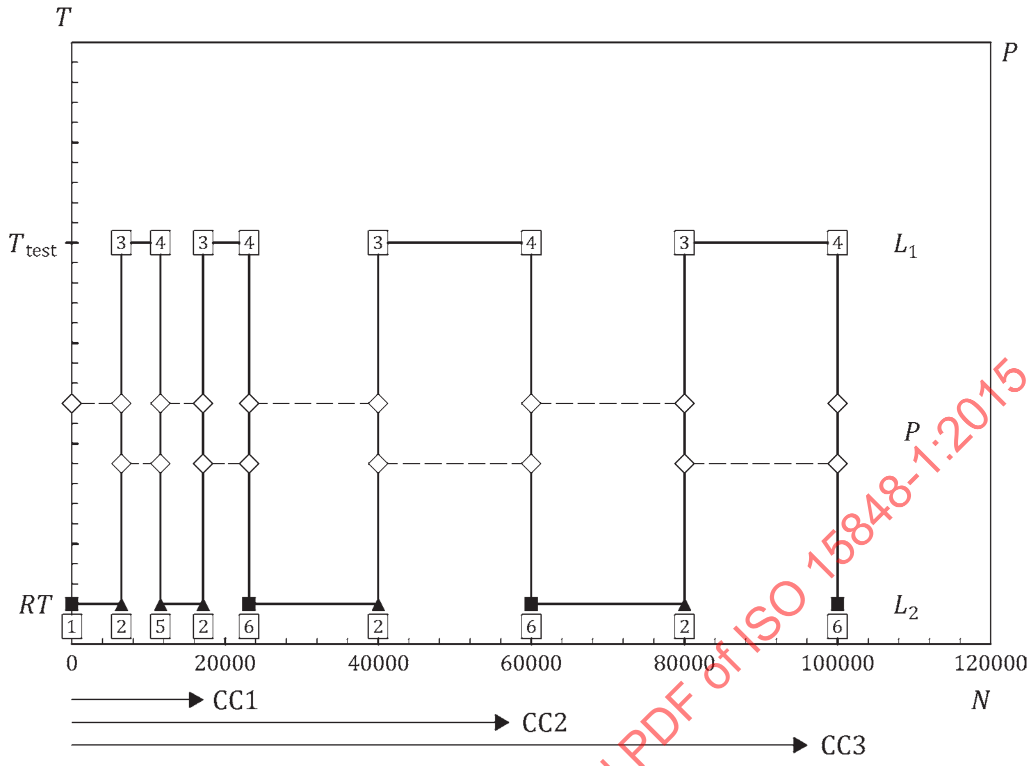
P test fluid pressure

NOTE The numbers 1 to 6 refer to the test sequences test 1 to test 6 as defined in 5.2.4.4 to 5.2.4.9.

Figure 5 — Mechanical-cycle classes for isolating valves (endurance Classes CO2 and CO3)

6.3.2 Mechanical-cycle classes for control valves

The required minimum number of mechanical cycles for control valves shall be 20 000 cycles having two thermal cycles (a total of 10 000 cycles at RT and 10 000 cycles at test temperature). This classification stage shall be identified as CC1. An extension to classification CC2 shall be accomplished by addition of 40 000 mechanical cycles having one thermal cycle (a total of 20 000 cycles at RT followed by 20 000 cycles at test temperature). Further extension to CC3 etc. shall be achieved by repetition of the requirement for CC2 (see Figure 6).



Key

T_{test} test temperature, °C

L_1 measurement of leakage of stem seal

L_2 measurement of leakage of body seal

N number of mechanical cycles

P test fluid pressure

NOTE The numbers 1 to 6 refer to the test sequences test 1 to test 6 as defined in 5.2.4.4 to 5.2.4.9.

Figure 6 — Mechanical-cycle classes for control valves

6.4 Temperature classes

The target temperature class shall be selected from Table 5. If the test is carried out at any temperature other than those specified in Table 5, the next lower class shall apply in case of the test temperature being above zero, or the next higher class shall apply in case of the test temperature being below zero.

EXAMPLE If the test temperature is 405 °C, the value shall be classified as (t400 °C).

Table 5 — Temperature classes

(t-196 °C)	(t-46 °C)	(tRT)	(t200 °C)	(t400 °C)
−196 °C	−46 °C	Room temperature, °C	200 °C	400 °C

All test temperatures shall be recorded in the test report.

— Test at −196 °C qualifies the valve in the range −196 °C up to RT.

— Test at −46 °C qualifies the valve in the range −46 °C up to RT.

— Test at RT qualifies the valve in the range −29 °C to +40 °C.

— Test at 200 °C qualifies the valve in the range RT up to 200 °C.

— Test at 400 °C qualifies the valve in the range RT up to 400 °C.

To qualify a valve in the range −46 °C up to 200 °C, two tests are necessary:

— The test at −46 °C qualifies the valve in the range −46 °C up to RT;

— The test at 200 °C qualifies the valve in the range RT up to 200 °C.

Alternative temperature classes shall be subject to the agreement between the manufacturer and the purchaser.

6.5 Examples of class designation

— tightness class: B (reference in Table 1)

— endurance class:

  — isolating valve CO1 (reference in Figure 4);

  — control valve CC1 (reference in Figure 6).

— temperature class: a test at t200 °C and a test at t−46 °C

— test pressure: according to PN or ANSI class rating depending on a relevant valve standard or in bar at room temperature and at test temperature for specific tests; the standard reference is ISO 15848-1

— number of stem seal adjustments (SSA): 1

6.6 Marking

In addition to the marking required by relevant standards, production valves qualified by type testing in accordance with this part of ISO 15848 can be marked with "ISO FE", which stands for ISO fugitive emission, and the information as indicated in 6.5.

EXAMPLE 1 Performance class: ISO FE BH (or BM) — CO1 — SSA 1 — t(−46°C, 200 °C) — PN 16 — ISO 15848-1.

EXAMPLE 2 Performance class: ISO FE BH (or BM) — CO1 — SSA 1 — t(−46°C, 200 °C) — CL150 — ISO 15848-1.

EXAMPLE 3 In case of specific tests in bars:

Performance class: ISO FE BH (or BM) — CO1 — SSA 1 — t200 °C — (40/30) — ISO 15848-1.

7 Reporting

The test report shall include the following information:

a) name and address of the valve manufacturer;

b) valve sizes and pressure class;

c) valve model number and style;

d) method of sample selection;

e) diagram of the test rig and the data of the test equipment, including the detector make and model or the probe flow rate where any sniffing measurement is quoted;

f) date of test;

g) reference standards with applicable revision numbers;

h) test fluid;

i) valve performance classes achieved;

j) valve mounting instructions;

k) valve repacking before type test to be reported, if applicable;

l) insulation of test valve to be reported, if applicable;

m) valve operation data:

— valve operating torque or force;

— gland bolt tightening torque;

— stroke/angle;

n) description of the actuator, if applicable;

o) copy of the test sequence;

p) detailed results of the test;

q) qualification certificate: the certificate shall indicate the number of the standard and its year of issue (e.g. ISO 15848-1:2015).

The specific product data file including the following information shall be the responsibility of the manufacturer and shall be included as an annex:

a) cross sectional valve assembly drawing;

b) bill of valve materials;

c) stem or shaft seal description, dimensions, and specifications;

d) body seal(s) description, dimensions, and specifications;

e) material specifications of stem (or shaft) seal components;

f) hydrostatic test certificate.

8 Extension of qualification to untested valves

Upon the successful completion of the test program as defined in this part of ISO 15848, this qualification can be extended to untested sizes and classes of valves of the same type, if the following criteria are met:

a) the stem (or shaft) seals and body seals are of the same material, design (shape), and construction, independent of the size;

b) loading arrangement applies a similar sealing stress to the seal element as that applied in the test valve;

c) the type of motion of the stem (or shaft) is identical;

d) tolerances classes and surface finishes specifications of all valve components which affect sealing performance are identical;

NOTE The tolerances classes are in accordance with ISO 286-1 and ISO 286-2.

e) stem diameters are from half to twice the tested valve diameter, half diameter and double diameter included: $D_0/2 \leq D \leq 2\ D_0$ with D_0 being the stem diameter of the tested valve;

f) the valve class or PN designation is equal or lower;

g) the required temperature class falls between the room temperature and the test temperature of the qualified valve;

h) the tightness class required is equal to, or less severe than that of the qualified valve.

The use of gearbox or other actuator does not require separated qualification, provided above criteria are met.

Annex A
(normative)

Total leak rate measurement

A.1 Vacuum method (helium only)

A.1.1 General

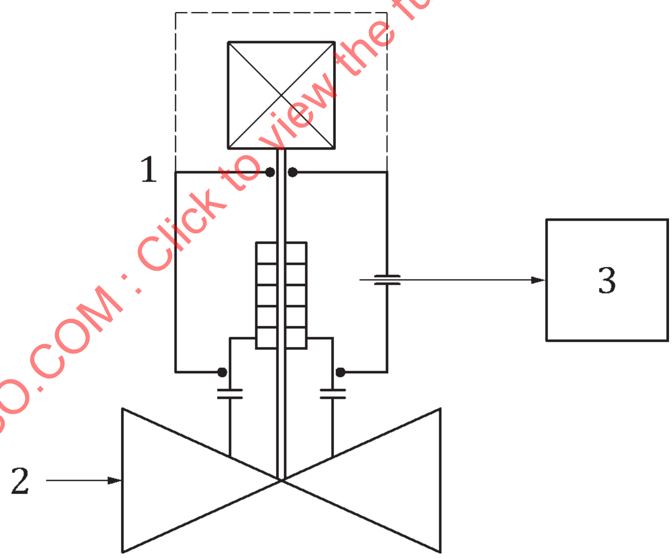
This Clause specifies the vacuum method used to measure the total leak rate of the stem sealing system of an industrial valve in using a helium mass spectrometer.

The test fluid is helium (97 % purity).

A.1.2 Principle

The principle of the vacuum method is illustrated in Figure A.1. The leakage source is enclosed in a tight chamber, which is evacuated and then connected to the helium mass spectrometer.

The tight chamber may be fulfilled by the design of the stem sealing system.



Key

1 vacuum chamber

2 pressurized helium

3 vacuum helium detector

Figure A.1 — Principle of the vacuum method

A.1.3 Equipment and definitions

A.1.3.1 Helium mass spectrometer

The helium mass spectrometer type and main characteristics shall be specified.

The sensitivity of the helium mass spectrometer shall be in accordance with the range of the leak rate to be measured.

The helium mass spectrometer measurement corresponds to the rate at which a volume of helium at specified pressure passes a given cross section of the test system (SI unit: $Pa \cdot m^3 \cdot s^{-1}$).

Then, the leak rate is reported to the outer stem diameter (see A.1.7).

As regards the helium systems, the instrument shall have sensitivity at least $1 \cdot 10^{-9} \cdot mbar \cdot l \cdot s^{-1}$ for helium.

The response time of the helium mass spectrometer is evaluated (or verified) by using the standard calibrated leak. The time is recorded when the standard calibrated leak is opened to the helium mass spectrometer and when the increase in helium mass spectrometer output signal becomes stable.

The elapse time between the helium application and the moment where the reading represents 90 % of the equilibrium signal is the response time of the helium mass spectrometer.

A.1.3.2 Auxiliary pump system

The size of the tested valve can necessitate the use of an auxiliary vacuum pump system. Then the ultimate absolute pressure and pump speed capability shall be sufficient to attain required test sensitivity and response time.

A.1.3.3 Helium pressurization

It shall be possible to apply helium pressure up to the nominal test pressure of the valve.

A.1.3.4 Standard calibrated leak

In order to evaluate the response time of the whole measuring system, the standard calibrated leak connection should be placed on the vacuum enclosure as near as possible to the stem sealing system.

The standard calibrated leak may be either of a permeation or a capillary type. The standard calibrated leak shall be selected depending on the tightness class of the tested valve. Depending on the helium mass spectrometer manufacturer, different standard calibrated leaks exist for one item of equipment:

— a permeation type leak standard, which shall be a calibrated permeation type leak through fused glass or quartz. The standard shall have a helium leakage rate in the range of 1×10^{-6} atm·cm³/s to 1×10^{-10} atm·cm³/s (1×10^{-7} Pa·m³/s to 1×10^{-11} Pa·m³/s);

— a capillary type leak standard, which shall be a calibrated capillary type leak through a tube. The standard shall have a leakage rate equal to or smaller than the required test sensitivity times the actual percent test concentration of the selected tracer gas.

A.1.4 Calibration

A.1.4.1 Helium mass spectrometer

A.1.4.1.1 Warm up

The instrument shall be turned on and allowed to warm up for the minimum time specified by the manufacturer of the instrument prior to calibrating with the calibrated leak standard.

A.1.4.1.2 Calibration

The instrument shall be calibrated as specified by the manufacturer of the instrument using permeation or a capillary type standard.

The helium mass spectrometer shall be calibrated

— at the beginning of each test and routinely if the test takes a long time (e.g. calibration once a week), and

— over the tightness class range required.

A.1.4.2 System calibration

A standard calibrated leak with 100 % helium shall be attached, where possible, to the component as far as possible from the instrument connection to the component (Figure A.2).

The instrument shall be turned on and allowed to warm up for the minimum time specified by the manufacturer of the instrument prior to calibrating with the standard calibrated leak. The standard calibrated leak shall remain open during system calibration until the response time has been determined.

a) Evacuation: with the component evacuated to an absolute pressure sufficient for connection of the helium mass spectrometer to the system, the standard calibrated leak shall remain open during system calibration until the response time has been determined.

b) Response time of the full system: the time is recorded when the standard calibrated leak is opened to the system and when the increase in helium mass spectrometer output signal becomes stable. The elapse time between the helium application and the moment where the reading represents 90 % of the equilibrium signal is the response time of the system. Calibration measurement duration shall be approximately two times the instrument response time.

c) Background reading: background is established after determining response time. The standard calibrated leak is closed to the system and the instrument reading shall be recorded when it becomes stable.

A.1.5 Requirements for the test

A.1.5.1 Tight chamber

The tight chamber shall be tight enough to enhance the establishment of a vacuum warranting the measurement accuracy.

The tight chamber shall be so sized as to allow the valve actuator to be moved. During heating, the inside of the tight chamber should be ventilated, or the tight chamber can be removed to stabilize the temperature and avoid any overheating of the valve body that is not representative of real operating conditions.

A.1.5.2 Instrumented stem sealing system

It shall meet the same tightness requirements as the tight chamber.

In addition, the operator shall check that

— the vacuum tap is correctly positioned for leak rate measurement, and

— the vacuum tap remains unclogged throughout the test.

In addition, the sealing of instrumented stem sealing system shall withstand the temperature and mechanical cycling conditions required during testing (durability conditions).

While the stem sealing system is being instrumented, the modifications made on the gland shall maintain operating conditions representative of the real valve stem operation.

A.1.5.3 Pollution and packing degradation

Provision shall be made for a filter to protect the helium mass spectrometer against any pollution, which might result from packing degradation products and make the leak measurement erroneous.

It is also recommended to properly establish a vacuum within the spectrometer prior to any measurement, so that to ensure the absence of any pollution and possibly eliminate it.

A.1.5.4 Safety

All accessories used to contain pressure in the valve body (flanges, bolting, all fittings, etc.) shall be suitable for test pressure and temperature.

The valve to be tested shall be carefully fastened before pressurization and cycling.

The pressure inside the valve body shall be increased slowly.

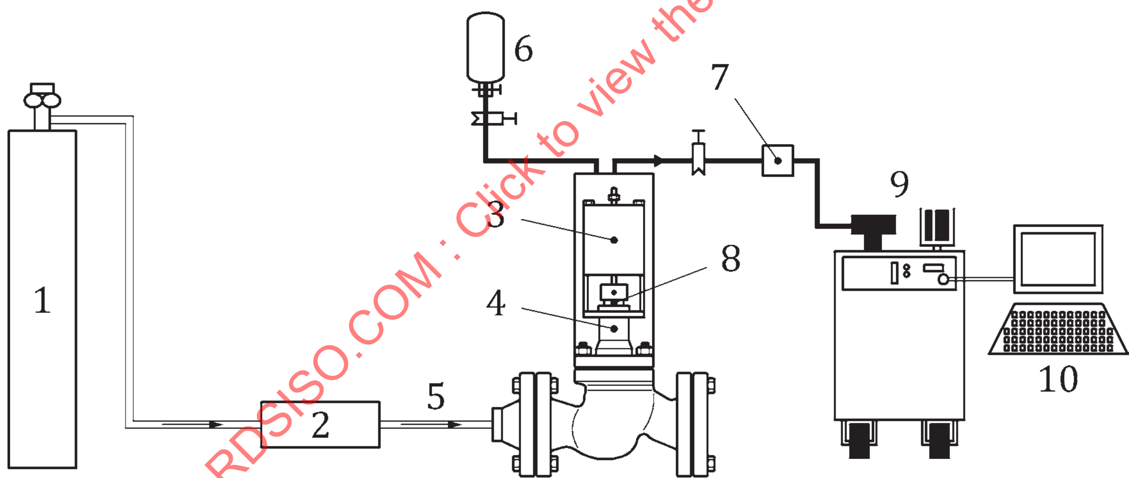
A.1.5.5 Personnel qualification

This method shall be applied by qualified and suitably trained operators.

A.1.6 Testing procedure

A.1.6.1 Test set-up

The test set-up is shown schematically in Figure A.2.



Key

1	helium at 97 % purity	6	standard calibrated leak
2	pressure control	7	vacuum breaker (optional)
3	actuator	8	tested stem sealing
4	vacuum	9	helium mass spectrometer
5	helium	10	data acquisition

Figure A.2 — Equipment

A.1.6.2 Preparation of the tested valve

Before each test

— the valve is cleaned and dried, and

— the packing tightening checked.

The hydrostatic test shall be performed before testing the valve in high pressure and high temperature conditions.

After the hydrostatic test, the packing shall be dry before any sealing test (when using packing in the stem sealing system). It is recommended that the packing is replaced.

If the tight chamber encloses the entire valve, connection flanges shall be welded to avoid any leaks that come from them. In this case, the measurements correspond to the leaks from stem sealing system and body seals.

A.1.6.3 Calibration

See A.1.4.

A.1.6.4 Measurement

The measurement is carried out as follows:

a) establishment of a vacuum inside the tight chamber and connection of the helium mass spectrometer to the tight chamber;

b) determination of the system response time (e.g. by use of a calibrated leak as shown in Figure A.2);

c) helium background levels recording;

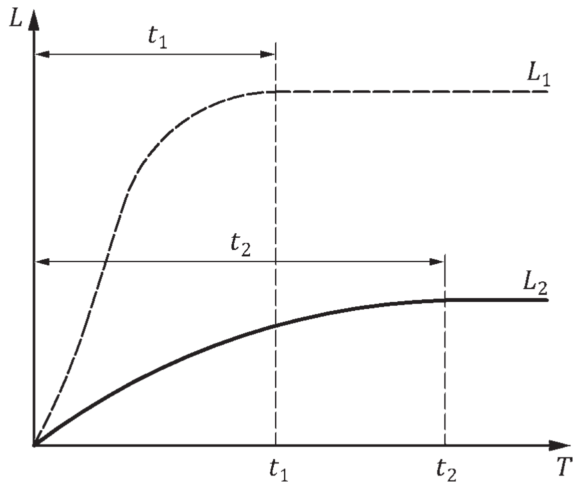
d) valve pressurization;

e) test temperature stabilization;

f) leak recording;

g) leak stabilization (see Figure A.3);

h) leak measurement.



Key

L leak rate, in milligrams per second per metre

L_1 leakage 1

L_2 leakage 2

T time, in seconds

t_1 stabilization time t_1

t_2 stabilization time t_2

Figure A.3 — Examples of stabilization times for leaks measured using the global method

A.1.7 Leak rate calculation

The vacuum method allows the measurement of the total (global) leak rate of the stem sealing system.

The measurement L_v is expressed in millibars litre per second.

The mass flow rate, L_m, expressed in milligrams per second, is calculated from L_v by the following formula:

$$L_m = L_v \times 0{,}164 \quad \text{(A.1)}$$

from EN 1779:1999, Annex B, at 298 °K.

Then the leak rate, L_{mm}, expressed in milligrams per second per millimetre stem outside diameter, is calculated from L_m by the following formula:

$$L_{mm} = \frac{L_m}{OD_{stem}} \quad \text{(A.2)}$$

where

OD_{stem} is the stem outside diameter, expressed in millimetres.

A.2 Bagging method (helium only)

A.2.1 General

This Clause specifies the bagging method used to measure the total leak rate of the stem sealing system of an industrial valve using a helium mass spectrometer.

The test fluid is helium (97 % purity).

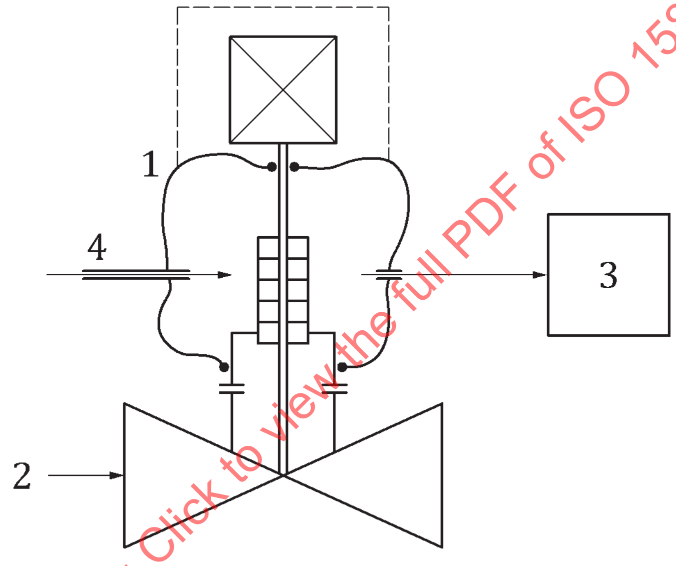
Two methods can be used to measure the leak rate of the stem sealing system by bagging:

— the accumulation method as described in EN 13185:2001, 10.4;

— the "Suck Through Method" as described in Reference [14] and below.

A.2.2 Principle ("Suck Through Method")

The principle of the "Suck Through Method" is illustrated in Figure A.4. The leakage source is enclosed by a bagged volume. This volume, or bag, is connected to helium mass spectrometer through a constant flow rate detector probe (sniffer). The extracted volume is replenished through a balancing tube with a length at least 50 times the probe inside diameter, connected to atmosphere. Air passes through the bag, where it mixes with the leakage stream of the test gas. Then, it passes down the sniffer probe to the instrument detector. All leaked test gas passes through the helium mass spectrometer.



Key

1 bagged volume

2 pressurized helium

3 helium detector

4 balancing tube

Figure A.4 — Principle of the bagging method (Suck Through Method)

A.2.3 Equipment and definitions

A.2.3.1 Helium mass spectrometer

The helium mass spectrometer type and main characteristics shall be specified.

The sensitivity of the helium mass spectrometer shall be in accordance with the range of the leak rate to be measured.

The helium mass spectrometer measurement corresponds to the rate at which a volume of helium at specified pressure passes a given cross section of the test system.

Then, the leak rate is reported to the stem outside diameter (see A.2.7).

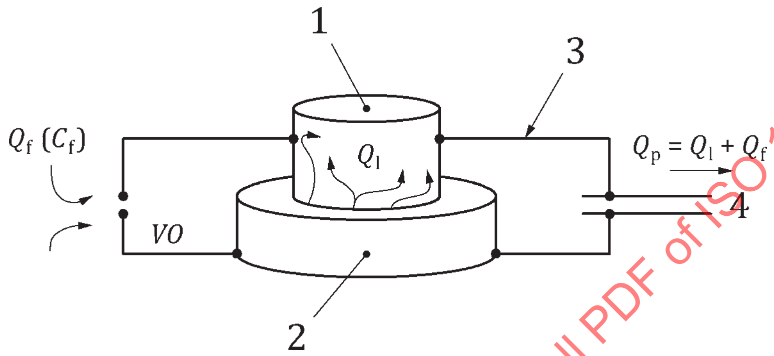
As regards the helium systems, the instrument shall have a sensitivity of at least $1 \cdot 10^{-9}$ mbar·l·s^{-1}. When using the bagging method with a sniffer, the sensitivity shall be at least $1 \cdot 10^{-7}$ mbar·l·s^{-1}.

The response time of the helium mass spectrometer is evaluated (or verified) in using the standard calibrated leak. The time is recorded when the standard calibrated leak is opened to the helium mass spectrometer and when the increase in helium mass spectrometer output signal becomes stable.

The elapse time between the helium application and the moment where the reading represents 90 % of the equilibrium signal is the response time of the helium mass spectrometer.

A.2.3.2 Bagged volume

The stem sealing system is as presented in Figure A.5.



Key

1 valve stem

2 valve body

3 bagged volume

4 to detector

Figure A.5 — Sealed volume

The hypothesis is that the concentration level found by the detector is representative of the concentration throughout the volume *VO*.

A preliminary measurement with a standard leak in the volume *VO* allows to verify this hypothesis and to estimate the system response time (time required to obtain a stable signal that corresponds at least to 90 % of the leak).

The increased concentration of the tracer gas is the balance of inflow and outflows collected by the detector (neglecting leakage of bagging).

The concentration C in the bag is measured continuously up to stabilization C_∞.

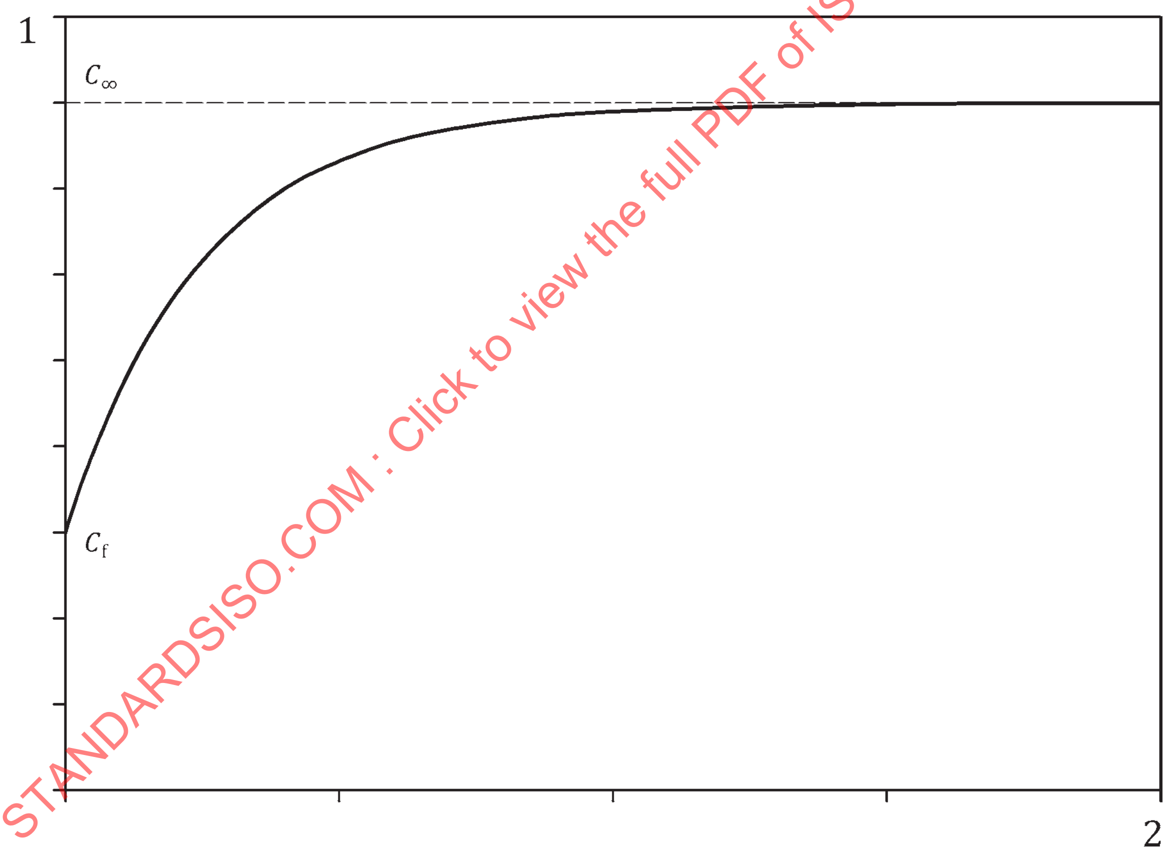
Based on Reference [14], the calculated Q_l is expressed by the following formula:

$$Q_l = \frac{(C_\infty - C_f) \times Q_p}{(1 - C_f)} \tag{A.3}$$

where

- C is the concentration in the bag;
- C_∞ is the stabilized C versus time;
- C_f is the concentration of the inflow;
- Q_f is the inflow rate;
- Q_l is the leakage flow rate;
- Q_p is the flow rate of the pump of the helium mass spectrometer.

A graphical presentation of C_∞ is given in Figure A.6.



Key

1 reading of the helium mass spectrometer, in millibar litre per second (mbar·l·s^{-1})

2 time, in second (s)

Figure A.6 — Graphical representation of reading

If C_f is negligible (typical concentration of helium in the air) and the flow probe, Q_p, is equal to 1 cm^3·s^{-1}, the reading of the helium mass spectrometer is close to the leak rate, Q_l.

A.2.4 Calibration

A.2.4.1 Helium mass spectrometer

A.2.4.1.1 Warm up

The instrument shall be turned on and allowed to warm up for the minimum time specified by the manufacturer of the instrument prior to calibrating with the calibrated leak standard.

A.2.4.1.2 Calibration of the helium mass spectrometer

The instrument shall be calibrated as specified by the manufacturer of the instrument using permeation or a capillary type standard.

The helium mass spectrometer shall be calibrated

— at the beginning of each test and routinely if the test takes a long time (e.g. calibration once a week), and

— over the tightness class range required.

A.2.4.2 System calibration

A standard calibrated leak with 100 % helium shall be attached, where possible, to the component as far as possible from the instrument connection to the component (Figure A.7).

The instrument shall be turned on and allowed to warm up for the minimum time specified by the manufacturer of the instrument prior to calibrating with the standard calibrated leak.

a) The valve stem shall be positioned such that the bag is at its maximum contained volume and at its maximum length. The standard calibrated leak shall remain open during system calibration until the response time has been determined.

b) Response time of the full system: the time is recorded when the standard calibrated leak is opened to the system and when the increase in helium mass spectrometer output signal becomes stable. The elapse time between the helium application and the moment where the reading represents 90 % of the equilibrium signal is the response time of the system. Calibration measurement duration shall be approximately two times the instrument response time.

c) Background reading: background is established after determining response time. The standard calibrated leak is closed to the system and the instrument reading shall be recorded when it becomes stable.

A.2.5 Requirements for the test

A.2.5.1 Sealed volume

The sealed volume, or bag, shall be tight enough and fitted with a balancing tube long enough to ensure all leakage is collected warranting the measurement accuracy.

The bag shall be sized and attached, so that to allow the valve actuator to be moved.

To replenish the extracted volume by the sniffer probe, a balancing tube of at least 50 probe-diameter-length is connected to the bag, with the inlet connected to open air.

A.2.5.2 Instrumented stem sealing system

Piping, tubing, and hose connections between the sniffer probe and helium mass spectrometer shall be capable of sealing against internal vacuum.

Pick up and record the test temperature before the measurement.

In addition, the sealing of instrumented stem sealing system shall withstand the temperature and mechanical cycling conditions required during testing (durability conditions).

While the stem sealing system is being instrumented, the modifications made on the gland shall maintain operating conditions representative of the real valve stem operation.

A.2.5.3 Pollution and packing degradation

Provision shall be made for a filter to protect the helium mass spectrometer against any pollution, which might result from packing degradation products, and make the leak measurement erroneous.

A.2.5.4 Safety

All accessories used to contain pressure in the valve body (flanges, bolting, all fittings, etc.) shall be suitable for test pressure and temperature.

The valve to be tested shall be carefully fastened before pressurization and cycling. The pressure inside the valve body shall be increased slowly.

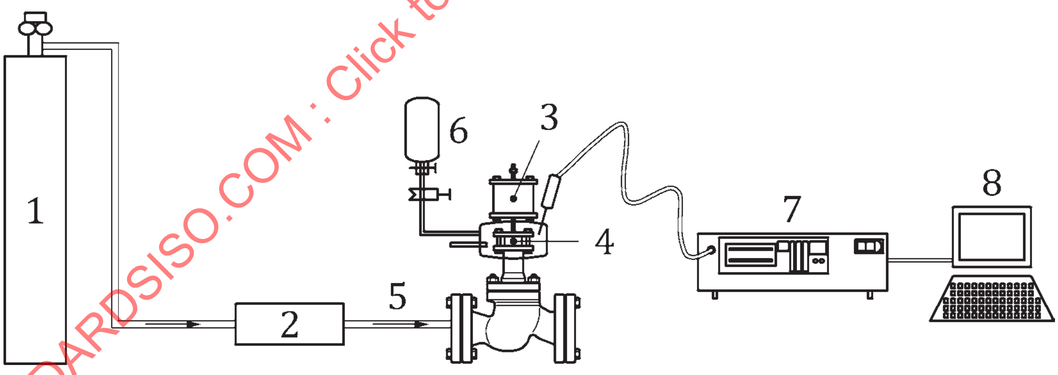
A.2.5.5 Personnel qualification

This method shall be applied by qualified and suitably trained operators.

A.2.6 Testing procedure

A.2.6.1 Test set-up

The test set-up is shown schematically in Figure A.7.



Key

1 helium at 97 % purity
2 pressure control
3 actuator
4 sealed volume or bag
5 helium
6 standard calibrated leak
7 helium mass spectrometer
8 data acquisition

Figure A.7 — Equipment

A.2.6.2 Preparation of the tested valve

Before each test

— the valve is cleaned and dried, and

— the packing tightening checked.

The hydrostatic test shall be performed before testing the valve in high pressure and high temperature conditions.

After the hydrostatic test, the packing shall be dry before any sealing test (when using packing in the stem sealing system). It is recommended that the packing is replaced.

A.2.6.3 Calibration

See A.2.4.

A.2.6.4 Measurement

The measurement is carried out as follows:

a) establishment of a pressure-balanced sealed volume and connection of the helium mass spectrometer probe to the sealed volume;

b) determination of the system response time in accordance with A.2.4.2 (e.g. by use of a calibrated leak as shown in Figure A.7);

c) helium background levels recording;

d) valve pressurization;

e) test temperature stabilization;

f) leak recording;

g) waiting for leak stabilization (Figure A.6);

h) leak measurement.

A.2.7 Leak rate calculation

The bagging method allows the measurement of the total (global) leak rate of the stem sealing system.

The measurement L_v, is expressed in millibars litre per second (mbar·l·s^{-1}).

The leak rate, L_{vm}, expressed in millibars litre per second per millimetre stem outside diameter (mbar·l·s^{-1}·mm^{-1}), is calculated from L_v by the following formula:

$$L_{vm} = \frac{L_v}{OD_{stem}} \tag{A.4}$$

where

OD_{stem} is the the stem outside diameter, expressed in millimetres.

If required, the mass flow rate, L_m, expressed in milligrams per second, is calculated from L_v by the following formula:

$$L_m = L_v \times 0{,}164 \tag{A.5}$$

from EN 1779:1999, Annex B, at 298 °K.

Then the leak rate, L_{mm}, expressed in milligrams per second per millimetre stem outside diameter, is calculated from L_m by the following formula:

$$L_{mm} = \frac{L_m}{OD_{stem}} \tag{A.6}$$

where

OD_{stem} is the stem outside diameter, expressed in millimetres.

Annex B
(normative)

Leak measurement using the sniffing method

B.1 Helium as test fluid

B.1.1 General

This Clause specifies the use of a helium leak detector, fitted with a detector probe (sniffer), to measure helium concentration due to emissions from stem sealing systems and body seals.

The test fluid is helium.

The measurements are made according to the principle described in EPA procedure 21 (see Reference [15]).

B.1.2 Terms and definitions

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

B.1.2.1
leak definition concentration
local helium concentration at the surface of a leak source that indicates that a leak is present

B.1.2.2
calibration gas
concentration approximately equal to the leak definition concentration

B.1.2.3
no-detectable emission
any helium concentration at a potential leak source (adjusted for local helium ambient concentration) that is less than a value corresponding to the instrument readability specification of B.1.4.1.1 and which indicates that a leak is not present

B.1.2.4
calibration precision
degree of agreement between measurements of the same known value, expressed as the relative percentage of the average difference between the meter readings and the known concentration to the known concentration

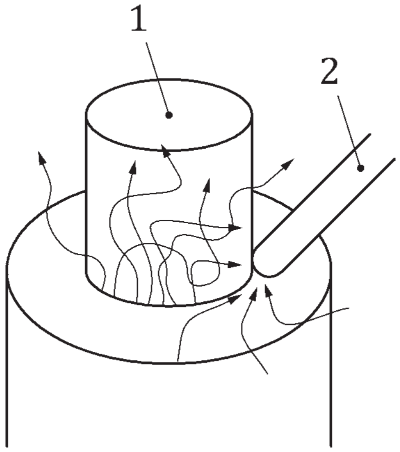
B.1.2.5
response time
time interval from a step change in helium concentration at the input of the sampling system to the time at which 90 % of the corresponding final value is reached as displayed on the instrument readout master

B.1.3 Principle

A portable instrument is used to detect leaks from valves. The instrument detector type is not specified, but the selected detector and its sensitivity shall be able to meet the tightness class limits. This procedure is intended to locate and classify leaks only, and is not used as a direct measure of mass emission rates from individual sources.

The detector probe (sniffing) method, see Figure B.1 and Figure B.2, allows the measurement of the local emission of the stem sealing system and body seals.

The measured concentration can be expressed in parts per million volume (ppmv).

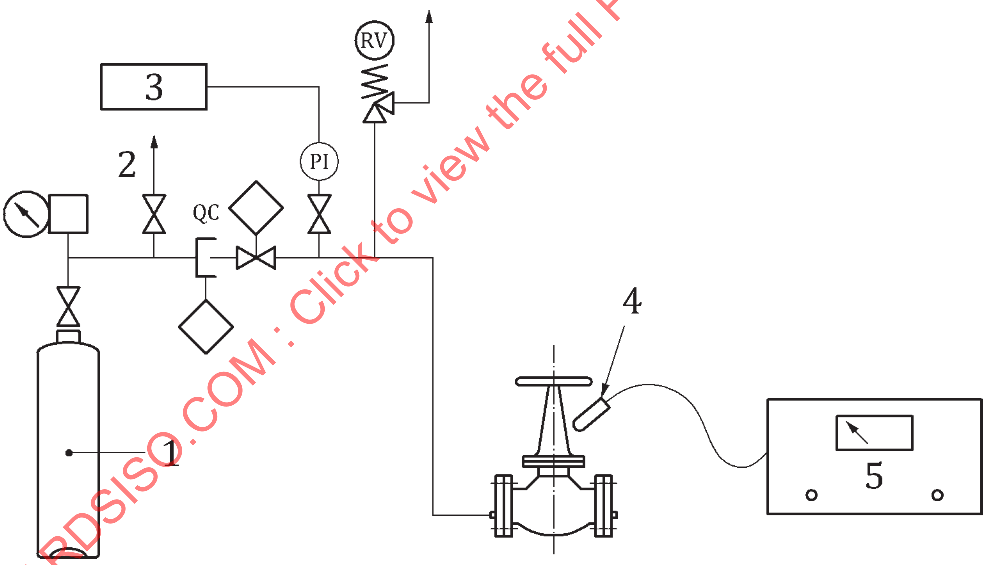


Key

1 valve stem

2 probe

Figure B.1 — Local measurement sniffing



Key

1 helium gas supply

2 vent

3 pressure recorder

4 probe

5 mass spectrometer

QC quick coupling

RV relief valve

PI pressure sensor

Figure B.2 — Local measurement by sniffing method

B.1.4 Apparatus

B.1.4.1 Monitoring instrument

B.1.4.1.1 Specifications

The helium instrument detector type may include, but is not limited to, mass spectrometry, infrared absorption, and molecular screening.

Both the linear response range and the measurable range of the instrument shall encompass the leak definition concentration specified in the regulation. A dilution probe assembly can be used to bring the helium concentration within this range, however, the specification for helium sample probe diameter shall still be met.

The scale of the instrument meter shall be readable to ±2,5 % of the specified leak definition concentration when performing a no-detectable emission survey.

The instrument shall be equipped with an electrically driven pump to ensure that a sample is provided to the detector at a constant flow rate. The probe flow rate shall be between 0,5 $l·min^{-1}$ and 1,5 $l·min^{-1}$. Typical value of probe flow rate (used for this International standard) for helium mass spectrometer is 1 $cm^3·s^{-1}$.

The instrument shall be equipped with a probe or probe extension for sampling not to exceed 6,4 mm in outside diameter, with a single end opening for admission of sample.

B.1.4.1.2 Performance criteria

The instrument pump, dilution probe (if any), sample probe and probe filter, which is used during testing, shall all be in place during the response time determination.

The calibration precision shall be equal to or less than 10 % of the calibration gas value.

B.1.4.1.3 Performance evaluation requirements

The calibration precision test shall be completed prior to placing the analyser into service, and at subsequent three-month intervals or at the next use, whichever is later.

B.1.4.2 Calibration gases

The monitoring instrument is calibrated in terms of parts per million by volume (ppmv) of helium specified in the applicable regulation.

The calibration gases required for monitoring and instrument performance evaluation are a zero gas (air, less than 10 ppmv helium) and a calibration gas in air mixture approximately equal to the leak definition specified in the regulation.

Alternatively, the monitoring instrument can also be calibrated in terms of $Pa·m^3/s$ or mbar·l/s of helium specified in the applicable regulation. In this case, calibration leak standards can be either a permeation or capillary type standard.

The type of leak standard used shall be established by the instrument or system sensitivity requirement, or as specified by the applicable regulation.

— A permeation type leak standard shall be a calibrated permeation type leak through fused glass or quartz. The standard shall have a helium leakage rate in the range of 1×10^{-6} $mbar·l·s^{-1}$ to 1×10^{-10} $mbar·l·s^{-1}$ (1×10^{-7} $Pa·m^3·s^{-1}$ to 1×10^{-11} $Pa·m^3·s^{-1}$).

— A capillary type leak standard shall be a calibrated capillary type leak through a tube. The standard shall have a leakage rate equal to or smaller than the required test sensitivity times the actual percent test concentration of the selected tracer gas.

