API STANDARD 6Y - Fugitive Emissions Testing on Pipeline and Wellhead Equipment used in the Petroleum and Natural Gas Industries

FIRST EDITION – XXXXXXXXXX 202X

Precautions

Warning – Depending on the design of the test valve and/or the nature of the test itself, the potential exists for a rupture of the pressure boundary components during testing. Protection for test personnel must be provided.

Caution – This test procedure has provisions for testing with flammable gases. Proper safety protocols must be implemented

The emissions leak test system shall conform to all local and governmental safety standards and should be equipped with pressure relief valve(s) and rupture disc and vents.

1. Scope

This standard identifies the requirements for testing of valves where fugitive emission of methane at pressures up to 20,000 psi is a consideration. Factors affecting fugitive emissions performance that are considered by this standard include temperature, pressure, and thermal and mechanical cycling. Through bore valve leakage is outside the scope of this document.

In this specification, product is expressed in U.S. customary (USC) for product and pressures and metric (SI) units for test and acceptance criteria.

2. Normative References

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

ISO 15848-1 Industrial Valves Measurement test and qualification procedures for fugitive emissions

3. Terms, Definitions, Acronyms, and Symbols

For the purposes of this standard, the following definitions shall apply.

3.1. Terms and Definitions

3.1.1. axial
In the direction of a shaft or stem axis.

3.1.2. body seal
Any seal in pressure containing part except stem (or shaft) seals

3.1.3. die-formed packing
A valve stem packing typically constructed from ribbons of graphite tape or braided packing that has been subjected to pre-compression with tooling of a specific geometry. This process changes the shape and density of the material from its original free shape and natural density to a defined shape and higher density.

3.1.1. fugitive emissions
Gaseous leak given off to the environment by a piece of equipment. Used in reference to volatile organic hydrocarbons (VOCs) and expressed as either a concentration or a rate (e.g. ppm or mol/sec)
Note: This does not address through bore valve leakage

3.1.2. gland
A movable part which protrudes into a seal box to compress a packing set or packing ring.

3.1.3. gland load
The amount of load applied to a packing set.

3.1.4. leak
Measurable amount of test gas escaping from the system.

3.1.5. leak rate
The quantity of test gas passing through (or around) a seal system in a given period of time.

3.1.6. mechanical cycle
For an on/ off valve: A motion of the stem simulating the movement of a valve closure member (such as disc or ball) from the fully closed position to the fully open position and returning to the fully closed position or from the fully open position to the fully closed position and returning to the fully open position.

For a control or choke valve: A motion of the stem simulating the movement of a valve closure member (such as disc or ball) plus and minus 10% from mid-point of the stroke.

3.1.7. packing set
A seal ring or grouping of individual packing rings designed to fill the cavity of the valve seal box.

3.1.8. rising stem valve
A valve in which the movement of the stem is in an axial direction, without rotation

3.1.9. rotating stem valve
A valve in which the movement of the stem is in rotation

3.1.10. rising – rotating valve
A valve in which the movement of the stem is in an axial direction, with rotation.

3.1.11. Stem/shaft
A metal shaft that connects the closure member (such as a disc or ball) of a valve to a lever, gear, or actuator.

3.1.12. stroke
One half of a mechanical cycle starting from either a fully open or fully closed position. See also, mechanical cycle.

3.1.13. Seal adjustment
increasing the seal preload/compression by mechanical means or by the injection of a sealant into the seal system in accordance with the manufacturer's procedure.

3.1.14. seal box
A space into which a sealing system is inserted.

3.2. Acronyms, Abbreviations, Symbols, and Units

CC Mechanical Cycle Class for Control Valves
CK Mechanical Cycle Class for Chokes
CO Mechanical Cycle Class for On/Off Valves
DOM Date of Manufacture
FE Fugitive Emissions
HT High Temperature
LT Low Temperature
AT Ambient Temperature
ppm parts per million

ppmv parts per million volumetric
VOC Volatile Organic Compound

4. Type Test

4.1. Test Conditions

4.1.1. Test Equipment

WARNING: Testing of valves is potentially hazardous, and it is essential that the safety of personnel be given prime consideration. Given the nature of this test, hazardous release of pressurized gas could occur. The test facility shall be designed to ensure that all the test conditions are conducted in a safe and protected environment.

The test facility shall be designed to ensure that all the test operations are conducted in a safe and protected environment appropriate for the test conditions. It is the responsibility of the test facility to analyze the hazards resulting from the pressure and temperatures and take proper safety precautions.

All equipment shall be suitable to withstand the minimum and maximum pressures and temperatures in the testing environment.

Hoses or pipes used for inlet and outlet supply of the test gas shall be suitable for maximum pressures and temperatures. Where hoses are used, appropriately designed restraints shall be used to prevent hose detachment from the test rig in the event that a blowout occurs.

All testing shall be in accordance with local and national codes and regulations.

4.1.2. Personnel

Personnel performing emission testing shall be qualified in accordance with the manufacturer's documented training program which is based on the Level 1 requirements specified in ISO 9712 or ASNT SNT-TC-1A for the tracer gas method.

4.1.3. Preparation of a valve to be tested

A valve to be tested shall complete a standard factory acceptance test to the applicable industry standards prior to performing the fugitive emissions test. If the factory acceptance test is performed with liquid, care shall be taken to remove any remaining liquids from the valve prior to testing per this procedure. When lubricant is used for assembly of pressure-controlling or containing parts, the lubricant shall not exceed the viscosity range of SAE 10W motor oil or equivalent. The valve body shall not be packed with grease or lubricants.

The sealing system manufacturer shall document the parameters associated with performance and manufacture, such as materials, dimensions, tolerances, and manufacturing process controls.

The test valve shall orient the stem in a horizontal position unless the valve is designed to only install the stem in a vertical position in the field.

The test actuator(s) shall not apply any transverse forces, such as side load, to the test stem outside of normal production allowable.

The sealing system shall be installed according to the manufacturer's standard installation instructions. Packing gland torque shall be verified and, if necessary, adjusted to be in accordance with manufacturer's published installation specifications.

Note: This procedure is written for testing of a complete valve assembly.

4.1.4. Seal Adjustment

If the manufacturer's selected tightness class leakage is exceeded, as measured in section 5.1, seal adjustments may be made, at any point during the test, as follows:

- A maximum of one adjustment is accepted for endurance class 1.
- A maximum of two adjustments is accepted for endurance class 2.
- A maximum of three adjustments is accepted for endurance class 3.

NOTE Refer to Section 5.3 for details on endurance classes

Mechanical cycling may be suspended during adjustment and the test equipment (e.g. valve or fixture) may be depressurized.

After a seal adjustment, the test shall be continued from the point of suspension at the test conditions (temperature, pressure, cycle count).

Seal adjustments shall in accordance with the product specification for the valve and shall be recorded on the test record.

Note/Example: Adjusting packing gland torque, change in clearance height between bonnet and gland flange.

Refer to Section 4.1.8 if leakage exceeds the manufacturer's selected tightness class after the permitted adjustments.

4.1.5. Test Gas

The test gas shall be selected from one of the following:

a) Methane (not suitable for testing below –50°C (-58 °F))

  - minimum 97% purity for AT pressure ratings below 1600 psi (up to ANSI/ASME Class 600)
  - 10% trace of Methane in Nitrogen for AT pressure rating of 1600 psi or above (i.e. ANSI/ASME 900 and above)

b) Helium with minimum 97% purity (for testing at any temperature)

c) Argon with minimum 97% purity (not suitable for testing below –170 °C (-274 °F))

d) Nitrogen with 10% trace of Helium (not suitable for testing below -190 °C (-310 °F))

Caution: Methane is a flammable gas which requires that appropriate measures be taken during testing

4.1.6. Test Temperature

4.1.6.1. General
Temperature shall be considered stabilized when it has been in the required temperature range for 10 minutes. For high temperature tests, the temperature shall be maintained at or above the target temperature throughout the test. For low temperature tests, the temperature shall be maintained at or below the target temperature throughout the test.

4.1.6.2. Temperature Monitoring:

The test temperatures shall be continuously monitored and recorded. The controlling temperature shall be measured in contact with the equipment and within 13 mm (1/2 in.) of the bore. For production valves without thermocouple ports, the thermocouple may be placed in a test flange within ½" of the valve bore. The temperature on the outside of the valve shall be measured on the valve body and near the stem seals for reference.

4.1.7. Test Pressure

Test pressure shall be the rated working pressure at the test temperature as specified by the manufacturer. Rated working pressure shall be defined by the applicable industry standard.

Maintain minimum of 100% of test pressure during stroking.
Note: Manufacturer may need to include accumulation to account for volume changes depending on the valve design.

Test pressure shall be considered stabilized when the rate of change is no more than 5% of the test pressure per hour or 500 psi, whichever is less.

4.1.8. Leakage Measurement

Static and dynamic leak measurements shall be taken at the beginning of the test and at established intervals throughout the test, per section 5.3.

The leak measurement instrument shall be adjusted to compensate for the background test gas level. The static/dynamic leakage shall be recorded after a time delay of twice the response time of the instrument.

To ensure leak measurements are conducted in still air, all potential leak paths shall be shielded from environmental impacts with a foil (or similar) enclosure. The enclosure for the stem seal shall include both the stem outside diameter and stem seal outside diameter. Additional enclosures shall be used for each external leak path and connection. The valve shall not be backseated during leakage measurement.

Leakage measurements shall be taken within the enclosure(s). For each measurement, a minimum of ten (10) readings shall be taken over a 1-minute duration. The maximum reading shall be recorded. If the maximum reading is more than 50 percent (50 %) greater than the average of the ten, except for when the average leakage rates are less than 10 ppmv, the readings shall be repeated.

Any leak measurement that exceeds the allowable during the test constitutes failure of the valve. Leakage from end connections or test apparatus does not constitute valve failure but shall be corrected prior to continuing the test. If it is not possible to meet the leakage requirements, the test shall be terminated, and the valve can be rated to a lower endurance or tightness class if it met all requirements for that class.

4.1.9. Mechanical Cycles

4.1.9.1. General

The operating rate and stroke shall be recorded in the test report.

4.1.9.2. Mechanical cycles for On/Off valves

The cycling shall simulate the full design stroke intended for the valve in service. For the purpose of a full mechanical cycles, rising stems, shall not be required to bottom out or backseat during endurance cycling. For force or torque seated valves, the valve closing force or torque as defined by the manufacturer at the test pressure shall be applied during each mechanical cycle.

4.1.9.3. Mechanical cycles of control and choke valves

The test valve shall be equipped with an actuator capable of stroking the test stem to simulate the mechanical cycle of a valve as follows.

a) Rising stem:
   Stroke: +/- 10% of full stroke starting from the midpoint

b) Rotating stem:
   Rotation: +/- 10° ± 2° from mid stroke

c) Rising and Rotating stem:
   Stroke: +/- 10% of full stroke starting from the midpoint
   or
   Rotation: +/- 10° ± 2° from mid stroke.

4.2. Test Procedure

4.2.1. General

The following steps apply to type testing. See Annex A for production tests when specified.
Figure 1 shows the test steps detailed in this section. Reference Section 5.3 for endurance class mechanical cycle requirements.

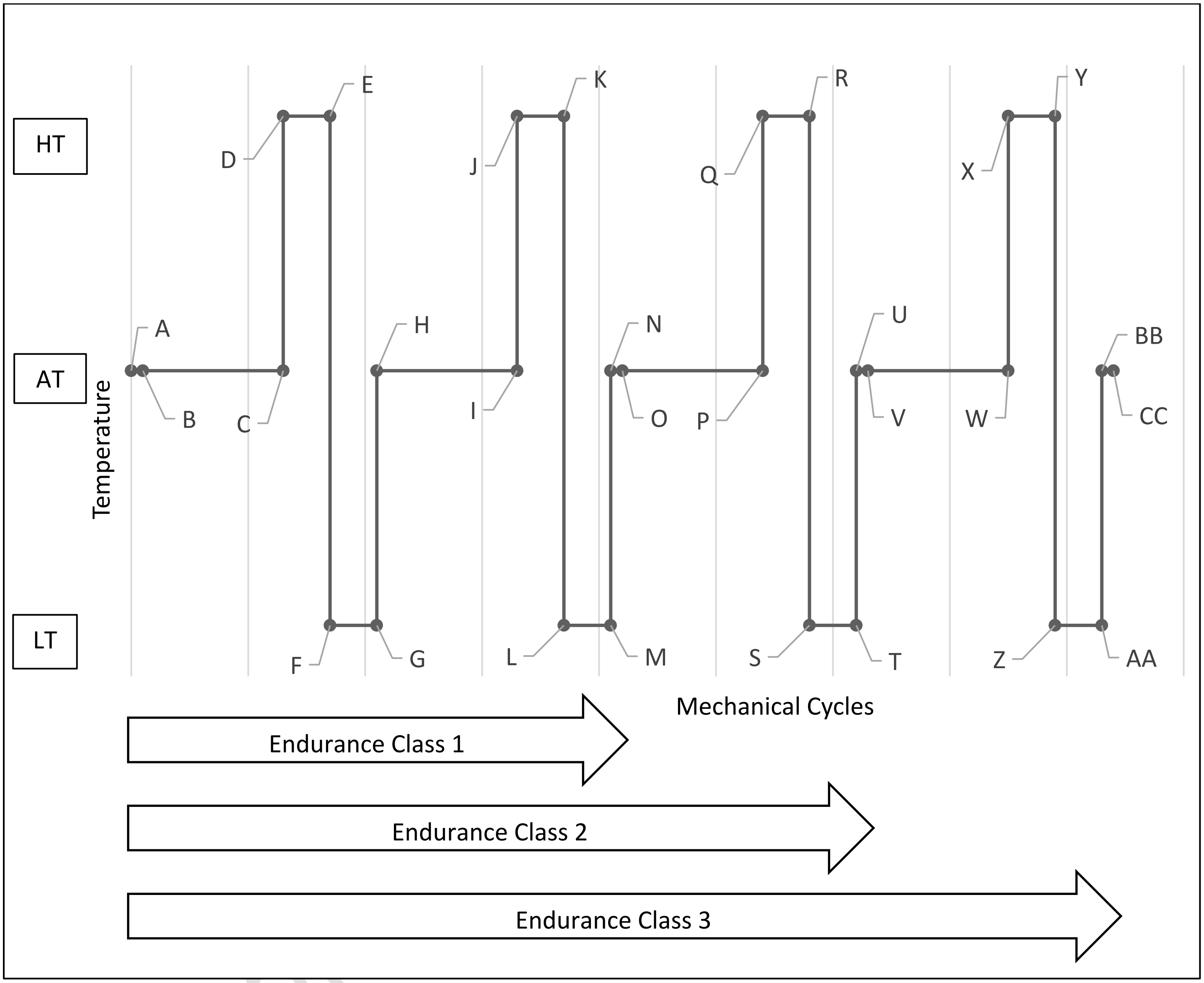

Figure 1 — Valve Cycling

4.2.2. Pressure Test at ambient temperature

Apply the test pressure to the test equipment with the test gas. After the test pressure and leakage have been stabilized, perform 5 mechanical cycles and measure leakage from the seal location(s), in accordance with 4.1.8. Record the test result in a test report.

Note: Reference Point A and B in Figure 1

4.2.3. Mechanical cycle test at ambient temperature.

Perform mechanical cycles at ambient temperature while the test equipment is pressurized per 4.1.7. After completing the mechanical cycles, measure the leakage in accordance with 4.1.8. Record the test result in the test report.

Note: Reference Point B and C in Figure 1

4.2.4. Increase Temperature

Raise the temperature to the high temperature while maintaining 50% to 100% of the test pressure during transition.

If the high temperature is ambient temperature, then there is no temperature change required at this step but mechanical cycles shall be completed.

Note: Reference Point C and D in Figure 1

4.2.5. Static test at the selected high test temperature.

Apply pressure with the test gas to the test pressure.
After the test pressure has stabilized, ensure the test temperature has been stabilized per the previous step.

After the temperature has been stabilized measure the leakage from the seals being tested in accordance with section 4.1.8 Record the test result in the test report.

Note: Reference Point D in Figure 1

4.2.6. Mechanical cycle test at high temperature.

Perform mechanical cycles at the selected test temperature while the pressure is maintained.
Measure the leakage from the stem (or shaft) seal. Record the test result in a test report.
Note: Reference Point D and E in Figure 1

4.2.7. Reduce temperature from high test temperature to low test temperature.

Reduce the temperature to the low temperature while maintaining 50% to 100% of the test pressure of Point F during transition.

Note: Reference Point E and F in Figure 1

4.2.8. Pressure test at low temperature

Apply pressure with the test gas to the test pressure.
After the test pressure has stabilized, ensure the test temperature has been stabilized per the previous step.

After the temperature has been stabilized measure the leakage from the seals being tested in accordance with section 4.1.8 Record the test result in the test report.

Note: Reference Point F in Figure 1

4.2.9. Mechanical cycle test at low temperature

Perform mechanical cycles at the selected test temperature while the pressure is maintained.

Measure the leakage from the stem (or shaft) seal. Record the test result in a test report.

Note: Reference Point F and G in Figure 1

4.2.10. Increase Temperature to ambient temperature.

Raise the temperature to the ambient temperature without artificial heating while maintaining 50% to 100% of the test pressure during transition.
If the low temperature is ambient temperature, then there is no temperature change required at this step.
Note: Reference Point G and H in Figure 1

4.2.11. Continue Valve Cycling

Repeat steps 4.2.2 through 4.2.10 to achieve the number of mechanical cycles, pressure tests and leakage tests as required for the selected endurance class described in section 5.3.

4.2.12. Post-test examination

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

5. Performance Classes

5.1. Classification Criteria

The purpose of this section 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 5.2
b) "endurance class": see 5.3
c) "temperature class": see 5.4

5.2. Tightness Classes

Leakage shall meet the requirement in Table 1 for the applicable class, test fluid, and detection method. For the type test, leakage detection shall be performed by the vacuum method or the suck through method. For a production test, leakage detection may be performed by the sniffing method.

Table 1 — Tightness classes

Class	**Methane[H]**		**Argon**		**Helium[H]**	
	PPMV [A]	**cc/sec [B]**	**cc/sec [C]**	**PPM [D]**	**cc/sec [E] [G]**	**PPM [F]**
A	50	8.33E-04	1.24E-03	(Measured Leak Rate) x (60) x (1E6) / (Sampling Rate of Mass Spec) Leak Rate: cc/sec, Sampling Rate: cc/min	Argon * PF	(Measured Leak Rate) x (60) x (1E6) / (Sampling Rate of Mass Spec) Leak Rate: cc/sec, Sampling Rate: cc/min
B	100	1.67E-03	2.49E-03		Argon * PF	
C	500	8.33E-03	1.24E-02		Argon * PF	

Notes:
(A) Methane leak concentrations in "PPMV" are the industry standard acceptable levels
(B) Methane leak rates in "cc/sec" are converted from PPM using a nominal flow rate of 1.00 L/min. Refer to calibration procedure section 6.2
(C) Argon leak rates in "cc/sec" are correlated to Methane from the study done with the University of Oklahoma
(D) Argon leak concentrations in "PPMV" are converted from leak rates in "cc/sec" using the sampling rate of the mass spectrometer
(E) Helium leak rates in "cc/sec" are correlated to Methane from the study done with the University of Oklahoma, using a "pressure factor" multiplier
(F) Helium leak concentrations in "PPMV" are converted from leak rates in "cc/sec" using the sampling rate of the mass spectrometer
(G) Pressure Factor (PF) = 13.75 + .0013 (P), where P = maximum allowable pressure
(H) When testing with 10% trace Methane or Helium in Nitrogen, the allowable leak rate in this table shall be divided by 10

Example 1

Sniffer Sampling Rate = 40 cc/min **Helium Pressure = 10,000 psig**

Methane		Argon		Helium	
PPMV (A)	cc/sec (B)	cc/sec (C)	PPM (D)	cc/sec (E) (G)	PPM (F)
50	8.33E-04	1.24E-03	1,866	3.33E-02	49,907
100	1.67E-03	2.49E-03	3,731	6.65E-02	99,813
500	8.33E-03	1.24E-02	18,657	3.33E-01	499,067

Example 2

Sniffer Sampling Rate = 300 cc/min **Helium Pressure = 10,000 psig**

Methane		Argon		Helium	
PPMV (A)	cc/sec (B)	cc/sec (C)	PPM (D)	cc/sec (E) (G)	PPM (F)
50	8.33E-04	1.24E-03	249	3.33E-02	6654
100	1.67E-03	2.49E-03	498	6.65E-02	13,308
500	8.33E-03	1.24E-02	2,488	3.33E-01	66,542

5.3. Endurance Classes

The test article shall be qualified to one of the endurance classes described in this section. Table *2* indicates the number of cycles required for each endurance class and valve type shall be as outlined in Table *2*.

Note: Mechanical endurance cycles are not applicable for equipment without dynamic seals.

Table 2 — Endurance classes for Valves

Endurance Class	Refer to Figure 1		Choke Valve		On/Off Valve		Control Valve		Leak Check
	Temp	Point	Cycles	Cumulative	Cycles	Cumulative	Cycles	Cumulative	
Endurance Class 1 (CK1, CO1, or CC1)	AT	A	0	0	0	0	0	0	
	AT	B	5	5	5	5	5	5	Y
	AT	C	55	60	55	60	5995	6000	Y
	HT	D	0	60	0	60	0	6000	Y
	HT	E	20	80	20	80	2000	8000	Y
	LT	F	0	80	0	80	0	8000	
	LT	G	20	100	20	100	2000	10000	
	AT	H	0	100	0	100	0	10000	
	AT	I	60	160	60	160	6000	16000	
	HT	J	0	160	0	160	0	16000	Y
	HT	K	20	180	20	180	2000	18000	Y
	LT	L	0	180	0	180	0	18000	Y
	LT	M	20	200	20	200	2000	20000	Y
	AT	N	0	200	0	200	0	20000	
	AT	O	5	205	5	205	5	20005	Y
Endurance Class 2 (CK2, CO2, or CC2)	AT	P	195	400	695	900	19995	40000	Y
	HT	Q	0	400	0	900	0	40000	Y
	HT	R	50	450	300	1200	10000	50000	Y
	LT	S	0	450	0	1200	0	50000	Y
	LT	T	50	500	300	1500	10000	60000	Y
	AT	U	0	500	0	1500	0	60000	
	AT	V	5	505	5	1505	5	60005	Y
Endurance Class 3 (CK3, CO3, or CC3)	AT	W	395	900	495	2000	19995	80000	Y
	HT	X	0	900	0	2000	0	80000	Y
	HT	Y	50	950	250	2250	10000	90000	Y
	LT	Z	0	950	0	2250	0	90000	Y
	LT	AA	50	1000	250	2500	10000	100000	Y
	AT	BB	0	1000	0	2500	0	100000	
	AT	CC	5	1005	5	2505	5	100005	Y

5.4. Temperature Classes

The target temperature class shall be determined by selecting a low temperature (LT) at or below ambient temperature and selecting a high temperature (HT) at or above ambient temperature. The temperature range shall meet or exceed the range of the intended application of the test article.
Note: Reference the applicable product specification for temperature ratings.

The temperature rating shall be designated in the form (tLT)-(tHT).

EXAMPLE 1 If the low test temperature is -46°C and the high test temperature is 200°C, the valve is classified as Temperature Range of -46°C-200°C.

EXAMPLE 2 If the low test temperature is ambient temperature and the high test temperature is 250°F, the valve is classified as Temperature Range of AT-250°F.

When one of the test temperatures is at ambient temperature, the total cumulative cycles shall be per Table 2.

For type testing ambient temperature shall be considered between 15-40°C (59-104°F)

The temperature shall remain:

- at or below the target low temperature value.
- at or above the target high temperature value.
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6. Emission Detection Equipment

6.1. Equipment Requirements

6.1.1. Mass Spectrometer (Helium & Argon)

The sensitivity of the mass spectrometer shall be in accordance with the range of the leak rate to be measured. Reference tightness class in Section 5.2. The sensitivity of the mass spectrometer shall be at least 1*10^-7 mbar-l/s and shall be calibrated for use with the test gas.

The equipment shall be capable of internal or external calibration using a permeation or capillary type leak standard.

6.1.2. Methane Gas Analyzer (Methane)

Monitoring equipment shall be a flame ionization organic vapor analyzer with an integral data logger or a signal output for data collection.

Monitoring equipment shall be certified as intrinsically safe for use with the test fluid.

The equipment shall meet the following performance requirements in the flame ionization mode using methane as the test fluid:

- Maximum repeatability: ±2.0 ppmv at 0 ppmv to 100 ppmv.
- Minimum detectable level: <= 1.0 ppmv.
- Maximum response time to reach final value (from 0 ppmv to 100 ppmv): 15 seconds.
- Maximum recovery time to return to 10 % of initial value: 10 seconds.
- Sample flow rate at probe inlet: 0.25 – 1.5 l/min.

6.2. CALIBRATION:

6.2.1. Mass Spectrometer (Helium & Argon)

Equipment calibration shall be conducted daily prior to testing.

The instrument shall be turned on and allowed to warm up for the minimum time specified by the manufacturer of the instrument.

The instrument shall be calibrated as specified by the manufacturer of the instrument using a permeation or capillary type leak standard (internal or external). Leak standards shall be calibrated annually or per manufacturer's recommendation, whichever is more frequent.

The sampling rate used in calibration of the mass spectrometer shall be documented in the test report.

6.2.2. Methane Gas Analyzer (Methane)

To increase accuracy of readings between different measuring instruments and testers, the leakage device shall be calibrated to known leak rate standards daily prior to testing. A current record of test equipment calibration shall be maintained by the test facility.

A porous or sintered metal/ceramic leak standard or similar device shall be used per the following procedure:

- Using a nominal flow rate of 1.00 l/min, a 0.050 ml/min leak standard shall produce by definition a 0.050 / (1.00 liter x 1000 ml/liter) = 0.005% concentration of test gas by volume or 50.0 ppmv concentration. Therefore, the reading of the leakage monitor shall be tuned to be the verified flow rate of the leak standard in ml/min x 1000 in ppmv.
- Verify the sampling flow rate of the leakage monitoring device to be in the range of 0.5 to 1.5 l/min with a calibrated flow meter.
- Verify the flow rate through the calibrated standard leak at a regulated differential pressure using 97 % minimum purity test gas. The calibrated standard leak shall be in the range of 0.050 ml/min to 0.100 ml/min of methane. The inverted beaker technique may be used with a sufficient amount of time to collect a measurable amount of sample. The test time shall be sufficient to fill the tubing and fittings used in the calibration setup.
- After the flow rate is verified and it is ensured that the test gas has completely saturated the calibrated leak standard, the leakage monitor probe shall be attached to the tee fitting connected to the standard. After stabilization has occurred, calibrate the leakage monitoring device per the manufacturer's instructions using the calculation in 4.2.5.1. Leakage for calibration shall be between 50 ppmv and 100 ppmv. Calibration shall be performed before the start of each test and the results recorded.

Calibration of the leak standard shall be performed annually at a minimum.

7. Documentation / Reporting

7.1. General

The manufacturer shall maintain documentation of the following information:

a) name and address of the equipment manufacturer;
b) equipment model/family designation
c) Equipment size and pressure class/rating;
d) Equipment part number, revision and bill of material
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) test location;
h) Test temperature range
i) test gas;
j) Leakage measurement type
k) Leakage measurement at each seal location
l) Leak detection calibration certificate
m) Other test equipment calibration certificates
n) performance classes achieved;stem seal adjustments during testing, if applicable;
o) operation data:
   — operating torque or force;
   — sealing system preload; if applicable
   — stroke/angle;
   — operating rate (for chokes and control valves)
p) sealing system diameter and pressure class;
q) sealing model number and style;
r) Sealing system parameters, such as materials, dimension, tolerances and surface finishes of fixture surfaces;
s) method of sample selection;
t) reference standards with applicable revision numbers;
u) DOM of fixture and design revision
v) installation instructions;
w) copy of the test sequence;
x) detailed results of the test;
y) cross sectional sealing system assembly drawing;
z) stem or shaft seal description, dimensions, and specifications;
aa) material specifications of stem (or shaft) seal components;

7.2. Test Report

The test report shall indicate the number of the standard and its year of issue (e.g. API xxxx: 20xx). The specific product data file including the following information shall be the responsibility of the manufacturer and shall be included as an annex:

a) name and address of the equipment manufacturer;
b) equipment model/family designation
c) Equipment size and pressure class/rating;
d) Equipment part number, revision and bill of material
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 completion;
g) test location;

h) Test temperature range
i) test gas;
j) Leakage measurement type
k) Leakage measurement equipment calibration certificate
l) performance classes achieved;
m) stem seal adjustments during testing, if applicable;

8. Marking

Valves qualified to this spec may be marked API 6Y on the nameplate or on a separate tag. If the valve is marked API 6Y, the name plate shall include:

- API 6Y
- Tightness Class
- Temperature Range

9. Scaling and Qualification Extension

9.1. General

Any change in valve stem sealing system design including, but not limited to, packing material, packing manufacturer, or packing type/model requires a requalification

9.2. Scaling

Upon the successful completion of the test program as defined in this standard, qualification can be extended to untested sizes and classes/ratings of valves of the same type/product family, if the following criteria are met:

a) the seals are of the same material and design (shape, cross-section, preload, stress);
b) the type of motion of the stem (or shaft), e.g. linear or rotation is the same;
c) Tolerance classes (grades) and surface finish specifications of all valve components that affect sealing performance are identical.
d) The product family includes designs that are based on the same design specifications or standards
e) stem seal diameters are from half to twice the tested sealing system diameter, half diameter and double diameter included: $D_o/2 \leq D \leq 2\,D_o$ with D_o being the tested stem diameter;
f) For valves that do not have stem seals, one nominal valve size smaller and one nominal valve size larger than the one being tested
g) the dimension of the overall seal set height is between 75% and 125% of the tested stem seal
h) the metallic materials have the same temperature response (coefficient of thermal expansion) as the qualified system;
i) the ASME class or API pressure rating is equal or lower;
j) the required temperature rating is within the temperature range that was qualified;
k) the tightness class required is equal to, or less severe than that of the qualified sealing system.
l) The sealing system, geometry of seals or components that interface with the seals are the same.

9.3. Qualification Extension

A change in the material (including material grade), design or construction of the following seals; independent of the size, shall be qualified in a valve or by a fixture test per Annex B.

a) lip seal

b) v-pack/chevron type

c) delta seal

d) bellows seal

e) die-formed packing

Changing to a different type of seal than previously qualified shall require qualification in a valve.

Annex A
Production Testing
(Informative)

A.1 General

This annex specifies additional requirements, which shall be performed by the manufacturer if specified by the purchaser at time of order placement. This annex specifies the requirements, test procedure, and acceptance criteria for the evaluation of external leakage of valves in accordance with this specification intended for application with volatile air pollutants and hazardous fluids.

Vacuum application, effects of corrosion, and radiation are excluded.
The production acceptance test is intended for standard production valves where fugitive emissions standards are specified.

All valves tested under this annex shall have the design successfully qualified to the main body of this document. The selected valves shall have been successfully tested according to the relevant factory acceptance test standards, prior to the acceptance test specified in this annex. The valve shall be drained and dried before the start of the production test.

A.2 Preparation of Test Valves

A.2.1 Stem (or shaft) seal adjustment prior to testing

The sealing system shall be installed according to the manufacturer's standard installation instructions. Packing gland torque shall be verified and, if necessary, adjusted to be in accordance with manufacturer's published installation specifications.

A.2.2 Lot definition

Unless specified otherwise, the lot for each inspection campaign from which the test samples are drawn is defined as, all valves from the same purchase order, manufactured in the same manufacturing location, having the same tightness class, of the same valve type, design and stem diameter.

A.3 Sampling

The purchase order quantity determines how many samples (n) shall be drawn from each lot, as indicated in Table A.1. The samples shall be selected at random from each lot. When the lot consists of various sizes and pressure classes, then sampling shall be applied in such a way that it covers the entire production range from that lot. Alternative sampling may be agreed between manufacturer and purchaser.

Table A.1 – Sample Strategy for Production Testing

Lot Size	Minimum Sample size (n)
1	1
2 - 10	2

11 - 100	3
> 100	5

A.4 Lot Acceptance

The lot shall be accepted when each tested valve meets the acceptance criteria per Section A.0.

In case a valve fails, the lot shall be rejected. The valve(s) that failed the test shall be repaired and retested. Additional valves equal to the minimum sample size shall be drawn from the failed lot for the retest. Upon subsequent rejection, the failed valve(s) shall be repaired and retested. The retest shall contain all valves from the lot.

Leakage of test equipment do not constitute a valve failure requiring the lot to be rejected. Test equipment shall be repaired or replaced, and the leakage test shall be repeated.

A.2 Test conditions

A.2.1 Test fluid

The test fluid shall be per section 4.1.5 option b) or d).

A.2.2 Test pressure

Pressure shall be maintained at 6 bar (+2/-0 bar) (87psi +29/-0 psi) throughout the test. Do not exceed 8 bar (116 psi) unless otherwise agreed by the manufacturer and the purchaser. The measurements shall commence after the test pressure has been maintained for a minimum of 15 minutes.

A.2.3 Test temperature

The test temperature shall be at ambient temperature.

A.2.4 Test Equipment

Test equipment and personnel shall meet the requirements of Section 4.1.1 and Section 4.1.2 respectively. Reference leakage measuring equipment shall be calibrated per Section 6.

A.2.5 Test Procedure

The procedure for measuring the leakage of stem or shaft seals is as follows.

a) Partially open the test valve and apply the test pressure to the valve bore ensuring that it is exposed to the stem seal.

   When this procedure states to partially open the valve, soft seated ball valves may be set in the fully open position (to prevent possible damage of the soft seats) and subjected to the test pressure if pressure is applied to ensure it reaches all the seals being tested.

b) Hold the test pressure for a minimum of 15 minutes, then measure the leakage per A.2.6.

c) Fully open and close the pressurized test valve five times.

d) Partially open the valve and after opening, immediately measure the leakage per A.2.6.

e) If the reading exceeds the values of the required tightness class according to Table A.4 for stem seals, the test shall be considered as having failed. If the reading exceeds 50 PPMV for any body seal, the test shall be considered as having failed. A corrective action shall be proposed and agreed with the purchaser or the lot of valves shall be rejected.

Table A.3 Tightness classes for stem seals

Class	**PPMV**
A	< 50
B	< 100
C	< 200
NOTE: When testing with 10% trace Helium in Nitrogen, the allowable leak rate in this table shall be divided by 10	

A.2.6 Leak Measurement

The leakage shall be measured using the sniffing method in accordance with ISO 15848-1 Annex B. All measurements using the sniffing method shall be carried out in a still (draft free) environment. Leakage measurement shall include the stem seal and any other seals between the bore and the environment (i.e. body joints, drains, end connections etc.)

A.2.7 Certification of Conformance

If requested by the purchaser, the manufacturer shall provide a certificate of compliance that this production acceptance test has been completed successfully.

Annex B
Fixture Testing

(Informative)

B.1 General

This section outlines the qualification of alternative materials for stem and static seals, different from those used in the valve fugitive emissions type test. Fixture testing shall not be used to complete initial fugitive emissions qualification of a valve assembly.

Fixture testing shall comply with the requirements of Section 4 - Section 6, with applicable modifications outlined in this Annex.

The test fixture shall be equipped with thermocouples to continuously monitor temperature during testing. Temperature shall be monitored and recorded at a minimum of two locations, one in the pressurized volume of the test fixture, and one within ½" from the sealing arrangement. The thermocouple in the pressurized volume shall be the controlling temperature.

End glands on test fixtures may include additional seals to assist in leakage measurement.

B.2 Stem Seal Test Fixture

A fixture to qualify different stem seal materials within the valve assembly shall meet the following design criteria:

a) Capable of retaining test pressure at full testing temperature range,
b) The type of motion of the shaft shall be the same as in the valve,
c) Tolerancing and surface finish of sealing surfaces shall remain the same as in the qualified valve,
d) Preload on the seal (if applicable) shall remain the same,
e) Geometry of seal groove or volume shall remain the same as the qualified valve.

An example stem seal test fixture is shown in Figure B.1.

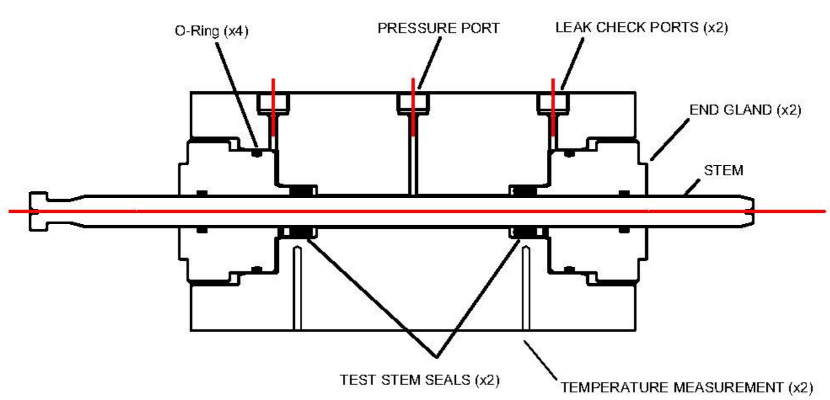

Figure B.1 - Stem Seal Test Fixture

B.3 Static Seal Test Fixture

A fixture to qualify different static seal materials within the valve assembly shall meet the following design criteria:

a) Capable of retaining test pressure at full testing temperature range,
b) Tolerancing and surface finish of sealing surfaces shall remain the same as in the qualified valve,
c) Preload on the seal (if applicable) shall remain the same,
d) Geometry of seal groove or volume shall remain the same as the qualified valve.

An example static seal test fixture is shown in Figure B.2.

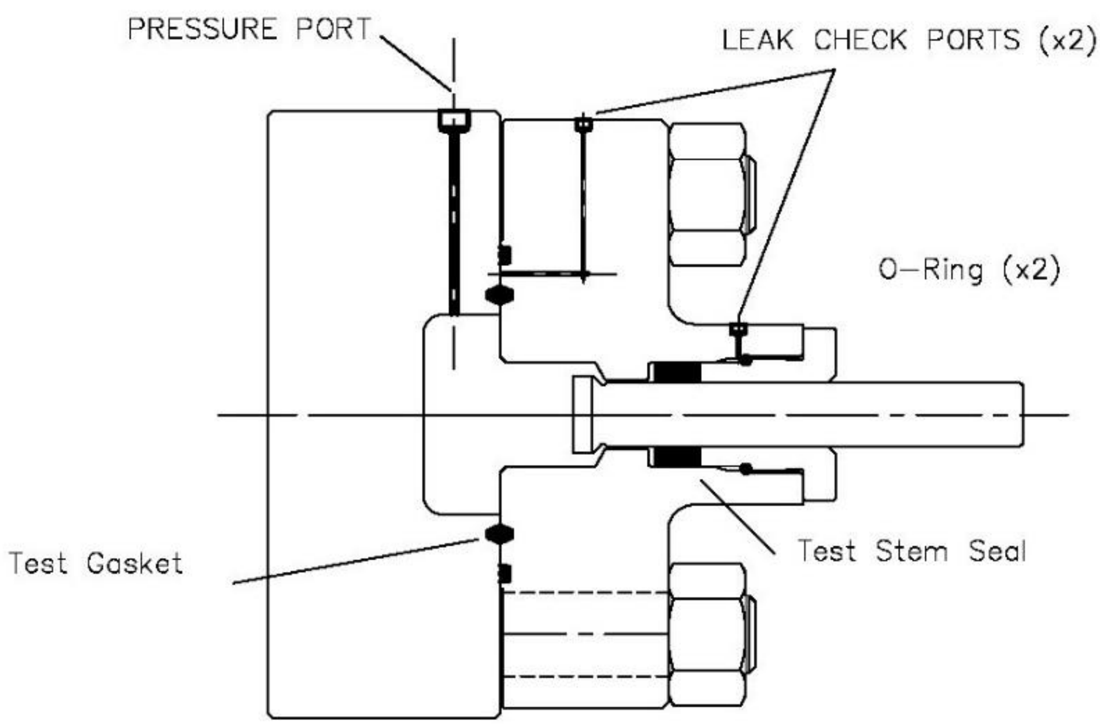

Figure B.2 - Body and Stem Seal Test Fixture

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