EUROPEAN STANDARD
NORME EUROPÉENNE
EUROPÄISCHE NORM

EN 12567

July 2000

ICS 23.060.01

English version

Industrial valves

Isolating valves for LNG

Specification for suitability and appropriate verification tests

Robinetterie industrielle – Robinets de sectionnement pour GNL – Prescriptions d'aptitude à l'emploi et vérifications s'y rapportant

Industriearmaturen – Absperrarmaturen für Flüssigerdgas – Anforderungen an die Gebrauchstauglichkeit und deren Prüfungen

This European Standard was approved by CEN on 2000-06-25.

CEN members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration.

Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the Central Secretariat or to any CEN member.

The European Standards exist in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CEN member into its own language and notified to the Central Secretariat has the same status as the official versions.

CEN members are the national standards bodies of Austria, Belgium, the Czech Republic, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, the Netherlands, Norway, Portugal, Spain, Sweden, Switzerland, and the United Kingdom.

CEN

European Committee for Standardization
Comité Européen de Normalisation
Europäisches Komitee für Normung

Central Secretariat: rue de Stassart 36, B-1050 Brussels

Ref. No. EN 12567 : 2000 E

Contents

Foreword

This European Standard has been prepared by Technical Committee CEN/TC 69 "Industrial valves", the secretariat of which is held by AFNOR.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by January 2001, and conflicting national standards shall be withdrawn at the latest by January 2001.

According to the CEN/CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, Czech Republic, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and the United Kingdom.

1 Scope

This European Standard specifies the general performance requirements of isolating valves (gate valves, globe

road or sea) of Liquefied Natural Gas (LNG). LNG filling valves for vehicule refuelling systems are excluded from the scope of this standard.

DN range from DN 8 to DN 1000.

PN range from PN 16 to PN 100.

Class range from Class 150 to Class 900.

Temperature range from – 196 °C to + 60 °C.

2 Normative references

This European Standard incorporates by dated or undated reference, provisions from other publications. These normative references are cited at the appropriate places in the text and the publications are listed hereafter. For dated references, subsequent amendments to or revisions of any of these publications apply to this European Standard only when incorporated in it by amendment or revision. For undated references the latest edition of the publication referred to applies (including amendments).

EN 19, *Industrial Valves – Marking.*

EN 736-1, *Valves - Terminology - Part 1 : Definition of types of valves.*

EN 736-2, *Valves - Terminology - Part 2 : Definition of components of valves.*

EN 736-3, *Valves - Terminology - Part 3 : Definition of terms.*

EN 764, *Pressure equipment - Terminology and symbols - Pressure, temperature and volume.*

EN 1160, *Installations and equipment for liquefied natural gas - General characteristics of liquefied natural gas.*

EN 10045-1, *Metallic materials - Charpy impact tests - Part 1 : Test method.*

EN 12308, *Installations and equipment for LNG - Suitability testing of gaskets designed for flanged joints used on LNG piping.*

EN ISO 5210, *Industrial valves – Multi-turn actuator attachments (ISO 5210:1991).*

prEN ISO 5211:2000, *Industrial valves - Part-turn valve actuator attachments (ISO/FDIS 5211:2000).*

prEN 12266-1:1999, *Industrial valves – Testing of valves - Part 1 : Tests, test procedures and acceptance criteria to be fulfilled by every valve.*

prEN 12516-1:2000, *Industrial Valves – Shell Design Strength – Part 1: Tabulation Method for Steel Valves.*

prEN 12516-2:2000, *Industrial Valves – Shell Design Strength – Part 2: Calculation Method for Stell Valves*

prEN 12516-3:1999, *Valves - Shell design strength - Part 3 : Experimental method.*

EN 12570, *Industrial valves - Method for sizing the operating element.*

ISO 10497, *Testing of valves - Fire type-testing requirements.*

ASTM A 380, *Standard practice to cleaning, descaling and passivation of stainless steel parts, equipment and systems.*

3 Terms and definitions

For the purposes of this European Standard, the terms and definitions of EN 736-1, EN 736-2, EN 736-3 and EN 764 apply together with the following terms and definitions :

3.1
LNG (liquefied natural gas)
see EN 1160

3.2
allowable pressure p_s
see EN 764

3.3
minimum allowable temperature
minimum temperature which a valve can permanently withstand at pressures equal to or less than the allowable pressure p_s (see EN 764)

3.4
operating cycle
full motion from closed position to open position and back to closed position

3.5
type test
see EN 736-3

3.6
production test
see EN 736-3

4 Tests and design requirements

4.1 Tests

The requirements for production and type tests shall be as given in Tables 1 to 23.

The range of valves approved on the basis of a type test shall be as given in annexes C and D.

4.2 Consideration of thermal conditions in steady state

The stress and the strength calculations shall be in accordance with the requirements of prEN 12516-1:2000, prEN 12516-2:2000 and prEN 12516-3:1999.

4.3 Consideration of thermal conditions in transient state

Table 1

Requirement	Production test	Type test
The valve shall be designed to take into account the thermal stresses in transient state occurring during the cool down operation. NOTE Thermal stresses in transient state present the following characteristics : — they are often much larger than static pressure stresses ; — they increase with an increase in thickness of the valve body. The general requirements of EN 1160 shall be observed when necessary. The valve design with respect to thermal stresses in transient state shall be accepted provided that the valve passes the thermal shock test.	No test is required.	Thermal shock test defined in annex A (normative).

4.4 Protection against thermal expansion of LNG

Table 2

Requirement	Production test	Type test
The valve shall be designed in such a way that LNG cannot be trapped in any cavity, regardless of the position of the obturator, or an internal safety device shall be fitted to prevent the pressure from rising above the p_s. Under no circumstances shall LNG be allowed to be released to the atmosphere.	Examination of drawings.	Examination of drawings.

4.5 Cryogenic neck extension

Table 3

Requirement	Production test	Type test
The valve shall be designed so that the sealing device on the stem or the shaft, and the operating device shall remain above a minimum temperature ensuring proper operation of the valve. Any icing shall not hinder operation of the valve nor impair the sealing device of the stem or the shaft.	No test is required.	Examination carried out during the endurance strength test defined in annex B (normative).

4.6 Sealing devices for stem or shaft

Table 4

Requirement	Production test	Type test
The sealing device shall be sufficiently distant from the body to prevent any risk of icing.	Verification that the materials and design of the valve are in conformity with those of the valve submitted to the type test.	Examination carried out during the endurance strength test defined in annex B (normative).

4.7 Assembly of valve (with the exception of the connection to the pipework)

Table 5

Requirement	Production test	Type test
External sealing of the valve shall ensure leak tightness in any operating position, at both ambient temperature and minimum allowable temperature, as well as during cooling and warming operations. The bolting load shall be determined to take into account the relaxation of bolts occurring during the cooling down. Flange gaskets shall be in accordance with EN 12308. NOTE The relaxation is due to : — the delay between cooling of the body and cooling of bolting ; — the difference in contraction coefficients between the metal of the body and the metal of the bolts ; — the gasket. The flanges shall be designed to withstand : — pressure stresses ; — bolting loads necessary to ensure leak tightness of the joint at both ambient and low temperatures.	Verifications that the materials and design of the valve is in conformity with those of the valve submitted to the type test.	The external leak tightness shall be confirmed during the endurance strength test defined in annex B (normative).

4.8 Connections to the pipework

Table 6

Requirement	Production test	Type test
Flanges and welding ends shall be in accordance with European Standards.	Examination of drawings.	Examination of drawings.

4.9 External protection

Table 7

Requirement	Production test	Type test
Passivation shall be performed after the machining, before assembly. However, the necessity of the passivation should be agreed between purchaser and supplier. The passivation is not necessary, if there exists a procedure for storage, machining and handling of austenitic stainless steel valve parts.	ASTM A380 shall apply.	No test is required.

4.10 Pressure retaining metal parts

Table 8

Requirement	Production test	Type test
Materials shall be selected from the following : — austenitic stainless steels ; — nickel steels ; — aluminium alloys [a]. Metals and alloys commonly used for LNG applications shall be as listed in EN 1160. Other metals are permissible provided that they are capable of withstanding an operating temperature of – 196 °C. The impact energy K_V , measured at –196 °C in accordance with EN 10045-1, shall be greater than 60 J. For aluminium alloys, impact test is not required.	Examination of the chemical analysis and mechanical test certificates.	Examination of the chemical analysis and mechanical test certificates.
[a] Due to the low melting temperature of aluminium alloys, if required fire safe protection system shall be provided for the valve.		

4.11 Electro-chemical effects

Table 9

Requirement	Production test	Type test
The materials shall be carefully selected so as to prevent any formation of electrolytic coupling greater than 250 mV.	Examination of the technical data sheet.	Examination of the technical data sheet.

5 Functional requirements and tests

5.1 General

The requirements of prEN 12266-1:1999 shall apply. In case of contradictions between prEN 12266-1:1999 and this standard, this standard prevails.

5.2 Electrical continuity

Table 10

Requirement	Production test	Type test
It is recommended that the electrical resistance between body and shaft or stem be equal to or less than 10 ohms. NOTE Permanent electrical continuity may be required between the body, the shaft or stem and the obturator.	No test is required.	Measurement of electrical resistance.

5.3 Mechanical strength of the shell

Table 11

Requirement	Production test	Type test
The shell shall withstand a minimum internal pressure of 1,5 x p_s value at ambient temperature.	This test shall be carried out with liquid in accordance with the test P 10 of prEN 12266-1:1999.	This test shall be carried out with liquid in accordance with test P 10 of prEN 12266-1:1999.

5.4 Endurance

Table 12

Requirement	Production test	Type test
Each new design of valve shall be subjected to an endurance test carried out with LNG or with liquid nitrogen.	No test is required.	The endurance test shall be carried out in accordance with annex B (normative).

5.5 Fire resistance

Table 13

Requirement	Production test	Type test
At the request of the purchaser, a fire test shall be carried out.	No test is required.	The fire test shall be carried out in accordance with ISO 10497.

5.6 Seat leak tightness

Table 14

Requirement	Production test	Type test
The valve shall be leaktight for all pressures up to 1,1 x p_s. The leakage rate shall be equal to or less than the rate specified by the purchaser.	The seat test shall be carried out in accordance with test P 12 of prEN 12266-1:1999 at ambient temperature, at a pressure of 1,1 x p_s.	Test carried out during the endurance test defined in annex B (normative).

5.7 Operability

Table 15

Requirement	Production test	Type test
The maximum operating torque or the maximum operating load shall be specified by the manufacturer at minimum allowable temperature for a pressure differential equal to 1 x p_s . In case of valves equipped with actuators, the maximum torque or load values shall be specified by the purchaser. In case of manually operated valves, the torque or load values shall not exceed the maximum values given in EN 12570.	The test conditions shall be specified by the purchaser.	The test conditions shall be specified by the purchaser.

5.8 Number of turns

Table 16

Requirement	Production test	Type test
If more than a quarter turn is necessary, the number of turns to cover the full stroke shall be given.	Examination of the technical data sheet of the manufacturer.	Examination of the technical data sheet of the manufacturer.

5.9 Attachment of actuator to the valve

Table 17

Requirement	Production test	Type test
The attachment shall be in accordance with the requirements of EN ISO 5210 or prEN ISO 5211:2000.	Examination of drawings.	Examination of drawings.

5.10 Manually operated valve

Table 18

Requirement	Production test	Type test
The manual loads applied both at ambient temperature and at minimum allowable temperature shall not exceed the limits given in the product standards.	No test is required.	Examination carried out during the endurance test defined in annex B (normative).

5.11 Stems or shafts

Table 19

Requirement	Production test	Type test
The valve shall be designed so as not to permit stems or shafts to be ejected when the operating or sealing devices are removed.	Examination of drawings.	Examination of drawings.

5.12 Cryogenic product acceptance

Table 20

Requirement	Production test	Type test
At the request of the purchaser, and in agreement with the manufacturer, a cryogenic acceptance test shall be carried out.	The test shall be carried in accordance with annex E (normative).	No test is required.

6 Marking

Table 21

Requirement	Production test	Type test
Marking shall be carried out in accordance with EN 19. In case of valve with a preferential direction for flow, it shall be marked in accordance with EN 19. When the preferential direction of sealing is different from the preferential direction for flow, an additional marking shall be done in accordance with annex F.	Visual check.	Not applicable.

7 Preparation for storage and transportation

Table 22

Requirement	Production test	Type test
Outer surfaces shall be cleaned with solvent in order to prevent any visible deposits of oil, grease , cutting or drilling compounds. The cleaning solvent shall be organic and free from any metallic components, with an inorganic halogen content under 50 ppm.The valve ends shall be adequately protected to prevent any damage to the connection or sealing surfaces.	Visual check.	Not applicable.

8 Information to be provided by the supplier

Table 23

Requirement	Production test	Type test
The supplier shall give the following information : — general design drawing (as built) with nomenclature and overall dimensions ; — material certificates for the body, bonnet and obturator as specified by the purchaser ; — certificates of testing and final inspection ; — performance characteristics : — K_V coefficient ; — maximum operating torque or maximum operating stress ; — instructions for use, maintenance and assembly.	Verification of documents.	Verification of documents.

Annex A
(normative)

Thermal shock test

A.1 Scope

The purpose of the thermal shock test is to verify that a valve can withstand the transient thermal stresses induced by the cooling down process under operating conditions.

A.2 Testing method

By agreement between manufacturer and purchaser, valves with flanged connections may be checked dimensionally before assembly on the test bench and after warming and dis-assembly, in order to determine any dimensional changes.

A crack detection test shall be carried out before the thermal shock test by a method defined jointly by the manufacturer and the purchaser.

The thermal shock shall be as close as possible to the following procedure :

— the valve shall be filled with a test liquid of either LNG or liquid methane (temperature equal to or lower than – 150 °C) ;

NOTE Reason of choice of use of LNG or liquid methane as test liquid is the following : thermal stresses induced by liquid nitrogen (-196°C) are lower that those induced by LNG (-160°C), in spite of the temperature differences, due to the mechanism of heat transfer.

— the valve shall be in the partially open position during filling, i.e. all inner areas liable to come in contact with the test medium shall be subjected to the thermal shock ;

— the outer surface of the valve shall be exposed to the atmosphere throughout the entire test ;

— filling of the valve shall be completed within 5 min; no specific pressure is necessary ;

NOTE Every effort shall be made to ensure to the greatest possible extent that, on completion of the filling, no gas pocket remains where the liquid should normally be present.

— the valve shall remain filled with the test liquid for at least 1 h.

For valves with flanged connections, after coming back to room temperature and valve dis-assembly from the test bench, a new dimensional inspection shall be carried out as performed initially.

The valve shall then be fully dismantled. All non-pressure retaining parts shall be visually examined. The entire inner surface of the pressure retaining parts shall be subjected to a crack detection test defined jointly by the manufacturer and the purchaser.

A.3 Acceptance criteria

No external leak in the pressure retaining parts.

No cracks.

For valves with flanged connections, dimensional tests results shall be within the limits defined by agreement between the manufacturer and the purchaser.

Annex B
(normative)

Endurance tests

B.1 Test bench

An example of test bench is given in Figure B.1.

B.2 Test at ambient temperature

B.2.1 Shell test

A shell test shall be performed in accordance with test P 10 of prEN 12266-1:1999.

B.2.2 Seat leaktightness test

An obturator leaktightness test shall be performed in accordance with test P 12 of prEN 12266-1:1999, with liquid under a pressure equal to 1,1 x p_s.

B.2.3 Test of operability under pressure

A test of operability under pressure shall be performed at ambient under conditions specified by the purchaser.

The torques or the induced operating stresses for opening and closing shall be measured.

B.3 Test assembly

The valve shall be vertically mounted on the test bench in the closed position.

The spool/valve assembly shall be thermally insulated. The heat insulating material (polyurethane, glass wool...) shall be at least 160 mm thick.

The valve shall have been previously dried and treated to remove any trace of moisture or liquid liable to freeze during the cool down process.

In case of a vented obturator, the vented side shall be positioned upstream.

B.4 Cooling down

Cooling shall be carried out with LNG or with liquid nitrogen inside the valve ; in either case, the liquid temperature shall be lower than –150 °C.

Should it become necessary to retighten the bolts during the cooling process, the bolting torques shall be recorded.

B.5 Preliminary tests at low temperature

B.5.1 Internal leaktightness

The valve shall be closed and the downstream spool shall be depressurized and drained.

Once temperatures have stabilized, the leakage rate shall be measured under the following pressures: 0,5 bar (if possible), 0,25 x p_s, 0,5 x p_s, 0,75 x p_s and 1 x p_s of the obturator.

B.5.2 External leaktightness

External leaktightness shall be checked under the allowable pressure of the shell, in open position as well as in closed position.

The necessity (or not) of retightening the packing box shall be recorded.

A gas detector with a sensitivity at least of 10 % of the methane low flammability limit in air, shall be used to detect any gas leakage from the valve. No gas leakage is permissible.

B.5.3 Test of operability under pressure

A test of operability under pressure shall be performed at low temperature under conditions specified by the purchaser.

The torques or the induced operating stresses for opening and closing shall be measured.

B.6 Endurance test at low temperature

B.6.1 Number of cycles

The number of operating cycles (opening/closing) to be performed depends upon the endurance class of the valve :

- for endurance class I, 2000 operating cycles shall be completed ;
- for endurance class II, 500 operating cycles shall be completed.

B.6.2 Intermediate

External and internal leaktightness, as well as the torque or the induced operating stress at low temperature (as described in B.5) shall be measured at the intermediate test stages, as defined in Table B.1.

Table B.1 - Intermediate test stages

Number of cycles

Endurance class I	**Endurance class II**
75	20
150	40
300	80
600	150
1200	300
2000	500

B.7 Final tests

B.7.1 Shell test

A shell test at ambient temperature shall be performed in accordance with test P 10 of prEN 12266-1:1999.

B.7.2 Seat leaktightness test

An obturator leaktightness test shall be performed in accordance with test P 12 of prEN 12266-1:1999 with liquid under a pressure equal to 1,1 x p_s.

B.7.3 Inspection after dismantling

The valve shall be fully dismantled. The various components shall be examined, with special attention to rotating and friction parts, seats, etc.

B.8 Final report

B.8.1 Leaktightness classes

The following classes represent the level of internal leaktightness :

— class L1 0 $< L_{max} \leq$ 0,5 DN ;

— class L2 0,5 DN $< L_{max} \leq$ 1 DN ;

— class L3 1 DN $< L_{max} \leq$ 2 DN ;

— class L4 2 DN $< L_{max} \leq$ 4 DN .

where :

L_{max} is the maximum liquid leakage rate (expressed in cubic millimetres per minute (mm^3/min) under conditions of test pressure and temperature).

B.8.2 Determination of the leak tightness class

The internal leakage rate is generally expressed in terms of gas flow under normal conditions (1013 mbar, 0°C). This value shall be subsequently corrected to derive the equivalent liquid leakage rate :

$$L = \frac{Q_G}{C_{EXP}}$$

where

L is the liquid leakage rate ;

Q_G is the gas leakage rate (as measured under normal conditions) expressed in cubic millimeters per minute (mm^3/min) ;

C_{Exp} is the expansion coefficient (ratio of gas volume under normal conditions over liquid volume under tests conditions).

The following values shall be use for C_{Exp} :

— LNG 580 ;

— pure methane 600 ;

— liquid nitrogen 650.

The maximum value of L, checked during the endurance test at low temperature, shall determine the leaktightness class of the valve in accordance with B.8.1

B.8.3 Test results

All measurements and conclusions shall be recorded in a test report. The valve shall be approved only if it fulfils the requirements of the different tests.

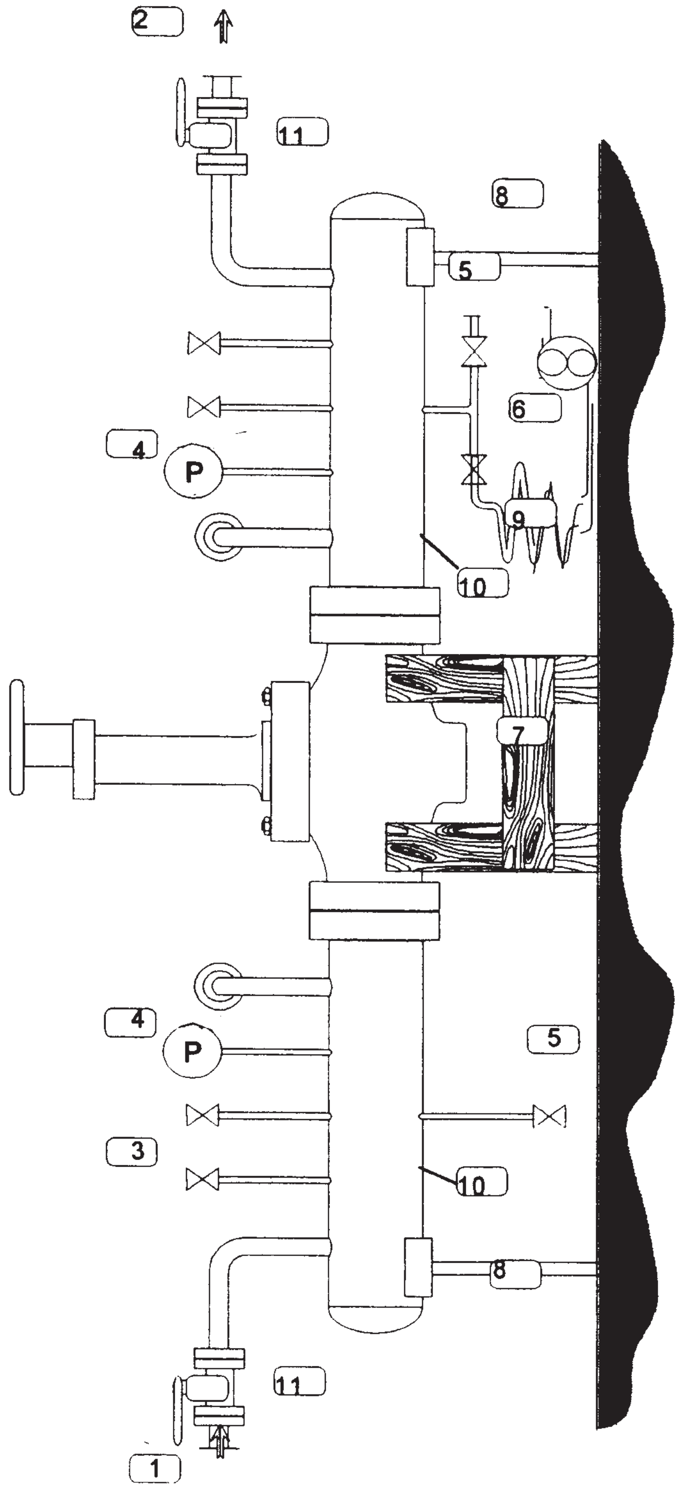
This report shall include the following :

— the measured leakage rates and stresses / torques during the initial, endurance and final tests at ambient temperature and low temperature ;

— the leakage rate during the seat leaktightness test during the initial and final tests at ambient temperature ;

— the endurance class (see B.6) ;

— the leaktightness class (see B.8).



Key

1 Liquid inlet
2 Liquid outlet
3 Nitrogen pressurization
4 Manometer or pressure gauge
5 Drain valve
6 Gas meter
7 Support
8 Support
9 Heating coil
10 Spool
11 Isolating valve

Figure B.1 – Test bench diagram

Annex C
(normative)

Range of DN for type tests

Table C.1 - Range of DN for type tests

Tested DN	DN of approved valves																			
8	8	10	15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
10	8	10	15	20	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
15	-	10	15	20	25	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
20	-	-	15	20	25	32	-	-	-	-	-	-	-	-	-	-	-	-	-	-
25	-	-	-	20	25	32	40	-	-	-	-	-	-	-	-	-	-	-	-	-
32	-	-	-	-	25	32	40	50	-	-	-	-	-	-	-	-	-	-	-	-
40	-	-	-	-	-	32	40	50	80	-	-	-	-	-	-	-	-	-	-	-
50	-	-	-	-	-	-	40	50	80	100	-	-	-	-	-	-	-	-	-	-
80	-	-	-	-	-	-	-	50	80	100	125	-	-	-	-	-	-	-	-	-
100	-	-	-	-	-	-	-	-	80	100	125	150	-	-	-	-	-	-	-	-
125	-	-	-	-	-	-	-	-	-	100	125	150	200	-	-	-	-	-	-	-
150	-	-	-	-	-	-	-	-	-	-	125	150	200	250	-	-	-	-	-	-
200	-	-	-	-	-	-	-	-	-	-	-	150	200	250	300	-	-	-	-	-
250	-	-	-	-	-	-	-	-	-	-	-	-	200	250	300	350	-	-	-	-
300	-	-	-	-	-	-	-	-	-	-	-	-	-	250	300	350	400	-	-	-
350	-	-	-	-	-	-	-	-	-	-	-	-	-	-	300	350	400	450	-	-
400	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	400	450	...	1000
	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	...	...	...	...
1000	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	400	450	...	1000
NOTE	For example, if a DN 50 valve passes the type test, then all valves ranging from DN 40 to DN 100 shall be approved.																			

Annex D
(normative)

Range of PN and Class for type tests

Table D.1 - Range of PN and Class for type tests

Tested PN	*Tested Class*	PN and *Class* of approved valves											
-	*900*	*900*	-	100	-	-	-	-	-	-	-	-	-
100	*600*	-	*600*	100	-	63	-	-	-	-	-	-	-
63		-	-	-	*600*	100	63	*300*	40	-	-	-	-
	300	-	-	-	-	-	63	*300*	40	25	-	-	-
40		-	-	-	-	-	63	*300*	40	25	*150*	16	-
25		-	-	-	-	-	-	-	40	25	*150*	16	-
	150	-	-	-	-	-	-	-	40	25	*150*	16	-
16		-	-	-	-	-	-	-	-	25	*150*	16	10

NOTE For example, if a PN 63 valve passes the type test, then all valves ranging from PN 40 to PN 100 and valves ranging Class 300 to Class 600 shall be approved.

Annex E
(normative)

Low temperature acceptance test

E.1 General

If a cryogenic test is required on valves manufactured against a specific purchaser's contract, then the number of valves to be tested shall be subject to prior agreement between the purchaser and the manufacturer. The cryogenic test shall be performed as described below.

E.2 Cryogenic test

E.2.1 The purpose of the test is to verify the performance of the valve under cryogenic conditions.

E.2.2 The cryogenic test temperature shall be –196 °C.

E.3 Prior to test

E.3.1 The valve components shall be degreased and dried. The valve shall subsequently be assembled in an environment which is free of grease and dust.

E.3.2 Suitable test connections shall be provided to enable the valve to be pressurized and all bolts shall be tightened to a predetermined torque or tension depending on the type of joints and the bolting used.

E.3.3 Suitable thermocouples shall be attached to the valve to enable the valve body and bonnet temperatures to be monitored throughout the test. In particular, a thermocouple, intended for the measurement of the fluid temperature, shall be positioned inside the valve.

E.4 Test

E.4.1 An example of installation of the test bench is shown in Figure E.1. The valve shall be set up in the test tank and all connections shall be made. Care shall be taken to ensure that the packing box of the stem/shaft is protected from the boil-off gas in the top of the test tank.

E.4.2 A valve pressure test shall first be performed at the allowable seat pressure at ambient temperature (see E.4.5 c)) using helium gas, in order to ensure that the valve is in a suitable condition for the test to proceed.

E.4.3 The valve shall be dry prior to cooling down and be subjected to a pressurised helium gas purge through the valve throughout the cooling process. The valve shall be cooled down by immersion into liquid nitrogen to a depth such that the level of the liquid covers the top of the body/bonnet joint. Throughout the cool down the obturator shall remain in the open position.

E.4.4 During cool down, the temperature of the valve body and bonnet shall be monitored by means of suitably located thermocouples.

E.4.5 Once the valve body and bonnet have reached a temperature of -196°C, the following operations shall be carried out :

a) the valve shall be allowed to soak at the test temperature during a minimum of 1 h to ensure that all temperatures have stabilized ;

b) repeat the initial valve pressure test as described in E.4.2 at the cryogenic test temperature ;

c) the valve shall then be subjected to a seat test in the preferential sealing direction. Measurement of the leakage rate shall only be carried out once the internal temperature has stabilized. Closing and opening stresses or torques shall be measured and recorded, the test conditions agreed between the manufacturer and the purchaser. For bi-directional valves, the leaktigthness test shall be performed in both directions. Closing and opening stresses or torques shall also be measured and recorded in both directions ;

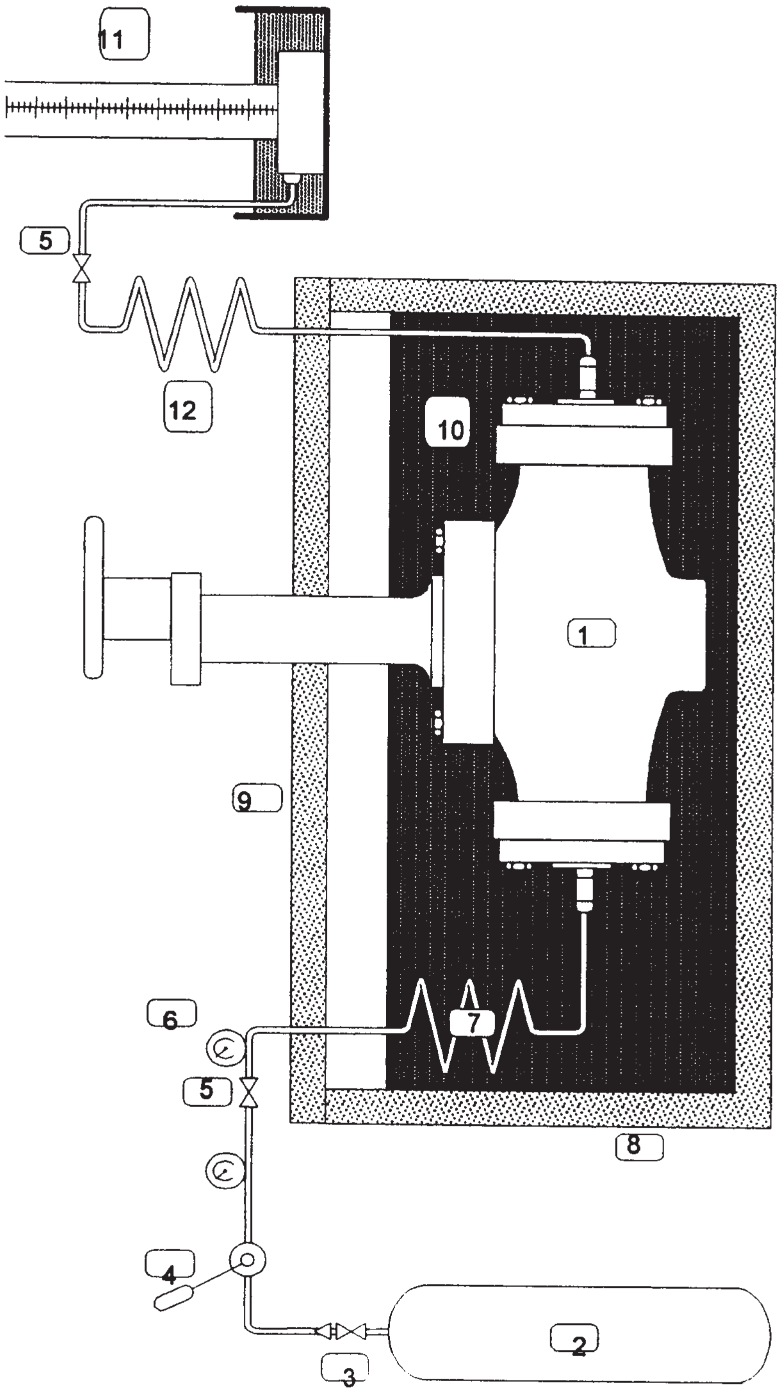
d) the valve should be operated by opening and closing prior to carrying out the test in the second direction ;

e) if the allowable pressure of the obturator is lower than the rated PN or Class value, this value shall be taken as the seat test pressure. The internal leakage rate shall be measured only at the seat test pressure ;

f) the internal leakage rate shall be measured by means of a manometer, a flow rotameter or a flowmeter. The internal leakage rate shall not exceed a value equal to twice the leakage rate of the leaktightness class determined by the type test (see B.8.1) ;

g) with the valve in partially open position, the needle valve on the outlet side of the valve shall be closed in order to pressurize the body at the seat test pressure of the obturator. This pressure shall be maintained for a period of 10 min. The leaktightness at the shaft or stem and body joints shall then be checked. No leakage shall occur neither at the bonnet joint nor at the shaft or stem/body joint (leakage $\leq 10^{-4}$ cm^3(n)/s of helium) ;

h) the test is completed. Return valve to open position.



Key

1 Valve under test
2 Helium tank
3 Pressure reducing valve
4 Pump
5 Needle valve
6 Pressure gauge
7 Cooling coil
8 Insulated tank
9 Insulated cover
10 Liquid nitrogen
11 Measuring cylinder
12 Warning coil

NOTE Valve stem packing box has to be positioned above tank liquid level

Figure E.1 – Diagram of test bench

Annex F
(normative)

Marking for sealing direction

Table F.1 - Marking related to the preferential direction for sealing

Valve with preferential direction for sealing ΔP $\Rightarrow$