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LNG 벙커링기자재 시험평가 설비 기본 및 상세설계

PURCHASING SPECIFICATION FOR CRYOGENIC BALL VALVE

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한국가스기술공사
KOREA GAS TECHNOLOGY CORPORATION

CONTENTS

1. SCOPE

This specification applies to the manufacture test, inspection, and other related matters of cryogenic ball valves.

2. CODES AND STANDARDS

The following laws, codes, and standards referred to in this specification shall be their latest editions. Any item inc insistent with this specification shall be approved by Purchaser prior to manufacturing those valves.

American petroleum Institute (API)

API 6D	Specification for Pipe line Valves
API 598	Valve Inspection and Testing
API 607	Fire Test for Soft Seated Quarter-Turn Valves
API 6FA	Specification for Fittings

American Society of Mechanical Engineers (ASME)

ASME B16.5	Pipe Flanges and Flanged Fittings
ASME B16.10	Face-to-Face and End-to-End Dimensions of Valves
ASME B16.11	Forged Fittings, Socket-Welding and Threaded
ASME B16.25	Buttwelding Ends
ASME B16.34	Valves-Flanged, Threads, and Welding End
ASME B46.1	Surface Texture
ASME B31.3	Process Piping
ASME B16.47	Series"A" Large Diameter Steel Flange (NPS 26 through60)

Contractors Standardization Society (MSS)

MSS-SP-25	Standard marking System for Valves, Fittings, Flanges and unions.
MSS-SP-44	Steel Pipe Line Flanges
MSS-SP-55	Quality Standard for Steel Castings for Valves, Flanges and Fittings and Other Piping Components (Visual Method)

American Society for Testing and Materials (ASTM)

A182/A182M	Forged or rolled Alloy-Steel Pipe Forged Fittings and Valves and Parts for High-Temperature Service
A194/A194M	Carbon and Alloy Steel Nuts for Bolts for High-Pressure and High-Temperature Service
A216/A216M	Steel Castings, Carbon Suitable for Fusion Welding for High-Temperature Service
A312/A312M	Seamless and Welded Austenitic Stainless Steel Pipes
A320/A320M	Alloys-Steel Bolting Material for Low-Temperature Service
A350/A350M	Forgings, Carbon and Low-Alloy Steel, Requiring Notch Toughness Testing for Piping Components
A351/A351M	Casting, Austenitic, Austnitic-Ferritic (Duplex) for Pressure - Containing Parts
A358/A358M	Electric-Fusion-Welded Austenitic Chromium-Nickel Alloy Steel Pipe for High-Temperature Service
A370	Test Methods and Definition for Mechanical Testing of Steel Products.
E186	Reference Radiographs for Heavy-Walled(2 to 4½-in) Steel Castings
E446	Reference Radiographs for Steel Castongs up to 2in. in Thickness

American Society of Mechanical Engineers (ASME), Boiler and Pressure Vessel Code

Sec. V	Nondestructive Examination
Sec. Ⅷ	Pressure Vessels
Sec. IX	Welding and Brazing Qualifications

British Standard (BS)

BS 6364	Valves for Cryogenic Service

ISO (International Organization for Standardization)

ISO 8501-1	Preparation of steel substrates before application of paints and related products - Visual assessment of surface cleanliness - Part 1 : Rust grades and preparation grades of uncoated steel substrates and of steel substrates after overall removal of previous coatings
ISO 8504-1	Preparation of steel substrates before application of paints and

related products - Surface preparation methods - Part 1 : General principles

Korean Gas-Related Laws

High-Pressure Gas Safety Control Act

Urban Gas Business Law

Safety Control and Business Regulation of Liquefied Petroleum Gas Act

3. TECHNICAL SPECIFICATION

3.1 General

3.1.1 Fluid

Classification	Temperature (at atmospheric pressure)	Density(liquid)
LNG	-183℃ to -88℃	434 to 478kg/㎥
NG	-160℃ to 65℃	(0.7 to 0.89kg/㎥)
LN2	-196℃	804kg/㎥
N2	-196℃ to 65℃	(1.1848kg/㎥)

3.1.2 Working pressure and design temperature

Pressure Rating of Valve	Maximum Working Pressure of Valve, Bar	Remarks
Class 150	19.8	On the basis of ambient temperature
Class 300	51.7	
Class 600	103.4	
Class 900	155.1	
Class 2500	490.9	

a. The pressure rating the maximum working pressure of the valves hall conform to ASME B16.34

b. The maximum working pressure over class 2500 shall conform to Class 2500.

c. The normal working pressure of the valves shall conform to the line list supplied by purchaser.

d. The design temperature shall be -196℃ to +65℃.

3.2 Valve Specification

The construction, function, and specification shall satisfy the following requirements. Any deviation from this specification shall be reported in the "deviation sheet" and approved by the purchaser.

3.2.1 Type and materials of body

a. Type

Valve bodies of NPS 2 and over shall be of a top entry type (one piece bolted type), and those of under NPS 2 shall be of a side entry type (three piece bolted type).

b. Materials

The materials of valve bodies shall be as follows or equivalent. The materials of welded type valves may be used also for flanged type valves.

NPS	Manufacturing Method	Material	
		Flanged Type	Welded Type
2 and Over	Casting or Forging	ASTM A351 CF8, CF8M	ASTM A351 CF3, F316L
1.1/2 and Under	Forging	ASTM A182 F304, F316	ASTM A182 F304L, F316L

* The forging materials for NPS 2 and over shall be the same as those for NPS 2 and under.

c. Manufacture

The followings shall be applied, unless otherwise specified

1) The body shall be of a reduced bore type conforming to API 6D. However, the bodies of shut-off valves in front of relief valves or in pipelines to be cleaned by cleaved by pigging shall be of a full-bore type.
2) The face-to-face distance shall conform to ASME B 16.10
3) The minimum thickness of the valve body shall be equal to or over toe minimum wall thickness specified in ASME B 16.34, Table 3, and 4.
4) The end connections of valve bodies shall be either a welded end type or a flanged type, and shall be fabricated as follows:
   (a) Welded end type
      (1) Under NPS 2 : Socket welding except for class 25R1J
         - Class 150 and class 300 : To conform to class 3000 specified in ASME B16.11
         - Class 600 : To conform to class 6000 specified in ASME B 16.11

- Class 800 to 1500 : To conform to class 9000 specified in ASME B16.11.

(2) NPS 2 and over or class 25R1J : Butt welding

- In case the wall thickness of connected piping is of 40S or under, the valve ends shall be trimmed to a minimum of 40S in accordance with ASME B 16.25.
- In case the wall thickness of connected piping exceeds 40S, the valve ends shall be trimmed to the piping wall thickness in accordance with ASME B 16.25.

(b) Flanged type

(1) NPS 24 and under : To conform to ASME B16.5.

- Class 150, class 300 : Raised Face(Rf. type flanges
- Class 600 and over : Large Groove Face (LGF) type flanges or RF type flanges

(2) NPS 26 and over : To conform to ASME B16.47 series A.

- Class 150, class 300 : RF type flanges
- Class 600 and over : LGF type flanges or RF type flanges

(3) Flange faces shall be machined in accordance with ASME B16.5 and ASME B16.47 series A for each flange type and shall be measured in accordance with ASME B 46.1

- RF type flange: 3.2-6.3㎛ Ra(125-250μin)
- LGF type flange : under 3.2 ㎛ Ra (125μin)

3.2.2 Type and material of ball

a. Type

The balls are classified as follows according to the support method of balls. The types may be changed according to the field condition. The roundness of balls shall be satisfactory.

1) Floating type : Under NPS 2

2) Trunnion type : NPS 2 and over

b. Materials

Materials shall be ASTM A182, F316 or ASTM A351, CF8M or equivalent.

3.2.3 Type and material of stem

a. Type

In principle, the stem shall be of an extended type unless otherwise specified and shall be constructed so that it will not be broken sway from the ball (anti-blow out).

b. Materials

Materials shall be ASTM A182, F316 or equivalent.

3.2.4 Stem sealing

a. To prevent any leakage through the stem, the sealing shall be of a double or multiple sealing construction and the stem outer surface shall be in precise contact with the sealing to maintain tightness and shall be precisely machined not to damage while working (surface roughness: under 6㎛).

b. Stem packing shall be constructed for easy replacement.

3.2.5 Transition piece

Both ends of weld joint type valves shall be provided with transition pieces to prevent any damage to the valve seats and for easy welding between a valve and pipes during field welding works. The transition pieces shall be prepared to have plain ends (for socket welding) or bevel ends (for butt welding). The length and material pieces shall be as specified below or equivalent, and no circumferential weld is permitted in them. In case wilded pipes are used as transition pieces, they shall have only longitudinal seam.

a. Length of transition pieces

- NPS 2 and under : 100㎜
- NPS 3~8 : 150㎜
- NPS 10 and over : 200㎜

b. The materials of transition pieces shall be as follows according to valve classes

NPS	Valve Class	Material
6 and under	class 150 to 2500	A312 TP304 seamless
8 to 24	class 150 to 900	A312 TP304 seamless or welded A358 Gr. 304 class1
26 to 42	class 150	A358 Gr. 304 class1

However, carbon content shall be 0.06% or less.

c. The thickness of transition pieces shall conform to the line schedule supplied by the purchaser.

3.2.6 Type and materials of seat

a. Type

1) The shutoff direction of the valves shall be as follows

- NPS 2 and over : Bidirectional(self relieving type)
- Under NPS 2: Single-directional (with a 1/8" vent hole drilled upstream of

the ball)

2) Unless otherwise specified, the fluid shutoff system of valves shall be of a self-relieving type.

3) Tightness of valve seats shall be achieved primarily by the soft seal and secondarily by metal-metal contact.

4) Valve seats shall secure adequate tightness and strength to withstand the impacts of long period use and repeated open-close operations.

b. Material

1) The material of the seat unit (including plating) shall be the same as that of the ball.

2) The material of the soft seal shall be Kel-F, reinforced PTFF or equivalent materials which do not cause any chemical or physical reaction with the fluid components to form any adhesive material which sticks to the valve interior and hinders valve operation.

3.2.7 Materials of bolts and nuts

a. Materials of bolts shall be ASTM A320 Gr.B8M class 2 or equivalent.

b. Materials of nuts shall be ASTM A194 Gr.8MA or equivalent.

3.2.8 Extended bonnet

a. The location of Extended Bonnets and the location, diameter, thickness of heat sink shall be referred to the followings for Stem Packing to maintain the ambient temperature. However, the contractor shall submit to the purchaser for approval about the actual manufacturing length based on test and calculations.

NPS	1/2 to 1	1½ to 3	4 to 6	8 and over
Length of Extension, ㎜ (in)	254 (10)	304.8 (12)	355.6 (14)	457.2 (18)

b. The bonnet shall be fabricated either by casting it in whole or casting (or forging) the bonnet part only and welding transition pieces to it.

1) In case the bonnet is cast in whole, the material shall be the same as that of the body or equivalent.

2) In case the cast(or forged) part and transition pieces are welded, the casting material shall be ASTM A351 CF3, CF3M, the forging material ASTM A182 304L, 316L and the transition piece austenitic stainless steel 304L, 316L or equivalent. However, no circumferential welding is allowed for transition pieces, which shall be fabricated with seamless or

one-longitudinal-seam pipe only.

c. Insulation collars or drip plates shall be provided in the proper locations of the extended bonnet that is not insulated. However, the contractor shall submit to the purchaser for approval the proper material, size and location of Insulation Collar or Drip Plate based on test and calculations.

d. The operating mechanism such as a gearbox shall be constructed so that it will not will not be frozen in extremely-cold seasons and the area to be insulated shall be marked in the manufacturing drawings.

3.2.9 Driving mode and operating mechanism

a. The driving modes of valves are classified as follows according to valve classes and it may be changed according to design conditions. The valves shall be able to be easily operated without using a special tool or applying excessive power.

NPS	Valve Class	Driving Mode
Under 4	class 600 and over	lever
4 and under	class 150 & class 300	
4 and over	class 600 & class 900	gear(or motor)
6 and over	class 150 & class 300	gear

b. The manual operation of valves shall be performed with a hand wheel or a hand lever and the applied force at the end tip of the manually-operating mechanism shall not exceed a maximum of 254 N (25㎏f) at the normal differential pressure.

c. Manually-operating mechanism shall be fabricated with forged or cast austenitic stainless steel or with aluminum alloy. The valves shall be designed and manufactured to sufficiently withstand the stress to be caused during the operation by the operating differential pressure.

d. The explosion-proof class of the motor-driven mechanism shall conform to the explosion-proof classification of the area where such a valve is to be installed.

e. All valves shall be provided with a locking device (locked-open or locked-closed) on their stems or on their operating mechanisms.

f. Valves shall be provided with a position indicator so that the valve opening can be checked at a distance and with a stopper to prevent the ball from

turning beyond 90 degrees.

g. In the case of valves with a motor-driven mechanism, the valves shall also de provided with a position indicator so that the valve opening can be checked at a distance and with a stopper to prevent the ball from turning beyond degrees. The contractor shall submit the manufacturing specification to the purchaser for approval.

h. Gearboxes shall be of a waterproof construction to prevent any ingress of water.

i. The opening direction of valves shall be counter-clockwise.

j. The operating direction and the location of the valve operating mechanism shall be approved by the purchaser prior to their manufacture.

3.2.10 Painting

The operating systems of valves (Hand lever, Hand wheel, Gear box and Actuator) shall be surface-treated and painted as follows

a. Surface treatment

The surfaces shall be removed of foreign materials such as oil, grease, rust and blasted with steel shots, steel grits or other equivalent abrasives to secure necessary roughness. The treated surface condition shall conform to SA 2½ or ISO-8501-1.

b. External painting

The internal and external valve surfaces shall be completely cleaned of abrasives and dust. Exposed above-ground valves shall be painted with primer, epoxy and urethane to the dry thickness of 250㎛ (color : Munsell No.7.5. Gr-5.5/1 green grey).

c. The contractor shall submit detailed painting specifications of all painting works for the purchaser's approval prior to the painting and shall keep ready at painting thickness gauge.

d. Others shall conform to the manufacturer's specification.

3.3 Surface Treatment

After fabrication and testing, all valves shall be treated with pickling and passivation to form passive coating.

3.4 Welding and Heat Treatment

3.4.1 Welding

a. Welding works shall be performed in accordance with the welding procedure specification (WPS) and the procedure qualification record (PQR) teat have been approved in accordance with ASME Sec.IX.

b. Repair welding shall be performed in accordance with the repair welding procedure prepared by the contractor and approved by the purchaser. However, repair of cracked defects shall not be accepted.

c. Nondestructive test on the repair welds shall be undertaken by the test method of the related location.

d. The contractor shall prepare a list of defects in major parts such as a valve body prior to the repair works and it to the inspector during the inspection.

3.4.2 Heat treatment

Heat treatment shall be conducted in accordance with the heat treatment specification for each material and each size approved by the purchaser.

4. TEST AND INSPECTION

All tests and inspections shall be performed in accordance with this specification, related standards sand specifications, the latest test and inspection procedures approved by the purchaser, and manufacturing drawings.

The test and inspection may be performed by either the purchaser or an authorized third-party inspector appointed by the purchaser.

4.1 Material Tests

4.1.1 Mill certificates and cryogenic impact test results of major parts (such as a body, a ball, a stem, transition pieces, a seat ring, an extended bonnet, bolts, and nuts) specified with chemical analyses and mechanical test results shall be submitted to the purchaser for his approval, and the test results shall satisfy the requirements of related standards.

4.1.2 The cryogenic impact tests shall be performed at a temperature of -196℃ in accordance with ASME Sec. Ⅷ Div. 1, Paragraphs UHA 51 and UG 84, and the test values of 3 test pieces shall be 0.381㎜ (15 mils) or over for each piece in lateral expansion.

4.1.3 The δ-ferrite value of the valve body shall be 5 to 10%

4.2 Nondestructive Test

The test procedures shall be approved by the purchaser prior to such

nondestructive tests. The contractor shall keep and manage radiographs and nondestructive test reports for at least the period of guaranty and warranty, and immediately submit them to the purchaser upon his request.

4.2.1 Radiography test(RT)

a. Test range

1) In accordance with ASME B16.34 Chapter 8, all cast valve bodies, bonnets (covers), all welds on valves (butt welds between the body and transition pieces, butt welds of fabricated extended bonnets, and longitudinal welds of transition pieces and fabricated extended bonnets) and critical areas shall be tested a hundred percent by radiography. However, the body ends shall be tested prior to beveling.

2) In the case of cast valves, radiography test shall be performed on 5% of the cast quantity for each class (bore size and pressure. (a minimum of 1 valve a hundred percent by radiography. In case any defect is discovered, 10% of the related class shall be additionally sampled and tested. In case any defect is found again among them, the whole cast quantity of the related valve class shall be rejected.

b. Test procedure and acceptance standards

1) Tests shall be performed in accordance with ASME Sec. V and ASME B 16.34 Mandatory Appendix I.

2) In the case of case of casting, radiograph reading shall be performed in comparison with the reference radiographs in ASTM E446 [wall thickness under 50.8㎜ (2")] and ASTM E186 [wall thickness 50.8㎜ (2") and over to 114.3㎜ (4.5") inclusive].

3) The acceptance standards shall be as follows for cast products

Category	Discontinuity Type		Acceptable Severity Level	
			Critical Areas	Non Critical Areas
A	Gas porosity		A1	A2
B	Sand & slag inclusion		B1	B2
C	Shrinkage	Type 1	CA1	CA2
		Type 2	CB1	CB2
		Type 3	CC1	CC2
		Type 4	CD1	CD2
D	Crack		none	none
E	Hot tear		none	none
F	Insert		none	none
G	Mottling`		none	none

* Critical areas are the seat, end parts, and end of the valve body to be tested a hundred percent by radiography. (Refer to ASME B16.34 Fig 6, 10.)
* According to the results of nondestructive tests performed by Korea Gas Safety Corporation on the welds of valve ends installed at the site, any defect shall be repaired by the valve manufacturer under his responsibility.

4) Welds shall be tested in accordance with ASME Sec.Ⅷ, DIV.1, UW-51, and Appendix 4.

4.2.2 Penetrant test (PT)

a. Test scope

1) All outer surfaces of the valve body and bonnet, their inner surfaces accessible for test, beveled end parts of the body, and sockets and fillet welds (lifting lugs and support legs) which can not be radiography-tested shall be penetrant-tested a hundred percent in accordance with ASME B16.34 Chapter 8.
2) Defective cast parts gouged for removal of such defects shall be tested a hundred percent.
3) Bolts over 25.4㎜ (1") in diameter shall be tested a hundred percent.

b. The test procedure shall conform to ASME Sec. V and ASME B16.34, Mandatory Appendix III and the cast surfaces shall be prepared to 400 to 500μ inch in roughness to secure reliable test results and the welds shall be ground, if necessary. The penetrant shall be free of any chloride and halogen compounds that are harmful to the tested parts and all

contaminants shall be cleaned out with proper solvent after testing.

c. Acceptance standards

1) Cast and forged parts shall conform to ASME B16.34 Mandatory Appendix III

2) Welds shall conform to ASME Sec.1 Appendix.8

4.2.3 Ultrasonic test (UT)

a. Test range

1) The bodies and bonnets of forged valves shall be tested a hundred percent in accordance with ASME B16.34 Chapter 8.

2) The stems of all valves shall be tested a hundred percent.

b. The test procedure shall conform to ASME B 16.34 Mandatory Appendix IV.

c. Acceptance standards shall conform to ASME B16.34 Mandatory Appendix IV

4.2.4 Retest

Parts rejected after testing shall be repaired and each related part shall be tested again in accordance with the corresponding test method and test procedure.

4.2.5 Submittal of test results

The contractor shall submit to the purchaser the test results in the test and inspection report (with accompanying drawings with sketched test areas).

4.3 Dimensional Check

All manufactured valves shall be checked and the major dimensions shall be checked against the related specifications and manufacturing drawings.

4.4 Visual Inspection

All valves shall be checked if there is any harmful scratch, crack, crease, shrinkage, protrusion, surface discontinuity, casting sand, or rust in accordance with MSS-SP-55 and shall be checked if there is any damage to the machined surfaces and surfaces and seats. The welds shall be free of any scratch, undercut, or arc strike harmful to sue and the height of weld bead shall not be lower than the base metal surface.

4.5 Inspection of Heat Treatment

The inspection of heat treatment shall be performed in accordance with the heat

treatment specification approved by the purchaser, and the heating temperature, heating method, heating time, holding time, cooling rate, and cooling method shall be included in the specification. The furnace temperature shall be recorded by an automatic temperature recorder and the heat treatment record charts shall be submitted to the purchaser.

4.6 Operation Test

The operation test of a manufactured valve shall be performed 15 times or more. The first 5 tests shall be performed without any pressure and the remaining 10 tests shall be performed at the normal working pressure to confirm its normal operation. And the operation test shall be performed again at the normal differential pressure for 1 time or more and the applying force shall not exceed a maximum of 245 N (25㎏f.)

4.7 Pressure and pneumatic tests

All manufactured valves shall be tested with the transition pieces attached by welding to check the strength and tightness of valves in accordance with API 598 as follows and the test results shall be submitted to the purchaser in the form of record charts recorded by an automatic pressure recorder. Proper test equipment shall be prepared to prevent applying any undue pressure to the valve body during the process of shutting off the valve inlet and outlet for the pressure and pneumatic tests.

4.7.1 Pressure test

Item	Shell Pressure Test	Low Pressure Closure Test	High Pressure Closure Test
Test media	Approved media such as kerosene, methanol, alcohol, etc.	Dry air or nitrogen	Approved media such as kerosene, methanol, alcohol, etc
Test pressure	1.5 times the maximum working pressure at 38℃ (100°F) specified in ASME B16.34, Table 2-2.1B, 2.2B (special class) (ball slightly open)	0.7MPa (7bar) (ball closed)	1.1 times the maximum working pressure at 38℃ (100°F) specified in ASME B16.34, Table 2-2.1 B, 2.2 B (special class) (ball closed)
Test time	5 minutes minimum	5 minutes minimum (bubble test)	5 minutes minimum
Acceptance standard	No external leakage	To conform to API 598	To conform to API 598

* The closure test of bidirectional shut-off valves shall be performed in both directions.

4.7.2 Shell pneumatic test

The test medium shall be either nitrogen or dry air. The ball shall be kept slightly open at a pressure of 1.1 times the normal working pressure for 30 minutes. The valve shall be free of any abnormal stress and external leakage.

4.8 Fire Safe Test

The test may be replaced by replaced by the submittal of the certificate in accordance with API 607 or API 6FA.

4.9 Cryogenic Test

Cryogenic tests shall be performed as follows. Any items not covered herein shall be in accordance with BS 6364, Appendix A.

4.9.1 Test scope

a. Five percent (5%) of all valves for each valve class (bore size and pressure. shall be sampled and cryogenic-tested (a minimum of 1 valve). [However, all the valves for emergency shut down (ESD) shall be tested a hundred percent]
b. In case the test result fails to satisfy the requirements, 10% of related classes

shall be additionally sampled and tested. In case the test results fails again to satisfy the requirements, the whole lot of the related valve class shall be rejected. (Satisfaction of cryogenic test requirements means that the test results of initial proving test, cryogenic performance test, ambient temperature restoration test, and disassembly test satisfy their corresponding standards.)

4.9.2 Test procedure

Test cryogenic performance test, ambient temperature restoration test, and disassembly test, and method procedure of each test shall be as follows:
However, the pneumatic test on bidirectional valves shall be performed at both directions

a. Initial proving test

This is a test to confirm the tightness of valves at ambient temperature and is carried out with valves closed as follows

1) Test temperature : Ambient temperature
2) Test medium : Helium gas
3) Test pressure : 1.1 times normal working pressure of the valve
4) Test time : 5 minutes
5) Allowable leakage : No visible leaks
6) Valves shall be pressurized in steps to the test pressure as follows

Valve Pressure Class	Pressurization at Each Step [MPa(bar)]	Holding Time for Each Step (minute)	Remarks
Class 150	0.35 (3.5)	10	Measure and record the leak at each pressurization step.
Class 300	0.75 (7.5)	10	
Class 600	1.0 (10.0)	10	
Class 800 and over	2.0 (20.0)	10	

b. Cryogenic performance test

1) Test preparation

(a) Measure and record the bolting torques of valves bodies, bonnets (covers), and glands.

(b) Prepare the test equipment suitable for cryogenic tests in accordance with BS 6364, Appendix A, and install thermocouples in proper locations on the valve body, bonner, and gland housing to measure cryogenic test temperatures.

(c) Cool down the valve by submerging the valve body, bonnet, and upper end of connection part in a liquefied nitrogen container.
purge the valve inside with helium gas during cool-down process and check the temperatures of the inside and outside of the valve body, bonnet, and gland housing.

(d) Keep the valve in the liquefied nitrogen container at least one hour until the temperatures of the valve body and bonnet are stabilized.

2) Kind and methods of tests

When the cryogenic test temperature of -196℃ is uniformly maintained, the tests shall be performed as follows

(a) Cryogenic pressure test

The test medium shall be helium gas. The valve shall be tested with the ball slightly opened at 1.1 times the normal pressure of the valve for 15 minutes. There shall be no leakage on the valve outside surface [valve body, gland, and connection parts.]

(b) Cryogenic operation test

The valve shall be opened and closed 5 times each at the differential pressure condition of normal working pressure at the cryogenic temperature of -196℃, and the applied forces at the end tip of operating device shall be measured and recorded at least during the first and the last open/close operations [acceptance standard: 254 N (25㎏f. and under].

(c) Cryogenic pneumatic test

Right after the cryogenic operation test, the test shall be performed in accordance with the initial proving test procedure in above 4.9.2 a. at the temperature of -196℃, and the allowable leakage shall be 5 normal ㎤ /(min. inch) for nominal diameter of the valve.

c. Ambient temperature restoration test

After the completion of cryogenic tests and when the valve temperature is returned to the ambient temperature, the following tests shall be performed

1) Pneumatic test at ambient temperature

Valve leakage shall be checked by the same method of the initial proving test in 4.9.2. a.

2) Operation test

The valve shall be opened and closed 5 times each at the differential pressure condition of normal working pressure at ambient temperature. And

the applied forces at the end tip of operating device shall be measured and recorded at least during the first and the last open/close operations [acceptance standard : 254 N (25㎏f. and under)]

d. Disassembly test

After the completion of the ambient temperature restoration test, the valve shall be disassembled in a clean place and checked for the easiness of disassembly, and for any damage and wear of its parts.

e. Final pneumatic test

After the completion of the disassembly test, the valve shall be reassembled and final pneumatic test shall be performed in accordance with the standards of the low pressure closure test and the high pressure closure test in 4.7.1

4.9.3 Submittal of test results

After the cryogenic test, the result report including following contents shall be submitted to the purchaser:

a. Result of initial proving test at ambient temperature [4.9.2 a.]
b. Bolting torques of the valve body, the bonnet, and the gland [4.9.2 b. 1) (a)]
c. Temperature measurement result at cryogenic temperature [4.9.2 b. 1) (c)]
d. Pressure test result at cryogenic temperature [4.9.2 b. 2) (a)]
e. Operation(open/close. test result at cryogenic temperature [4.9.2 b. 2) (b)]
f. Pneumatic test result at cryogenic temperature at each step of pressure [4.9.2 b. 2) (c)]
g. Pneumatic test result after restoration to ambient temperature [4.9.2 c. 1)]
h. Operation(open/close. test result after restoration to ambient temperature [4.9.2 c. 2)]
i. Conditions of valve parts after cryogenic tests [4.9.2 d.]

5. MARKING

5.1 Markings on the valve body shall conform to API 6D Sec.6 and the flow direction shall be marked also.
"LT" shall be marked at the upper or lower place of the flow direction marking (center of body)

5.2 The description on the nameplate shall conform to API 6D Sec. 6 and the tag number, purchaser, and inspector of the valve shall be included. The

dimension, material, marking method, and nameplate location shall be approved by the purchaser prior to manufacturing nameplate.

5.3 The open/close directions of the valve shall be marked.

6. PACKING

6.1 Valves shall be packed with their balls fixed in open position prevent any damage.

6.2 Welded valves shall be covered at their end openings with solid covers (caps of wood, plastic, or metal) to prevent any damage and ingress of foreign materials, and to protect the valve ends during transportation and storage.

6.3 Flanged valves shall be covered with flange covers to prevent any damage to flange faces and the valve inside.

6.4 All valves shall be packed with polyethylene sheets with the moisture absorbent inside to prevent any ingress of moisture and contaminants. (However, ocean-freighted valves shall be packed in a sealed condition to prevent corrosion).

6.5 Valves shall be delivered in plastic or wooden packing to prevent any damage during transportation and storage. Tags shall be attached so that the contents can be identified in detail from the outside.

6.6 Valves shall be supported in a proper way to keep them fixed safe during transportation.

6.7 Quarantine requirements for wood packing materials

All wood packing materials for all imported consignments shall be subject to quarantine requirements of National Quarantine Service, under the sole responsibility of seller.

7. OTHERS

7.1 All valves shall be inspected and stamped by korea Gas Safety Corporation.

7.2 The contractor shall submit to the purchaser the drawings specified with materials and dimensions and get his approval prior to manufacturing the

valves.

7.3 Items to be witness-tested will be approved by the purchaser after reviewing the inspection items submitted by the contractor.

7.4 All valves weighing 40㎏ and over shall be provided with lifting lugs for easy transportation and handling, and be provided with supporting legs, if necessary. Lifting lugs and supporting legs shall be fabricated after the manufacturing drawing specified with dimensions and manufacturing method approved by the purchaser.

7.5 Valves shall be of an anti-static design to prevent static electricity between ball and stem, and stem and body, and from external impacts.
in case the valve specification has to be modified due to the contractor's specific characteristics, the contractor's specification may be adopted if better quality is guaranteed.

7.6 In case the valve specification is to be modified because of the contractor's specific characteristics, the contractor's specification may be adopted if improved quality is guaranteed.

7.7 All costs and expenses for the tests and inspections of valves (including retest and re-inspection) shall be borne by the valve contractor.

7.8 The purchaser shall be entitled to select the kind and submittal schedule of all documents to be submitted in connection with valves, and to request them. The language may be either English or korean. All manuals shall be prepared in computer files by means of MS-WORD 2007 or its upgrade versions. And all certificates and inspection records to be submitted shall be scanned and converted to ***. jpeg files and submitted in the form of diskettes or CD ROMs during the approval stage of manufacturing drawings and documents.