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Hellenic Gas Transmission System Operator

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TECHNICAL JOB SPECIFICATION

510/1

REVISION 1

DATE 02/11/2011

LIQUEFIED NATURAL GAS PLANTS

GENERAL REQUIREMENTS FOR VALVES (INCLUDING CRYOGENIC SERVICE)

QUALITY ASSURANCE PAGE

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1	**02-11-2011**	**FIRST ISSUE**	**PQ DPT**	**V.G.**
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ELOT EN 558
[Industrial valves. Face-to-face and centre-to-face dimensions of metal valves for use in flanged pipe systems. PN and Class designated valves]

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[Metallic materials - Charpy pendulum impact test - Part 1: Test method]

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[Testing of valves - Fire type-testing]

ELOT EN ISO 15614-1
[Specification and qualification of welding procedures for metallic materials - Welding procedure test - Part 1: Arc and gas welding of steels and arc welding of nickel and nickel alloys]

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[Pipe threads, general purpose]

EU DIRECTIVES

PED 97/23/EC
[Approximation of the laws of the Member States concerning pressure equipment]

1.0 SCOPE

This specification covers technical requirements for valves, and is to be used to supplement but not detract from the requirements of the valve standard specified on the requisition.

In the event of conflicts between any requirements or when interpretation of requirements is needed, written clarification shall be obtained from the Owner before proceeding with the manufacture of the affected parts.

2.0 GENERAL REQUIREMENTS

Valves shall be manufactured in accordance with the standards and Specifications (latest edition) listed in this section, and with the additional requirements as stated in this document.

Body and bonnet valve dimensions shall be in accordance with the relevant specifications for each type of valve. Face to face and flanged end dimensions shall be in accordance with **EN 558** (class designated valves). Butt welding ends shall be in accordance with **EN 12627.**

1 All valves stated in this specification must be in brand new condition. No old technology, or in stock, or refurbished state valves are accepted.

TABLE **1 - CODES & STANDARDS**

Codes and Standards governing design and selection of valves shall be the following:

ELOT EN 287-1
ELOT EN 558-2
ELOT EN 593
ELOT EN 1171
ELOT EN 1473
ELOT EN 1503-1
ELOT EN 1759-1
ELOT EN 1984 E2
ELOT EN 10204
ELOT EN 12266-1 & 2.
ELOT EN 12760
ELOT EN 13709 E2
ELOT EN ISO 10497 E2
ELOT EN ISO 15614-1

TABLE 2

MATERIAL SPECIFICATIONS FOR VALVE BODY AND COVER

BASE MATERIAL	FORGING ELOT EN 10222	CASTING ELOT EN 10213
Carbon Steel	P245GH	GP240GH
Carbon Steel with Impact properties at -40°C	P285NH	G17Mn5
Creep Resisting Steels		
C-1/2 Mo	16Mo3	G20Mo5
11/4 CM/2 Mo	13CrMo4-5	G17CrMo5-5
21/4 Cr-1 Mo	11CrMo9-10	G17CrMo9-10
5 Cr-1/2 Mo	X16CrMo9-1	GX15CrMo5
9 Cr-1 Mo	X10CrMoVNb9-1	----
Stainless Steels		
18 Cr-8Ni (304)	X5CrNi18-10	GX5CrNi19-10
16 Cr-12Ni-2 Mo (316)	X5CrNiMo17-12-2	GX5CrNiMo19-11-2
16 Cr-12Ni-2 Mo (316L)	X2CrNiMo17-12-2	GX2CrNiMo19-11-2
18 Cr-10Ni-Ti (321)	X6CrNiTi18-10	----
18 Cr-10Ni-Nb (347)	X6CrNiNb18-10	GX5CrNiNb19-10
Cast Iron		EN-GJL-250/EN 1561
Copper Alloy		EN 1982

Small bore valves (50DN and below) shall normally be reduced bore, except when "full bore" is specified.

Valves supplied to a "Manufacturer's Standard" shall be subject to the approval of the Owner.

It will be assumed by the Purchaser that unless Vendor makes specific exceptions in his quotation, all valves supplied will comply exactly with the requirements specified in the Material Requisition and in the Standards and Specifications attached thereto.

Vendor must clearly state in his quotation all instances in which the valve offered deviates from the Material Requisition Specification including, but not limited to, all

differences in mechanical design, codes of fabrication or design, materials of construction, and face to face dimension on overall length.

2.2 DESIGN AND SPECIAL REQUIREMENTS

2.2.1 GATE AND GLOBE VALVES

Gate and globe valves shall be suitable for repacking under pressure in the fully open position.

When 13 Cr. trim is specified, Stellite No. 6 seats are an acceptable alternative.

When specified on requisition, "Combination" is the same as for 13 Cr. Trim except that the valve seat is to be nickel copper alloy of approximately 54% nickel, 33% copper and 13% tin (Crane "Xκ" trim or equal).

1 Soft seated valves shall be clearly marked by the Vendor with the soft seal material and working temperature range.

Yoke sleeve (also known as stem nut or yoke bush) shall be of non rusting metal having a suitable bearing quality and melting point above 1750°F (955°C).

Yoke sleeve nut (where used) shall be of a material having a melting point above 1750°F (955°C).

A one piece gland or any gland flange shall be of steel. The bushing of a one piece bushed gland or the gland proper of a two piece gland shall be made of a material having a melting point above 1750°F (955°C). For cryogenic service a single piece
1 gland or any gland shall be made of material similar to the valve body.

Handwheel shall be of steel, cast iron is not acceptable.

Gate valves shall be concentric full port type.

1 Cryogenic valves trim materials shall correspond to Table 3.

2.2.2 CHECK VALVES

For carbon steel and ferritic alloy swing type check valves, disc retaining components, e.g. studs, nuts, washers and pins shall be of 13 Cr steel unless otherwise specified.
1 For cryogenic valves, component materials shall be suitable for the intended operating temperature based on Table 3.

Check valves 50DN and smaller shall be for horizontal and vertical installation (i.e. spring loaded).

2.2.3 BALL AND PLUG VALVES

1 Soft seated ball valves shall be of "fire safe and antistatic" design and shall meet the requirements of **ELOT EN ISO 10497 E2.**
All sizes and types of ball valves shall be proven "fire safe" to the satisfaction of the Owner. Valves not meeting the foregoing requirement will not be purchased as "fire safe".

Ball valve stem retention shall not depend on the packing gland. A bottom entry shouldered stem is preferred.

Extension stems when specified on requisition shall be to Manufacturer's Standard.

Plugs in steel plug valves shall normally be of similar material to body, and hardened or hard faced to minimize galling. Cast iron plugs in steel valves are not acceptable.

Lubricated plug valves up to 500°F (260°C) shall be fitted with combination lubricator and charged with a lubricant suitable for the service stated on the requisition.

Wrench operated valves shall be furnished complete with wrenches.

Non-lubricated plug valves where the plug is electrically insulated from the body shall have an anti-static device fitted.

1 Soft seated valves shall be clearly marked by the Vendor with the soft seal material and maximum working temperature.

1 Cryogenic valves trim materials shall correspond to Table 3.

2.2.4 BUTTERFLY VALVES

Requisition for butterfly valves shall state the O.D., wall thickness and lining thickness (if applicable) of the mating pipework. Vendor shall confirm in his quotation that mating pipework bore will give adequate disc swing clearance.

All gear operated butterfly valves are to be fitted with a disc position indicator.

1 On wrench operated butterfly valves, the wrench must be capable of being self-steady locked in any position.

1 Cryogenic valves trim materials shall correspond to Table 3.

2.2.5 MANUAL OPERATORS

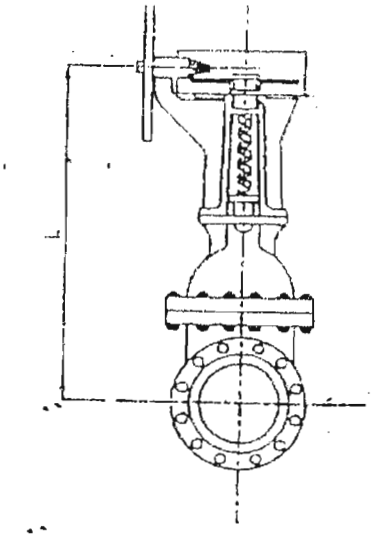
Gear operators shall be heavy duty and shall be weatherproof by total enclosure. Any lubricants shall be suitable for the Minimum Winter Design Temperature in the location where they are to be installed.

When specified on material requisition, manual gear operators shall be fitted to the valve.

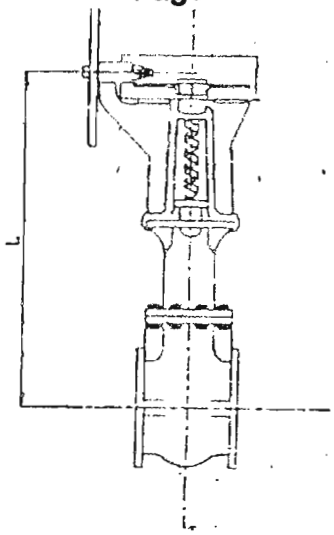
Manually operated gear operators shall be supplied for valves in the following sizes and larger.

Class	Ball or Plug	Globe	Gate	B/Fly
150	150 DN	300 DN	350 DN	250 DN
300	150 DN	250 DN	300 DN	200 DN
600	-	200 DN	250 DN	-
900	-	150 DN	250 DN	-
1500	-	150 DN	250 DN	-

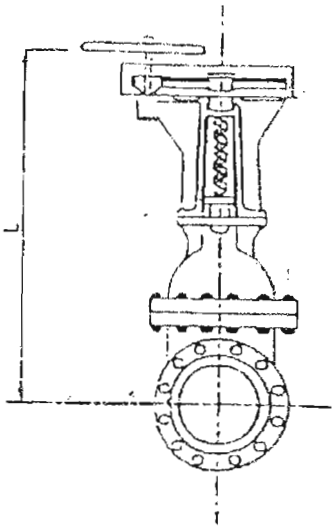
Gear operators for gate and globe valves shall be bevel type unless spur type is specifically stated Both bevel and spur gear operators shall be the type with 4 or 8 bolt mountings which allows them to be orientated on site at any of 4 - 90° positions, (e.g. Torkmatic type B (Bevel) or S (Spur), or equal) without releasing bonnet joint.
Style shall be **those** indicated below.



STYLE N – BEVEL GEARING



STYLE O – BEVEL GEARING



STYLE P – SPUR GEARING

Gear operated plug and ball valves shall normally be provided with worm gears.

1 Chain wrenches shall be to Manufacturer's Standard and must be applied when the height of installation exceeds the human body height.

Chain wheels shall be of the adjustable sprocket rim type, with chain guides included. Chain wheel attached to valve handle by bolting shall use "U" bolts and not "J" bolts. Bolts shall 316 SS and chain non-sparking.

Extension stems when specified on requisition shall be to Manufacturer's Standard.

Hand wheels and gear operators shall be designed for easy operation with a maximum pull of 35 kg at the rim.

Handwheel shall be of steel, cast iron is not acceptable.

2.2.6 BONNET OR COVER JOINTS, GASKETS AND BOLTING

Bonnet or cover flange gasket shall be metallic spiral wound, steel, soft iron or single or double-jacketed steel and asbestos free, suitable for the pressure rating of the valve and the maximum or minimum temperature specified on the requisition.

Note: Neither bonnet gasket shall contain asbestos.

Metallic gaskets shall have chemical and mechanical properties at least equal to the body material.

The type of facing for the bonnet or cap joint shall be equal or superior to the end flange facing.

Valve bonnet or cover bolting shall be as follows:

VALVE BODY MATERIAL	TEM. RANGE	BOLTING MATERIAL
Carbon Steel (Impact Tested)	-40° to 400°C	42CrMo4/EN10269
1 1/4 Cr-1/2 Mo 5 Cr-1/2 Mo	-10° to 540°C	21CrMoV5-7
Austenitic SS and all Non-ferrous	Similar composition to valve	

2.2.7 END CONNECTIONS

The body end flanges of all flanged valves shall be drilled for through bolting. Flanges which are drilled and tapped for studs are not acceptable unless approved by the Owner.

The ends of socket weld valves shall be in accordance with **ELOT EN 12760.**

The ends of tapped valves shall be threaded female to **ASME B1.20.1 (NPT).**

The ends of butt weld valves shall be to **ELOT EN 12627**. The O.D. and wall thickness of bevel ends shall be as stated on the purchase requisition.

1 All butt-weld end valves shall be delivered by the manufacturer with suitable spool pieces to avoid thermal damage of valve internals during site welding.

Gasket characteristics for raised face and ring joint flanges shall be in accordance with **ELOT EN 12560 series** unless otherwise specified.

2.2.8 FACE TO FACE DIMENSIONS

The face to face dimensions of flanged ball valves shall be to **ELOT EN 558.** Any deviation shall be subject to approval by the Owner.

The face to face dimensions of plug valves shall be the same as gate valves wherever possible In cases where this is not possible. Owner shall be informed.

Valves to manufacturer's standard shall have face to face dimensions to **ELOT EN 558** wherever possible, and the actual face to face dimension shall be advised by the Vendor in his quotation.

2.2.9 VALVES OF WELDED OR FABRICATED CONSTRUCTION AND WELD REPAIRS

For valves of welded construction or for valves involving welded attachments such as pups, flanges or bosses, the manufacturer's welding procedures (including any necessary heat treatment) shall be sent within 14 days of order placement to the Owner for approval. No welding shall be done before this approval is given.

Repairs by welding to pressure containing parts shall be carried out in accordance with **ELOT EN ISO 15614-1** qualified procedure (including any necessary heat treatment) for the base material concerned. Such work shall be done only by welders qualified in accordance to **ELOT EN 287-1**.

All weld repairs for valve casting shall be carried out using a procedure approved by the Owner. Austenitic stainless steel valve castings that have been subject to weld repairs shall be solution heat treated unless otherwise agreed with the Owner.

2.2.10 VALVE GLAND PACKING

The packing to be mounted is the same of the Manufacturer whom requisitions are referred to.

All valves are grouped according to the service for which the various types of gland packing are suitable. This grouping is shown in **TABLE 5** below.

No deviation from the type specified by the indicated manufacturer is permitted without prior approval from the Owner. If packing is not defined by the indicated manufacturer, **TABLE 5** is the guide for the selection.

Valve packing shall be of the preformed molded ring type.

All valves shall be packed ready for service.

Refer to **Section 2.4** for tagging of packing group.

Valve gland packing shall not contain asbestos.

TABLE 5 – SELECTION GUIDELINE FOR GLAND PACKING

Group	Packing Type	Rating Class Pressure limit	Packing Temperature Range (Oc)	Process Fluid (Ph RANGE)	Typical Valve service applications
A	Braided synthetic Fiber (1) Teflon treated	600	-73 to 260	3 - 1 0	Moderate corrosive general refinery services at moderate pressure temperature condition
			-100 to 260	3 - 1 0	Refrigerated services
B	Braided Teflon Teflon treated	400	-73 to 260	1 - 13	Corrosive refinery and chemical services at moderate pressure temperature conditions. Refrigerated services. Service with high product purity requirements
C	All graphite ribbon with braided or solid graphite end retainer rings with Z N corrosion inhibitor. All graphite solid ring with zinc corrosion inhibitor	2500	Cryogenic - 240 to 427 (2) or 1370	0 - 1 4	General and corrosive refinery and chemical services at high temperature and moderate to high pressure conditions
D	Braided synthetic fiber (1) graphite treated	600	Ambient to 340	4 - 8	General refinery services at moderate pressure / temperature conditions
E	Special	—	—	—	To suit specific service requirements

(1) Synthetic fiber such as: Aramidic, glass, ceramic.

(2) 427^{0}C limitation applies only when in an oxidizing process fluid environment.

2.2.11 TAPPED CONNECTIONS

Valves specified to be tapped on purchase requisition shall be tapped and plugged at the location indicated in the appropriate valve specification. Plugs shall be of the same chemical analysis as the body material and shall be round or hex headed.

Valve taps shall be in accordance with the relevant valve specifications and shall be provided when and where specified.

All tapped connections shall be threaded female to **ASME B1.20.1** (NPT) unless noted otherwise.

2.2.12 VALVE TRIM MATERIALS DESCRIPTION

Unless otherwise indicated, valve trim comprises the following valve parts, which are liable to come into contact with process fluid:

- gate or disc or plate seating surfaces
- body seating surfaces
- stem
- internal pins
- springs
- bushing for backseat and stem-hole guide
- small internal parts in contact with service fluid

All trim parts shall be manufactured from materials that are suitable for use in the minimum design temperature of the valve and provide at least the same corrosion resistance to the fluid being carried as the body and bonnet material of the valve.

Trim materials shall have a chemical composition and mechanical properties which ensure the mechanical integrity of the valve.
Table 3 below gives recommendation as to the materials that can be used in various trim parts.

Parts of the trim	Material and designation of trim						
	Trim A soft seated valves	Trim B metallic seated valves	Trim C other coatings	Trim D epoxy coated	Trim E enamel coated	Trim F rubber lined	Trim G fluored plastic lined
Body seat	Manufacturer's standard		Metallic corrosion resistant alloy		Enamel coated	Rubber lined	PTFE, PVDF, PFA or ECTFE
Shaft - seat seal	To be specified by the manufacturer						
Shaft	Minimum 12% Cr or Cu-alloy					Rubber lined or CrNi- or Cu-alloy	Manufacturer's standard
Bushes	Manufacturer's standard						
Connecting part shaft/disc	Manufacturer's standard		Minimum 12 % Cr or Cu-alloy				Manufacturer's standard
Clamping ring for seat/disc seal	Manufacturer's standard			Minimum 12 % Cr or epoxy coated or Cu-alloy	Minimum 12 % Cr or enamel coated or Cu-alloy	Rubber lined or corrosion resistant alloy	–
Bolting for the clamping ring	Manufacturer's standard Minimum A2-70 or A4-70 in accordance with EN ISO 3506-1 and EN ISO 3506-2, or Cu-alloy						
Body lining/coating	Manufacturer's standard			Epoxy coated	Enamel coated	Rubber lined	PTFE, PVDF, PFA or ECTFE
Disc lining or coating	Manufacturer's standard			Epoxy coated or disc stainless	Enamel coated or disc stainless	Rubber lined or disc CrNi- or Cu-alloy	PTFE, PVDF, PFA or ECTFE

Table 3. Guidelines for trim material selection.

2.3 VALVE MARKING AND IDENTIFICATION

Marking of valves shall comply with the appropriate Standard stated on this specification and the relevant valve data sheet. Valves shall bear the CE marking in accordance with EC Directive **(PED No. 97/23/EC).**

Proprietary valves not ordered **to** a standard specification shall be marked with the rating, material and size as stated on the requisition together with **the** manufacturer's name.

All check and globe valves shall have a flow direction arrow on the body.

1 Soft seated valves shall be clearly marked by the Vendor with the soft seal material and the working temperature range.

Color coding shall be according to **DESFA Spec. 900/3.**

Positive Material Identification (P.M.I.) shall be according to **DESFA Spec. 930/1.**

2.4 VALVE TAGGING

All valves shall be tagged with the appropriate Standard as stated on the requisition and Valve Data Sheet and be prefixed by the valve nominal size. This shall be clearly stamped on a non-corrodible metal tag which is to be securely attached to the valve with a non- corrodible metal wire.

The metal tag shall also be stamped with the Packing Group letter and month & year when gland was packed.

EXAMPLE :

8-VGA10101	-	represents 8"-VGA 10101
GRP A	-	represents packing group A
3-81	-	represents March 1981 (when was packed)

3.0 TECHNICAL DOCUMENTATION, INSPECTION AND CERTIFICATION

3.1 INSPECTION

All valves are subject to inspection by their Client, or their nominated representatives. Inspection requirements are defined in **DESFA Spec. 970/2.2**

3.2 TESTS

Valves shall be tested at the manufacturer's works in accordance with the applicable valve Standard.

Valves supplied to manufacturer's standard shall be tested to the relevant valve standard and **ELOT EN 12266-1& -2**. No grease shall be used during assembly and testing.

For carbon steel and low alloy steel valves, either water or kerosene may be used for hydrostatic tests. Valves shall be adequately dried after testing with air. When kerosene is used, the valves must be thoroughly flushed with clean water and air blown to prevent a contamination hazard from kerosene and possible corrosion from the water.

Austenitic stainless steel valves shall be tested using water with a chloride content of less than 1 ppm, i.e. condensate or demineralized water shall be used.

All Valves intended for cryogenic service shall be tested additionally according to the requirements described in Appendices A and B of the present specification.

3.3 CERTIFICATION

It is the Vendor's responsibility to ensure that all materials used in the manufacture of valves comply with the requirements of the present specification.

The Vendor shall keep a record of the certified Chemical and Mechanical Properties and maintain suitable control of the materials used.

3.4 DOCUMENTATION REQUIREMENTS

TYPE OF DOCUMENTATION		REQUIRED	No. of Copies	REMARKS
QUOTATION	General Arrgt Dwg And Parts List	See Remarks	2	See para 3.4.1
FIRST ISSUE AFTER ORDER	General Arrgt. Dwg And Parts List	No		
	Detail Dwg	No		
	Letter for Packing Confirmation	Yes	2	See para 2.2.10
CERTIFIED FOR APPROVAL	General Arrgt. Dwg And Parts List	See Remarks	2	Not normally required, unless specifically called for elsewhere in this document (see para 3.4.1)
	Detail Dwg	No		
Complete valve data book with all test reports and material certificates		Yes	6	
3.1/3.2 Certificates in accordance with **ELOT EN 10204**		Yes	6	
EC "Declaration of Conformity"		Yes	6	

It is essential that quotations shall include the following point a or b.

a. A complete description for a thorough understanding of the valve offered.

b. A general arrangement outline drawing complete with all materials of the valve offered.

3.4.1 DRAWINGS

When an order is placed, 4 copies of the valve drawings shall be supplied in the following instances:

Valves fitted with manual gear operators.

Valves to Manufacturer's Standard not conforming to International Standards.

When any welding is employed in the valve manufacture, Drawing shall show the position of each weld, and refer to the manufacturer's proposed welding procedure. (See also **para 2.2.9)**

All ball and butterfly valves.

Where valve drawings are required these shall include the following information printed clearly in, or adjacent to the title block:

a) Contract No.

b) Requisition No. and Item No.

c) Purchase Order No.

d) Valve Code

e) The principal dimensions of the valve, any gear operator, size, type, and style.

f) Materials of construction

g) Pressure-Temperature limitations.

Drawings shall be checked and certified by the Vendor as being an actual record of the valve being supplied against the Purchase Order
Drawings shall be sent to the Owner accompanied by a transmittal note or letter marked for the attention of Procurement Department

Owner approval of vendor's drawings shall not be considered as relieving the vendor of any responsibility for detailed design, dimensions, and construction of equipment or deviation from specification.

Vendor shall not commence final manufacture of valves until receipt of Owner Approval of his drawings.

4.0 PACKING AND SHIPPING

Packaging and Shipping requirements are defined in **DESFA Spec. 900/2.**

4.1 PROTECTIVE COATING AND END PROTECTION

Un-machined exterior surfaces of valves shall be painted per manufacturer's standard. Bituminous paint shall not be used.

Machined or threaded surfaces subject to atmospheric corrosion during shipment or subsequent storage shall be coated with easily removable rust preventive.

Austenitic stainless steel and non-ferrous valves shall not be painted.

Valves with threaded or socket weld ends shall have the ends protected with metal, wood or plastic plugs.

Valves with flanged ends shall have the gasket surface protected by means of a suitable disc wired on.

Valves with butt-weld ends shall have the bevels covered with a suitable close fittings protector.

4.2 SPECIAL REQUIREMENTS FOR SHIPPING

Valves shall be closed for shipment, except for ball and plug valves which shall be shipped in the open position.

Gate and globe valves with soft seats shall have the wedge/disc backed off to relieve the pressure on the seals.

APPENDIX A

CRYOGENIC TESTING AND ACCEPTANCE REQUIREMENTS

A.1 TEMPERATURE

The cryogenic test temperature shall be -196°C.

A.2 REQUIREMENTS

A.2.1 1 in 10 of each valve type shall be subject to cryogenic testing. If there are less than 10 valves of one type, at least 1 valve shall be tested.

A.2.2 If any valve tested fails to meet the requirements a further 10% of the batch valves shall be tested. Failure of any valve from this group shall constitute failure of the entire batch, which shall be rejected.

A.2.3 During the initial proving test (see A.4.2) no leakage shall occur.

A.2.4 During the test at cryogenic temperature (see A.4.4) the maximum allowable leakage rate at seat test pressure shall be 15 ncc/min/inch of nominal diameter for the main sealing direction. For the unidirectional valve it shall be 30ncc/inch (double the allowance leakage rate) when tested in the non preferred direction (ncc = normal cubic centimetre).

A.2.5 After return to ambient temperature (see A.4.5) the maximum allowable leakage rate shall be 15 ncc/min/inch at nominal diameter.

A.2.6 The Vendor shall be responsible for the cost of any re-testing required.

A.3 PRIOR TO TESTING

A.3.1 Degrease the valve components, dry them and assemble the valve in a clean and dust- and grease-free environment.

A.3.2 Tighten bolts to the Vendor specified torque or tension and record the value.

A.3.3 Make suitable thermocouple connections to the valve to enable valve body and bonnet temperature to be monitored throughout the test. NOTE: It is considered suitable to place one thermocouple in each of the following locations:

a) on the body in the axis of the flow;

b) on the bonnet cover;

c) in the cavity between the body and the disc.

d) on the gland housing.

A.4 TESTING

A.4.1 A suitable test apparatus is shown diagrammatically in figure 1. Set up the valve as shown in figure 1 in the test tank and make all connections. Take care to ensure that the valve gland is positioned clear of the cold boil-off gas in the top of the tank.

A.4.2 Make an initial system proving test at the maximum seat pressure (see C.4.4(d)) at ambient temperature, for 30 minutes, using helium gas to ensure that the valve is in a suitable condition for the test to proceed.

There shall be no visible leakages.

A.4.3 Cool down the valve by immersing it in liquid nitrogen to a depth such that the level of the liquid covers at least the top of the valve body/bonnet joint. Maintain a purge of helium gas throughout the cooling operation.

During cool-down monitor the temperature of the valve body and bonnet by means of suitably placed thermocouples.

NOTE: It is considered suitable to place one thermocouple in each of the following locations:-

a) on the body in the axis of the flow,
b) on the bonnet cover,
c) in the cavity between the body and the disc.
d) on the gland housing.

A.4.4 When the valve body and bonnet are at a temperature of -196°C carry out the following operations (a) to (e).

a) Soak the valve at the test temperature for at least 1 hour until all temperatures have stabilised. Take temperature measurements by means of the thermocouples to ensure uniform temperature of the valve.
b) Repeat the initial test described in C.4.2 at the test temperature.
c) Open the valve and close it 5 times. Measure the open and close forces for at least the first and last operation.
d) Subject the valve to a seat pressure in the normal flow direction for the valve. For valves which are capable of sealing in both directions, test each seat separately. Raise the pressure in increments, as given in Table 4 up to the rated test pressure for the valve. Hold each pressure increment for 10 minutes.

Where the valve seat rating has been downrated by the manufacturer, use this valve as the rated seat test pressure.

Measure and record leakage rate at each pressure stage.

The downstream system of the test valve shall be depressurised at the beginning of each pressure increment.

e) With the valve in the open position, close the needle valve N (see figure 1) on the outlet side of the valve and pressurise the valve body to the seat test pressure. Maintain this pressure for a period of 15 mins and check the valve gland and body/bonnet joint for leak tightness. There shall be no visible leakages.

A.4.5 Return the valve to ambient temperature, then carry out the following operations (a) and (b) and compare the results with the readings taken under A.4.4.
a) Repeat the helium gas proving test detailed in A.4.2. Measure any leakage through the valve and record it.
b) Measure and record valve opening and closing torque.

A.4.6 After completion of the test, dismantle the valve in a clean, dust-free environment. Check for ease of dismantling and examine all component parts for wear and damage.

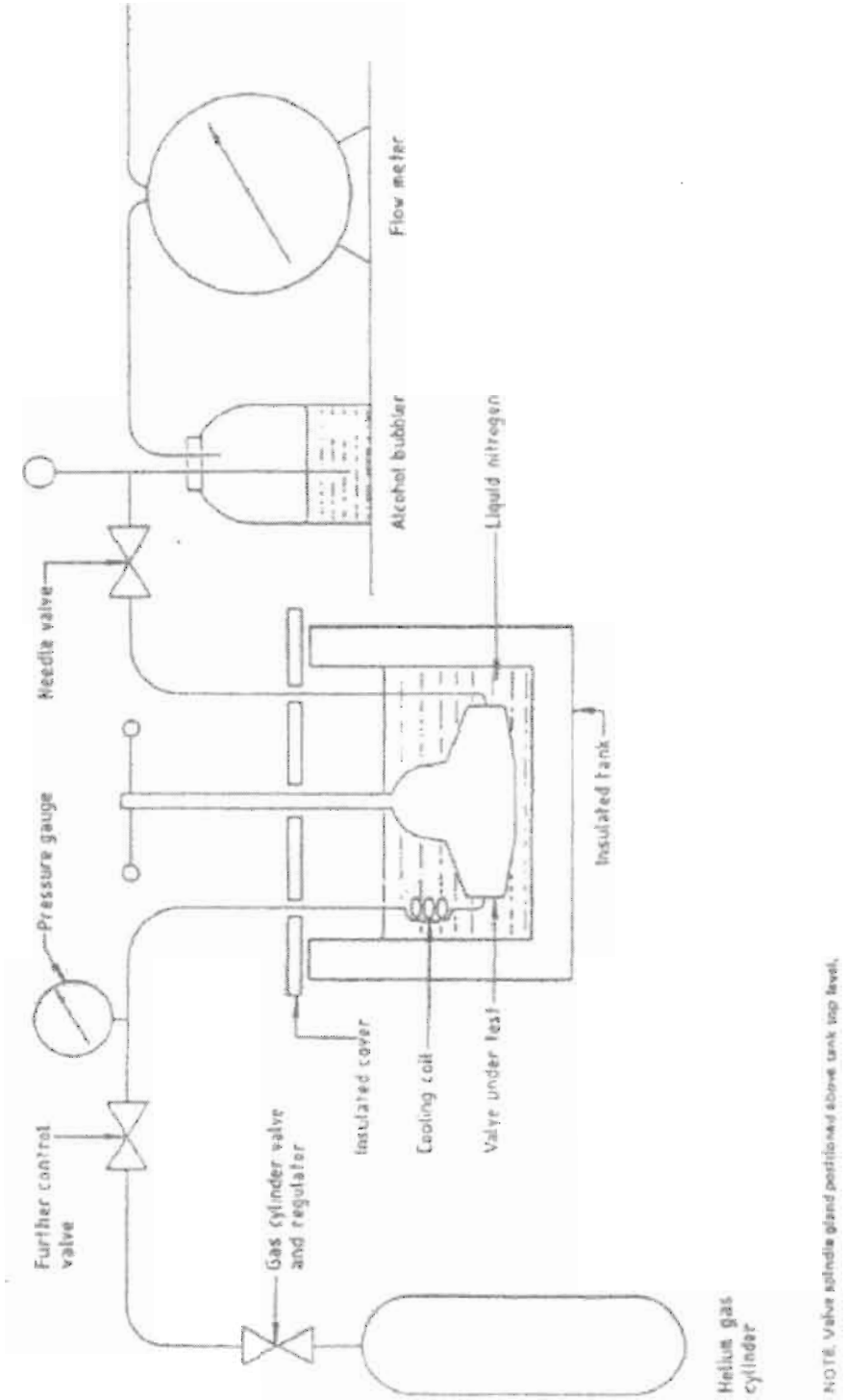
TABLE 4 - CRYOGENIC PRESSURE TEST INCREMENTS

Class	Increment bar
150	3.5
300	7.5
600	10.0
900	20.0

A.5 TEST REPORT

The report shall include the following information:

a) conditions of valve parts after the test (see A.4.6);
b) torque applied to valve body, bonnet and gland bolts (see A.3.2);
c) leakage rates;
d) results of proving tests at ambient temperature (see A.4.2) and at test temperature (see A.4.4(b));
e) record of valve body temperature measurements (see A.4.4.(a));
f) opening and closing force at test temperature (see A.4.4(c));
g) any other measurements or observations made during the course of the test



Typical Arrangement for low temperature type test rig

APPENDIX B

GENERAL TESTING AND ACCEPTANCE LEVELS

B.1 SCOPE

There is a number of additional testing requirements needed to qualify the cryogenic valves. These requirements and their acceptance levels are listed in the subsequent paragraphs.

B.2 MATERIAL COMPOSITION

B.2.1 Full traceability of the material and its composition shall be required for pressure retaining components i.e. body, cover, extended bonnet, bolting, shaft, seat and disc.

Any welding shall include the welding rod / wires used. The material certificates shall be at least 3.1 according to EN 10204.

NOTE: On pressure retaining components of specific valves 3.2 certification may be required.

B.2.2 Chemical analysis of each cast and heat batch shall be required for all pressure retaining cast sections.

B.2.3 Chemical analysis of each melt and heat batch shall be required for all pressure retaining forged or bar sections.

B.2.4 On finished parts, product analysis shall be carried out on 3 valves per type to record elements of C-Mo-Cr-N-Mn.

B.2.5 Samples for product analysis shall be taken from the top and bottom of the body and flanges.

B.2.6 Samples for product analysis shall be taken from forged components, such as bolts.

B.3 MECHANICAL PROPERTIES

B.3.1 Mechanical tests shall be carried out on representative samples of each cast and heat batch in the fully heat treated condition as specified. The properties shall meet the relevant material specifications.

If test bars are cast attached to the main body, they shall not be detached until after completion of heat treatment.

If separate test bars are used, they shall be cast from the same batch of steel as the castings and shall have the same heat treatment.

B.4 IMPACT REQUIREMENTS

B.4.1 Impact testing shall be carried out on pressure retaining parts, using Charpy "V" specimens, at -196°C. The samples shall be from each cast and heat batch or heat treatment condition and shall meet the requirements specified.

B.4.2 The impact test shall be in accordance with **ELOT EN ISO 148**-1. For austenitic stainless steels the lateral expansion, for each of 3 specimens, shall be not less than 0.381 mm. The energy levels recorded shall be stated on the material certificates.

B.5 NON - DESTRUCTIVE TESTING / EXAMINATION

B.5.1 Visual examination shall be carried out on all valves. The components shall include all pressure retaining parts, valve seats and sealing rings, gaskets, bolts, glands and packings.

B.5.2 100% radiographic inspection shall be carried out on the complete castings of 5% of each valve type, with not less than one valve test.

B.5.3 If unacceptable defects are found in a valve from the group examined in accordance with B.5.2, a further 10% of the batch of valves shall be 100% radiographically inspected at the Vendor's cost. If unacceptable defects are found in this further group, the entire batch shall be rejected.

B.5.4 The radiographed valves shall be marked with "X".

B.5.5 100% radiography shall be carried out on all welded joints including seat areas, rings and welded bonnet joints.

B.5.6 The defect acceptance levels on welded joints shall be in accordance with **ELOT EN 12517-1** Acceptance level 1.

B.5.7 Dye Penetrant examination shall be in accordance with **ELOT EN 571-1** and **ELOT EN ISO 23277** Acceptance level 1.

NOTE 1: On castings a surface finish of 400-500μ is desirable.

NOTE 2: The welded surfaces may require some grinding prior to application.

B.5.8 Liquid Penetrant examination shall be carried out on 100% of valves on the exterior and the accessible interior surfaces of body and bonnet of castings, all welds on the extended bonnet.

B.5.9 Liquid Penetrant materials shall not contain chemicals harmful to the body, bonnet or trims, e.g. clorides, halides. After test all contaminants shall be removed by suitable solvents.

B.5.10 All forged valves or components for the pressure retaining parts shall be examined by ultrasonic examination. Maximum length or depth of forgings examined shall be not more than 1.5m.

B.5.11 The bolting materials shall be subjected to Brinell hardness, Charpy V notch impact, visual and dye Penetrant checks.

B.5.12 Brinell hardness tests shall be carried out on 10% of all bars in each size and heat with acceptance level as given in the relevant material specification.

B.5.13 A Charpy V notch impact test shall be carried out on the bar having the highest hardness value found in B.5.12 for each batch, size and cast of material. The impact test shall be in accordance with **ELOT EN ISO 148**-1 and acceptance levels according to the relevant material specification. For austenitic stainless steels the

lateral expansion, for each of 3 specimens shall be not less than 0.381mm. The energy levels recorded shall be stated on the material certificates.

B.5.14 Bolting made from bar of diameter greater than 25mm shall be subjected to 100% visual and dye Penetrant examination.

B.6 REPAIR OF CAST STEEL VALVES

B.6.1 When necessary repairs of castings by welding shall be in accordance with the requirements of the applicable material specification and as given in B.6.2 to B.6.7.

B.6.2 All repair welding shall comply with the approved welding procedures and shall be carried out by the approved welders. The approvals shall be by Purchaser or appointed representative.

B.6.3 The welding procedures and qualifications shall be in accordance with **ELOT EN ISO 15614-1.**

B.6.4 Defects shall be removed to sound metal before welding and excavated areas subjected to dye Penetrant test. If additional heat treatment is carried out on the castings, the heat treatment data shall be supplied with the certificates.

B.6.5 The defect description and acceptance standards shall be in accordance with relevant European standards. The following defects shall not be acceptable:

a) cracks (linear or angular)

b) lack of Penetration

c) inter or side wall fusion

d) excessive porosity

B.6.6 After repair and any heat treatment, the castings or welded joints shall be re-examined to the original non-destructive testing and acceptance criteria.

All repairs shall be recorded and contained in the valve data books.

B.6.7 All major defect repairs shall be "hold points" on the quality plans.

B.7 PRESSURE TESTING

All valves shall be subjected to pressure tests given in Table 3, under ambient conditions with the acceptance levels indicated.

TABLE 3 – PRESSURE TESTS

Requirement	Hydrotest	Porosity Test	Seat Test
Test Medium	By agreement between Purchaser and Vendor	Dry air to Nitrogen	Dry air to Nitrogen
Test Pressure	1.5 times cold rating	5.5 barg (80 PSIG)	5.5 barg (80 PSIG)
Time	5 minutes minimum	Sufficient time for soap bobble test	Sufficient time for soap bobble test
Acceptance	**ELOT EN 12266-1** and **-2**	No leaks bubble tight	No leaks bubble tight