

TOP PERFORMANCE
CRYOGENIC BALL VALVE



 **STAR LINE**[®]

STARLINE S.p.A.
Via F. Baracca, 30 - 24060 S.PAOLO D'ARGON (Bergamo) ITALY

For more details www.starline.it

STARLINE



TO WHOM IT MAY CONCERN

OBJECT: Life of our valve type Cryostar

We are pleased to inform that we received today letter from our Italian Customer CHEMSYS in the person of Mr. Brugnoni, production plant manager, advising that valves delivered to them 4 Years ago just got the first maintenance.

They installed different valves of our model Cryostar which are used on the inlet of liquid nitrogen on a blast column for the process vent treatment. Valve keep on the column a temperature of -160°C . The plant is working 24h day all year long, and each valve produce approx 30 cycles x our.

So the total number of cycles produced before need of maintenance was over one Million.

The use of our model Cryostar was decided as a "Test" trying to solve the existing problem of previous used valves which were able to guarantee 3-4 months life maximum.

22 December 2005

Best Regards
Dr. Marco Ghilardi
Q.A. Manager
STARLINE SPA



Marine Design Appraisal Document

Lloyd's Register EMEA
Engineering Systems
London Design Support Services
71 Fenchurch Street
London EC3M 4BS

Date
17 December 2007

Quote this reference on all future communications
LDSS/ENG/PKL/O-86245

LLOYD'S REGISTER TYPE APPROVAL SYSTEM, 2002.

Issued to: STARLINE S.P.A.
for: CRYOGENIC FORGED STEEL BALL VALVE
TYPE APPROVAL CERTIFICATE No. 07/00072

1. The documentation listed below has been examined in accordance with the Type Approval System for compliance with the design and testing requirements of Lloyd's Register's *Rules and Regulations for the Classification of Ships*, and other Codes and Standards as specified below, and is assigned an appraisal status as indicated, subject to the conditions stated.

Producer:	Starline S.p.A
Place of Production:	Via Francesco Baracca, 30 24060 San Paolo D'argon BG Italy
Description	Cryostar forged steel ball valve
Standards/Codes:	Lloyd's Register Rules and Regulations for the Classification of Ships Lloyd's Register Rules and Regulations for the Construction and Classification of Ships for the Carriage of Liquefied Gases in Bulk. BS 6364:1984 BS EN 1626:1999 BS EN ISO 10497:2004
Application:	Cryogenic forged steel ball valve
Approval Conditions:	Valves are to be installed in accordance with the manufacturer's recommendations

FINAL ACCEPTANCE OF ACTUAL ITEM(S) DEPEND(S) ON SATISFACTORY SURVEY AND TESTING

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Lloyd's Register EMEA
 Engineering Systems
 London Design Support Services
 71 Fenchurch Street
 London EC3M 4BS

Date
17 December 2007

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Appendix

1. The documents listed below have been examined

Document No.	Rev.	Title	Status	Date
CRY-0001-LT	0	Cryogenic Test for Ball Valve – DN15 – PN250 /Class 1500 - Full Bore	B	17-Dec.-2007
CRY-0002-LT	0	Cryogenic Test for Ball Valve – DN20 – PN250 /Class 1500 - Full Bore	B	17-Dec.-2007
CRY-0003-LT	0	Cryogenic Test for Ball Valve – DN25 – PN250 /Class 1500 - Full Bore	B	17-Dec.-2007
CRY-0004-LT	0	Cryogenic Test for Ball Valve – DN40 – PN138 /Class 800 - Full Bore	B	17-Dec.-2007
CRY-0005-LT	0	Cryogenic Test for Ball Valve – DN50 – PN138 /Class 800 - Full Bore	B	17-Dec.-2007
CRY-0006-LT	0	Cryogenic Test for Ball Valve – DN80 – PN50 /Class 300 - Full Bore	B	17-Dec.-2007
CRY-0007-LT	0	Cryogenic Test for Ball Valve – DN100 – PN50 /Class 300 - Full Bore	B	17-Dec.-2007
CRY-0008-LT	0	Cryogenic Test for Ball Valve – DN150 – PN20 /Class 150 - Full Bore	B	17-Dec.-2007
CRY-0009-LT	0	Cryogenic Test for Ball Valve – DN15 – PN420 /Class 2500 - Full Bore	B	17-Dec.-2007
CRY-0010-LT	0	Cryogenic Test for Ball Valve – DN20 – PN420 /Class 2500 - Full Bore	B	17-Dec.-2007
CRY-0011-LT	0	Cryogenic Test for Ball Valve – DN25 – PN420 /Class 2500 - Full Bore	B	17-Dec.-2007
CRY-0012-LT	0	Cryogenic Test for Ball Valve – DN40 – PN420 /Class 2500 - Full Bore	B	17-Dec.-2007
CRY-0013-LT	0	Cryogenic Test for Ball Valve – DN50 – PN420 /Class 2500 - Full Bore	B	17-Dec.-2007
CRY-0014-LT	0	Cryogenic Test for Ball Valve – DN80 – PN420 /Class 2500 - Full Bore	B	17-Dec.-2007
CRY-0015-LT	0	Cryogenic Test for Ball Valve – DN100 – PN420 /Class 2500 - Full Bore	B	17-Dec.-2007
CRY-0015-LT	0	Cryogenic Test for Ball Valve – DN150 – PN420 /Class 2500 - Full Bore	B	17-Dec.-2007
STAR-0001-CRY	0	½" Class 1500 Ball Valve Tested : "Floating Cryo Star" No. 5	B	17-Dec.-2007
STAR-0002-CRY	0	¾" Class 1500 Ball Valve Tested : "Floating Cryo Star" No. 5	B	17-Dec.-2007
STAR-0003-CRY	0	1" Class 1500 Ball Valve Tested : "Floating Cryo Star" No. 5	B	17-Dec.-2007
STAR-0004-CRY	0	1½" Class 800 Ball Valve Tested : "Floating Cryo Star" No. 5	B	17-Dec.-2007
STAR-0005-CRY	0	2" Class 800 Ball Valve Tested : "Floating Cryo Star" No. 5	B	17-Dec.-2007
STAR-0006-CRY	0	3" Class 300 Ball Valve Tested : "Floating Cryo Star" No. 5	B	17-Dec.-2007

FINAL ACCEPTANCE OF ACTUAL ITEM(S) DEPEND(S) ON SATISFACTORY SURVEY AND TESTING

Lloyd's Register EMEA
 Engineering Systems
 London Design Support Services
 71 Fenchurch Street
 London EC3M 4BS

Date
17 December 2007

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Document No.	Rev.	Title	Status	Date
STAR-0007-CRY	0	4" Class 300 Ball Valve Tested : "Floating Cryo Star" No. 5	B	17-Dec.-2007
STAR-0008-CRY	0	6" Class 150 Ball Valve Tested : "Floating Cryo Star" No. 5	B	17-Dec.-2007
STAR-0009-CRY	0	½" Class 2500 Ball Valve Tested : "Floating Cryo Star" No. 5	B	17-Dec.-2007
STAR-0010-CRY	0	¾" Class 2500 Ball Valve Tested : "Floating Cryo Star" No. 5	B	17-Dec.-2007
STAR-0011-CRY	0	1" Class 2500 Ball Valve Tested : "Floating Cryo Star" No. 5	B	17-Dec.-2007
STAR-0012-CRY	0	1½" Class 2500 Ball Valve Tested : "Floating Cryo Star" No. 5	B	17-Dec.-2007
STAR-0013-CRY	0	2" Class 2500 Ball Valve Tested : "Floating Cryo Star" No. 5	B	17-Dec.-2007
STAR-0014-CRY	0	3" Class 2500 Ball Valve Tested : "Floating Cryo Star" No. 5	B	17-Dec.-2007
STAR-0015-CRY	0	4" Class 2500 Ball Valve Tested : "Floating Cryo Star" No. 5	B	17-Dec.-2007
STAR-0016-CRY	0	6" Class 2500 Ball Valve Tested : "Floating Cryo Star" No. 5	B	17-Dec.-2007
MLN0700628/10A1	-	Fire Test For DN50 Class 150 Starline Forged Steel Ball Valve – Cryostar Floating Ball	B	17-Dec.-2007
MLN0700628/09A1	-	Fire Test For DN50 Class 600 Starline Forged Steel Ball Valve – Cryostar Floating Ball	B	17-Dec.-2007
MLN0700628/08A1	-	Fire Test For DN50 Class 1500 Starline Forged Steel Ball Valve – Cryostar Floating Ball	B	17-Dec.-2007
MLN0700628/07A1	-	Fire Test For DN150 Class 150 Starline Forged Steel Ball Valve – Cryostar Floating Ball	B	17-Dec.-2007
MLN0700628/06A1	-	Fire Test For DN50 Class 150 Starline Forged Steel Ball Valve – Cryostar Trunnion Mounted	B	17-Dec.-2007
MLN0700628/05A1	-	Fire Test For DN50 Class 600 Starline Forged Steel Ball Valve – Cryostar Trunnion Mounted	B	17-Dec.-2007
MLN0700628/04	-	Fire Test For DN50 Class 1500 Starline Forged Steel Ball Valve – Cryostar Trunnion Mounted	B	17-Dec.-2007
MLN0700628/03	-	Fire Test For DN150 Class 150 Starline Forged Steel Ball Valve – Cryostar Trunnion Mounted	B	17-Dec.-2007
MLN0700628/02	-	Fire Test For DN150 Class 600 Starline Forged Steel Ball Valve – Cryostar Trunnion Mounted	B	17-Dec.-2007
MLN0700628/01	-	Fire Test For DN150 Class 1500 Starline Forged Steel Ball Valve – Cryostar Trunnion Mounted	B	17-Dec.-2007
STAR T.C. 01/2000	0	Internal Job and Inspection Plan	B	17-Dec.-2007
20 December 2006	-	Approval Services – Request for Quotation	B	17-Dec.-2007
21 December 2006	-	Inspection and Surveillance of Production Facilities	B	17-Dec.-2007

FINAL ACCEPTANCE OF ACTUAL ITEM(S) DEPEND(S) ON SATISFACTORY SURVEY AND TESTING

**Lloyd's Register EMEA
Engineering Systems
London Design Support Services
71 Fenchurch Street
London EC3M 4BS**

Date
17 December 2007

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Appendix

Appraisal Status Key

- B** Examined for compliance with the design and testing requirements of the Rules/Codes/Standards listed above and considered in order.

The date is the date with which the document is stamped.

FINAL ACCEPTANCE OF ACTUAL ITEM(S) DEPEND(S) ON SATISFACTORY SURVEY AND TESTING

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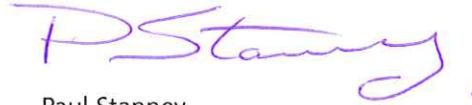
**Lloyd's Register EMEA
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Date
17 December 2007

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FINAL ACCEPTANCE OF ACTUAL ITEM(S) DEPEND(S) ON SATISFACTORY SURVEY AND TESTING

Lloyd's Register EMEA
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Project: STARLINE S.p.A.
Via F.Baracca 30 S.Paolo d'Argon-
Bergamo - ITALY

Client:

Office: BRESCIA

Clients Order Number: Fax of 28.05.03 no. B181-03

Date: 20 January 2004

Order Status: Incomplete

Inspection Dates

First: 23 October 2003

Final: 09 December 2003

This certificate is issued to STARLINE S.p.A.Via F.Baracca 30 S.Paolo d'Argon-Bergamo - ITALY


The material described herein has been satisfactorily inspected at the Works of Starline SpA, San Paolo d'Argon, Bergamo – JOB 11123

No.1 CRYOGENIC BALL VALVE – DN25-PN100-FULL BORE F316/F316-DWG.CODE C146TTT-DWG.No. STAR 2003 CRYO

The following scope of inspection was satisfactorily carried out against order and specification requirements:

- Witnessed Cryogenic test as per BS 6364 and Starline procedure no.STAR 089.
- Endorsed Cryogenic test cert.no.CRY 14.25.
- Endorsed inspection certificate no.R47/2003 A
- Reviewed Mill Test Certificates for Conformity to EN 10204 – 3.1.B.

On the basis of the scope of inspection detailed above, we certify that the material is considered to comply with specification and the scope of inspection above reported.



F.SERVALLI

Inspector to Lloyd's Register EMEA

gf

A member of the Lloyd's Register Group



STAR LINE

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24060 S.PAOLO D'ARGON
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CRYOGENIC TEST -196 °C FOR BALL VALVES

(According to BS6364)

**TEST
CERTIFICATE
CV-TCE
No. : CRY-14-25**

PAGE 1 of 1

Starline certificate for cryogenic test at -196 °C with Liquid Nitrogen and Helium Gas for pressure test.
The test is in accordance to BS6364 and Starline procedure n° STAR 089

1. DESCRIPTION OF BALL VALVE TESTED

Manufacturer	STARLINE S.P.A.
Valve Type	CRYOGENIC BALL VALVE
Port Design	FULL BORE
DN	25
PN	100
Dwg Code	C 146 TTT
Drawing N°:	STAR-2003-CRYO

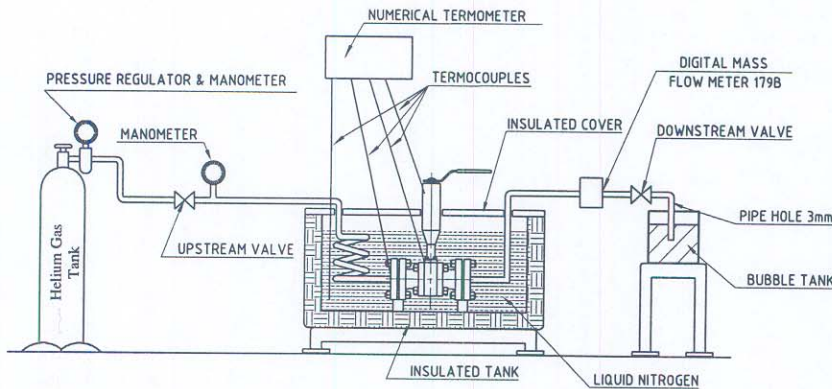
2. BREAK AWAY TORQUE AT AMBIENT TEMPERATURE

Pressure	0 Bar	5 Bar	40 Bar	60 Bar	100 Bar
Torque Nm	15 Nm	15 Nm	30 Nm	38 Nm	45 Nm

3. LEAKAGE TEST (before cryogenic test) according to API 598, BS 6755 Part.1, API 6D, ISO 5208

Test carry out on:	STARLINE S.P.A.
3.1B Inspection Certificate Nr.	R47/2003A
Result	SATISFACTORY

4. CRYOGENIC TEST



4.1 Initial System proving test (room temp.; Test fluid: Helium gas)

Test pressure	External Leakage valve in half-open position	Seat Leakage valve in closed position
100 bar	0	0
Result	Satisfactory	

4.2 Cooling Operation

Time	Thermocouple 1	Thermocouple 2	Thermocouple 3	Thermocouple 4
0	196	196	196	130
15 min	196	196	196	132
30 min	196	196	196	135
45 min	196	196	196	138
60 min	196	196	196	138

4.3 System Proving Test (-196°C; Test fluid: Helium gas)

Test pressure	External Leakage
100 bar	0
Result	Satisfactory

4.4 Break Away Torque (open and close valve tested 20 times)

N° of cycle	Open Force (Nm)	Close Force (Nm)
1	65 Nm	65 Nm
20	60 Nm	60 Nm

4.5 Seat Leakage Test (-196 °C; Test fluid: Helium gas)

Test Pressure	Maximum Permissible Leakage mm³/s	Recorded mm³/s
5 bar	2500 mm³/s	483
20 bar	2500 mm³/s	500
40 bar	2500 mm³/s	550
60 bar	2500 mm³/s	583
80 bar	2500 mm³/s	583
100 bar	2500 mm³/s	616
Result	Satisfactory	

5. Seat Leakage Test (Room Temperature; Test fluid: Helium gas)

Test Pressure	Maximum Permissible Leakage mm³/s	Recorded mm³/s
5 bar	2500 mm³/s	0
20 bar	2500 mm³/s	0
40 bar	2500 mm³/s	0
60 bar	2500 mm³/s	0
80 bar	2500 mm³/s	0
100 bar	2500 mm³/s	0
Result	Satisfactory	

4.6 Shell Leakage Test (-196 °C; Test fluid: Helium gas)

Test Pressure	Test Duration	Max Permissible Leakage	Recorded
100 bar	15 min	0 mm³/s	0
Result	Satisfactory		

6. Shell Leakage Test (Room Temperature; Test fluid: Helium gas)

Test Pressure	Test Duration	Max Permissible Leakage	Recorded
100 bar	15 min	0 mm³/s	0
Result	Satisfactory		

7. DISMANTLING (check for case of dismantling and examine components for wear or damage)

Result: SATISFACTORY

Remarks: All components are in perfect condition

8. CONCLUSION

The valves are suitable for cryogenic service

9. INDEX OF ATTACHED DOCUMENTS

Drawing N° :	STAR-2003-CRYO
Inspection Certificate N° :	R47/2003A
Material Certificates N° :	R47/2003A



Tested by

Verified by

Witnessed by

Date

24/11/2003

[Signature]

[Signature]

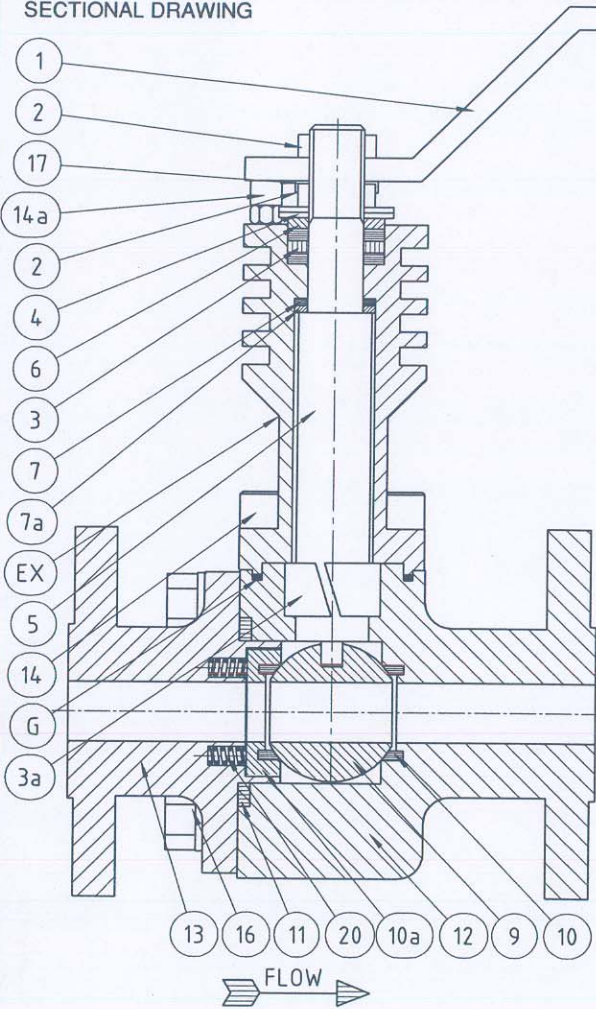
[Signature]

Project :
 Customer :
 P.O. Number :
 Valve Specification :
 Tag No. :

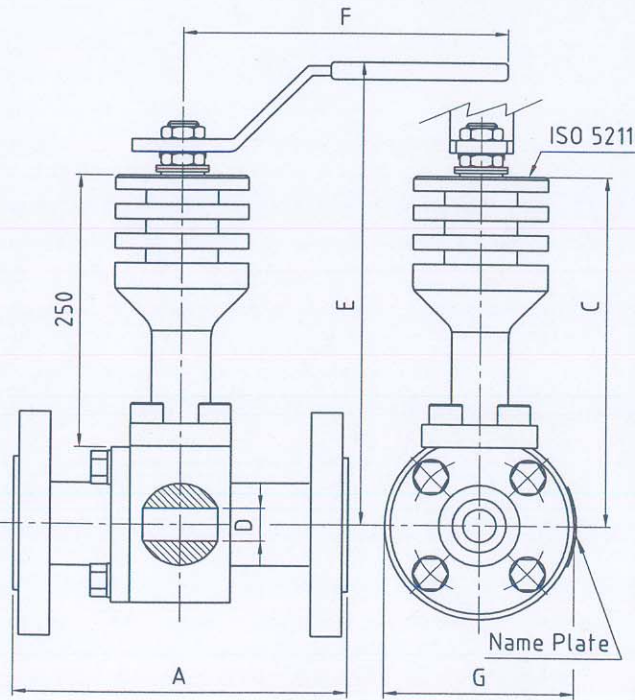
CRYOGENIC (n° 4) forged steel ball valves
 Two pieces bolted construction -ANTI-BLOW-OUT prof stem design - Soft seats
 Construction in according to BS 5351 - ASME/ANSI B16.34 .

CRYOGENIC SERVICE

SECTIONAL DRAWING



DIMENSIONAL DRAWING



UNIDIRECTIONAL BALL VALVE FOR CRYOGENIC SERVICE

PRESSURE TESTING ACCORDING TO : ASME / ANSI B16.34 - MSS SP 61 - API 598 - API 6D - BS 6755 part 1 - ISO 5208

Hydrostatic Shell (body) Test : 150Bar | Pneumatic Shell (body) Test : 6 + 7 Bar
 Hydrostatic Clousure (seats) Test : 110Bar | Pneumatic Clousure (seats) Test : 6 + 7 Bar

Duration Test and Leakage Rates in Accordance to Above Mentioned Specifications

ITEM	Q.TY	TAG. No.	SIZE	DIMENSIONS							WEIGHT KG	ISO 5211
				A	B	C	D	E	F	G		
			1"	160	60	291	25	358	297	104	7	F 05

PART NO	UNIT Q.TY	PART NAME	MATERIAL	MDS	EDS	
						x
x	G	1	EXTENTION GASKET	PTFE		
x	EX	1	EXTENTION	S.S. 316		
x	1	1	HANDLE	Stainless Steel + Plastic		
xx	2	2	HANDLE NUT	Stainless Steel		
x	3	3	PACKING RING	PTFE		
x	3a	1	SLIPER	PTFE		
xx	4	2	SPRING WASHER	Stainless Steel Treated		
xx	5	1	STEM	S.S. 316		
x	6	1	GLAND PACKING	S.S. 316		
xx	7	1	THRUST WASHER	TFE + 25% C. Graphite		
xx	7a	1	THRUST WASHER RING	Stainless Steel		
xx	9	1	BALL	S.S. 316		
xx	10	2	SEATS	PTFE		
xx	10a	1	SEATS RING	S.S. 316		
x	11	2	BODY GASKET	PTFE		
x	12	1	BODY	S.S. 316		
x	13	2	END CONNECTION	S.S. 316		
x	14	4	EXTENTION SCREW	Stainless Steel		
x	14a	1	STOP PIN	Stainless Steel		
x	16	nota1	BOLTS	ASTM A193 B8		
xx	17	1	STOP WASHER	Stainless Steel		
x	20	nota2	SEAT SPRING	Inconel X 750		

Note :
 1) For size 1/4" to 1.1/2" n° 4 bolts - For size 2" n° 6 bolts .
 2) For size 1/4" to 1.1/2" n° 4 springs - For size 2" n° 6 springs .

REGISTERED ENGINEER
 BRESCIA
 F. SERVALLI INSPECTOR
 Witnessed
 Monitored
 Reviewed

0	05-09-1999	First Issue			
Rev.	Date	Reason for revision	Made By	Ch'd By	Appr. By
Ball Valves Type : CRYOGENIC BALL VALVE (No 4)					
Port Design : FULL BORE					
Class of Valve : PN 100					
End Connections : FLANGED RF					
Surface Protection : PICKLING and PASSIVATED					
Certification : EN 10204 type 3.1B					
STAR LINE		Starline Fig. n°:	146 - TTT		
S. PAOLO D'ARGON BERGAMO ITALY		Drawing n°:	STAR-2003-CRYO		



Project:

Client: STARLINE S.p.A.
S. Paolo d'Argon (Bergamo)

Office: Milan

Clients Order Number:

Date: 03 September 2007

Order Status: Complete

Inspection Dates

First: 14 June 2007

Final: 06 July 2007

This certificate is issued to STARLINE S.p.A. S. Paolo d'Argon Bergamo. The undersigned Surveyor to this Society did attend the work of Messrs Starline S.p.A. for the purpose of witnessing the Cryogenic Test in accordance with BS6364 and Starline Procedure STAR 089 carried out on the Starline model Type Cryostar valve selected at random from current production of job 34/2007.

No.1 CRYOGENIC BALL VALVE - DN15 - PN250 / CLASS1500 - FULL BORE
No.1 CRYOGENIC BALL VALVE - DN20 - PN250 / CLASS1500 - FULL BORE
No.1 CRYOGENIC BALL VALVE - DN25 - PN250 / CLASS1500 - FULL BORE
No.1 CRYOGENIC BALL VALVE - DN40 - PN138 / CLASS800 - FULL BORE
No.1 CRYOGENIC BALL VALVE - DN50 - PN138 / CLASS800 - FULL BORE
No.1 CRYOGENIC BALL VALVE - DN80 - PN50 / CLASS300 - FULL BORE
No.1 CRYOGENIC BALL VALVE - DN100 - PN50 / CLASS300 - FULL BORE
No.1 CRYOGENIC BALL VALVE - DN150 - PN20 / CLASS150 - FULL BORE
No.1 CRYOGENIC BALL VALVE - DN15 - PN420 / CLASS2500 - FULL BORE
No.1 CRYOGENIC BALL VALVE - DN20 - PN420 / CLASS2500 - FULL BORE
No.1 CRYOGENIC BALL VALVE - DN25 - PN420 / CLASS2500 - FULL BORE
No.1 CRYOGENIC BALL VALVE - DN40 - PN420 / CLASS2500 - FULL BORE
No.1 CRYOGENIC BALL VALVE - DN50 - PN420 / CLASS2500 - FULL BORE
No.1 CRYOGENIC BALL VALVE - DN80 - PN420 / CLASS2500 - FULL BORE
No.1 CRYOGENIC BALL VALVE - DN100 - PN420 / CLASS2500 - FULL BORE
No.1 CRYOGENIC BALL VALVE - DN150 - PN420 / CLASS2500 - FULL BORE

Scope of Inspection:

Witness Cryogenic test as per BS6364 and Starline procedure no. STAR 089

Endorse of Cryogenic test cert. From No. CRY-0001-LT to CRY-0016-LT

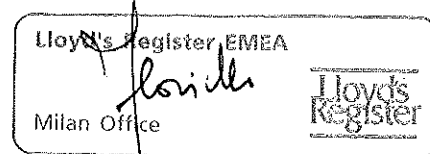
Endorse of inspection certificate no. C174_2007

Review of Mill Test Certificates for Conformity to EN10204 - 3.1

Review of Starline Drawings STAR-0001 to 0016-CRY

The above is considered in accordance with the above mentioned specifications requirements and therefore the valve has satisfactorily passed the fire test.

gf



Giuseppe FLORIELLO
Surveyor to Lloyd's Register EMEA

A member of the Lloyd's Register Group

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Starline certificate for cryogenic test at -196 °C with Liquid Nitrogen and Helium Gas for pressure test.
 The test is in accordance to BS6364 and Starline procedure n° STAR 089

1. DESCRIPTION OF BALL VALVE

Manufacturer	STARLINE S.p.A.	Valve Type	Cryogenic Floating Ball Valve	DWG Code	156 - KGG	Drawing N°	STAR-0001-CRY
Port Design	Full Port	DN	15	PN	250 CLASS 1500	Serial N°	BF 5351

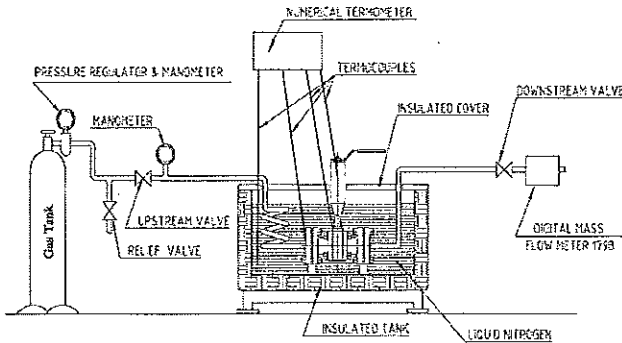
2. BREAK AWAY TORQUE AT AMBIENT TEMPERATURE

Pressure	0 Bar	6 Bar	20 Bar	50 Bar	100 Bar	150 Bar	250 Bar
Torque	14 Nm	14 Nm	16 Nm	18 Nm	20 Nm	22 Nm	28 Nm

3. LEAKAGE TEST (before cryogenic test) ACCORDING TO : API 598, BS 6755 Part.1, API 6D, ISO 5208

Test carry out on	STARLINE S.p.A. - San Paolo D'Argon (Bergamo) Italy
3.1 Inspection Certificate N°	
Result	Satisfactory

4 CRYOGENIC TEST



TIGHTEN BODY BOLTS 50 Nm
 TIGHTEN PACKING NUTS 20 Nm

4.1 Initial System proving test (Room Temperature ; Test fluid: Helium gas)

Test pressure	External Leakage Valve in half-open position	Seat Leakage Valve in closed position
273 Bar	0	0
Result	Satisfactory	

4.2 Cooling Operation

Time	Thermocouple 1	Thermocouple 2	Thermocouple 3	Thermocouple 4
0 minutes	-196 °C	-196 °C	-196 °C	-142 °C
15 minutes	-196 °C	-196 °C	-196 °C	-143 °C
30 minutes	-196 °C	-196 °C	-196 °C	-145 °C
45 minutes	-196 °C	-196 °C	-196 °C	-146 °C
60 minutes	-196 °C	-196 °C	-196 °C	-146 °C

4.3 System proving Test (-196°C; Test fluid: Helium gas)

Test pressure	External Leakage
273 Bar	0
Result	Satisfactory

4.4 Break Away Torque (Open and close valve tested 20 times)

N° of cycle	Open Force (Nm)	Close Force (Nm)
1	35	35
20	28	28

4.5 Seat Leakage Test (-196°C; Test fluid: Helium gas)

Test pressure	Maximim Permissible Leakage mm ³ /s	Recorded mm ³ /s
30 Bar	1500 mm ³ /s	464,8 mm ³ /s
60 Bar	1500 mm ³ /s	398,4 mm ³ /s
90 Bar	1500 mm ³ /s	298,8 mm ³ /s
120 Bar	1500 mm ³ /s	273,9 mm ³ /s
150 Bar	1500 mm ³ /s	222,4 mm ³ /s
180 Bar	1500 mm ³ /s	151,1 mm ³ /s
210 Bar	1500 mm ³ /s	106,2 mm ³ /s
230 Bar	1500 mm ³ /s	53,1 mm ³ /s
250 Bar	1500 mm ³ /s	34,9 mm ³ /s
273 Bar	1500 mm ³ /s	19,9 mm ³ /s
Result	Satisfactory	

4.5 Shell Leakage Test (-196°C; Test fluid: Helium gas)

Test Pressure	Test Duration	Max Permissible Leakage	Recorded
273 Bar	15	0	0
Result	Satisfactory		

5 Seat Leakage Test (Room Temperature ; Test fluid: Helium gas)

Test pressure	Maximim Permissible Leakage mm ³ /s	Recorded mm ³ /s
30 Bar	0 mm ³ /s	0 mm ³ /s
60 Bar	0 mm ³ /s	0 mm ³ /s
90 Bar	0 mm ³ /s	0 mm ³ /s
120 Bar	0 mm ³ /s	0 mm ³ /s
150 Bar	0 mm ³ /s	0 mm ³ /s
180 Bar	0 mm ³ /s	0 mm ³ /s
210 Bar	0 mm ³ /s	0 mm ³ /s
230 Bar	0 mm ³ /s	0 mm ³ /s
250 Bar	0 mm ³ /s	0 mm ³ /s
273 Bar	0 mm ³ /s	0 mm ³ /s
Result	Satisfactory	

4.5 Shell Leakage Test (Room Temperature ; Test fluid: Helium gas)

Test Pressure	Test Duration	Max Permissible Leakage	Recorded
273 Bar	15	0	0
Result	Satisfactory		

4.6 Break Away Torque (Open and close valve tested at room temperature)

Open Force (Nm)	12	Close Force (Nm)	12	Result	Satisfactory
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7. DISMANTLING (check for case of dismantling and examine components for wear or damage)



Result	Satisfactory
Remarks	All components are in perfect condition

8 CONCLUSION

The valve are suitable for cryogenic service

9. INDEX OF ATTACHED DOCUMENTS

Drawing n°	STAR-0001-CRY
Inspection Certificate n°	C174_2007
Material Certificarte n°	C174_2007

OPERATOR QUALIFIED IN ACCORDING TO UNI EN473 - LEVEL 1 LEAK TEST	VERIFIED	WITNESS	DATE
		Lloyd's Register EMEA Milan Office <input checked="" type="checkbox"/> Witnessed <input type="checkbox"/> Monitored <input type="checkbox"/> Reviewed G. Fioriello Surveyor	14-06-2007

Starline certificate for cryogenic test at -196 °C with Liquid Nitrogen and Helium Gas for pressure test.
 The test is in accordance to BS6364 and Starline procedure n° STAR 089

1. DESCRIPTION OF BALL VALVE

Manufacturer	STARLINE S.p.A.	Valve Type	Cryogenic Floating Ball Valve	DWG Code	156 - KGG	Drawing N°	STAR-0002-CRY
Port Design	Full Port	DN	20	PN	250 CLASS 1500	Serial N°	BF 5352

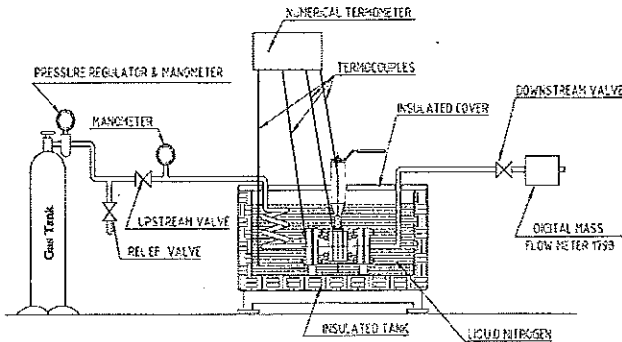
2. BREAK AWAY TORQUE AT AMBIENT TEMPERATURE

Pressure	0 Bar	6 Bar	20 Bar	50 Bar	100 Bar	150 Bar	250 Bar
Torque	16 Nm	16 Nm	24 Nm	28 Nm	32 Nm	38 Nm	46 Nm

3. LEAKAGE TEST (before cryogenic test) ACCORDING TO : API 598, BS 6755 Part.1, API 6D, ISO 5208

Test carry out on	STARLINE S.p.A. - San Paolo D'Argon (Bergamo) Italy
3.1 Inspection Certificate N°	
Result	Satisfactory

4 CRYOGENIC TEST



TIGHTEN BODY BOLTS 80 Nm
 TIGHTEN PACKING NUTS 20 Nm

4.1 Initial System proving test (Room Temperature ; Test fluid: Helium gas)

Test pressure	External Leakage Valve in half-open position	Seat Leakage Valve in closed position
273 Bar	0	0
Result	Satisfactory	

4.2 Cooling Operation

Time	Thermocouple 1	Thermocouple 2	Thermocouple 3	Thermocouple 4
0 minutes	-196 °C	-196 °C	-196 °C	-136 °C
15 minutes	-196 °C	-196 °C	-196 °C	-136 °C
30 minutes	-196 °C	-196 °C	-196 °C	-137 °C
45 minutes	-196 °C	-196 °C	-196 °C	-137 °C
60 minutes	-196 °C	-196 °C	-196 °C	-139 °C

4.3 System proving Test (-196°C; Test fluid: Helium gas)

Test pressure	External Leakage
273 Bar	0
Result	Satisfactory

4.4 Break Away Torque (Open and close valve tested 20 times)

N° of cycle	Open Force (Nm)	Close Force (Nm)
1	55	55
20	48	48

4.5 Seat Leakage Test (-196°C; Test fluid: Helium gas)

Test pressure	Maximim Permissible Leakage mm ³ /s	Recorded mm ³ /s
30 Bar	2000 mm ³ /s	499,7 mm ³ /s
60 Bar	2000 mm ³ /s	365,2 mm ³ /s
90 Bar	2000 mm ³ /s	298,8 mm ³ /s
120 Bar	2000 mm ³ /s	249,0 mm ³ /s
150 Bar	2000 mm ³ /s	215,8 mm ³ /s
180 Bar	2000 mm ³ /s	149,4 mm ³ /s
210 Bar	2000 mm ³ /s	116,2 mm ³ /s
230 Bar	2000 mm ³ /s	83,0 mm ³ /s
250 Bar	2000 mm ³ /s	66,4 mm ³ /s
273 Bar	2000 mm ³ /s	49,8 mm ³ /s
Result	Satisfactory	

4.5 Shell Leakage Test (-196°C; Test fluid: Helium gas)

Test Pressure	Test Duration	Max Permissible Leakage	Recorded
273 Bar	15	0	0
Result	Satisfactory		

5 Seat Leakage Test (Room Tempetature ; Test fluid: Helium gas)

Test pressure	Maximim Permissible Leakage mm ³ /s	Recorded mm ³ /s
30 Bar	0 mm ³ /s	0 mm ³ /s
60 Bar	0 mm ³ /s	0 mm ³ /s
90 Bar	0 mm ³ /s	0 mm ³ /s
120 Bar	0 mm ³ /s	0 mm ³ /s
150 Bar	0 mm ³ /s	0 mm ³ /s
180 Bar	0 mm ³ /s	0 mm ³ /s
210 Bar	0 mm ³ /s	0 mm ³ /s
230 Bar	0 mm ³ /s	0 mm ³ /s
250 Bar	0 mm ³ /s	0 mm ³ /s
273 Bar	0 mm ³ /s	0 mm ³ /s
Result	Satisfactory	

4.5 Shell Leakage Test (Room Tempetature ; Test fluid: Helium gas)

Test Pressure	Test Duration	Max Permissible Leakage	Recorded
273 Bar	15	0	0
Result	Satisfactory		

4.6 Break Away Torque (Open and close valve tested at room temperature)

Open Force (Nm)	20	Close Force (Nm)	20	Result	Satisfactory
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7. DISMANTLING (check for case of dismantling and examine components for wear or damage)

Result	Satisfactory
Remarks	All components are in perfect condition


8 CONCLUSION

The valve are suitable for cryogenic service

9. INDEX OF ATTACHED DOCUMENTS

Drawing n°	STAR-0002-CRY
Ispection Certificate n°	C174_2007
Material Certificarte n°	C174_2007

OPERATOR QUALIFIED IN ACCORDING TO UNI EN473 LEVEL 1 LEAK TEST



VERIFIED




WITNESS

Lloyd's Register EMEA
 Milan Office Witnessed
 Monitored
 Reviewed

Floriello
 G. Floriello - Surveyor

DATE: 15-06-2007





Starline certificate for cryogenic test at -196 °C with Liquid Nitrogen and Helium Gas for pressure test.
The test is in accordance to BS6364 and Starline procedure n° STAR 089

1. DESCRIPTION OF BALL VALVE

Manufacturer	STARLINE S.p.A.	Valve Type	Cryogenic Floating Ball Valve	DWG Code	156 - KGG	Drawing N°	STAR-0003-CRY
Port Design	Full Port	DN	25	PN	250 CLASS 1500	Serial N°	BF 5353

2. BREAK AWAY TORQUE AT AMBIENT TEMPERATURE

Pressure	0 Bar	6 Bar	20 Bar	50 Bar	100 Bar	150 Bar	250 Bar
Torque	18 Nm	18 Nm	28 Nm	38 Nm	42 Nm	48 Nm	64 Nm

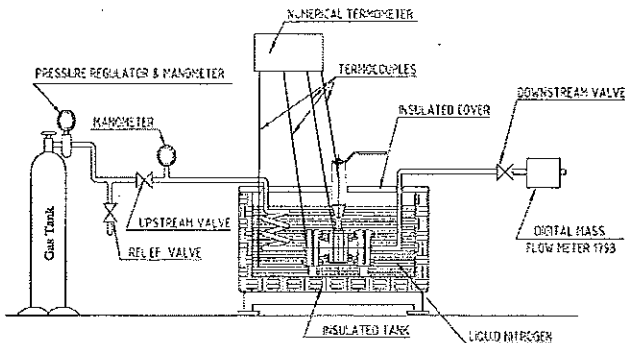
3. LEAKAGE TEST (before cryogenic test) ACCORDING TO : API 598, BS 6755 Part.1, API 6D, ISO 5208

Test carry out on STARLINE S.p.A. - San Paolo D'Argon (Bergamo) Italy

3.1 Inspection Certificate N°

Result Satisfactory

4 CRYOGENIC TEST



TIGHTEN BODY BOLTS 120 Nm
TIGHTEN PACKING NUTS 30 Nm

4.1 Initial System proving test (Room Temperature ; Test fluid: Helium gas)

Test pressure	External Leakage Valve in half-open position	Seat Leakage Valve in closed position
273 Bar	0	0
Result	Satisfactory	

4.2 Cooling Operation

Time	Thermocouple 1	Thermocouple 2	Thermocouple 3	Thermocouple 4
0 minutes	-196 °C	-196 °C	-196 °C	-138 °C
15 minutes	-196 °C	-196 °C	-196 °C	-138 °C
30 minutes	-196 °C	-196 °C	-196 °C	-139 °C
45 minutes	-196 °C	-196 °C	-196 °C	-139 °C
60 minutes	-196 °C	-196 °C	-196 °C	-142 °C

4.3 System proving Test (-196°C; Test fluid: Helium gas)

Test pressure	External Leakage
273 Bar	0
Result	Satisfactory

4.4 Break Away Torque (Open and close valve tested 20 times)

N° of cycle	Open Force (Nm)	Close Force (Nm)
1	55	55
20	48	48

4.5 Seat Leakage Test (-196°C; Test fluid: Helium gas)

Test pressure	Maximim Permissible Leakage mm ³ /s	Recorded mm ³ /s
30 Bar	2500 mm ³ /s	564,4 mm ³ /s
60 Bar	2500 mm ³ /s	531,2 mm ³ /s
90 Bar	2500 mm ³ /s	464,8 mm ³ /s
120 Bar	2500 mm ³ /s	431,6 mm ³ /s
150 Bar	2500 mm ³ /s	398,4 mm ³ /s
180 Bar	2500 mm ³ /s	298,8 mm ³ /s
210 Bar	2500 mm ³ /s	265,6 mm ³ /s
230 Bar	2500 mm ³ /s	232,4 mm ³ /s
250 Bar	2500 mm ³ /s	132,8 mm ³ /s
273 Bar	2500 mm ³ /s	66,4 mm ³ /s
Result	Satisfactory	

4.5 Shell Leakage Test (-196°C; Test fluid: Helium gas)

Test Pressure	Test Duration	Max Permissible Leakage	Recorded
273 Bar	15	0	0
Result	Satisfactory		

5 Seat Leakage Test (Room Tempetature ; Test fluid: Helium gas)

Test pressure	Maximim Permissible Leakage mm ³ /s	Recorded mm ³ /s
30 Bar	0 mm ³ /s	0 mm ³ /s
60 Bar	0 mm ³ /s	0 mm ³ /s
90 Bar	0 mm ³ /s	0 mm ³ /s
120 Bar	0 mm ³ /s	0 mm ³ /s
150 Bar	0 mm ³ /s	0 mm ³ /s
180 Bar	0 mm ³ /s	0 mm ³ /s
210 Bar	0 mm ³ /s	0 mm ³ /s
230 Bar	0 mm ³ /s	0 mm ³ /s
250 Bar	0 mm ³ /s	0 mm ³ /s
273 Bar	0 mm ³ /s	0 mm ³ /s
Result	Satisfactory	

4.5 Shell Leakage Test (Room Tempetature ; Test fluid: Helium gas)

Test Pressure	Test Duration	Max Permissible Leakage	Recorded
273 Bar	15	0	0
Result	Satisfactory		

4.6 Break Away Torque (Open and close valve tested at room temperature)

Open Force (Nm)	35	Close Force (Nm)	35	Result	Satisfactory
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7. DISMANTLING (check for case of dismantling and examine components for wear or damage)

Result Satisfactory

Remarks All components are in perfect condition

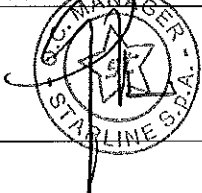
8 CONCLUSION

The valve are suitable for cryogenic service

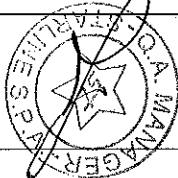
9. INDEX OF ATTACHED DOCUMENTS

Drawing n°	STAR-0003-CRY
Inspection Certificate n°	C174_2007
Material Certificarte n°	C174_2007

OPERATOR QUALIFIED IN ACCORDING TO
UNI EN473 - LEVEL 1 LEAK TEST



VERIFIED



WITNESS

Lloyd's Register EMEA
Milan Office
Floriello
 Witnessed
 Monitored
 Reviewed
G Floriello Surveyor



DATE

18-06-2007

Starline certificate for cryogenic test at -196 °C with Liquid Nitrogen and Helium Gas for pressure test.
 The test is in accordance to BS6364 and Starline procedure n° STAR 089

1. DESCRIPTION OF BALL VALVE

Manufacturer	STARLINE S.p.A.	Valve Type	Cryogenic Floating Ball Valve	DWG Code	156 - TGG	Drawing N°	STAR-0004-CRY
Port Design	Full Port	DN	40	PN	138 CLASS 800	Serial N°	BF 5354

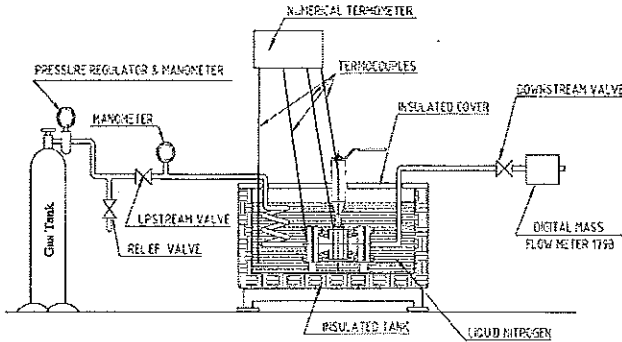
2. BREAK AWAY TORQUE AT AMBIENT TEMPERATURE

Pressure	0 Bar	6 Bar	20 Bar	50 Bar	100 Bar	138 Bar
Torque	26 Nm	26 Nm	30 Nm	42 Nm	58 Nm	62 Nm

3. LEAKAGE TEST (before cryogenic test) ACCORDING TO : API 598, BS 6755 Part.1, API 6D, ISO 5208

Test carry out on	STARLINE S.p.A. - San Paolo D'Argon (Bergamo) Italy
3.1 Inspection Certificate N°	
Result	Satisfactory

4 CRYOGENIC TEST



TIGHTEN BODY BOLTS 120 Nm
 TIGHTEN PACKING NUTS 45 Nm

4.5 Seat Leakage Test (-196°C; Test fluid: Helium gas)

Test pressure	Maximim Permissible Leakage mm ³ /s	Recorded mm ³ /s
20 Bar	4000 mm ³ /s	1693,2 mm ³ /s
40 Bar	4000 mm ³ /s	1527,2 mm ³ /s
60 Bar	4000 mm ³ /s	1427,6 mm ³ /s
80 Bar	4000 mm ³ /s	1394,4 mm ³ /s
100 Bar	4000 mm ³ /s	1029,2 mm ³ /s
120 Bar	4000 mm ³ /s	713,8 mm ³ /s
140 Bar	4000 mm ³ /s	531,2 mm ³ /s
152 Bar	4000 mm ³ /s	464,8 mm ³ /s
Result	Satisfactory	

4.5 Shell Leakage Test (-196°C; Test fluid: Helium gas)

Test Pressure	Test Duration	Max Permissible Leakage	Recorded
152 Bar	15	0	0
Result	Satisfactory		

4.6 Break Away Torque (Open and close valve tested at room temperature)

Open Force (Nm)	32	Close Force (Nm)	32	Result	Satisfactory
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7. DISMANTLING (check for case of dismantling and examine components for wear or damage)

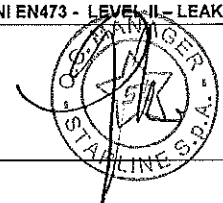
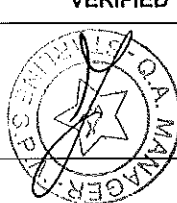

Result	Satisfactory
Remarks	All components are in perfect condition

8 CONCLUSION

The valve are suitable for cryogenic service

9. INDEX OF ATTACHED DOCUMENTS

Drawing n°	STAR-0004-CRY
Inspection Certificate n°	C174_2007
Material Certificate n°	C174_2007

OPERATOR QUALIFIED IN ACCORDING TO UNI EN473 - LEVEL II - LEAK TEST	VERIFIED	WITNESS	DATE
		Lloyd's Register, EMEA Milan Office <input checked="" type="checkbox"/> Witnessed <input type="checkbox"/> Monitored <input type="checkbox"/> Reviewed G. Floriello - Surveyor 	19-06-2007

4.1 Initial System proving test (Room Temperature ; Test fluid: Helium gas)

Test pressure	External Leakage Valve in half-open position	Seat Leakage Valve in closed position
152 Bar	0	0
Result	Satisfactory	

4.2 Cooling Operation

Time	Thermocouple 1	Thermocouple 2	Thermocouple 3	Thermocouple 4
0 minutes	-196 °C	-196 °C	-196 °C	-148 °C
15 minutes	-196 °C	-196 °C	-196 °C	-149 °C
30 minutes	-196 °C	-196 °C	-196 °C	-149 °C
45 minutes	-196 °C	-196 °C	-196 °C	-149 °C
60 minutes	-196 °C	-196 °C	-196 °C	-150 °C

4.3 System proving Test (-196°C; Test fluid: Helium gas)

Test pressure	External Leakage
152 Bar	0
Result	Satisfactory

4.4 Break Away Torque (Open and close valve tested 20 times)

N° of cycle	Open Force (Nm)	Close Force (Nm)
1	78	78
20	64	64

5 Seat Leakage Test (Room Temperature ; Test fluid: Helium gas)

Test pressure	Maximim Permissible Leakage mm ³ /s	Recorded mm ³ /s
20 Bar	0 mm ³ /s	0 mm ³ /s
40 Bar	0 mm ³ /s	0 mm ³ /s
60 Bar	0 mm ³ /s	0 mm ³ /s
80 Bar	0 mm ³ /s	0 mm ³ /s
100 Bar	0 mm ³ /s	0 mm ³ /s
120 Bar	0 mm ³ /s	0 mm ³ /s
140 Bar	0 mm ³ /s	0 mm ³ /s
152 Bar	0 mm ³ /s	0 mm ³ /s
Result	Satisfactory	

4.5 Shell Leakage Test (Room Temperature ; Test fluid: Helium gas)

Test Pressure	Test Duration	Max Permissible Leakage	Recorded
152 Bar	15	0	0
Result	Satisfactory		

CRYOGENIC TEST -196°C
FOR BALL VALVES
(According to BS 6364)

Starline certificate for cryogenic test at -196 °C with Liquid Nitrogen and Helium Gas for pressure test.
 The test is in accordance to BS6364 and Starline procedure n° STAR 089

1. DESCRIPTION OF BALL VALVE

Manufacturer	STARLINE S.p.A.	Valve Type	Cryogenic Floating Ball Valve	DWG Code	156 - TGG	Drawing N°	STAR-0005-CRY
Port Design	Full Port	DN	50	PN	138 CLASS 800	Serial N°	BF 5355

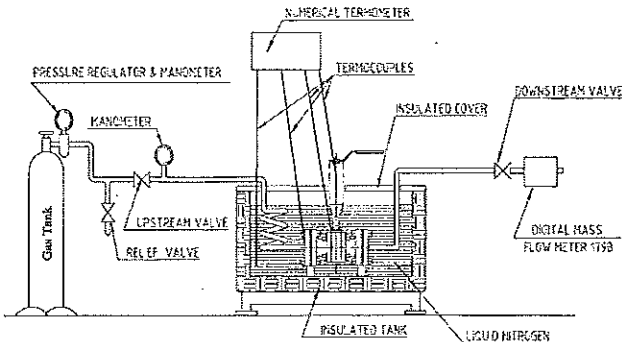
2. BREAK AWAY TORQUE AT AMBIENT TEMPERATURE

Pressure	0 Bar	6 Bar	20 Bar	50 Bar	100 Bar	138 Bar
Torque	30 Nm	30 Nm	38 Nm	48 Nm	84 Nm	106 Nm

3. LEAKAGE TEST (before cryogenic test) ACCORDING TO : API 598, BS 6755 Part.1, API 6D, ISO 5208

Test carry out on	STARLINE S.p.A. - San Paolo D'Argon (Bergamo) Italy
3.1 Inspection Certificate N°	
Result	Satisfactory

4 CRYOGENIC TEST



TIGHTEN BODY BOLTS 120 Nm
 TIGHTEN PACKING NUTS 45 Nm

4.5 Seat Leakage Test (-196°C; Test fluid: Helium gas)

Test pressure	Maximim Permissible Leakage mm ³ /s	Recorded mm ³ /s
20 Bar	5000 mm ³ /s	3051,6 mm ³ /s
40 Bar	5000 mm ³ /s	2788,8 mm ³ /s
60 Bar	5000 mm ³ /s	2058,4 mm ³ /s
80 Bar	5000 mm ³ /s	1892,4 mm ³ /s
100 Bar	5000 mm ³ /s	1593,6 mm ³ /s
120 Bar	5000 mm ³ /s	1460,8 mm ³ /s
140 Bar	5000 mm ³ /s	1062,4 mm ³ /s
152 Bar	5000 mm ³ /s	531,2 mm ³ /s
Result	Satisfactory	

4.5 Shell Leakage Test (-196°C; Test fluid: Helium gas)

Test Pressure	Test Duration	Max Permissible Leakage	Recorded
152 Bar	15	0	0
Result	Satisfactory		

4.6 Break Away Torque (Open and close valve tested at room temperature)

Open Force (Nm)	44	Close Force (Nm)	44	Result	Satisfactory
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7. DISMANTLING (check for case of dismantling and examine components for wear or damage)




Result	Satisfactory
Remarks	All components are in perfect condition

8 CONCLUSION

The valve are suitable for cryogenic service

9. INDEX OF ATTACHED DOCUMENTS

Drawing n°	STAR-0005-CRY
Ispection Certificate n°	C174_2007
Material Certificarte n°	C174_2007

OPERATOR QUALIFIED IN ACCORDING TO UNI EN473 LEVEL 1 - LEAK TEST	VERIFIED	WITNESS	DATE
		Lloyd's Register EMEA Milan Office <input checked="" type="checkbox"/> Witnessed <input type="checkbox"/> Monitored <input type="checkbox"/> Reviewed G. Floriello Surveyor 	20-06-2007

4.1 Initial System proving test (Room Temperature ; Test fluid: Helium gas)

Test pressure	External Leakage Valve in half-open position	Seat Leakage Valve in closed position
152 Bar	0	0
Result	Satisfactory	

4.2 Cooling Operation

Time	Thermocouple 1	Thermocouple 2	Thermocouple 3	Thermocouple 4
0 minutes	-196 °C	-196 °C	-196 °C	-154 °C
15 minutes	-196 °C	-196 °C	-196 °C	-154 °C
30 minutes	-196 °C	-196 °C	-196 °C	-154 °C
45 minutes	-196 °C	-196 °C	-196 °C	-155 °C
60 minutes	-196 °C	-196 °C	-196 °C	-155 °C

4.3 System proving Test (-196°C; Test fluid: Helium gas)

Test pressure	External Leakage
152 Bar	0
Result	Satisfactory

4.4 Break Away Torque (Open and close valve tested 20 times)

N° of cycle	Open Force (Nm)	Close Force (Nm)
1	90	90
20	86	86

5 Seat Leakage Test (Room Temperature ; Test fluid: Helium gas)

Test pressure	Maximim Permissible Leakage mm ³ /s	Recorded mm ³ /s
20 Bar	0 mm ³ /s	0 mm ³ /s
40 Bar	0 mm ³ /s	0 mm ³ /s
60 Bar	0 mm ³ /s	0 mm ³ /s
80 Bar	0 mm ³ /s	0 mm ³ /s
100 Bar	0 mm ³ /s	0 mm ³ /s
120 Bar	0 mm ³ /s	0 mm ³ /s
140 Bar	0 mm ³ /s	0 mm ³ /s
152 Bar	0 mm ³ /s	0 mm ³ /s
Result	Satisfactory	

4.5 Shell Leakage Test (Room Temperature ; Test fluid: Helium gas)

Test Pressure	Test Duration	Max Permissible Leakage	Recorded
152 Bar	15	0	0
Result	Satisfactory		

CRYOGENIC TEST -196°C
FOR BALL VALVES
(According to BS 6364)

Starline certificate for cryogenic test at -196 °C with Liquid Nitrogen and Helium Gas for pressure test.
 The test is in accordance to BS6364 and Starline procedure n° STAR 089

1. DESCRIPTION OF BALL VALVE

Manufacturer	STARLINE S.p.A.	Valve Type	Cryogenic Floating Ball Valve	DWG Code	156 - TGG	Drawing N°	STAR-0006-CRY
Port Design	Full Port	DN	80	PN	50 CLASS 300	Serial N°	BF 5356

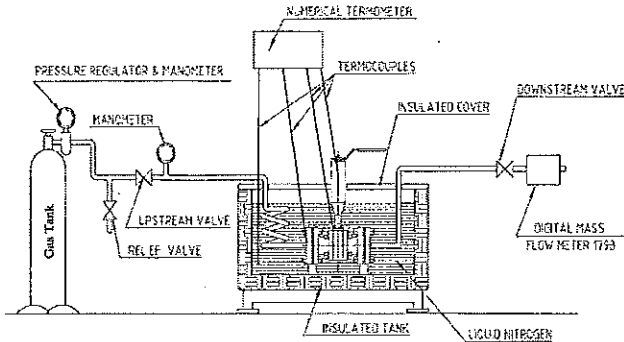
2. BREAK AWAY TORQUE AT AMBIENT TEMPERATURE

Pressure	0 Bar	6 Bar	20 Bar	50 Bar
Torque	60 Nm	60 Nm	82 Nm	106 Nm

3. LEAKAGE TEST (before cryogenic test) ACCORDING TO : API 598, BS 6755 Part.1, API 6D, ISO 5208

Test carry out on	STARLINE S.p.A. - San Paolo D'Argon (Bergamo) Italy
3.1 Inspection Certificate N°	
Result	Satisfactory

4 CRYOGENIC TEST



TIGHTEN BODY BOLTS 80 Nm
 TIGHTEN PACKING NUTS 55 Nm

4.5 Seat Leakage Test (-196°C; Test fluid: Helium gas)

Test pressure	Maximim Permissible Leakage mm ³ /s	Recorded mm ³ /s
7.5 Bar	8000 mm ³ /s	5229,0 mm ³ /s
15.0 Bar	8000 mm ³ /s	4017,2 mm ³ /s
22.5 Bar	8000 mm ³ /s	3087,6 mm ³ /s
30.0 Bar	8000 mm ³ /s	2224,4 mm ³ /s
37.5 Bar	8000 mm ³ /s	1925,6 mm ³ /s
45.0 Bar	8000 mm ³ /s	1792,8 mm ³ /s
52.5 Bar	8000 mm ³ /s	1527,2 mm ³ /s
55.0 Bar	8000 mm ³ /s	1228,4 mm ³ /s
Result	Satisfactory	

4.5 Shell Leakage Test (-196°C; Test fluid: Helium gas)

Test Pressure	Test Duration	Max Permissible Leakage	Recorded
55 Bar	15	0	0
Result	Satisfactory		

4.6 Break Away Torque (Open and close valve tested at room temperature)

Open Force (Nm)	68	Close Force (Nm)	68	Result	Satisfactory
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7. DISMANTLING (check for case of dismantling and examine components for wear or damage)

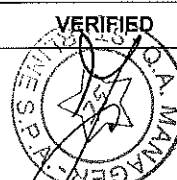
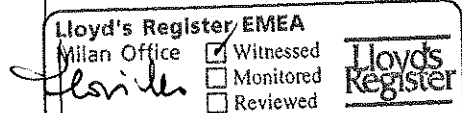
Result	Satisfactory
Remarks	All components are in perfect condition

8 CONCLUSION

The valve are suitable for cryogenic service

9. INDEX OF ATTACHED DOCUMENTS

Drawing n°	STAR-0006-CRY
Ispection Certificate n°	C174_2007
Material Certificarte n°	C174_2007

OPERATOR QUALIFIED IN ACCORDING TO UNI EN473 - LEVEL 1 - LEAK TEST	VERIFIED 	WITNESS 	DATE 21-08-2007
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CRYOGENIC TEST -196°C
FOR BALL VALVES
(According to BS 6364)

Starline certificate for cryogenic test at -196 °C with Liquid Nitrogen and Helium Gas for pressure test.
 The test is in accordance to BS6364 and Starline procedure n° STAR 089

1. DESCRIPTION OF BALL VALVE

Manufacturer	STARLINE S.p.A.	Valve Type	Cryogenic Floating Ball Valve	DWG Code	156 - TGG	Drawing N°	STAR-0007-CRY
Port Design	Full Port	DN	100	PN	50 CLASS 300	Serial N°	BF 5357

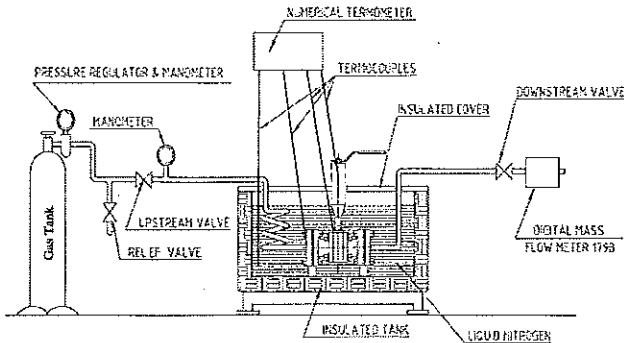
2. BREAK AWAY TORQUE AT AMBIENT TEMPERATURE

Pressure	0 Bar	6 Bar	20 Bar	50 Bar
Torque	90 Nm	90 Nm	110 Nm	140 Nm

3. LEAKAGE TEST (before cryogenic test) ACCORDING TO : API 598, BS 6755 Part.1, API 6D, ISO 5208

Test carry out on	STARLINE S.p.A. - San Paolo D'Argon (Bergamo) Italy
3.1 Inspection Certificate N°	
Result	Satisfactory

4 CRYOGENIC TEST



TIGHTEN BODY BOLTS 80 Nm
 TIGHTEN PACKING NUTS 55 Nm

4.5 Seat Leakage Test (-196°C; Test fluid: Helium gas)

Test pressure	Maximim Permissible Leakage mm ³ /s	Recorded mm ³ /s
7.5 Bar	8000 mm ³ /s	5328,6 mm ³ /s
15.0 Bar	8000 mm ³ /s	3984,0 mm ³ /s
22.5 Bar	8000 mm ³ /s	3336,6 mm ³ /s
30.0 Bar	8000 mm ³ /s	2788,8 mm ³ /s
37.5 Bar	8000 mm ³ /s	2423,6 mm ³ /s
45.0 Bar	8000 mm ³ /s	2091,6 mm ³ /s
52.5 Bar	8000 mm ³ /s	1792,8 mm ³ /s
55.0 Bar	8000 mm ³ /s	1427,6 mm ³ /s
Result	Satisfactory	

4.5 Shell Leakage Test (-196°C; Test fluid: Helium gas)

Test Pressure	Test Duration	Max Permissible Leakage	Recorded
55 Bar	15	0	0
Result	Satisfactory		

4.6 Break Away Torque (Open and close valve tested at room temperature)

Open Force (Nm)	68	Close Force (Nm)	68	Result	Satisfactory
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7. DISMANTLING (check for case of dismantling and examine components for wear or damage)

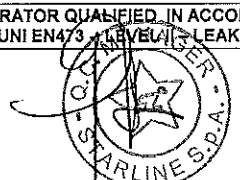
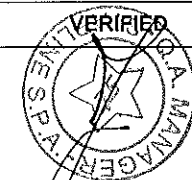

Result	Satisfactory
Remarks	All components are in perfect condition

8 CONCLUSION

The valve are suitable for cryogenic service

9. INDEX OF ATTACHED DOCUMENTS

Drawing n°	STAR-0007-CRY
Inspection Certificate n°	C174_2007
Material Certificarte n°	C174_2007

OPERATOR QUALIFIED IN ACCORDING TO UNI EN473 LEVEL 1 LEAK TEST			WITNESS Lloyd's Register EMEA Milan Office  G. Floriello Surveyor	DATE 22-06-2007
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4.1 Initial System proving test (Room Temperature ; Test fluid: Helium gas)

Test pressure	External Leakage Valve in half-open position	Seat Leakage Valve in closed position
55 Bar	0	0
Result	Satisfactory	

4.2 Cooling Operation

Time	Thermocouple 1	Thermocouple 2	Thermocouple 3	Thermocouple 4
0 minutes	-196 °C	-196 °C	-196 °C	-146 °C
15 minutes	-196 °C	-196 °C	-196 °C	-148 °C
30 minutes	-196 °C	-196 °C	-196 °C	-148 °C
45 minutes	-196 °C	-196 °C	-196 °C	-149 °C
60 minutes	-196 °C	-196 °C	-196 °C	-149 °C

4.3 System proving Test (-196°C; Test fluid: Helium gas)

Test pressure	External Leakage
55 Bar	0
Result	Satisfactory

4.4 Break Away Torque (Open and close valve tested 20 times)

N° of cycle	Open Force (Nm)	Close Force (Nm)
1	180	180
20	154	154

5 Seat Leakage Test (Room Temperature ; Test fluid: Helium gas)

Test pressure	Maximim Permissible Leakage mm ³ /s	Recorded mm ³ /s
7.5 Bar	0 mm ³ /s	0 mm ³ /s
15.0 Bar	0 mm ³ /s	0 mm ³ /s
22.5 Bar	0 mm ³ /s	0 mm ³ /s
30.0 Bar	0 mm ³ /s	0 mm ³ /s
37.5 Bar	0 mm ³ /s	0 mm ³ /s
45.0 Bar	0 mm ³ /s	0 mm ³ /s
52.5 Bar	0 mm ³ /s	0 mm ³ /s
55.0 Bar	0 mm ³ /s	0 mm ³ /s
Result	Satisfactory	

4.5 Shell Leakage Test (Room Temperature ; Test fluid: Helium gas)

Test Pressure	Test Duration	Max Permissible Leakage	Recorded
55 Bar	15	0	0
Result	Satisfactory		

CRYOGENIC TEST -196°C
FOR BALL VALVES
(According to BS 6364)

Starline certificate for cryogenic test at -196 °C with Liquid Nitrogen and Helium Gas for pressure test.
 The test is in accordance to BS6364 and Starline procedure n° STAR 089

1. DESCRIPTION OF BALL VALVE

Manufacturer	STARLINE S.p.A.	Valve Type	Cryogenic Floating Ball Valve	DWG Code	156 - TGG	Drawing N°	STAR-0008-CRY
Port Design	Full Port	DN	150	PN	20 CLASS 150	Serial N°	BF 5358

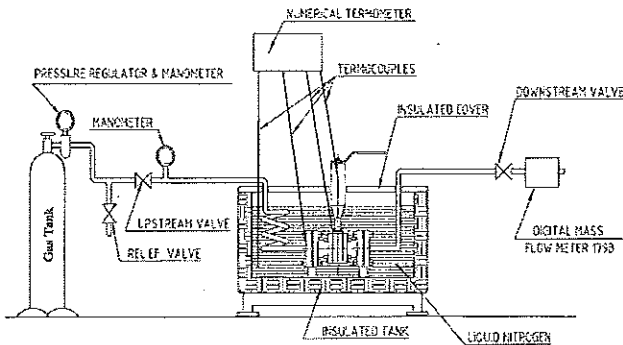
2. BREAK AWAY TORQUE AT AMBIENT TEMPERATURE

Pressure	0 Bar	6 Bar	20 Bar
Torque	105 Nm	160 Nm	320 Nm

3. LEAKAGE TEST (before cryogenic test) ACCORDING TO : API 598, BS 6755 Part.1, API 6D, ISO 5208

Test carry out on	STARLINE S.p.A. - San Paolo D'Argon (Bergamo) Italy
3.1 Inspection Certificate N°	
Result	Satisfactory

4 CRYOGENIC TEST



TIGHTEN BODY BOLTS 120 Nm
 TIGHTEN PACKING NUTS 85 Nm

4.1 Initial System proving test (Room Temperature ; Test fluid: Helium gas)

Test pressure	External Leakage Valve in half-open position	Seat Leakage Valve in closed position
21 Bar	0	0
Result	Satisfactory	

4.2 Cooling Operation

Time	Thermocouple 1	Thermocouple 2	Thermocouple 3	Thermocouple 4
0 minutes	-196 °C	-196 °C	-196 °C	-162 °C
15 minutes	-196 °C	-196 °C	-196 °C	-162 °C
30 minutes	-196 °C	-196 °C	-196 °C	-162 °C
45 minutes	-196 °C	-196 °C	-196 °C	-164 °C
60 minutes	-196 °C	-196 °C	-196 °C	-164 °C

4.3 System proving Test (-196°C; Test fluid: Helium gas)

Test pressure	External Leakage
21 Bar	0
Result	Satisfactory

4.4 Break Away Torque (Open and close valve tested 20 times)

N° of cycle	Open Force (Nm)	Close Force (Nm)
1	320	320
20	296	296

4.5 Seat Leakage Test (-196°C; Test fluid: Helium gas)

Test pressure	Maximim Permissible Leakage mm ³ /s	Recorded mm ³ /s
3.5 Bar	15000 mm ³ /s	5942,8 mm ³ /s
7.0 Bar	15000 mm ³ /s	5743,6 mm ³ /s
10.5 Bar	15000 mm ³ /s	4797,4 mm ³ /s
14.0 Bar	15000 mm ³ /s	3751,6 mm ³ /s
17.5 Bar	15000 mm ³ /s	3087,6 mm ³ /s
21.0 Bar	15000 mm ³ /s	1892,4 mm ³ /s
Result	Satisfactory	

4.5 Shell Leakage Test (-196°C; Test fluid: Helium gas)

Test Pressure	Test Duration	Max Permissible Leakage	Recorded
21 Bar	15	0	0
Result	Satisfactory		

5 Seat Leakage Test (Room Temperature ; Test fluid: Helium gas)

Test pressure	Maximim Permissible Leakage mm ³ /s	Recorded mm ³ /s
3.5 Bar	0 mm ³ /s	0 mm ³ /s
7.0 Bar	0 mm ³ /s	0 mm ³ /s
10.5 Bar	0 mm ³ /s	0 mm ³ /s
14.0 Bar	0 mm ³ /s	0 mm ³ /s
17.5 Bar	0 mm ³ /s	0 mm ³ /s
21.0 Bar	0 mm ³ /s	0 mm ³ /s
Result	Satisfactory	

4.5 Shell Leakage Test (Room Temperature ; Test fluid: Helium gas)

Test Pressure	Test Duration	Max Permissible Leakage	Recorded
21 Bar	15	0	0
Result	Satisfactory		

4.6 Break Away Torque (Open and close valve tested at room temperature)

Open Force (Nm)	125	Close Force (Nm)	125	Result	Satisfactory
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7. DISMANTLING (check for case of dismantling and examine components for wear or damage)


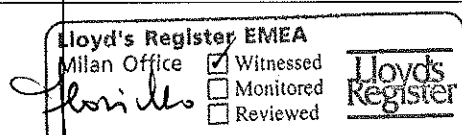
Result	Satisfactory
Remarks	All components are in perfect condition

8 CONCLUSION

The valve are suitable for cryogenic service

9. INDEX OF ATTACHED DOCUMENTS

Drawing n°	STAR-0008-CRY
Inspection Certificate n°	C174_2007
Material Certificarte n°	C174_2007

OPERATOR QUALIFIED IN ACCORDING TO UNI EN473 - LEVEL II - LEAK TEST	VERIFIED 	WITNESS  G. Fioriello Surveyor	DATE 25-06-2007
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CRYOGENIC TEST -196°C
FOR BALL VALVES
 (According to BS 6364)

Starline certificate for cryogenic test at -196 °C with Liquid Nitrogen and Helium Gas for pressure test.
 The test is in accordance to BS6364 and Starline procedure n° STAR 089

1. DESCRIPTION OF BALL VALVE

Manufacturer	STARLINE S.p.A.	Valve Type	Cryogenic Trunnion Ball Valve	DWG Code	LT 106 - KGG	Drawing N°	STAR-0009-CRY
Port Design	Full Port	DN	15	PN	420 CLASS 2500	Serial N°	BF 6359

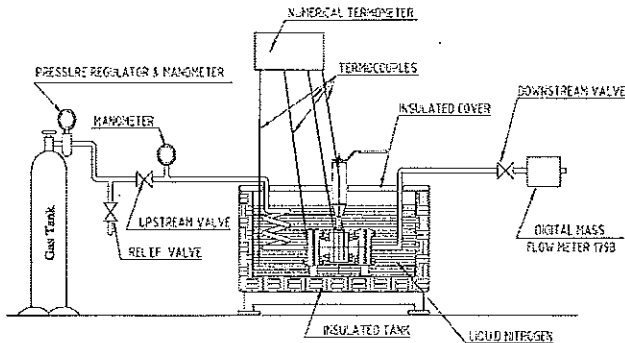
2. BREAK AWAY TORQUE AT AMBIENT TEMPERATURE

Pressure	0 Bar	6 Bar	20 Bar	50 Bar	100 Bar	150 Bar	250 Bar	420 Bar
Torque	8 Nm	8 Nm	8 Nm	14 Nm	16 Nm	18 Nm	25 Nm	40 Nm

3. LEAKAGE TEST (before cryogenic test) ACCORDING TO : API 598, BS 6755 Part.1, API 6D, ISO 5208

Test carry out on	STARLINE S.p.A. - San Paolo D'Argon (Bergamo) Italy
3.1 Inspection Certificate N°	
Result	Satisfactory

4 CRYOGENIC TEST



TIGHTEN BODY BOLTS 50 Nm

4.1 Initial System proving test (Room Temperature ; Test fluid: Helium gas)

Test pressure	External Leakage Valve in half-open position	Seat Leakage Valve in closed position	
		Side A	Side B
455 Bar	0	0	0
Result		Satisfactory	

4.2 Cooling Operation

Time	Thermocouple 1	Thermocouple 2	Thermocouple 3	Thermocouple 4
0 minutes	-196 °C	-196 °C	-196 °C	-154 °C
15 minutes	-196 °C	-196 °C	-196 °C	-154 °C
30 minutes	-196 °C	-196 °C	-196 °C	-155 °C
45 minutes	-196 °C	-196 °C	-196 °C	-155 °C
60 minutes	-196 °C	-196 °C	-196 °C	-156 °C

4.3 System proving Test (-196°C; Test fluid: Helium gas)

Test pressure	External Leakage
455 Bar	0
Result	
Satisfactory	

4.4 Break Away Torque (Open and close valve tested 20 times)

N° of cycle	Open Force (Nm)	Close Force (Nm)
1	42	42
20	38	38

4.5 Seat Leakage Test (-196°C; Test fluid: Helium gas)

Test pressure	Maximum Permissible Leakage mm ³ /s	SIDE A Recorded mm ³ /s	SIDE B Recorded mm ³ /s
30 Bar	1500	597,6	406,7
60 Bar	1500	408,4	323,7
90 Bar	1500	308,8	260,6
120 Bar	1500	209,2	224,1
150 Bar	1500	146,1	174,3
180 Bar	1500	106,2	126,2
210 Bar	1500	59,8	84,7
240 Bar	1500	53,1	61,4
270 Bar	1500	43,2	48,1
300 Bar	1500	36,5	41,5
330 Bar	1500	23,2	31,5
360 Bar	1500	19,9	21,6
390 Bar	1500	13,3	11,6
420 Bar	1500	6,6	5,0
455 Bar	1500	1,0	0,8
Result		Satisfactory	

4.5 Shell Leakage Test (-196°C; Test fluid: Helium gas)

Test Pressure	Test Duration	Max Permissible Leakage	Recorded
455 Bar	15	0	0
Result		Satisfactory	

5 Seat Leakage Test (Room Temperature ; Test fluid: Helium gas)

Test pressure	Maximum Permissible Leakage mm ³ /s	SIDE A Recorded mm ³ /s	SIDE B Recorded mm ³ /s
30 Bar	0	0	0
60 Bar	0	0	0
90 Bar	0	0	0
120 Bar	0	0	0
150 Bar	0	0	0
180 Bar	0	0	0
210 Bar	0	0	0
240 Bar	0	0	0
270 Bar	0	0	0
300 Bar	0	0	0
330 Bar	0	0	0
360 Bar	0	0	0
390 Bar	0	0	0
420 Bar	0	0	0
455 Bar	0	0	0
Result		Satisfactory	

4.5 Shell Leakage Test (Room Temperature ; Test fluid: Helium gas)

Test Pressure	Test Duration	Max Permissible Leakage	Recorded
255 Bar	15	0	0
Result		Satisfactory	

4.6 Break Away Torque (Open and close valve tested at room temperature)

Open Force (Nm)	15	Close Force (Nm)	15	Result	Satisfactory
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7. DISMANTLING (check for case of dismantling and examine components for wear or damage)

Result	Satisfactory
Remarks	All components are in perfect condition

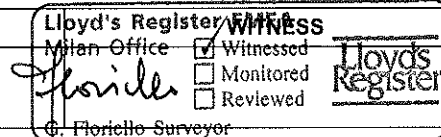
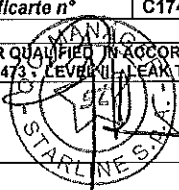
8 CONCLUSION

The valve are suitable for cryogenic service

9. INDEX OF ATTACHED DOCUMENTS

Drawing n°	STAR-0009-CRY
Inspection Certificate n°	C174_2007
Material Certificate n°	C174_2007

OPERATOR QUALIFIED IN ACCORDING TO
 UNI EN473 - LEVEL II - LEAK TEST



DATE

26-06-2007

Starline certificate for cryogenic test at -196 °C with Liquid Nitrogen and Helium Gas for pressure test.
 The test is in accordance to BS6364 and Starline procedure n° STAR 089

1. DESCRIPTION OF BALL VALVE

Manufacturer	STARLINE S.p.A.	Valve Type	Cryogenic Trunnion Ball Valve	DWG Code	LT 106 - KGG	Drawing N°	STAR-0010-CRY
Port Design	Full Port	DN	20	PN	420 CLASS 2500	Serial N°	BF 5360

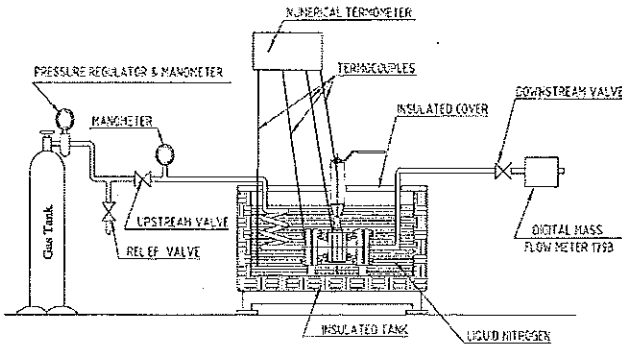
2. BREAK AWAY TORQUE AT AMBIENT TEMPERATURE

Pressure	0 Bar	6 Bar	20 Bar	50 Bar	100 Bar	150 Bar	250 Bar	420 Bar
Torque	9 Nm	9 Nm	12 Nm	14 Nm	18 Nm	18 Nm	25 Nm	52 Nm

3. LEAKAGE TEST (before cryogenic test) ACCORDING TO : API 598, BS 6755 Part.1, API 6D, ISO 5208

Test carry out on	STARLINE S.p.A. - San Paolo D'Argon (Bergamo) Italy
3.1 Inspection Certificate N°	
Result	Satisfactory

4 CRYOGENIC TEST



TIGHTEN BODY BOLTS 80 Nm

4.5 Seat Leakage Test (-196°C; Test fluid: Helium gas)

Test pressure	Maximum Permissible Leakage mm ³ /s	SIDE A Recorded mm ³ /s	SIDE B Recorded mm ³ /s
30 Bar	2000	830,0	682,3
60 Bar	2000	740,4	463,1
90 Bar	2000	637,4	356,9
120 Bar	2000	534,5	290,5
150 Bar	2000	474,8	224,1
180 Bar	2000	371,8	164,3
210 Bar	2000	308,8	141,1
240 Bar	2000	205,8	107,9
270 Bar	2000	112,9	59,8
300 Bar	2000	79,7	44,8
330 Bar	2000	43,2	31,5
360 Bar	2000	29,9	24,9
390 Bar	2000	19,9	14,9
420 Bar	2000	13,3	5,0
455 Bar	2000	3,3	2,5
Result	Satisfactory		

4.5 Shell Leakage Test (-196°C; Test fluid: Helium gas)

Test Pressure	Test Duration	Max Permissible Leakage	Recorded
455 Bar	15	0	0
Result	Satisfactory		

4.1 Initial System proving test (Room Temperature ; Test fluid: Helium gas)

Test pressure	External Leakage Valve in half-open position	Seat Leakage Valve in closed position	
		Side A	Side B
455 Bar	0	0	0
Result	Satisfactory		

4.2 Cooling Operation

Time	Thermocouple 1	Thermocouple 2	Thermocouple 3	Thermocouple 4
0 minutes	-196 °C	-196 °C	-196 °C	-148 °C
15 minutes	-196 °C	-196 °C	-196 °C	-149 °C
30 minutes	-196 °C	-196 °C	-196 °C	-149 °C
45 minutes	-196 °C	-196 °C	-196 °C	-149 °C
60 minutes	-196 °C	-196 °C	-196 °C	-149 °C

4.3 System proving Test (-196°C; Test fluid: Helium gas)

Test pressure	External Leakage
455 Bar	0
Result	Satisfactory

4.4 Break Away Torque (Open and close valve tested 20 times)

N° of cycle	Open Force (Nm)	Close Force (Nm)
1	46	46
20	36	36

5 Seat Leakage Test (Room Temperature ; Test fluid: Helium gas)

Test pressure	Maximum Permissible Leakage mm ³ /s	SIDE A Recorded mm ³ /s	SIDE B Recorded mm ³ /s
30 Bar	0	0	0
60 Bar	0	0	0
90 Bar	0	0	0
120 Bar	0	0	0
150 Bar	0	0	0
180 Bar	0	0	0
210 Bar	0	0	0
240 Bar	0	0	0
270 Bar	0	0	0
300 Bar	0	0	0
330 Bar	0	0	0
360 Bar	0	0	0
390 Bar	0	0	0
420 Bar	0	0	0
455 Bar	0	0	0
Result	Satisfactory		

4.5 Shell Leakage Test (Room Temperature ; Test fluid: Helium gas)

Test Pressure	Test Duration	Max Permissible Leakage	Recorded
455 Bar	15	0	0
Result	Satisfactory		

4.6 Break Away Torque (Open and close valve tested at room temperature)

Open Force (Nm)	18	Close Force (Nm)	18	Result	Satisfactory
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7. DISMANTLING (check for case of dismantling and examine components for wear or damage)

Result	Satisfactory
Remarks	All components are in perfect condition

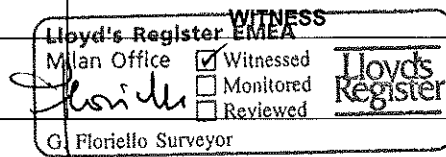
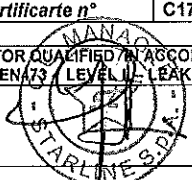
8 CONCLUSION

The valve are suitable for cryogenic service

9. INDEX OF ATTACHED DOCUMENTS

Drawing n°	STAR-0010-CRY
Inspection Certificate n°	C174_2007
Material Certificarte n°	C174_2007

OPERATOR QUALIFIED IN ACCORDING TO UNI EN473 / LEVEL II - LEAK TEST



DATE
27-06-2007

Starline certificate for cryogenic test at -196 °C with Liquid Nitrogen and Helium Gas for pressure test.
The test is in accordance to BS6364 and Starline procedure n° STAR 089

1. DESCRIPTION OF BALL VALVE

Manufacturer	STARLINE S.p.A.	Valve Type	Cryogenic Trunnion Ball Valve	DWG Code	LT 106 - KGG	Drawing N°	STAR-0011-CRY
Port Design	Full Port	DN	25	PN	420 CLASS 2500	Serial N°	BF 5361

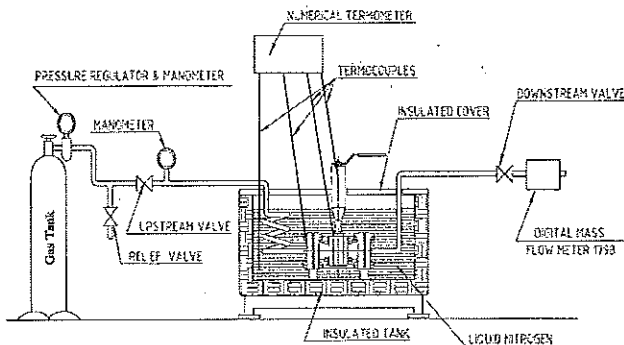
2. BREAK AWAY TORQUE AT AMBIENT TEMPERATURE

Pressure	0 Bar	6 Bar	20 Bar	50 Bar	100 Bar	150 Bar	250 Bar	420 Bar
Torque	10Nm	10 Nm	14 Nm	22 Nm	30 Nm	40 Nm	48 Nm	58 Nm

3. LEAKAGE TEST (before cryogenic test) ACCORDING TO : API 598, BS 6755 Part.1, API 6D, ISO 5208

Test carry out on	STARLINE S.p.A. - San Paolo D'Argon (Bergamo) Italy
3.1 Inspection Certificate N°	
Result	Satisfactory

4 CRYOGENIC TEST



TIGHTEN BODY BOLTS 120 Nm

4.1 Initial System proving test (Room Temperature ; Test fluid: Helium gas)

Test pressure	External Leakage Valve in half-open position	Seat Leakage Valve in closed position	
		Side A	Side B
455 Bar	0	0	0
Result	Satisfactory		

4.2 Cooling Operation

Time	Thermocouple 1	Thermocouple 2	Thermocouple 3	Thermocouple 4
0 minutes	-196 °C	-196 °C	-196 °C	-162 °C
15 minutes	-196 °C	-196 °C	-196 °C	-162 °C
30 minutes	-196 °C	-196 °C	-196 °C	-162 °C
45 minutes	-196 °C	-196 °C	-196 °C	-162 °C
60 minutes	-196 °C	-196 °C	-196 °C	-162 °C

4.3 System proving Test (-196°C; Test fluid: Helium gas)

Test pressure	External Leakage
455 Bar	0
Result	Satisfactory

4.4 Break Away Torque (Open and close valve tested 20 times)

N° of cycle	Open Force (Nm)	Close Force (Nm)
1	52	46
20	40	40

4.5 Seat Leakage Test (-196°C; Test fluid: Helium gas)

Test pressure	Maximim Permissible Leakage mm³/s	SIDE A		SIDE B	
		Recorded mm³/s	Recorded mm³/s	Recorded mm³/s	Recorded mm³/s
30 Bar	2500 mm³/s	1261,6	mm³/s	1090,6	mm³/s
60 Bar	2500 mm³/s	972,8	mm³/s	891,4	mm³/s
90 Bar	2500 mm³/s	710,5	mm³/s	722,1	mm³/s
120 Bar	2500 mm³/s	640,8	mm³/s	592,6	mm³/s
150 Bar	2500 mm³/s	537,8	mm³/s	463,1	mm³/s
180 Bar	2500 mm³/s	411,7	mm³/s	356,9	mm³/s
210 Bar	2500 mm³/s	272,2	mm³/s	224,1	mm³/s
240 Bar	2500 mm³/s	142,8	mm³/s	151,1	mm³/s
270 Bar	2500 mm³/s	69,7	mm³/s	124,5	mm³/s
300 Bar	2500 mm³/s	59,8	mm³/s	94,6	mm³/s
330 Bar	2500 mm³/s	46,5	mm³/s	61,4	mm³/s
360 Bar	2500 mm³/s	39,8	mm³/s	38,2	mm³/s
390 Bar	2500 mm³/s	19,9	mm³/s	28,2	mm³/s
420 Bar	2500 mm³/s	16,6	mm³/s	14,9	mm³/s
455 Bar	2500 mm³/s	9,6	mm³/s	5,1	mm³/s
Result	Satisfactory				

4.5 Shell Leakage Test (-196°C; Test fluid: Helium gas)

Test Pressure	Test Duration	Max Permissible Leakage	Recorded
455 Bar	15	0	0
Result	Satisfactory		

5 Seat Leakage Test (Room Temperature ; Test fluid: Helium gas)

Test pressure	Maximim Permissible Leakage mm³/s	SIDE A		SIDE B	
		Recorded mm³/s	Recorded mm³/s	Recorded mm³/s	Recorded mm³/s
30 Bar	0 mm³/s	0	mm³/s	0	mm³/s
60 Bar	0 mm³/s	0	mm³/s	0	mm³/s
90 Bar	0 mm³/s	0	mm³/s	0	mm³/s
120 Bar	0 mm³/s	0	mm³/s	0	mm³/s
150 Bar	0 mm³/s	0	mm³/s	0	mm³/s
180 Bar	0 mm³/s	0	mm³/s	0	mm³/s
210 Bar	0 mm³/s	0	mm³/s	0	mm³/s
240 Bar	0 mm³/s	0	mm³/s	0	mm³/s
270 Bar	0 mm³/s	0	mm³/s	0	mm³/s
300 Bar	0 mm³/s	0	mm³/s	0	mm³/s
330 Bar	0 mm³/s	0	mm³/s	0	mm³/s
360 Bar	0 mm³/s	0	mm³/s	0	mm³/s
390 Bar	0 mm³/s	0	mm³/s	0	mm³/s
420 Bar	0 mm³/s	0	mm³/s	0	mm³/s
455 Bar	0 mm³/s	0	mm³/s	0	mm³/s
Result	Satisfactory				

4.5 Shell Leakage Test (Room Temperature ; Test fluid: Helium gas)

Test Pressure	Test Duration	Max Permissible Leakage	Recorded
455 Bar	15	0	0
Result	Satisfactory		

4.6 Break Away Torque (Open and close valve tested at room temperature)

Open Force (Nm)	24	Close Force (Nm)	24	Result	Satisfactory
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7. DISMANTLING (check for case of dismantling and examine components for wear or damage)

Result	Satisfactory
Remarks	All components are in perfect condition

8 CONCLUSION

The valve are suitable for cryogenic service

9. INDEX OF ATTACHED DOCUMENTS

Drawing n°	STAR-0011-CRY
Inspection Certificate n°	C174_2007
Material Certificarte n°	C174_2007

OPERATOR QUALIFIED IN ACCORDING TO UNI EN473 LEVEL 1 LEAK TEST



WITNESS
Lloyd's Register EMEA
Milan Office
 Witnessed
 Monitored
 Reviewed
G. Floriello Surveyor

DATE

28-06-2007

CRYOGENIC TEST -196°C
FOR BALL VALVES
 (According to BS 6364)

Starline certificate for cryogenic test at -196 °C with Liquid Nitrogen and Helium Gas for pressure test.
 The test is in accordance to BS6364 and Starline procedure n° STAR 089

1. DESCRIPTION OF BALL VALVE

Manufacturer	STARLINE S.p.A.	Valve Type	Cryogenic Trunnion Ball Valve	DWG Code	LT 106 - KGG	Drawing N°	STAR-0012-CRY
Port Design	Full Port	DN	40	PN	420 CLASS 2500	Serial N°	BF 5362

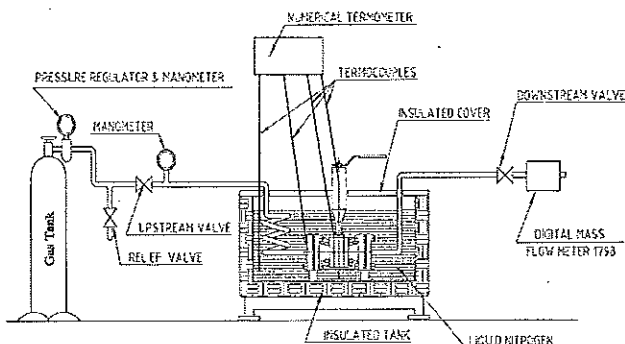
2. BREAK AWAY TORQUE AT AMBIENT TEMPERATURE

Pressure	0 Bar	6 Bar	20 Bar	50 Bar	100 Bar	150 Bar	250 Bar	420 Bar
Torque	24 Nm	24 Nm	33 Nm	45 Nm	80 Nm	100 Nm	140 Nm	180 Nm

3. LEAKAGE TEST (before cryogenic test) ACCORDING TO : API 598, BS 6755 Part.1, API 6D, ISO 5208

Test carry out on	STARLINE S.p.A. - San Paolo D'Argon (Bergamo) Italy
3.1 Inspection Certificate N°	
Result	Satisfactory

4 CRYOGENIC TEST



TIGHTEN BODY BOLTS 190 Nm

4.1 Initial System proving test (Room Temperature ; Test fluid: Helium gas)

Test pressure	External Leakage Valve in half-open position	Seat Leakage Valve in closed position	
		Side A	Side B
455 Bar	0	0	0
Result		Satisfactory	

4.2 Cooling Operation

Time	Thermocouple 1	Thermocouple 2	Thermocouple 3	Thermocouple 4
0 minutes	-196 °C	-196 °C	-196 °C	-162 °C
15 minutes	-196 °C	-196 °C	-196 °C	-162 °C
30 minutes	-196 °C	-196 °C	-196 °C	-162 °C
45 minutes	-196 °C	-196 °C	-196 °C	-162 °C
60 minutes	-196 °C	-196 °C	-196 °C	-162 °C

4.3 System proving Test (-196°C; Test fluid: Helium gas)

Test pressure	External Leakage
455 Bar	0
Result	
Satisfactory	

4.4 Break Away Torque (Open and close valve tested 20 times)

N° of cycle	Open Force (Nm)	Close Force (Nm)
1	85	85
20	60	60

4.5 Seat Leakage Test (-196°C; Test fluid: Helium gas)

Test pressure	Maximum Permissible Leakage mm ³ /s	SIDE A Recorded mm ³ /s		SIDE B Recorded mm ³ /s	
		30 Bar	4000 mm ³ /s	1593,6	1510,6
60 Bar	4000 mm ³ /s	1298,1	1213,5	1213,5	1213,5
90 Bar	4000 mm ³ /s	1198,5	1117,2	1117,2	1117,2
120 Bar	4000 mm ³ /s	1102,2	891,4	891,4	891,4
150 Bar	4000 mm ³ /s	936,2	785,2	785,2	785,2
180 Bar	4000 mm ³ /s	710,5	688,9	688,9	688,9
210 Bar	4000 mm ³ /s	610,9	539,5	539,5	539,5
240 Bar	4000 mm ³ /s	541,2	449,9	449,9	449,9
270 Bar	4000 mm ³ /s	438,2	260,6	260,6	260,6
300 Bar	4000 mm ³ /s	205,8	151,1	151,1	151,1
330 Bar	4000 mm ³ /s	139,4	131,1	131,1	131,1
360 Bar	4000 mm ³ /s	109,6	84,7	84,7	84,7
390 Bar	4000 mm ³ /s	39,8	58,1	58,1	58,1
420 Bar	4000 mm ³ /s	19,9	21,6	21,6	21,6
455 Bar	4000 mm ³ /s	13,3	8,3	8,3	8,3
Result		Satisfactory			

4.5 Shell Leakage Test (-196°C; Test fluid: Helium gas)

Test Pressure	Test Duration	Max Permissible Leakage	Recorded
455 Bar	15	0	0
Result		Satisfactory	

5 Seat Leakage Test (Room Temperature ; Test fluid: Helium gas)

Test pressure	Maximum Permissible Leakage mm ³ /s	SIDE A Recorded mm ³ /s		SIDE B Recorded mm ³ /s	
		30 Bar	0 mm ³ /s	0 mm ³ /s	0 mm ³ /s
60 Bar	0 mm ³ /s	0 mm ³ /s	0 mm ³ /s	0 mm ³ /s	
90 Bar	0 mm ³ /s	0 mm ³ /s	0 mm ³ /s	0 mm ³ /s	
120 Bar	0 mm ³ /s	0 mm ³ /s	0 mm ³ /s	0 mm ³ /s	
150 Bar	0 mm ³ /s	0 mm ³ /s	0 mm ³ /s	0 mm ³ /s	
180 Bar	0 mm ³ /s	0 mm ³ /s	0 mm ³ /s	0 mm ³ /s	
210 Bar	0 mm ³ /s	0 mm ³ /s	0 mm ³ /s	0 mm ³ /s	
240 Bar	0 mm ³ /s	0 mm ³ /s	0 mm ³ /s	0 mm ³ /s	
270 Bar	0 mm ³ /s	0 mm ³ /s	0 mm ³ /s	0 mm ³ /s	
300 Bar	0 mm ³ /s	0 mm ³ /s	0 mm ³ /s	0 mm ³ /s	
330 Bar	0 mm ³ /s	0 mm ³ /s	0 mm ³ /s	0 mm ³ /s	
360 Bar	0 mm ³ /s	0 mm ³ /s	0 mm ³ /s	0 mm ³ /s	
390 Bar	0 mm ³ /s	0 mm ³ /s	0 mm ³ /s	0 mm ³ /s	
420 Bar	0 mm ³ /s	0 mm ³ /s	0 mm ³ /s	0 mm ³ /s	
455 Bar	0 mm ³ /s	0 mm ³ /s	0 mm ³ /s	0 mm ³ /s	
Result		Satisfactory			

4.5 Shell Leakage Test (Room Temperature ; Test fluid: Helium gas)

Test Pressure	Test Duration	Max Permissible Leakage	Recorded
455 Bar	15	0	0
Result		Satisfactory	

4.6 Break Away Torque (Open and close valve tested at room temperature)

Open Force (Nm)	40	Close Force (Nm)	40	Result	Satisfactory
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7. DISMANTLING (check for case of dismantling and examine components for wear or damage)

Result	Satisfactory
Remarks	All components are in perfect condition

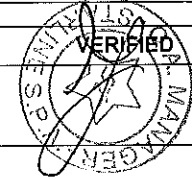
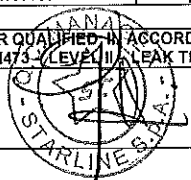
8 CONCLUSION

The valve are suitable for cryogenic service

9. INDEX OF ATTACHED DOCUMENTS

Drawing n°	STAR-0012-CRY
Inspection Certificate n°	C174_2007
Material Certificarte n°	C174_2007

OPERATOR QUALIFIED IN ACCORDING TO UNI EN473 - LEVEL II LEAK TEST



Lloyd's Register WITNESS
 Milan Office
 Witnessed
 Monitored
 Reviewed
 G. Fioretto Surveyor

DATE
 29-06-2007

CRYOGENIC TEST -196°C
FOR BALL VALVES
 (According to BS 6364)

Starline certificate for cryogenic test at -196 °C with Liquid Nitrogen and Helium Gas for pressure test.
 The test is in accordance to BS6364 and Starline procedure n° STAR 089

1. DESCRIPTION OF BALL VALVE

Manufacturer	STARLINE S.p.A.	Valve Type	Cryogenic Trunnion Ball Valve	DWG Code	LT 106 - KGG	Drawing N°	STAR-0013-CRY
Port Design	Full Port	DN	50	PN	420 CLASS 2500	Serial N°	BF 5363

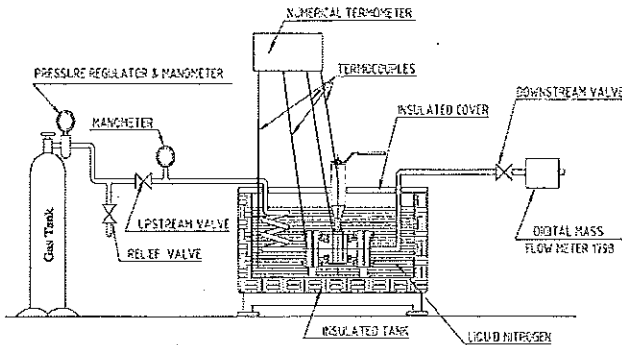
2. BREAK AWAY TORQUE AT AMBIENT TEMPERATURE

Pressure	0 Bar	6 Bar	20 Bar	50 Bar	100 Bar	150 Bar	250 Bar	420 Bar
Torque	24 Nm	24 Nm	38 Nm	60 Nm	90 Nm	120 Nm	200 Nm	240 Nm

3. LEAKAGE TEST (before cryogenic test) ACCORDING TO : API 598, BS 6755 Part.1, API 6D, ISO 5208

Test carry out on	STARLINE S.p.A. - San Paolo D'Argon (Bergamo) Italy
3.1 Inspection Certificate N°	
Result	Satisfactory

4 CRYOGENIC TEST



TIGHTEN BODY BOLTS 300 Nm

4.1 Initial System proving test (Room Temperature ; Test fluid: Helium gas)

Test pressure	External Leakage Valve in half-open position	Seat Leakage Valve in closed position	
		Side A	Side B
455 Bar	0	0	0
Result		Satisfactory	

4.2 Cooling Operation

Time	Thermocouple 1	Thermocouple 2	Thermocouple 3	Thermocouple 4
0 minutes	-196 °C	-196 °C	-196 °C	-158 °C
15 minutes	-196 °C	-196 °C	-196 °C	-158 °C
30 minutes	-196 °C	-196 °C	-196 °C	-158 °C
45 minutes	-196 °C	-196 °C	-196 °C	-158 °C
60 minutes	-196 °C	-196 °C	-196 °C	-158 °C

4.3 System proving Test (-196°C; Test fluid: Helium gas)

Test pressure	External Leakage
455 Bar	0
Result	
Satisfactory	

4.4 Break Away Torque (Open and close valve tested 20 times)

N° of cycle	Open Force (Nm)	Close Force (Nm)
1	120	120
20	114	114

4.5 Seat Leakage Test (-196°C; Test fluid: Helium gas)

Test pressure	Maximim Permissible Leakage mm³/s	SIDE A Recorded mm³/s		SIDE B Recorded mm³/s	
		Recorded mm³/s	Recorded mm³/s	Recorded mm³/s	Recorded mm³/s
30 Bar	5000 mm³/s	1762,9	1748,0	1748,0	1748,0
60 Bar	5000 mm³/s	1533,8	1512,3	1512,3	1512,3
90 Bar	5000 mm³/s	1367,8	1389,4	1389,4	1389,4
120 Bar	5000 mm³/s	1238,4	1193,5	1193,5	1193,5
150 Bar	5000 mm³/s	1132,1	1057,4	1057,4	1057,4
180 Bar	5000 mm³/s	906,4	914,7	914,7	914,7
210 Bar	5000 mm³/s	800,1	722,1	722,1	722,1
240 Bar	5000 mm³/s	537,8	622,5	622,5	622,5
270 Bar	5000 mm³/s	468,1	493,0	493,0	493,0
300 Bar	5000 mm³/s	305,4	353,6	353,6	353,6
330 Bar	5000 mm³/s	242,4	260,6	260,6	260,6
360 Bar	5000 mm³/s	205,8	161,0	161,0	161,0
390 Bar	5000 mm³/s	142,8	88,0	88,0	88,0
420 Bar	5000 mm³/s	69,7	51,5	51,5	51,5
455 Bar	5000 mm³/s	26,6	28,2	28,2	28,2
Result		Satisfactory			

4.5 Shell Leakage Test (-196°C; Test fluid: Helium gas)

Test Pressure	Test Duration	Max Permissible Leakage	Recorded
455 Bar	15	0	0
Result		Satisfactory	

5 Seat Leakage Test (Room Temperature ; Test fluid: Helium gas)

Test pressure	Maximim Permissible Leakage mm³/s	SIDE A Recorded mm³/s		SIDE B Recorded mm³/s	
		Recorded mm³/s	Recorded mm³/s	Recorded mm³/s	Recorded mm³/s
30 Bar	0 mm³/s	0	0	0	0
60 Bar	0 mm³/s	0	0	0	0
90 Bar	0 mm³/s	0	0	0	0
120 Bar	0 mm³/s	0	0	0	0
150 Bar	0 mm³/s	0	0	0	0
180 Bar	0 mm³/s	0	0	0	0
210 Bar	0 mm³/s	0	0	0	0
240 Bar	0 mm³/s	0	0	0	0
270 Bar	0 mm³/s	0	0	0	0
300 Bar	0 mm³/s	0	0	0	0
330 Bar	0 mm³/s	0	0	0	0
360 Bar	0 mm³/s	0	0	0	0
390 Bar	0 mm³/s	0	0	0	0
420 Bar	0 mm³/s	0	0	0	0
455 Bar	0 mm³/s	0	0	0	0
Result		Satisfactory			

4.5 Shell Leakage Test (Room Temperature ; Test fluid: Helium gas)

Test Pressure	Test Duration	Max Permissible Leakage	Recorded
455 Bar	15	0	0
Result		Satisfactory	

4.6 Break Away Torque (Open and close valve tested at room temperature)

Open Force (Nm)	42	Close Force (Nm)	42	Result	Satisfactory
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7. DISMANTLING (check for case of dismantling and examine components for wear or damage)

Result	Satisfactory
Remarks	All components are in perfect condition

8 CONCLUSION

The valve are suitable for cryogenic service

9. INDEX OF ATTACHED DOCUMENTS

Drawing n°	STAR-0013-CRY
Inspection Certificate n°	C174_2007
Material Certificarte n°	C174_2007

OPERATOR QUALIFIED ACCORDING TO UNI EN473 (LEVEL 1) LEAK TEST



Lloyd's Register **WITNESS**
 Milan Office
 Witnessed
 Monitored
 Reviewed
 G. Fioriello Surveyor

DATE
 02-07-2007

CRYOGENIC TEST -196°C
FOR BALL VALVES
 (According to BS 6364)

Starline certificate for cryogenic test at -196 °C with Liquid Nitrogen and Helium Gas for pressure test.
 The test is in accordance to BS6364 and Starline procedure n° STAR 089

1. DESCRIPTION OF BALL VALVE

Manufacturer	STARLINE S.p.A.	Valve Type	Cryogenic Trunnion Ball Valve	DWG Code	LT 106 - KGG	Drawing N°	STAR-0014-CRY
Port Design	Full Port	DN	80	PN	420 CLASS 2500	Serial N°	BF 5364

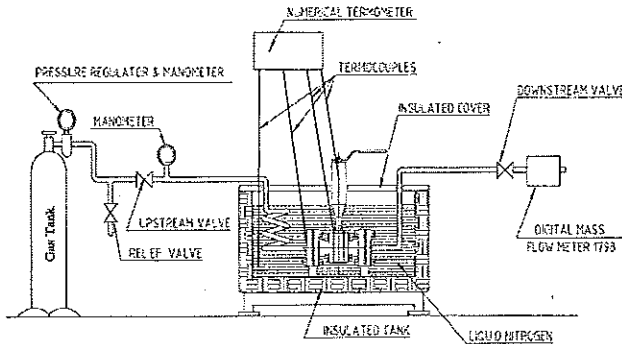
2. BREAK AWAY TORQUE AT AMBIENT TEMPERATURE

Pressure	0 Bar	6 Bar	20 Bar	50 Bar	100 Bar	150 Bar	250 Bar	420 Bar
Torque	42 Nm	42 Nm	68 Nm	90 Nm	170 Nm	260 Nm	360 Nm	420 Nm

3. LEAKAGE TEST (before cryogenic test) ACCORDING TO : API 598, BS 6755 Part.1, API 6D, ISO 5208

Test carry out on	STARLINE S.p.A. - San Paolo D'Argon (Bergamo) Italy
3.1 Inspection Certificate N°	
Result	Satisfactory

4 CRYOGENIC TEST



TIGHTEN BODY BOLTS 630 Nm

4.1 Initial System proving test (Room Temperature ; Test fluid: Helium gas)

Test pressure	External Leakage Valve in half-open position	Seat Leakage Valve in closed position	
		Side A	Side B
455 Bar	0	0	0
Result		Satisfactory	

4.2 Cooling Operation

Time	Thermocouple 1	Thermocouple 2	Thermocouple 3	Thermocouple 4
0 minutes	-196 °C	-196 °C	-196 °C	-146 °C
15 minutes	-196 °C	-196 °C	-196 °C	-146 °C
30 minutes	-196 °C	-196 °C	-196 °C	-147 °C
45 minutes	-196 °C	-196 °C	-196 °C	-147 °C
60 minutes	-196 °C	-196 °C	-196 °C	-148 °C

4.3 System proving Test (-196°C; Test fluid: Helium gas)

Test pressure	External Leakage
455 Bar	0
Result	
Satisfactory	

4.4 Break away Torque (Open and close valve tested 20 times)

N° of cycle	Open Force (Nm)	Close Force (Nm)
1	160	160
20	142	142

4.5 Seat Leakage Test (-196°C; Test fluid: Helium gas)

Test pressure	Maximim Permissible Leakage mm ³ /s	SIDE A		SIDE B	
		Recorded mm ³ /s	Recorded mm ³ /s	Recorded mm ³ /s	Recorded mm ³ /s
30 Bar	8000 mm ³ /s	1859,2	1842,6	1842,6	1842,6
60 Bar	8000 mm ³ /s	1762,9	1784,5	1784,5	1784,5
90 Bar	8000 mm ³ /s	1527,2	1721,4	1721,4	1721,4
120 Bar	8000 mm ³ /s	1434,2	1522,2	1522,2	1522,2
150 Bar	8000 mm ³ /s	1367,8	1416,0	1416,0	1416,0
180 Bar	8000 mm ³ /s	1308,1	1319,7	1319,7	1319,7
210 Bar	8000 mm ³ /s	1165,3	1047,5	1047,5	1047,5
240 Bar	8000 mm ³ /s	1072,4	947,9	947,9	947,9
270 Bar	8000 mm ³ /s	966,1	755,3	755,3	755,3
300 Bar	8000 mm ³ /s	766,9	649,1	649,1	649,1
330 Bar	8000 mm ³ /s	577,7	356,9	356,9	356,9
360 Bar	8000 mm ³ /s	401,7	227,4	227,4	227,4
390 Bar	8000 mm ³ /s	205,8	124,5	124,5	124,5
420 Bar	8000 mm ³ /s	106,2	51,5	51,5	51,5
455 Bar	8000 mm ³ /s	29,9	21,6	21,6	21,6
Result		Satisfactory			

4.5 Shell Leakage Test (-196°C; Test fluid: Helium gas)

Test Pressure	Test Duration	Max Permissible Leakage	Recorded
455 Bar	15	0	0
Result		Satisfactory	

5 Seat Leakage Test (Room Temperature ; Test fluid: Helium gas)

Test pressure	Maximim Permissible Leakage mm ³ /s	SIDE A		SIDE B	
		Recorded mm ³ /s	Recorded mm ³ /s	Recorded mm ³ /s	Recorded mm ³ /s
30 Bar	0 mm ³ /s	0	0	0	0
60 Bar	0 mm ³ /s	0	0	0	0
90 Bar	0 mm ³ /s	0	0	0	0
120 Bar	0 mm ³ /s	0	0	0	0
150 Bar	0 mm ³ /s	0	0	0	0
180 Bar	0 mm ³ /s	0	0	0	0
210 Bar	0 mm ³ /s	0	0	0	0
240 Bar	0 mm ³ /s	0	0	0	0
270 Bar	0 mm ³ /s	0	0	0	0
300 Bar	0 mm ³ /s	0	0	0	0
330 Bar	0 mm ³ /s	0	0	0	0
360 Bar	0 mm ³ /s	0	0	0	0
390 Bar	0 mm ³ /s	0	0	0	0
420 Bar	0 mm ³ /s	0	0	0	0
455 Bar	0 mm ³ /s	0	0	0	0
Result		Satisfactory			

4.5 Shell Leakage Test (Room Temperature ; Test fluid: Helium gas)

Test Pressure	Test Duration	Max Permissible Leakage	Recorded
455 Bar	15	0	0
Result		Satisfactory	

4.6 Break Away Torque (Open and close valve tested at room temperature)

Open Force (Nm)	56	Close Force (Nm)	56	Result	Satisfactory
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7. DISMANTLING (check for case of dismantling and examine components for wear or damage)

Result	Satisfactory
Remarks	All components are in perfect condition

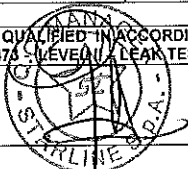
8 CONCLUSION

The valve are suitable for cryogenic service

9. INDEX OF ATTACHED DOCUMENTS

Drawing n°	STAR-0014-CRY
Inspection Certificate n°	C174_2007
Material Certificarte n°	C174_2007

OPERATOR QUALIFIED IN ACCORDING TO UNI EN473 LEVEL 1 LEAK TEST



WITNESS
 Lloyd's Register EMEA
 Milan Office
 Witnessed
 Monitored
 Reviewed
 G. Fioriello Surveyor

DATE
 03-07-2007

Starline certificate for cryogenic test at -196 °C with Liquid Nitrogen and Helium Gas for pressure test.
 The test is in accordance to BS6364 and Starline procedure n° STAR 089

1. DESCRIPTION OF BALL VALVE

Manufacturer	STARLINE S.p.A.	Valve Type	Cryogenic Trunnion Ball Valve	DWG Code	LT 106 - KGG	Drawing N°	STAR-0015-CRY
Port Design	Full Port	DN	100	PN	420 CLASS 2500	Serial N°	BF 5365

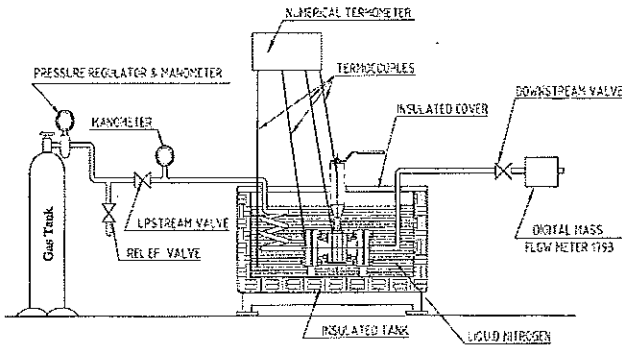
2. BREAK AWAY TORQUE AT AMBIENT TEMPERATURE

Pressure	0 Bar	6 Bar	20 Bar	50 Bar	100 Bar	150 Bar	250 Bar	420 Bar
Torque	100 Nm	100 Nm	145 Nm	210 Nm	350 Nm	590 Nm	900 Nm	1400 Nm

3. LEAKAGE TEST (before cryogenic test) ACCORDING TO : API 598, BS 6755 Part.1, API 6D, ISO 5208

Test carry out on	STARLINE S.p.A. - San Paolo D'Argon (Bergamo) Italy
3.1 Inspection Certificate N°	
Result	Satisfactory

4 CRYOGENIC TEST



TIGHTEN BODY BOLTS 1550 Nm

4.1 Initial System proving test (Room Temperature ; Test fluid: Helium gas)

Test pressure	External Leakage Valve in half-open position	Seat Leakage Valve in closed position	
		Side A	Side B
455 Bar	0	0	0
Result		Satisfactory	

4.2 Cooling Operation

Time	Thermocouple 1	Thermocouple 2	Thermocouple 3	Thermocouple 4
0 minutes	-196 °C	-196 °C	-196 °C	-141 °C
15 minutes	-196 °C	-196 °C	-196 °C	-142 °C
30 minutes	-196 °C	-196 °C	-196 °C	-142 °C
45 minutes	-196 °C	-196 °C	-196 °C	-142 °C
60 minutes	-196 °C	-196 °C	-196 °C	-143 °C

4.3 System proving Test (-196°C; Test fluid: Helium gas)

Test pressure	External Leakage
455 Bar	0
Result	
Satisfactory	

4.4 Break Away Torque (Open and close valve tested 20 times)

N° of cycle	Open Force (Nm)	Close Force (Nm)
1	230	230
20	182	182

4.5 Seat Leakage Test (-196°C; Test fluid: Helium gas)

Test pressure	Maximum Permissible Leakage mm ³ /s	SIDE A		SIDE B	
		Recorded mm ³ /s	Recorded mm ³ /s	Recorded mm ³ /s	Recorded mm ³ /s
30 Bar	10000 mm ³ /s	2008,6	mm ³ /s	1958,8	mm ³ /s
60 Bar	10000 mm ³ /s	1792,8	mm ³ /s	1875,8	mm ³ /s
90 Bar	10000 mm ³ /s	1626,8	mm ³ /s	1743,0	mm ³ /s
120 Bar	10000 mm ³ /s	1361,2	mm ³ /s	1510,6	mm ³ /s
150 Bar	10000 mm ³ /s	1228,4	mm ³ /s	1377,8	mm ³ /s
180 Bar	10000 mm ³ /s	962,8	mm ³ /s	1145,4	mm ³ /s
210 Bar	10000 mm ³ /s	763,6	mm ³ /s	1012,6	mm ³ /s
240 Bar	10000 mm ³ /s	614,2	mm ³ /s	747,0	mm ³ /s
270 Bar	10000 mm ³ /s	365,2	mm ³ /s	614,2	mm ³ /s
300 Bar	10000 mm ³ /s	232,4	mm ³ /s	348,6	mm ³ /s
330 Bar	10000 mm ³ /s	99,6	mm ³ /s	249,0	mm ³ /s
360 Bar	10000 mm ³ /s	64,6	mm ³ /s	182,6	mm ³ /s
390 Bar	10000 mm ³ /s	33,2	mm ³ /s	116,2	mm ³ /s
420 Bar	10000 mm ³ /s	28,4	mm ³ /s	49,8	mm ³ /s
455 Bar	10000 mm ³ /s	23,2	mm ³ /s	19,92	mm ³ /s
Result		Satisfactory			

4.5 Shell Leakage Test (-196°C; Test fluid: Helium gas)

Test Pressure	Test Duration	Max Permissible Leakage	Recorded
455 Bar	15	0	0
Result		Satisfactory	

5 Seat Leakage Test (Room Temperature ; Test fluid: Helium gas)

Test pressure	Maximum Permissible Leakage mm ³ /s	SIDE A		SIDE B	
		Recorded mm ³ /s	Recorded mm ³ /s	Recorded mm ³ /s	Recorded mm ³ /s
30 Bar	0 mm ³ /s	0 mm ³ /s	0 mm ³ /s	0 mm ³ /s	0 mm ³ /s
60 Bar	0 mm ³ /s	0 mm ³ /s	0 mm ³ /s	0 mm ³ /s	0 mm ³ /s
90 Bar	0 mm ³ /s	0 mm ³ /s	0 mm ³ /s	0 mm ³ /s	0 mm ³ /s
120 Bar	0 mm ³ /s	0 mm ³ /s	0 mm ³ /s	0 mm ³ /s	0 mm ³ /s
150 Bar	0 mm ³ /s	0 mm ³ /s	0 mm ³ /s	0 mm ³ /s	0 mm ³ /s
180 Bar	0 mm ³ /s	0 mm ³ /s	0 mm ³ /s	0 mm ³ /s	0 mm ³ /s
210 Bar	0 mm ³ /s	0 mm ³ /s	0 mm ³ /s	0 mm ³ /s	0 mm ³ /s
240 Bar	0 mm ³ /s	0 mm ³ /s	0 mm ³ /s	0 mm ³ /s	0 mm ³ /s
270 Bar	0 mm ³ /s	0 mm ³ /s	0 mm ³ /s	0 mm ³ /s	0 mm ³ /s
300 Bar	0 mm ³ /s	0 mm ³ /s	0 mm ³ /s	0 mm ³ /s	0 mm ³ /s
330 Bar	0 mm ³ /s	0 mm ³ /s	0 mm ³ /s	0 mm ³ /s	0 mm ³ /s
360 Bar	0 mm ³ /s	0 mm ³ /s	0 mm ³ /s	0 mm ³ /s	0 mm ³ /s
390 Bar	0 mm ³ /s	0 mm ³ /s	0 mm ³ /s	0 mm ³ /s	0 mm ³ /s
420 Bar	0 mm ³ /s	0 mm ³ /s	0 mm ³ /s	0 mm ³ /s	0 mm ³ /s
455 Bar	0 mm ³ /s	0 mm ³ /s	0 mm ³ /s	0 mm ³ /s	0 mm ³ /s
Result		Satisfactory			

4.5 Shell Leakage Test (Room Temperature ; Test fluid: Helium gas)

Test Pressure	Test Duration	Max Permissible Leakage	Recorded
455 Bar	15	0	0
Result		Satisfactory	

4.6 Break Away Torque (Open and close valve tested at room temperature)

Open Force (Nm)	124	Close Force (Nm)	124	Result	Satisfactory
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7. DISMANTLING (check for case of dismantling and examine components for wear or damage)

Result	Satisfactory
Remarks	All components are in perfect condition

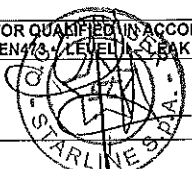
8 CONCLUSION

The valve are suitable for cryogenic service

9. INDEX OF ATTACHED DOCUMENTS

Drawing n°	STAR-0015-CRY
Inspection Certificate n°	C174_2007
Material Certificate n°	C174_2007

OPERATOR QUALIFIED IN ACCORDING TO UNI EN 413 - LEVEL 1 - LEAK TEST



Lloyd's Register **WITNESS**
 Milan Office
 Witnessed
 Monitored
 Reviewed
 G. Floriello Surveyor

DATE
 04-07-2007

Starline certificate for cryogenic test at -196 °C with Liquid Nitrogen and Helium Gas for pressure test.
 The test is in accordance to BS6364 and Starline procedure n° STAR 089

1. DESCRIPTION OF BALL VALVE

Manufacturer	STARLINE S.p.A.	Valve Type	Cryogenic Trunnion Ball Valve	DWG Code	LT 106 - KGG	Drawing N°	STAR-0016-CRY
Port Design	Full Port	DN	150	PN	420 CLASS 2500	Serial N°	BF 5366

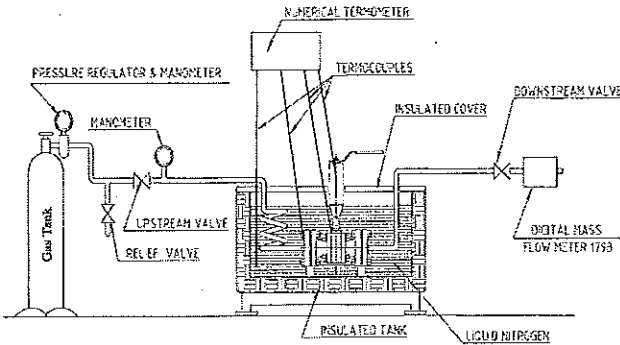
2. BREAK AWAY TORQUE AT AMBIENT TEMPERATURE

Pressure	0 Bar	6 Bar	20 Bar	50 Bar	100 Bar	150 Bar	250 Bar	420 Bar
Torque	210 Nm	210 Nm	365 Nm	420 Nm	760 Nm	1000 Nm	1600 Nm	3800 Nm

3. LEAKAGE TEST (before cryogenic test) ACCORDING TO : API 598, BS 6755 Part.1, API 6D, ISO 5208

Test carry out on	STARLINE S.p.A. - San Paolo D'Argon (Bergamo) Italy
3.1 Inspection Certificate N°	
Result	Satisfactory

4 CRYOGENIC TEST



TIGHTEN BODY BOLTS 6550 Nm

4.1 Initial System proving test (Room Temperature ; Test fluid: Helium gas)

Test pressure	External Leakage Valve in half-open position	Seat Leakage Valve in closed position	
455 Bar	0	Side A	Side B
Result	Satisfactory		

4.2 Cooling Operation

Time	Thermocouple 1	Thermocouple 2	Thermocouple 3	Thermocouple 4
0 minutes	-196 °C	-196 °C	-196 °C	-138 °C
15 minutes	-196 °C	-196 °C	-196 °C	-138 °C
30 minutes	-196 °C	-196 °C	-196 °C	-138 °C
45 minutes	-196 °C	-196 °C	-196 °C	-139 °C
60 minutes	-196 °C	-196 °C	-196 °C	-139 °C

4.3 System proving Test (-196°C; Test fluid: Helium gas)

Test pressure	External Leakage
455 Bar	0
Result	Satisfactory

4.4 Break Away Torque (Open and close valve tested 20 times)

N° of cycle	Open Force (Nm)	Close Force (Nm)
1	310	310
20	290	290

4.5 Seat Leakage Test (-196°C; Test fluid: Helium gas)

Test pressure	Maximum Permissible Leakage mm³/s	SIDE A		SIDE B	
		Recorded mm³/s	Recorded mm³/s	Recorded mm³/s	Recorded mm³/s
30 Bar	15000 mm³/s	4316,0	4234,7	4234,7	4234,7
60 Bar	15000 mm³/s	4083,6	3907,6	3907,6	3907,6
90 Bar	15000 mm³/s	3950,8	3701,8	3701,8	3701,8
120 Bar	15000 mm³/s	3685,2	3574,0	3574,0	3574,0
150 Bar	15000 mm³/s	3353,2	3203,8	3203,8	3203,8
180 Bar	15000 mm³/s	3087,6	2905,0	2905,0	2905,0
210 Bar	15000 mm³/s	2456,8	2241,0	2241,0	2241,0
240 Bar	15000 mm³/s	2257,6	1510,6	1510,6	1510,6
270 Bar	15000 mm³/s	1925,6	1278,2	1278,2	1278,2
300 Bar	15000 mm³/s	1361,2	622,5	622,5	622,5
330 Bar	15000 mm³/s	564,4	383,5	383,5	383,5
360 Bar	15000 mm³/s	265,6	257,3	257,3	257,3
390 Bar	15000 mm³/s	132,8	117,9	117,9	117,9
420 Bar	15000 mm³/s	66,4	51,5	51,5	51,5
455 Bar	15000 mm³/s	36,5	28,2	28,2	28,2
Result	Satisfactory				

4.5 Shell Leakage Test (-196°C; Test fluid: Helium gas)

Test Pressure	Test Duration	Max Permissible Leakage	Recorded
455 Bar	15	0	0
Result	Satisfactory		

5 Seat Leakage Test (Room Temperature ; Test fluid: Helium gas)

Test pressure	Maximum Permissible Leakage mm³/s	SIDE A		SIDE B	
		Recorded mm³/s	Recorded mm³/s	Recorded mm³/s	Recorded mm³/s
30 Bar	0 mm³/s	0	0	0	0
60 Bar	0 mm³/s	0	0	0	0
90 Bar	0 mm³/s	0	0	0	0
120 Bar	0 mm³/s	0	0	0	0
150 Bar	0 mm³/s	0	0	0	0
180 Bar	0 mm³/s	0	0	0	0
210 Bar	0 mm³/s	0	0	0	0
240 Bar	0 mm³/s	0	0	0	0
270 Bar	0 mm³/s	0	0	0	0
300 Bar	0 mm³/s	0	0	0	0
330 Bar	0 mm³/s	0	0	0	0
360 Bar	0 mm³/s	0	0	0	0
390 Bar	0 mm³/s	0	0	0	0
420 Bar	0 mm³/s	0	0	0	0
455 Bar	0 mm³/s	0	0	0	0
Result	Satisfactory				

4.5 Shell Leakage Test (Room Temperature ; Test fluid: Helium gas)

Test Pressure	Test Duration	Max Permissible Leakage	Recorded
455 Bar	15	0	0
Result	Satisfactory		

4.6 Break Away Torque (Open and close valve tested at room temperature)

Open Force (Nm)	245	Close Force (Nm)	245	Result	Satisfactory
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7. DISMANTLING (check for case of dismantling and examine components for wear or damage)

Result	Satisfactory
Remarks	All components are in perfect condition

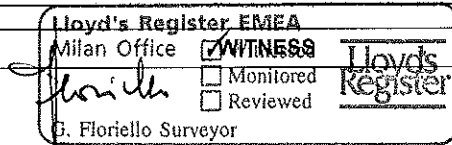
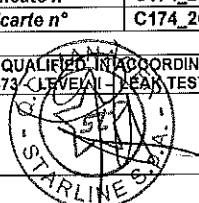
8 CONCLUSION

The valve are suitable for cryogenic service

9. INDEX OF ATTACHED DOCUMENTS

Drawing n°	STAR-0016-CRY
Inspection Certificate n°	C174_2007
Material Certificarte n°	C174_2007

OPERATOR QUALIFIED IN ACCORDING TO UNI EN473 LEVEL 1 LEAK TEST



DATE
05-07-2007

BALL VALVE TESTED : "FLOATING CRYO STAR" No. 5

Material : F316 / F316 Size : 1/2" Class : 1500 Lbs Our Fig.n° : 156-KGG

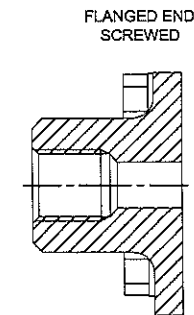
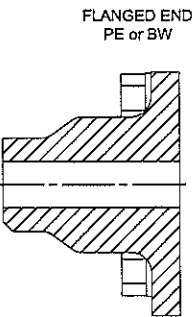
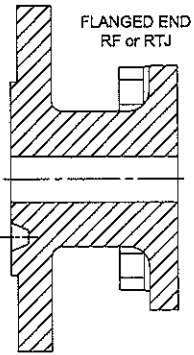
VALVE CONSTRUCTION

Forged Steel Ball Valves Two Pieces Bolted Construction (Type "CRYO STAR" No. 5)
 Floating Ball, Anti - Blow - Out Proof Stem Design, Antistatic Design.
 Designed in Conformity to Last Edition of :
 - BS 5351 (EN-ISO-17292) - ASME / ANSI B16.34 - API 6D -

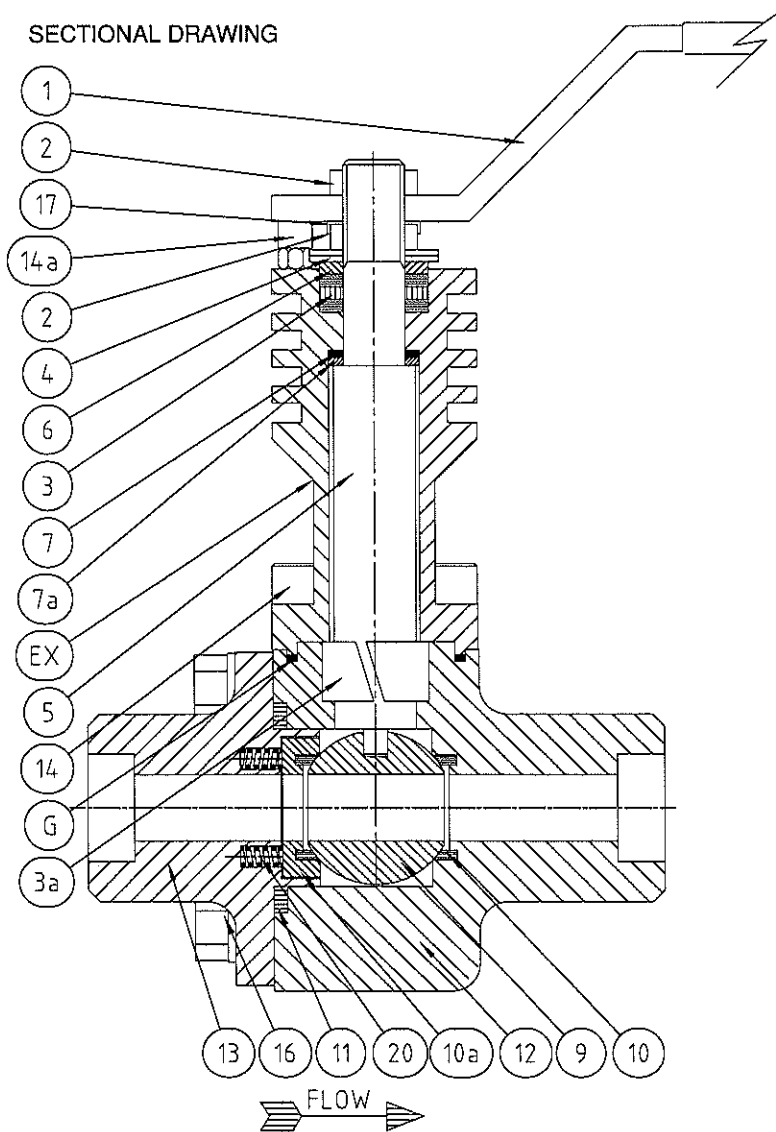
CRYOGENIC TEST CERTIFICATE n° : CRY-0001-LT

Date : 14/06/07

Issued in : S. PAOLO D'ARGON - BG - ITALY



SECTIONAL DRAWING



UNIDIRECTIONAL BALL VALVE FOR CRYOGENIC SERVICE

PART No.	UNIT Q.ty	PART NAME	MATERIAL
NP	1	Name Plated	Stainless Steel
x 6	1	Extention Gasket	Graphite
EX	1	Extention	S.S. 316
1	1	Handle	Stainless Steel + Plastic
2	2	Handle Nut	Stainless Steel
x 3	3	Packing Ring	Graphite
x 3a	1	Sliper	PTFE + 25% C. Graphite
4	2	Spring Washer	Stainless Steel Treated
5	1	Stem	S.S. 316
6	1	Gland Packing	S.S. 316
x 7	1	Thrust Washer	PTFE + 25% C. Graphite
7a	1	Thrust Washer Ring	Stainless Steel
9	1	Ball	S.S. 316
x 10	2	Seat	Kel'f
10a	1	Seat Ring	S.S. 316
x 11	2	Body Gasket	Graphite
12	1	Body	S.S. 316
13	2	End Connection	S.S. 316
14	4	Extention Screw	Stainless Steel
14a	1	Stop Pin	Stainless Steel
16	6	Bolts	ASTM A193 B8
17	1	Stop Washer	Stainless Steel
20	6	Seat Spring	Inconel x 750

* Suggested Material After Two Years

Lloyd's Register EMEA
 Milan Office
 G. Floricello Surveyor

Witnessed
 Monitored
 Reviewed

Lloyd's Register

0	14-06-07	First Issue			
Rev.	Date	Reason for revision	Made By	Chk'd By	Appr. By

Ball Valves Type : CRYOSTAR (N°4) FLOATING VALVE
 Port Design : FULL BORE
 Class of Valve : 1500 Lbs
 End Connections : SOCKET WELD

STAR LINE  Startline Fig. n°: 156-KGG
 S. PAOLO D'ARGON BERGAMO ITALY Drawing n°: STAR-0001-CRY

BALL VALVE TESTED : "FLOATING CRYO STAR" No. 5

Material : F316 / F316 Size : 3/4" Class : 1500 Lbs Our Fig.n° : 156-KGG

VALVE CONSTRUCTION

Forged Steel Ball Valves Two Pieces Bolted Construction (Type "CRYO STAR" No. 5)
Floating Ball, Anti - Blow - Out Proof Stem Design, Antistatic Design.

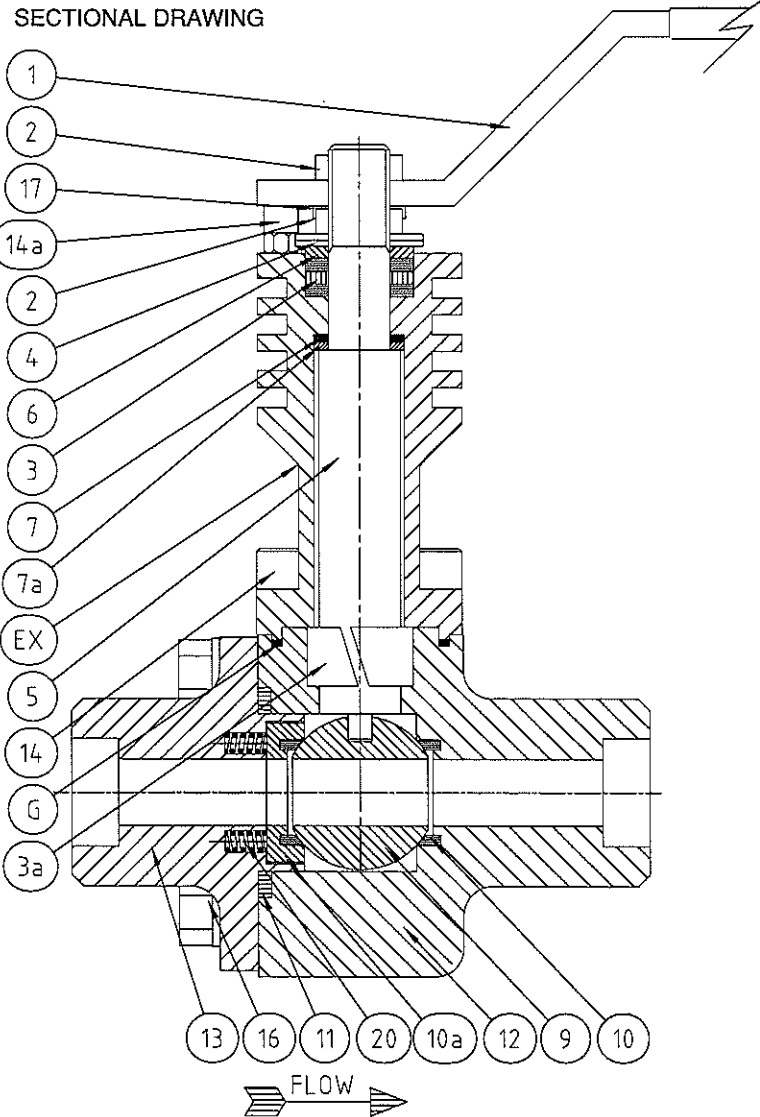
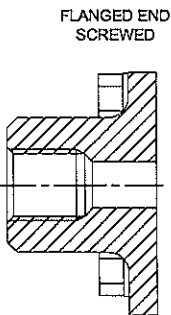
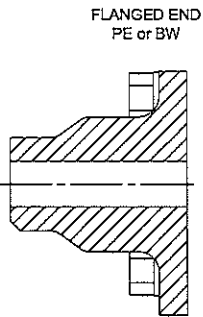
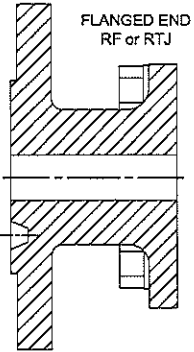
Designed in Conformity to Last Edition of :

- BS 5351 (EN-ISO-17292) - ASME / ANSI B16.34 - API 6D -

CRYOGENIC TEST CERTIFICATE n° : CRY-0002-LT

Date : 15/06/07

Issued in : S. PAOLO D'ARGON - BG - ITALY



UNIDIRECTIONAL BALL VALVE FOR CRYOGENIC SERVICE

PART No.	UNIT Qty	PART NAME	MATERIAL
NP	1	Name Plated	Stainless Steel
x G	1	Extention Gasket	Graphite
EX	1	Extention	S.S. 316
1	1	Handle	Stainless Steel + Plastic
2	2	Handle Nut	Stainless Steel
x 3	3	Packing Ring	Graphite
x 3a	1	Sliper	PTFE + 25% C. Graphite
4	2	Spring Washer	Stainless Steel Treated
5	1	Stem	S.S. 316
6	1	Gland Packing	S.S. 316
x 7	1	Thrust Washer	PTFE + 25% C. Graphite
7a	1	Thrust Washer Ring	Stainless Steel
9	1	Ball	S.S. 316
x 10	2	Seat	Kel'f
10a	1	Seat Ring	S.S. 316
x 11	2	Body Gasket	Graphite
12	1	Body	S.S. 316
13	2	End Connection	S.S. 316
14	4	Extention Screw	Stainless Steel
14a	1	Stop Pin	Stainless Steel
16	6	Bolts	ASTM A193 B8
17	1	Stop Washer	Stainless Steel
20	6	Seat Spring	Inconel x 750

* Suggested Material After Two Years

Lloyd's Register EMEA

Milan Office Witnessed

Monitored

Reviewed



G. Fioriello Surveyor

Rev.	Date	Reason for revision	Made By	Chk'd By	Appr. By
0	15-06-07	First Issue			

Ball Valves Type : CRYOSTAR (N°4) FLOATING VALVE
 Port Design : FULL BORE
 Class of Valve : 1500 Lbs
 End Connections : SOCKET WELD

STAR LINE



S. PAOLO D'ARGON BERGAMO ITALY

Starline Fig. n° : 156-KGG

Drawing n° : STAR-0002-CRY

BALL VALVE TESTED : "FLOATING CRYO STAR" No. 5

Material : F316 / F316 Size : 1" Class : 1500 Lbs Our Fig.n° : 156-KGG

CRYOGENIC TEST CERTIFICATE n° : CRY-0003-LT

Date : 18/06/07

Issued in : S. PAOLO D'ARGON - BG - ITALY

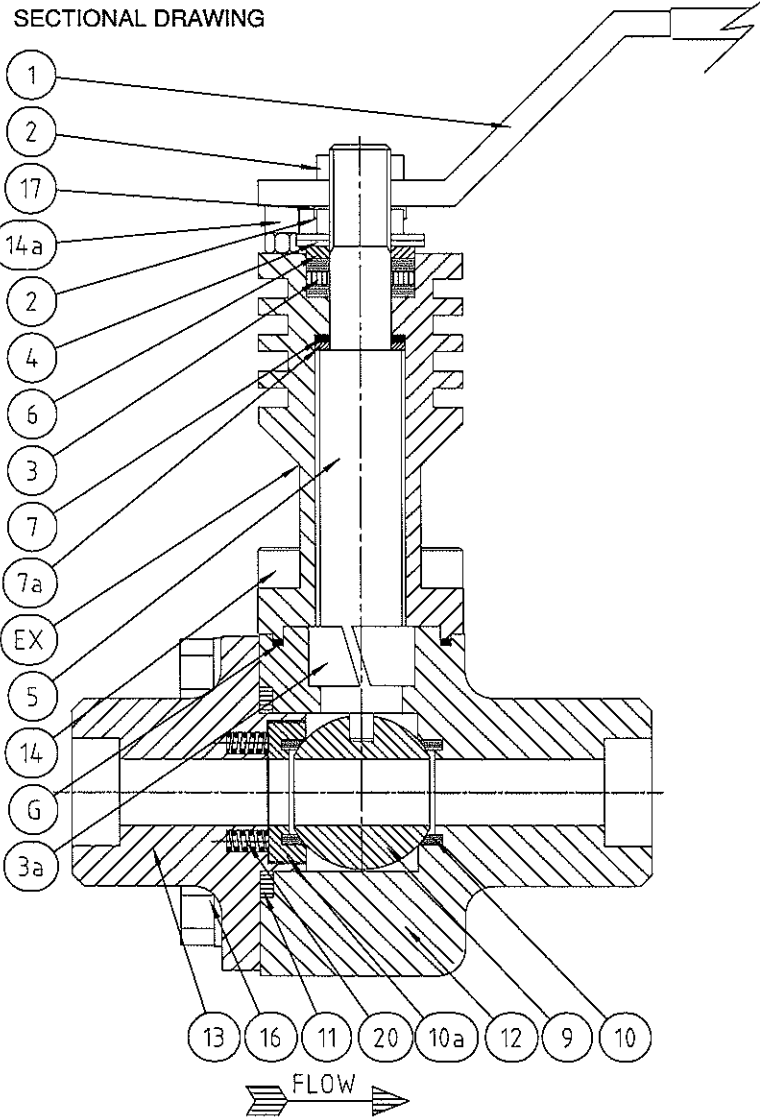
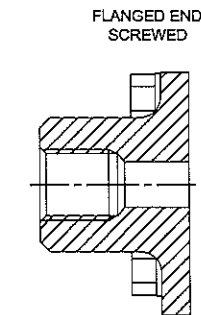
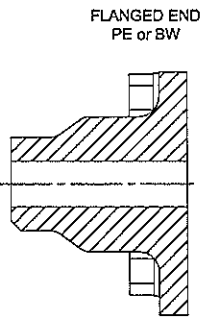
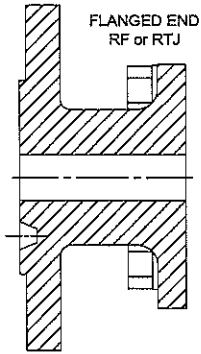
VALVE CONSTRUCTION

Forged Steel Ball Valves Two Pieces Bolted Construction (Type "CRYO STAR" No. 5)

Floating Ball, Anti - Blow - Out Proof Stem Design, Antistatic Design.

Designed in Conformity to Last Edition of :

- BS 5351 (EN-ISO-17292) - ASME / ANSI B16.34 - API 6D -



	PART No.	UNIT Q.ty	PART NAME	MATERIAL
	NP	1	Name Plated	Stainless Steel
x	G	1	Extention Gasket	Graphite
	EX	1	Extention	S.S. 316
	1	1	Handle	Stainless Steel + Plastic
	2	2	Handle Nut	Stainless Steel
x	3	3	Packing Ring	Graphite
x	3a	1	Sliper	PTFE + 25% C. Graphite
	4	2	Spring Washer	Stainless Steel Treated
	5	1	Stem	S.S. 316
	6	1	Gland Packing	S.S. 316
x	7	1	Thrust Washer	PTFE + 25% C. Graphite
	7a	1	Thrust Washer Ring	Stainless Steel
	9	1	Ball	S.S. 316
x	10	2	Seat	Kel'f
	10a	1	Seat Ring	S.S. 316
x	11	2	Body Gasket	Graphite
	12	1	Body	S.S. 316
	13	2	End Connection	S.S. 316
	14	4	Extention Screw	Stainless Steel
	14a	1	Stop Pin	Stainless Steel
	16	6	Bolts	ASTM A193 B8
	17	1	Stop Washer	Stainless Steel
	20	6	Seat Spring	Inconel x 750

* Suggested Material After Two Years

Lloyd's Register EMEA

Milan Office Witnessed

Monitored

Reviewed

G. Floriello Surveyor



0	18-06-07	First Issue			
Rev.	Date	Reason for revision	Made By	Chk'd By	Appr. By
Ball Valves Type : CRYOSTAR (N°4) FLOATING VALVE					
Port Design : FULL BORE					
Class of Valve : 1500 Lbs					
End Connections : SOCKET WELD					

STAR LINE



S. PAOLO D'ARGON BERGAMO ITALY

Starline Fig. n° : 156-KGG

Drawing n° : STAR-0003-CRY

BALL VALVE TESTED : "FLOATING CRYO STAR" No. 5

Material : F316 / F316 Size : 1.1/2" Class : 800 Lbs Our Fig.n° : 156-TGG

CRYOGENIC TEST CERTIFICATE n° : CRY-0004-LT

Date : 19/06/07

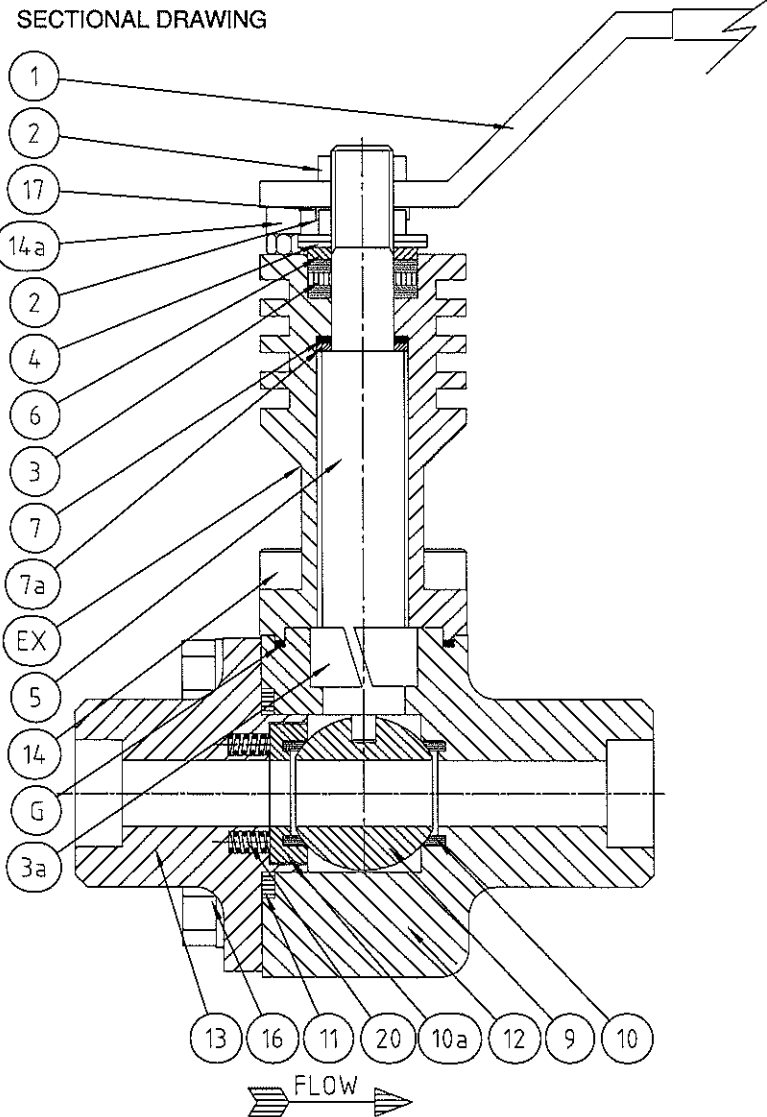
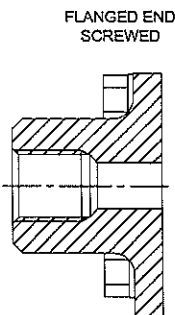
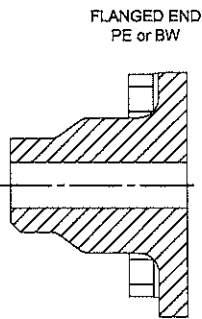
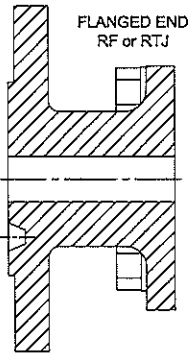
Issued in : S. PAOLO D'ARGON - BG - ITALY

VALVE CONSTRUCTION

Forged Steel Ball Valves Two Pieces Bolted Construction (Type "CRYO STAR" No. 5)
Floating Ball, Anti - Blow - Out Proof Stem Design, Antistatic Design.

Designed in Conformity to Last Edition of :

- BS 5351 (EN-ISO-17292) - ASME / ANSI B16.34 - API 6D -



UNIDIRECTIONAL BALL VALVE FOR CRYOGENIC SERVICE

PART No.	UNIT Q.ty	PART NAME	MATERIAL
NP	1	Name Plated	Stainless Steel
x G	1	Extention Gasket	Graphite
EX	1	Extention	S.S. 316
1	1	Handle	Stainless Steel + Plastic
2	2	Handle Nut	Stainless Steel
x 3	3	Packing Ring	Graphite
x 3a	1	Sliper	PTFE + 25% C. Graphite
4	2	Spring Washer	Stainless Steel Treated
5	1	Stem	S.S. 316
6	1	Gland Packing	S.S. 316
x 7	1	Thrust Washer	PTFE + 25% C. Graphite
7a	1	Thrust Washer Ring	Stainless Steel
9	1	Ball	S.S. 316
x 10	2	Seat	PTFE
10a	1	Seat Ring	S.S. 316
x 11	2	Body Gasket	Graphite
12	1	Body	S.S. 316
13	2	End Connection	S.S. 316
14	4	Extention Screw	Stainless Steel
14a	1	Stop Pin	Stainless Steel
16	6	Bolts	ASTM A193 B8
17	1	Stop Washer	Stainless Steel
20	6	Seat Spring	Inconel x 750

* Suggested Material After Two Years

Lloyd's Register EMEA
Milan Office Witnessed Monitored Reviewed
C. Fioriello Surveyor

Rev.	Date	Reason for revision	Made By	Chk'd By	Appr. By
0	19-06-07	First Issue			

Ball Valves Type : CRYOSTAR (N°4) FLOATING VALVE
Port Design : FULL BORE
Class of Valve : 800 Lbs
End Connections : SOCKET WELD

STAR LINE 
S. PAOLO D'ARGON BERGAMO ITALY

Startline Fig. n° : 156-TGG

Drawing n° : STAR-0004-CRY

BALL VALVE TESTED : "FLOATING CRYO STAR" No. 5

Material : F316 / F316 Size : 2" Class : 800 Lbs Our Fig.n° : 156-TGG

CRYOGENIC TEST CERTIFICATE n° : CRY-0005-LT

Date : 20/06/07

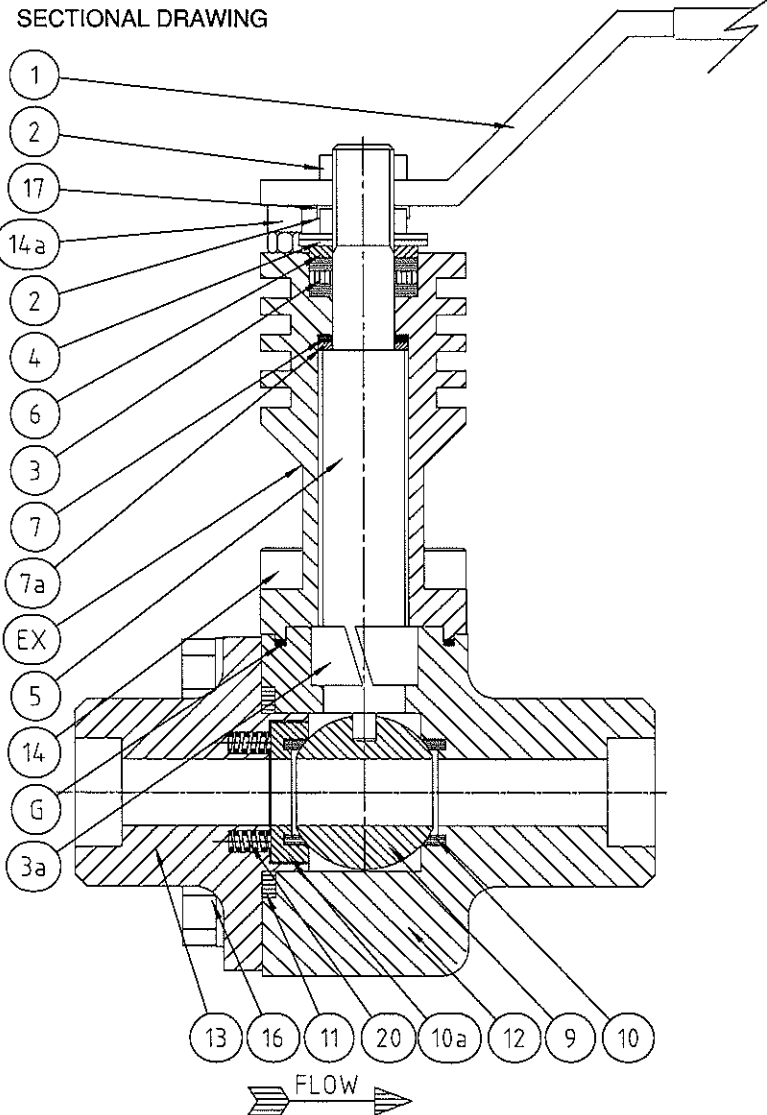
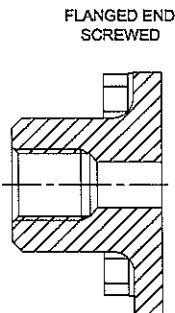
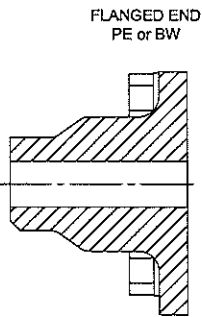
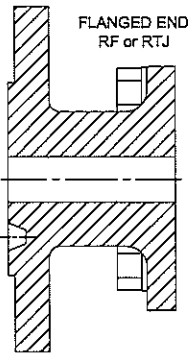
Issued in : S. PAOLO D'ARGON - BG - ITALY

VALVE CONSTRUCTION

Forged Steel Ball Valves Two Pieces Bolted Construction (Type "CRYO STAR" No. 5)
Floating Ball, Anti - Blow - Out Proof Stem Design, Antistatic Design.

Designed in Conformity to Last Edition of :

- BS 5351 (EN-ISO-17292) - ASME / ANSI B16.34 - API 6D -



UNIDIRECTIONAL BALL VALVE FOR CRYOGENIC SERVICE

	PART No.	UNIT Q.ty	PART NAME	MATERIAL
	NP	1	Name Plated	Stainless Steel
x	G	1	Extention Gasket	Graphite
	EX	1	Extention	S.S. 316
	1	1	Handle	Stainless Steel + Plastic
	2	2	Handle Nut	Stainless Steel
x	3	3	Packing Ring	Graphite
x	3a	1	Sliper	PTFE + 25% C. Graphite
	4	2	Spring Washer	Stainless Steel Treated
	5	1	Stem	S.S. 316
	6	1	Gland Packing	S.S. 316
x	7	1	Thrust Washer	PTFE + 25% C. Graphite
	7a	1	Thrust Washer Ring	Stainless Steel
	9	1	Ball	S.S. 316
x	10	2	Seat	PTFE
	10a	1	Seat Ring	S.S. 316
x	11	2	Body Gasket	Graphite
	12	1	Body	S.S. 316
	13	2	End Connection	S.S. 316
	14	4	Extention Screw	Stainless Steel
	14a	1	Stop Pin	Stainless Steel
	16	6	Bolts	ASTM A193 B8
	17	1	Stop Washer	Stainless Steel
	20	6	Seat Spring	Inconel x 750

* Suggested Material After Two Years

Lloyd's Register EMEA
Milan Office Witnessed
 Monitored
 Reviewed
G. Fioriello Surveyor

Rev.	Date	Reason for revision	Made By	Chk'd By	Appr. By
0	20-06-07	First Issue			

Ball Valves Type : CRYOSTAR (N°4) FLOATING VALVE
Port Design : FULL BORE
Class of Valve : 800 Lbs
End Connections : SOCKET WELD

STAR LINE  Starline Fig. n° : 156-TGG
S. PAOLO D'ARGON BERGAMO ITALY Drawing n°: STAR-0005-CRY

BALL VALVE TESTED : "FLOATING CRYO STAR" No. 5

Material : F316 / F316 Size : 3" Class : 300 Lbs Our Fig.n° : 156-TGG

VALVE CONSTRUCTION

Forged Steel Ball Valves Two Pieces Bolted Construction (Type "CRYO STAR" No. 5)

Floating Ball, Anti - Blow - Out Proof Stem Design, Antistatic Design.

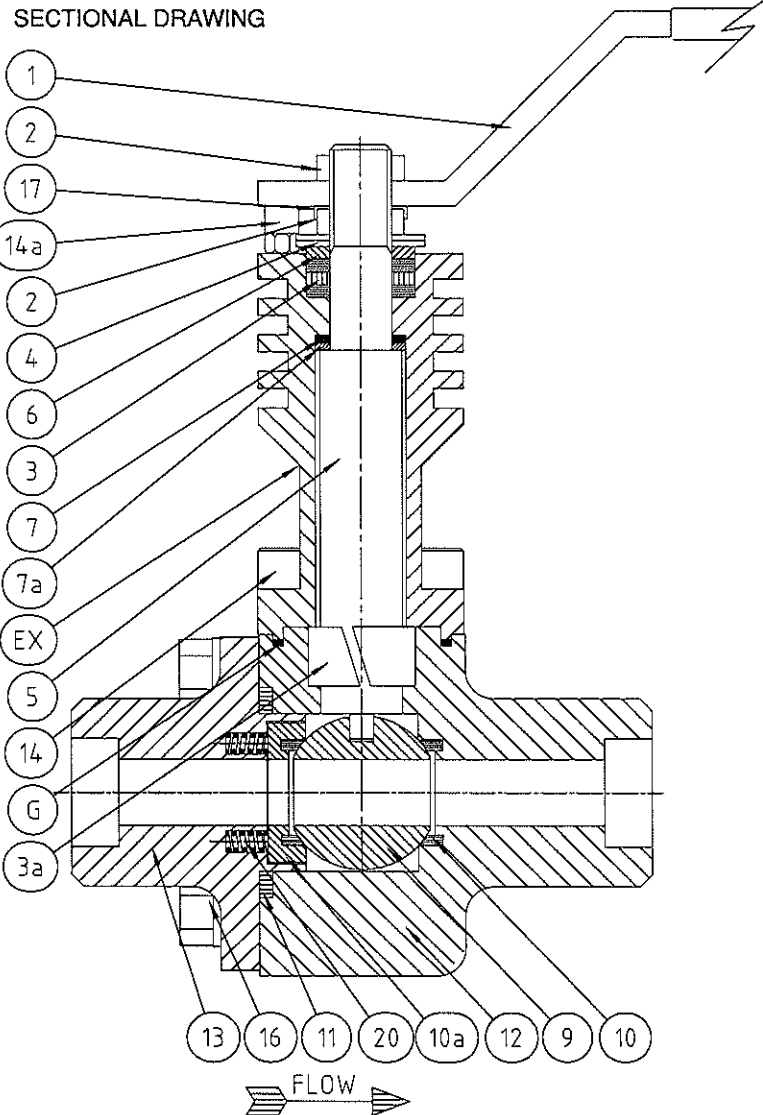
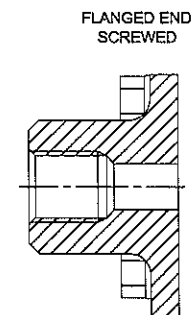
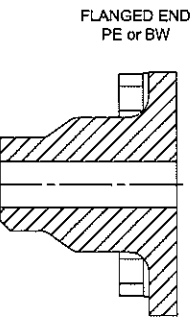
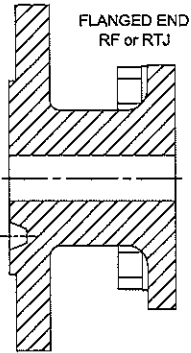
Designed in Conformity to Last Edition of :

- BS 5351 (EN-ISO-17292) - ASME / ANSI B16.34 - API 6D -

CRYOGENIC TEST CERTIFICATE n° : CRY-0006-LT

Date : 21/06/07

Issued in : S. PAOLO D'ARGON - BG - ITALY



PART No.	UNIT Q.ty	PART NAME	MATERIAL
NP	1	Name Plated	Stainless Steel
x G	1	Extention Gasket	Graphite
EX	1	Extention	S.S. 316
1	1	Handle	Stainless Steel + Plastic
2	2	Handle Nut	Stainless Steel
x 3	3	Packing Ring	Graphite
x 3a	1	Sliper	PTFE + 25% C. Graphite
4	2	Spring Washer	Stainless Steel Treated
5	1	Stem	S.S. 316
6	1	Gland Packing	S.S. 316
x 7	1	Thrust Washer	PTFE + 25% C. Graphite
7a	1	Thrust Washer Ring	Stainless Steel
9	1	Ball	S.S. 316
x 10	2	Seat	PTFE
10a	1	Seat Ring	S.S. 316
x 11	2	Body Gasket	Graphite
12	1	Body	S.S. 316
13	2	End Connection	S.S. 316
14	4	Extention Screw	Stainless Steel
14a	1	Stop Pin	Stainless Steel
16	6	Bolts	ASTM A193 B8
17	1	Stop Washer	Stainless Steel
20	6	Seat Spring	Inconel x 750

* Suggested Material After Two Years

Lloyd's Register EMEA

Milan Office Witnessed

Monitored

Reviewed



G. Fiorillo Surveyor

Rev.	Date	Reason for revision	Made By	Chk'd By	Appr. By
0	21-06-07	First Issue			

Ball Valves Type : CRYOSTAR (N°4) FLOATING VALVE
 Port Design : FULL BORE
 Class of Valve : 300 Lbs
 End Connections : SOCKET WELD

STAR LINE 
 S. PAOLO D'ARGON BERGAMO ITALY

Starline Fig. n° : 156-TGG

Drawing n° : STAR-0006-CRY

BALL VALVE TESTED : "FLOATING CRYO STAR" No. 5

Material : F316 / F316 Size : 4" Class : 300 Lbs Our Fig.n° : 156-TGG

CRYOGENIC TEST CERTIFICATE n° : CRY-0007-LT

Date : 22/06/07

Issued in : S. PAOLO D'ARGON - BG - ITALY

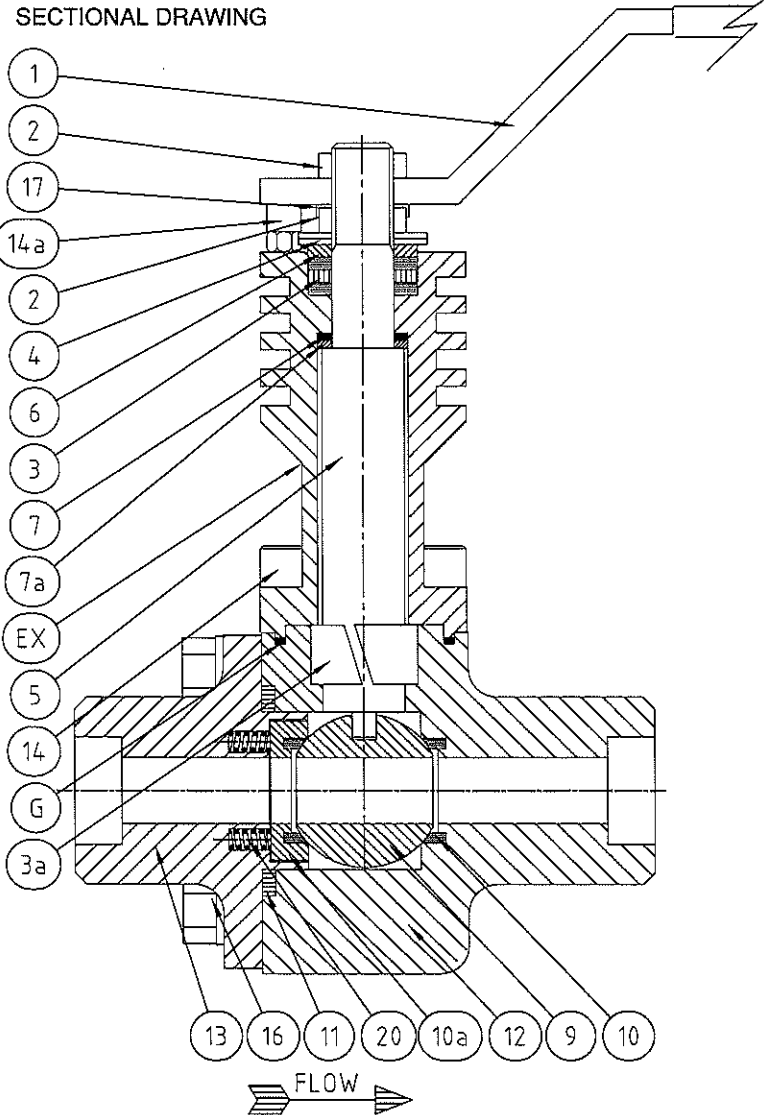
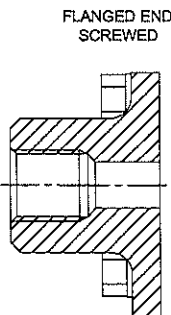
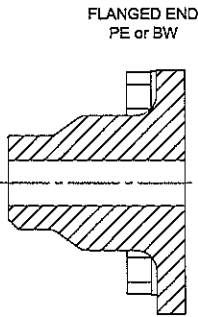
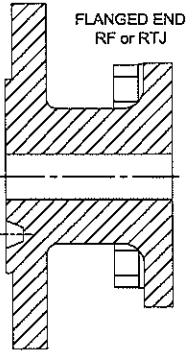
VALVE CONSTRUCTION

Forged Steel Ball Valves Two Pieces Bolted Construction (Type "CRYO STAR" No. 5)

Floating Ball, Anti - Blow - Out Proof Stem Design, Antistatic Design.

Designed in Conformity to Last Edition of :

- BS 5351 (EN-ISO-17292) - ASME / ANSI B16.34 - API 6D -



UNIDIRECTIONAL BALL VALVE FOR CRYOGENIC SERVICE

PART No.	UNIT Qty	PART NAME	MATERIAL
NP	1	Name Plated	Stainless Steel
x 6	1	Extention Gasket	Graphite
EX	1	Extention	S.S. 316
1	1	Handle	Stainless Steel + Plastic
2	2	Handle Nut	Stainless Steel
x 3	3	Packing Ring	Graphite
x 3a	1	Sliper	PTFE + 25% C. Graphite
4	2	Spring Washer	Stainless Steel Treated
5	1	Stem	S.S. 316
6	1	Gland Packing	S.S. 316
x 7	1	Thrust Washer	PTFE + 25% C. Graphite
7a	1	Thrust Washer Ring	Stainless Steel
9	1	Ball	S.S. 316
x 10	2	Seat	PTFE
10a	1	Seat Ring	S.S. 316
x 11	2	Body Gasket	Graphite
12	1	Body	S.S. 316
13	2	End Connection	S.S. 316
14	4	Extention Screw	Stainless Steel
14a	1	Stop Pin	Stainless Steel
16	6	Bolts	ASTM A193 B8
17	1	Stop Washer	Stainless Steel
20	6	Seat Spring	Inconel x 750

* Suggested Material After Two Years

Lloyd's Register EMEA

Milan Office Witnessed

Monitored

Reviewed



G. Floriello Surveyor

Rev.	Date	Reason for revision	Made By	Chk'd By	App'd By
0	22-06-07	First Issue			
Ball Valves Type : CRYOSTAR (N°4) FLOATING VALVE					
Part Design : FULL BORE					
Class of Valve : 300 Lbs					
End Connections : SOCKET WELD					

STAR LINE



S. PAOLO D'ARGON BERGAMO ITALY

Starline Fig. n° : 156-TGG

Drawing n° : STAR-0007-CRY

BALL VALVE TESTED : "FLOATING CRYO STAR" No. 5

Material : F316 / F316 Size : 6" Class : 150 Lbs Our Fig.n° : 156-TGG

VALVE CONSTRUCTION

Forged Steel Ball Valves Two Pieces Bolted Construction (Type "CRYO STAR" No. 5)
 Floating Ball, Anti - Blow - Out Proof Stem Design, Antistatic Design.

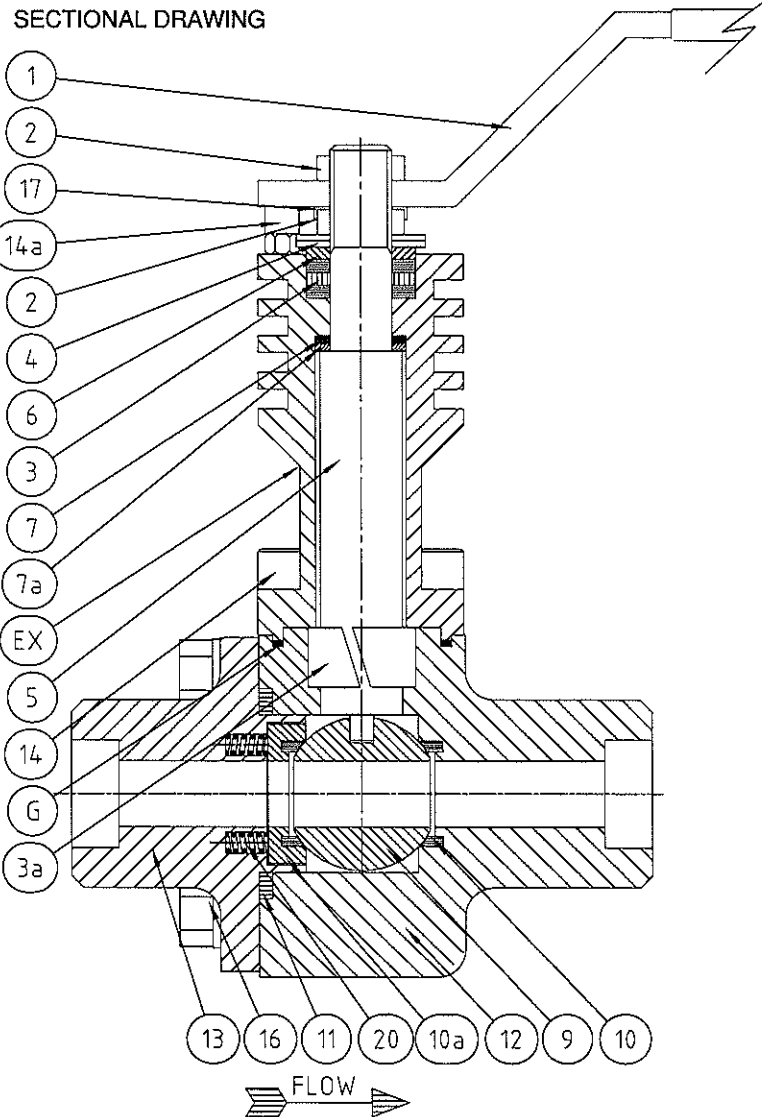
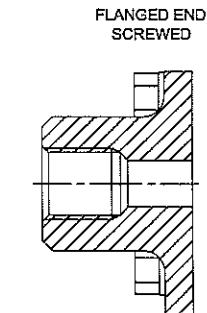
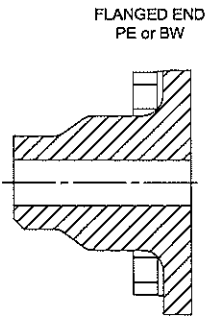
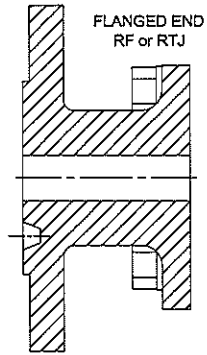
Designed in Conformity to Last Edition of :

- BS 5351 (EN-ISO-17292) - ASME / ANSI B16.34 - API 6D -

CRYOGENIC TEST CERTIFICATE n°: CRY-0008-LT

Date : 25/06/07

Issued in : S. PAOLO D'ARGON - BG - ITALY



UNIDIRECTIONAL BALL VALVE FOR CRYOGENIC SERVICE

	PART No.	UNIT Q.ty	PART NAME	MATERIAL
	NP	1	Name Plated	Stainless Steel
x	G	1	Extention Gasket	Graphite
	EX	1	Extention	S.S. 316
	1	1	Handle	Stainless Steel + Plastic
	2	2	Handle Nut	Stainless Steel
x	3	3	Packing Ring	Graphite
x	3a	1	Sliper	PTFE + 25% C. Graphite
	4	2	Spring Washer	Stainless Steel Treated
	5	1	Stem	S.S. 316
	6	1	Gland Packing	S.S. 316
x	7	1	Thrust Washer	PTFE + 25% C. Graphite
	7a	1	Thrust Washer Ring	Stainless Steel
	9	1	Ball	S.S. 316
x	10	2	Seat	PTFE
	10a	1	Seat Ring	S.S. 316
x	11	2	Body Gasket	Graphite
	12	1	Body	S.S. 316
	13	2	End Connection	S.S. 316
	14	4	Extention Screw	Stainless Steel
	14a	1	Stop Pin	Stainless Steel
	16	6	Bolts	ASTM A193 B8
	17	1	Stop Washer	Stainless Steel
	20	6	Seat Spring	Inconel x 750

* Suggested Material After Two Years

Lloyd's Register EMEA

Milan Office Witnessed
 Monitored
 Reviewed



G. Floriello Surveyor

Rev.	Date	Reason for revision	Made By	Chk'd By	Appr. By
0	25-06-07	First Issue			

Ball Valves Type : CRYOSTAR (N°4) FLOATING VALVE
 Port Design : FULL BORE
 Class of Valve : 150 Lbs
 End Connections : SOCKET WELD

STAR LINE
 S. PAOLO D'ARGON BERGAMO ITALY



Starline Fig. n°: 156-TGG

Drawing n°: STAR-0008-CRY

BALL VALVE TESTED : "TRUNNION CRYO STAR" No. 0

Material : F316 / F316 Size : 1/2" Class : 2500 Lbs Our Fig.n° : LT106-KGG

VALVE CONSTRUCTION

Forged Steel Ball Valves Three Pieces Bolted Construction (Type "TRUNNION CRYO STAR" No. 0)

Trunnion Mounted, Anti - Blow - Out Proof Stem Design, Antistatic Design.

Designed in Conformity to Last Edition of :

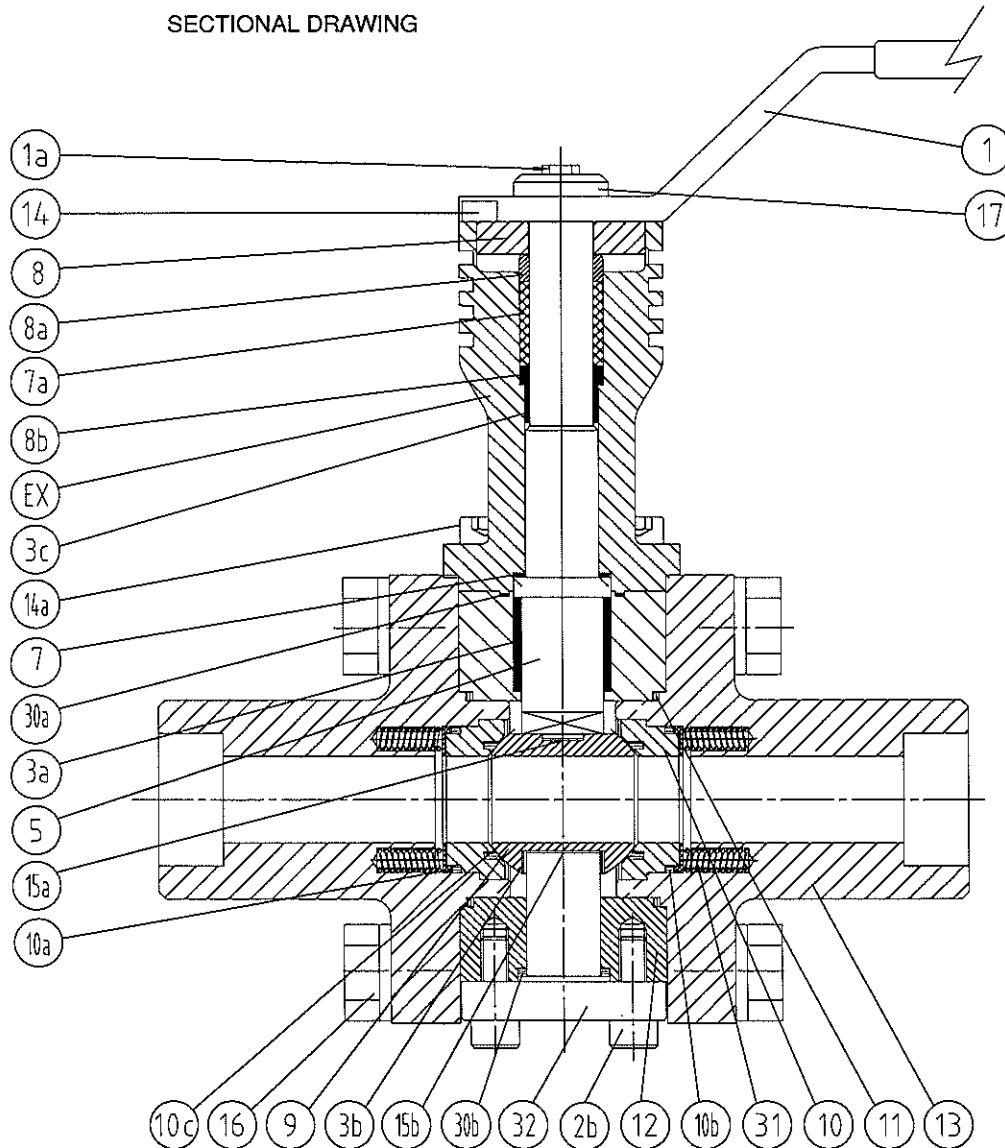
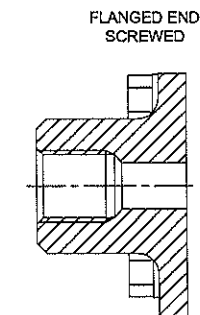
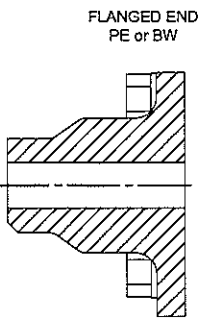
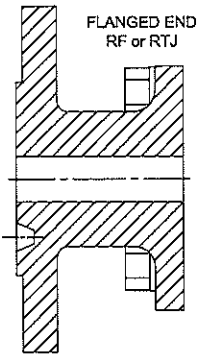
- BS 5351 (EN-ISO-17292) - ASME / ANSI B16.34 - API 6D -

CRYOGENIC TEST CERTIFICATE n° : CRY-0009-LT

Date : 26/06/07

Issued in : S. PAOLO D'ARGON - BG - ITALY

SECTIONAL DRAWING



PART No.	UNIT Q.ty	PART NAME	MATERIAL
NP	1	NAME PLATE	Stainless Steel
EX	1	EXTENTION	S.S. 316
1	1	HANDLE	Stainless Steel+Plastic
1a	1	HANDLE BOLT	Stainless Steel
2b	4	TRUNNION RETAINER SCREW	Stainless Steel
3a-3b-3c	2+2	STEM / TRUNNION BEARINGS	Stainless Steel+PTFE
5	1	UPPER STEM	S.S. 316
7	1	THRUST WASHER	Stainless Steel+PTFE
x 7a	2	PACKING RING	Graphite
8	1	EXTENTION TOP COVER	S.S. 316
8a	1	GLAND PACKING	S.S. 316
8b	1	STEM RING	S.S. 316
9	1	BALL	S.S. 316
x 10	2	SEAT	S.S. 316
10a	1+1	SEAT RING	S.S. 316
x 10b	2	SEAT SEAL	Graphite
x 10c	2	SEAT INSERT	Kel'f
x 11	2	ADAPTOR SEAL	Graphite
12	1	BODY	S.S. 316
13	2	ADAPTOR FLANGE	S.S. 316
14	1	STOP PIN	Stainless Steel
14a	4	EXTENTION SCREW	A270
15a-15b	1+1	ANTISTATIC SPRING	Stainless Steel
16	6+6	BOLTS	ASTM A193 B8M
17	1	STOP HANDLE WASHER	Stainless Steel
x 30a	2	EXTENTION SEAL	Graphite
x 30b	1	TRUNNION SEAL	Graphite
31	4+4	SEAT SPRING	Inconel X 750
32	1	TRUNNION	S.S. 316
33	1	DRAIN PLUG	S.S. 316

Lloyd's Register FIMM
 Milan Office
 Witnessed
 Monitored
 Reviewed
 G. Floriello Surveyor
 Lloyd's Register

0	26-06-07	First Issue	
Rev.	Date	Reason for revision	Made By/Chk'd By/App'd By
Ball Valves Type		: CRYOSTAR (N°0) TRUNNION MOUNTED	
Port Design		: FULL BORE	
Class of Valve		: 2500 Lbs	
End Connections		: SOCKET WELD	

BALL VALVE TESTED : "TRUNNION CRYO STAR" No. 0

Material : F316 / F316 Size : 3/4" Class : 2500 Lbs Our Fig.n° : LT106-KGG

VALVE CONSTRUCTION

Forged Steel Ball Valves Three Pieces Bolted Construction (Type "TRUNNION CRYO STAR" No. 0)

Trunnion Mounted, Anti - Blow - Out Proof Stem Design, Antistatic Design.

Designed in Conformity to Last Edition of :

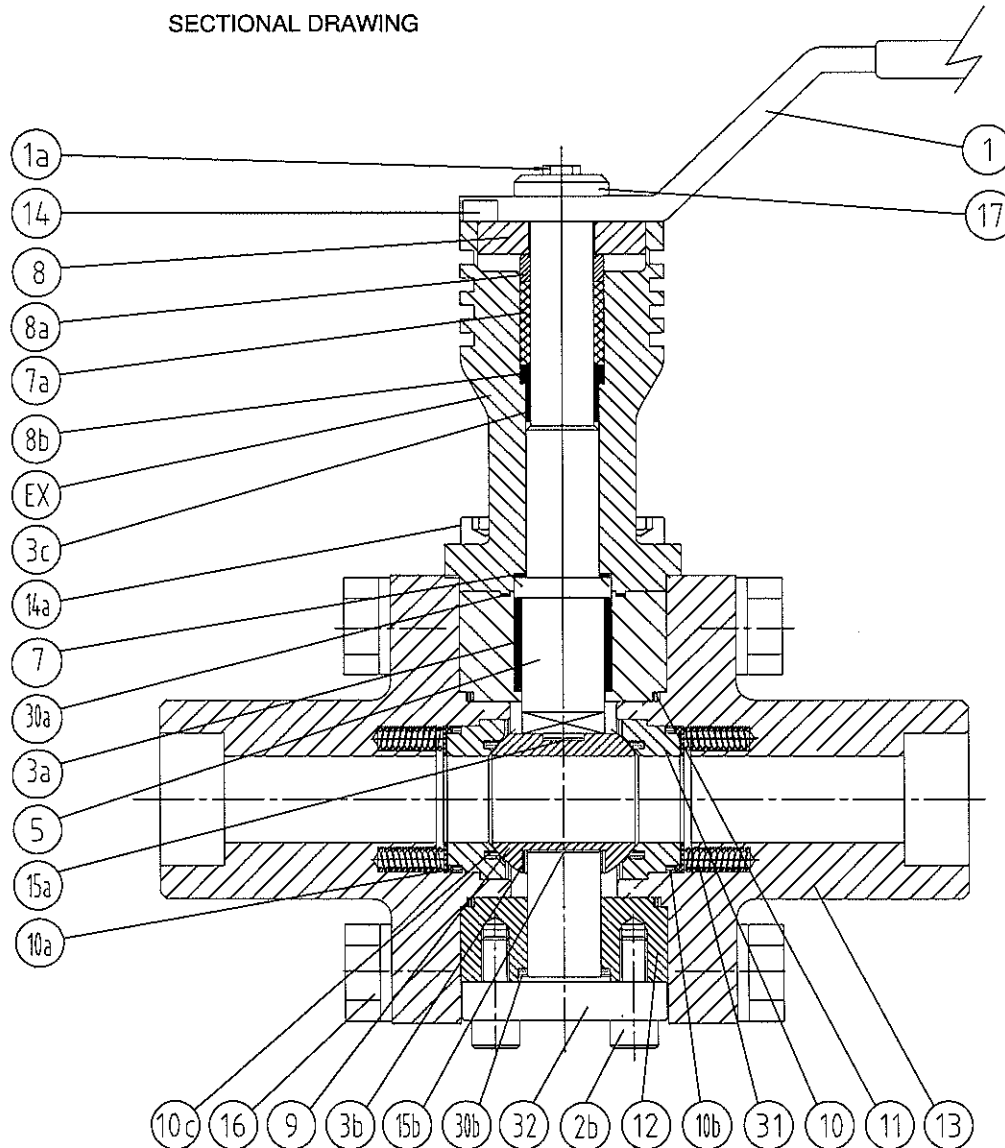
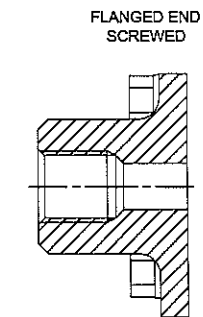
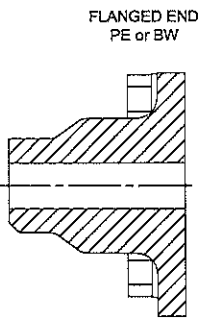
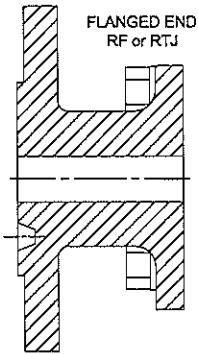
- BS 5351 (EN-ISO-17292) - ASME / ANSI B16.34 - API 6D -

CRYOGENIC TEST CERTIFICATE n° : CRY-0010-LT

Date : 27/06/07

Issued in : S. PAOLO D'ARGON - BG - ITALY

SECTIONAL DRAWING



PART No.	UNIT Q.ty	PART NAME	MATERIAL
NP	1	NAME PLATE	Stainless Steel
EX	1	EXTENTION	S.S. 316
1	1	HANDLE	Stainless Steel+Plastic
1a	1	HANDLE BOLT	Stainless Steel
2b	4	TRUNNION RETAINER SCREW	Stainless Steel
3a-3b-3c	2+2	STEM / TRUNNION BEARINGS	Stainless Steel+PTFE
5	1	UPPER STEM	S.S. 316
7	1	THRUST WASHER	Stainless Steel+PTFE
x 7a	2	PACKING RING	Graphite
8	1	EXTENTION TOP COVER	S.S. 316
8a	1	GLAND PACKING	S.S. 316
8b	1	STEM RING	S.S. 316
9	1	BALL	S.S. 316
x 10	2	SEAT	S.S. 316
x 10a	1+1	SEAT RING	S.S. 316
x 10b	2	SEAT SEAL	Graphite
x 10c	2	SEAT INSERT	Kel'f
x 11	2	ADAPTOR SEAL	Graphite
12	1	BODY	S.S. 316
13	2	ADAPTOR FLANGE	S.S. 316
14	1	STOP PIN	Stainless Steel
14a	4	EXTENTION SCREW	A270
15a-15b	1+1	ANTISTATIC SPRING	Stainless Steel
16	6+6	BOLTS	ASTM A193 B8M
17	1	STOP HANDLE WASHER	Stainless Steel
x 30a	2	EXTENTION SEAL	Graphite
x 30b	1	TRUNNION SEAL	Graphite
31	6+6	SEAT SPRING	Inconel X 750
32	1	TRUNNION	S.S. 316
37	1	DRAIN PLUG	S.S. 316

Lloyd's Register - 10 years warranty after two years service

Milan Office
 Witnessed
 Monitored
 Reviewed
 G. Fioriello Surveyor



0	27-06-07	First Issue	
Rev.	Date	Reason for revision	Made By/Chk'd By/Appr. By
Ball Valves Type		: CRYOSTAR (N°0) TRUNNION MOUNTED	
Port Design		: FULL BORE	
Class of Valve		: 2500 Lbs	
End Connections		: SOCKET WELD	

STAR LINE **ST**
 S. PAOLO D'ARGON BERGAMO ITALY

Starline Fig. n°: LT106-KGG
 Drawing n°: STAR-0010-CRY

BALL VALVE TESTED : "TRUNNION CRYO STAR" No. 0

Material : F316 / F316 Size : 1" Class : 2500 Lbs Our Fig.n° : LT106-KGG

VALVE CONSTRUCTION

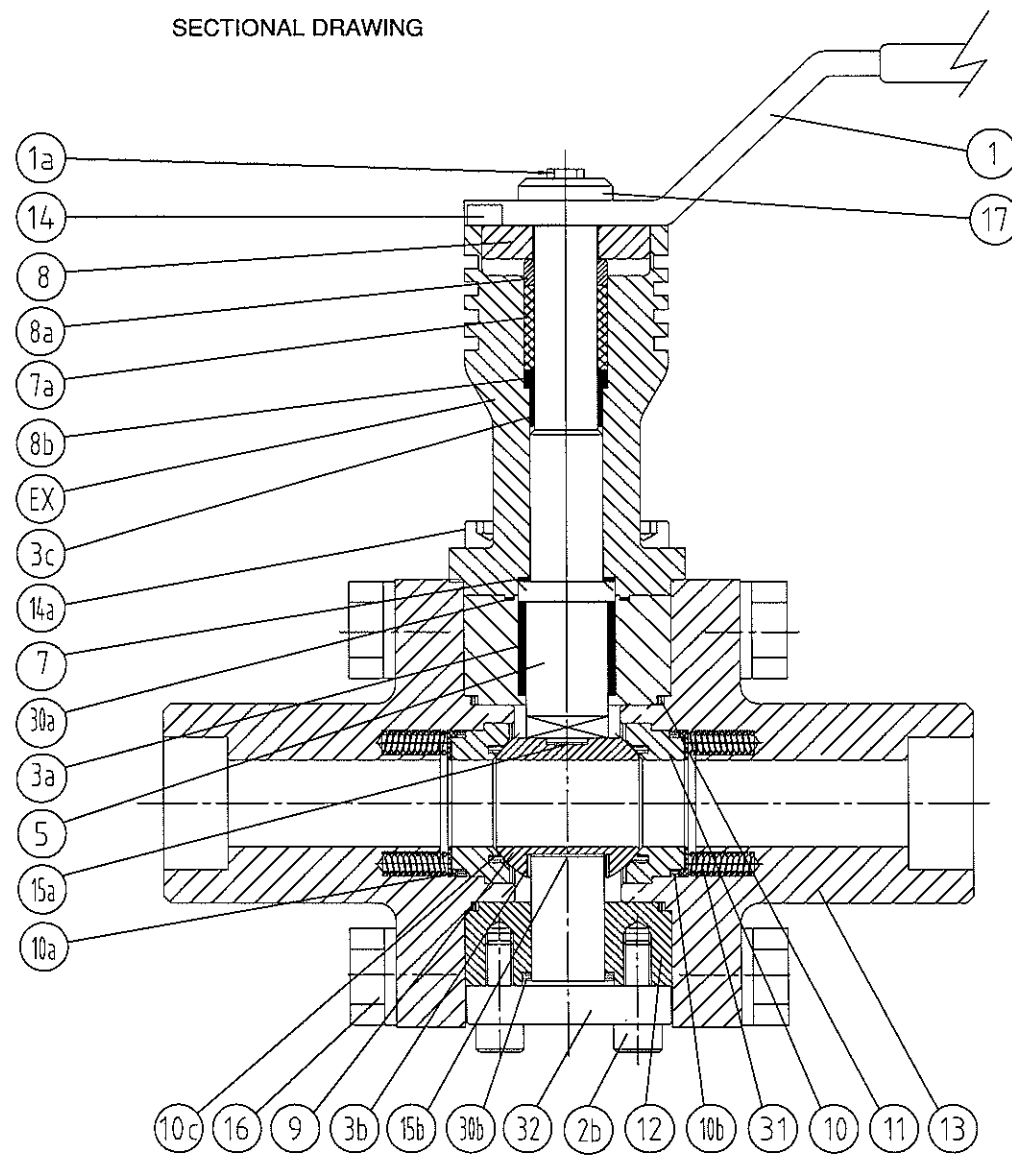
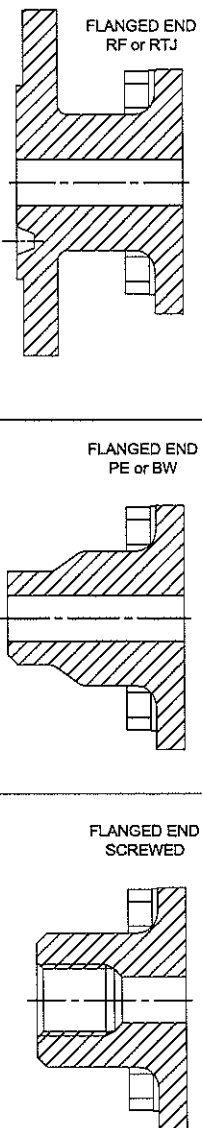
Forged Steel Ball Valves Three Pieces Bolted Construction (Type "TRUNNION CRYO STAR" No. 0)
 Trunnion Mounted, Anti - Blow - Out Proof Stem Design, Antistatic Design.
 Designed in Conformity to Last Edition of :
 - BS 5351 (EN-ISO-17292) - ASME / ANSI B16.34 - API 6D -

CRYOGENIC TEST CERTIFICATE n° : CRY-0011-LT

Date : 28/06/07

Issued in : S. PAOLO D'ARGON - BG - ITALY

SECTIONAL DRAWING



PART No.	UNIT Q.ty	PART NAME	MATERIAL
NP	1	NAME PLATE	Stainless Steel
EX	1	EXTENTION	S.S. 316
1	1	HANDLE	Stainless Steel+Plastic
1a	1	HANDLE BOLT	Stainless Steel
2b	4	TRUNNION RETAINER SCREW	Stainless Steel
3a-3b-3c	2+2	STEM / TRUNNION BEARINGS	Stainless Steel+PTFE
5	1	UPPER STEM	S.S. 316
7	1	THRUST WASHER	Stainless Steel+PTFE
x 7a	2	PACKING RING	Graphite
8	1	EXTENTION TOP COVER	S.S. 316
8a	1	GLAND PACKING	S.S. 316
8b	1	STEM RING	S.S. 316
9	1	BALL	S.S. 316
x 10	2	SEAT	S.S. 316
10a	1+1	SEAT RING	S.S. 316
x 10b	2	SEAT SEAL	Graphite
x 10c	2	SEAT INSERT	Kel'f
x 11	2	ADAPTOR SEAL	Graphite
12	1	BODY	S.S. 316
13	2	ADAPTOR FLANGE	S.S. 316
14	1	STOP PIN	Stainless Steel
14a	4	EXTENTION SCREW	A270
15a-15b	1+1	ANTISTATIC SPRING	Stainless Steel
16	6+6	BOLTS	ASTM A193 B8M
17	1	STOP HANDLE WASHER	Stainless Steel
x 30a	2	EXTENTION SEAL	Graphite
x 30b	1	TRUNNION SEAL	Graphite
31	6+6	SEAT SPRING	Inconel X 750
32	1	TRUNNION	S.S. 316
37	1	DRAIN PLUG	S.S. 316

*Suggested material after two years service

Lloyd's Register EMEA
 Milan Office Witnessed Monitored Reviewed
Florillo
 G. Floriello, Surveyor

0	28-06-07	First Issue	<i>[Signature]</i>
Rev.	Date	Reason for revision	Made By/Chk'd By/Appr. By
Ball Valves Type : CRYOSTAR (N°0) TRUNNION MOUNTED Port Design : FULL BORE Class of Valve : 2500 Lbs End Connections : SOCKET WELD			

BALL VALVE TESTED : "TRUNNION CRYO STAR" No. 0

Material : F316 / F316 Size : 1.1/2" Class : 2500 Lbs Our Fig.n° : LT106-KGG

VALVE CONSTRUCTION

Forged Steel Ball Valves Three Pieces Bolted Construction (Type "TRUNNION CRYO STAR" No. 0)

Trunnion Mounted, Anti - Blow - Out Proof Stem Design, Antistatic Design.

Designed in Conformity to Last Edition of :

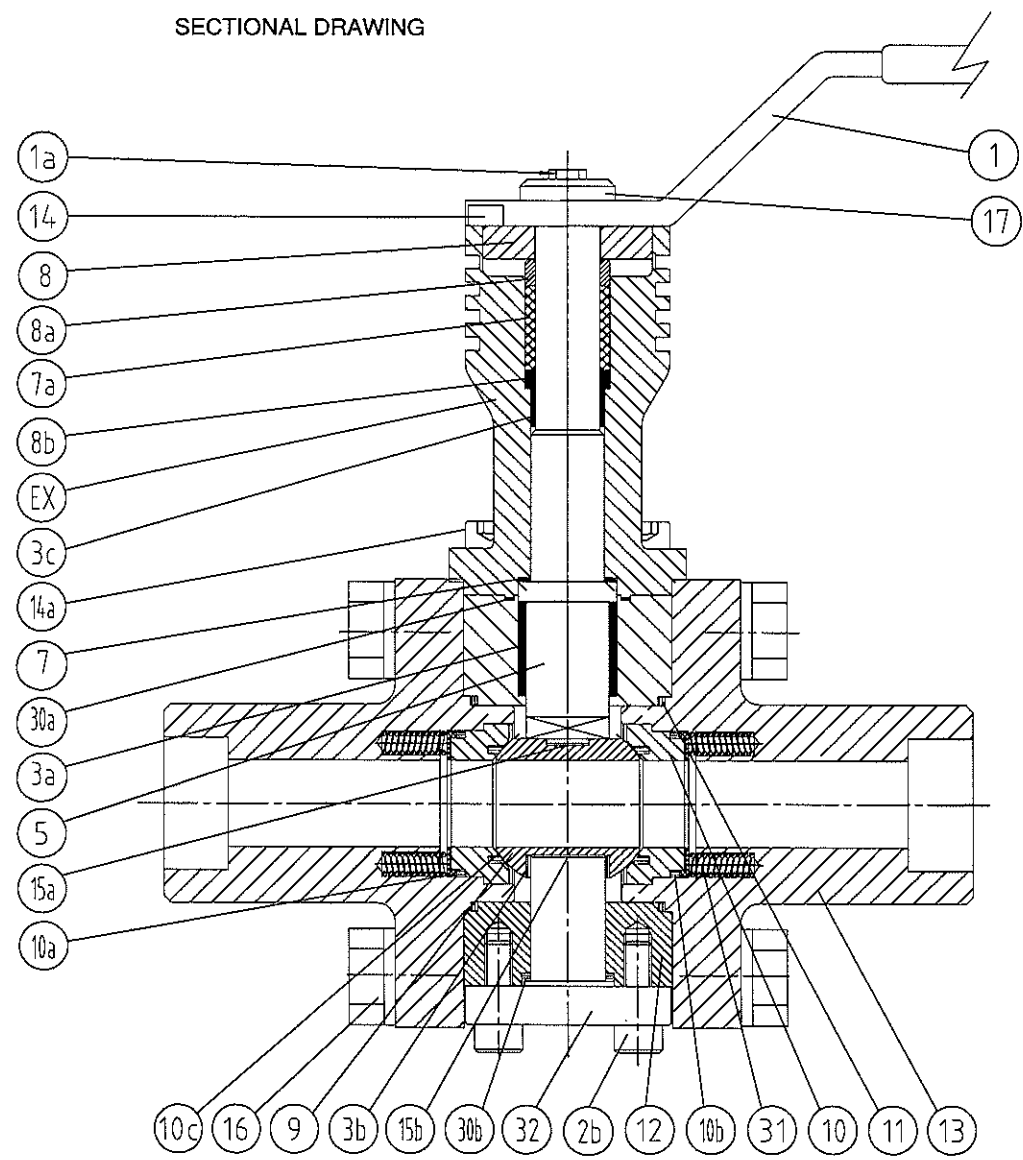
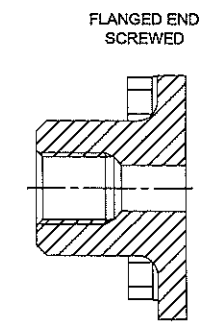
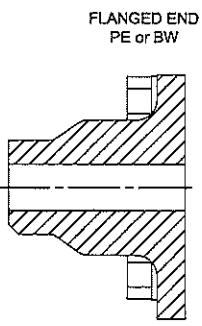
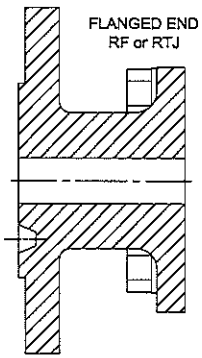
- BS 5351 (EN-ISO-17292) - ASME / ANSI B16.34 - API 6D -

CRYOGENIC TEST CERTIFICATE n° : CRY-0012-LT

Date : 29/06/07

Issued in : S. PAOLO D'ARGON - BG - ITALY

SECTIONAL DRAWING



PART No.	UNIT Q.ty	PART NAME	MATERIAL
NP	1	NAME PLATE	Stainless Steel
EX	1	EXTENTION	S.S. 316
1	1	HANDLE	Stainless Steel+Plastic
1a	1	HANDLE BOLT	Stainless Steel
2b	4	TRUNNION RETAINER SCREW	Stainless Steel
3a-3b-3c	2+2	STEM / TRUNNION BEARINGS	Stainless Steel+PTFE
5	1	UPPER STEM	S.S. 316
7	1	THRUST WASHER	Stainless Steel+PTFE
x 7a	2	PACKING RING	Graphite
8	1	EXTENTION TOP COVER	S.S. 316
8a	1	GLAND PACKING	S.S. 316
8b	1	STEM RING	S.S. 316
9	1	BALL	S.S. 316
x 10	2	SEAT	S.S. 316
x 10a	1+1	SEAT RING	S.S. 316
x 10b	2	SEAT SEAL	Graphite
x 10c	2	SEAT INSERT	Kel'f
x 11	2	ADAPTOR SEAL	Graphite
12	1	BODY	S.S. 316
13	2	ADAPTOR FLANGE	S.S. 316
14	1	STOP PIN	Stainless Steel
14a	4	EXTENTION SCREW	A270
15a-15b	1+1	ANTISTATIC SPRING	Stainless Steel
16	6+6	BOLTS	ASTM A193 B8M
17	1	STOP HANDLE WASHER	Stainless Steel
x 30a	2	EXTENTION SEAL	Graphite
x 30b	1	TRUNNION SEAL	Graphite
31	6+6	SEAT SPRING	Inconel X 750
32	1	TRUNNION	S.S. 316
37	1	DRAIN PLUG	S.S. 316

Lloyd's Register EMEA Suggested material after two years service
 Milan Office Witnessed Monitored Reviewed
G. Fioriello
 G. Fioriello Surveyor

0	29-06-07	First Issue	<i>[Signature]</i>
Rev.	Date	Reason for revision	Made By <i>[Signature]</i> & By <i>[Signature]</i> Appr. By
Ball Valves Type : CRYOSTAR (N°0) TRUNNION MOUNTED			
Port Design : FULL BORE			
Class of Valve : 2500 Lbs			
End Connections : SOCKET WELD			

STAR LINE  Starline Fig. n°: LT106-KGG
 S. PAOLO D'ARGON BERGAMO ITALY Drawing n°: STAR-0012-CRY

BALL VALVE TESTED : "TRUNNION CRYO STAR" No. 0

Material : F316 / F316 Size : 2" Class : 2500 Lbs Our Fig.n° : LT106-KGG

VALVE CONSTRUCTION

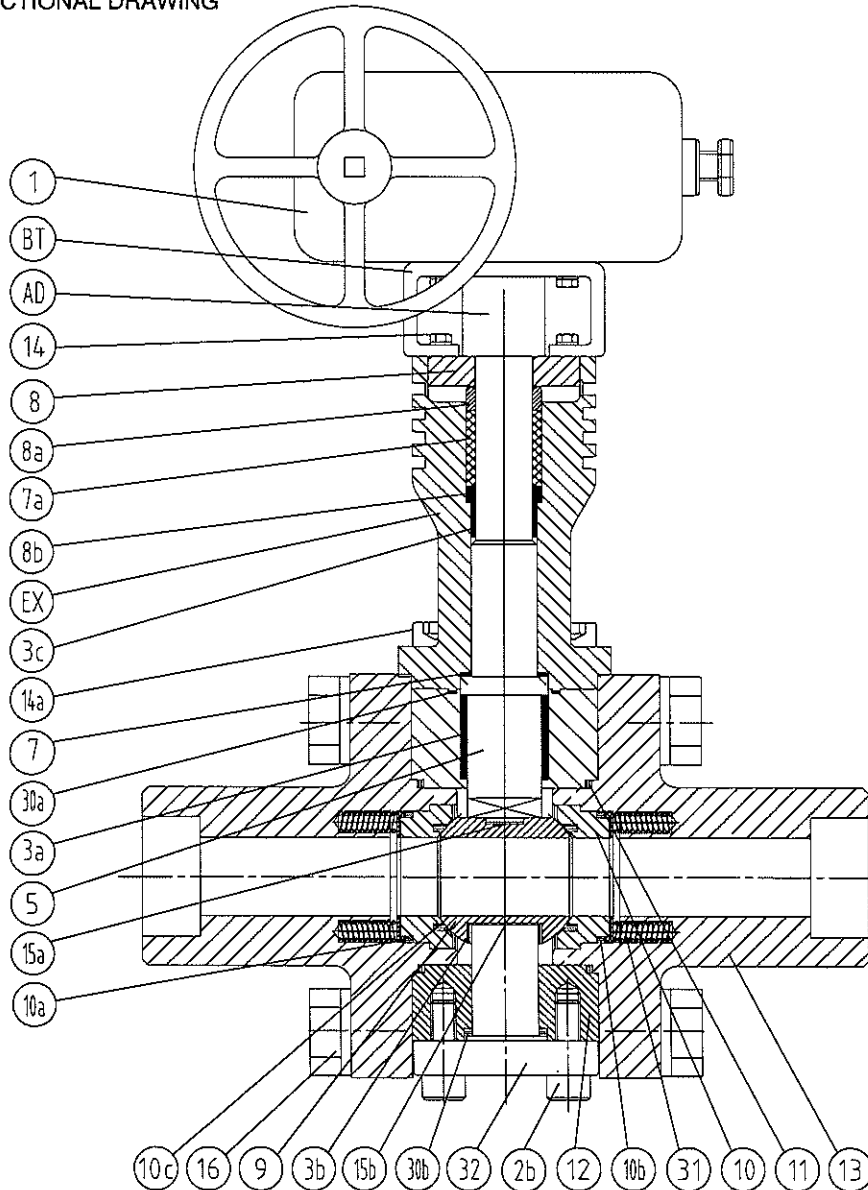
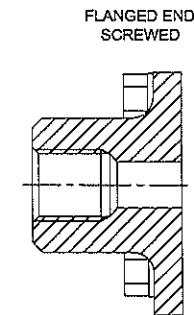
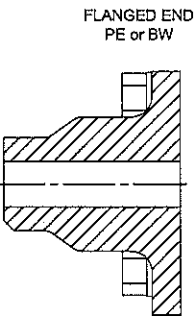
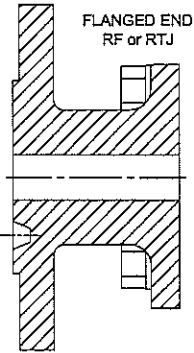
Forged Steel Ball Valves Three Pieces Bolted Construction (Type "TRUNNION CRYO STAR" No. 0)
 Trunnion Mounted, Anti - Blow - Out Proof Stem Design, Antistatic Design.
 Designed in Conformity to Last Edition of :
 - BS 5351 (EN-ISO-17292) - ASME / ANSI B16.34 - API 6D -

CRYOGENIC TEST CERTIFICATE n° : CRY-0013-LT

Date : 02/07/07

Issued in : S. PAOLO D'ARGON - BG - ITALY

SECTIONAL DRAWING



PART No.	UNIT Q.ty	PART NAME	MATERIAL
NP	1	NAME PLATE	Stainless Steel
EX	1	EXTENTION	S.S. 316
BT	1	BRACKET	Stainless Steel
AD	1	ADAPTOR	Stainless Steel
1	1	GEAR	Cast Iron
2b	4	TRUNNION RETAINER SCREW	Stainless Steel
3a-3b-3c	2+2	STEM / TRUNNION BEARINGS	Stainless Steel+PTFE
5	1	UPPER STEM	S.S. 316
7	1	THRUST WASHER	Stainless Steel+PTFE
x 7a	2	PACKING RING	Graphite
8	1	EXTENTION TOP COVER	S.S. 316
8a	1	GLAND PACKING	S.S. 316
8b	1	STEM RING	S.S. 316
9	1	BALL	S.S. 316
x 10	2	SEAT	S.S. 316
10a	1+1	SEAT RING	S.S. 316
x 10b	2	SEAT SEAL	Graphite
x 10c	2	SEAT INSERT	Kel'f
x 11	2	ADAPTOR SEAL	Graphite
12	1	BODY	S.S. 316
13	2	ADAPTOR FLANGE	S.S. 316
14	8	BRACKET SCREW	Stainless Steel
14a	4	EXTENTION SCREW	A270
15a-15b	1+1	ANTISTATIC SPRING	Stainless Steel
16	8+8	BOLTS	ASTM A193 B8M
x 30a	2	EXTENTION SEAL	Graphite
x 30b	1	TRUNNION SEAL	Graphite
31	6+6	SEAT SPRING	Inconel X 750
32	1	TRUNNION	S.S. 316
37	1	DRAIN PLUG	S.S. 316

Lloyd's Register Engineering - Tested material after two years service

Milan Office Witnessed Monitored Reviewed
 G. Fioriello Surveyor



0	02-07-07	First Issue	
Rev.	Date	Reason for revision	Made By/Chk'd By/Appr. By
Ball Valves Type	:	CRYOSTAR (N°0) TRUNNION MOUNTED	
Port Design	:	FULL BORE	
Class of Valve	:	2500 Lbs	
End Connections	:	SOCKET WELD	

STAR LINE **ST**
 S. PAOLO D'ARGON BERGAMO ITALY

Starline Fig. n°: LT106-KGG
 Drawing n°: STAR-0013-CRY

BALL VALVE TESTED : "TRUNNION CRYO STAR" No. 0

Material : F316 / F316 Size : 3" Class : 2500 Lbs Our Fig.n° : LT106-KGG

VALVE CONSTRUCTION

Forged Steel Ball Valves Three Pieces Bolted Construction (Type "TRUNNION CRYO STAR" No. 0)

Trunnion Mounted, Anti - Blow - Out Proof Stem Design, Antistatic Design.

Designed in Conformity to Last Edition of :

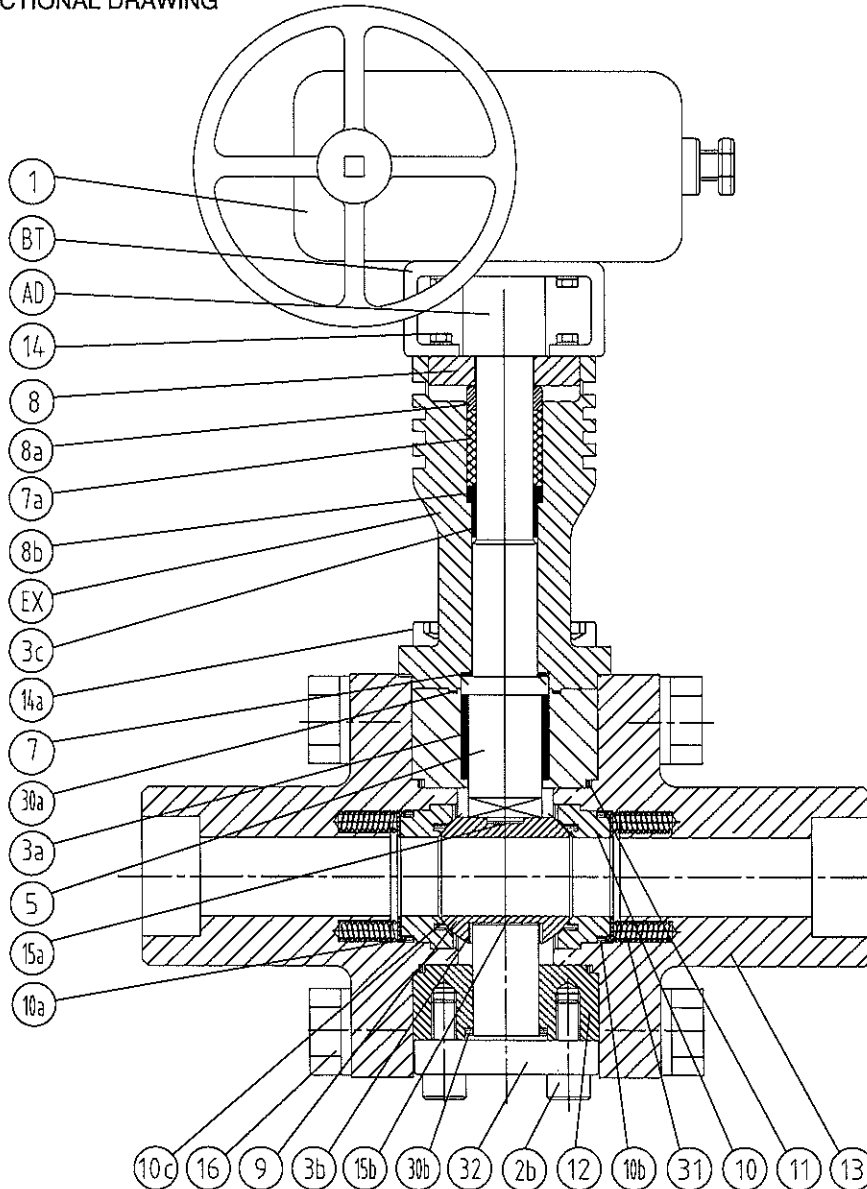
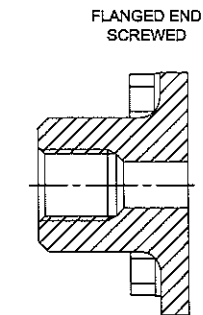
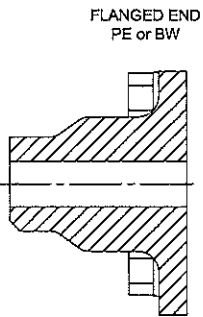
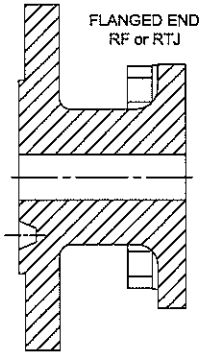
- BS 5351 (EN-ISO-17292) - ASME / ANSI B16.34 - API 6D -

CRYOGENIC TEST CERTIFICATE n° : CRY-0014-LT

Date : 03/07/07

Issued in : S. PAOLO D'ARGON - BG - ITALY

SECTIONAL DRAWING



PART No.	UNIT Q.ty	PART NAME	MATERIAL
NP	1	NAME PLATE	Stainless Steel
EX	1	EXTENTION	S.S. 316
BT	1	BRACKET	Stainless Steel
AD	1	ADAPTOR	Stainless Steel
1	1	GEAR	Cast Iron
2b	4	TRUNNION RETAINER SCREW	Stainless Steel
3a-3b-3c	2+2	STEM / TRUNNION BEARINGS	Stainless Steel+PTFE
5	1	UPPER STEM	S.S. 316
7	1	THRUST WASHER	Stainless Steel+PTFE
* 7a	2	PACKING RING	Graphite
8	1	EXTENTION TOP COVER	S.S. 316
8a	1	GLAND PACKING	S.S. 316
8b	1	STEM RING	S.S. 316
9	1	BALL	S.S. 316
x 10	2	SEAT	S.S. 316
10a	1+1	SEAT RING	S.S. 316
x 10b	2	SEAT SEAL	Graphite
x 10c	2	SEAT INSERT	Kel'f
x 11	2	ADAPTOR SEAL	Graphite
12	1	BODY	S.S. 316
13	2	ADAPTOR FLANGE	S.S. 316
14	8	BRACKET SCREW	Stainless Steel
14a	4	EXTENTION SCREW	A270
15a-15b	1+1	ANTISTATIC SPRING	Stainless Steel
16	12+12	BOLTS	ASTM A193 B8M
x 30a	2	EXTENTION SEAL	Graphite
x 30b	1	TRUNNION SEAL	Graphite
31	6+6	SEAT SPRING	Inconell X 750
32	1	TRUNNION	S.S. 316
37	1	DRAIN PLUG	S.S. 316

*Suggested material after two years service

Lloyd's Register EMEA

Milan Office Witnessed
 Monitored
 Reviewed

Lloyd's Register

G. Fioriello Surveyor

0 03-07-07 First Issue

Rev. Date Reason for revision Made By/Chk'd By/Appr. By

Ball Valves Type : CRYOSTAR (N°0) TRUNNION MOUNTED
Port Design : FULL BORE
Class of Valve : 2500 Lbs
End Connections : SOCKET WELD

STAR LINE 
S. PAOLO D'ARGON BERGAMO ITALY

Starline Fig. n°:LT106-KGG

Drawing n°: STAR-0014-CRY

BALL VALVE TESTED : "TRUNNION CRYO STAR" No. 0

Material : F316 / F316 Size : 4" Class : 2500 Lbs Our Fig.n° : LT106-KGG

VALVE CONSTRUCTION

Forged Steel Ball Valves Three Pieces Bolted Construction (Type "TRUNNION CRYO STAR" No. 0)

Trunnion Mounted, Anti - Blow - Out Proof Stem Design, Antistatic Design.

Designed in Conformity to Last Edition of :

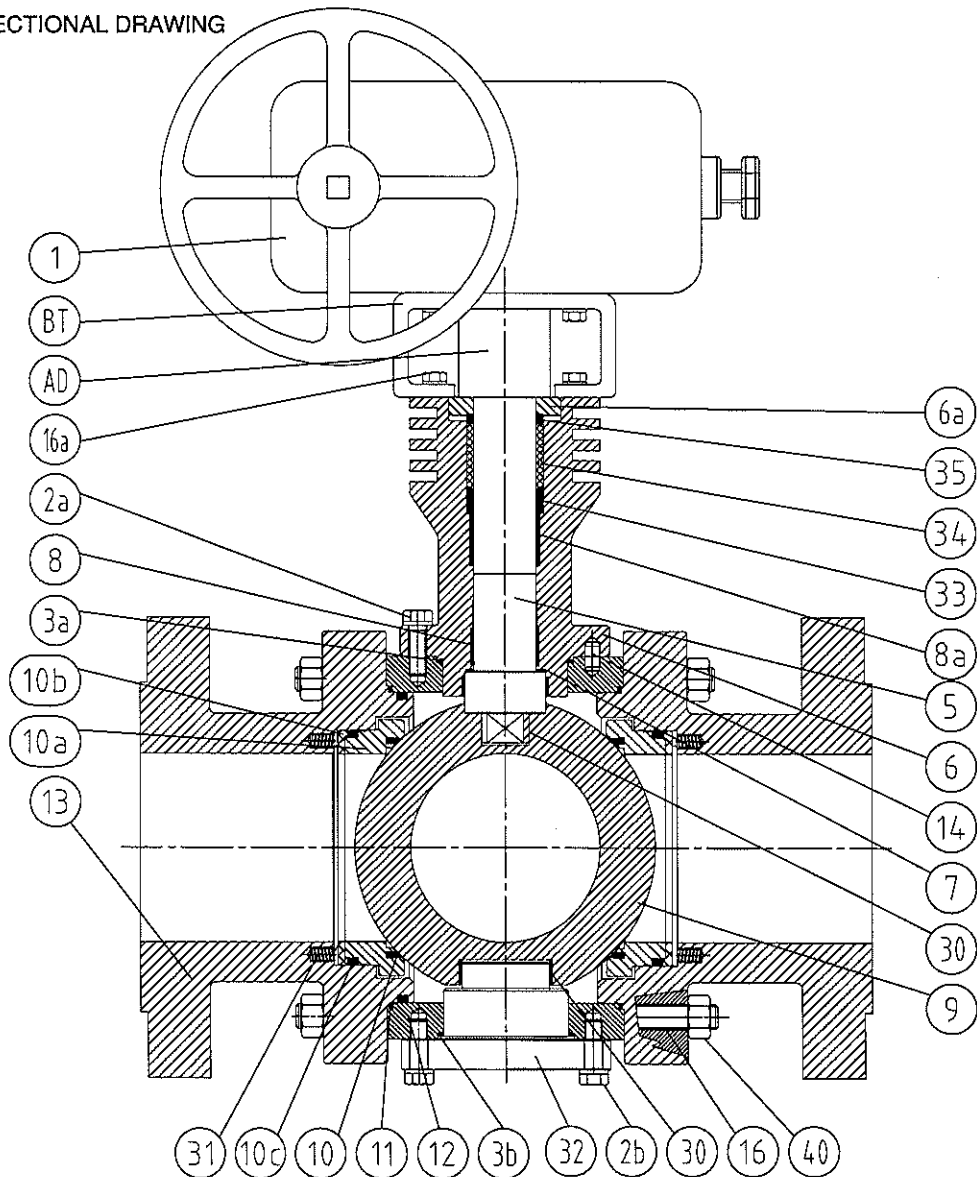
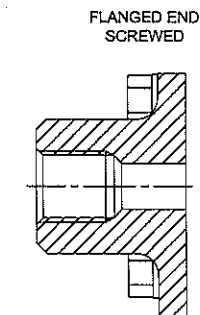
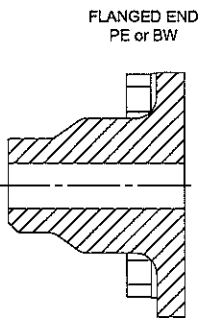
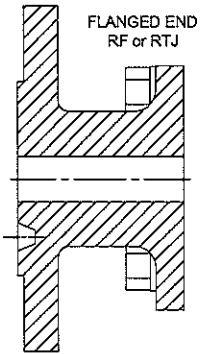
- BS 5351 (EN-ISO-17292) - ASME / ANSI B16.34 - API 6D -

CRYOGENIC TEST CERTIFICATE n° : CRY-0015-LT

Date : 04/07/07

Issued in : S. PAOLO D'ARGON - BG - ITALY

SECTIONAL DRAWING



PART No.	UNIT Qty	PART NAME	MATERIAL
NP	1	Name Plated	Stainless Steel
BT	1	Bracket	Stainless Steel
AD	1	Adaptor	Stainless Steel
1	1	Gear	Cast Iron
2a	4	Top Cover Screw	Stainless Steel
2b	4	Trunnion Retainer Screw	Stainless Steel
x 3a-3b	2+2	Stem/Trunnion Fire Seal	Graphite
5	1	Upper Stem	S.S. 316
6	1	Top Cover	S.S. 316
6a	1	Extension Top Cover	S.S. 316
7	1	Thrust Washer	Stainless Steel+PTFE
8-8a	2	Stem Bearing	Stainless Steel+PTFE
9	1	Ball	S.S. 316
x 10	2	Seat Insert	Kel'f
x 10a	2	Seat	S.S. 316
10b	2	Seat Ring	S.S. 316
x 10c	2	Seat seal	Graphite
x 11	2	Adaptor Fire Seal	Graphite
12	1	Body	S.S. 316
13	2	Adaptor Flange	S.S. 316
14	1	Pin	Stainless Steel
16	14+14	Bolts	ASTM A193 B8M
16a	8	Bracket Screw	Stainless Steel
30	2	Ball Bearing	Stainless Steel+PTFE
31	12+12	Seat Spring	Inconel x 750
32	1	Trunnion	S.S. 316
33	1	Stem Ring	S.S. 316
x 34	2	Packing Ring	Graphite
35	1	Gland Packing	Stainless Steel
37	2	Drain Plug	S.S. 316
40	14+14	Nuts Adaptor Flange	ASTM A194 GR.8

x Recommended Spare Parts

Lloyd's Register EMEA

Milan Office Witnessed
 Monitored
 Reviewed

Lloyd's Register

G. Floriello Surveyor

0	04-07-07	First Issue	
Rev.	Date	Reason for revision	Made By/Chk'd By/Appr. By
		Ball Valves Type : CRYOSTAR (N°0) TRUNNION MOUNTED	
		Port Design : FULL BORE	
		Class of Valve : 2500 Lbs	
		End Connections : SOCKET WELD	

STAR LINE 
S. PAOLO D'ARGON BERGAMO ITALY

Starline Fig. n°: LT106-KGG

Drawing n°: STAR-0015-CRY

BALL VALVE TESTED : "TRUNNION CRYO STAR" No. 0

Material : F316 / F316 Size : 6" Class : 2500 Lbs Our Fig.n° : LT106-KGG

VALVE CONSTRUCTION

Forged Steel Ball Valves Three Pieces Bolted Construction (Type "TRUNNION CRYO STAR" No. 0)

Trunnion Mounted, Anti - Blow - Out Proof Stem Design, Antistatic Design.

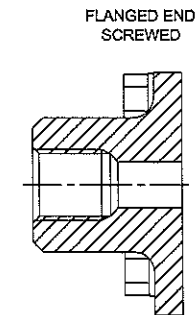
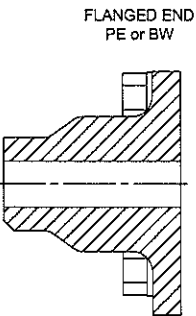
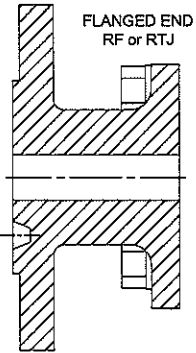
Designed in Conformity to Last Edition of :

- BS 5351 (EN-ISO-17292) - ASME / ANSI B16.34 - API 6D -

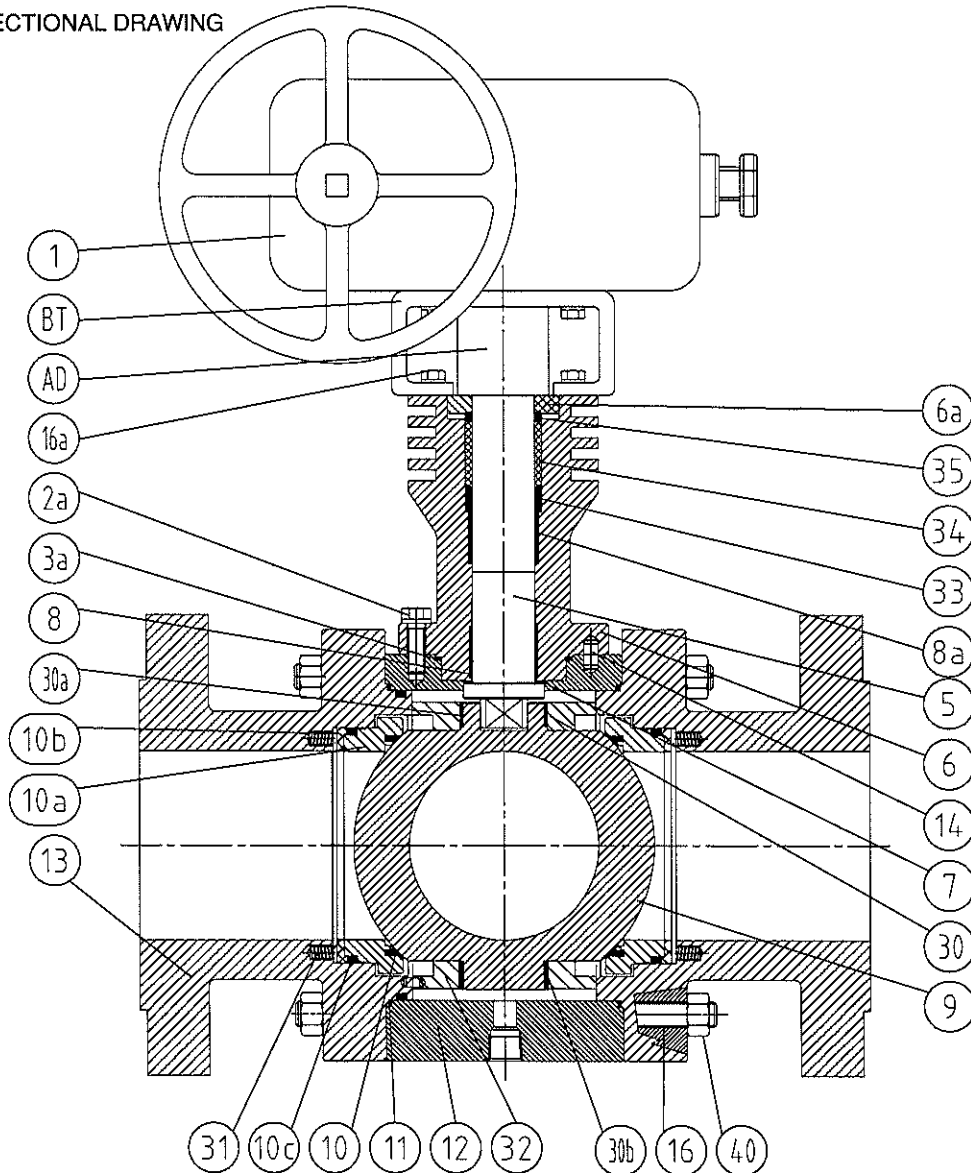
CRYOGENIC TEST CERTIFICATE n° : CRY-0016-LT

Date : 05/07/07

Issued in : S. PAOLO D'ARGON - BG - ITALY



SECTIONAL DRAWING



PART No.	UNIT Q.ty	PART NAME	MATERIAL
NP	1	Name Plated	Stainless Steel
BT	1	Bracket	Stainless Steel
AD	1	Adaptor	Stainless Steel
1	1	Gear	Cast Iron
2a	4	Top Cover Screw	Stainless Steel
x 3-3a	2x2	Stem/Top Cover Fire Seal	Graphite
5	1	Upper Stem	UNS S31803
6	1	Top Cover	S.S. 316
6a	1	Upper Flange	S.S. 316
7	1	Thrust Washer	Stainless Steel+PTFE
8-8a	2	Stem Bearing	Stainless Steel+PTFE
9	1	Ball	UNS S31803
x 10	2	Seat Insert	Kel'f
x 10a	2	Seat	UNS S31803
10b	2	Seat Ring	UNS S31803
x 10c	2	Seat seal	Graphite
x 11	2	Adaptor Fire Seal	Graphite
12	1	Body	S.S. 316
13	2	Adaptor Flange	S.S. 316
14	4+4	Pin	Stainless Steel
16	12+12	Stud Bolts	ASTM A193 B8M
16a	4	Stud Bolts Gear	Stainless Steel
30-30a-30b	2+1+1	Ball/Body/Upper Flange Bearing	DU-DRY
31	16+16	Seat Spring	Inconel x 750
32	2	Bearing Plate	UNS S31803
33	2	Seat Fire Seal	Graphite
x 34	2	Packing Ring	Graphite
35	1	Gland Packing	Stainless Steel
37	2	Drain Plug	S.S. 316
4.0	12+12	Nuts Adaptor Flange	ASTM A194 GR.8
4.1	2	Lifting lug	Stainless Steel
4.2	2	Foot	Stainless Steel

x Recommended Spare Parts

Lloyd's Register EMEA

Milan Office Witnessed

Florillo Monitored

Reviewed

G. Florillo Surveyor



0	05-07-07	First Issue	<i>[Signature]</i>
Rev.	Date	Reason for revision	Made By/Chk & By/ Appr. By
Ball Valves Type : CRYOSTAR (N°0) TRUNNION MOUNTED			
Port Design : FULL BORE			
Class of Valve : 2500 Lbs			
End Connections : SOCKET WELD			

STAR LINE

S. PAOLO D'ARGON BERGAMO ITALY

Starline Fig. n°: LT106-KGG

Drawing n°: STAR-0016-CRY



Project:

Client: STARLINE S.p.A.
S. Paolo d'Argon (Bergamo)

Office: Milan

Clients Order Number:

Date: 29 June 2007

Order Status: Complete

Inspection Dates

First: 06 June 2007

Final: 13 June 2007

This certificate is issued to STARLINE S.p.A. S. Paolo d'Argon Bergamo. The undersigned Surveyor to this Society did attend the work of Messrs Starline S.p.A. for the purpose of witnessing the FIRE TEST in accordance with EN ISO 10497:2004 and ANSI/API 607 Fifth Edition, June 2005 carried out on the following valve selected at random from current production.

DN 150 (NPS 6") CLASS 1500 Lbs-STARLINE FORGED STEEL BALL VALVE, THREE PIECES BOLTED CONSTRUCTION TYPE " CRYO STAR" TRUNNION MOUNTED-FIGURE N. LT 106-KGG ACCORDING TO DWG. FT 509/07E MATERIAL F316/F316

The test conducted on the valve previously subject to hydraulic and air test was as follow:

-The valve, in closed position, filled with water under pressure, was put in a box and exposed to flames with an environmental temperature in the region of the valve of 750 Deg. C to 1000 Deg. C for a period of 30 minutes minimum and established the leakage through the valve and to atmosphere during this period. The temperature was checked by means of calorimeter cubes and flame environment thermocouples and recorded every 30 seconds, while leakage were determined using containers collecting the water leaked during burn period. After cool-down to 100 Deg. C the valve was hydrostatically tested to the low test pressure (applicable only for PN100-CLASS 600 and lower), subsequently operated and tested at the appropriate high test pressure in the fully open position, to assess the pressure containing capability of the valve shell and seats.

All the following values were determined and recorded together with temperature times and pressure as shown on manufacturer's fire test sheet record No. FT 509/07B and fire test chart record FT 509/07C detailing the following points:

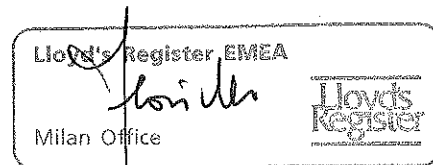
5.1 Through-seat leakage (high test pressure) during burn period	Satisfactory
5.2 External leakage (high test pressure) during burn / cool down periods	Satisfactory
5.3 Through-set leakage (low test pressure) after cool down	Not Applicable
5.4 Operability under high pressure from closed to open position	Satisfactory
5.5 External leakage in fully open position at high pressure	Satisfactory

The valve was subject to visual examination with satisfactory results and subsequently disassembled in order to verify that valve components comply with the drawing and part list supplied by the manufacturer, while seat rings were found completely destroyed.

The manufacturer's documentation No. FT 509/07A erewith attached was satisfactorily checked and signed.

The above is considered in accordance with the above mentioned specifications requirements and therefore the valve has satisfactorily passed the fire test.

gf



Giuseppe FLORIELLO
Surveyor to Lloyd's Register EMEA

A member of the Lloyd's Register Group

Lloyd's Register, its affiliates and subsidiaries and their respective officers, employees or agents are, individually and collectively, referred to in this clause as the 'Lloyd's Register Group'. The Lloyd's Register Group assumes no responsibility and shall not be liable to any person for any loss, damage or expense caused by reliance on the information or advice in this document or howsoever provided, unless that person has signed a contract with the relevant Lloyd's Register Group entity for the provision of this information or advice and in that case any responsibility or liability is exclusively on the terms and conditions set out in that contract.

Project:

Client: STARLINE S.p.A.
S. Paolo d'Argon (Bergamo)

Office: Milan

Clients Order Number:

Date: 29 June 2007

Order Status: Complete

Inspection Dates

First: 06 June 2007

Final: 13 June 2007

This certificate is issued to STARLINE S.p.A. S. Paolo d'Argon Bergamo. The undersigned Surveyor to this Society did attend the work of Messrs Starline S.p.A. for the purpose of witnessing the FIRE TEST in accordance with EN ISO 10497:2004 and ANSI/API 607 Fifth Edition, June 2005 carried out on the following valve selected at random from current production.

DN 50 (NPS 2") CLASS 150 Lbs-STARLINE FORGED STEEL BALL VALVE, THREE PIECES BOLTED CONSTRUCTION TYPE " CRYO STAR" FLOATING BALL-FIGURE N. LT 156-TGG ACCORDING TO DWG. FT 500/07E MATERIAL F316/F316

The test conducted on the valve previously subject to hydraulic and air test was as follow:

-The valve, in closed position, filled with water under pressure, was put in a box and exposed to flames with an environmental temperature in the region of the valve of 750 Deg. C to 1000 Deg. C for a period of 30 minutes minimum and established the leakage through the valve and to atmosphere during this period. The temperature was checked by means of calorimeter cubes and flame environment thermocouples and recorded every 30 seconds, while leakage were determined using containers collecting the water leaked during burn period. After cool-down to 100 Deg. C the valve was hydrostatically tested to the low test pressure (aplicable only for PN100-CLASS 600 and lower), subsequently operated and tested at the appropriate high test pressure in the fully open position, to assess the pressure containing capability of the valve shell and seats.

All the following values were determined and recorded together with temperature times and pressure as shown on manufacturer's fire test sheet record No. FT 500/07B and fire test chart record FT 500/07C detailing the following points:

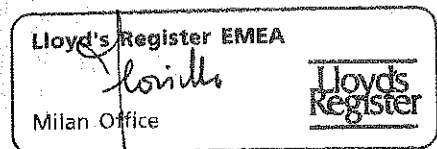
5.1 Through-seat leakage (high test pressure) during burn period	Satisfactory
5.2 External leakage (high test pressure) during burn / cool down periods	Satisfactory
5.3 Through-set leakage (low test pressure) after cool down	Satisfactory
5.4 Operability under high pressure from closed to open position	Satisfactory
5.5 External leakage in fully open position at high pressure	Satisfactory

The valve was subject to visual examination with satisfactory results and subsequently disassembled in order to verify that valve components comply with the drawing and part list supplied by the manufacturer, while seat rings were found completely destroyed.

The manufacturer's documentation No. FT 500/07A erewith attached was satisfactorily checked and signed.

The above is considered in accordance with the above mentioned specifications requirements and therefore the valve has satisfactorily passed the fire test.

gf



Giuseppe FLORIELLO
Surveyor to Lloyd's Register EMEA

A member of the Lloyd's Register Group

Lloyd's Register, its affiliates and subsidiaries and their respective officers, employees or agents are, individually and collectively, referred to in this clause as the 'Lloyd's Register Group'. The Lloyd's Register Group assumes no responsibility and shall not be liable to any person for any loss, damage or expense caused by reliance on the information or advice in this document or howsoever provided, unless that person has signed a contract with the relevant Lloyd's Register Group entity for the provision of this information or advice and in that case any responsibility or liability is exclusively on the terms and conditions set out in that contract.



Project:

Client: STARLINE S.p.A.
S. Paolo d'Argon (Bergamo)

Office: Milan

Clients Order Number:

Date: 29 June 2007

Order Status: Complete

Inspection Dates

First: 06 June 2007

Final: 13 June 2007

This certificate is issued to STARLINE S.p.A. S. Paolo d'Argon Bergamo. The undersigned Surveyor to this Society did attend the work of Messrs Starline S.p.A. for the purpose of witnessing the FIRE TEST in accordance with EN ISO 10497:2004 and ANSI/API 607 Fifth Edition, June 2005 carried out on the following valve selected at random from current production.

DN 50 (NPS 2") CLASS 1500 Lbs-STARLINE FORGED STEEL BALL VALVE, THREE PIECES BOLTED CONSTRUCTION TYPE " CRYO STAR" TRUNNION MOUNTED-FIGURE N. LT 106-KGG ACCORDING TO DWG. FT 506/07E MATERIAL F316/F316

The test conducted on the valve previously subject to hydraulic and air test was as follow:

-The valve, in closed position, filled with water under pressure, was put in a box and exposed to flames with an environmental temperature in the region of the valve of 750 Deg. C to 1000 Deg. C for a period of 30 minutes minimum and established the leakage through the valve and to atmosphere during this period. The temperature was checked by means of calorimeter cubes and flame environment thermocouples and recorded every 30 seconds, while leakage were determined using containers collecting the water leaked during burn period. After cool-down to 100 Deg. C the valve was hydrostatically tested to the low test pressure (applicable only for PN100-CLASS 600 and lower), subsequently operated and tested at the appropriate high test pressure in the fully open position, to assess the pressure containing capability of the valve shell and seats.

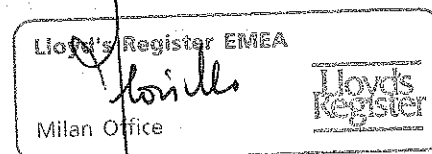
All the following values were determined and recorded together with temperature times and pressure as shown on manufacturer's fire test sheet record No. FT 506/07B and fire test chart record FT 506/07C detailing the following points:

- | | |
|---|----------------|
| 5.1 Through-seat leakage (high test pressure) during burn period | Satisfactory |
| 5.2 External leakage (high test pressure) during burn / cool down periods | Satisfactory |
| 5.3 Through-set leakage (low test pressure) after cool down | Not Applicable |
| 5.4 Operability under high pressure from closed to open position | Satisfactory |
| 5.5 External leakage in fully open position at high pressure | Satisfactory |

The valve was subject to visual examination with satisfactory results and subsequently disassembled in order to verify that valve components comply with the drawing and part list supplied by the manufacturer, while seat rings were found completely destroyed. The manufacturer's documentation No. FT 506/07A erewith attached was satisfactorily checked and signed.

The above is considered in accordance with the above mentioned specifications requirements and therefore the valve has satisfactorily passed the fire test.

gf



Giuseppe FLORIELLO
Surveyor to Lloyd's Register EMEA

A member of the Lloyd's Register Group

Lloyd's Register, its affiliates and subsidiaries and their respective officers, employees or agents are, individually and collectively, referred to in this clause as the 'Lloyd's Register Group'. The Lloyd's Register Group assumes no responsibility and shall not be liable to any person for any loss, damage or expense caused by reliance on the information or advice in this document or howsoever provided, unless that person has signed a contract with the relevant Lloyd's Register Group entity for the provision of this information or advice and in that case any responsibility or liability is exclusively on the terms and conditions set out in that contract.



Project:

Client: STARLINE S.p.A.
S. Paolo d'Argon (Bergamo)

Office: Milan

Clients Order Number:

Date: 29 June 2007

Order Status: Complete

Inspection Dates

First: 06 June 2007

Final: 13 June 2007

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DN 50 (NPS 2") CLASS 1500 Lbs-STARLINE FORGED STEEL BALL VALVE, THREE PIECES BOLTED CONSTRUCTION TYPE " CRYO STAR"
FLOATING BALL-FIGURE N. LT 156-KGG ACCORDING TO DWG. FT 502/07E MATERIAL F316/f316

The test conducted on the valve previously subject to hydraulic and air test was as follow:

-The valve, in closed position, filled with water under pressure, was put in a box and exposed to flames with an environmental temperature in the region of the valve of 750 Deg. C to 1000 Deg. C for a period of 30 minutes minimum and established the leakage through the valve and to atmosphere during this period. The temperature was checked by means of calorimeter cubes and flame environment thermocouples and recorded every 30 seconds, while leakage were determined using containers collecting the water leaked during burn period. After cool-down to 100 Deg. C the valve was hydrostatically tested to the low test pressure (applicable only for PN100-CLASS 600 and lower), subsequently operated and tested at the appropriate high test pressure in the fully open position, to assess the pressure containing capability of the valve shell and seats.

All the following values were determined and recorded together with temperature times and pressure as shown on manufacturer's fire test sheet record No. FT 502/07B and fire test chart record FT 502/07C detailing the following points:

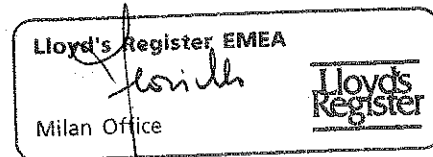
- | | |
|---|----------------|
| 5.1 Through-seat leakage (high test pressure) during burn period | Satisfactory |
| 5.2 External leakage (high test pressure) during burn / cool down periods | Satisfactory |
| 5.3 Through-set leakage (low test pressure) after cool down | Not Applicable |
| 5.4 Operability under high pressure from closed to open position | Satisfactory |
| 5.5 External leakage in fully open position at high pressure | Satisfactory |

The valve was subject to visual examination with satisfactory results and subsequently disassembled in order to verify that valve components comply with the drawing and part list supplied by the manufacturer, while seat rings were found completely destroyed.

The manufacturer's documentation No. FT 502/07A erewith attached was satisfactorily checked and signed.

The above is considered in accordance with the above mentioned specifications requirements and therefore the valve has satisfactorily passed the fire test.

gf



Giuseppe FLORIELLO
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Project:

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S. Paolo d'Argon (Bergamo)

Office: Milan

Clients Order Number:

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DN 50 (NPS 2") CLASS 600 Lbs-STARLINE FORGED STEEL BALL VALVE, THREE PIECES BOLTED CONSTRUCTION TYPE " CRYO STAR" FLOATING BALL-FIGURE N. LT 156-TGG ACCORDING TO DWG. FT 501/07E MATERIAL F316/f316

The test conducted on the valve previously subject to hydraulic and air test was as follow:

-The valve, in closed position, filled with water under pressure, was put in a box and exposed to flames with an environmental temperature in the region of the valve of 750 Deg. C to 1000 Deg. C for a period of 30 minutes minimum and established the leakage through the valve and to atmosphere during this period. The temperature was checked by means of calorimeter cubes and flame environment thermocouples and recorded every 30 seconds, while leakage were determined using containers collecting the water leaked during burn period. After cool-down to 100 Deg. C the valve was hydrostatically tested to the low test pressure (applicable only for PN100-CLASS 600 and lower), subsequently operated and tested at the appropriate high test pressure in the fully open position, to assess the pressure containing capability of the valve shell and seats.

All the following values were determined and recorded together with temperature times and pressure as shown on manufacturer's fire test sheet record No. FT 501/07B and fire test chart record FT 501/07C detailing the following points:

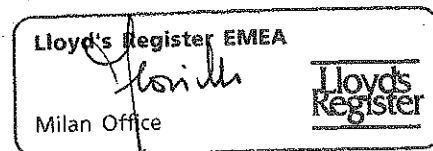
- | | |
|---|--------------|
| 5.1 Through-seat leakage (high test pressure) during burn period | Satisfactory |
| 5.2 External leakage (high test pressure) during burn / cool down periods | Satisfactory |
| 5.3 Through-set leakage (low test pressure) after cool down | Satisfactory |
| 5.4 Operability under high pressure from closed to open position | Satisfactory |
| 5.5 External leakage in fully open position at high pressure | Satisfactory |

The valve was subject to visual examination with satisfactory results and subsequently disassembled in order to verify that valve components comply with the drawing and part list supplied by the manufacturer, while seat rings were found completely destroyed.

The manufacturer's documentation No. FT 501/07A erewith attached was satisfactorily checked and signed.

The above is considered in accordance with the above mentioned specifications requirements and therefore the valve has satisfactorily passed the fire test.

gf



Giuseppe FLORIELLO
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Project:

Client: STARLINE S.p.A.
S. Paolo d'Argon (Bergamo)

Office: Milan

Clients Order Number:

Date: 29 June 2007

Order Status: Complete

Inspection Dates

First: 06 June 2007

Final: 13 June 2007

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DN 50 (NPS 2") CLASS 600 Lbs-STARLINE FORGED STEEL BALL VALVE, THREE PIECES BOLTED CONSTRUCTION TYPE " CRYO STAR"
TRUNNION MOUNTED-FIGURE N. LT 106-TGG ACCORDING TO DWG. FT 505/07E MATERIAL F316/F316

The test conducted on the valve previously subject to hydraulic and air test was as follow:

-The valve, in closed position, filled with water under pressure, was put in a box and exposed to flames with an environmental temperature in the region of the valve of 750 Deg. C to 1000 Deg. C for a period of 30 minutes minimum and established the leakage through the valve and to atmosphere during this period. The temperature was checked by means of calorimeter cubes and flame environment thermocouples and recorded every 30 seconds, while leakage were determined using containers collecting the water leaked during burn period. After cool-down to 100 Deg. C the valve was hydrostatically tested to the low test pressure (applicable only for PN100-CLASS 600 and lower), subsequently operated and tested at the appropriate high test pressure in the fully open position, to assess the pressure containing capability of the valve shell and seats.

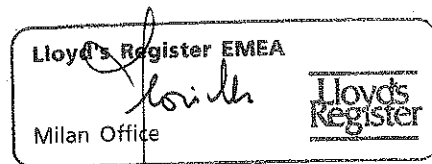
All the following values were determined and recorded together with temperature times and pressure as shown on manufacturer's fire test sheet record No. FT 505/07B and fire test chart record FT 505/07C detailing the following points:

- | | |
|---|--------------|
| 5.1 Through-seat leakage (high test pressure) during burn period | Satisfactory |
| 5.2 External leakage (high test pressure) during burn / cool down periods | Satisfactory |
| 5.3 Through-set leakage (low test pressure) after cool down | Satisfactory |
| 5.4 Operability under high pressure from closed to open position | Satisfactory |
| 5.5 External leakage in fully open position at high pressure | Satisfactory |

The valve was subject to visual examination with satisfactory results and subsequently disassembled in order to verify that valve components comply with the drawing and part list supplied by the manufacturer, while seat rings were found completely destroyed. The manufacturer's documentation No. FT 505/07A erewith attached was satisfactorily checked and signed.

The above is considered in accordance with the above mentioned specifications requirements and therefore the valve has satisfactorily passed the fire test.

gf



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Project:

Client: STARLINE S.p.A.
S. Paolo d'Argon (Bergamo)

Office: Milan

Clients Order Number:

Date: 29 June 2007

Order Status: Complete

Inspection Dates

First: 06 June 2007

Final: 13 June 2007

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DN 150 (NPS 6") CLASS 150 Lbs-STARLINE FORGED STEEL BALL VALVE, THREE PIECES BOLTED CONSTRUCTION TYPE " CRYO STAR" FLOATING BALL-FIGURE N. LT 156-TGG ACCORDING TO DWG. FT 503/07E MATERIAL F316/F316

The test conducted on the valve previously subject to hydraulic and air test was as follow:

-The valve, in closed position, filled with water under pressure, was put in a box and exposed to flames with an environmental temperature in the region of the valve of 750 Deg. C to 1000 Deg. C for a period of 30 minutes minimum and established the leakage through the valve and to atmosphere during this period. The temperature was checked by means of calorimeter cubes and flame environment thermocouples and recorded every 30 seconds, while leakage were determined using containers collecting the water leaked during burn period. After cool-down to 100 Deg. C the valve was hydrostatically tested to the low test pressure (applicable only for PN100-CLASS 600 and lower), subsequently operated and tested at the appropriate high test pressure in the fully open position, to assess the pressure containing capability of the valve shell and seats.

All the following values were determined and recorded together with temperature times and pressure as shown on manufacturer's fire test sheet record No. FT 503/07B and fire test chart record FT 503/07C detailing the following points:

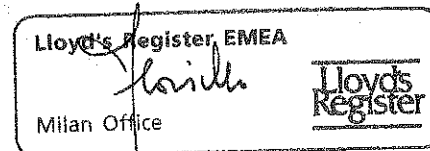
5.1 Through-seat leakage (high test pressure) during burn period	Satisfactory
5.2 External leakage (high test pressure) during burn / cool down periods	Satisfactory
5.3 Through-set leakage (low test pressure) after cool down	Satisfactory
5.4 Operability under high pressure from closed to open position	Satisfactory
5.5 External leakage in fully open position at high pressure	Satisfactory

The valve was subject to visual examination with satisfactory results and subsequently disassembled in order to verify that valve components comply with the drawing and part list supplied by the manufacturer, while seat rings were found completely destroyed.

The manufacturer's documentation No. FT 503/07A erewith attached was satisfactorily checked and signed.

The above is considered in accordance with the above mentioned specifications requirements and therefore the valve has satisfactorily passed the fire test.

gf



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Project:

Client: **STARLINE S.p.A.**
S. Paolo d'Argon (Bergamo)

Office: **Milan**

Clients Order Number:

Date: **29 June 2007**

Order Status: **Complete**

Inspection Dates

First: **06 June 2007**

Final: **13 June 2007**

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DN 150 (NPS 6") CLASS 600 Lbs-STARLINE FORGED STEEL BALL VALVE, THREE PIECES BOLTED CONSTRUCTION TYPE " CRYO STAR" TRUNNION MOUNTED-FIGURE N. LT 106-KGG ACCORDING TO DWG. FT 508/07E MATERIAL F316/F316

The test conducted on the valve previously subject to hydraulic and air test was as follow:

-The valve, in closed position, filled with water under pressure, was put in a box and exposed to flames with an environmental temperature in the region of the valve of 750 Deg. C to 1000 Deg. C for a period of 30 minutes minimum and established the leakage through the valve and to atmosphere during this period. The temperature was checked by means of calorimeter cubes and flame environment thermocouples and recorded every 30 seconds, while leakage were determined using containers collecting the water leaked during burn period. After cool-down to 100 Deg. C the valve was hydrostatically tested to the low test pressure (aplicable only for PN100-CLASS 600 and lower), subsequently operated and tested at the appropriate high test pressure in the fully open position, to assess the pressure containing capability of the valve shell and seats.

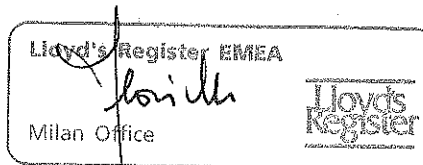
All the following values were determined and recorded together with temperature times and pressure as shown on manufacturer's fire test sheet record No. FT 508/07B and fire test chart record FT 508/07C detailing the following points:

- | | |
|---|--------------|
| 5.1 Through-seat leakage (high test pressure) during burn period | Satisfactory |
| 5.2 External leakage (high test pressure) during burn / cool down periods | Satisfactory |
| 5.3 Through-set leakage (low test pressure) after cool down | Satisfactory |
| 5.4 Operability under high pressure from closed to open position | Satisfactory |
| 5.5 External leakage in fully open position at high pressure | Satisfactory |

The valve was subject to visual examination with satisfactory results and subsequently disassembled in order to verify that valve components comply with the drawing and part list supplied by the manufacturer, while seat rings were found completely destroyed. The manufacturer's documentation No. FT 508/07A herewith attached was satisfactorily checked and signed.

The above is considered in accordance with the above mentioned specifications requirements and therefore the valve has satisfactorily passed the fire test.

gf



Giuseppe FLORIELLO
Surveyor to Lloyd's Register EMEA

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Project:

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Office: Milan

Clients Order Number:

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DN 150 (NPS 6") CLASS 150 Lbs-STARLINE FORGED STEEL BALL VALVE, THREE PIECES BOLTED CONSTRUCTION TYPE " CRYO STAR" TRUNNION MOUNTED-FIGURE N. LT 106-KGG ACCORDING TO DWG. FT 507/07E MATERIAL F316/F316

The test conducted on the valve previously subject to hydraulic and air test was as follow:

-The valve, in closed position, filled with water under pressure, was put in a box and exposed to flames with an environmental temperature in the region of the valve of 750 Deg. C to 1000 Deg. C for a period of 30 minutes minimum and established the leakage through the valve and to atmosphere during this period. The temperature was checked by means of calorimeter cubes and flame environment thermocouples and recorded every 30 seconds, while leakage were determined using containers collecting the water leaked during burn period. After cool-down to 100 Deg. C the valve was hydrostatically tested to the low test pressure (applicable only for PN100-CLASS 600 and lower), subsequently operated and tested at the appropriate high test pressure in the fully open position, to assess the pressure containing capability of the valve shell and seats.

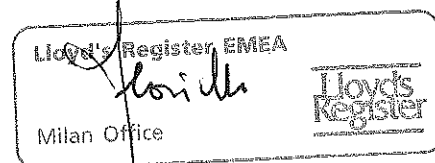
All the following values were determined and recorded together with temperature times and pressure as shown on manufacturer's fire test sheet record No. FT 507/07B and fire test chart record FT 507/07C detailing the following points:

- | | |
|---|--------------|
| 5.1 Through-seat leakage (high test pressure) during burn period | Satisfactory |
| 5.2 External leakage (high test pressure) during burn / cool down periods | Satisfactory |
| 5.3 Through-set leakage (low test pressure) after cool down | Satisfactory |
| 5.4 Operability under high pressure from closed to open position | Satisfactory |
| 5.5 External leakage in fully open position at high pressure | Satisfactory |

The valve was subject to visual examination with satisfactory results and subsequently disassembled in order to verify that valve components comply with the drawing and part list supplied by the manufacturer, while seat rings were found completely destroyed. The manufacturer's documentation No. FT 507/07A erewith attached was satisfactorily checked and signed.

The above is considered in accordance with the above mentioned specifications requirements and therefore the valve has satisfactorily passed the fire test.

gf



Giuseppe FLORIELLO
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DN 50 (NPS 2") CLASS 150 Lbs-STARLINE FORGED STEEL BALL VALVE, THREE PIECES BOLTED CONSTRUCTION TYPE " CRYO STAR" TRUNNION MOUNTED-FIGURE N. LT 106-TGG ACCORDING TO DWG. FT 504/07E MATERIAL F316/F316

The test conducted on the valve previously subject to hydraulic and air test was as follow:

-The valve, in closed position, filled with water under pressure, was put in a box and exposed to flames with an environmental temperature in the region of the valve of 750 Deg. C to 1000 Deg. C for a period of 30 minutes minimum and established the leakage through the valve and to atmosphere during this period. The temperature was checked by means of calorimeter cubes and flame environment thermocouples and recorded every 30 seconds, while leakage were determined using containers collecting the water leaked during burn period. After cool-down to 100 Deg. C the valve was hydrostatically tested to the low test pressure (aplicable only for PN100-CLASS 600 and lower), subsequently operated and tested at the appropriate high test pressure in the fully open position, to assess the pressure containing capability of the valve shell and seats.

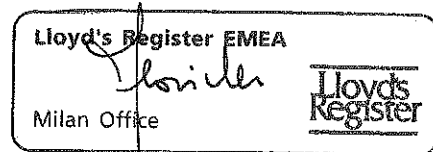
All the following values were determined and recorded together with temperature times and pressure as shown on manufacturer's fire test sheet record No. FT 504/07B and fire test chart record FT 504/07C detailing the following points:

5.1 Through-seat leakage (high test pressure) during burn period	Satisfactory
5.2 External leakage (high test pressure) during burn / cool down periods	Satisfactory
5.3 Through-set leakage (low test pressure) after cool down	Satisfactory
5.4 Operability under high pressure from closed to open position	Satisfactory
5.5 External leakage in fully open position at high pressure	Satisfactory

The valve was subject to visual examination with satisfactory results and subsequently disassembled in order to verify that valve components comply with the drawing and part list supplied by the manufacturer, while seat rings were found completely destroyed. The manufacturer's documentation No. FT 504/07A erewith attached was satisfactorily checked and signed.

The above is considered in accordance with the above mentioned specifications requirements and therefore the valve has satisfactorily passed the fire test.

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