Base Load Power Hub (BLPH)

INSTALLATION, OPERATION AND MAINTENANCE MANUAL

FOR CHECK AND GLOBES VALVES

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1 INTRODUCTION

1.1 PROJECT OVERVIEW

Crosswind, a Shell and Eneco joint venture, was awarded the tender to develop the offshore Hollandse Kust Noord (HKN) wind farm, located 18.5km off the coast of Netherlands near the town of Egmond aan Zee. The consortium plans to have HKN operational in 2023 with an installed capacity of 759MW generating at least 3.3TWh per year. This is sufficient renewable power to supply more than 1 million Dutch households with green electricity.

Offshore wind farms produce intermittent electricity and balancing these dips and peaks and integrating this electricity into the national energy system requires new technologies. For this reason, the offshore wind farm will include several new technologies that could be implemented at full-scale in the future. The new technologies being explored include a floating solar park, a short-duration battery storage as well as long-term storage via green hydrogen produced by water electrolysis and subsequently consumed in a fuel cell. The combination of these individual measures, herein referred to as the Base Load Power Hub (BLPH) will ensure a continuous power supply regardless of the wind situation.

1.1.1 Project Location

The Hollandse Kust Noord (HKN) wind farm is located 18.5km off the coast of the Netherlands near the town of Egmond aan Zee.

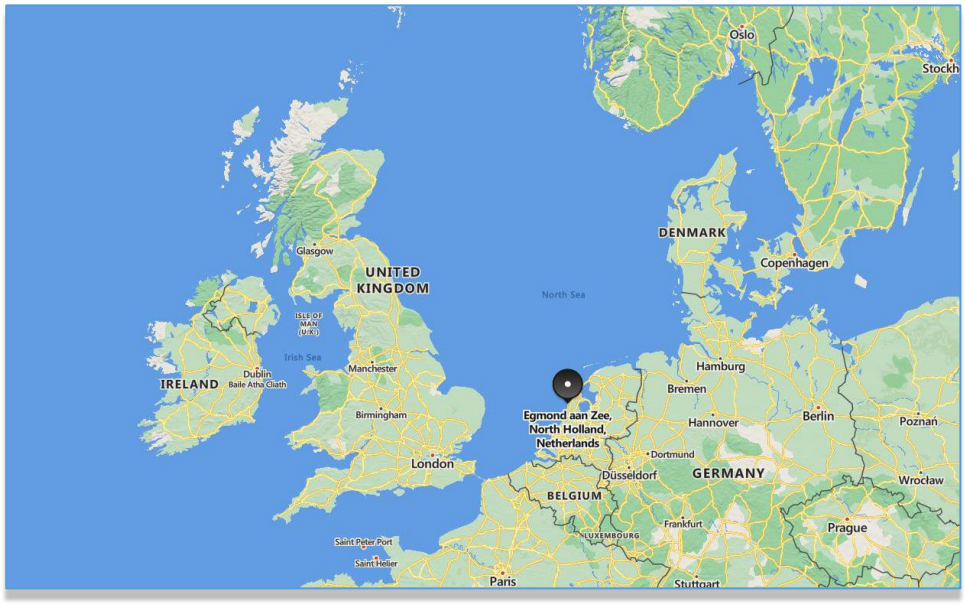


Figure 1 HOLLANDSE KUST NOORD WIND PARK Location Map



Figure 2 - Wind Park Details

The wind farm will consist of No. 69 x 11.5MW wind turbine generators each to be installed on a dedicated monopile structure. A 70th monopile located on coordinates E 590719.1, N 5841602.3 is reserved for installing the platform accommodating the BLPH. The monopile structure was designed and installed by Van Oord Offshore Wind (VooW) and therefore not part of the BLPH scope.

1.1.2 Project Concept

All components included in the BLPH will be integrated onshore on a topsides and installed in an offshore location within the boundaries of the HKN wind farm. At its simplest, the BLPH will store energy during periods of high electricity generation from renewable sources (a wind turbine generator and the floating solar PV farm) and release it during periods of low generation. In practice. It is expected that the energy stored will supplement generation from renewable sources to ensure that at least 1.0MW of power is exported to the electrical grid regardless of wind/solar availability.

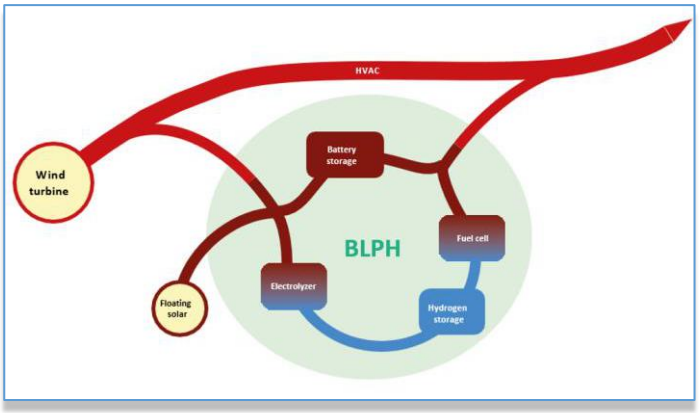


Figure 3 – BLPH Concept

Electricity in the BLPH will be stored in the form of electrons in a battery energy storage system (BESS) as well as converted into green hydrogen via water electrolysis. When the power output from the connecting wind turbine drops to below 1 MWe, the BLPH will return its stored energy to supplement the remaining power output. This will be by discharging the BESS, while stored hydrogen will be converted back into electricity using a fuel cell to extend the discharge duration.

The purpose of the BLPH s to function as a testbed for the integration of energy storage technologies with renewable generation. It is expected that equipment installed on the BLPH will operate as Normally Unmanned Installation for at least two (2) years with no or minimal maintenance and it will have its own independent control room with the ability to communicate with Crosswind's control room.

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2 DOCUMENT SCOPE

The document's scope is to define installation, operation and maintenance instructions.

2.1 REFERENCES

Doc. No.	Description
123A90-DDL-PP-SP-70000	Piping Material Classes
123A90-DDL-PP-DS-70003	Manual Valve Data Sheets
Appendix 1 extracted from doc. 123A90-DDL-PP-LIS-70002	Gate, Globe & Check Valves MTO
123A90-DDL-PP-SP-70030	TSS - Manual Valves & Strainers
1724000799-QC-DB-00008	Factory acceptance test procedure
1724000799-QC-ITP-00002_00	Inspection and test plan

Table 1 - Reference Documents

2.2 DEFINITIONS AND ABBREVIATIONS

COMPANY or Client (CPY):	Crosswind
CONTRACTOR (CTR):	ROSETTI MARINO S.p.A.
PROJECT:	HOLLANDSE KUST NOORD WIND PARK Project

Table 2 - Definitions and Abbreviations

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3 INSTALLATION

3.1 BEFORE USE

The care given to the valves, starting from delivery to the moment of installation is important since in this lapse of time, which is often long lasting, most of the handling takes place.

Even if industrial valves are not delicate objects, they must nevertheless be used with the same care used for any mechanical device.

F.R.I. valves are supplied with appropriate end-protections and/or individual weather-proof packages, which, at the same time, prevent any external agent to get into the valve.

Valves should be kept indoors. If valves are stored outdoors, they should be kept away from the ground and waterproof covers should be used if missing.

IMPORTANT NOTE

Before installation it is important to verify that valves and identification tags show the operating data: type of valves, pressure class, maximum pressures at minimum and maximum temperatures (see relevant paragraph).

The valve should be operated to check possible damages occurred during its transportation and handling. It is also very important to verify that the internal of the valve and of the pipes, the valve will be connected to, are clean. We must in fact not forget that most damages and particularly seating surfaces damages are due to the presence of external objects and debris in the pipes.

After all this, extremities must be checked to be sure that no damage has been caused to the bevels or to flange sealing areas.

3.2 VALVE IDENTIFICATION

Every F.R.I. valve is supplied with an identification nameplate. The identification tag is an important tool during the installation, maintenance steps and for possible spare parts orders.

3.3 OPERATING CONDITIONS

IMPORTANT NOTE

Valves F.R.I. manufactured must be installed and assembled according to the conditions indicated on this manual, and/or according to the pressure conditions and project working temperatures and to the pressure table for hydrostatic and pneumatic tests.

Attachment B shows pressure valves for the hydrostatic test for the most commonly used materials: these valves, like the ones used for the other materials, are in accordance with ANSI/ASME B 16.34 international standards.

If the contract foresees any different value, they will be used for the tests and will therefore be shown on the final inspection certificate.

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IMPORTANT NOTE

Installation method shall prevent dirtiness accumulation inside the valve, which may be dangerous for seat surfaces. If line cleaning methods are used, they shall not accumulate dirtiness and/or debris inside the valve.

During installation and service the packing set shall not leak. Leakages may cause erosion/corrosion damages to the packing material. Packing adjustment may be needed during hydrostatic testing of the line during installation and during temperature start up of the line. Leaking packing sets have to be adjusted to stop the leak.

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4 MAINTENANCE

4.1 GENERAL

Replacement of important parts such as: Body, Bonnet, Stem, Seat and Disc. These parts should be replaced in ours or in a well-equipped workshop.

Maintenance of other parts, easier to check and in case to replace, such as gasket seals, nuts and gland studs, body-bonnet bolts and packing can be easily performed on site.

When needed, F.R.I. Commercial Office can be contacted to obtain correct replacement parts by submitting any possible detail.

F.R.I. s.r.l. does not, anyway, assume any responsibility for any possible damage due to negligence or inattention of the following instructions.

4.2 PERIODIC CHECKS AND MAINTENANCE

Once the valve has been installed properly, it must be checked periodically. The user can perform maintenance.

Once the valve has been installed properly, it must be checked periodically. The user can perform maintenance.

Critical areas of any valve usually are located in the stem threads and in the areas where it is most probable that leakages may occur: packing set, body-bonnet connection, seats, seals and connections between the valve and the pipes.

The most critical part for possible leakages is the stem seal. Any such leakage can be, however, stopped by regulating the packing set or the seal mechanism.

IMPORTANT NOTE

If the stem sealing system adjustment does not stop the leakage, the packing set or seals must be substituted or integrated with additional rings. This operation is dangerous and must be performed by pro

4.3 SAFETY INTEGRATION LEVEL (SIL)

F.R.I valves are certified up to SIL 3 according to following tables. The applicable failure rate (PFD, Probability of Failure on Demand) per valve type strictly depends on test / maintenance and partial stroke frequency. The final user can perform maintenance and partial stroke periodically to grant a lower failure rate.perly trained staff.

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GATE VALVES (SIL 3)

	Gate Valves
λ_{DD}	1,8328E-08
λ_{DU}	9,9068E-10
λ_S	2,3776E-08
λ_{TOT}	4,3095E-08
MRT	24h
MTTR	48h
SFF	>90%
β	0,05
β_D	0,05

PFD estimation

Partial Stroke frequency (months)	Test Interval frequency (months) 6	12	24	36	48
1	9,3228E-06	1,1492E-05	1,5832E-05	2,0171E-05	2,4510E-05
2	1,6012E-05	1,8182E-05	2,2521E-05	2,6860E-05	3,1199E-05
3	2,2702E-05	2,4871E-05	2,9211E-05	3,3550E-05	3,7889E-05
6		4,4940E-05	4,9279E-05	5,3618E-05	5,7958E-05
9				7,3687E-05	
12			8,9417E-05	9,3756E-05	9,8095E-05

NO Partial Stroke Test	Test Interval frequency (months) 6	12	24	36	48
	4,2307E-05	8,4614E-05	1,6923E-04	2,5384E-04	3,3846E-04

Partial Stroke frequency (months)	Test Interval frequency (months) 6	12	24	36	48
1	SIL3	SIL3	SIL3	SIL3	SIL3
2	SIL3	SIL3	SIL3	SIL3	SIL3
3	SIL3	SIL3	SIL3	SIL3	SIL3
6		SIL3	SIL3	SIL3	SIL3
9				SIL3	
12			SIL3	SIL3	SIL3

NO Partial Stroke Test	Test Interval frequency (months) 6	12	24	36	48
	SIL3	SIL3	SIL3	SIL3	SIL3

GLOBE VALVES (SIL 3 with partial stroke & yearly test without partial stroke)

	Globe Valves
λ_{DD}	1,1267E-07
λ_{DU}	5,4296E-09
λ_S	0,0000E+00
λ_{TOT}	1,1809E-07
MRT	24h
MTTR	48h
SFF	>90%
β	0,05
β_D	0,05

PFD estimation

Partial Stroke frequency (months)	Test Interval frequency (months) 6	12	24	36	48
1	5,5848E-05	6,7739E-05	9,1521E-05	1,1530E-04	1,3908E-04
2	9,6971E-05	1,0886E-04	1,3264E-04	1,5643E-04	1,8021E-04
3	1,3809E-04	1,4998E-04	1,7377E-04	1,9755E-04	2,2133E-04
6		2,7335E-04	2,9713E-04	3,2092E-04	3,4470E-04
9				4,4428E-04	
12			5,4387E-04	5,6765E-04	5,9144E-04

NO Partial Stroke Test	Test Interval frequency (months) 6	12	24	36	48
	2,5863E-04	5,1726E-04	1,0345E-03	1,5518E-03	2,0690E-03

Partial Stroke frequency (months)	Test Interval frequency (months) 6	12	24	36	48
1	SIL3	SIL3	SIL3	SIL3	SIL3
2	SIL3	SIL3	SIL3	SIL3	SIL3
3	SIL3	SIL3	SIL3	SIL3	SIL3
6		SIL3	SIL3	SIL3	SIL3
9				SIL3	
12			SIL3	SIL3	SIL3

NO Partial Stroke Test	Test Interval frequency (months) 6	12	24	36	48
	SIL3	SIL3	SIL2	SIL2	SIL2

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CHECK VALVES (SIL 3)

	Check Valves
λ_{DD}	3,3452E-08
λ_{DU}	1,5929E-09
λ_S	5,2567E-08
λ_{TOT}	8,7612E-08
MRT	24h
MTTR	48h
SFF	>90%
β	0,05
β_D	0,05

PFD estimation

Partial Stroke frequency (months)	Test Interval frequency (months) 6	12	24	36	48
1	1,6539E-05	2,0028E-05	2,7005E-05	3,3982E-05	4,0959E-05
2	2,8749E-05	3,2238E-05	3,9215E-05	4,6192E-05	5,3169E-05
3	4,0959E-05	4,4448E-05	5,1425E-05	5,8402E-05	6,5379E-05
6		8,1077E-05	8,8054E-05	9,5032E-05	1,0201E-04
9				1,3166E-04	
12			1,6133E-04	1,6829E-04	1,7527E-04

NO Partial Stroke Test	Test Interval frequency (months) 6	12	24	36	48
	7,6748E-05	1,5350E-04	3,0699E-04	4,6049E-04	6,1398E-04

Partial Stroke frequency (months)	Test Interval frequency (months) 6	12	24	36	48
1	SIL3	SIL3	SIL3	SIL3	SIL3
2	SIL3	SIL3	SIL3	SIL3	SIL3
3	SIL3	SIL3	SIL3	SIL3	SIL3
6		SIL3	SIL3	SIL3	SIL3
9				SIL3	
12			SIL3	SIL3	SIL3

NO Partial Stroke Test	Test Interval frequency (months) 6	12	24	36	48
	SIL3	SIL3	SIL3	SIL3	SIL3

BALL VALVES (SIL 3 with partial stroke & yearly test without partial stroke)

	Ball Valves
λ_{DD}	1,5885E-07
λ_{DU}	8,9912E-09
λ_S	2,3977E-08
λ_{TOT}	1,9181E-07
MRT	24h
MTTR	48h
SFF	95,31%
β	0,05
β_D	0,05

PFD estimation

Partial Stroke frequency (months)	Test Interval frequency (months) 6	12	24	36	48
1	8,1697E-05	1,0139E-04	1,4077E-04	1,8015E-04	2,1953E-04
2	1,3968E-04	1,5937E-04	1,9875E-04	2,3813E-04	2,7751E-04
3	1,9765E-04	2,1735E-04	2,5673E-04	2,9611E-04	3,3549E-04
6		3,9128E-04	4,3066E-04	4,7004E-04	5,0943E-04
9				6,4398E-04	
12			7,7853E-04	8,1792E-04	8,5730E-04

NO Partial Stroke Test	Test Interval frequency (months) 6	12	24	36	48
	3,7159E-04	7,3915E-04	1,4743E-03	2,2094E-03	2,9445E-03

Partial Stroke frequency (months)	Test Interval frequency (months) 6	12	24	36	48
1	SIL3	SIL3	SIL3	SIL3	SIL3
2	SIL3	SIL3	SIL3	SIL3	SIL3
3	SIL3	SIL3	SIL3	SIL3	SIL3
6		SIL3	SIL3	SIL3	SIL3
9				SIL3	
12			SIL3	SIL3	SIL3

NO Partial Stroke Test	Test Interval frequency (months) 6	12	24	36	48
	SIL3	SIL3	SIL2	SIL2	SIL2

5 PACKING SET

5.1 INTRODUCTION

Particular care must be given to the tightening of the packing gland bolts during the installation or after the substitution of the packing set or also during the periodical checks we recommend (it must be noted that due to the natural loss of elasticity in time of the rings of the packing set a further tightening might be needed).

To this regard it must be noted that nowadays great attention is given to the fugitive emissions from valves and general components for petrochemical and related industries. In fact, in some areas, it is compulsory to monitor the emissions caused by the combination stem-packing set, since these are considered as the major cause of emissions in the atmosphere from chemical and petrochemical industries.

Valves at F.R.I. are manufactured according to the main standards and rules. Periodical checks and possible adjustments or substitutions are anyway, obviously, needed.

5.2 RECOMMENDATIONS

Most of the valves at F.R.I. are equipped with multi-use packing sets, which are made of a combination of braided rings at upper and lower ends and of a series of compressed rings in the central sections.

The tightening of the packing gland bolts must guarantee on one side the sealing of the packing set on the stem and on the other side a non-excessive effort to handle the valve.

When the packing gland has reached the half of the packing area, new sealing rings should be added. In order to perform this operation, it would be preferable to clean the stem.

The new rings must be identical to the originals. F.R.I. packing sets may contain inhibitors to prevent any corrosion phenomenon during service according to use and Customer specifications.

It is recommended to order the packing sets from F.R.I. to be sure that all characteristics are apt to the use.

5.3 PACKING SET ADJUSTMENT

The tightening of the packing gland bolts must guarantee on one side the sealing of the packing set on the stem and on the other side a non-excessive force to operate the valve. We suggest to adjust the packing set at least every 20-complete valve opening/closing cycles or after 6 months of continuous functioning in operating conditions.

The adjustment of the packing set is the operation that guarantees what above stated and consists in the tightening and/or loosening of such bolts according to following simple points:

1. The tightening/loosening must be done slowly and alternatively (first one nut then another one) checking that the gland flange is always parallel to the bonnet.

2. The gland flange, subject to movements caused by the operator, must not make horizontal or circular movements with respect to the bonnet flange.
3. The tightening/loosening must be done alternatively by opening and closing operation of the valve in order to settle the packing set and to verify that the operating effort is acceptable.

If, despite the fact that the operator has followed all instructions, some leaks occur or the handling effort is excessive, the packing set will have to be substituted.

5.4 PACKING SET INTEGRATION

When the packing gland has reached the half of the packing area, new sealing rings should be added.

This operation must be done as follows:

1. Put the valves out of service and check that no residual pressure is in it.
2. Remove the packing gland bolts and raise the gland.
3. Remove (where possible) the first sealing ring (type braided graphite) and have the stuffing box ready to accept one or more sealing rings.
4. Divide a sufficient number of replacement rings, put them singularly in the stuffing box using the packing gland to push the rings. Put the rings scattered by 90° when more than one piece will be needed.
5. Tight the packing gland bolts uniformly.
6. Operate the valve a couple of times for adjustment of the packing set and to check that the operating force is acceptable.
7. Put the valve back in service.

5.5 COMPLETE SUBSTITUTION OF THE PACKING SET WITH OUT-OF-SERVICE VALVE

The modern packing sets guarantee a long-lasting service. To guarantee better performances great care must be put in the adequate tightening of the gland studs after the substitution of the packing set.

Indications must be follower:

1. Every part, and in particular the stem, should be cleaned and free from any abrasion;
2. The internal components and the bonnet must be assembled before the assembly of the packing set;
3. Put the cut rings one over the other leaving the cuts scattered by 90°;

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4. Put the packing set together following the original sequence, which is:

- upper ring – braided graphite
- central rings – compressed flexible graphite rings
- lower ring – braided graphite

5. Clean the packing gland bolts;
6. Insert in the stuffing box every single ring following every precaution shown in points 3,4.
7. Tighten the packing gland bolts respecting the tightening criteria.
8. While tightening consider following precautions:

- Proceed slowly and alternatively (first one nut then the other) checking that the gland flange is always parallel to the bonnet flange.
- The gland flange, subject to movements caused by the operator, must not make horizontal or circular movements with respect to the bonnet flange.

9. Operate the valve and check its tightening.

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6 BOLTS AND STUDS

6.1 BODY – BONNET

Substitution does not need particular attention.

Bolts must however be changed one by one in order to prevent pressure loss of the seals. If this is not possible, replace the body-bonnet seal by tightening the bolts in a crossed way.

6.2 PACKING SET

Substitution is done with the valve out of service and does not require particular attention.

It is however absolutely forbidden to substitute the packing set if the valve is working.

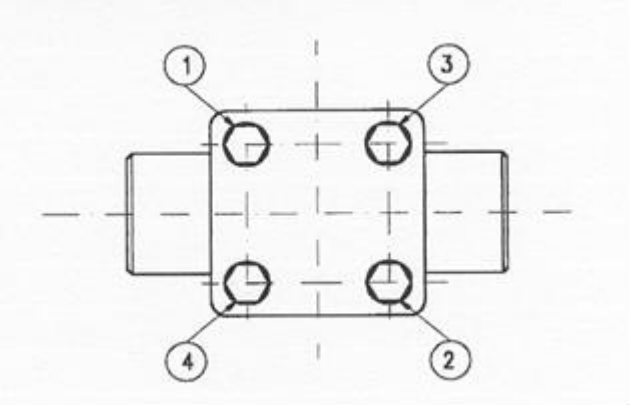
6.3 YOKE

Studs should be substituted when valve is out of service by loosening the bolts and performing usual operations.

This operation must not be done when the valve is working

6.4 BONNET

What already stated above should be followed. Once the substitution is complete a further tightening must be performed to assure sealing. The crossed tightening criteria must be followed.



6.5 FIXING STUDS – MANUAL OR ELECTRIC ACTUATORS

operation must be performed when the valve is out of service and crossed tightening must be done.

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7 MAINTENANCE OF DISC, STEM AND SEATS ON GATE WITH BOLTED BONNET

7.1 DISC

1. Open the valve completely making sure the stem is in the backseat sealing position.
2. Loose the body – bonnet bolts.
3. Remove the bonnet and take the disc out (take note of the coupling sides with the seats, see figure) freeing it from the special stem-to-disc connection.
4. Verify that the sealing areas do not show any scratch, damage or dirt. In case something is found use sand or emery paper to eliminate it taking care that planarity of said areas remains unaltered.
5. Once possible defects are eliminated according to point d, proceed with substitution of the body – bonnet gasket, insert the ring in the connection making sure that it matches with the surfaces of the stem sealing areas as before.
6. Proceed with the tightening of the body – bonnet bolts as described before

IMPORTANT NOTE

Final situation (matching of the seats surfaces) must be identical to the situation before disassembling. Since this matching is the one obtained during the first assembly. If the operator does not follow these instructions F.R.I. CANNOT GUARANTEE perfect sealing between seats and disc and, for this reason, we recommend repeating the hydrostatic test in accordance with the original test specifications.

7.2 STEM

1. Open the valve completely making sure the stem is in the backseat sealing position (valve completely open).
2. Loosen the body – bonnet bolts
3. Remove the bonnet – stem group (leaving the disc inside, where it is). Extract the stem taking it out from the bonnet.
4. Verify that the stem surfaces (in particular the ones in contact with the packing set) are not damaged. If this is not the case, then:
5. Contact our Commercial office giving all needed information as described below to obtain a new stem and substitute it by tightening it clockwise to the bonnet die.
6. Proceed with the substitution of the body – bonnet gasket.
7. Insert the stem in the stem connection, and put the bonnet in the original position. Tighten the body – bonnet bolts as already described.

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7.3 SEATS

No maintenance is foreseen for seats of gate valves, apart from in-line cleaning. They can only be substituted.

Being this a very complicated operation it would be preferable to perform it in our workshop in order to perform also a new testing cycle

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8 DISC, STEM AND SEAT MAINTENANCE OF GLOBE BOLTED BONNET VALVES

8.1 DISC

Verification of the sealing characteristics between the disc and the seat can be done using the below described "BLUEING TEST":

1. Open the valve completely making sure the stem is in the backseat sealing position.
2. Loosen the body – bonnet bolts.
3. Remove the bonnet together with the stem and the disc. Spread a light film of "Prussian" blue on the seat surface, which will be in contact with the disc.
4. Replace the bonnet – stem – disc set in the original position and tighten the bolts as described in the relevant paragraph.
5. Close the valves, wait for 20 seconds (about) and repeat points 1 and 2;
6. Remove the bonnet again and check that the blue trace on the disc is uniform in the contact area. If this is not the case, look for possible scratching or any sign on the sealing surfaces. NOTE: these minor defects can be eliminated by smoothing the disc with very thin sand or emery paper. Make sure that the original planarity of the surfaces is not modified. Any other case is a sign of heavier damages.
7. Contact out Commercial office and submit needed information as described below in order to receive a new disc. The new disc could be substituted by loosening the fixing ring nut to the stem.
8. Replace the body – bonnet gasket.
9. Re-assemble the bonnet – stem – disc set with the valves body and tighten the bolts as described in the relevant paragraph.

8.2 STEM

1. Open the valve completely making sure the stem is in the backseat sealing position.
2. Loosen the body – bonnet bolts.
3. Remove the bonnet together with the stem and the disc.
4. Make sure the stem surfaces are not damaged (especially the ones in contact with the packing set). If this is not the case contact our Commercial office and submit all needed information as described below to obtain a new stem to substitute the damaged one.
5. Substitute the body – bonnet gasket.
6. Re-assemble the body – stem – disc set and tighten the bolts as already described.

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8.3 SEAT

Check the seat as described in previous paragraph from point 1 to point 5.

1. Remove the bonnet again and check that the blue trace on the seat is uniform on all the area in contact with the disc and that there are no damages. If this is not the case, verify if there are any signs on the sealing surfaces. NOTE: these minor defects can be eliminated by smoothing the disc with very thin sand or emery paper. Make sure that the original planarity of the surfaces is not modified.
2. Substitute the body – bonnet gasket.
3. Re-assemble the body – bonnet – stem set and tighten the bolts as already described

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9 MAINTENANCE OF BOLTED BONNET / PRESSURE SEAL CHECK VALVES

For group of Check Valve which includes Swing, Tilting and Lift type disc:

1. Disassemble the valve.
2. Keep a visual check on all the disc contact surfaces.
3. No signs or engravings must appear on the sealing area. If any of these is found pull the connecting plug out and proceed with the disassembling. If possible, use very thin sand or emery paper to eliminate any sign or engraving paying attention that the original form of the surface is not modified. If the result is not satisfactory, contact our Commercial office and submit all needed indications, as shown below, to have replacements. Substitute the old swing, re-assemble all pieces to the bonnet and re-insert the plug.
4. Substitute the body – bonnet gasket.
5. Re-assemble the group and tighten the bolts as described in the relevant paragraph.

9.1 SEATS OF SWING CHECK VALVES

As already indicated for gate valves no maintenance is possible on the seat but only their substitution.

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10 MAINTENANCE FOR PRESSURE SEAL VALVES

10.1 GENERAL

Pressure Seal valves have been developed by F.R.I .due to the important market requests. These valves are particularly indicated to operate at high temperatures and pressures. Designs are made according to ASME codes. Combination of designing, precision mechanical manufacturing and accurate quality checks result in products with high security factors and high reliability indexes.

If a comparison is made with other types of valves, at equal working conditions, Pressure Seal valves show lower weights and dimensions as well as a simpler construction.

The fundamental working principle of Pressure Seal valves is characterized by the fact that the internal pressure of the fluid is used to create the sealing between body and bonnet.

10.2 GASKET RING

Gasket rings have a trapezoidal section and are on the bonnet

10.3 MAINTENANCE OF PRESSURE SEAL VALVES

The maintenance of pressure seal valves follows the same directions as above described for bolted bonnet valves, except substitution, when valve is not in service, of the seal ring. Steps to follow are:

1. Remove the yoke, when applicable.
2. Remove the bonnet retainer flange and lower the bonnet.
3. Remove the sector ring (this ring, cut in sectors, has to be pushed out of its position sector by sector by using a small diameter rod through the proper holes drilled for this purpose on the body neck on a diameter corresponding to the sectors ring).
4. Remove the spacer ring and the seal ring and replace the seal ring with a spare seal ring supplied by the original manufacturer of the valve, after having cleaned the sealing surfaces without altering and/or damaging them.
5. Reassemble the valve following above steps in backwards order. Particular care has to be taken in tightening the bonnet retainer bolts in order to compress the seal ring properly. This operation is very critical for the proper alignment of the sealing components and to obtain sealing at low operating pressures of the valve.

IMPORTANT NOTE:

The operation above described must be performed by experienced personnel. In lack of that the original manufacturer of the valve must be contacted by the user. It is also important that a pressure test of the valve is performed before putting the valve in service, and during the test further proper tightening of the bonnet retainer bolts must be performed. This tightening has to be done when pressure test (closure test) is performed at the maximum rating pressure.

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11 NAME VALVE IDENTIFICATION

Each F.R.I. valve is supplied with an identification nameplate usually put above the yoke. This tag is stamped with a method that can guarantee an easy individuation of possible falsifications.

Legend:

- FRI s.r.l. Logo, name and address
- CE marking symbol and Notified Body Code
- Valve Type
- Valve Nominal Diameter
- Valve Pressure Class
- TAG as Manufacturing identification number
- TAG as per Customer identification code
- Manufacturing Year
- Design Pressure
- Design Temperature
- Testing Pressure
- Body material
- Bonnet material
- Stem material
- Disc or Wedge material
- Seat material
- Fluid Category (if specified by Customer) *
- (Design Code applicable if required)

(*) The Fluid Category is determined in accordance with Regulation No 1272/2008/EC of the European Parliament and of the Council of 16 December 2008 on classification, labeling and packaging of substances and mixtures, amending and repealing Directives 67/548/ EEC and 1999/45/EC, and amending the Regulation No. 907/2006/EC.

IMPORTANT NOTE

If not notified to F.R.I. s.r.l. under contract, it is the responsibility of the Customer / User to adopt the use and safety requirements relating to the fluid used.

IMPORTANT NOTE

The nameplates dimensions are accordingly to valves dimensions and applicable standards and codes design.

12 SPARE PARTS

The use of original spare parts guarantees a better reliability and duration of valves in time. Our commercial office should be contacted for any order for spare parts submitting the identification number of the valve.

Spare parts typically supplied:

- For globes valves 1 set of gaskets + 1 set of packing rings
- For check valves 1 set of valves

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13 DISPOSAL OF THE VALVE

Unless otherwise arranged by the user, the valve must be discharged after 100,000 hours of service at the most or no later than 20 years after the first installation

Disposal and decontamination must be carried out in accordance with current legislation in the country of installation. These activities are under the responsibility of the user unless otherwise agreed.

14 ESSENTIAL SAFETY INSTRUCTIONS

This paragraph describes the minimum essential requisition the user must take into consideration to guarantee security, as define in the European Directive 2014/68/UE (PED).

Security notes are written in bold characters, while the others make reference to the relevant paragraph showing all details

RISK	PREVENTIVE ACTION
Accidental contact with dangerous fluid (toxic, high or low temperature, corrosive fluid ...) which has come out from the gasket.	1) Periodical control of the tightening of the body/bonnet bolts and of the bolts connection pipes. 2) Periodical control of the tightening of the gland studs. 3) Periodical substitution of the gaskets and packing sets. 4) Timely substitution of gaskets and of the packing set after huge leakages 5) **Individual protection devices (masks, gloves, etc.) must be used during maintenance activities.** 6) **Further protection can be foreseen for bolted connections.** 7) Use only suitable and approved materials for gaskets and packing sets. 8) **Avoid any over-pressure in closed cavities due to the temperature increase. If needed venting devices should be installed.** **IMPORTANT NOTE: the protection for exceeding the essential limits (PS, TSmin, TSmax) is under full responsibility of the user**
Accidental contact with service, dangerous fluid (toxic fluid, high or low temperature, corrosive, ...) during maintenance activities.	1) **Discharge pressure completely before any maintenance operation.** 2) **Open and close the valves to equal external pressure, before maintenance operations.** 3) **Empty and let any liquid flow out of the valve before disassembling.** 4) **The liquid out of the valve must be collected in suitable containers.** 5) **Vent the valves when it is disassembled.** 6) **Individual protection devices (masks, gloves, etc.) must be used during maintenance activities.** **IMPORTANT NOTE: the protection for exceeding the essential limits (PS, TSmin, TSmax) is under full responsibility of the user**
Accidental contact with dangerous fluid (toxic, high or low temperature, corrosive fluid ...) which has come out from the gasket.	1) **Periodical control of the tightening of the body/bonnet bolts and of the bolts connection pipes.** **IMPORTANT NOTE: the protection for exceeding the essential limits (PS, TSmin, TSmax) is under full responsibility of the user**

RISK	PREVENTIVE ACTION
Valve distortion with possible risk of contact with dangerous fluids (toxic, high or low with dangerous fluids (toxic, high or low temperature, corrosive fluid…), of explosions or fire	1) Use valves only within the foreseen pressure and temperatures limits. 2) Check periodically valve body should be free from any corrosive or erosive phenomena. 3) Avoid any ram stroke, install if necessary anti-shock device (pressure reducers). 4) Avoid excessive vibration of the valve. 5) Avoid abrupt pressure and/or temperatures variation. 6) Avoid any overpressure in the closed cavities due to the temperature increase – install if needed ventil device. IMPORTANT NOTE: the protection for exceeding the essential limits (PS, TSmin, TSmax) is under full responsibility of the user
Accidental contact with hot or low temperature parts.	1) Individual protection devices (masks, gloves, etc.) must be used during maintenance activities. 2) Arrange valve isolation devices 3) Arrange signals showing possible fire risk 4) For cryogenic service, only extended valves should be used. IMPORTANT NOTE: the protection for exceeding the essential limits (PS, TSmin, TSmax) is under full responsibility of the user
Fire or explosion in case of inflammable fluid service	1) Intrinsic security electrical devices (EEX) should be installed in the area. 2) Periodical check of the tightening of the body – bonnet bolts and of the connection pipe bolts. 3) Periodical check of the tightening of the gland nuts. 4) Periodical substitution of gasket and packing should be done. 5) Tension should be eliminated from the electrical devices in the area during maintenance. 6) Don't smoke and don't use electrical device without intrinsic security. 7) Empty and let flow out any liquid of the valve before disassembling. IMPORTANT NOTE: the protection for exceeding the essential limits (PS, TSmin, TSmax) is under full responsibility of the user

RISK	PREVENTIVE ACTION
Explosion in case of oxygen service	1) Install and use only completely degreased valves. 2) Grease must not be used on valve components. 3) Use valve manufactured with materials adequate to oxygen service. 4) Install in the area only intrinsic security electrical devices (EEX). 5) Periodical check of the tightening of the body – bonnet studs and of the pipe connecting studs. 6) Periodical check of the tightening of the gland studs. 7) Periodical substitution gasket and packing 8) Tension must be eliminated from the electrical devices in the area during maintenance. 9) Don't smoke and don't use electrical devices without intrinsic security. IMPORTANT NOTE: the protection for exceeding the essential limits (PS, TSmin, TSmax) is under full responsibility of the user
Explosion in case of hydrogen service	1) Use valve manufactured with materials adequate to hydrogen service. 2) Install in the area only intrinsic security electrical devices (EEX). 3) Periodical check of the tightening of the body – bonnet studs and of the pipe connecting studs. 4) Periodical check of the tightening of the gland studs. 5) Periodical substitution gasket and packing 6) Tension must be eliminated from the electrical devices in the area during maintenance. 7) Don't smoke and don't use electrical devices without intrinsic security. 8) IMPORTANT NOTE: the protection for exceeding the essential limits (PS, TSmin, TSmax) is under full responsibility of the user

15 PRESSURE TABLE FOR HYDRAULIC TEST IN BAR

	BODY							SEAT AND COUNTERSEAT							SEAT						
	150	300	400	600	900	1500	2500	150	300	400	600	900	1500	2500	150	300	400	600	900	1500	2500
WCB	31.02	77.6	103.4	153.4	231.0	384.4	639.5	21.6	56.1	75.1	112.3	168.4	281	469							
WC1 LC1 LCB	27.6	72.4	96.6	144.8	217.2	360.3	599.9	20.1	52.7	70.2	105.4	158.2	263.2	438.8							
WC4 WC5 WCC LC2 WC6 LC3 WC9 C5 C12 LCC	31.02	77.6	103.5	155.2	232.7	387.9	646.4	22.0	56.9	75.9	113.7	170.7	284.5	474	5.6						
CF8 CF3 CF3M CF8M CF8C	29.3	75.9	100.0	150.0	224.1	372.4	620.6	20.1	54.6	72.8	109.2	163.9	273	455							

16 PRESSURE [BAR] - TEMPERATURE RATINGS

Temp °C	Carbon Steel (WCB -A 105 – LF2)							WC6-F11 Cl. 2						
	150	300	600	800	900	1500	2500	150	300	600	800	900	1500	2500
-30+38	19.7	51.0	102.0	136.1	153.1	255.5	425.4	20.0	51.7	103.4	137.9	155.1	258.6	430.9
93	17.9	46.5	93.1	124.1	139.6	232.7	387.8	17.9	51.7	103.4	137.9	155.1	258.6	430.9
149	15.9	45.2	90.7	120.8	135.8	226.1	377.1	15.9	49.6	99.6	132.7	149.3	248.9	414.7
204	13.8	43.8	87.6	116.5	131.0	218.6	364.0	13.8	47.9	95.5	127.4	143.4	238.9	398.2
260	11.7	41.4	82.7	110.1	123.8	206.5	344.0	11.7	45.9	91.7	122.3	137.6	229.3	382.0
316	9.7	37.9	75.5	100.5	113.1	188.6	314.4	9.7	41.7	83.4	111.2	125.1	208.6	347.5
343	8.6	36.9	74.1	98.7	111.0	185.1	308.5	8.6	40.7	81.0	108.1	121.7	202.7	338.2
371	7.6	36.9	73.4	98.0	110.3	183.7	306.1	7.6	39.3	78.3	104.5	117.6	195.8	326.1
399	6.6	34.8	69.6	92.6	104.1	173.7	289.6	6.6	36.5	73.4	97.8	110.0	183.4	305.4
427	5.5	28.3	56.9	75.7	85.2	142.0	236.5	5.5	35.2	70.0	93.4	105.1	175.1	291.6
454	4.5	18.6	36.9	49.3	55.5	92.4	153.8	4.5	33.4	67.2	89.5	100.7	167.9	279.9
482	3.4	11.7	23.8	31.6	35.5	59.3	98.6	3.4	31.0	62.1	82.7	93.1	154.8	258.2
510	2.4	7.2	14.1	19.0	21.4	35.5	59.3	2.4	22.1	44.1	58.6	65.8	110.0	183.1
538	1.4	3.4	7.2	9.5	10.7	17.9	29.6	1.4	14.8	29.6	39.8	44.8	74.5	124.1
566	-	-	-	-	-	-	-	1.4	10.0	20.0	26.4	29.6	49.6	82.7
593	-	-	-	-	-	-	-	1.4	6.6	13.1	17.7	20.0	33.1	55.2
621	-	-	-	-	-	-	-	1.4	4.1	8.6	11.4	12.8	21.4	35.5
649	-	-	-	-	-	-	-	1.0	2.8	5.2	7.0	7.9	13.1	21.7

Temp °C	WC9-F22 Cl. 3							C5-F5 – F5a						
	150	300	600	800	900	1500	2500	150	300	600	800	900	1500	2500
-30+38	20.0	51.7	103.4	137.9	155.1	258.6	430.9	20.0	51.7	103.4	137.9	155.1	258.6	430.9
93	17.9	51.7	103.4	137.9	155.1	258.6	430.9	17.9	51.4	102.7	137.0	154.1	258.6	427.8
149	15.9	49.6	99.6	133.6	150.7	251.0	418.5	15.9	49.3	98.6	131.7	148.2	246.8	411.3
204	13.8	47.9	97.2	129.6	145.8	243.4	405.4	13.8	48.6	97.2	129.6	145.8	243.4	405.4
260	11.7	45.9	91.7	122.3	137.6	229.3	382.0	11.7	45.9	91.7	122.3	137.6	229.3	382.0
316	9.7	41.7	83.4	111.2	125.1	208.6	347.5	9.7	41.7	83.4	111.2	125.1	208.6	347.5
343	8.6	40.7	81.0	108.1	121.7	202.7	338.2	8.6	40.7	81.0	108.1	121.7	202.7	338.2
371	7.6	39.3	78.3	104.5	117.6	195.8	326.1	7.6	39.3	78.3	104.5	117.6	195.8	326.1
399	6.6	36.5	73.4	97.8	110.0	183.4	305.4	6.6	36.5	72.7	97.1	109.3	182.0	303.4
427	5.5	35.2	70.0	93.4	105.1	175.1	291.6	5.5	35.2	70.0	93.4	105.1	175.1	291.6
454	4.5	33.4	67.2	89.5	100.7	167.9	279.9	4.5	33.4	66.5	88.8	100.0	166.5	277.9
482	3.4	31.0	62.1	82.7	93.1	154.8	258.2	3.4	25.5	51.0	68.0	76.5	127.6	212.7
510	2.4	22.1	52.1	69.3	77.9	130.0	216.8	2.4	19.0	37.9	50.6	56.9	94.5	157.5
538	1.4	14.8	35.9	47.8	53.8	90.0	149.6	1.4	13.8	27.6	36.5	41.0	68.6	114.1
566	1.4	10.0	24.1	32.2	36.2	60.3	100.3	1.4	10.0	20.0	26.4	29.6	49.6	82.7
593	1.4	6.6	15.2	20.2	22.8	37.9	63.1	1.4	6.9	13.8	18.4	20.7	34.1	57.2
621	1.4	4.1	9.3	12.5	14.1	23.8	39.3	1.4	4.1	8.6	11.4	12.8	21.4	35.5
649	1.0	2.8	5.5	7.6	8.6	14.1	23.8	1.0	2.4	4.8	6.4	7.2	11.7	19.7

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Temp °C	C12-F9							C12A-F91						
	150	300	600	800	900	1500	2500	150	300	600	800	900	1500	2500
-30+38	20.0	51.7	103.4	137.9	155.1	258.6	430.9	20.0	51.7	103.4	137.9	155.1	258.6	430.9
93	17.9	51.7	103.4	137.9	155.1	258.6	430.9	17.9	51.7	103.4	137.9	155.1	258.6	430.9
149	15.9	49.6	99.6	133.6	150.7	251.0	418.5	15.9	49.6	99.6	133.6	150.7	251.0	418.5
204	13.8	47.9	97.2	129.6	145.8	243.4	405.4	13.8	47.9	97.2	129.6	145.8	243.4	405.4
260	11.7	45.9	91.7	122.3	137.6	229.3	382.0	11.7	45.9	91.7	122.3	137.6	229.3	382.0
316	9.7	41.7	83.4	111.2	125.1	208.6	347.5	9.7	41.7	83.4	111.2	125.1	208.6	347.5
343	8.6	40.7	81.0	108.1	121.7	202.7	338.2	8.6	40.7	81.0	108.1	121.7	202.7	338.2
371	7.6	39.3	78.3	104.5	117.6	195.8	326.1	7.6	39.3	78.3	104.5	117.6	195.8	326.1
399	6.6	36.5	73.4	97.8	110.0	183.4	305.4	6.6	36.5	73.4	97.8	110.0	183.4	305.4
427	5.5	35.2	70.0	93.4	105.1	175.1	291.6	5.5	35.2	70.0	93.4	105.1	175.1	291.6
454	4.5	33.4	67.2	89.5	100.7	167.9	279.9	4.5	33.4	67.2	89.5	100.7	167.9	279.9
482	3.4	31.0	62.1	82.7	93.1	154.8	258.2	3.4	31.0	62.1	82.7	93.1	154.8	258.2
510	2.4	25.9	52.1	69.3	77.9	130.0	216.8	2.4	26.5	52.1	70.7	80.0	133.1	222.0
538	1.4	17.6	34.8	46.5	52.4	87.6	145.8	1.4	25.2	50.0	66.8	75.2	125.5	208.9
566	1.4	11.7	23.8	31.6	35.5	59.0	98.6	1.4	24.8	49.6	66.2	74.5	124.1	206.8
593	1.4	7.9	15.5	20.8	23.4	39.0	65.2	1.4	20.7	41.7	55.5	62.4	104.1	173.4
621	1.4	5.2	10.3	13.8	15.5	25.9	43.4	1.4	15.5	30.7	41.0	46.2	76.9	127.9
649	1.4	3.4	7.2	9.5	10.7	17.6	29.6	1.4	10.0	20.0	26.4	29.6	49.6	82.7

Temp °C	CF8- F304 – F304H							CF8M-F316 – F316H						
	150	300	600	800	900	1500	2500	150	300	600	800	900	1500	2500
-30+38	19.0	49.6	99.3	132.4	148.9	248.2	413.7	19.0	49.6	99.3	132.4	148.9	248.2	413.7
93	15.9	41.4	82.7	110.3	124.1	206.8	344.7	15.9	42.7	85.5	114.0	128.2	213.4	355.8
149	14.1	37.2	74.5	99.3	111.7	186.2	310.3	14.1	38.6	77.2	103.0	115.8	192.7	321.3
204	13.1	34.1	68.6	91.4	102.7	171.3	285.4	13.1	35.5	70.7	94.3	106.2	177.2	295.1
260	11.7	32.1	64.1	85.5	96.2	160.6	267.5	11.7	33.1	65.8	87.9	98.9	164.8	274.4
316	9.7	30.0	60.3	80.3	90.3	150.7	251.0	9.7	31.0	62.1	83.0	93.4	155.5	259.2
343	8.6	29.6	59.3	79.1	88.9	148.2	246.8	8.6	30.7	61.4	81.6	91.7	153.1	255.1
371	7.6	29.3	58.6	78.1	87.9	146.5	244.1	7.6	29.6	60.0	80.0	90.0	149.6	249.6
399	6.6	28.6	57.2	76.3	85.8	143.1	238.6	6.6	29.3	59.0	78.5	88.3	147.2	245.5
427	5.5	27.9	55.5	74.1	83.4	138.9	231.7	5.5	29.0	58.3	77.6	87.2	145.5	242.7
454	4.5	27.2	54.5	72.9	82.0	136.5	227.5	4.5	29.0	57.6	76.9	86.5	144.1	239.9
482	3.4	26.9	53.8	71.5	80.3	134.1	223.4	3.4	28.6	57.2	76.3	85.8	143.1	238.6
510	2.4	26.2	52.7	70.2	78.9	131.7	219.3	2.4	26.5	53.4	71.1	80.0	133.1	222.0
566	1.4	20.0	42.4	56.7	63.8	106.5	177.2	1.4	23.8	47.2	63.1	71.0	118.6	197.5
593	1.4	17.6	35.5	47.2	53.1	88.6	147.9	1.4	21.0	42.1	56.1	63.1	105.1	175.5
649	1.4	10.7	21.4	28.5	32.1	53.1	88.6	1.4	12.8	25.5	34.0	38.3	63.8	106.5
677	1.4	7.9	15.5	20.8	23.4	39.0	65.2	1.4	10.0	20.3	27.0	30.3	50.7	84.8
704	1.4	5.9	11.7	15.6	17.6	29.6	49.3	1.4	7.9	16.2	21.5	24.1	40.3	66.9
732	1.4	4.1	8.6	11.4	12.8	21.4	35.5	1.4	6.6	13.1	17.7	20.0	33.1	55.2
760	1.4	3.4	6.6	8.8	10.0	16.5	27.6	1.4	5.2	10.3	13.8	15.5	26.2	43.4
816	0.7	1.7	3.8	4.9	5.5	9.3	15.9	0.7	2.8	5.9	7.7	8.6	14.1	23.8

Temp °C	CF3-CF3M-F304L – F316L							F44 – F51 – F53 – F55						
	150	300	600	800	900	1500	2500	150	300	600	800	900	1500	2500
-30+38	15.9	41.4	82.7	110.3	124.1	206.8	344.7	20.0	51.7	103.4	117.2	124.1	206.8	344.7
93	13.4	34.8	70.0	93.2	104.8	174.4	291.0	13.4	34.8	70.0	93.2	104.8	174.4	291.0
149	12.1	31.4	62.7	83.4	93.8	156.5	260.6	12.1	31.4	62.7	83.4	93.8	156.5	260.6
204	11.0	28.6	56.9	76.0	85.5	142.4	237.2	11.0	28.6	56.9	76.0	85.5	142.4	237.2
260	10.0	26.2	52.7	70.2	78.9	131.7	219.3	10.0	26.2	52.7	70.2	78.9	131.7	219.3
316	9.7	24.8	49.6	66.2	74.5	124.1	206.8	9.7	24.8	49.6	66.2	74.5	124.1	206.8
343	8.6	24.1	48.3	64.4	72.4	120.7	201.3	8.6	24.1	48.3	64.4	72.4	120.7	201.3
371	7.6	23.8	47.2	63.1	71.0	118.2	197.2	7.6	23.8	47.2	63.1	71.0	118.2	197.2
399	6.6	23.1	46.2	61.8	69.6	115.8	193.1	6.6	23.1	46.2	61.8	69.6	115.8	193.1
427	5.5	22.8	45.5	60.4	67.9	113.4	188.9	5.5	22.8	45.5	60.4	67.9	113.4	188.9
454	4.5	22.1	44.5	59.2	66.5	111.0	184.8	4.5	22.1	44.5	59.2	66.5	111.0	184.8

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Temp °C	CF8C-F321 – F321H							CF8C-F347 – F347H						
	150	300	600	800	900	1500	2500	150	300	600	800	900	1500	2500
-30+38	19.0	49.6	99.3	132.4	148.9	248.2	413.7	19.0	49.6	99.3	132.4	148.9	248.2	413.7
93	15.9	44.5	88.9	118.6	133.4	222.7	370.9	17.9	45.5	91.0	121.3	136.5	227.5	379.2
149	14.1	41.0	82.0	109.4	123.1	205.1	342.0	14.1	42.4	84.8	113.1	127.2	211.7	353.0
204	13.1	37.9	76.2	101.5	114.1	190.3	317.2	13.1	39.6	78.9	105.4	118.6	197.9	329.6
260	11.7	35.5	71.0	94.7	106.5	177.2	295.4	11.7	37.2	74.5	99.3	111.7	186.2	310.3
316	9.7	33.4	67.2	89.5	100.7	167.9	279.9	9.7	35.5	70.7	94.3	106.2	177.2	295.1
343	8.6	33.1	65.8	87.9	98.9	164.8	274.4	8.6	34.8	69.6	92.6	104.1	173.7	289.6
371	7.6	32.1	64.1	85.5	96.2	160.6	267.5	7.6	34.1	68.3	91.0	102.4	170.3	284.1
399	6.6	31.7	63.1	84.2	94.8	157.9	263.4	6.6	33.8	67.9	90.4	101.7	169.6	282.7
427	5.5	31.0	62.1	83.0	93.4	155.5	259.2	5.5	33.4	67.2	89.5	100.7	167.8	279.9
454	4.5	30.7	61.7	82.2	92.4	153.8	256.5	4.5	33.4	66.9	89.2	100.3	167.2	278.5
482	3.4	30.3	61.0	81.2	91.4	152.4	253.7	3.4	31.0	62.1	82.7	93.1	154.8	258.2
510	2.4	26.5	53.4	71.1	80.0	133.1	222.0	2.4	26.5	53.4	71.1	80.0	133.1	222.0
538	1.4	21.7	43.1	57.6	64.8	107.9	179.6	1.4	24.8	49.6	66.2	74.5	124.1	206.8
593	1.4	18.6	37.6	50.0	56.2	93.8	156.2	1.4	22.4	44.5	59.2	66.5	111.0	185.1
649	1.4	12.8	25.2	33.9	38.3	63.8	106.5	1.4	11.7	23.8	31.6	35.5	59.0	98.6
677	1.4	9.7	19.3	25.7	29.0	48.6	80.7	1.4	8.6	16.9	22.6	25.5	42.4	71.0
704	1.4	7.6	15.2	20.2	22.8	37.9	63.1	1.4	6.6	12.8	17.1	19.3	32.1	53.1
732	1.4	5.9	11.7	15.6	17.6	29.6	49.3	1.4	4.8	9.3	12.5	14.1	23.8	39.3
760	1.4	4.5	9.0	12.0	13.4	22.4	37.6	1.4	3.8	7.6	10.1	11.4	19.0	31.4
816	0.7	2.8	5.2	7.0	7.9	13.1	21.7	1.0	2.4	4.8	6.4	7.2	11.7	19.7

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17 PROCEDURE PWHT AFTER WELDING OF VALVES IN PIPELINE

This procedure is applicable on valves welded in pipelines (BW) and on materials that need a post welding heat treatment. During the PWHT treatment in all types of valves up to 2" (Gate, globe, check), due to the small dimension and face to face length, the temperature is almost the same in all parts of the valve. Therefore, it is impossible to execute a local treatment only on the welding areas.

Due to bigger dimension and Face to Face length for the valves bigger than 2" it is possible to execute the PWHT only on the welded areas (BW) and have the high temperature not affecting all parts of the valve.

In any case before starting the PWHT all valves (small and big) need to be closed, BUT NOT BLOCKED in close position, that means do not apply torque values exceeding 15 N/m in closing the valve. This allows an equal distribution of temperature on all components avoiding any deformation.

The temperatures measured with thermocouples on the welds SHOULD never exceed following values:

MATERIAL LF2 – LCB – A105

These materials don't need a Post Welding Heat Treatment

MATERIAL F22 – WC9

1. Start the PWHT at max 150°C
2. Raise up the temperature of 50°C max per hour
3. Reach max 670°C
4. Hold the temperature for 2 hours for for thickness up to 2" and addictional 1h/in of wall thickness above 2".
5. Reduce temperature by 50°C max per hour
6. Reached the temperature of 150°C let cool down at ambient temperature

MATERIAL F91 – C12A

1. Start the PWHT at max 150°C
2. Raise up the temperature of 50°C max per hour
3. Reach max 700°C
4. Hold the temperature for 2 hours for for thickness up to 2" and addictional 1h/in of wall thickness above 2".
5. Reduce temperature by 50°C max per hour
6. Reached the temperature of 150°C let cool down at ambient temperature

IMPORTANT NOTE

The pipeline and valves must be cleaned accordingly correct procedure and using correct tools.

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