

Operation Instruction Manual

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1 Introduction

Once again, many thanks for showing your confidence in our products by selecting it for use in your plant.

The installation, operation and maintenance instructions in this manual are intended to be used for all valves we supply from our standard product range. They may also apply to non-standard products, as long as the special additional instructions are followed as well; these can be made available upon request or can be found on our website www.hpvalves.com. Also on-line we introduce you to the elementary steps on valve dis- and re-assembly by means of a video presentation. Watch these videos to get started www.hpvalves.com/service/youtube/

2 Safety precautions



In terms of their hazard potential, in addition to being subject to these instructions, our products should also be handled in accordance with general safe handling instructions and on a par with pressure vessels. The handling and use of our valves and products should therefore only be entrusted to properly trained personnel.

Proper installation, operation and maintenance are essential to safe and reliable operation of all products supplied by HP Valves. The procedures described in this manual show effective methods for performing the aforementioned activities.

The installation, operation and maintenance of valves may involve working in proximity to fluids at extremely high pressures and/or high temperatures. To minimize the risk of personal injury or damage to the valve, or rendering it unsafe, it is important to follow the instructions described.

Prior to working with valves or related products, personnel should familiarise themselves with this manual and be fully aware of the hazards related to these procedures.

It is also important to note that "safety messages" are not exhaustive. Due to the broad application of the products supplied, HP Valves cannot possibly complete a full risk analysis related to the installation, operation and maintenance of its products.

The safety precautions listed here are for customer information only. HP Valves Oldenzaal BV waives any responsibility related to any omissions in the precautions and instructions for installation, operation and/or maintenance.

Should anyone decide to install, operate or maintain HP Valves products in a way which differs from the procedures described in this manual, they must make sure that this will not jeopardize personal safety, nor valve reliability.

Furthermore we would like to point out that all personnel handling our products should be trained professionals and instructed properly prior to performing the required activity.

If you are dissatisfied or have any questions regarding the tools or methods described, please contact HP Valves by e-mail or phone. Our contact details are shown on the cover page.

- I Valves are shipped with the packing gland nuts properly tightened, however you should ensure that the packing gland nuts are firmly tightened before pressurizing any valve.
- II Do not attempt to remove the gland flange nuts while the valve is pressurized.
- III Do not attempt to remove the body-bonnet bolts while the valve is pressurized.
- IV All valves supplied by HP Valves with integral, fixed or screwed in backseat are in theory capable of being repacked under pressure. However, due to the inherent dangers involved in working on equipment under pressure, HP Valves strongly recommends that the backseat is only be used to prevent the fluid from escaping through the packing chamber and not used for repacking under pressure.
- V No alteration or modification should be made to any valve or related product, except as sanctioned and/or authorized in writing by HP Valves.
- VI Extreme care should be taken to ensure that the arrow located on the valve-body of all globe and check valves, and possibly for gate valves, is pointing in the same direction as the normal flow direction of the system.
- VII Never install or attempt to use any valve that cannot be properly identified as to its material and/or pressure class.

3 Transport and Storage

Transport

When loading or unloading our products, ensure that they are handled with care and not subjected to sudden knocks. To ensure proper functioning of our products, visually inspect all related products and check and rectify misaligned glands and bonnets of valves.

Heavy valves and/or related products should be handled with a rope slung to the body of the valve or its designated lifting eye. The use of chains is prohibited. Always make sure that the product is securely fixed and the ropes are aligned in such manner they cannot damage the product or any of its parts.

If the products are to be shipped further after unloading, make sure that each individual product is properly secured against damage and properly packaged, taking into account the means of shipment.

Receipt

Unless specified otherwise, products are packed in wooden cases fitted with tarred paper on the inside and a layer of plywood between the layers of valves (if applicable). This kind of packing allows normal requirements for transport to be satisfied, guaranteeing effective resistance against humidity. All products have an adequate protection for storage in a closed environment up to a maximum period of 3 months. Standard protection (if not otherwise specified) includes treatment against rust by means of coating or phosphatising and caps in/on exposed openings, such as valve ends and cable/pneumatic entries. Damaged coating should be touched-up as soon as possible in order to prevent corrosion! If protective caps are removed for inspection purposes, ensure these are refitted in order to maintain cleanliness. If caps are missing we suggest you tape over the openings. If foreign debris has got into the product, remove it immediately. If using a cleaning agent for this purpose, ensure that the proper solvent is used, especially if the valve is installed in piping by means of welding. On receipt of our products, ensure the items can be properly identified and the following documents are available for verification:

- Packing list
- Operation Instruction Manual
- Material and pressure test certificates

Storage

On site, products delivered must be stored properly to protect them against mechanical damage, ingress of foreign objects, water and/or moisture and corrosion. Storage indoors at ambient temperature is preferred. Should it be unavoidable to store the products outdoors, make sure that products are supported off the ground or paving and are protected by a watertight enclosure.

The protective packaging we provide must be left in place during storage and should only be removed prior to installation or commissioning. Make sure stainless steel valves are stored separately from carbon- / alloy steel valves in order to prevent contamination.

The valves supplied should be stored in the position in which they are delivered, this being closed for all manually and motor-operated valves and in fail-safe position for valves with pneumatic actuator.

Long-term storage

The following recommendations should be followed when preparing our products for long-term storage. These are necessary to maintain the valves and related products in a proper condition prior to installation and use. It is the purchaser's responsibility to take the necessary precautions for the protection of products in storage.

On receipt of the products at their destination, the wooden cases supplied should be examined thoroughly for signs of mishandling or damage during shipment, exposure to rain and/or ocean spray or ingress of foreign debris.

If the products are to be stored for more than 3 months, make sure that the storage facilities are in an enclosed, weatherproof building with a concrete floor provided with uniform heating, preferably at ambient temperature, or at least 6°C (43°F), maximum temperature variations and/or relative humidity should not exceed 50%.



Long-term storage outdoors is not permitted, unless otherwise explicitly agreed with HP Valves!

During long-term storage ensure to protect the products against mechanical damage, ingress of rain and/or foreign objects and/or corrosion. Likewise, during long-term storage, the protective packaging we provide must be left in place and only removed prior to installation or commissioning.

Furthermore, we recommend opening open the lid of the wooden cases slightly to allow air circulation; prevent condensation and corrosion (keep the cases covered to protect against ingress of water and foreign debris). Our products are packed with protective caps on/in all openings; do not remove these protective caps unless required for inspection and installation. For storage longer than one year, you could consider removing the packing and applying an absorber, i.e. silica gel, in the correct quantity.

Periodic inspections should be performed on products in long-term storage. The frequency of these inspections should be determined on the basis of storage conditions available. All products should be inspected at least every 4-6 months. Inspect for dirt, moisture or any other type of contamination. If any of the former are found, the product should be thoroughly cleaned and dried.

When products are stored for a long period of time, it is recommended they are labelled as long-term storage items. When these products are ready for use, extra attention should be paid to the condition of the products. Prior to installing valves and/or related products, it is advisable to test these products hydrostatically following visual inspection of the packing and/or gasket and to re-torque all bolts to factory specifications in order to compensate for any possible bolt relaxation.

If high-temperature coatings are applied to our products, superficial corrosion can be found on both interior and exterior surfaces after storage of over more than 6 months, due to the fact these coatings require heating to obtain full curing. This superficial corrosion does not affect the functionality of the valve.

To protect uncoated surfaces from corrosion, treat these surfaces with a rust-prevention agent, such as: Cortec VpIC377 or a similar product.

4 Valve Installation

Installation

The purchaser, contractor or end-user has overall responsibility for the positioning, installation and operation of the products supplied in the plant.

Planning and installation errors can affect the proper operation of valves and related products, and may even constitute a major hazard potential (e.g. incorrect positioning of check valves or wrong direction of flow). So please take notice of the following safety precautions;



- **Before fitting the valve in position, remove the protective caps from the flange, butt weld, socket weld or threaded ends. The valve must be free of all foreign matter. Cleanliness is the cardinal rule when fitting valves. If the pipe-ends require machining, foreign matter must be removed prior to installation of the valve.**
- **The operating limits of the valve must be at least the same as, or exceed the operating limits of the adjacent piping. Relevant pressure-temperature tables should be respected – these can be found in section 10 of this OIM and on our corporate website www.hpvalves.com**

- Direction

Check, globe and control valves are supplied with an arrow stamped on the body, which indicates flow direction.

When fitting these valves, be aware that the arrow located on the valve-body points in the same direction as the normal flow direction of the system.

Standard gate valves are bi-directional and therefore not marked with a flow direction arrow. If gate valves are equipped with special features e.g. a bonnet equalizing device or by-pass, the valve might be unidirectional and if so, this is marked with a flow direction arrow.

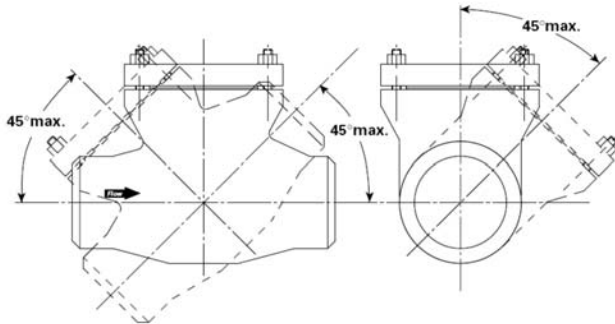
- Position

It is recommended to install gate and globe valves with the stem in the vertical position and in horizontal lines. This orientation provides enhanced packing life and simplifies disassembly and re-assembly. In case of restricted space, these valves may be installed tilted at an angle (max 45°) between the vertical and the horizontal plane. Ensure proper drainage of the bonnet area is not compromised.

When installed in vertical lines or with the stem tilted at an angle over 45°, possible build-up of debris in the bonnet area can occur and may ultimately lead to packing erosion and/or damage to the stem.

In the case of actuated valves, external support for the actuator should be provided to avoid damage and unwanted strain that could cause valve or actuator malfunctioning and reduce service life.

Check valves (swing-, piston- and ball type) are fitted in either vertical or horizontal lines. If piston- or ball type check valves are to be installed in vertical lines, they should be spring-assisted. In case of small bore swing- and Y-type check valves, ensure the flow direction is facing up. For large bore swing type check valves it is recommended to not exceed 45° inclined / slant position, where we recommend to limit this position for large bore tilting disc valves to 30° maximum.



Control valves should be fitted with the stem in the vertical position and in horizontal lines.

In general stop/check valves, check valves and control valves should be installed in a straight run of pipe, preferably away from bends or sections of pipe operated at very high velocities. Ideally, ten (10) pipe diameters of straight pipe should be allowed upstream and five (5) pipe diameters of straight pipe downstream of the valve.

Welding

The contractor is responsible for welding valves into the piping and for any heat treatment that may be necessary. All welding should be performed in compliance with applicable standards, by qualified welding personnel and with the equipment required to obtain operator safeguard and secure material integrity.

Valves must be welded when they are in their fully closed position. When fitting the valve into the pipe, make sure that the flow direction matches the arrow marked on the valve-body. If there is no arrow on the valve, the valve is bi-directional.

The pipe-ends must be properly aligned so as to prevent the valve being subjected to unnecessary strain.

When welding valves with socket weld (SW) ends, make sure that the valve is installed using approximately 2.0 mm clearance between the bottom of the socket and the end of the inserted pipe; this allows for expansion of the pipe-end during welding.

When welding the valve into the pipe, the valve may remain in its fully assembled condition; the metal seated valves do not have to be disassembled before welding.

Prior to welding, make sure the valve is in its fully closed position to minimize the risk of any weld spattering reaching the seat facing. In case of motor- or pneumatically actuated valves, the emergency handwheel can be used to close the valves. Before welding make sure that the actuator is not connected to the power and/or air-supply. For valves with a fail-safe-to-open actuator without emergency handwheel, welding of the valve in its fail-safe position is acceptable.

For control valves completed with soft seated trim, temperatures during welding shall not exceed 240°C / 464°F. If temperatures exceed the stated maximum value, the valve should be dismantled prior to the welding activities. Upon completion of the welding activities, reassembly of soft seated control valves should always be completed with new gaskets and seals.

It is prohibited to attach the welding cable (ground terminal) to the yoke, stem, handwheel or any other part of the upper valve assembly. The ground terminal should be attached to an area on the valve body which is free of coating or, even better, on the adjacent pipe itself.

- Heat treatment

Heat treatment has to be performed in compliance with the applicable standards / guidelines and with the valve in a slightly opened position. Heating should only be applied by inductive means or by resistance heating pads on the welding area to prevent damage occurring. If post-weld heat treatment is performed and temperatures in excess of 650°C (1200°F) are expected at the bonnet- / packing area, disassembly of the valve is strongly recommended prior to heat treatment since packing and/or gasket material could deteriorate at higher temperatures. A useful tool to monitor the temperature of this area during heat treatment is an infrared thermometer or use a thermocouple.

For control valves the temperature at the valve body web should be monitored and, to prevent component damage, not allowed to exceed 240°C / 464°F.

Threaded valves

When fitting threaded-end valves, it is important to ensure that both the valve- and pipe threads are clean and undamaged. During installation of threaded-end valves onto piping, make sure to use the correct sealing material for the threaded connection and apply no more material than is required. It is mandatory to hold on to the valve body and prohibited to hold the valve in place using the handwheel or the yoke whilst screwing in and tightening, since this may cause damage to the valve.

Flanges / hubs

When fitting flanged end valves, it is important to ensure that both the valve and pipe flange surfaces are clean and undamaged. Depending on the flange type, apply the correct gasket between the valve and the adjacent flanges. Make sure to align the valve and the adjacent piping properly in order to eliminate stress to the installation and prevent the creation of a possible leak path. Flange bolting should take place in compliance with the flange pressure class and its corresponding specifications. Always apply the correct torque value for flange bolting whilst installing flanged end valves.

Actuator setting

All valves supplied with a motor- or pneumatic actuator are factory tested. The contractor or end-user has overall responsibility for installation of electrical and/or pneumatic connections to the actuated valve. More details on actuator terminal connections and setting instructions can be found in the corresponding actuator manual.

Preservation

- Shot blasting

If, for any reason valves are shot-blasted, make sure to prevent ingress of blasting abrasive into the gland and/or packing chamber; afterwards it is mandatory to clean the valves thoroughly. Before starting to shot blast, make sure the valves are in their fully closed positions and stems are properly protected. For pressure sealed valves, the bonnet area should also be protected against ingress of blasting abrasive.

- Painting

Make sure valves are in their fully closed position. Moving parts, stems and identification plates should not be painted and need to be protected. Before applying additional layers of paint, check the compatibility with the coating systems already applied.

- Insulation



Gland bolting and bonnet bolting should be accessible after insulation. Make sure the tightness of the stem packing can be checked without removing the insulation and especially for pressure sealed valves, accessibility of bonnet bolting is mandatory.

For control valves acoustic insulation could be applied to meet particular noise specifications. Ensure that all supports, fittings, or other rigid connections to the downstream pipe are thoroughly insulated as well, since these components also can become a source of noise radiation.

System cleaning

- Steam blowing

Before steam blowing, ensure the valves are in their fully open position. The aforementioned does not apply in the case of check valves, control valves and strainers, but it is recommended the internals of these fittings are removed before steam blowing. It is permitted to use both puff and thermal cycle steam blow procedures on our products. When performing thermal cycle steam blow, in order to protect the valves and their internals, utmost care should be taken to avoid excessive thermal fluctuation in cooling and heating curves.

If thermal fluctuation is greater than 100°C/hr (180°F/hr), damage can occur to discs, seats and/or internal guide structures.

- Flushing

Before chemical treatment, ensure valves are in their fully open position. The aforementioned does not apply for check valves, control valves and strainers, but it is recommended the internals of these products are removed before chemical treatment. Failure to do this could result in welding scale, debris or other foreign matter getting trapped between the valve plug and seat/cage, causing damage to one or both faces. Valves should be set to an almost open position in order to facilitate thorough flushing of the valve internals after pickling is performed.

- Cleaning / pickling

Applying the correct pickling process is the sole responsibility of the contractor. In case of doubt, HP Valves should be contacted. Before commencing the pickling process, the valves should be in their fully open position to prevent ingress of pickling medium in the packing area. After pickling, the system should be thoroughly flushed.

During flushing after pickling, the valves should be set in an almost open position in order to facilitate thorough flushing of the valve internals. Generally, it is recommended the system's non-operational time is minimized after pickling. Depending on the pickling medium and process applied, a maximum of one day could be used as general recommendation.

- Hydrostatic testing

During hydrostatic testing it is recommended to set motor operated and/or pneumatic operated globe- and/or stop/check valves in their opened position, unless specified otherwise. After completion of hydrostatic testing, all valves should be drained to prevent trapped water in the bonnet area to freeze up under cold conditions or cause over pressurisation of the bonnet area during first heat.

5 Valve Operation



- **Since valves are frequently subjected to high temperatures, protective clothing (particularly gloves) should be worn during operation.**
- **Gate & Globe valves should only be used in their fully open or closed position, in case intermediate position is required a throttle type globe valve should be used instead. Make sure minimum opening percentage remains at $\geq 20\%$, as valves opened at $< 20\%$ are highly susceptible to seat and/or plug erosion.**
- **When a main valve is equipped with a special safety device, such as an over pressure safety valve or equalizing valve, these devices shall be kept in their (locked) open position during normal operation of the main valve.**
- **The valve drawings shall be checked for actual valve configuration and additional instructions.**
- **Valves are not grounded against static electricity.**

Manual

Valves close when the handwheel is rotated clockwise. The handwheel size is selected on the basis of the valve type and design conditions. The use of spanners or pipes to increase leverage can damage the valves and are therefore not

permitted. If valves do not seal using the normal operating mechanism, often spanners will not solve the problem because other reasons, such as trapped foreign objects, damaged sealing surfaces, misaligned glands or scoured stems - rather than a handwheel of insufficient size - will prevent the valve from fully closing.

In the case of parallel slide gate valves, be aware that the stopper on the valve stem is set to secure the valve is shut in its closed position. "Over-tightening" will only lead the stopper becoming bent and the valve internals being damaged.

Electric

Valves fitted with an electric actuator must be connected and operated in compliance with the actuator manufacturer's instructions (please refer to the actuator manual).

In general, the following settings are used for motor-operated valves:

Valve type	Open switch	Close switch
Globe	Limit	Torque
Stop/check	Limit	Torque
Solid wedge gate	Limit	Torque
Flexible wedge gate	Limit	Limit
Parallel slide gate	Limit	Limit

The handwheel on electric actuators is for emergency operation only; it should be disengaged during normal operation and only engaged for manual operation when required in an emergency situation.

Pneumatic

Valves fitted with a pneumatic actuator must be connected and operated in compliance with the manufacturer's instructions (please refer to the actuator manual).

The handwheel (optional) on pneumatic actuators is for emergency operation only; it should be set in its neutral position during normal operation and only engaged after the actuator has been fully depressurized for manual operation in an emergency.

General recommendations

Medium and high-pressure vent and drain valves are often placed in tandem, where the upstream valve is used as "isolator" and the downstream valve as "regulator". To prevent damage to the disc and the seat of the upstream "isolator", both valves need to be operated in the following sequence:

Opening	Closing
1 st Open Isolator	1 st Close Regulator
2 nd Open Regulator	2 nd Close Isolator

6 Start-up & Commissioning

Packing & Gasket

On commissioning and during operating, check the stem packing and bonnet gasket for leakage. If any leakage is observed, tighten the gland- and/or bonnet bolting immediately to stop this leakage and to prevent erosion of the stem packing or bonnet gasket. If a (control) valve equipped with a PTFE packing is found leaking, the packing should be replaced rather than retightened.

If a valve has been designated as a long-term storage item, extra attention should be paid to its packing and gasket. Deterioration of these parts may cause the valve to leak, in which case the gland and/or bonnet bolts should be retightened or the packing and/or gasket replaced. If the packing and/or gasket need to be replaced, check our disassembly & re-assembly instructions, submitted separately, for detailed instructions.

After installation, check the position of the gland; make sure there is no contact between the gland and the stem surface.



During initial operations under service conditions, both after installation and after disassembly, all bonnet bolting on pressure sealed valves should be tightened (hot-torqued) to ensure proper sealing of the gasket and to prevent misalignment of the bonnet.

- Retightening the stem packing / bonnet gasket

In the event of any leakage through the stem packing, the gland bolting needs to be retightened sufficiently to compress the stem packing and stop the leakage and so prevent erosion and possible blow out of the stem packing.

If leakage through the bonnet gasket occurs, the bonnet bolting needs to be retightened sufficiently to compress the bonnet gasket and stop the leakage and so prevent erosion of the bonnet gasket.

The factory torque values indicate the approximate required value for different valve types, sizes and pressure classes and are stipulated in the maintenance instructions in section 7 of this manual.

Precautions

To prevent damage and leakage of valves due to rapid heating or cooling, standard temperature rise rates, approximately 100°C/hr (180°F/hr) should not be exceeded.



- o **It is the responsibility of the contractor to apply the correct temperature rise rates.**
- o **During the start-up process, avoid water hammer as this may damage the valves.**

Seat and obturator

If the valves are reported to be leaking through the seat during start-up and/or commissioning, this is usually caused by debris and/or foreign particles. If leakage is identified, try to flush the valves by opening and closing them with sufficient flow. If seat leakage remains, stop operations immediately and disassemble the valve for inspection and to clean the internals. Failing to do so may lead to damaged valve internals. Check our disassembly & re-assembly instructions, submitted separately, for detailed instructions.

Pressure locking

Pressure locking is a phenomenon that can occur to high pressure gate valves with pressure seal bonnet. It causes the valve to become inoperable and occurs when the valve is closed and pressure in the body cavity increases or when the pressure decreases in the line but remains in the valve body cavity.

In order to relieve the body cavity on a valve with no equalizing device installed, we would advise you to loosen the gland bolting and bleed the overpressure through the packing.

This procedure should be performed with the utmost care and should only be entrusted to skilled personnel. Attempting to operate the valve whilst being pressure locked by using a handwheel lever is prohibited and can cause severe damage to the valve internals.

Thermal binding

Thermal binding is a phenomenon that can occur to wedge type gate valves. It occurs when the valve is closed while the system is hot and then allowed to cool before opening the valve. Attempting to operate the valve by using a handwheel lever whilst it is being subjected to thermal binding is prohibited and can cause severe damage to the valve internals. Instead, allow the valve to heat up uniformly in order to relieve the thermal binding.

We recommend to install a by-pass line in case the main valve is in high temperature service and operating procedures cause thermal binding.

7 Maintenance

General



Before undertaking maintenance and/or (dis)assembly activities, please read the general safety precautions and relevant safety rules of the plant.

Our products must be serviced regularly to ensure trouble-free operation. Typical maintenance includes inspection of the gland and pressure seal construction. Furthermore, it is recommended a functional test is performed at least every 3 months. Early detection of minor defects will prevent malfunctioning or major repairs in the future.



Before undertaking maintenance and/or (dis)assembly activities, make sure that the valve is free of pressure, sufficiently cooled and the system is free of hazardous media (steam, water or acid).

Formal risk analysis, e.g. as per PED 97/23/EC, does not allow repacking valves under pressure. Because of the risks for operating personnel, this applies to valves with floating backseat which do not permit renewal of the packing under pressure, but also for valves with fixed or integral backseat.

On-line we introduce you to the elementary steps on valve dis- and re-assembly by means of a video presentation. www.hpvalves.com/service/youtube/

Please note that the explanatory videos are meant to support and not to replace this manual. Proper installation, operation and maintenance are essential to safe and reliable operation of all products supplied by HP Valves and require compliance with the precautions and instructions in this manual.

Lubrication

Thanks to the design of our hand operated valves, little to no lubrication is required for proper functioning. Depending on the location of the valves, we recommend the following:

If lubrication is applied, make sure to clean the lubricated parts thoroughly before applying fresh high temperature grease. Apply a limited amount of grease with a brush on the threaded part of the stem as a thin grease film. If the hand operated valves are equipped with grease fittings, apply a limited amount of grease using a grease gun every 6 months.

For hand operated valves located outdoors we would advise not to use lubrication on exposed parts, since this will only attract sand and dust.

For motor operated valves, we advise to lubricate the stem thread and drive nut once every 6 months.

Actuators:

For lubrication instructions for actuators (electric actuators or bevel gears) please refer to the actuator maintenance manual. Compressed air used for operating pneumatic actuators shall be free of oil.

Cleaning

The frequency and extent of cleaning depends on the location of the valve and its service conditions. It is important that the stem, packing and gland are kept clean and free of foreign material. Do not allow water or dirt to accumulate in body cavities. Accumulation of any corrosive or extraneous material may interfere with removal of valve parts during disassembly. Excessive rust should not be allowed to build up on valves: if any is detected it is recommended this is removed and an anti-rust agent applied.

Disassembly & re-assembly

Please refer to the attached disassembly & reassembly section for valve specific instructions (for non-standard valves: available upon request) or visit our website www.hpvalves.com/service/ for additional online content.

Spare parts

When, during inspection, it becomes apparent parts need to be replaced, it is mandatory to use genuine parts to guarantee proper fit and operation of our products after re-assembly.



The use of packing cord is prohibited unless specifically agreed with the valve manufacturer. Only genuine packing materials should be used.

When ordering spare parts, please specify the following:
Type of valve, year of manufacture, nominal diameter, body markings, pressure rating, drawing number and (when possible) the purchase order number under which the products were supplied.

If you have any questions on this matter, please contact us at sales@hpvalves.com

Torque values

Depending on the bolting used, we recommend applying the following torque values for retightening of the bonnet bolting after re-assembly and/or during standard inspection.

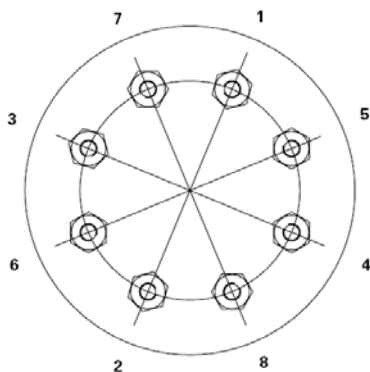
These factory torques are approximate values and based on new equipment with lubricated bolts. Specific site conditions and other factors, such as surface corrosion, may require higher torques for bonnet and gland bolting.

- in case graphite gaskets are used, apply the following instructions;
 - a. If the valve is not pressurized, apply 130% of the torque values below.
 - b. If pressurized to design pressure (operating) apply 60% of the values below.
 - c. For pressures between zero and design pressure, the torque to be used is approximated by linear interpolation.
- for valve operating temperatures above 400°C (752°F) apply 75% of the values below.

Recommended torque values (Nm)

Size	B7/B16	630/A574	B8/B8M	660
M8 ~ 5/16UNC	15	15	7	16
M10 ~ 3/8UNC	27	27	12	27
M12 ~ 1/2UNC	68	68	27	61
M14 ~ 9/16UNC	95	95	39	84
M16 ~ 5/8UNC	129	129	54	115
M18	284	284	72	203
M20 ~ 3/4UNC	400	400	95	270
M22 ~ 7/8UNC	550	550	153	370
M24 ~ 1UNC	690	690	227	460
M27 ~ 1.1/8UNC	1030	1030	333	690
M33 ~ 1.1/4UNC	1890	1890	468	1270
M36 ~ 1.3/8UNC	2400	2400	633	1620
M39 ~ 1.1/2UNC	3100	3100	834	2100
M42 ~ 1.3/4UNC	3900	3900	1355	2610
M45 ~ 2UNC	4450	4450	2054	3270

After tightening bolts by hand, follow the bolt tightening sequence as shown in the figure below. This sequence depends on the quantity of the bolts used. The drawing illustrates the logical sequence that should be followed.



To maintain proper bonnet alignment, the valve should be fully back-seated prior to retightening bonnet bolting.

Depending on the pressure class and size, we recommend applying the following torque values for retightening of the gland bolting of **Gate** valves after re-assembly and/or during regular inspection.

Recommended torque values (Nm)

Class Size	150	300	600	800	900	1500	2500
1/2" DN15	-	-	-	-	25	40	40
3/4" DN20	-	-	-	30	40	40	50
1" DN25	-	-	-	30	40	40	50
1 1/2" DN32	-	-	-	50	125	125	170
2" DN50	-	-	-	50	170	200	200
2 1/2" DN65	3.5	3.5	4	-	29	48	81
3" DN80	3.5	3.5	4	7	25	42	55
4" DN100	3.5	3.5	6	8	20	33	97
6" DN150	5	5	8.5	10	58	96	157
8" DN200	5	5	8.5	11.5	57	94	193
10" DN250	5	7.5	10	13.5	69	144	339
12" DN300	7.5	7.5	13.5	17.5	146	244	448
14" DN350	7.5	7.5	15	20	146	269	497
16" DN400	7.5	7.5	15	-	161	298	858
18" DN450	7.5	9.5	15	-	179	514	948
20" DN500	9.5	9.5	17	-	309	568	1354
24" DN600	11	12.5	19.5	-	341	812	1463

Depending on the pressure class and size, we recommend applying the following torque values for retightening of the gland bolting of **Globe** valves after re-assembly and/or during regular inspection.

Recommended torque values (Nm)

Class Size	150	300	600	800	900	1500	2500
1/2" DN15	-	-	-	-	25	40	40
3/4" DN20	-	-	-	30	40	40	50
1" DN25	-	-	-	30	40	40	50
1 1/2" DN32	-	-	-	50	125	125	170
2" DN50	-	-	-	50	170	200	200
2 1/2" DN65	3.5	3.5	4	-	30	51	85
3" DN80	3.5	3.5	6	7	30	51	157
4" DN100	5	5	6	10	57	94	241
6" DN150	5	6	10	15.5	146	244	448
8" DN200	5	8.5	13	15.5	161	269	858
10" DN250	7.5	9.5	13	20.5	-	411	662
12" DN300	7.5	9.5	13	-	-	397	1463
14" DN350	7.5	11	22.5	-	-	676	1231
16" DN400	8	13	25.5	-	374	-	1147
18" DN450	11	18.5	28.5	-	-	-	-
20" DN500	-	-	-	-	406	-	-
24" DN600	-	-	-	-	-	-	-

Reseating & lapping

Specially designed HP Valves reseating tools allow recutting of worn or damaged seats at the correct angle and without removing the valve body from the line.

These special reseating tools can be made available for HP Valves-manufactured globe and piston type check valves.

For enquiries, we would ask you to contact sales@hpvalves.com

For seat repair on large bore valves, special grinding and lapping tools can be made available. However, these should only be handled and operated by one of our trained service engineers.

To repair valve seats, follow our reseating instructions included in the attached disassembly & reassembly section of this IOM.

High stress areas

All valves supplied by HP Valves are designed for application in severe (high temperature / high pressure) service conditions. If valves are installed in power plants, used in high frequency hot & cold start-up service, it is recommended the high stress areas are checked every 10 to 15 years by LPE (liquid penetrant examination) for signs of fatigue. High stress areas are mainly identified by sharp edges in the valve design and are often found around the seating area. In particular, valves manufactured from A182-F91 (X10CrMoVNb9-1) / A182-F92 (X10CrWMoVNb9-2) material should be checked thoroughly because of their creep resistance properties.

8 Troubleshooting

Probable cause	Rectification
High operating force	
Misalignment of gland flange causing the gland flange to contact the stem.	Realign gland flange and check stem for damage. If the stem is damaged it should be replaced.
Overstressed gland-bolting	Loosen the gland bolting to reduce the packing friction. Make sure no leakage occurs during operation.
Foreign object(s) between stem and gland flange	Unscrew gland bolting and remove foreign object(s). If the stem is damaged it should be replaced.
Non-genuine stem packing has been used, increasing stem friction.	Replace with genuine parts.

Valve will not completely close / passing valves

Foreign object(s) inside the valve prevent it from fully closing.	Try to flush the foreign object(s) from the valve by opening it and providing sufficient flow. If the problem persists, disassemble the valve in line with manufacturer's maintenance instructions as quickly as possible in order to prevent erosion, remove foreign object(s) and replace damaged parts.
Seating surfaces have been damaged by foreign objects.	Disassemble the valve in line with manufacturer's maintenance instructions as quickly as possible in order to prevent erosion. Remove foreign object(s) and reseat / lap the valve seat(s) according to the manufacturer's instructions.
Limit switches of electric operated valves are malfunctioning or are incorrectly adjusted; preventing the valve from reaching its fully closed position.	Operate the valve manually and readjust the limit switches according to the actuator manufacturers' manual. If limit switches malfunction, these should be replaced.
Torque switches of electric operated valves are malfunctioning or are incorrectly adjusted.	Reset the switches to manufacturer's settings, to be found in the MDR of the supplied valve & actuator combination.

Setting of the coupling between the pneumatic actuator and the valve is incorrect and prevents the valve from fully closing.	Readjust the coupling according to the manufacturer's instructions.
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Valve will not completely open

Foreign object(s) inside the valve prevent it from fully opening.	Try to flush the foreign object(s) from the valve by opening it and providing sufficient flow. If the problem persists, disassemble the valve in line with manufacturer's instructions, remove foreign object(s) and replace damaged parts.
Limit switches of electric operated valves are malfunctioning or are incorrectly adjusted, preventing the valve from reaching its fully opened position.	Operate the valve manually and readjust the limit switches according to the actuator manufacturers' manual. If limit switches malfunction these should be replaced.
Torque switches of electric operated valves are malfunctioning or incorrectly adjusted.	Reset the switches to manufacturer's settings, to be found in the MDR of the supplied valve & actuator combination.
Setting of the coupling between the pneumatic actuator and the valve is incorrect, preventing the valve from fully closing.	Readjust the coupling according to the manufacturer's instructions.

Gate valve will not open

Limit switches of electric operated valves are malfunctioning or are incorrectly adjusted, preventing the valve from opening.	Operate the valve manually and readjust the limit switches according to the actuator manual. If limit switches malfunction, these should be replaced.
The force required to unseat the wedge or discs has increased due to pressure locking (high pressure water captured in the inter-disc space) or over-pressurization (heating up water captured in the inter-disc space).	Make sure not to apply excessive force to open the valve, since this will cause damage to the internals. In the case of a pressure equalizing line, make sure the equalizing valve is opened. If a pressure equalizing line is non-existent, carefully loosen the gland bolting to allow water or steam passing the stem-packing. Be careful not to cause packing blow-out. Consult the valve manufacturer for more detailed instructions on how to proceed as well as for

	recommended accessories for pressure equalizing.
The force required to unseat the wedge has increased due to thermal binding.	Make sure not to apply excessive force to open the valve since this will cause damage to the internals. In the case of a bypass line, make sure the bypass valve is opened. If a bypass line is non-existent, try to heat up the valve uniformly in another manner.

Leaking stem packing

Misaligned gland or insufficiently tightened gland bolting.	Carefully tighten the gland bolting immediately until the leakage stops.
Valve has been a long-term storage item at the user's site before being installed.	Replace stem packing.
Non-genuine stem packing has been used, leading to leakage.	Replace with genuine parts.

Leaking gasket

Misaligned bonnet (for bolted bonnet valves) due to transportation or incorrect maintenance.	Realign bonnet and replace gasket if required.
Bonnet bolting has not been tightened immediately after the valve first (after installation or re-assembly) reached its service conditions preventing the gasket to seal optimum.	Tighten the bonnet bolting immediately. If leakage doesn't stop, the gasket and/or valve body sealing area has been damaged due to erosion and should be replaced/repared as per manufacturer's recommendations.
Non-genuine gaskets have been used leading to leakage.	Replace with genuine parts.

Leakage through valve body or bonnet

Long-term leakage across seat has eroded through the valve body.	Replace valve. To prevent future problems, repair passing valves as quickly as possible
Imperfection in casting.	If possible, weld repair the casting defect following the correct WPS. If the casting defect cannot be repaired by welding, the valve should be replaced. To prevent future problems, review minimum NDE specifications.

Handwheel and/or stem is bent

Damaged during transportation or installation or excessive force has been applied to the valve using spanners or other leveraging devices.	Replace damaged parts and prevent future damage.
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Corrosion on valve parts

This can be caused by incorrect selection of coating systems, incorrect application, failure of full curing during long-term storage or due to damage during transportation and installation.	Touch-up the damaged areas immediately as per manufacturer's instructions. If result is insufficient contact the manufacturer.
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9 Disposal

All our products are designed and manufactured for long-life service. However at the end of the product lifecycle, we would advise our products are recycled in a proper manner. Since the products are free of dangerous substances, such as asbestos, they can be disposed of without the need for special precautions. For the disposal of actuators and/or gearboxes, the lubrication (oil / grease) should be recycled separately.

10 Pressure-Temperature ratings

Valves supplied by HP Valves are compliant with project specifications. Depending on the applicable specifications, our products are selected, tested and supplied in compliance with e.g. ASME B16.34, EN 12516-1 or API598 regulations. Pressure class is selected accordingly and taking into account design pressure and temperature together with valve wall thickness and body material.

Pressure-Temperature Ratings

ASME B16.34 - 2013 (Standard Class)

Version : 3

Date of last modification: 2-11-2014

Working Pressure (barg)

Drawn by: S. Komdeur

Below working pressures have been calculated as per ASME B16.34-2013 nonmandatory Appendix B

Approved: R. Laanveld

Class	Material	Temperature (°C)																					
		38	50	100	150	200	250	300	325	350	375	400	425	450	475	500	525	538	550	575	600	625	650
150	A105 / WCB	19.5	19.2	17.6	15.8	13.9	12.1	10.2	9.3	8.3	7.4	6.5	5.5										
	F11 / WCB	19.8	19.5	17.6	15.8	13.9	12.1	10.2	9.3	8.3	7.4	6.5	5.5	4.6	3.7	2.7	1.8	1.3	1.3	1.3			
	F12	19.8	19.5	17.6	15.8	13.9	12.1	10.2	9.3	8.3	7.4	6.5	5.5	4.6	3.7	2.7	1.8	1.3	1.3	1.3			
	F22 / WC9	19.8	19.5	17.6	15.8	13.9	12.1	10.2	9.3	8.3	7.4	6.5	5.5	4.6	3.7	2.7	1.8	1.3	1.3	1.3			
	F91 / C12A	19.8	19.5	17.6	15.8	13.9	12.1	10.2	9.3	8.3	7.4	6.5	5.5	4.6	3.7	2.7	1.8	1.3	1.3	1.3	1.3	1.3	1.3
	F92	19.8	19.5	17.6	15.8	13.9	12.1	10.2	9.3	8.3	7.4	6.5	5.5	4.6	3.7	2.7	1.8	1.3	1.3	1.3	1.3	1.3	1.3
	F316 / CF8M	19.0	18.4	16.1	14.7	13.6	12.1	10.2	9.3	8.3	7.4	6.5	5.5	4.6	3.7	2.7	1.8	1.3					
300	F51	19.8	19.5	17.6	15.8	13.9	12.1	10.2															
	A105 / WCB	51.0	50.1	46.6	45.0	43.8	41.9	39.8	38.7	37.5	36.3	34.7	28.7										
	F11 / WCB	51.7	51.7	51.4	49.7	47.9	46.3	42.8	41.3	40.2	38.7	36.5	34.9	33.8	31.6	25.7	18.5	14.8	12.7	8.8			
	F12	51.7	51.5	50.4	48.1	46.2	44.8	42.8	41.3	40.2	38.7	36.5	34.9	33.8	27.8	21.3	16.3	13.7	12.0	8.8			
	F22 / WC9	51.7	51.7	51.5	50.1	48.6	46.3	42.8	41.3	40.2	38.7	36.5	34.9	33.8	31.6	28.2	21.7	18.4	15.6	10.5			
	F91 / C12A	51.7	51.7	51.5	50.1	48.6	46.3	42.8	41.3	40.2	38.7	36.5	34.9	33.8	31.6	28.2	26.1	25.0	24.9	23.9	19.5	14.6	9.9
	F92	51.7	51.7	51.5	50.1	48.6	46.3	42.8	41.3	40.2	38.7	36.5	34.9	33.8	31.6	28.2	26.1	25.0	24.9	23.9	21.4	18.2	13.2
600	F316 / CF8M	49.6	48.1	42.1	38.4	35.6	33.3	31.6	30.8	30.3	29.8	29.4	29.1	28.8	28.6	28.2	26.1	25.0					
	F51	51.7	51.7	50.6	45.9	42.6	40.4	38.8															
	A105 / WCB	102.1	100.2	93.2	90.1	87.6	83.8	79.6	77.4	75.1	72.7	69.4	57.5										
	F11 / WCB	103.4	103.4	102.9	99.4	95.9	92.6	85.6	82.6	80.4	77.5	73.1	69.9	67.6	63.3	51.4	37.1	29.7	25.4	17.6			
	F12	103.4	103.0	100.8	96.3	92.5	89.6	85.6	82.6	80.4	77.5	73.1	69.9	67.6	55.7	42.7	32.6	27.4	24.0	17.6			
	F22 / WC9	103.4	103.4	103.0	100.3	97.3	92.6	85.6	82.6	80.4	77.5	73.1	69.9	67.6	63.3	56.4	43.5	36.8	31.2	21.0			
	F91 / C12A	103.4	103.4	103.0	100.3	97.3	92.6	85.6	82.6	80.4	77.5	73.1	69.9	67.6	63.3	56.4	52.2	50.1	49.8	47.8	39.0	29.2	19.8
800	F92	103.4	103.4	103.0	100.3	97.3	92.6	85.6	82.6	80.4	77.5	73.1	69.9	67.6	63.3	56.4	52.2	50.1	49.8	47.8	42.8	36.5	26.4
	F316 / CF8M	99.2	96.2	84.3	76.9	71.3	66.7	63.2	61.7	60.6	59.7	58.8	58.2	57.6	57.3	56.4	52.2	50.1					
	F51	103.4	103.4	101.3	91.8	85.3	80.9	77.7															
	A105 / WCB	136.1	133.6	124.2	120.1	116.8	111.8	106.1	103.2	100.1	96.9	92.5	76.7										
	F11 / WCB	137.9	137.9	137.2	132.6	127.8	123.5	114.2	110.1	107.2	103.4	97.5	93.2	90.1	84.4	68.6	49.5	39.7	33.8	23.4			
	F12	137.9	137.3	134.5	128.4	123.3	119.5	114.2	110.1	107.2	103.4	97.5	93.2	90.1	74.2	57.0	43.5	36.5	32.1	23.4			
	F22 / WC9	137.9	137.9	137.4	133.8	129.7	123.5	114.2	110.1	107.2	103.4	97.5	93.2	90.1	84.4	75.2	58.0	49.1	41.6	28.0			
900	F91 / C12A	137.9	137.9	137.4	133.8	129.7	123.5	114.2	110.1	107.2	103.4	97.5	93.2	90.1	84.4	75.2	69.6	66.8	66.5	63.8	52.0	38.9	26.4
	F92	137.9	137.9	137.4	133.8	129.7	123.5	114.2	110.1	107.2	103.4	97.5	93.2	90.1	84.4	75.2	69.6	66.8	66.5	63.8	57.1	48.6	35.3
	F316 / CF8M	132.3	128.3	112.5	102.6	95.0	88.9	84.3	82.3	80.8	79.6	78.5	77.7	76.9	76.4	75.2	69.6	66.8					
	F51	137.9	137.9	135.0	122.4	113.7	107.8	103.6															
	A105 / WCB	153.1	150.3	139.8	135.2	131.4	125.8	119.4	116.1	112.7	109.1	104.1	86.3										
	F11 / WCB	155.1	155.1	154.4	149.2	143.8	138.9	128.5	123.9	120.6	116.3	109.7	104.9	101.4	94.9	77.1	55.7	44.6	38.1	26.4			
	F12	155.1	154.5	151.3	144.5	138.8	134.4	128.5	123.9	120.6	116.3	109.7	104.9	101.4	83.5	64.1	49.0	41.1	36.1	26.4			
1500	F22 / WC9	155.1	155.1	154.6	150.5	145.9	138.9	128.5	123.9	120.6	116.3	109.7	104.9	101.4	94.9	84.6	65.3	55.3	46.9	31.5			
	F91 / C12A	155.1	155.1	154.6	150.5	145.9	138.9	128.5	123.9	120.6	116.3	109.7	104.9	101.4	94.9	84.6	78.3	75.1	74.8	71.8	58.5	43.8	29.7
	F92	155.1	155.1	154.6	150.5	145.9	138.9	128.5	123.9	120.6	116.3	109.7	104.9	101.4	94.9	84.6	78.3	75.1	74.8	71.8	64.2	54.7	39.7
	F316 / CF8M	148.9	144.3	126.5	115.4	106.9	100.1	94.8	92.6	90.9	89.6	88.3	87.4	86.5	86.0	84.6	78.3	75.1					
	F51	155.1	155.1	151.9	137.7	127.9	121.3	116.5															
	A105 / WCB	255.3	250.6	233.0	225.3	219.0	209.7	199.1	193.5	187.8	181.8	173.6	143.8										
	F11 / WCB	258.5	258.5	257.4	248.7	239.8	231.6	214.2	206.5	201.1	193.9	182.8	174.9	169.0	158.2	128.6	92.9	74.4	63.5	44.0			
2500	F12	258.5	257.5	252.2	240.9	231.3	224.1	214.2	206.5	201.1	193.9	182.8	174.9	169.0	139.2	106.9	81.6	68.5	60.2	44.0			
	F22 / WC9	258.5	258.5	257.6	250.9	243.2	231.6	214.2	206.5	201.1	193.9	182.8	174.9	169.0	158.2	141.0	108.8	92.2	78.1	52.6			
	F91 / C12A	258.5	258.5	257.6	250.9	243.2	231.6	214.2	206.5	201.1	193.9	182.8	174.9	169.0	158.2	141.0	130.6	125.2	124.7	119.7	97.5	73.0	49.6
	F92	258.5	258.5	257.6	250.9	243.2	231.6	214.2	206.5	201.1	193.9	182.8	174.9	169.0	158.2	141.0	130.6	125.2	124.7	119.7	107.1	91.2	66.2
	F316 / CF8M	248.2	240.5	210.9	192.4	178.3	166.8	158.1	154.4	151.6	149.4	147.2	145.7	144.2	143.3	141.0	130.6	125.2					
	F51	258.5	258.5	253.3	229.6	213.2	202.3	194.2															
	A105 / WCB	425.5	417.7	388.3	375.6	365.0	349.5	331.8	322.6	313.0	303.0	289.3	239.7										
2700	F11 / WCB	430.9	430.9	429.0	414.5	399.6	386.0	357.0	344.2	335.1	323.2	304.7	291.5	281.6	263.7	214.3	154.9	124.1	105.8	73.3			
	F12	430.9	429.1	420.3	401.5	385.5	373.5	357.0	344.2	335.1	323.2	304.7	291.5	281.6	232.1	178.1	136.1	114.2	100.3	73.3			
	F22 / WC9	430.9	430.9	429.4	418.2	405.4	386.0	357.0	344.2	335.1	323.2	304.7	291.5	281.6	263.7	235.0	181.4	153.6	130.2	87.7			
	F91 / C12A	430.9	430.9	429.4	418.2	405.4	386.0	357.0	344.2	335.1	323.2	304.7	291.5	281.6	263.7	235.0	217.7	208.7	207.8	199.5	162.5	121.7	82.7
	F92	430.9	430.9	429.4	418.2	405.4	386.0	357.0	344.2	335.1	323.2	304.7	291.5	281.6	263.7	235.0	217.7	208.7	207.8	199.5	178.5	152.1	110.3
	F316 / CF8M	413.6	400.9	351.6	320.7	297.1	278.1	263.5	257.3	252.7	249.0	245.3	242.8	240.3	238.9	235.0	217.7	208.7					
	F51	430.9	430.9	422.1	382.7	355.4	337.1	323.7															
4500	A105 / WCB	459.5	451.1	419.4	405.6	394.2	377.4	358.3	348.4	338.1	327.3	312.4	258.9										
	F11 / WCB	465.4	465.4	463.3	447.7	431.6	416.8	385.5	371.7	361.9	349.0	329.1	314.8	304.2	284.8	231.5	167.3	134.0	114.3	79.2			



Pressure-Temperature Ratings

ASME B16.34 - 2013 (Special Class)

Working Pressure (barg)

Below working pressures have been calculated as per ASME B16.34-2013 nonmandatory Appendix B

Version : 3

Date of last modification: 2-11-2014

Drawn by: S. Komdeur

Approved: R. Laanveld

Class	Material	Temperature (°C)																						
		38	50	100	150	200	250	300	325	350	375	400	425	450	475	500	525	538	550	575	600	625	650	
150	A105 / WCB	19,8	19,8	19,7	19,5	19,3	19,3	19,3	19,2	18,7	18,0	16,6	13,7											
	F11 / WCB	19,8	19,8	19,8	19,8	19,8	19,8	19,8	19,8	19,7	19,3	19,2	19,0	18,0	16,3	12,3	8,9	7,1	6,0	4,2				
	F12	19,8	19,7	19,4	19,0	19,0	19,0	18,7	18,6	18,3	18,0	18,0	18,0	16,4	13,3	10,2	7,8	6,5	5,7	4,2				
	F22 / WC9	19,8	19,8	19,7	19,5	19,2	19,1	19,0	19,0	18,8	18,6	18,6	18,6	18,0	16,3	13,6	10,4	8,8	7,4	5,0				
	F91 / C12A	19,8	19,8	19,8	19,8	19,8	19,8	19,8	19,8	19,8	19,7	19,3	19,2	19,0	18,0	16,3	13,6	11,9	11,1	11,1	10,9	9,3	6,9	4,7
	F92	19,8	19,8	19,8	19,8	19,8	19,8	19,8	19,8	19,8	19,7	19,3	19,2	19,0	18,0	16,3	13,6	11,9	11,1	11,1	10,9	10,2	8,7	6,3
	F316 / CF8M	19,8	19,4	18,0	16,4	15,2	14,2	13,5	13,2	12,9	12,7	12,5	12,4	12,3	12,2	12,1	11,4	11,1						
300	F51	19,8	19,8	19,8	19,6	18,2	17,3	16,6																
	A105 / WCB	51,7	51,7	51,6	51,0	50,5	50,5	50,5	50,1	48,9	47,1	43,4	35,9											
	F11 / WCB	51,7	51,7	51,7	51,7	51,7	51,7	51,7	51,7	51,4	50,4	50,2	49,6	47,1	42,7	32,1	23,2	18,6	15,8	11,0				
	F12	51,7	51,5	50,6	49,7	49,7	49,5	49,0	48,5	47,8	47,0	47,0	47,0	43,0	34,8	26,7	20,4	17,1	15,0	11,0				
	F22 / WC9	51,7	51,7	51,6	50,9	50,2	49,9	49,7	49,5	49,2	48,7	48,7	48,7	47,1	42,7	35,6	27,3	23,0	19,5	13,1				
	F91 / C12A	51,7	51,7	51,7	51,7	51,7	51,7	51,7	51,7	51,4	50,4	50,2	49,6	47,1	42,7	35,6	31,2	29,0	29,0	28,5	24,3	18,2	12,4	
	F92	51,7	51,7	51,7	51,7	51,7	51,7	51,7	51,7	51,4	50,4	50,2	49,6	47,1	42,7	35,6	31,2	29,0	29,0	28,5	26,7	22,8	16,5	
600	F316 / CF8M	51,7	50,8	47,0	42,9	39,8	37,2	35,2	34,4	33,8	33,3	32,8	32,5	32,1	32,0	31,7	29,9	29,0						
	F51	51,7	51,7	51,7	51,2	47,6	45,1	43,3																
	A105 / WCB	103,4	103,4	103,2	102,0	101,1	101,0	101,0	100,2	97,8	94,2	86,8	71,9											
	F11 / WCB	103,4	103,4	103,4	103,4	103,4	103,4	103,4	103,4	102,8	100,9	100,4	99,2	94,3	85,5	64,3	46,4	37,2	31,7	22,0				
	F12	103,4	103,0	101,2	99,4	99,4	99,1	98,0	97,1	95,6	94,1	94,1	94,1	86,0	69,6	53,4	40,8	34,2	30,1	22,0				
	F22 / WC9	103,4	103,4	103,2	101,9	100,4	99,9	99,5	99,1	98,4	97,5	97,5	97,5	94,3	85,5	71,3	54,7	46,0	39,0	26,3				
	F91 / C12A	103,4	103,4	103,4	103,4	103,4	103,4	103,4	103,4	102,8	100,9	100,4	99,2	94,3	85,5	71,3	62,5	58,0	58,0	57,1	48,7	36,5	24,8	
800	F92	103,4	103,4	103,4	103,4	103,4	103,4	103,4	102,8	100,9	100,4	99,2	94,3	85,5	71,3	62,5	58,0	58,0	57,1	53,5	45,7	33,0		
	F316 / CF8M	103,4	101,6	94,1	85,9	79,6	74,5	70,5	68,9	67,6	66,6	65,7	65,0	64,3	64,0	63,4	59,8	58,0						
	F51	103,4	103,4	103,4	102,5	95,2	90,3	86,7																
	A105 / WCB	137,9	137,9	137,6	136,0	134,8	134,7	133,6	130,4	125,6	115,7	95,8												
	F11 / WCB	137,9	137,9	137,9	137,9	137,9	137,9	137,9	137,9	137,1	134,6	133,9	132,3	125,7	114,0	85,7	61,9	49,6	42,3	29,3				
	F12	137,9	137,3	135,0	132,5	132,5	132,2	130,7	129,5	127,5	125,4	125,4	125,4	114,7	92,8	71,2	54,4	45,7	40,1	29,3				
	F22 / WC9	137,9	137,9	137,6	135,8	133,9	133,2	132,7	132,2	131,2	130,0	130,0	130,0	125,7	114,0	95,1	72,9	61,4	52,1	35,0				
900	F91 / C12A	137,9	137,9	137,9	137,9	137,9	137,9	137,9	137,9	137,1	134,6	133,9	132,3	125,7	114,0	95,1	83,4	77,3	77,3	76,2	64,9	48,6	33,1	
	F92	137,9	137,9	137,9	137,9	137,9	137,9	137,9	137,9	137,1	134,6	133,9	132,3	125,7	114,0	95,1	83,4	77,3	77,3	76,2	71,4	60,9	44,1	
	F316 / CF8M	137,9	135,5	125,5	114,5	106,1	99,3	94,0	91,9	90,2	88,9	87,6	86,7	85,8	85,3	84,5	79,8	77,3						
	F51	137,9	137,9	137,9	136,6	126,9	120,4	115,6																
	A105 / WCB	155,1	155,1	154,9	153,1	151,7	151,5	151,5	150,3	146,7	141,3	130,2	107,8											
	F11 / WCB	155,1	155,1	155,1	155,1	155,1	155,1	155,1	155,1	154,2	151,4	150,6	148,9	141,5	128,2	96,4	69,7	55,8	47,6	33,0				
	F12	155,1	154,5	151,8	149,1	149,1	148,7	147,1	145,7	143,5	141,1	141,1	141,1	129,0	104,4	80,1	61,2	51,4	45,1	33,0				
1500	F22 / WC9	155,1	155,1	154,8	152,8	150,6	149,9	149,3	148,7	147,6	146,2	146,2	146,2	141,5	128,2	107,0	82,1	69,1	58,6	39,4				
	F91 / C12A	155,1	155,1	155,1	155,1	155,1	155,1	155,1	155,1	154,2	151,4	150,6	148,9	141,5	128,2	107,0	93,8	87,0	87,0	85,7	73,1	54,7	37,2	
	F92	155,1	155,1	155,1	155,1	155,1	155,1	155,1	155,1	154,2	151,4	150,6	148,9	141,5	128,2	107,0	93,8	87,0	87,0	85,7	80,3	68,5	49,6	
	F316 / CF8M	155,1	152,4	141,2	128,8	119,4	111,7	105,8	103,4	101,5	100,0	98,5	97,5	96,5	96,0	95,1	89,7	87,0						
	F51	155,1	155,1	155,1	153,7	142,8	135,4	130,0																
	A105 / WCB	258,5	258,5	258,1	255,1	252,8	252,6	252,6	250,5	244,5	235,5	217,0	179,7											
	F11 / WCB	258,5	258,5	258,5	258,5	258,5	258,5	258,5	258,5	257,1	252,4	251,0	248,2	235,8	213,7	160,8	116,2	93,0	79,4	55,0				
2500	F12	258,5	257,5	253,1	248,5	248,5	247,9	245,1	242,9	239,2	235,3	235,3	235,3	215,1	174,1	133,6	102,0	85,7	75,3	55,0				
	F22 / WC9	258,5	258,5	258,1	254,7	251,1	249,9	248,9	247,9	246,0	243,7	243,7	243,7	235,8	213,7	178,4	136,8	115,2	97,7	65,8				
	F91 / C12A	258,5	258,5	258,5	258,5	258,5	258,5	258,5	258,5	257,1	252,4	251,0	248,2	235,8	213,7	178,4	156,4	145,0	145,0	142,9	121,8	91,2	62,0	
	F92	258,5	258,5	258,5	258,5	258,5	258,5	258,5	258,5	257,1	252,4	251,0	248,2	235,8	213,7	178,4	156,4	145,0	145,0	142,9	133,9	114,2	82,7	
	F316 / CF8M	258,5	254,1	235,4	214,8	199,0	186,2	176,4	172,3	169,2	166,7	164,3	162,6	160,9	160,0	158,5	149,6	145,0						
	F51	258,5	258,5	258,5	256,3	238,0	225,8	216,8																
	A105 / WCB	430,9	430,9	430,2	425,2	421,4	421,0	417,6	407,6	392,5	361,6	299,6												
2700	F11 / WCB	430,9	430,9	430,9	430,9	430,9	430,9	430,9	428,5	420,7	418,4	413,6	393,1	356,2	268,0	193,7	155,1	132,3	91,7					
	F12	430,9	429,1	421,8	414,2	414,2	413,2	408,6	404,8	398,6	392,1	392,1	392,1	358,5	290,1	222,7	170,1	142,8	125,5	91,7				
	F22 / WC9	430,9	430,9	430,1	424,6	418,5	416,5	414,8	413,2	410,0	406,2	406,2	393,1	356,2	297,4	228,1	192,0	162,8	109,6					
	F91 / C12A	430,9	430,9	430,9	430,9	430,9	430,9	430,9	430,9	428,5	420,7	418,4	413,6	393,1	356,2	297,4	260,7	241,7	241,7	238,2	203,1	152,1	103,4	
	F92	430,9	430,9	430,9	430,9	430,9	430,9	430,9	430,9	428,5	420,7	418,4	413,6	393,1	356,2	297,4	260,7	241,7	241,7	238,2	223,2	190,4	137,8	
	F316 / CF8M	430,9	423,5	392,4	358,0	331,6	310,4	294,0	287,2	282,0	277,8	273,8	271,0	268,2	266,6	264,2	249,4	241,7						
	F51	430,9	430,9	430,9	427,1	396,7	376,3	361,3																
4500	A105 / WCB	465,4	465,4	464,7	459,3	455,1	454,7	454,7	451,0	440,2	423,9	390,6	323,5											
	F11 / WCB	465,4	465,4	465,4	465,4	465,4	465,4	465,4	465,4	462,8	454,4	451,9	446,7	424,5	384,7	289,4	209,2	167,5	142,9	99,0				

Pressure-Temperature Ratings
Working Pressure (bar)

Version : 05

Date of last modification : 2-11-2014

Drawn by : S. Komdeur

Approved : R. Laarveld

NEN-EN 12516-1 - 2014 - Tabulation method

Outside scope NEN-EN 12516-1 - 2014

Temperature (°C)

EN/DIN Grade	Design	20	50	100	150	200	250	300	350	375	400	425	450	475	500	525	530	540	550	575	580	600	625	650	
40 PN	P 250 GH	1.0460	40	40	40	40	39,1	37,1	35	33,9	32,4	26,8	21,4												
	15 NiCuMoNb 5	1.6368	40	40	40	40	40	39,9	37,5	36,2	34,1	32,6	31,5												
	16 Mo 3	1.5415	40	40	40	39,1	36,4	34	31,6	29,7	29,2	28,8	27,7	26,6	26,2	18,1	11,3	10	8,2						
	13 CrMo 4-5	1.7335	40	40	40	40	40	39,9	37,2	35,9	34,1	32,6	31,5	29,5	24,9	18,3	17	14,3	11,7						
	11 CrMo 9-10	1.7383	40	40	40	40	40	39,9	37,5	36,2	34,1	32,6	31,5	29,5	26,3	21,5	20	17	14	13,7	12,2	5,9			
	X 10 CrMoVNb 9-1	1.4903	40	40	40	40	40	39,9	37,5	36,2	34,1	32,6	31,5	29,5	26,3	24	23,9	23,5	23,2	22,3	21,8	19,9			
	X 10 CrWMoVNb 9-2	1.4901	40	40	40	40	40	39,9	37,5	36,2	34,1	32,6	31,5	29,5	26,3	24	23,9	23,5	23,2	22,3	21,8	19,9	17	11,9	
	X 2 CrNiMo 17-12-2	1.4404	40	40	39,2	35,8	32,4	29,1	25,7	24,6	24	23,5	22,9	22,4	22,1	21,9	20,8	20,7	20,7						
160 PN	P 250 GH	1.0460	160	160	160	160	156,6	148,7	140,3	135,8	129,6	107,4	85,9												
	15 NiCuMoNb 5	1.6368	160	160	160	160	160	160	160	150,2	144,8	136,5	130,6	126,2											
	16 Mo 3	1.5415	160	160	160	156,5	145,9	136,3	126,7	119	117,1	115,2	111	106,7	104,8	72,5	45,2	40,1	32,8						
	13 CrMo 4-5	1.7335	160	160	160	160	160	160	160	149	143,6	136,5	130,6	126,2	118,2	99,8	73,4	68,1	57,5	46,9					
	11 CrMo 9-10	1.7383	160	160	160	160	160	160	160	150,2	144,8	136,5	130,6	126,2	118,2	105,3	86,2	80,2	68,3	56,3	55	48,8	23,9		
	X 10 CrMoVNb 9-1	1.4903	160	160	160	160	160	160	160	150,2	144,8	136,5	130,6	126,2	118,2	105,3	96,2	95,6	94,4	93,1	89,4	87,5	80		
	X 10 CrWMoVNb 9-2	1.4901	160	160	160	160	160	160	160	150,2	144,8	136,5	130,6	126,2	118,2	105,3	96,2	95,6	94,4	93,1	89,4	87,5	80	68,1	47,8
	X 2 CrNiMo 17-12-2	1.4404	160	160	156,8	143,4	129,9	116,5	103	98,6	96,3	94,1	91,8	89,6	88,7	87,8	83,2	83,1	82,9						
250 PN	P 250 GH	1.0460	250	250	250	250	244,7	232,3	219,2	212,2	202,5	167,8	134,2												
	15 NiCuMoNb 5	1.6368	250	250	250	250	250	249,9	234,6	226,3	213,3	204,1	197,2												
	16 Mo 3	1.5415	250	250	250	244,5	228	213	198	186	183	180	173,4	166,8	163,8	113,3	70,6	62,6	51,3						
	13 CrMo 4-5	1.7335	250	250	250	250	250	249,9	232,8	224,4	213,3	204,1	197,2	184,6	156	114,7	106,4	89,9	73,3						
	11 CrMo 9-10	1.7383	250	250	250	250	250	250	249,9	234,6	226,3	213,3	204,1	197,2	184,6	164,5	134,7	125,3	106,7	88	86	76,2	37,3		
	X 10 CrMoVNb 9-1	1.4903	250	250	250	250	250	249,9	234,6	226,3	213,3	204,1	197,2	184,6	164,5	150,4	149,4	147,5	145,5	139,6	136,7	125			
	X 10 CrWMoVNb 9-2	1.4901	250	250	250	250	250	249,9	234,6	226,3	213,3	204,1	197,2	184,6	164,5	150,4	149,4	147,5	145,5	139,6	136,7	125	106,5	74,6	
	X 2 CrNiMo 17-12-2	1.4404	250	250	245	224	203	182	161	154	150,5	147	143,5	140	138,6	137,2	130	129,9	129,6						
400 PN	P 250 GH	1.0460	400	400	400	400	391,5	371,7	350,7	339,5	324,1	268,5	214,8												
	15 NiCuMoNb 5	1.6368	400	400	400	400	400	399,9	375,5	362,1	341,4	326,5	315,5												
	16 Mo 3	1.5415	400	400	400	391,3	364,9	340,9	316,8	297,7	292,9	288,1	277,5	266,9	262,1	181,3	113	100,2	82,1						
	13 CrMo 4-5	1.7335	400	400	400	400	400	399,9	372,5	359,1	341,4	326,5	315,5	295,5	249,6	183,5	170,3	143,8	117,3						
	11 CrMo 9-10	1.7383	400	400	400	400	400	399,9	375,5	362,1	341,4	326,5	315,5	295,5	263,2	215,5	200,6	170,7	140,8	137,6	122	59,7			
	X 10 CrMoVNb 9-1	1.4903	400	400	400	400	400	399,9	375,5	362,1	341,4	326,5	315,5	295,5	263,2	240,6	239,1	236	232,9	223,5	218,8	200			
	X 10 CrWMoVNb 9-2	1.4901	400	400	400	400	400	399,9	375,5	362,1	341,4	326,5	315,5	295,5	263,2	240,6	239,1	236	232,9	223,5	218,8	200	170,4	119,5	
	X 2 CrNiMo 17-12-2	1.4404	400	400	392,1	358,5	324,9	291,3	257,6	246,4	240,8	235,2	229,6	224	221,8	219,5	208	207,8	207,4						
500 B	P 250 GH	1.0460	500	500	500	500	489,4	464,7	438,4	424,4	405,2	335,7	268,5												
	15 NiCuMoNb 5	1.6368	500	500	500	500	500	499,9	469,4	452,6	426,7	408,2	394,4												
	16 Mo 3	1.5415	500	500	500	489,1	456,1	426,1	396,1	372,1	366,1	360,1	346,9	333,7	327,7	226,7	141,3	125,3	102,7						
	13 CrMo 4-5	1.7335	500	500	500	500	500	499,9	465,7	448,9	426,7	408,2	394,4	369,4	312	229,4	212,9	179,8	146,7						
	11 CrMo 9-10	1.7383	500	500	500	500	500	499,9	469,4	452,6	426,7	408,2	394,4	369,4	329,1	269,4	250,7	213,4	176	172	152,5	74,6			
	X 10 CrMoVNb 9-1	1.4903	500	500	500	500	500	499,9	469,4	452,6	426,7	408,2	394,4	369,4	329,1	300,8	298,9	295	291,1	279,3	273,5	250			
	X 10 CrWMoVNb 9-2	1.4901	500	500	500	500	500	499,9	469,4	452,6	426,7	408,2	394,4	369,4	329,1	300,8	298,9	295	291,1	279,3	273,5	250	213	149,3	
	X 2 CrNiMo 17-12-2	1.4404	500	500	490,1	448,1	406,1	364,1	322,1	308,1	301,1	294,1	287,1	280	277,2	274,4	260,1	259,8	259,3						
640 B	P 250 GH	1.0460	640	640	640	640	626,5	594,8	561,1	543,2	518,6	429,7	343,6												
	15 NiCuMoNb 5	1.6368	640	640	640	640	640	639,9	600,8	579,4	546,2	522,5	504,9												
	16 Mo 3	1.5415	640	640	640	626,1	583,9	545,4	507	476,3	468,6	461	444	427,1	419,4	290,2	180,9	160,4	131,4						
	13 CrMo 4-5	1.7335	640	640	640	640	640	639,9	596,1	574,6	546,2	522,5	504,9	472,8	399,4	293,6	272,5	230,1	187,8						
	11 CrMo 9-10	1.7383	640	640	640	640	640	639,9	600,8	579,4	546,2	522,5	504,9	472,8	421,2	344,8	320,9	273,1	225,3	220,1	195,2	95,6			
	X 10 CrMoVNb 9-1	1.4903	640	640	640	640	640	639,9	600,8	579,4	546,2	522,5	504,9	472,8	421,2	385,1	382,6	377,6	372,6	357,6	350,1	320			
	X 10 CrWMoVNb 9-2	1.4901	640	640	640	640	640	639,9	600,8	579,4	546,2	522,5	504,9	472,8	421,2	385,1	382,6	377,6	372,6	357,6	350,1	320	272,6	191,2	
	X 2 CrNiMo 17-12-2	1.4404	640	640	627,4	573,6	519,8	466	412,3	394,3	385,4	376,4	367,4	358,5	354,9	351,3	332,9	332,5	331,9						