INSTALLATION
OPERATION & MAINTENANCE MANUAL

- **Cast Steel Gate according API 600**
- **Globe Valves according BS 1873**
- **Check Valves according BS 1868**

Document change records

Rev. No.	Rev. Page/ Section	Change Description	Effect. Date	Rev. Sheet No.
2018	All	Fist issue	2018/05/20	04033
2019	Parts	Adding valve's hoist, modifying partial data in Annex A	2019/06/07	12011

Cast Steel Gate, Globe &Check Valves

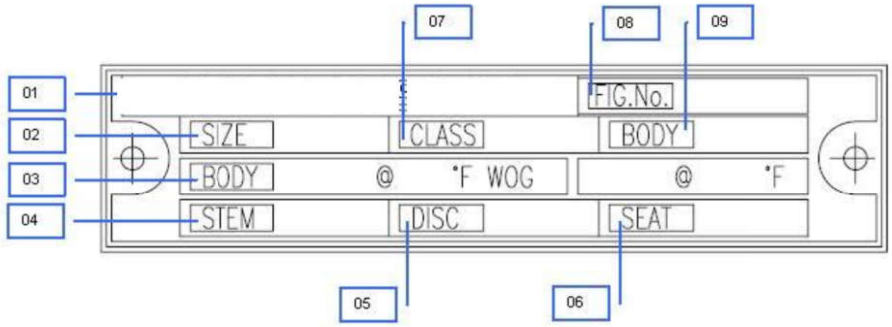
Installation, Operation &Maintenance Manual

CONTENTS

1)

1 Introduction

This manual is suitable for DN≥2" bolted bonnet gate valves, globe valves, swing check valves and position check valves. Before beginning any major work, we recommend you carefully check the nameplate on the valve, record the size of valve and read this manual; it is helpful for you to install, operate &maintain the valve correctly.



ITEM	MEANINGS	ITEM	MEANINGS
01	Fromme LOGO	06	Seat Sealing Face Material
02	Valve Size	07	Valve Class Rating
03	Max Pressure @Min Temperature Max Pressure @Min Temperature	08	FIG No of Purchase
04	Stem Material	09	Body Material
05	Disc（Wedge）Sealing Face Material		

Important Mention

- Any use beyond the purchase specification is not permitted, such as fluid, pressure, temperature, and the external environment etc.
The manufacturer is not responsible for the loss caused by these.
- The one who makes any adjustments on the valves should have the knowledge of safety and wear safety equipment.
- Before removing a valve from a pipeline, line pressure must be relived with no exception.
- If found loose phenomenon of bolts, nuts, prohibit operating pressure containers directly.
- It is dangerous that maintaining or touching a valve when you don't know the fluid clearly.
- For the torque set valves, the torque, designed against the specified differential pressure and set during factory assembly, don't change the torque for any cause.
- It is suggested that complex maintenance achieved by FROMME ARMATUREN .

2) Essential Health & Safety Requirements Of PED/ATEX And Solution

2.1 Design Philosophy

- Gate valve are designed as standard product, which may don't take into account of every specific service condition since it's too wide.
- Gate valve is designed to base on API 600, Globe valve is designed to base on BS 1873, Check valve is designed to base on BS 1868, and has adequate strength according to ASME B16.34 pressure-temperature rating. The gate valve was EC-type approved by European Notified Body.
- Valve has different sealing materials in accordance with related standard, which are used to avoid corrosion to certain type of fluid and abrasion.
- Valve contains no light metal (such as Mg) and all parts are electricity conductive and connected together to prevent ignite resource.
- Valve is designed with hand wheel, or gear operator or electric actuator according to its size and torque, and operation requirements.

2.2 User Notes

- In any occurrence first ensure personnel safety.
- Use the valves in accordance with ASME B16.34 pressure-temperature rating.
- Make sure that the selected valve materials are corrosion/wear resistance to the service fluid.
- When the medium is flammable/explosive, it should ensure that the operating temperature is within the

scope of valve designing requirement.

- When performing Repair maintenance operations make sure that the valves are always depressurized, vented, and drained.
- For actuator operated valves, make sure all supply lines (Electrical, hydraulic, Air) are disconnected before starting any operation.
- When performing Repair/maintenance operations, always use appropriate protection e.g. protective clothing, (oxygen) masks, gloves, etc.
- When performing Repair/maintenance operations, do not smoke, do not use any portable no-Ex-proof electrical device in the area and do not use open fire without a valid work permit.
- Valve must periodically be checked:
  - Tightness of bolted connection (body/bonnet, gland, flange connection).
  - Corrosion/wear damages (crack, pitting, thickness of the valve).
  - Make sure the valves are fully opened/fully closed.

2.3 Specifics

Risk	Preventive Action
Accidental contact with dangerous service fluid* Due to: failure of Packing and Gasket	1. See 2.1
	2. Immediately replace Gasket and Packing after the failure (use approved/suitable materials only)
	3. Use recommended torque as in the annex B
Accidental contact with dangerous service fluid* during disassembly or maintenance operations	1. See 2.1
	2. After removal from the production line, open and close valve to guarantee depressurized cavity.
	3. Drain any remainder fluid or substances with suitable devices before disassembly.
Structural yielding of valves body with consequent risk of contact with dangerous service medium*, explosion or fire	1. See 2.1
	2.Create precautions to avoid additional forces on the valves
	3. Avoid absolutely water hammer: install precaution devices if necessary (e.g. brakes, anti shock devices, etc.)
	4. Avoid submitting excessive vibrations to the valves.
	5. Avoid quick Pressure and/or Temperature abrupt change.
Accidental contact with High or Low temperature parts	1. See 2.1
	2. Predispose apposite insulation on the valve.
	3. Alert by means of warning signs about risk of burns.
	4. For Cryogenic-/High Temperature service use only valves equipped with Cryogenic-/High Temp. Extension.

Fire or explosion in case of service with flammable fluids	1. See 2.1
	2. Install only Ex-proof electrical devices in the area
	3. While performing maintenance in the area, shut down all electrical devices.
Explosion in case of oxygen service	1. See 2.1
	2. Install only Ex-proof electrical devices in the area
	3. Install and use only valves completely degreased.
	4. Use valves only made with materials suitable for oxygen service (see EN 1797-1) 5. Adopt operation fittings which don't have grease or grease can't outflow

Dangerous service fluid as there are: Toxic-, Corrosive-, Flammable-, High- or Low temperature etc. fluid

3 Essential Feature of Fromme Valves

Typical description of Fromme valves includes essential feature of a valve. For the benefit of installing / operating / maintaining the valve, you had better understand the description.

4	G	15	R	-	G	,	WCB	/	NO.5
①	②	③	④		⑤		⑥		⑦

① NPS

② Valve Type

Valve Type	Gate	Globe	Check
Code	G	GL	S

③ Pressure Class

Code	1	3	6	9	15	25
Pressure Class	150	300	600	900	1500	2500

④ End Connection

Code	End Connection	Code	End Connection
R	Flanged(Raised Face)	S	Socket Welding
J	Ring Joint	N	In-threaded
B	Butt Welding	F	Flanged(Flat Face)
W	Wafer		

⑤ Operation

G	Gear Box
M	Motor Actuator
P	Pneumatic Actuator
F	Hand Wheel(torque≤350N·M)
A	Gear Box(torque≤350N·M)

⑥ Vale Body Material

Material	WCB	LCB	LCC	WC6	WC9	C5	CF8	CF8M	CF3	CF3M	CN7M
	A216	A352	A352	A217	A217	A217	A351	A351	A351	A351	A351
ASTM SPC.	WCB	LCB	LCC	WC6	WC9	C5	CF8	CF8M	CF3	CF3M	CN7M

Code	Disc seal face	Seat seal face	Stem
1	13%Cr	13%Cr	ASTM A182 F6a
2	18%Cr,8%Ni	18%Cr,8%Ni	ASTM A182 F304
5	Stellite	Stellite	ASTM A182 F6a
8	13%Cr	Stellite	ASTM A182 F6a
10	18%Cr,8%Ni	18%Cr,8%Ni	ASTM A182 F316
12	18%Cr,8%Ni	Stellite	ASTM A182 F316
16	Stellite	Stellite	ASTM A182 F316

4 Receiving Inspection

- All valves must be examined for signs of damage that may have occurred during transportation. Serious damage should be reported to FROMME ARMATUREN so that a suitable arrangement can be made.

5 Storage and Transportation

5.1 Transportation

- Check the package of valves before transportation. Looking for the reason and repairing, if the package has been marred.
- Checking the valve and ensuring the valve is at full - close status. If the valve is opened, the sealing face of seat and wedge shall be cleaned, then closing the valve and blocking the face of body run.
- The valve as a heavy product of metal, Cord and lift device and transportation tool shall be ready before transporting. The valve can't be dragged on the ground directly. When the valve is been lift, the cord shall be tied to the yoke, tied to the hand wheel or the stem is forbidden, refers to 6.2. Handling the valve shall be careful to avoid bumping to other thing.
- The paint, the name plate and the sealing face of the flange shall be protected during the transportation.

5.2 Storage

- Valve shall be stored in ventilated and dry storehouse for protection. It is not permitted to store the valve at outdoors in any case. Valve end flanges shall be blanked with covers.
- The valve shall be stored at a safety location to against rain and dust if it can't install for a while.
- Don't scratching the stem during storage. The packing box can't contact the shelf if the valve is stored on a shelf. It had better don't store the valve on the ground directly.
- Gate/Globe Valve: The valve shall be stored with the gate/disc closed.
- The sealing face shall keep cleanness to avoid scratching when the valve will be stored for a long time. Checking/cleaning the valve if the valve has been stored over six months and Doing pressure tests before using the valve if the valve has been stored over twelve months.

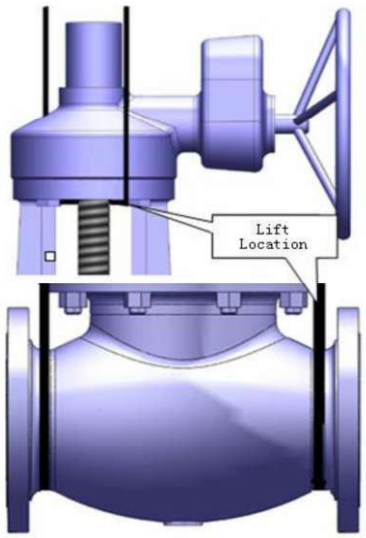
6 Installation and Operation Instructions for GGC Valves

6.1 Check before installation

- Before installation check the indication plate of valve and make the valve be accord with the purchase list. Check the flow direction and insure the installation correctly.
- Before installation, check the body run, the sealing face, stem, packing box, any mess shall be removed with soft cloth.
- Before installation check the actuator carefully to avoid locking.
- The valve shall be full closed before installation.

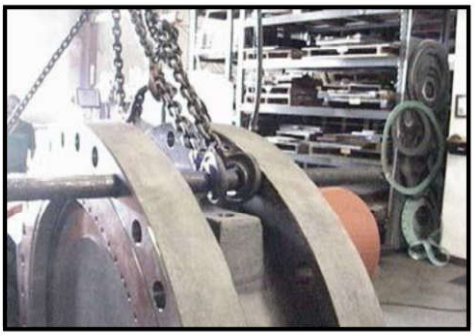
6.2 Lift

- Whenever handling or installing the valve, possible to prevent foreign matter damage to the gate and seat sealing surfaces.
- When handling or installing the valve, a sling should be placed under the valve body or around the valve yoke so that the unit can be lift vertically to its final destination. As shown in picture A:

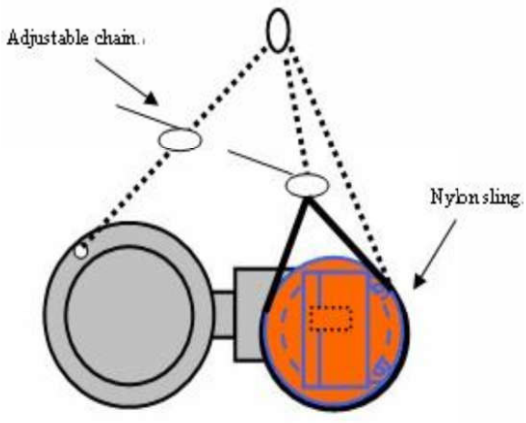


Picture A

- On large valves, a hoist is needed to assist installation.
  1) The flange end valve which is on the horizontal installation is lifted at 3 points. One point is at the center housing on the actuator. This may be accomplished with a nylon sling around the housing or a chain/cable attached to a lifting lug on the actuator. The second point is at the lower end of the valve. A bar is inserted through the flange bolts and a chain is attached to the bar. When installing in the piping system a bar which does not extend outside of the flange face to face will make it easier to install between the flanges. The third point is around the spring cylinder of the actuator. A nylon sling should be used so the actuator paint is not damaged. An adjustable chain device on point two and three will make the leveling of the package much easier. As shown in picture B and C:

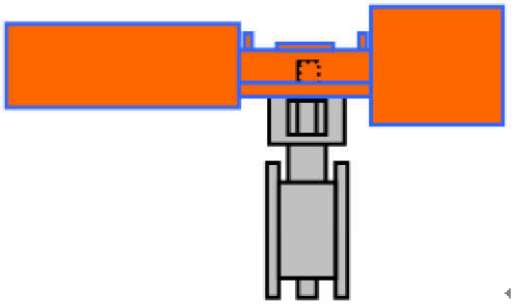


Picture B



Picture C

2) The welding valve which is on the horizontal installation has the same lift method as the flange end valve. This time it may be accomplished with a nylon sling around the end of the valve directly or a chain/cable.
3) On the vertical installation it should be lifted at the valve bonnet area with an additional sling on the actuator spring cylinder for leveling. As shown below:



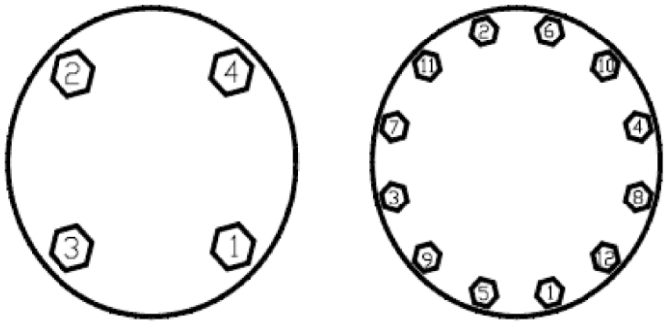
Do not use handwheels or other protruding parts of the valve, gearbox or actuator to lift the valve. The end connection necks are suitable places to attach lifting slings, if lifting lugs are not on the valve. During handling, careful attention should be paid to avoid impacting or dropping the components.

- To the big size check valve, there is a hook screw which is designed for lift.
- The face of flange end shall be protected by the cover during the process of lift. The cover can be removed only when the valve is installed.

During lift, please pay more attention to the face of flange end and the parts, or else the valve may be damaged. If the condition is bad, avoid the sand or other messes entering the body run.

6.3 Flange end Valves

- The flange end valve, in order to ensure uniform gasket stress, should be fastened to the line by cross pattern tightening method. As shown below,



6.4 Welding end Valves

- Welding end valves shall be performed by a qualified welder according to the ASME Boiler Construction Code Section IX.
- The welding-end preparation must be cleaned properly with a suitable solvent such as acetone or alcohol.
- Gate/Globe valve should be welded with the wedge or disc in a fully closed position.

6.5 Gate Valves

- The flow through gate valves can be from either end. There may be exceptions to these:
  - Bypass piping is used.
  - A pressure relief hole is drilling in the wedge.
- Note: Check the valve to ensure the correct position and direction of flow.

Flow-Direction Indication plate

- The preferred orientation of a gate Valve is upright. The valve may be installed in other orientations, but any deviation from vertical is a compromise. Installation upside down is not recommended, because possible dirt may build up in the bonnet.
- Gate valve should be installed and welded into the pipeline with the wedge in fully closed position. It could damage the sealing face if the valve is lifted open or partially open.
- During the process of installation, construction stage around the gland flange and stem should be protected at all times. As foreign debris which comes from welding, grinding, etc can fall in the tapered

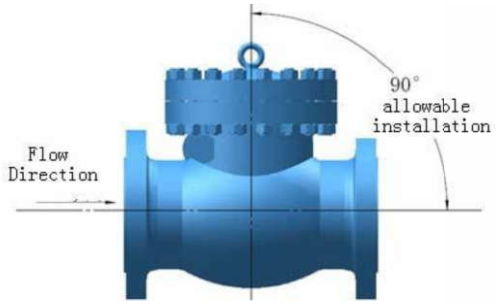
Gate valves should not be used for throttling to control the flow in any case; they are normally fully open or fully closed. Lifting the wedge in partially position can result in service damage to sealing surface, stem and guide rails.

6.6 Globe Valves

- Globe valves are usually installed with the inlet below the valve seat. This must be checked carefully to prevent incorrect installation. In fact, there is a flow indication in the body surface.
- The preferred orientation of a globe Valve is upright. The valve may be installed in other orientations, but any deviation from vertical is a compromise. Installation upside down is not recommended, because possible dirt may build up in the bonnet.
- Globe valves should be installed and welded with the disc in a fully closed position to present damage to the valve during installation.
- During the process of installation, construction stage around the gland flange and stem should be protected at all times. As foreign debris which comes from welding, grinding, etc can fall in the tapered area of the packing flange and stem.

6.7 Check Valves

- Check valves can be installed in the vertical, horizontal, incline direction. The suggested direction is shown in the illustration. It is suggested that the fluid flow uphill.



- Generally, the vertical center line of swing or position check valve can be inclined for 5°from vertical direction when the valve is installed in the horizontal direction.

- All check valves should be installed at least ten pipe diameters away from upstream pump, elbows, fittings or equipment. If closer installation is required, please consult the FROMME ARMATUREN Customer Service Manager.

There is a flow indication in the body surface. The installation direction must be checked carefully to prevent incorrect installation.

6.8 Re-screwed down nuts

- When the valve has been installed in the pipeline, the nuts of the bonnet –body had better be re-screwed down. The torque is listed in the annex B and the process of re-screwed down nuts refer to 7.2.

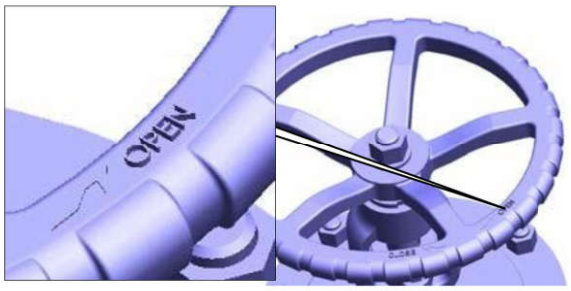
6.9 Pipeline cleaning

- To avoid the new valve being damaged, the valve shall be cleaned before the hydraulic test. the disc or the wedge shall be in the full open position to dash the mess out of the pipeline during the cleaning. Before end the cleaning, please make sure that the pipe don't have any messes, and then you can close or open the valve.

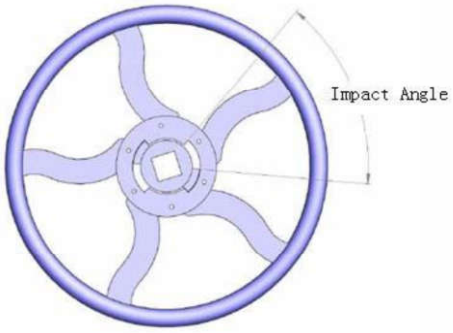
It is forbidden that valves are at the end of pipeline and cleaning the pipeline when the valve is not in the full position.

6.10 Operation instruction

Manually operation e.g. Handwheel, Impact Handwheel or Handwheel of Gearbox, normally follow the principles that cycle the Handwheel counter-clockwise to open the valve and clockwise to close.
And the operation direction arrows are casted on handwheel, As shown below:



- The impact hand wheel also is based on the principle that rotating the hand wheel anticlockwise to open the valve and rotate the hand wheel clockwise to close the valve. When use the impact hand wheel to close the valve, the hand wheel shall be rotated to the limited position shown in the illustration, then quickly rotate the hand wheel clockwise, the valve can be closed by repeating this several times. The valve can be opened by operating the valve anticlockwise.



- The default direction of gearbox is the same as the illustration if there is no special requirement from the customer. The customer can adjust the direction according to the requirement even if the valve has been completed. The optional direction is 90°or 180°from the illustration position.

- For the motor actuator or other actuator, the operation instruction refers to the actuator manual.

7 Regular Check And Maintenance

- Daily maintenance is a necessary way to guarantee the valves in good operation. The valve shall be checked regularly.

7.1 Valve's regular checking

- The seal capability check: the cleanness of the sealing face and the wear extent should be inspected regularly.
- The thickness of body and bonnet must be inspected every three months to ensure safety operation. When the thickness is less than value in the annex A, the valve must be scrapped.
- Check the torque of bolts, nuts every twelve months, avoid fastening.

7.2 Procedure of re-screwed down nuts

- The face of top flange or the end of studs shall be coated with lubricant.
- The other nut can be fixed by the wrench in the process of re-screwed down nuts.
- The stud can be screwed down by two steps, torques increase by the step, the first step shall be screwed down diagonally and torques of the first step can be 80% final torques.
- In the second step, every nut shall be screwed and screwed down nuts nearby (the number of N is listed in the next table.), the sequence is clockwise, the tools can be torque wrenches, such as the pneumatic, handle, electrical or hydraulic wrench. The final torque had better base on the annex B.

The number of N in the second step

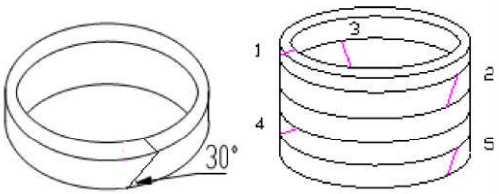
Studs No.	≤10	12 ~ 18	20 ~ 26	≥28
N	2	4	6	8

7.3 Valves' lubricate and maintenance

- The thread of stem and stem nut, the gear box shall be lubricated every six months to avoid the torque increasing day by day. The valve that hasn't been worked for a long time shall be operated every month.
- The advised lubricant of the stem or the stem nut: LOCTITE SILVER GRADE ANTI-S EIZE 76732
- The structure of lubricant shall be lubricated regularly.
- The lubricant or other tinder cannot be used in the oxygen valve. Advised: Krytox GPL206

7.4 Replacing packing

- The packing, gasket, bolt, nut shall use the same spec as usual. The packing shall be replaced every 2 or 3 years even if leakage doesn't happen. It can reduce the torque and present scratching the stem.
- Replace steps as follows: lift the packing flange nuts, lift packing flange and gland bushing as high as possible and secure, then use the special flexible removal tools to remove the packing. Clean the face of stem and the packing box. Then install new packing such as illustrations. Screw down the nuts. Take a pressure test. If the leakage happened in the area of packing, screw down the flange nuts equably, until the leakage disappears.
- FROMME ARMATUREN don't commend to repack the packing online if possible. If the action is needed, please contact with FROMME ARMATUREN and get the approval.



It is forbidden loosening the stud &nut when the valve is not in fully position under pressure.

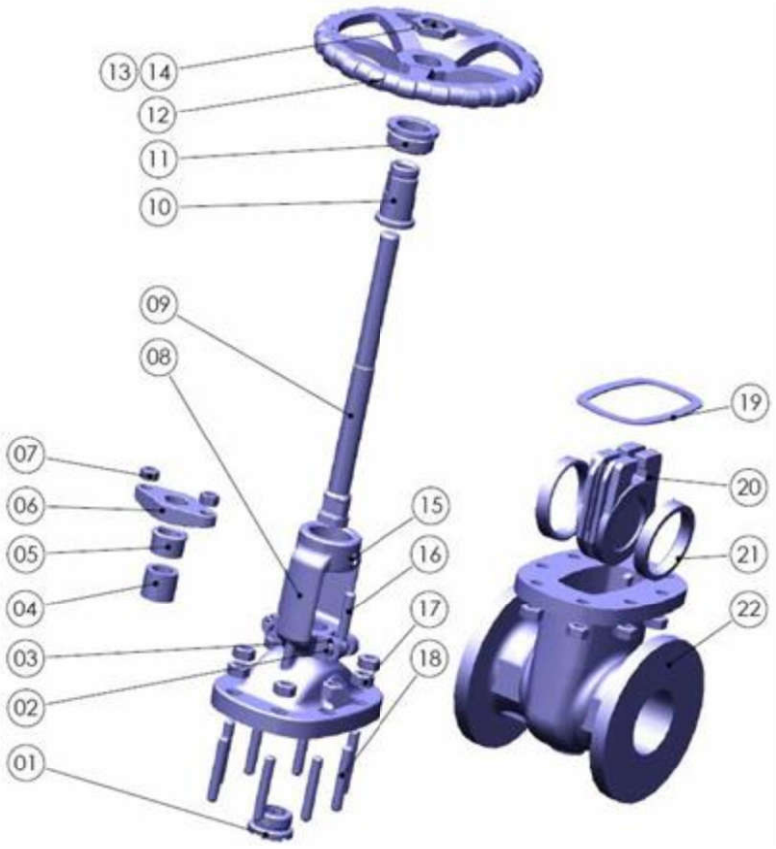
7.5 Potential failure and trouble shooting

Failure (risk)	Cause	Troubleshooting
Leakage of packing	Gland flange nuts loose	Equally tighten eyebolt nuts
	Rings of packing not enough	Add packing
	Packing aged or failure	Replace packing
	Stem sealing damaged	Stem shall be maintained periodically
Leakage between sealing surfaces	Dirties between sealing surfaces	Clean sealing surface
	Sealing surfaces damaged	Repair the sealing surfaces
	The Torque is not suitable	A torque increase refers to the Annex B
Operation failure	Packing too tight	Proper loose gland flange nuts
	Thread of stem nut over worn	Replace stem nut
	Stem bent	Rectify or replace stem
	Foreigner existence between stem and stem nut or gland or gland	Clean foreign matter
Leakage between bonnet flanges	Bonnet bolts loose	Proper tighten bonnet nuts
	Bonnet gasket failure	Replace bonnet gasket
Body and bonnet broken and leaked	Water hammer	Carefully operation to prevent suddenly stopping pumping and rapidly shutting.
	Fatigue	Replace valve that exceeds guarantee period or is found with early fatigue defection
	Freezing broken	Drain away water in winter when valve is not used
Disc failed to open	Disc blocked in the body.	Use proper torque
	Stem is overheated and blocks the disc.	When the valve is closed and the pipeline is heated, rotate the hand-wheel some bit counter-clockwise for unload at interval.

8 The Structures of Gate\Globe\Check valves

- The structures for Gate, Globe, Check valves partially shown as follows. The valves you purchased may be different from the illustrations. The structure will be accorded to the spec provided by the purchase.

8.1 The structure of gate valve

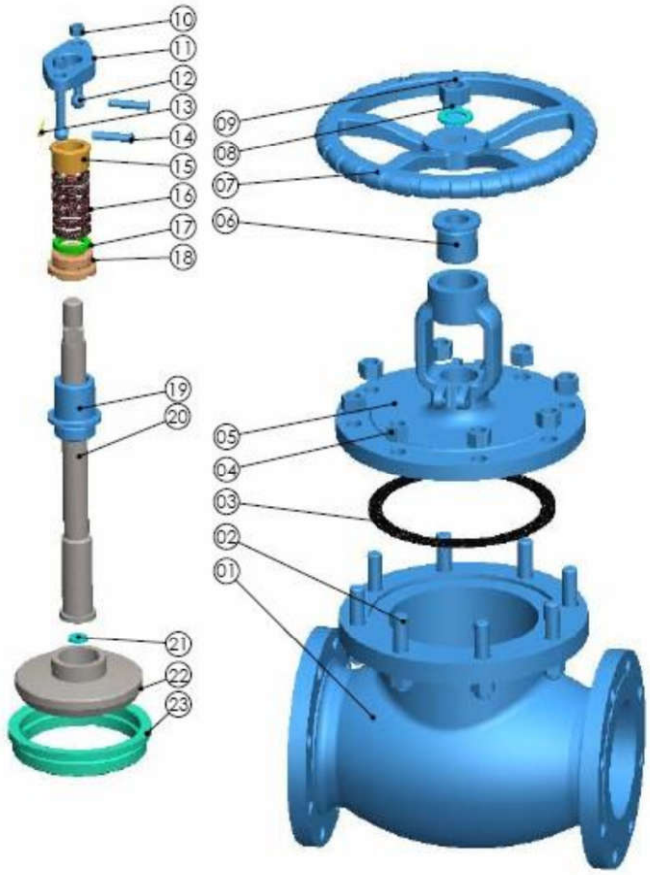


NO.	PART NAME
22	BODY
21	SEAT
20	WEDGE
19	GASKET
18	STUDS
17	NUTS
16	EYE BOLTS
15	GREASE FITTING
14	HANDWHEEL NUT
13	WASHER
12	HANDWHEEL
11	RETAINING NUT
10	STEM NUT
09	STEM
08	BONNET
07	NUTS
06	GLAND FLANGE
05	GLAND
04	PACKING
03	SPLIT PIN
02	PIN
01	BACK SEAT

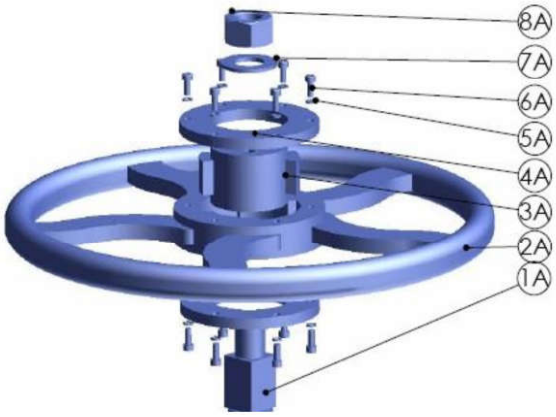
Notes:

- The Type of end flange may be: raised face, ring joint face, female/male face etc.
- Gear box or motor actuator can be chosen by purchases.
- Separated yoke/bonnet may be existed in the big size valve

8.2 The structure of globe valve



NO.	PART NAME
23	SEAT RING
22	DISC
21	STEM WASHER
20	STEM
19	DISC NUT
18	BACK SEAT
17	PACKING RING
16	PACKING
15	GLAND
14	PIN
13	SPLIT PIN
12	EYE BOLT
11	GLAND FLANGE
10	NUT
09	HANDWHEEL NUT
08	WASHER
07	HANDWHEEL
06	STEM NUT
05	BONNET
04	NUT
03	GASKET
02	STUD
01	BODY

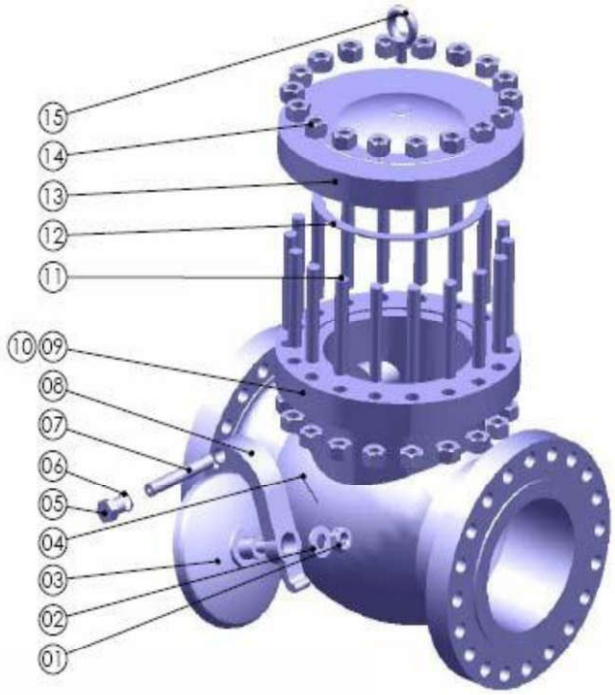


NO.	PART NAME
8A	NUT
7A	WASHER
6A	SCREW
5A	WASHER
4A	RETAIN PLATE
3A	IMPACT BLOCK
2A	HANDWHEEL
1A	STEM

Notes:

- The Type of end flange may be: raised face, ring joint face, female/male face etc.
- Gear box or motor actuator can be chosen by purchases.
- Separated yoke/bonnet may be existed in the big size valve.

8.3 The structure of check valve

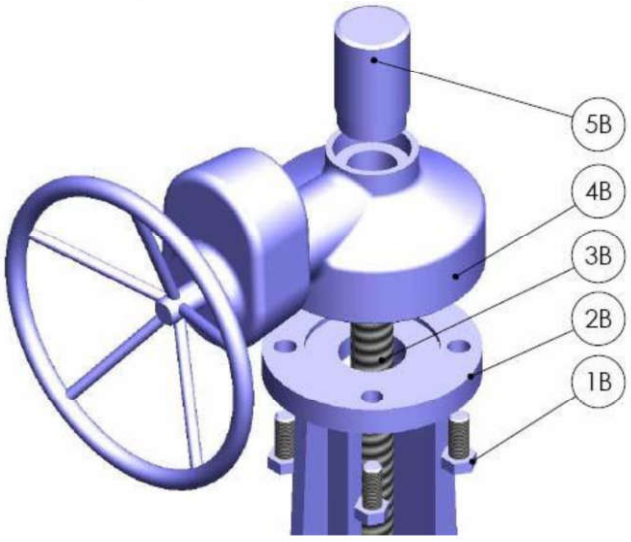


NO.	PART NAME
15	SCREW
14	NUT
13	BONNET
12	GASKET
11	STUD
10	SEAT RING
09	BODY
08	HINGE
07	HINGE PIN
06	WASHER
05	PLUG
04	SPLIT PIN
03	DISC
02	WASHER
01	BONNET

Notes:

The Type of end flange may be: raised face, ring joint face,female/male face etc.

8.4 Gear operation



NO.	PART NAME
5B	STEM ENCLOSURE
4B	GEAR OPERATOR
3B	STEM
2B	YOKE
1B	BOLT

Notes:

- Gear box can be installed in four directions;
- The maintenance of gear box refers to gearbox maintain manual.

9 Quality and Service

- FROMME ARMATUREN warrants its valves to the original purchaser for a period of 18 months from and after the date of delivery to the original customer, against defects in material and workmanship under proper and normal use and service and not caused of resulting from improper application or usage, improper installations, improper maintenance and repairs, modifications or alterations.
- Customers shall inform FROMME ARMATUREN, if a quality problem exists. The off quality valve which has been replaced by a new valve belongs to FROMME ARMATUREN . FROMME ARMATUREN owns the right to recall or deal with it.
- Purchaser shall give notice to FROMME ARMATUREN upon finding of any defect or assuming defect, FROMME ARMATUREN has privilege to check the facts of the defect.
- FROMME ARMATUREN sole obligation under this warranty shall be limited to the follows:
  - Repair of the material,
  - Replacement of the parts and materials,
  - Refund the purchase price or collect the defected products from the original purchaser.
- FROMME ARMATUREN is not responsible to claims caused from unexpected natural disaster such as earthquake, typhoon of any kind arising out of the defect.
- The scope and limitation of warranty can be changed through the agreement between FROMME ARMATUREN and purchaser.
- Where contractually specified, FROMME ARMATUREN may provide field installation and adjustment. FROMME ARMATUREN will trace the quality of sold valve and provide service to customer requirements.
- The action, the customer disassembles the valve without manufacturer’s approval, will regard as that the customer give up the quality assurance above.

Annex A Minimum Wall Thickness For Body And Bonnet

Class DN	20bars 150lb	50bars 300lb	100bars 600lb	150bars 900lb	250bars 1500lb	420bars 2500lb
DN50(2")	8.6	9.7	11.2	19.1	19.1	22.4
DN65(2-1/2")	9.7	11.2	11.9	22.4	22.4	25.4
DN80(3")	10.4	11.9	12.7	19.1	23.9	30.0
DN100(4")	11.2	12.7	16.0	21.3	28.7	35.8
DN125(5")	11.5	14.5	17.6	23.8	38.1	—
DN150(6")	11.9	16.0	19.1	26.2	38.1	48.5
DN200(8")	12.7	17.5	25.4	31.8	47.8	62.0
DN250(10")	14.2	19.1	28.7	36.6	57.2	67.6
DN300(12")	16.0	20.6	31.8	42.2	66.8	86.6
DN350(14")	16.8	22.4	35.1	46.0	69.9	—
DN400(16")	17.5	23.9	38.1	52.3	79.5	—
DN450(18")	18.3	25.4	41.4	57.2	88.9	—
DN500(20")	19.1	26.9	44.5	63.5	98.6	—
DN550(22")	20	28.6	47.7	—	—	—
DN600(24")	20.6	30.2	50.8	73.2	114.3	—
DN650(26")	22	32.8	—	—	—	—
DN700(28")	22.1	33.5	52.6	—	—	—
DN750(30")	23.4	35.3	56.2	89.3	—	—
DN800(32")	23.9	36.8	59.5	—	—	—
DN850(34")	25	38.2	62.5	—	—	—
DN900(36")	25.9	41.2	65.8	—	—	—

Annex B Body/Bonnet Bolting Torque

Annex B (a) Body/Bonnet Bolting Torque (B8、B8M、B8C、B8A、B8MA、B8/B8M/B8C-Class 2)

Torque (B8, B8M, B8C, B8A, B8MA) （N· M）				Torque (B8/B8M/B8C -Class 2) （N· M）	
Stud Size	Torque	Stud Size	Torque	Stud Size	Torque
1/2-13UNC	48~60	1-5/8-8 UN	1543~1929	1/2-13UNC	78~98
9/16-12 UNC	58~72	1-3/4-8 UN	1951~2439	9/16-12 UNC	113~142
5/8-11 UNC	80~100	1-7/8-8 UN	2426~3032	5/8-11 UNC	141~176
3/4-10 UNC	142~178	2-8 UN	2971~3714	3/4-10 UNC	223~279
7/8-9 UNC	230~287	2-1/4 -8UN	4296~5370	7/8-9 UNC	287~359
1-8 UNC	345~431	2-1/2-8UN	5966~7457	1-8 UNC	486~607
1-1/8-8 UN	507~634	2-3/4-8UN	7447~9309	1-1/8-8 UN	585~731
1-1/4 -8UN	714~893	3-8UN	9748~12185	1-1/4 -8UN	823~1029
1-3/8-8 UN	970~1213	3-1/4-8UN	12480~15601	1-3/8-8 UN	1048~1310
1-1/2-8 UN	1282~1602	3-1/2-8UN	15682~19602	1-1/2-8 UN	1321~1652

Annex B(b) Body/Bonnet Bolting Torque (B7、B7M、B16、L7、L7M)

Torque(B7、B7M、B16、L7、L7M)			
Stud Size	Torque（N·M）	Stud Size	Torque（N·M）
1/2-13UNC	82~102	1-5/8-8 UN	2371~2964
9/16-12 UNC	118~148	1-3/4-8 UN	2998~3748
5/8-11 UNC	147~184	1-7/8-8 UN	3727~4659
3/4-10 UNC	233~291	2-8 UN	4566~5707
7/8-9 UNC	376~470	2-1/4 -8UN	6601~8252
1-8 UNC	565~706	2-1/2-8UN	9167~11459
1-1/8-8 UN	727~909	2-3/4-8UN	11211~14013
1-1/4 -8UN	1024~1280	3-8UN	14674~18343
1-3/8-8 UN	1392~1739	3-1/4-8UN	18788~23485
1-1/2-8 UN	1838~2298	3-1/2-8UN	23607~29509