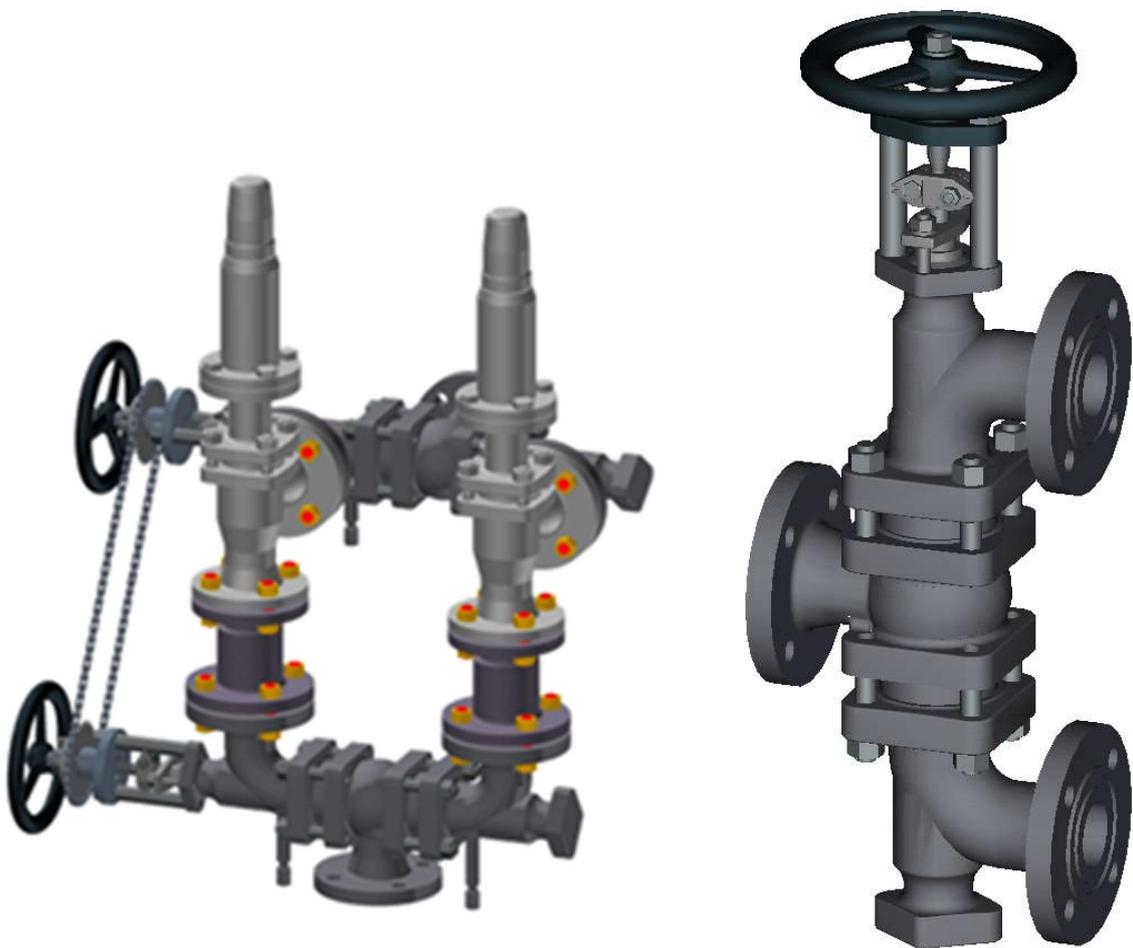




PHOENIX Armaturenwerke GmbH

Instruction for Change Over Valves
BA 099-WV-E

Edition 2023-08-00



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Date	Name	08/23	Wo						
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Operation Instruktion – Change- Over Valve

Declaration of conformity acc. to Directive 2014/68/EU

The manufacturer	PHOENIX Armaturenwerke GmbH 34471 Volkmarsen
declares that the valves	Change-over valves type 320, 320B with stuffing box seal. Change-over valves type 370, 370B with bellows sealed and secondary stuffing box seal. Change –over valves type 320/370/Safety valve combination. <ul style="list-style-type: none">• with handwheel and actuator• with square for gear assembling
<p>1. are pressure bearing equipment's within the meaning of the Pressure Equipment Directive 2014/68/EU and in conformity with the requirements of this directive, Note: Change-over valves <DN 32 are not concerned by this directive</p> <p>2. can only be used and operated under observance of the attached operation manual N° 099-WV.</p> <p>The commissioning of these valves is only admitted when all end orifices are connected to the corresponding piping system thus excluding each risk of injuries. (For change-over valves used as final valve please see operating instruction, section 2.3).</p>	

Related standards:

DIN EN 16668	Requirements and testing for metallic valves as pressure accessories Direction for pressure bearing body components. Body- and Bonnet Material acc. AD 2000 AD-A4 with Inspection Certificate 3.1 to DIN EN 10204
DIN EN 19	Marking of metallic valves

Description of type and technical features:

PHOENIX-type datasheets <320 and 370>

NOTE: This manufacturer declaration is valid for all variants of types mentioned in the PHOENIX catalogue

Applied procedure for the rating of the conformity:

to Annex II of the Pressure Equipment Directive 2014/68/EU Module „H“

Name of the notified body:

Identification N° of the notified body:

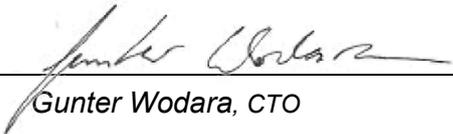
LRQA Deutschland GmbH

0525

Modifications on change-over valves with consequences for the technical features of the valve, of the <defined use> acc. to section 1 of the operation instruction and which will modify essentially the valve or supplied components of the valve cancel these declarations.

According to the guidelines for the application of the Council's general direction 2014/34/EU of 26.02.2014 for adapting legal regulations valid in the single member countries and dealing with apparatuses and safety systems and their application in areas endangered by explosion, changeover valves do not have an integrated potential source of sparks as revealed by the danger of releasing sparks analysis. Due to this, changeover valves are not subject to the guideline mentioned above.

Volkmarsen, 30.08.2023


Gunter Wodara, CTO

Operation Instruktion – Change- Over Valve

0 Introduction

This instruction shall support the user for installation, operation, and maintenance of change-over valve types **320 and 370**. **Installation procedure for Change over valves in combination see paragraph 9.**

This instruction is only valid for the valve itself. For actuated valves a separate instruction for the actuator will be attached.

 Attention	<p>The nonobservance of the following attention and warning notes might cause dangers with the consequence that the manufacturer's guarantee becomes void.</p> <p>For questions in this regard contact the manufacturer, addresses see section 8.</p>
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1 Defined use

After their installation in a piping system (either between flanges or by welding) the use of the change-over valve **types 320 and 370** is exclusively defined as to deviate the flow of media in relation to the design and position of the disc from one outlet orifice to the other one within the admitted pressure and temperature limits by manual operation.

A typical application for such kind of valves is their switch-off function between two safety valves which are fitted on the two outlets of the change-over valve.

The design document **<Pressure-Temperature-Tables TDB3/1 to 3/5>** (see section 8.1 <Information>) shows the admitted pressure-temperature-range for these change-over valves.

It is assumed that the safety instructions of section 2 <safety instructions> shall be observed.

2 Safety instructions

2.1 General safety instructions

Change-over valves are subject to the same safety impositions which are valid for the piping system where the valves shall be installed. Therefore, the present instruction mentions only such kind of safety notes which must additionally be considered for valves.

 Danger to life	<p>Valves whose admitted pressure-temperature range (= "Rating") is not sufficient for the operating conditions shall not be used. For materials or pressures or temperatures not indicated in the a.m. <Pressure-Temperature-Tables TDB 3/1 to 3/5> a release note from the manufacturer is mandatory.</p> <p>The disregard of this ordinance can provoke danger to life and cause damages in the piping system.</p>
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 Note	<p><i>Change-over valves are not suitable for an operation in intermediate position.</i></p> <p>A change-over valve shall only be used with its final positions totally open or totally closed.</p>
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2.2 Safety instructions for the user

It is not within the responsibility of the manufacturer and must be safeguarded by the user of the globe valve that.

⇒ the valve is only used as required by the "defined use" as described in section 1

 Danger	<p>Protection against wrong use for the change-over valve:</p> <p>It must be absolutely assured that the selected materials of the wetted parts of the change-over valve are suitable for the handled media. The manufacturer is not responsible for damages of the globe valve caused by corrosive agents.</p> <p>The disregard of this ordinance can provoke danger for the user and cause damages in the piping system.</p>
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Operation Instruktion – Change- Over Valve

- ⇒ a gear operator which is fitted to the valve later on shall be adapted and correctly adjusted to the final position of this valve,
- ⇒ The change-over valve will be installed workmanlike in the piping system, especially such types of valves which are fitted into the piping system by welding. The wall thickness of the valve body shall be calculated in such a way that an additional load F_z within the usual order of magnitude ($F_z = \pi/4 \cdot DN^2 \cdot PS$) is taken into account for such a workmanlike mounted piping system.
($PS = \text{max. admitted design pressure at ambient temperature}$),
- ⇒ the valve shall be fitted workmanlike with these systems,
- ⇒ inside this piping system the usual flow rates in continuous operation shall not be exceeded and exceptional operating conditions such as vibrations, water hammers, cavitation, and higher percentages of solid matters in the media – especially wearing ones – had been cleared with the manufacturer,
- ⇒ change-over valves used at operating temperatures $>+50^\circ\text{C}$ or $<-20^\circ\text{C}$, are protected against contact as it is intended for the pertinent piping system,
- ⇒ Only qualified staff is used for the operation and maintenance of pressure bearing piping systems.

2.3 Special risks

 Danger to life	<p>Before the disassembling of the change-over valve out of the piping system and/or before the loosening of the bolts and nuts of the bonnet the system shall be completely depressurized to avoid an uncontrollable fugitive emission of the media.</p>
 Danger	<p>For the refitting of the bolted fixation of body components the bolts shall be tightened in accordance with the repair instruction <A 099 R> (<i>how to procure see section 8</i>) using a dynamometric key.</p>
 Danger	<p>When a change-over valve shall be disassembled from the piping system, there is a risk that the media can flow out of the piping or the valve. In case of liquids which are harmful for the health or dangerous the piping system shall be completely drained before the valve can be removed from the system.</p> <p>Caution of residues coming out off or remaining in dead holes of the valve or the piping system itself.</p>
 Danger	<p>Whenever a change-over valve with a free outlet orifice shall be opened under pressure load this must be performed with extraordinary care and in such a manner to assure that the outspurring media cannot provoke damages.</p>
 Danger	<p><i>Change-over valves which are used as final shut-off valve for a free piping section:</i></p> <p>For normal operation, especially with gaseous, hot and/or dangerous media a blind flange shall be fitted on the free outlet or adequately secured against unauthorized operation acc. to the directives of EN 292 – Part 2.</p>

Operation Instruktion – Change- Over Valve

2.4 Marking of the change-over valve

Each change-over valve is normally marked as follows:

For	Marking	Note
CE-Mark	CE 0525	Corresponding to PED 2014/68/EU valves shall be marked with the CE-mark only for sizes DN 32 and more
CE-Mark	0525	Nominated body to EU Directive = LRQA Deutschland GmbH Register
Manufacturer	PHOENIX (PAG)	„ is the logo for <PHOENIX-Armaturenwerke>
Manufacturer-N°	e.g.:98898/02	The first figures before the strike are the factory number, the last figures after the strike = item n° g.g. /02 = item 2 of the order
Date of manufacture	e.g.: 05/02	The first figures before the strike indicate the month of manufacture (05 = May), the figures after the strike = year of manufacture, e.g. (02 = 2002)
Valve type	Type (and numerical value)	e.g. Type 320, see Data-sheet PHOENIX
Body material	e.g.: 1.0619.01	N° of material standard to DIN EN 10027, Part 2
Size	DN or NPS (and numerical value)	Numerical value in mm, e.g. DN 200 or NPS 8
Max. pressure	PS or PN (and numerical value)	Numerical value in [bar] at 20°C, e.g. PS 40
	ANSI and Class (numerical value)	e.g. ANSI 300
Heat-/ Melt N°	e.g.: 24603; GMC	Heat-/Melt N° of the foundry

Table 1 Marking of the change-over valve

 Attention	<p><i>When the valve is not marked with „PN“ in accordance with the impositions A4-AD2000 :</i></p> <p><i>The indication PS - max. admitted pressure for which the pressure equipment is designed – in conformity with the impositions to PED 2014/68/EU. The markings PN and PS are the max. admitted pressure for the valve at ambient temperature.</i></p>
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3 Transport and Storage

Change-over valves shall be carefully treated, transported, and stored:

- ⇒ The valve shall be stored on pallets (or similar) with its protecting packing and/or with its protecting caps on the inlet and outlet and shall also be transported in such a state (even on the transport to the installation point.

 Attention	<p><i>To protect the valve against damages:</i></p> <p>Ropes and belts shall only be fixed on the bonnet but never on the handwheel!</p>
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- ⇒ Before its installation the valve shall be normally stored in closed area and shall be protected against detrimental influences such as dirt and humidity.
- ⇒ In particular the handwheel and the end orifices of the change-over valves for the connection with the piping system shall not be damaged neither by mechanical nor other influences.
- ⇒ Change-over valves will be supplied with disc in closed position and shall be stored in this state.

4 Installation into the piping system

4.1. General

For the installation of valves into a system the same instructions are valid as for the connection of pipes among themselves and similar piping components. When in a plant the piping and other equipment are isolated, this must also be applied to the built-in changeover valves. In addition, the following instructions are valid for change over valves. For the transport to the installation place please mind the information given in section 3 of this manual.

 Danger to life	<p>If change over valves is installed in insulated piping systems, or in the area of other isolated equipment, so they must also be isolate. In absence of insulation, change over valves can be damaged. In serious cases, the pressurized parts could be damaged.</p>
 Attention	<p><i>To avoid damages of globe valves with weld ends:</i></p> <p>During the welding of the valves into the piping system the weld procedure shall be performed in such a way that the applied heat energy is limited, and deviations of the valve body are avoided. Therefore, larger sizes shall be welded in alternating procedures once from one side and then from the other to avoid restraints in the valve's body.</p> <p>During the weld procedure the disc of the change-over valve shall be brought and kept in the middle position until the weld conjunction is cooled down to <100°C.</p>
 Danger to life	<p>In case of a posterior installation of a gear operator the interface adaptation, the nominal moment and the sense of the rotation must be adapted to the change-over valve.</p> <p>The closed position always is the respective final position.</p> <p>Disregard of this imposition can provoke danger for the operator and damages in the piping system.</p>

 Note	<p>When change-over valves will be insulated after their installation it must be assured that the gland follower and the hand-wheel are well accessible.</p>
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As far as handwheels are concerned:

 Danger	<p><i>Handwheels are neither "stepboards nor ladders"!</i></p> <p>Handwheel shall not be charged with heavy loads; this can damage or distrust both the hand-wheel and/or the glob valve.</p>
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4.2 Working steps.

- ⇒ Transport the valve in its protecting packing to the installation site and unpack the valve just before its immediate fitting into the system to ensure that the valve is protected against each kind of contamination.
- ⇒ Inspect the valve and hand-wheel on possible transport damages. Damaged valves shall not be installed.
- ⇒ Make sure that only valves will be installed who's pressure rating, type and dimensions of connections correspond to the operating conditions. In this regard also see related marking of the change-over valve.

 Danger to life	<p>Change-over valves whose admitted pressure-/temperature rating is not sufficient for the operating conditions shall not be installed. This admitted range results in the marking and/or in the design document <Pressure-Temperature-Tables TDB3/1 to 3/5> see also section 1 <Defined use>.</p> <p>Disregard of this precautionary measure can provoke danger to life for the user and damages in the piping system.</p>
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- ⇒ The connections of the piping system shall be in strict alignment with the end connections of the gate valve and have plane-parallel ends.
- ⇒ Before the installation the valve and the corresponding pipe shall be carefully cleaned from dirt and contaminations, especially hard foreign particles shall be removed.
- ⇒ The mainstream of the flow is coming through the middle connection of the change-over valve. This main on-stream direction is marked by an arrow. For special applications and information regarding “equilibrating disc” see section 8 < Information>
- ⇒ The valve can be installed in each desired position.
The typical installation position is with top orientated outlet orifices.
- ⇒ Introducing the valve (and the flange gasket) into an existing piping system e.g. in case of replacement, the distance between the pipe ends must be dimensioned in such a way that the sealing surfaces of the flanges and the gaskets, too, will not be damaged.
However, the gap shall not be larger than necessary to avoid additional loads onto the piping system during the installation.

For change-over valves with weld ends only:

- ⇒ The weld ends of the valve shall be in true alignment and shall have parallel faces and must be of identical type and materials as the pipes – see type plate of the valve. Opposite weld ends must fit to each other as far as diameters and weld joints are concerned.
- ⇒ Make sure by workmanlike welding that neither worth mentioning tensions will be produced in this piping section or on the valve nor that the globe valve body might get distorted due to unilateral heat introduction during the weld procedure. Only temperatures of <math><300^{\circ}\text{C}</math>, measured on the body wall, are admitted.
- ⇒ The weldings must be performed workmanlike in such a way that the weld seam has all round about a uniform temperature. Gate valves >DN 300 shall be welded in alternation on their opposite sides.
- ⇒ Weld cables shall not be fixed on the valve itself but exclusively on the pipings.

 Attention	Disregard of these impositions can provoke distortion of the valve body. A permanent distortion in the seat area of the valve can signify that the valve becomes unserviceable.
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5 Pressure test of the piping section

For the pressure test of change-over valves the same instructions are valid as imposed for the piping system. In addition, the following shall be considered:

- ⇒ Newly installed pipe system shall be carefully cleansed to flush off all foreign particles.
- ⇒ The test pressure “PT” of an **opened valve** shall **not exceed the value 1,5x PN/PS** by virtue of the marking of the valve.
- ⇒ The test pressure “PT” of a **closed valve** shall **not exceed the value 1,1x PN/PS** by virtue of the marking of the valve.

6 Starting up/commissioning, normal operation and maintenance.

6.1 Starting up/Commissioning.

When a **change-over valve is installed in closed position or as final shut-off device**, during the “starting up phase” of a piping section it must be assured at temperatures of >100°C – especially when change-over valves of >DN 300 are involved - that the handled medium will be slowly fed-in. Otherwise, the valve’s body gets distorted, and the valve will leak.

6.2 Normal operation and maintenance

The switch-off of the change-over is performed via the turning of the hand- e. Normal hand force is sufficient for the operation of the handwheel. Only for a tight closure or in the opening phase of the valve increased hand force might be necessary for a short transition time.

Operation Instruktion – Change- Over Valve

The use of **extension rods, levers, and similar items to increase the operation moment** is not admitted.

 Note	<p><i>Change-over valves are not suitable for an operation in intermediate position.</i></p> <p>Change-over valves shall only be used in their final position, i.e. either completely opened or closed.</p> <p>When an intermediate/throttling position is required, the valve shall be equipped with a rigid regulating disc, i.e. no loose disc.</p>
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Regular maintenance work is not required for change-over valves, however, during the inspection of the piping section no leakage shall appear neither on the flanged and/or screwed connections nor on the stuffing box. In case of leakages and repairs please see section 2 – <Safety instructions> and section 7 <Failures>

7 Trouble shooting

During the remedy of failures section 2 <Safety instructions> shall be absolutely considered.

 Danger	<p><i>When a valve is removed from systems conveying dangerous media and shall be carried away from the plant:</i></p> <p>Then the change-over valve must be professionally decontaminated.</p>
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Kind of failures	Procedures for remedy	Note
Leakage on the flanges to the system or between body and bonnet	<p>Tighten bolts and nuts.</p> <p><i>When the valve is still leaking:</i></p> <p>Remove the valve, always considering the notes in section 2.3 <Special risks> and ask for spare gaskets for the bonnet and correlated instructions at PHOENIX:</p> <p><u>Change-over valves without bellows seal:</u></p> <p>Tighten the nuts of the gland follower alternating and clockwise in little steps of max. ¼ turn to ¼ turn until the leakage stops.</p> <p>In the document <A099R> <u>please see section 8</u> the max. admitted torque for the tightening is specified.</p> <p><i>In case the leakage cannot be eliminated by this procedure:</i> Repair will be necessary. Ask PHOENIX for new packing and corresponding instructions.</p> <p><i>In case the nuts of the gland follower shall be loosened or removed (anticlockwise turning) :</i></p> <div style="text-align: center;">  <u>Danger to life</u> </div> <p>To protect the staff against possible risks the complete system shall be absolutely depressurized.</p> <p>Mind and consider section 2.3 <Special risks>.</p>	<p>Note 1:</p> <p><i>Spare parts shall be ordered with all indications of the marking of the valve. Only the original PHOENIX spare parts shall be used for repairs and replacements</i></p> <p>Note 2:</p> <p><i>When it is noted after the disassembling of the valve that the body and/or trim is not sufficiently resistant against attacks of the media opt for more suitable materials of design</i></p>

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Leakage on the flanges to the system or between body and bonnet	<p><u>Change-over valves with bellows seal:</u></p> <p>The bellows is damaged and shall be replaced as soon as possible, especially when used with corrosive/hazardous media: Repair necessary. Remove the valve from the line, consider section 2.3 <Special risks>. Ask PHOENIX for required spares and corresponding instructions.</p> <p><i>As long as replacement is not possible:</i></p> <p>Retighten stuffing box as described above.</p>	<p><u>Note 1:</u></p> <p><i>Spare parts shall be ordered with all indications of the marking of the valve. Only the original PHOENIX spare parts shall be used for repairs and replacements</i></p> <p><u>Note 2:</u></p> <p><i>When it is noted after the disassembling of the valve that the body and/or trim is not sufficiently resistant against attacks of the media opt for more suitable materials of design</i></p>
Leakage in the closed position	<p>Remove the valve (Mind and consider notes of section 2.3 <Special risks>) and check the valve.</p> <p><i>In case of damaged seats:</i></p> <p>Repair necessary: Remove the valve, mind the notes of section 2.3 <Special risks>. Ask PHOENIX for corresponding instructions or send the valve back to PHOENIX for repair</p>	
Functional failures	<p>Check stem and stem nut.</p> <p><i>When these functional components are ok but not sufficiently lubricated:</i></p> <p>Clean stem from dirt and contaminations and lubricate with grease compatible with the operating temperatures.</p> <p>For normal operating temperatures lithium saponified greases are sufficient. (Standard greases.....).</p> <p><i>When this procedure will not remedy the failure: :</i></p> <p>Repair necessary: Remove the valve and inspect, mind the notes of section 2.3 <Special risks>. Ask PHOENIX for corresponding spares and required instructions.</p>	

In case of failures on the actuators see attached instructions.

8 Other information

The mentioned <Datasheets>, <Design documents> Repair instructions and other information – also in other languages - you can ask for under

Info@phoenix-valvegroup.com oder <http://www.phoenix-valvegroup.com>

Or at the following address:

PHOENIX Armaturenwerke GmbH

Am Stadtbruch 6
34471 Volkmarsen

Tel.: 05693-988-0
Fax.: 05693-988-140

Operation Instruktion – Change- Over Valve

8.1 Pressure – Temperature-Rating, Excerpt TDB 3/1 to 3/5

The requirements of DIN EN 12516 – 1 are principally fulfilled.

- **Low alloyed and not alloyed steels**

PN	DN-range	Admitted oper. pressure (bar) at oper. temperatures (°C)						
		-60*	-10	120	200	300	400	450
10	15-500	7,5	10	10	8	6	6	5
16	15-500	12	16	16	15	12	9	6
25	15-500	18,75	25	25	23	18	14	12
40	15-300	30	40	40	38	30	24	20
63	15-150	47,25	63	63	55	41	35	32
100	15-150	75	100	100	85	62	53	51
160	15-150	120	160	160	130	96	84	81

* AD-W10, Load case II

- **Stainless steels**

PN	DN-range	Admitted oper. pressure (bar) at oper. temperatures (°C)					
		-196*	-10	120	200	300	400
10	15-500	10	10	10	8	6	6
16	15-500	16	16	16	15	12	11
25	15-500	25	25	25	23	18	16
40	15-300	40	40	40	36	30	25
63	15-150	63	63	63	50	44	40
100	15-150	100	100	100	80	70	64
160	15-150	160	160	160	130	112	103

Not valid for SS 1.4581

- **Low temperature steels**

PN	DN-range	Admitted oper. pressure (bar) at oper. temperatures (°C)					
		-60*	-50	-10	120	200	300
10	15-500	10	10	10	10	8	6
16	15-500	16	16	16	16	15	12
25	15-500	25	25	25	25	23	18
40	15-300	40	40	40	40	36	30
63	15-150	63	63	63	63	55	41
100	15-150	100	100	100	100	85	62
160	15-150	160	160	160	160	130	96

1.0488

For steels not mentioned in these tables the user shall contact the manufacturer/supplier of the valve.

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8.2 Equilibrating disc

Combinations of nominal pressures – nominal diameters on the left side of the marked step line can be operated with pressure coming from the lower side of the disc also for the differential pressure equal to nominal pressure.

Combinations of nominal pressures – nominal diameters on the right side of the marked step line cannot be operated with equal to nominal pressure. Reference values for differential pressures which still allow a normal operation are indicated in the right side below the marked step line.

For higher differential pressures suitable measures shall be considered, e.g. equilibrating disc, re-version of the shut-off device or by-pass arrangements.

Table 1– Permissible differential pressure in bar

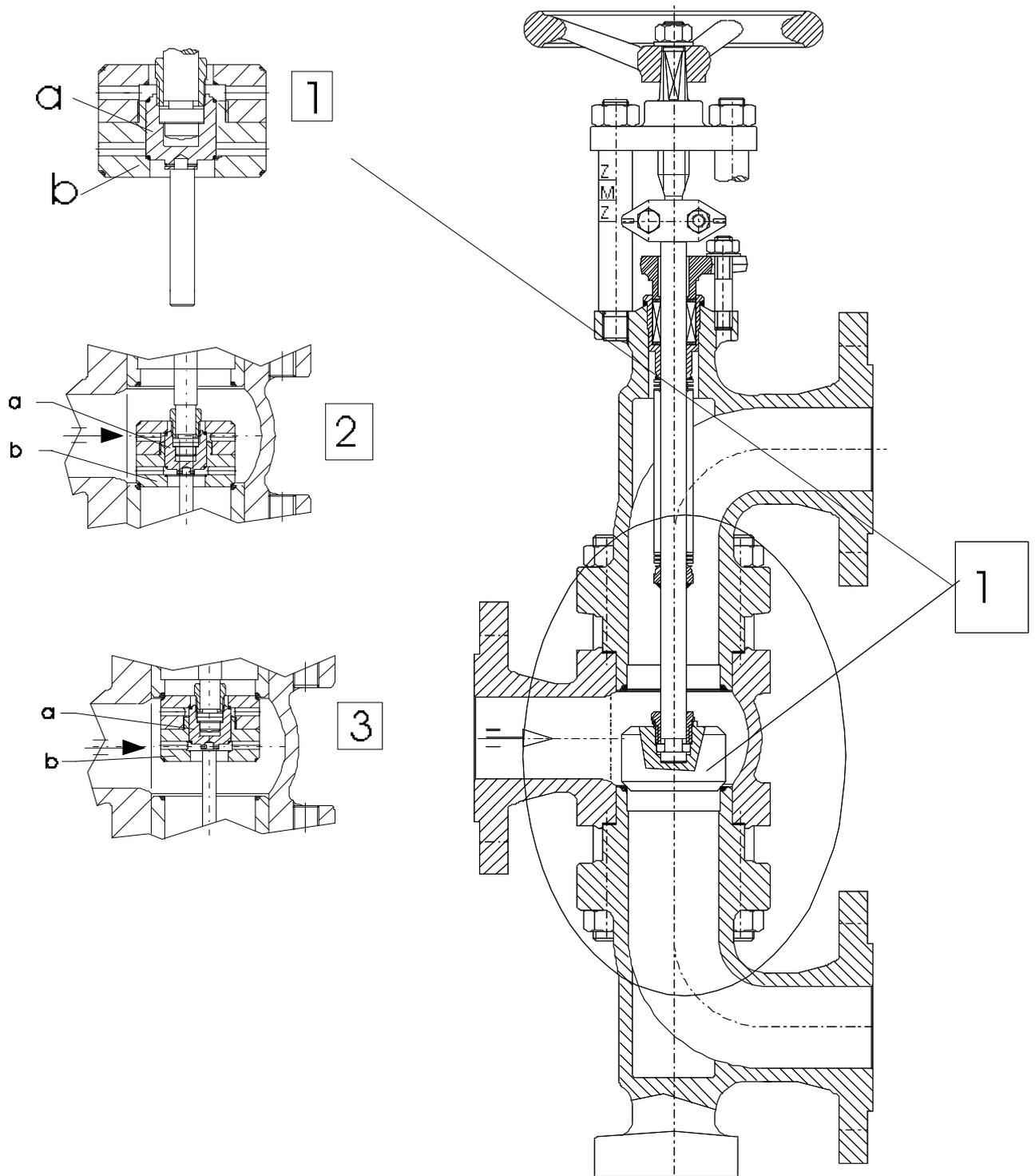
PN	DN																	
	10	15	20	25	32	40	50	65	80	100	125	150	200	250	300	350	400	500
10																		
16																		
25													13	8	5	4,5	3,5	2
40												25	13	8	5	4,5	3,5	2
63									64	55	35	25	13					
100									80	55	35	25	13					
160								125	80	55	35	25	13					

Operation Instruktion – Change- Over Valve

8.2.1 Function of the equilibrating disc

Valves equipped with an equilibrating disc shall be installed in the system in such a way that the flow (and the pressure) comes from atop the disc.

When the right outlet orifice (1) is closed the starter disc (a) will be lifted from its seat by turning the handwheel anti-clockwise. This lift provokes immediately an equilibration of the pressure of the media (2) under the main disc (b). As soon as this balance of pressures is reached up to values mentioned in the table 1, the valve can be operated without supplementary tools or devices by normal hand force by further turning the hand-wheel (3).



9. Installations instructions combinations of Change over valves



Remove the plastic protection caps from the orifices.

Marking: Each valve and other components which constitute one set are marked with an item number. Before installation the pairing/mating must be carefully checked.

Assembling: The complete combinations are delivered only on individual order base, i.e. not off-the-shelf. Normally, these valves will be mounted on jobsite by the user or the staff of the plant designer and should be fitted in a clean, dry ambient to avoid that dirt or other impurities could enter the valve and prejudice their function.

All bolts, nuts, washers, gaskets, and similar items which are added from client's stock must be checked before assembling on physical conditions and correct application.

Installation: After assembling, the combinations must be transported to jobsite and, with the aid of the necessary handling equipment (cranes, hydraulic jacks, etc.) installed on the piping or tank/vessel. When each combination is mounted, the spindles of all change-over valves must direct in the final position.

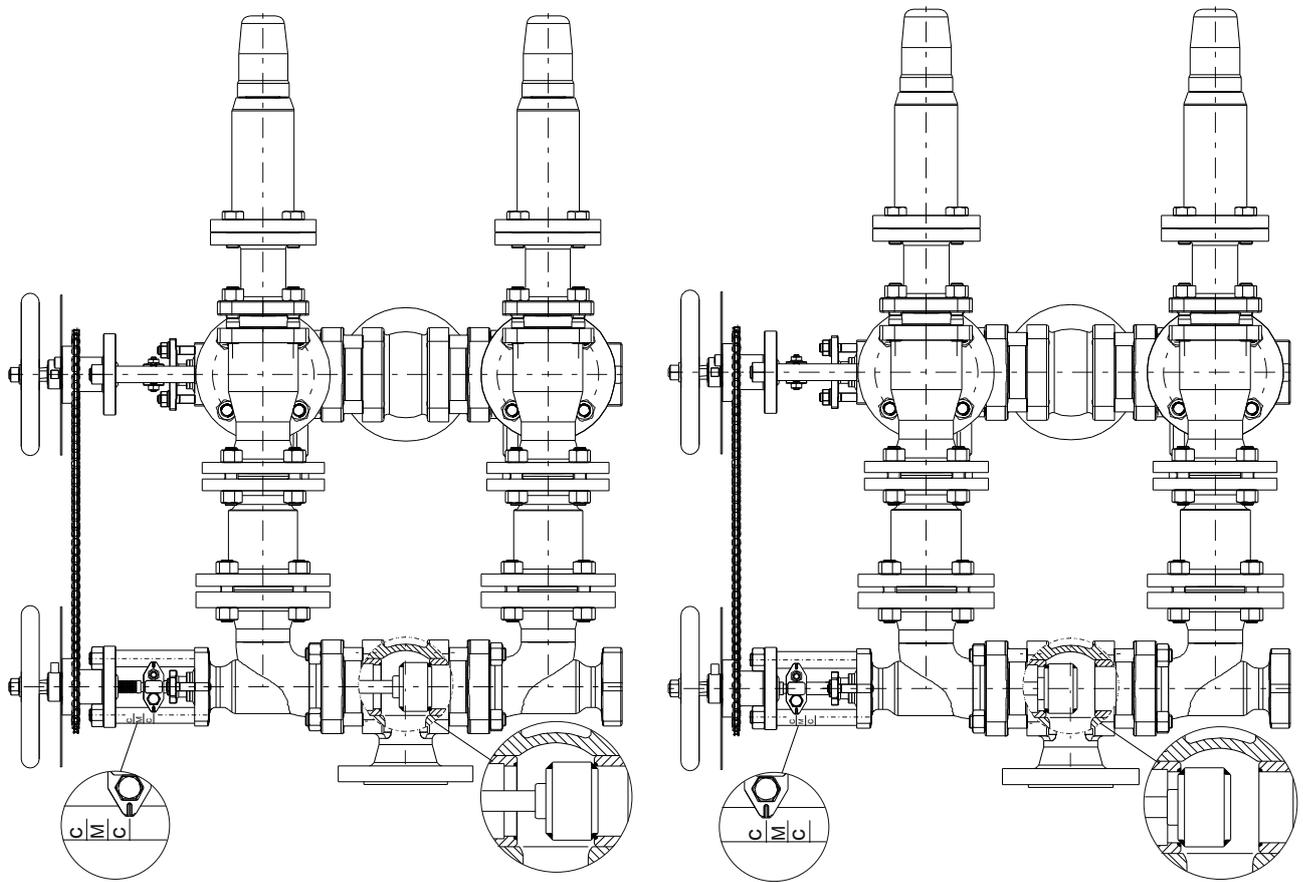
The final chain length must be adapted on jobsite. Please note that there is sufficient slack that both valves can be easily closed by rotating one handwheel only, that the joining link is properly closed, and the path of the chain is not blocked. A sufficient slack is necessary due to small deviations of the individual travels/lifts of the valves. After cutting the chain is to be closed with a chain lock. It is important to ensure that the running of the chain is not impeded.

Operation: The chain connected valve then can be operated or closed simultaneously by turning one handwheel only.

After having reached the closing position, give a short turn in closing direction with the handwheel of the second change-over valve.

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When a safety valve becomes defective and must be replaced, the discs of the change-over valves are switched on the side of the questioned safety valve by turning one handwheel. However, the handwheels of each valve must be separately loosened before starting with operation. When the change-over procedure is finished, each valve must be individually tightened, too.



Position Indicator shows which side of the COV is closed.

Note for operation of lockable PHOENIX change over valve combinations.

- there is the need after closing the valves to close every handwheel by hand afterwards in order to eliminate possible clearance between chainwheel and handwheel. this is to assure that the safety relief valve is cut off from the medium flow at the inlet and at the outlet.
- the PHOENIX change over valve combinations are considered to be taken when the safety relief valves are connected to the same blow off system.