Check valves and pre-fill valves type F

Pressure p_{max} = 400 bar
Flow Q_{max} = 7000 lpm

1. General application

1.1 Application

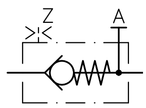
As check valves (DIN ISO 1219-1) for free flow in one direction and blocked flow in the opposite direction. (See also sect. 1.4) As pre-fill valves (hydraulic pilot-operated check valves, DIN ISO 1219-1) in the press controllers for further-suction and emptying the press cylinders when closing and opening in rapid traverse. Zero leakage in the blocked direction (plate-type seat valves).

Check valve

1.2 Surge-free decompression with pre-fill valves

Pre-fill valves are available without and (depending on their size) optionally with hydraulic pre-relief. In the case of the standard version without pre-relief, decompression takes place via a directional control valve with an up-stream orifice or throttle until there is complete decompression in the cylinder (see sect. 6.1). Decompression takes place automatically in valves with pre-relief (see sect. 6.2).

Pre-fill valve

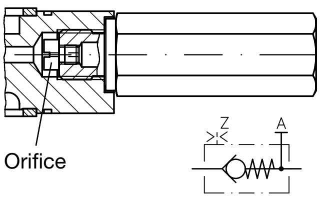


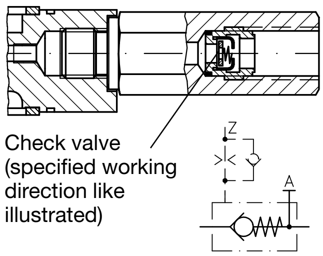
1.3 Installation

When directly fitted onto the cylinder, the valves are clamped between the cylinder base and welding neck flange. For line installation, they are positioned between the front faces of the welding neck flanges. The seal diameters are selected so that the material yield point is not exceeded when normal flanges are used and when the permissible operating pressures given in sect. 2.2 are kept to. Sealing rings type A DIN 7603-Cu or flange seals are used, depending on the size. For details of sealing surface working of flanges, see sect. 2.2

1.4 Functional description

- Damping with pre-fill valves
  The unblocking operation of the pre-fill valve is basically dampened by a built-in orifice (SOLEX carburetor nozzle M 5), so as to prevent mechanical impacts on the valve parts. This orifice also causes a delayed closing movement, which should be calculated with approx. 0.2 to 0.7sec (depending on the type), referred to approx. 60 mm²/sec viscosity of the hydraulic oil. In the vast majority of operating instances, this is no problem since the closing operation is completed within the press system's return time. If you require a faster closing time after triggering, e.g. for air cycles, unscrew this throttle from the connection piece and replace it as shown with a restrictor check valve BC 1-0.6 in accordance with D 6969 B (applies to type F 25-12. to F 160-76).





Type	Orifice
F 25-12 (V)	∅ 0.5
F 32-16 (V)	
F 40-20 (V)	∅ 0.7
F 50-25 (V)	
F 63-30 (V)	∅ 0.8
F 80-36 (V)	∅ 1.0
F 100-45	∅ 1.2
F 125-60	∅ 1.5
F 160-76	∅ 1.5
F 200-100	∅ 6

2.5

- Check valve (also suctionnig of the pre-fill valves)
  For use as a check valve (type F...), ensure that there are no sudden flow rate rises in the opening direction of the type which can be expected, e.g. with directional spool valve operations arising from the accumulation capability of the oil volume in lines and consumers during the switching operation. In the case of pilot-operated valves, e.g. this can be achieved by appropriately setting the switching time. The main purpose of this is to prevent the valve plate being pulled too strongly to its stroke stop while employing the max. flow rating of the valve and therefore to prevent the valve plate being damaged by excessive inertia forces. The perm. acceleration time $Q = 0 \rightarrow Q_{max}$ is approx. 250 msec (approx. 200 msec with F200 - 100)

2. Types available

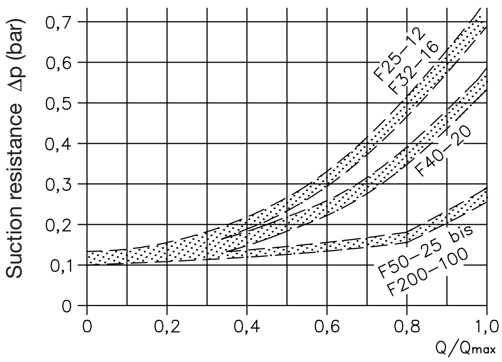
2.1 Type designation, main data

Coding Check valve	Pre-fill valve without pre-relief	Pre-fill valve with pre-relief	Nominal size	Flow Q_{max} (lpm)	Control part on pre-fill valves Release ratio (k)		Control volume (cm^3)	Mass (weight) approx. (kg) F..	 F.. - ..(V)
F 25	**F 25-12**	**F 25-12 V**	25	100	4.3		0.45	1	1.1
F 32	**F 32-16**	**F 32-16 V**	32	160	3.6		1	1	1.2
F 40	**F 40-20**	**F 40-20 V**	40	250	3.9	Valve plate opens	2.1	1.4	1.7
F 50	**F 50-25**	**F 50-25 V**	50	400	4.2	at residual pres-	4	2	2.4
F 63	**F 63-30**	**F 63-30 V**	63	630	4.2	sure in (press)	7	2.8	3.4
F 80	**F 80-36**	**F 80-36 V**	80	1000	4.5	cylinder	12.2	4.4	5.2
F 100	**F 100-45**		100	1600	4.3	$p_{cyl\ rest} = p_{St} : k$	25.4	9.9	11.7
F 125	**F 125-60**		125	2500	4.3		59.3	15.8	19.6
F 160	**F 160-76**		160	4000	4.3		113	43	50
F 200	**F 200-100**		200	7000	4.0		314	110	120

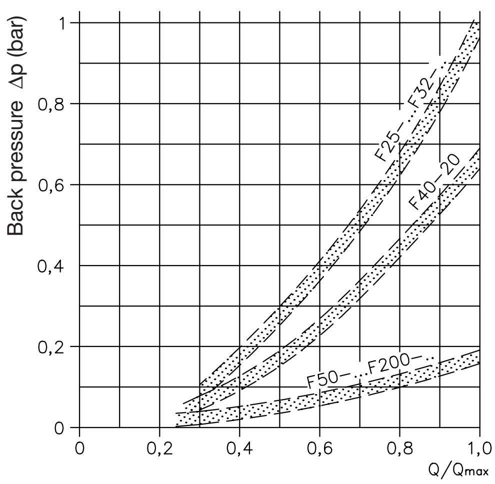
Type	Plate-type seat valve, spring-loaded
Installation position	Any for type F 25.. to F 80.., F 200.. only vertically standing or suspended for type F 100.. to F 160..
Pressure p_{max}	F 25.. to F160..: 400 bar; F 200..: 320 bar; permiss. operating pressure depends on installation and utilized welding neck flange, see page 3.
Opening press. p_o	Approx. 0.11 ... 0.12 bar
Control press. p_{St}	For unblocking $p_{St\ max}$ = 100 bar For pre-relief $p_{pre\text{-}relief}$ = 0.2 p_{cyl} + 7 bar For holding open $p_{St\ min}$ = 8 bar (return flow) Min. pressure while closing ≦ 2,5 bar reset pressure
Pressure fluid	Hydraulic oil conforming to DIN 51524, parts 1 to 3; ISO VG 10 to 68 in accord. with DIN 51 519 Optimum operation: F 50 ... F 200 10 to approx. 800 mm^2/sec F 40 10 to approx. 400 mm^2/sec F 32 and F 25 10 to approx. 200 mm^2/sec Viscosity limits not under 4...6 and not above 1500 mm^2/sec. Not over 500 mm^2/sec for F 32 and F 25. Also suitable are biologically degradable pressure fluids of the type HEPG (Polyalkylenglycol) and HEES (synth. Ester) at operation temperatures up to approx. +70°C.
Temperature	Ambient: approx. -40 ... +80°C Fluid: -25 ... +80°C, note the viscosity range! Permissible temperature during start: -40°C (observe start-viscosity!), as long as the service temperature is at least 20K (Kelvin) higher for the following operation. Biologically degradable pressure fluids: Observe manufacturer's specifications. By consideration of the compatibility with seal material not above +70°C

Δp-Q curves
(recommended values)

Suction resistance



Back pressure valve
completely opened



$$\frac{Q}{Q_{max}} = \frac{\text{Flow during operation}}{\text{Max. flow acc. to table above}}$$

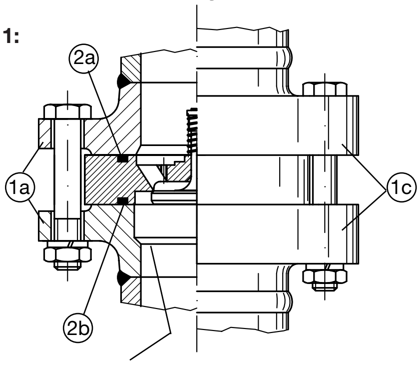
Oil viscosity during measurement approx. 60 mm^2/sec

2.2 Additional data, depending on installation method

Installation method 1:

With standard flanges only up to F 63. Above F 63, it is better to use flanges with rigid flange leaf corresponding to (1c).

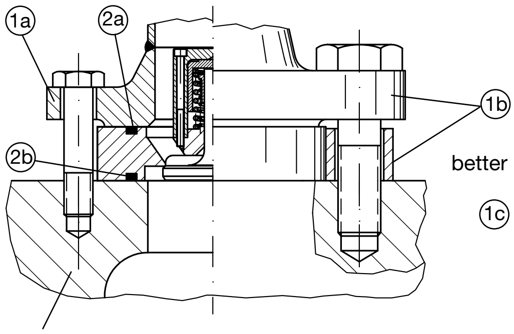
In line installation
Example:
Check valve



Reshape flange on valve side to improve flow around valve disc, see also sect. 4

Installation method 2:

Consumer construction
Example:
Pre-fill valve directly on bending resistant cylinder base



(1a) Standard welding neck flange ND 40 or 64, depending on valve size. The bolt sleeves serve directly to center the valve body

(1b) Spacer sleeves must be produced for standard flanges of the next-highest pressure class due to larger reference diameter, see table below

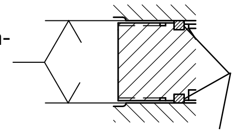
(1c) Costomer-furnished flanges with rigid, thick flange leaf to be designed so that the valve can be centered without spacer sleeves by as many screws as possible.

(2a) and (2b) depending on valve size and application (check or pre-fill valve)

F 25 to F 50-25 V

Utilized as check or pre-fill valve

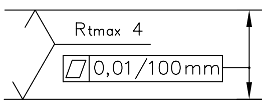
Flange facial side with common surface quality



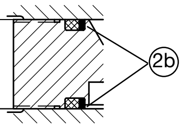
Type	Copper seal ring conf. DIN 7603-Cu-A..
F 25..	38x44x2
F 32..	45x52x2
F 40..	60x68x2.5
F 50..	75x84x2.5

F 63 to F 200-100

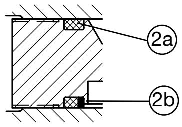
Requested machining tolerance for the mounting area of the valve on the facial side of flange or cylinder bottom.



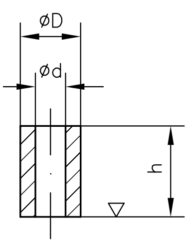
Utilized as check valve



Utilized as pre-fill valve



Type		F 63..	F 80..	F 100..	F 125..	F 160..	F 200
(2a)	KANTSIL-seal ring	FK 343	FK 349	FK 433	FK 441	FK 447	O-ring 290.00x7.0 90Sh +
(2b)	Profil-seal ring	6960 898 A	6960 898 B	6960 898 C	6960 898 D	6960 898 E	Back-up ring 6960 221

Type	Installation	Permissible pressure p_{zul} (bar)	Flange used 1) Material C 22		Spacer sleeve required (1b) (mm) D	d	h	Screws Material 8.8 3) pieces / size	Torque M_A (Nm)	Suct. pipe e.g. DIN 2448 seamless (non-binding)
F 25...	1	400	C 32x38	DIN 2635 (ND 40)				4 / M 16x80	210	38x2.6
	2	400						4 / M 16x65		
F 32...	1	350	C 40x44.5	DIN 2635 (ND 40)				4 / M 16x80		44.5x2.6
	2	400						4 / M 16x70		
F 40...	1	250	C 50x57	DIN 2635 (ND 40)				4 / M 16x90		57x2.9
	2	350						4 / M 16x75		
F 50...	1	250	C 65x76.1	DIN 2635 (ND 40)				8 / M 16x90		76.1x2.9
	2	350						8 / M 16x75		
	1	400	E 65x76.1	DIN 2636 (ND 64)	32	20.5	28.5	8 / M 20x110	380	
	2	400						8 / M 20x90		
F 63...	1	250	C 80x88.9	DIN 2635 (ND 40)	---	---	---	8 / M 16x100	210	88.9x3.2
	2	250						8 / M 16x80		
	1	400	E 80x88.9	DIN 2636 (ND 64)	27	20.5	33	8 / M 20x110	380	
	2	400						8 / M 20x90		
F 80...	2	250	C 100x108	DIN 2635 (ND 40)	---	---	---	8 / M 20x90	410	108x36
		400	E 100x108	DIN 2636 (ND 64)	31 2)	24.5	38	8 / M 24x110 2)	700 2)	
F 100..	2	300	E 125x133	DIN 2636 (ND 64)	---	---	---	8 / M 27x120	1000	133x4
		400	E 125x133	DIN 2637 (ND 100)	38	30.5	43.5	8 / M 30x130	1100	
F 125..	2	250	E 150x159	DIN 2636 (ND 64)	---	---	---	8 / M 30x130	1400	159x4.5
		400	E 150x159	DIN 2637 (ND 100)	42	30.5	49.5	12 / M 30x140		
F 160..	2	200	E 200x219.1	DIN 2636 (ND 64)	---	---	---	12 / M 33x160	630	219.1x5.9
		300	E 200x219.1	DIN 2637 (ND 100)	50	33.5	68.5	12 / M 33x170	1300	
		400	E 200x219.1	DIN 2638 (ND 160)	50	33.5	68.5	12 / M 33x180	2000	
F 200..	2	320	see example in sect. 4.3		---	---	---	16 / M 36x300	2300	273x6.3

1) If pressure surges can be expected due to the way in which the system is operated, it is advantageous to use the relevant higher stated flange - ND-class - for greater than F 50...

2) If a DIN 2637 flange (ND 100) is used for F80, the sleeve 41x27.5x38 and 8 screws M27x110, (M_A=1000Nm) must be used

3) In the case of customer-furnished flanges, it is better to use larger numbers of smaller screws combined with at least an equal overall force and, if possible, a rigid (thick) flange leaf

3. Using standard flanges

Flange and pipe preparation (non-binding suggestion)

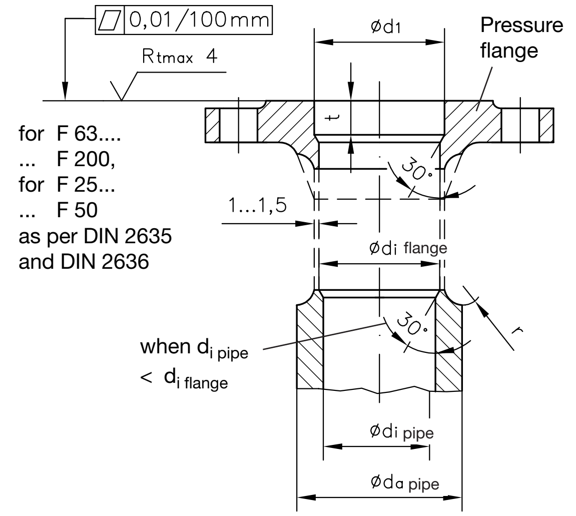
The pressure pipe dimension for installation methods 1 as described in sect. 2.2 are selected on the basis of the relevant safety details

The following standards can be used as a basis for working out the pressur pipes:

DIN 2413-1, -2:	Steel pipes: Calculating the wall thickness against internal pressure
DIN 2445-1, -2:	Seamless steel pipes for dynamic load
DIN 1629 (ISO 9329-1):	Seamless pipes made of unalloyed steels
DIN 2448 (ISO 4200):	Seamless pipes
DIN 2391-1, -2:	Seamless precision steel pipes

Both sides must be regarded as pressure sides when the valve is being used as a check valve.

Ensure in the normal way that both parts are joined together without misalignment.



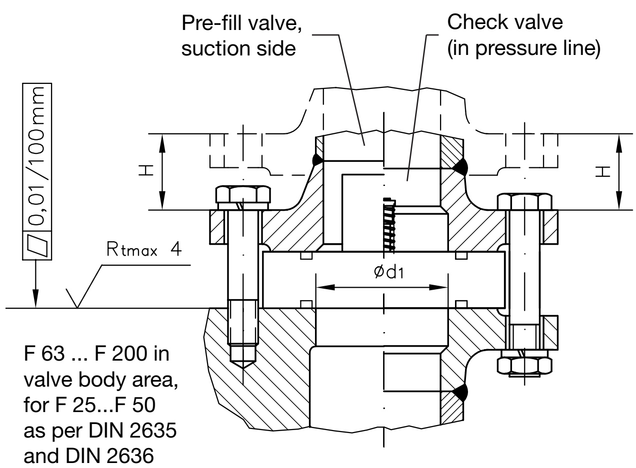
C 22 is the usual material for welding neck flanges in accordance with the various standards sheets in accordance with DIN 17 200.

Type	F 25...	F 32...	F 40...	F 50...	F 63...	F 80...	F 100..	F 125..	F 160..	F 200..
d1	35	43	54	73	88	(108)	(132)	(168)	(215)	(275)
t	6	7	9	11	12	(15)	(25)	(30)	(40)	55

From F 80... onwards, it is better to use flanges with rigid flange leaf as described in 1c in sect. 2.2.

When hollowing out r, ensure that there is still 1... 1.5 mm thickness up to the converse surface line of the largest internal diameter.

Assembly space required for axial travel of the line



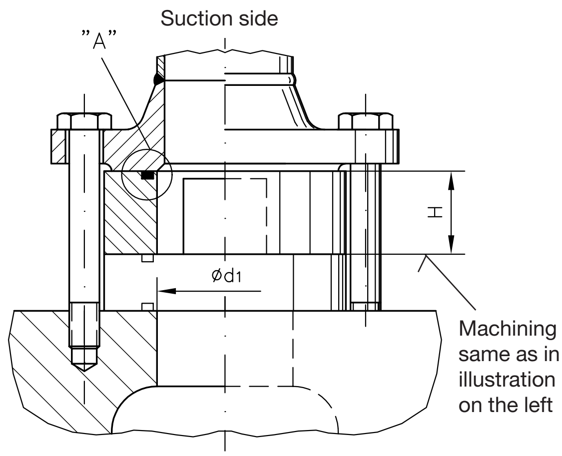
Type	F 25	F 25-12(V)	F 32	F 32-16(V)	F 40	F 40-20(V)	F 50	F 50-25(V)	F 63	F 63-30(V)	F 80	F 80-36(V)
H 1)	12	19	20	30	23	34	32	45	38	52	47	61
d1	35		43		54		73		88		108	
t_1 ± 0.1	1.2		1.2		1.7		1.7		4.0		4.3	
t_2	0		1		1		1.5		1.5		1	

Type	F 100	F 100-45	F 125	F 125-60	F 160	F 160-76	F 200-100
H 1)	55	76	78	106	115	165	155
d1	132		168		215		275
t_1 ±0.1	5.8		5.8		5.6		5.5
t_2	1.5		1		0		2

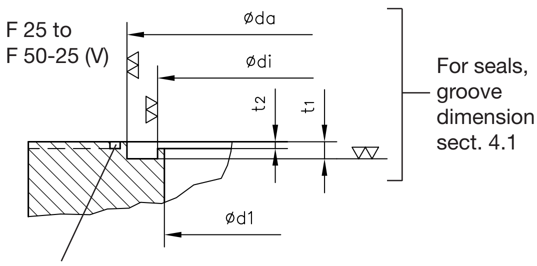
1) H = Minimum dimension

Side mounting without axial travel of the pipeline

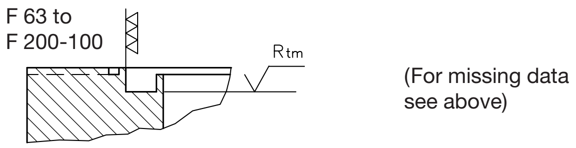
This disassembly possibility is achieved by way of an additional spacer ring (to be furnished by the customer, not scope of delivery). External diameter same as corresponding the pre-fill valve.



Detail with "A":



Relief groove, inside diameter approx. $\varnothing d_a + 4$, 1.5...2 mm wide, approx. 1.5 deep, with a groove towards the outside, approx. 2 wide, 1 deep

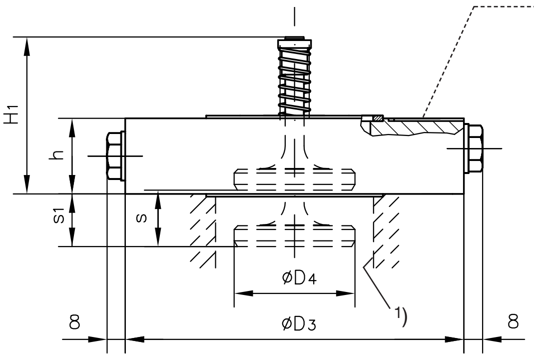


(For missing data see above)

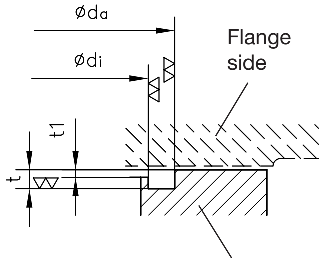
4. Dimensions of units

All dimensions are in mm, subject to change without notice !

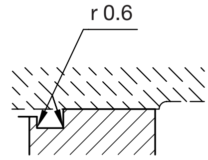
4.1 Check valve F 25 to F 160



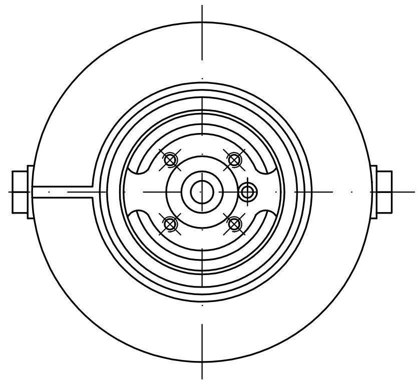
Situation for fitting copper ring F 25-12(V) to F 50-25(V):



For using flange seals as from F 63-30(V):



Front face of flange refinished, see sect. 3

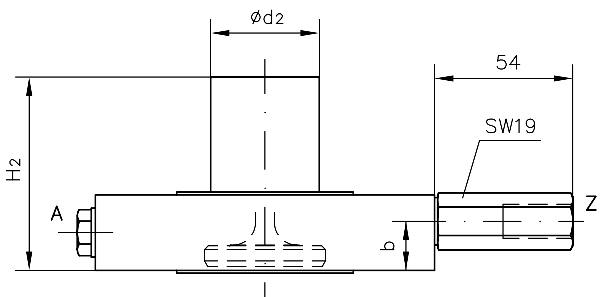


Type	D_3	D_4	H_1	h	d_a	d_i	s [2]	s_1	t $^{\pm0.1}$	t_1
F 25	83	26	36	26	44 $^{+0.1}$	37.5 $_{-0.1}$	5.5	5.5	1.2	0
F 32	93	32	45	27	52 $^{+0.1}$	44.5 $_{-0.1}$	7.5	7	1.2	1
F 40	108	41.5	48.5	28	68 $^{+0.1}$	59.5 $_{-0.1}$	10	9	1.7	1
F 50	128	53	59	29	84 $^{+0.1}$	74.5 $_{-0.1}$	12	11	1.7	1
F 63	143	64	69	33.5	104.3 $^{+0.2}$	89 $_{-0.2}$	14	12	4.0	1.5
F 80	169	77.5	83	38.5	123.8 $^{+0.2}$	109.3 $_{-0.3}$	17	15	4.3	1.5
F 100	212	95.5	97	44	152.6 $^{+0.2}$	134.4 $_{-0.3}$	22	22	5.8	1.5
F 125	248	127	127	51	190.6 $^{+0.2}$	171 $_{-0.3}$	30	30	5.8	1.5
F 160	310	163	182	70	241.2 $^{+0.2}$	220 $_{-0.3}$	37	37	5.6	1.5

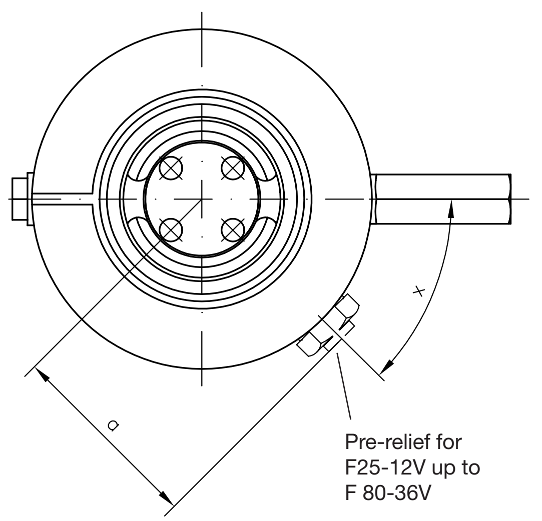
[1]) Bore in cylinder base or pressure flange, see ∅d1 in sect. 3

[2]) Full opening as from approx. 80% of Q_{max}

4.2 Pre-fill valve F 25-12. to F 160-76



SW19 = a/f19



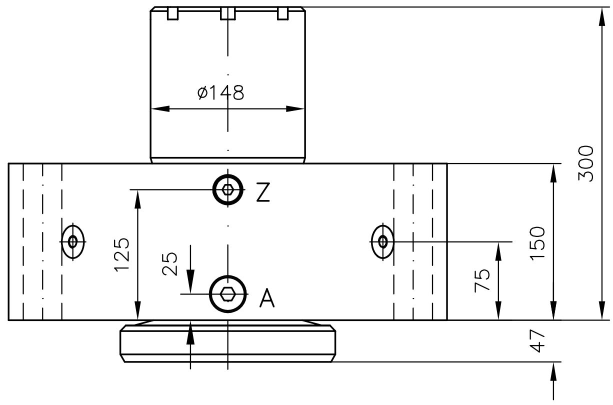
Pre-relief for F25-12V up to F 80-36V

See sect. 4.1 for missing details type

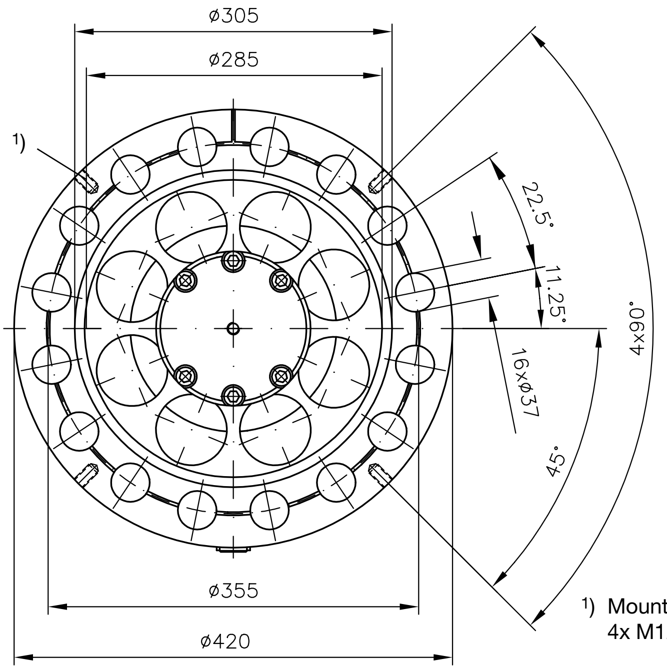
Type	Connection ISO 228/1 (BSPP)						
	A [3])	Z	H_2	d_2	a	b	x
F 25-12(V)	G 1/4	G 1/4	43	23	54	14.5	60°
F 32-16(V)	G 1/4	G 1/4	55	32	59	15.5	60°
F 40-20(V)	G 1/4	G 1/4	60	39	67	16.5	60°
F 50-25(V)	G 1/4	G 1/4	72	43	73	17.5	45°
F 63-30(V)	G 1/4	G 1/4	83	50	85	22	45°
F 80-36(V)	G 1/4	G 1/4	97.5	56	97	27	45°
F 100-45	G 3/8	G 1/4	118	69	---	32	---
F 125-60	G 3/8	G 1/4	155	88	---	39	---
F 160-76	G 1/2	G 1/4	233	120	---	52	---

[3]) Can also be used as pressure line port after un-doing the tappet plug

4.3 Pre-fill valve F 200-100

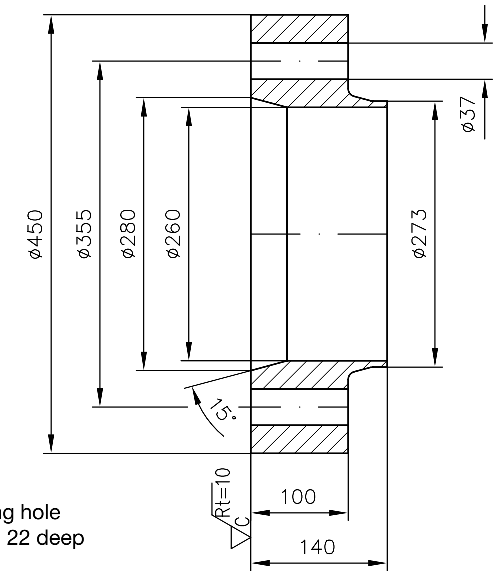


Ports A, Z = G 1/2 (BSPP)



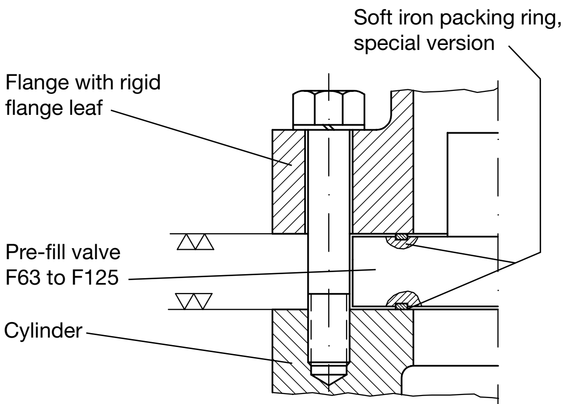
1) Mounting hole
4x M12, 22 deep

Example
Suction flange (general, not binding)



Material: St 52-3

5. Pre-fill valves type F 63.. to F 125.. (addition)



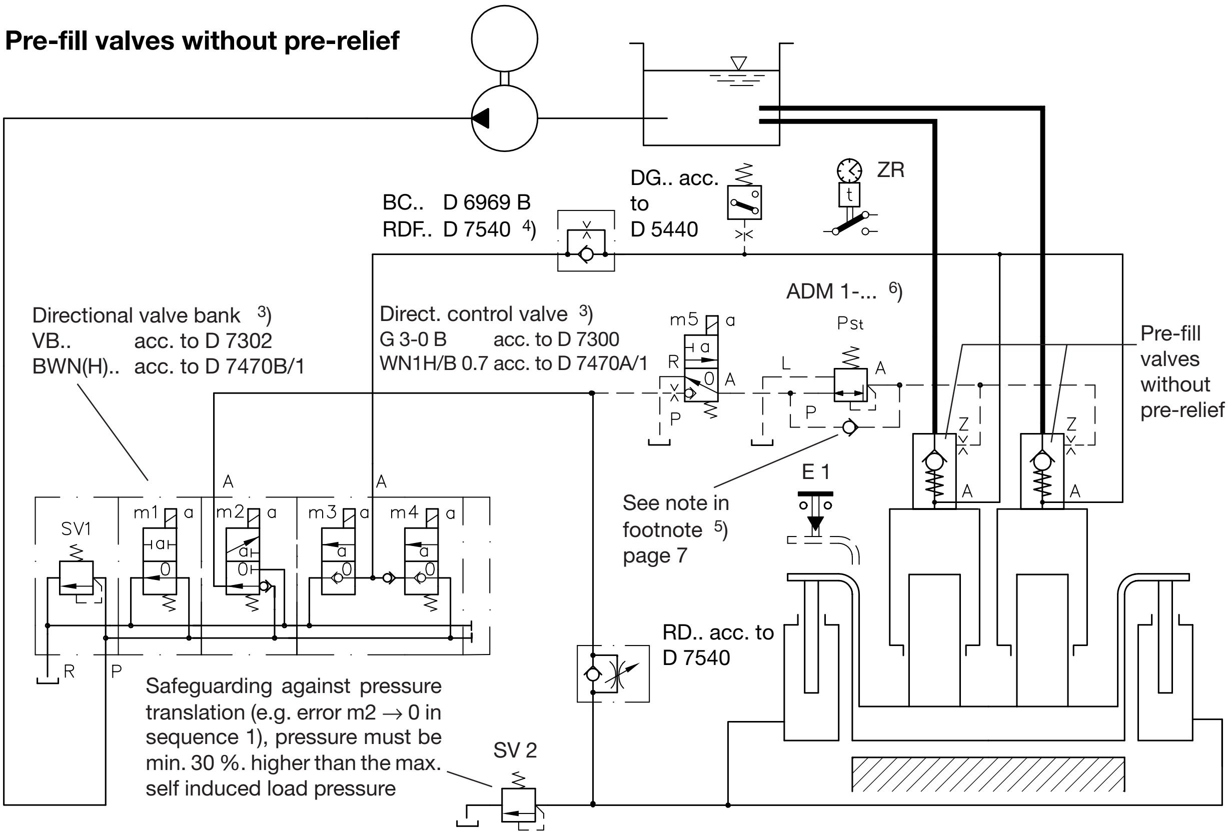
Pre-fill valves type F 63... to F 125... (supplement). The check valves and pre-fill valves F 63.. to F 125.. are available as a special version with soft iron packing rings if it is not possible to produce the surface quality of the mating surfaces on the flange or cylinder base required for the standard flange seal and outlines in sect. 2.2. It must be kept in mind that standard welding neck flanges cannot be used. Rather, customer-furnished flanges with a suitably rigid flange leaf for transferring the screw forces to the soft iron packing ring are necessary. The screws are best arranged so that their internal converse surface line centers the valve body.
When ordering, add in plain text that soft iron packing rings No.... (see table) are to be supplied instead of the flange seal.

Type	F 63..	F 80..	F 100..	F 125..
Min. pre-basing force (total) in built-in condition	560 kN	752 kN	1117 kN	1688 kN
Permissible pressure (bar)	400	400	400	400
Order No. of the soft iron packing ring	6960 998 A	6960 998 B	6960 998 C	6960 998 D
Dimensions Tolerance $\varnothing d_i$ + 0.5 $\varnothing d_a$ - 0.3 Thickness ± 0.2	92x104x5	112.5x123x5.3	138x152.1x6.8	174x189.8x6.8

6. Typical circuit diagram of a top-ram press

The control shown, represent non-binding, greatly simplified examples and are only intended to show the interaction of the pre-fill valves with the other units, including decompression as described in Item 1.2.

6.1 Pre-fill valves without pre-relief



Seq. No.	Movement	Pump	Valve m1	m2	m3	m4	m5	Pressure switch DG	Note
0	Ready for operat. (Pu. idling)	on	0	0	0	0	0	---	---
1	Rapid traverse down (fall.) and press. build-up	on	a	a	0	a	0	with set operat. press., contact making for sequence 2	A timer for the pressing time can be started simultaneously with contact making for operating pressure (timer shown as ZR)
2	Pressure maintenance	off (on)	0 (a) [1]	0 (a) [2]	0	0 (a) [2]	0	(a) - setting for possible series connection by the DG. Observe starting instructions for the pump motor [1]	
3	Decom-pression → 0	on	0	0	a	0	0	---	Start time relay ZR [4] and pump motor e.g. by run down timer from sequence 1
4	Rapid traverse up	on	a [4] [5]	0	a (0)	0	a	---	m1 and m5 → a a through time relay ZR
5	Open	off	0	0	0	0	0	---	Pumps and valves off through E 1

1) e.g. via time relay. Set it that m1 = a only after the pump motor is started up. Switch over to △ while m1 = 0 for Y- △ start.

2) (a) e.g. for pressed material which is still flexible during the pressing period. The pressure switch unit switches the pump back on when the pressure drops [1]). See for example D 5440 for restarting pressures.

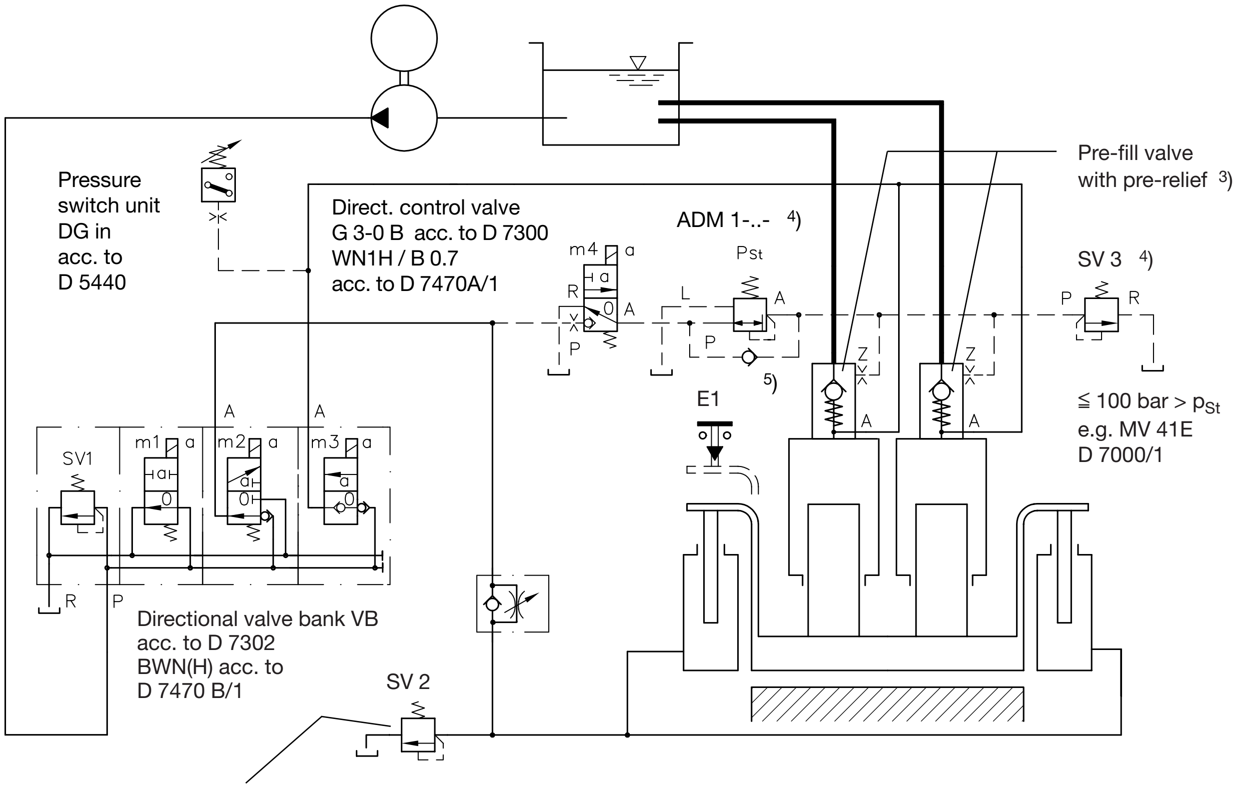
3) Observe the max. permissible operation pressure! (see corresponding pamphlets)

4) The orifice size determines the decompression time; it should be selected in such a way (acc. to the Δp-Q-curve), that the flow via the orifice during start of decompression (current pressure at the cylinder) does not exceed the perm. flow rating of the valve m3.
The decompression period at ZR must be sufficiently set, that m1 → a is activated after the pressure in the cylinder is securely removed.
Example: Directional valve bank m1 ... m4 = VB 21AM-... acc. to D 7302, perm. Q_{max} = 25 lpm. Max. cylinder pressure p_{cyl} = 350 bar (end of sequence 2), selected restrictor check valve RDF 31. The suited orifice -∅ is roughly 1.4 mm (Q ≈ 20 lpm) i.e. RDF 31/1.4 acc. to the Δp-Q-curve in D 7540 for 350 bar. The estimated decompression time for a press cylinder with a volume of 50 lpm will be roughly 6 to 7 sec. The decompression time for a certain volume of a press cylinder V_{cyl} (l) and a certain RDF- orifice ∅d (mm) can be roughly estimated $t \approx 0.014\, V_{cyl} \cdot \sqrt{p_{cyl}} / d^2$

5) If the pump motor is started by the timer from sequence 3, e.g. Y-△, ensure that the switchover time from Y to △ takes place during the decompression time sequence 3 [4]). Otherwise, the Y△ contactor would also have to actuate m1→a when switching over to △ if the switchover time was longer. The time relay ZR is, then, not absolutely essential.

6) ADM... (D 7458) to limit the control pressure to ≦100 bar (sect. 2.1). Necessary if the pressure for rapid traverse ↑ (sequence 4) is greater than 100 bar.

6.2 Pre-fill valves with pre-relief



Safeguarding against pressure translation (e.g. error m2 → 0 in sequence 1), pressure must be min. 30 %. higher than the max. self induced load pressure

Seq. No.	Movement	Pump	Valves m1	m2	m3	m4	Pressure switch unit DG	Note (example)
0	Ready for operation (idling)	on	0	0	0	0	---	---
1	Rapid traverse down (fall) and press. build-up	on	a	a	a	0	contact making for sequence 2 with operating pressure	The timer for the pressing time can be started simultaneously with contact making
2	Maintain pressure	off (on)	0 (a) 1)	0 (a)	0 (a)	0	(a) - setting in the event of any series connection by the DG. Follow starting instructions for pump motor !	
3	Decompression	on	a 1)	0	0	a	---	Contact making e.g. due to elapsed timer setting. Follow starting instructions for the pump motor ! 2)
4	Rapid traverse up	on	a	0	0	a	---	Follows sequence 3 automatically 2)
5	Open	off	0	0	0	0	---	Pumps and valves off through E 1

1) e.g. via time relay. Set it that m1 = a only after the pump motor is started up. Switch over to △ while m1 = 0 for Y - △ start.

2) Deblocking of the pre-relief in the pre-fill valves begins after the pump is started when m1→a is switched. During de-compression, the pump runs against the pressure set in SV 1. The opening of the pre-fill valves, i.e. sequence 4 (rapid traverse up) is automatically set when the pressure in the cylinder has fallen to the value $p_{cyl} = p_{contr} : k$. The control pressure p_{contr} must correspond to at least the pressure $p_{pre\text{-}relief}$ as described in sect. 2.1 (< 100 bar) here, e.g. set in the pressure reducing valve ADM 1... in accordance with D 7458 or ADM 11... in accordance with D 7120.

3) The decompression time t (sec.) down to a certain pressure p (bar) for a press cylinder volume V_{cyl} (l) can be roughly estimated, when the pre-relief (F 25-12V to F 80-36V) is utilized. $t \approx 0.0042\, V_{cyl} \cdot \left(\sqrt{p_{cyl}} - \sqrt{p}\right)$

4) Pressure in the SV 3 some what greater than p_{contr}, should serve only as safety against any control fault in the ADM... if the pressure setting in SV 1 and the return pressure during opening (sequence 4) is much greater than p_{contr}

5) It may be necessary for very short sequence times, to enable quick draining of the control cavity causing quick closure of the pre-fill valve by utilizing a by-pass check valve (sequence 5 → 1). Mostly utilized together with damping BC1 acc. to section 1.4. A suitable by-pass check valve is type RK 1G acc. to D 7445.