Compact hydraulic power pack type HC

for intermittent service
electrical connection via terminal box

CE

Pressure p_{max} = 700 bar
Flow Q_{max} = 22.8 lpm

1. Design and general information

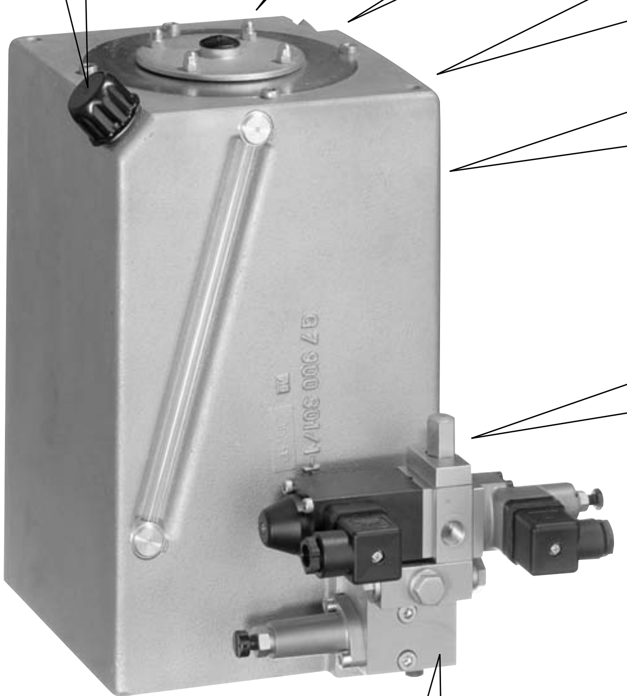
1.1 Basic design

Oil filling and breather with filter, tapped journal M 18 x 1.5 resp. G 3/4 (BSPP) and flat seal ring. This may be interchanged with the tapped plug located diagonally on the corner. This is only possible when the power pack is standing erect.

Built-in terminal box. Before connecting the mains supply, it is necessary to remove the cover plate with tapped journal M 16x1.5 resp. M 20x1.5 and the insulation plate located under it. The terminals for the motor are already properly connected for the voltage specified (3 x 400V Y or 3 x 230V △ with HC... or 1 x 230V ⊥ with HCW...). It is possible to convert the 3-phase connection of the power pack from Y in △ and vice versa on site.

Tapped plug M 18x1.5 or G 3/4 (BSPP) DIN 908 with flat seal ring DIN 7603-St-A 18x22x1.5 or A 27x32x2 (breather may be mounted here optionally).

Two tapped holes located diagonally opposite (e.g. for additional fastening).



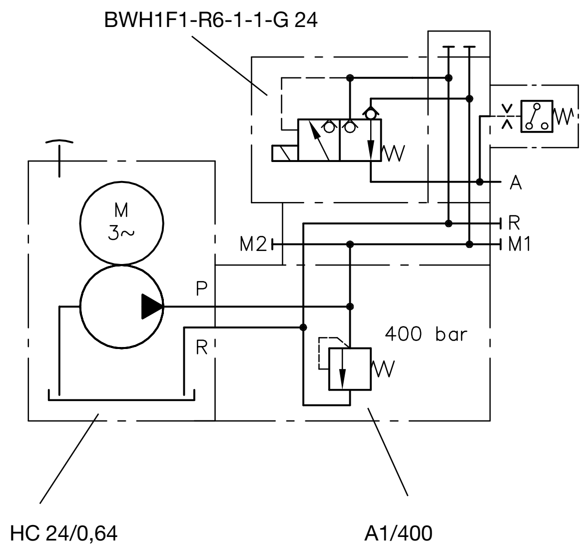
Basic unit intended for intermittent service S3. It consistings of the tank, 3-, 5, or 6-cylinder radial piston pump and/or gear pump (reduced noise than radial piston pump), 3- or 1-phase drive motor (stator and rotor).
The unit may be positioned either vertically or horizontally.
Flow 0.2 ... 22.8 lpm, depending on type.
Pressure up to 700 bar, depending on type.

Example for a directly mounted directional valve bank, here type BWH1.. acc. to D 7470 B/1 with pressure switch DG3. acc. to D 5440

Mounting holes in the four corners of the tank bottom.

Connection block in different versions acc. to D 6905 A/1, B or C etc., for detailed listing see sect. 5.6. They either enable the connection of pressure and return lines or direct mounting of various directional valve banks.
It is mounted directly at the connection pedestal (including pressure outlet and return inlet).

Symbol and photo
to the order example of page 2



March 2007-01

1.2 General description

The compact hydraulic power unit with electric drive type HC serves to supply intermittently operated hydraulic circuits (conforming to S3 DIN VDE 0530 part 1) with pressurized fluid. There is a wide field of applications within tool machines, jig assemblies and general mechanical engineering.
It consists of a radial piston pump (3-, 5-, or 6-cylinder) driven directly via an eccentric bearing on the rotor shaft or a gear pump. All this and the motor (3- and 1-phase) are enclosed in a one-unit casing which also serves as a tank. The pump is located in the bottom part of the casing. The oil immersed drive motor, consisting only of short-cut rotor and shrunk-in stator is located in the upper part of the casing.
This compact design yields a considerable saving of the spatial requirements when compared with conventional hydraulic power units. A price benefit is achieved by eliminating the coupling and bell housing. The motor can be loaded above its nominal peak output during the load cycles as it is only intended for intermittent service. The excess heat generated in the winding in this period is accumulated in the oil volume and the casing and is dissipated during stand-still periods.
The compact hydraulic power pack may be positioned erect or lying (version L) which enables it to be located even in low mounting cavities. Depending on application the unit may be equipped with a pressure limiting valve, a pressure switch, a check valve, a thread type throttle, directional seated valves or directional spool valves in suitable combinations directly from HAWE. See order example in sect. 2 resp. 5.6.
The electrical connection takes place in the built-in terminal enclosure (3-phase plus ground), which is accessible from top.
The internal connection takes place at HAWE according to the customer's requirements for power supply 400V Y, 230V △ or 230V ⊥.

2. Available versions, main data

The hydraulic power packs described in this pamphlet represent only the basic units, which are not ready for use. They have to be completed by connection blocks (see lay-out description on the title page and order example below) which enable connecting either pressure and return pipes or directional valve banks (see sect. 5.6). The corresponding pamphlets are also required.

Order examples:

HC 24 /0,64 - A1/400 - BWH1F1 - R4 - 1 - 1 - G 24 - **400V 50 Hz**
HC 12 K /0,94 - C5

Indicate additionally the motor voltage in uncoded text e.g. 400V 50 Hz or 230V 50 Hz (see also sect. 3.3 "Voltage range")

Directional valve bank mounted alternatively to the connection block (see listing in the appendix, sect. 5.6), in the example acc. to D 7470 B/1

Connection block completing the hydraulic power unit (see listing in the appendix, sect. 5.6), in the example acc. to D 6905 A/1 resp. D 6905 C

Table 1: Installed position and optional equipment

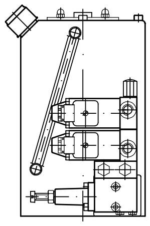
Coding		Remark	
without		Vertical version (standing), without optional equipment	
L		● Horizontal version (only with radial piston pump) - may be also operated also in vertical position ● Vertical version (only with radial piston pump) - must not be operated in horizontal position ● Not available: Type HC(W) 24./(0.46...2.27) - 5 pump cylinder Type HC(W) 22./(0.89...4.41) - 5 pump cylinder Type HC(W) 2../Z.. - gear pump Type HC(W) 44(48)./(1.8...13.1) - 6 pump cylinder Type HC 42(46)./(3.5...26) - 6 pump cylinder Type HC(W) 4./Z(HZ) ● Gear pump versions HC(W) 3. may be operated either in horizontal or in vertical position	
K [1]		Fluid level gauge	(only available for HC(W) 1...)
KK [1]		2 Fluid level gauges	
K1, KK1 [1]		Differing installation position than with K, KK , see dimensional drawings in sect. 4.1	
D	**S**	Float switch - NC-contact / NO-contact	NC-contact NO-contact
DD [1]	**SS** [1]	2 Float switch - NC-contact / NO-contact	
D1 [1] **D2**	**S1** [1] **S2**	Float switch - NC-contact / NO-contact Different position than with version D, see dimensional drawings sect. 4.2	
T		Temperature switch, type HCW 44 comes with windign protection switch	ϑ
T1, T2 [1]		Different position than with version T, see dimensional drawings sect. 4.2	
Order examples: HC 14 K/0.31; HC 12 KKT/0.4; HCW 22 DT/0.82; HC 34 DDT/2.5			

Basic type, size and delivery flow coding acc. to sect. 2.1 to 2.3

[1] **Attention:** Not available for horizontal type HC..L.

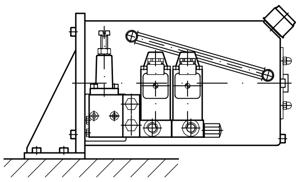
HC(W)...

for vertical installation



HC(W)..L

for horizontal installation



Filling volume vary insignificantly for vertical and horizontally installed positions, see hydraulic parameters sect. 3.2

2.1 Single circuit pumps

Table 2: Size 1 and 2 with radial piston pump and 3-phase motor (size 3 and 4 see table 3)

HC 14 and HC 24 = Nom. speed 1450 rpm (50 Hz), 1750 rpm (60 Hz)
HC 12 and HC 22 = Nom. speed 2800 rpm (50 Hz), 3400 rpm (60 Hz)
For nom. speed and electrical data, see sect. 3.3

Basic type and size	Characteristic data		Delivery flow coding, geom. displacement, perm. pressure, delivery flows Piston diameter (mm) 4	5	6	7	8	9
HC 14	Delivery flow coding 2)	(3 cyl.)	**0,2**	**0,31**	**0,44**	**0,61**	**0,87**	**1,05**
	Geom. displacement V_g	(cm^3/rev.)	0.15	0.24	0.34	0.46	0.60	0.76
	Pressure p_{max} 1)	(bar)	700	640	440	325	250	195
	Delivery flow Q_{Pu} (lpm)	50 Hz	0.20	0.32	0.46	0.62	0.82	1.03
		60 Hz	0.24	0.38	0.55	0.75	0.98	1.24
HC 12	Delivery flow coding 2)	(3 cyl.)	**0,4**	**0,65**	**0,94**	**1,28**	**1,71**	**2,14**
	Geom. displacement V_g	(cm^3/rev.)	0.15	0.24	0.34	0.46	0.60	0.76
	Pressure p_{max} 1)	(bar)	600	380	265	200	150	120
	Delivery flow Q_{Pu} (lpm)	50 Hz	0.42	0.66	0.95	1.29	1.69	2.14
		60 Hz 3)	0.51	0.79	1.14	1.55	2.03	2.57
HC 24 4)	Delivery flow coding 2)	(3 cyl.)	**0,27**	**0,42**	**0,64**	**0,81**	**1,1**	**1,35**
	Geom. displacement V_g	(cm^3/rev.)	0.19	0.29	0.42	0.58	0.75	0.95
	Pressure p_{max} 1)	(bar)	700	700	700	600	460	370
	Delivery flow Q_{Pu} (lpm)	50 Hz	0.26	0.40	0.58	0.79	1.03	1.30
		60 Hz	0.31	0.48	0.69	0.94	1.23	1.56
	Delivery flow coding 2)	(5 cyl.)	**0,46**	**0,7**	**1,08**	**1,39**	**1,77**	**2,27**
	Geom. displacement V_g	(cm^3/rev.)	0.31	0.49	0.71	0.96	1.26	1.59
	Pressure p_{max} 1)	(bar)	700	700	495	360	275	220
	Delivery flow Q_{Pu} (lpm)	50 Hz	0.43	0.67	0.96	1.31	1.71	2.17
		60 Hz	0.51	0.80	1.16	1.57	2.05	2.60
HC 22 4)	Delivery flow coding 2)	(3 cyl.)	**0,52**	**0,82**	**1,17**	**1,58**	**2,06**	**2,61**
	Geom. displacement V_g	(cm^3/rev.)	0.19	0.29	0.42	0.58	0.75	0.95
	Pressure p_{max} 1)	(bar)	700	700	540	400	300	240
	Delivery flow Q_{Pu} (lpm)	50 Hz	0.53	0.83	1.20	1.63	2.13	2.69
		60 Hz 3)	0.64	1.00	1.44	1.96	2.55	3.23
	Delivery flow coding 2)	(5 cyl.)	**0,89**	**1,36**	**2,09**	**2,68**	**3,41**	**4,41**
	Geom. displacement V_g	(cm^3/rev.)	0.31	0.49	0.71	0.96	1.26	1.59
	Pressure p_{max} 1)	(bar)	700	470	325	240	180	145
	Delivery flow Q_{Pu} (lpm)	50 Hz	0.89	1.39	2.00	2.72	3.55	4.49
		60 Hz 3)	1.06	1.66	2.39	3.26	4.26	5.39

1) The value indicated as max. pressure applies to cold motor or those with low service temperature, where the expected oil temperature $\vartheta_{B\ oil}$ doesn't exceed approx. 50 to 60°C (see sect. 3.2). The max. pressure should be reduced by approx. 10 to 15%, if a rough calculation yields an oil temperature of about 70 to 80°C.

2) The delivery flow coding can be regarded as coarse reference value for the delivery flow at mains frequency of 50 Hz. It has however to be taken into account, that the real delivery flow is always slightly lower, because it depends on the nominal speed of the respective motor size (see sect. 3.3) and the speed drop due to load situations.

3) The compact hydraulic power pack may be connected to mains with a frequency of 60 Hz, but the resulting revolution rating of approx. 3400 rpm is rather high. This not only can lead to increased running noise, but to suction problems with small piston diameters also. Therefore it is recommended that the viscosity of the pressure fluid during operation shouldn't exceed 160 to 200 mm^2/s.

4) Below versions are not available for horizontal installation (coding L, see table 1):
Type HC 24./(0.46...2.27) or type HC 22./(0.89...4.41) - version with 5 pump cylinders (5 cyl.)
Type HC 44(48)./(1.8...13.1) and type HC 42(46)./(3.5...26) - version with 6 pump cylinders (6 cyl.)

Table 3: Size 3 and 4 with radial piston pump and 3-phase motor

Footnotes [1]) to [4]) see page 3

HC 34, HC 44, and HC 48 = Nom. speed 1450 rpm (50 Hz), 1750 rpm (60 Hz)
HC 32, HC 42, and HC 46 = Nom. speed 2800 rpm (50 Hz), 3400 rpm (60 Hz)
For nom. speed and electrical data, see sect. 3.3

Basic type and size	Characteristic data		Delivery flow coding, geom. displacement, perm. pressure, delivery flows — Piston diameter (mm) 6	7	8	10	12	13	14	15	16
HC 34	Delivery flow coding [2])	(3 cyl.)	**0,9**	**1,25**	**1,5**	**2,5**	**3,6**	**4,3**	**5,1**	**5,6**	**6,5**
	Geom. displacement V_g	(cm^3/rev.)	0.64	0.88	1.15	1.79	2.58	3.03	3.51	4.03	4.58
	Pressure p_{max} [1])	(bar)	700	700	610	390	270	230	200	170	150
	Delivery flow Q_{Pu} (lpm)	50 Hz	0.89	1.21	1.58	2.47	3.56	4.18	4.85	5.57	6.33
		60 Hz	1.07	1.45	1.90	2.97	4.28	5.02	5.82	6.68	7.60
HC 32	Delivery flow coding [2])	(3 cyl.)	**1,75**	**2,44**	**3,0**	**4,9**	**7,1**	**8,5**	**10,2**	**11,1**	**12,9**
	Geom. displacement V_g	(cm^3/rev.)	0.64	0.88	1.15	1.79	2.58	3.03	3.51	4.03	4.58
	Pressure p_{max} [1])	(bar)	700	510	400	250	175	150	130	110	95
	Delivery flow Q_{Pu} (lpm)	50 Hz	1.80	2.45	3.20	5.00	7.20	8.45	9.80	11.25	12.80
		60 Hz [3])	2.16	2.94	3.84	6.00	8.64	10.14	11.76	13.50	15.36
HC 44 [4])	Delivery flow coding [2])	(3 cyl.)	**0,9**	**1,25**	**1,5**	**2,5**	**3,6**	**4,3**	**5,1**	**5,6**	**6,5**
	Geom. displacement V_g	(cm^3/rev.)	0.64	0.88	1.15	1.79	2.58	3.03	3.51	4.03	4.58
	Pressure p_{max} [1])	(bar)	700	700	700	670	460	400	340	300	260
	Delivery flow Q_{Pu} (lpm)	50 Hz	0.89	1.21	1.58	2.47	3.55	4.17	4.83	5.55	6.31
		60 Hz	1.07	1.45	1.89	2.96	4.26	5.00	5.80	6.66	7.57
	Delivery flow coding [2])	(6 cyl.)	**1,8**	**2,45**	**3,2**	**5,0**	**7,2**	**8,6**	**9,9**	**11,5**	**13,1**
	Geom. displacement V_g	(cm^3/rev.)	1.29	1.75	2.29	3.58	5.16	6.05	7.02	8.06	9.17
	Pressure p_{max} [1])	(bar)	700	680	520	330	230	200	170	150	130
	Delivery flow Q_{Pu} (lpm)	50 Hz	1.78	2.42	3.16	4.93	7.10	8.33	9.67	11.10	12.62
		60 Hz	2.13	2.90	3.79	5.92	8.52	10.00	11.60	13.31	15.15
HC 42 [4])	Delivery flow coding [2])	(3 cyl.)	**1,75**	**2,44**	**3,0**	**4,9**	**7,1**	**8,5**	**10,2**	**11,1**	**12,9**
	Geom. displacement V_g	(cm^3/rev.)	0.64	0.88	1.15	1.79	2.58	3.03	3.51	4.03	4.58
	Pressure p_{max} [1])	(bar)	700	700	700	460	320	270	240	210	180
	Delivery flow Q_{Pu} (lpm)	50 Hz	1.81	2.47	3.22	5.04	7.25	8.51	9.87	11.33	12.89
		60 Hz [3])	2.18	2.96	3.87	6.04	8.70	10.21	11.85	13.60	15.47
	Delivery flow coding [2])	(6 cyl.)	**3,5**	**4,85**	**6,55**	**10,3**	**---**	**---**	**---**	**---**	**---**
	Geom. displacement V_g	(cm^3/rev.)	1.29	1.75	2.29	3.58	---	---	---	---	---
	Pressure p_{max} [1])	(bar)	650	470	360	230	---	---	---	---	---
	Delivery flow Q_{Pu} (lpm)	50 Hz	3.63	4.94	6.45	10.07	---	---	---	---	---
		60 Hz [3])	4.35	5.92	7.74	12.09	---	---	---	---	---
HC 48 [4])	Delivery flow coding [2])	(3 cyl.)	**0,9**	**1,25**	**1,5**	**2,5**	**3,6**	**4,3**	**5,1**	**5,6**	**6,5**
	Geom. displacement V_g	(cm^3/rev.)	0.64	0.88	1.15	1.79	2.58	3.03	3.51	4.03	4.58
	Pressure p_{max} [1])	(bar)	700	700	700	700	490	420	360	315	275
	Delivery flow Q_{Pu} (lpm)	50 Hz	0.89	1.21	1.58	2.47	3.56	4.18	4.85	5.57	6.33
		60 Hz	1.07	1.45	1.90	2.97	4.28	5.02	5.82	6.68	7.60
	Delivery flow coding [2])	(6 cyl.)	**1,8**	**2,45**	**3,2**	**5,0**	**7,2**	**8,6**	**9,9**	**11,5**	**13,1**
	Geom. displacement V_g	(cm^3/rev.)	1.29	1.75	2.29	3.58	5.16	6.05	7.02	8.06	9.17
	Pressure p_{max} [1])	(bar)	700	700	700	500	350	300	250	220	200
	Delivery flow Q_{Pu} (lpm)	50 Hz	1.78	2.42	3.17	4.95	7.13	8.36	9.70	11.13	12.67
		60 Hz	2.14	2.91	3.80	5.94	8.55	10.04	11.64	13.36	15.20
HC 46 [4])	Delivery flow coding [2])	(3 cyl.)	**1,75**	**2,44**	**3,0**	**4,9**	**7,1**	**8,5**	**10,2**	**11,1**	**12,9**
	Geom. displacement V_g	(cm^3/rev.)	0.64	0.88	1.15	1.79	2.58	3.03	3.51	4.03	4.58
	Pressure p_{max} [1])	(bar)	700	700	700	700	490	420	360	315	275
	Delivery flow Q_{Pu} (lpm)	50 Hz	1.82	2.48	3.23	5.05	7.28	8.54	9.91	11.37	12.94
		60 Hz [3])	2.18	2.97	3.88	6.06	8.73	10.25	11.89	13.65	15.53
	Delivery flow coding [2])	(6 cyl.)	**3,5**	**4,85**	**6,55**	**10,3**	**---**	**---**	**---**	**---**	**---**
	Geom. displacement V_g	(cm^3/rev.)	1.29	1.75	2.29	3.58	---	---	---	---	---
	Pressure p_{max} [1])	(bar)	700	700	590	380	---	---	---	---	---
	Delivery flow Q_{Pu} (lpm)	50 Hz	3.64	4.95	6.47	10.11	---	---	---	---	---
		60 Hz [3])	4.37	5.94	7.76	12.13	---	---	---	---	---

Table 4: Size 1 to 4 with radial piston pump with 1-phase motor

Motor lay-out 230V 50 Hz ⊥ [3]

HCW 14 to HCW 44 = Nom. speed 1450 rpm (50 Hz)
HCW 12 to HCW 22 = Nom. speed 2800 rpm (50 Hz)
For nom. speed and electrical data, see sect. 3.3

Basic type and size	Characteristic data		Delivery flow coding, geom. displacement, perm. pressure, delivery flows — Piston diameter (mm): 4	5	6	7	8	9	10	12	13	14	15	16
HCW 14	Delivery flow coding [2] (3 cyl.)		**0,2**	**0,31**	**0,44**	**0,61**	**0,87**	**1,05**						
	Geom. displacement V_g (cm³/rev.)		0.15	0.24	0.34	0.46	0.60	0.76						
	Pressure p_{max} (bar) [1]	C_B= 8 µF	700	470	320	240	180	140						
		C_B=12 µF	700	540	380	280	210	170						
	Delivery flow Q_{Pu} (lpm)		0.21	0.32	0.46	0.63	0.82	104						
HCW 12	Delivery flow coding [2] (3 cyl.)		**0,4**	**0,65**	**0,94**	**1,28**	**1,71**	**2,14**						
	Geom. displacement V_g (cm³/rev.)		0.15	0.235	0.34	0.46	0.6	0.765						
	Pressure p_{max} (bar) [1]	C_B=12 µF	530	340	235	170	135	105						
		C_B=16 µF	660	420	300	215	165	130						
	Delivery flow Q_{Pu} (lpm)		0.40	0.62	0.90	1.22	1.60	2.02						
HCW 24 [4]	Delivery flow coding [2] (3 cyl.)		**0,27**	**0,42**	**0,64**	**0,81**	**1,1**	**1,35**						
	Geom. displacement V_g (cm³/rev.)		0.19	0.29	0.42	0.58	0.75	0.95						
	Pressure p_{max} (bar) [1]	C_B=16 µF	700	700	530	390	300	235						
		C_B= 24 µF	700	700	600	440	340	270						
	Delivery flow Q_{Pu} (lpm)		0.25	0.39	0.56	0.76	1.00	1.26						
	Delivery flow coding [2] (5 cyl.)		**0,46**	**0,7**	**1,08**	**1,39**	**1,77**	**2,27**						
	Geom. displacement V_g (cm³/rev.)		0.31	0.49	0.71	0.96	1.26	1.59						
	Pressure p_{max} (bar) [1]	C_B=16 µF	700	460	320	235	180	140						
		C_B= 24 µF	700	520	360	265	200	160						
	Delivery flow Q_{Pu} (lpm)		0.43	0.67	0.96	1.31	1.71	2.17						
HCW 22 [4]	Delivery flow coding [2] (3 cyl.)		**0,52**	**0,82**	**1,17**	**1,58**	**2,06**	**2,61**						
	Geom. displacement V_g (cm³/rev.)		0.19	0.29	0.42	0.58	0.75	0.95						
	Pressure p_{max} (bar) [1]	C_B= 16 µF	700	530	370	270	210	160						
	Delivery flow Q_{Pu} (lpm)		0.50	0.79	1.13	1.54	2.01	2.54						
	Delivery flow coding [2] (5 cyl.)		**0,89**	**1,36**	**2,09**	**2,68**	**3,41**	**4,41**						
	Geom. displacement V_g (cm³/rev.)		0.31	0.49	0.71	0.96	1.26	1.59						
	Pressure p_{max} (bar) [1]	C_B=16 µF	500	315	220	160	120	95						
	Delivery flow Q_{Pu} (lpm)		0.84	1.31	1.88	2.56	3.35	4.24						
HCW 34	Delivery flow coding [2] (3 Zyl.)				**0,9**	**1,25**	**1,5**		**2,5**	**3,6**	**4,3**	**5,1**	**5,6**	**6,5**
	Geom. displacement V_g (cm³/U)				0.64	0.88	1.15		1.79	2.58	3.03	3.51	4.03	4.58
	Pressure p_{max} (bar) [1]	C_B= 40 µF			700	520	400		250	180	150	130	115	100
	Delivery flow Q_{Pu} (lpm)				0.87	1.18	1.54		2.40	3.46	4.06	4.71	5.41	6.15
HCW 44 [4]	Delivery flow coding [2] (3 cyl.)				**0,9**	**1,25**	**1,5**		**2,5**	**3,6**	**4,3**	**5,1**	**5,6**	**6,5**
	Geom. displacement V_g (cm³/rev.)				0.64	0.88	1.15		1.79	2.58	3.03	3.51	4.03	4.58
	Pressure p_{max} (bar) [1]	C_B= 60 µF			700	700	700		460	320	270	230	200	180
	Delivery flow Q_{Pu} (lpm)				0.87	1.18	1.54		2.40	3.46	4.06	4.71	5.41	6.15
	Delivery flow coding [2] (6 cyl.)				**1,8**	**2,45**	**3,2**		**5,0**	**7,2**	**8,6**	**9,9**	**11,5**	**13,1**
	Geom. displacement V_g (cm³/rev.)				1.29	1.75	2.29		3.58	5.16	6.05	7.02	8.06	9.17
	Pressure p_{max} (bar) [1]	C_B= 60 µF			630	460	350		220	150	130	110	100	80
	Delivery flow Q_{Pu} (lpm)				1.73	2.36	3.08		4.81	6.92	8.13	9.42	10.82	12.31

[1] The value indicated as max. pressure applies to cold motor or those with low service temperature, where the expected oil temperature $\vartheta_{B\ oil}$ doesn't exceed approx. 50 to 60°C (see sect. 3.2). The max. pressure should be reduced by approx. 10 to 15%, if a rough calculation yields an oil temperature of about 70 to 80°C.

[2] The delivery flow coding can be regarded as coarse reference value for the delivery flow at mains frequency of 50 Hz. It has however to be taken into account, that the real delivery flow is always slightly lower, because it depends on the nominal speed of the respective motor size (see sect. 3.3) and the speed drop due to load situations.

[3] The standard motors for mains 230V 50 Hz ⊥ must not be connected to mains 220V 60 Hz, as this would cause a performance drop of more than 30 ... 40%. Motors with altered winding for increased performance are required for such cases (see also sect. 3.3 "Voltage ranges").

[4] Below versions are not available for horizontal installation (coding L, see table 1): Type HCW 24./(0.46...2.27) or type HCW 22./(0.89...4.41) - version with 5 pump cylinders (5 cyl.) type HCW 44./(1.8...13.1) and version with 6 pump cylinders (6 cyl.)

Table 5: Size 2 to 4 with gear pump and 3-phase motor

HC 24, HC 34, HC 44, and HC 48 = Nom. speed 1450 rpm (50 Hz), 1750 rpm (60 Hz)
HC 22, HC 32, HC 42, and HC 46 = Nom. speed 2800 rpm (50 Hz), 3400 rpm (60 Hz)
For nom. speed and electrical data, see sect. 3.3

Basic type and size	Characteristic data		Delivery flow coding, geom. displacement, perm. pressure, delivery flows											
HC 24	Delivery flow coding [1]		**Z 0,5**	**Z 1,0**	**Z 1,8**									
	Geom. displacement V_g	(cm³/rev.)	0.36	0.72	1.30									
	Pressure p_{max}	(bar)	150	150	150									
	Delivery flow	50 Hz	0.4	0.9	1.6									
	Q_{Pu} (lpm)	60 Hz	0.5	1.1	1.9									
HC 22	Delivery flow coding [1]		**Z 0,5**	**Z 1,0**	**Z 1,8**									
	Geom. displacement V_g	(cm³/rev.)	0.36	0.72	1.30									
	Pressure p_{max}	(bar)	150	150	150									
	Delivery flow	50 Hz	0.9	1.9	3.4									
	Q_{Pu} (lpm)	60 Hz	1.1	2.2	4.0									
HC 34	Delivery flow coding [1]					**Z 2,0**	**Z 2,7**	**Z 3,5**	**Z 4,5**	**Z 5,2**	**Z 6,9**			
	Geom. displacement V_g	(cm³/rev.)				1.4	1.9	2.4	3.1	3.6	4.8			
	Pressure p_{max}	(bar)				170	170	170	170	170	140			
	Delivery flow	50 Hz				1.8	2.4	3.0	3.9	4.6	6.1			
	Q_{Pu} (lpm)	60 Hz				2.1	2.9	3.6	4.7	5.5	7.3			
HC 32	Delivery flow coding [1]					**Z 2,0**	**Z 2,7**	**Z 3,5**	**Z 4,5**	**Z 5,2**	**Z 6,9**			
	Geom. displacement V_g	(cm³/rev.)				1.4	1.9	2.4	3.1	3.6	4.8			
	Pressure p_{max}	(bar)				170	170	170	140	115	85			
	Delivery flow	50 Hz				3.6	4.9	6.2	7.9	9.2	12.3			
	Q_{Pu} (lpm)	60 Hz				4.3	5.8	7.4	9.5	11.1	14.8			
HC 44	Delivery flow coding [1]									**Z 5,2**	**Z 6,9**	**Z 8,8**	**Z 9,8**	**Z 11,3**
	Geom. displacement V_g	(cm³/rev.)								3.6	4.8	6.1	7.0	7.9
	Pressure p_{max}	(bar)								170	170	170	160	140
	Delivery flow	50 Hz								4.6	6.1	7.7	8.8	10.0
	Q_{Pu} (lpm)	60 Hz								5.5	7.3	9.3	10.6	12.0
HC 42	Delivery flow coding [1]									**Z 5,2**	**Z 6,9**	**Z 8,8**	**Z 9,8**	**Z 11,3**
	Geom. displacement V_g	(cm³/rev.)								3.6	4.8	6.1	7.0	7.9
	Pressure p_{max}	(bar)								170	160	120	100	90
	Delivery flow	50 Hz								9.3	12.4	15.8	18.1	20.4
	Q_{Pu} (lpm)	60 Hz								11.2	14.9	18.9	21.7	24.5
HC 48	Delivery flow coding [1]									**Z 5,2**	**Z 6,9**	**Z 8,8**	**Z 9,8**	**Z 11,3**
	Geom. displacement V_g	(cm³/rev.)								3.6	4.8	6.1	7.0	7.9
	Pressure p_{max}	(bar)								180	180	180	160	160
	Delivery flow	50 Hz								4.6	6.1	7.7	8.8	10.0
	Q_{Pu} (lpm)	60 Hz								5.5	7.3	9.3	10.6	12.0
HC 46	Delivery flow coding [1]									**Z 5,2**	**Z 6,9**	**Z 8,8**	**Z 9,8**	**Z 11,3**
	Geom. displacement V_g	(cm³/rev.)								3.6	4.8	6.1	7.0	7.9
	Pressure p_{max}	(bar)								180	180	180	150	120
	Delivery flow	50 Hz								9.3	12.4	15.8	18.1	20.4
	Q_{Pu} (lpm)	60 Hz								11.2	14.9	18.9	21.7	24.5

[1]) The delivery flow coding can be regarded as coarse reference value for the delivery flow at mains frequency of 50 Hz. It has however to be taken into account, that the real delivery flow is always slightly lower, because it depends on the nominal speed of the respective motor size (see sect. 3.3) and the speed drop due to load situations.

Table 6: Size 2 to 4 with gear pump and with 1-phase motor

Motor lay-out 230V 50 Hz ⊥ [1]) — HCW 24, HCW 34, HCW 44 = Nom. speed 1450 rpm (50 Hz), 1750 rpm (60 Hz); HCW 22 = Nom. speed 2800 rpm (50 Hz), 3400 rpm (60 Hz). For nom. speed and electrical data, see sect. 3.3

Basic type and size	Characteristic data	Delivery flow coding, geom. displacement, perm. pressure, delivery flows								
HCW 24	Delivery flow coding [2])	**Z 0,5**	**Z 1,0**	**Z 1,8**						
	Geom. displacement Vg (cm³/rev.)	0.36	0.72	1.30						
	Pressure p_{max} (bar) C_B = 16 µF	150	150	150						
	Delivery flow Q_{Pu} (lpm)	0.4	0.9	1.6						
HCW 22	Delivery flow coding [2])	**Z 0,5**	**Z 1,0**	**Z 1,8**						
	Geom. displacement Vg (cm³/rev.)	0.36	0.72	1.3						
	Pressure p_{max} (bar) C_B = 16 µF	150	150	110						
	Delivery flow Q_{Pu} (lpm)	0.9	1.8	3.2						
HCW 34	Delivery flow coding [2])				**Z 2,0**	**Z 2,7**	**Z 3,5**	**Z 4,5**	**Z 5,2**	**Z 6,9**
	Geom. displacement Vg (cm³/rev.)				1.4	1.9	2.4	3.1	3.6	4.8
	Pressure p_{max} (bar) C_B = 40 µF				170	170	170	135	115	85
	Delivery flow Q_{Pu} (lpm)				1.7	2.3	3.0	3.8	4.4	5.9
HCW 44	Delivery flow coding [2])					**Z 5,2**	**Z 6,9**	**Z 8,8**	**Z 9,8**	**Z11,3**
	Geom. displacement Vg (cm³/rev.)					3.6	4.8	6.1	7.0	7.9
	Pressure p_{max} (bar) C_B = 60 µF					170	170	130	120	100
	Delivery flow Q_{Pu} (lpm)					4.5	5.9	7.5	8.7	9.8

[1]) The standard motors for mains 230V 50 Hz ⊥ must not be connected to mains 220V 60 Hz, as this would cause a performance drop of more than 30 ... 40%. Motors with altered winding for increased performance are required for such cases (see also sect. 3.3 "Voltage ranges").

[2]) The delivery flow coding can be regarded as coarse reference value for the delivery flow at mains frequency of 50 Hz. It has however to be taken into account, that the real delivery flow is always slightly lower, because it depends on the nominal speed of the respective motor size (see sect. 3.3) and the speed drop due to load situations.

2.2 Dual circuit pumps

The following pump combinations are available:

- Radial piston pump of (3-cyl.) - gear pump (avail. for type HC(W) 3.. and type HC(W) 4..)
- Radial piston pump of (3-cyl.) - radial piston pump of (3-cyl.) (avail. for type HC(W) 4.. only)

Because both pump circuits always deliver simultaneously, it has to be made sure that both can be switched individually via an idle circulation valve in idle circulation mode as soon as no pressurized fluid is required from it. These idle circulation valves may be either part of the required connection block (see section 5.6) or the subsequent directional valve bank.
Versions HH... and HZ... are mainly used for single circuits to enable stepwise velocity control of consumers, by switching the individual pump circuits in or out of idle circulation mode.
Version HH... is mainly used for applications where the consumers of two individual circuits are simultaneously operated

Order examples: **HC 46 HZ 3,0 / 8,8 - VV - A2 / 200**
HC 44 HH 5,1 / 6,5 - C 30

Dual circuit pumps, combination of radial piston pump with radial piston pump or gear pump

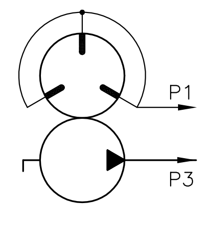
Pressure outlets P1 and P3 on one common pump pedestal

HC .. **HZ ... / ...**
HC .. **HH ... / ...**

Pump combinations: Pressure outlet P1 - pressure outlet P3

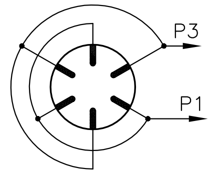
Radial piston pump - gear pump

Radial piston pump (H)
1 x 3 pump cylinder + gear pump (Z)



Radial piston pump - Radial piston pump

Radial piston pump (H)
2 x 3 pump cylinder



Order examples: **HC 44 /HH 0,9 /6,5**
HC 48 LT /HZ 1,25/9,8

Low pressure stage see table 8

Table 7: Radial piston pump (high pressure stage at dual stage pump)
Motor lay-out see table 3 and table 4

H	Coding for radial piston pump		Piston diameter (mm) 6	7	8	10	12	13	14	15	16
HC 34	Delivery flow coding (3 cyl.) [2]		**0,9**	**1,25**	**1,5**	**2,5**	**3,6**	**4,3**	**5,1**	**5,6**	**6,5**
	Geom. displacement V_g	(cm³/rev.)	0.64	0.88	1.15	1.79	2.58	3.03	3.51	4.03	4.58
	Perm. pressure p_{max} [1]	(bar)	700	700	610	390	270	230	200	170	150
	Delivery flow Q_{Pu} (lpm)	50 Hz	0.89	1.21	1.58	2.47	3.56	4.18	4.85	5.57	6.33
		60 Hz	1.07	1.45	1.90	2.97	4.28	5.02	5.82	6.68	7.60
HC 32	Delivery flow coding (3 cyl.) [2]										
	Geom. displacement V_g	(cm³/rev.)	0.64	0.88	1.15	1.79	2.58	3.03	3.51	4.03	4.58
	Perm. pressure p_{max} [1]	(bar)	700	510	400	250	175	150	130	110	95
	Delivery flow Q_{Pu} (lpm)	50 Hz	1.80	2.45	3.20	5.00	7.20	8.45	9.80	11.25	12.80
		60 Hz	2.16	2.94	3.84	6.00	8.64	10.14	11.76	13.50	15.36
HC 44	Delivery flow coding (3 cyl.) [2]		**0,9**	**1,25**	**1,5**	**2,5**	**3,6**	**4,3**	**5,1**	**5,6**	**6,5**
	Geom. displacement V_g	(cm³/rev.)	0.64	0.88	1.15	1.79	2.58	3.03	3.51	4.03	4.58
	Perm. pressure p_{max} [1]	(bar)	700	700	700	670	460	400	340	300	260
	Delivery flow Q_{Pu} (lpm)	50 Hz	0.89	1.21	1.58	2.47	3.56	4.18	4.85	5.57	6.33
		60 Hz	1.07	1.45	1.90	2.97	4.28	5.02	5.82	6.68	7.60
HC 42	Delivery flow coding (3 cyl.) [2]		**1,75**	**2,4**	**3,0**	**4,9**	**7,1**	**8,5**	**10,2**	**11,1**	**12,9**
	Geom. displacement V_g	(cm³/rev.)	0.64	0.88	1.15	1.79	2.58	3.03	3.51	4.03	4.58
	Perm. pressure p_{max} [1]	(bar)	700	700	700	460	320	270	240	210	180
	Delivery flow Q_{Pu} (lpm)	50 Hz	1.81	2.47	3.22	5.04	7.25	8.51	9.87	11.33	12.89
		60 Hz	2.18	2.96	3.87	6.04	8.70	10.21	11.85	13.60	15.47
HC 48	Delivery flow coding (3 cyl.) [2]		**0,9**	**1,25**	**1,5**	**2,5**	**3,6**	**4,3**	**5,1**	**5,6**	**6,5**
	Geom. displacement V_g	(cm³/rev.)	0.64	0.88	1.15	1.79	2.58	3.03	3.51	4.03	4.58
	Perm. pressure p_{max} [1]	(bar)	700	700	700	700	490	420	360	315	275
	Delivery flow Q_{Pu} (lpm)	50 Hz	0.89	1.21	1.58	2.47	3.56	4.18	4.85	5.57	6.33
		60 Hz	1.07	1.45	1.90	2.97	4.28	5.02	5.82	6.68	7.60
HC 46	Delivery flow coding (3 cyl.) [2]		**1,75**	**2,4**	**3,0**	**4,9**	**7,1**	**8,5**	**10,2**	**11,1**	**12,9**
	Geom. displacement V_g	(cm³/rev.)	0.64	0.88	1.15	1.79	2.58	3.03	3.51	4.03	4.58
	Perm. pressure p_{max} [1]	(bar)	700	700	700	700	490	420	360	315	275
	Delivery flow Q_{Pu} (lpm)	50 Hz	1.8	2.5	3.3	5.1	7.4	8.7	10.1	11.6	13.1
		60 Hz	2.2	3.0	4.0	6.2	8.9	10.4	12.1	13.6	15.8
HCW 34	Delivery flow coding (3 cyl.) [2]		**0,9**	**1,25**	**1,5**	**2,5**	**3,6**	**4,3**	**5,1**	**5,6**	**6,5**
	Geom. displacement V_g	(cm³/rev.)	0.64	0.88	1.15	1.79	2.58	3.03	3.51	4.03	4.58
	Perm. pressure p_{max} (bar) [1]	C_B = 40 µF	700	520	400	250	180	150	130	115	100
	Delivery flow Q_{Pu} (lpm)		0.87	1.18	1.54	2.40	3.46	4.06	4.71	5.41	6.15
HCW 44	Delivery flow coding (3 cyl.) [2]		**0,9**	**1,25**	**1,5**	**2,5**	**3,6**	**4,3**	**5,1**	**5,6**	**6,5**
	Geom. displacement V_g	(cm³/rev.)	0.64	0.88	1.15	1.79	2.58	3.03	3.51	4.03	4.58
	Perm. pressure p_{max} (bar) [1]	C_B = 60 µF	700	700	700	460	320	270	230	200	180
	Delivery flow Q_{Pu} (lpm)		0.87	1.18	1.54	2.40	3.46	4.06	4.71	5.41	6.15

[1]) The value indicated as max. pressure applies to cold motor or those with low service temperature, where the expected oil temperature $\vartheta_{B\ oil}$ doesn't exceed approx. 50 to 60°C (see sect. 3.2). The max. pressure should be reduced by approx. 10 to 15%, if a rough calculation yields an oil temperature of about 70 to 80°C.

[2]) The delivery flow coding can be regarded as coarse reference value for the delivery flow at mains frequency of 50 Hz. It has however to be taken into account, that the real delivery flow is always slightly lower, because it depends on the nominal speed of the respective motor size (see sect. 3.3) and the speed drop due to load situations.

Table 8: Gear pump **Z** and radial piston pump **H** (Low pressure stage at dual stage pump)

Z	Coding for gear pump (Size 1)										
Delivery flow coding 2)			**2,0**	**2,7**	**3,5**	**4,5**	**5,2**	**6,9**	**8,8**	**9,8**	**11,3**
Geom. displacement V_g		(cm^3/rev)	1.4	1.9	2.4	3.1	3.6	4.8	6.1	7.0	7.9
HC 34	Perm. pressure p_{max} 1)	(bar)	170	170	170	170	170	130			
	Delivery flow Q_{Pu} (lpm)	50 Hz	1.8	2.4	3.1	3.9	4.6	6.1			
		60 Hz	2.1	2.9	3.6	4.7	5.5	7.3			
HC 32	Perm. pressure p_{max} 1)	(bar)	170	170	170	130	110	80			
	Delivery flow Q_{Pu} (lpm)	50 Hz	3.6	4.9	6.2	7.9	9.3	12.3			
		60 Hz	4.3	5.8	7.4	9.5	11.1	14.8			
HC 44	Perm. pressure p_{max} 1)	(bar)					170	150	150	130	130
	Delivery flow Q_{Pu} (lpm)	50 Hz					4.5	6.1	7.7	8.8	10.0
		60 Hz					5.5	7.3	9.3	10.6	12.0
HC 42	Perm. pressure p_{max} 1)	(bar)					170	150	120	100	90
	Delivery flow Q_{Pu} (lpm)	50 Hz					10.4	13.8	17.5	20.2	20.4
		60 Hz					12.5	16.6	21		
HC 48	Perm. pressure p_{max} 1)	(bar)					210	180	180	160	160
	Delivery flow Q_{Pu} (lpm)	50 Hz					5.1	6.8	8.6	9.9	11.1
		60 Hz					6.2	8.3	10.5	12.1	13.7
HC 46	Perm. pressure p_{max} 1)	(bar)					170	170	150	130	115
	Delivery flow Q_{Pu} (lpm)	50 Hz					10.4	13.8	17.5	20.2	22.8
		60 Hz					12.5	16.6	21		
HCW 34	Perm. pressure p_{max} (bar) 1)	C_B = 40 µF	170	170	170	130	110	80			
	Delivery flow Q_{Pu} (lpm)		1.7	2.3	3.0	3.8	4.4	5.9			
HCW 44	Perm. pressure p_{max} (bar) 1)	C_B = 60 µF					170	170	120	100	90
	Delivery flow Q_{Pu} (lpm)						4.5	5.9	7.5	8.7	9.8

H	Coding for radial piston pump		Piston diameter (mm)								
			6	7	8	10	12	13	14	15	16
HC 44	Delivery flow coding (3 cyl.) 2)		**0,9**	**1,25**	**1,5**	**2,5**	**3,6**	**4,3**	**5,1**	**5,6**	**6,5**
	Geom. displacement V_g	(cm^3/rev.)	0.64	0.88	1.15	1.79	2.58	3.03	3.51	4.03	4.58
	Perm. pressure p_{max} 1)	(bar)	700	700	700	670	460	400	340	300	260
	Delivery flow Q_{Pu} (lpm)	50 Hz	0.89	1.21	1.58	2.47	3.56	4.18	4.85	5.57	6.33
		60 Hz	1.07	1.45	1.90	2.97	4.28	5.02	5.82	6.68	7.60
HC 42	Delivery flow coding (3 cyl.) 2)		**1,75**	**2,4**	**3,0**	**4,9**	**7,1**	**8,5**	**10,2**	**11,1**	**12,9**
	Geom. displacement V_g	(cm^3/rev.)	0.64	0.88	1.15	1.79	2.58	3.03	3.51	4.03	4.58
	Perm. pressure p_{max} 1)	(bar)	700	700	700	460	320	270	240	210	180
	Delivery flow Q_{Pu} (lpm)	50 Hz	1.81	2.47	3.22	5.04	7.25	8.51	9.87	11.33	12.89
		60 Hz	2.18	2.96	3.87	6.04	8.70	10.21	11.85	13.60	15.47
HC 48	Delivery flow coding (3 cyl.) 2)		**0,9**	**1,25**	**1,5**	**2,5**	**3,6**	**4,3**	**5,1**	**5,6**	**6,5**
	Geom. displacement V_g	(cm^3/rev.)	0.64	0.88	1.15	1.79	2.58	3.03	3.51	4.03	4.58
	Perm. pressure p_{max} 1)	(bar)	700	700	700	700	490	420	360	315	275
	Delivery flow Q_{Pu} (lpm)	50 Hz	0.89	1.21	1.58	2.47	3.56	4.18	4.85	5.57	6.33
		60 Hz	1.07	1.45	1.90	2.97	4.28	5.02	5.82	6.68	7.60
HC 46	Delivery flow coding (3 cyl.) 2)		**1,75**	**2,4**	**3,0**	**4,9**	**7,1**	**8,5**	**10,2**	**11,1**	**12,9**
	Geom. displacement V_g	(cm^3/rev.)	0.64	0.88	1.15	1.79	2.58	3.03	3.51	4.03	4.58
	Perm. pressure p_{max} 1)	(bar)	700	700	700	700	490	420	360	315	275
	Delivery flow Q_{Pu} (lpm)	50 Hz	1.8	2.5	3.3	5.1	7.4	8.7	10.1	11.6	13.1
		60 Hz	2.2	3.0	4.0	6.2	8.9	10.4	12.1	13.6	15.8
HCW 44	Delivery flow coding (3 cyl.) 2)		**0,9**	**1,25**	**1,5**	**2,5**	**3,6**	**4,3**	**5,1**	**5,6**	**6,5**
	Geom. displacement V_g	(cm^3/rev.)	0.64	0.88	1.15	1.79	2.58	3.03	3.51	4.03	4.58
	Perm. pressure p_{max} (bar) 1)	C_B = 60 µF	700	700	700	460	320	270	230	200	180
	Delivery flow Q_{Pu} (lpm)		0.87	1.18	1.54	2.40	3.46	4.06	4.71	5.41	6.15

Footnotes 1) and 2) see page 8!

3. Further characteristic data

3.1 General

Nomenclature	Constant delivery pump
Design	Valve controlled radial piston pump or play compensated gear pump
Direction of rotation	Radial piston pump - Any Gear pump, dual circuit pump - Counter clockwise (The rotation direction can be only detected by checking the delivery flow. The connection of two of the three mains wires have to be interchanged at the terminal strip, when there is no delivery with 3-phase pumps)
Installation position	Vertical (HC) or lying horizontally (HC . . L). Take into account that filling volumes vary insignificantly, see sect. 3.2.
Mounting	Four tapped holes at the bottom, two diagonal tapped holes on the top side. See dimensional drawings.
Mass (weight) (without oil filling)	HC(W)1.. approx. 6.3 kg HC(W)2.. approx. 10.1 kg HC(W)3.. approx. 17.2 kg HC(W)4.. approx. 23 kg HC(W)2../Z.. approx. 10.4 kg HC(W)3../Z. approx. 17.5 kg HC(W)4../Z. approx. 24 kg For mass (weight) of the required connection block see relevant pamphlet.
Pipe connection	only by means of directly mounted connection blocks. For selection table, see sect. 5.6 Basic pump: For connection hole patter, see sect. 4.

3.2 Hydraulic data

Pressure	Delivery side (outlet (P): Depending on delivery flow and assembly manner, see sect. 2.1 and 2.2. Suction side (inside the casing): Ambient pressure, not suited for charging.
Starting against pressure	The versions for 3-phase mains may start against p_{max} The versions for 1-phase (AC) may only start against a very low pressure. Therefore the control has in principle, to be laid out for pressureless start e.g. by means of an idle circulation solenoid valve, which is held open during start for a period of approx. 0.5 to 1s (e.g. by means of a delay relay).
Pressure fluid	Hydraulic oil conforming DIN 51524 part 1 to 3: ISO VG 10 to 68 conform. DIN 51519.

Viscosity range:

Viscosity during start		HC(W) 1.. HC(W) 2..	HC(W) 3.. HC(W) 4..
min. approx.	(mm²/s)	4	4
max. approx.	(mm²/s)	800	1500
opt. service	(mm²/s)	10... 500	

Also suitable are biologically degradable pressure fluids (Standards VDMA 24568 and VDMA 24569) type HEES (Synth. Ester) at service temperatures up to approx. +70°C. Electrically hazardous: Any fluid types containing water must not be used (short-cut)! Fluid types HEPG and HETG must not be used.

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 tempera-ture 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 over +70 °C.

Filling and usable volume

Radial piston pumps, dual circuit pumps radial piston pump - radial piston pump

Type	HC(W) 1..	HC(W) 1L..	HC(W) 2..	HC(W) 2L..	HC(W) 3..	HC(W) 3L..	HC(W) 4..	HC(W) 4L..
Filling vol. (l)	1.16	0.95	2.5	2.3	5.0	4.95	12	11
Usable vol. (l)	0.50	0.50	1.5	1.1	3.5	3.80	8	7.8

Gear pumps, dual circuit pumps radial piston pump - gear pump

Type	HC(W) 2.. (L)/Z..	HC 3.. (L)/Z..	HCW 34 (L)/Z..	HC(W) 4..
Filling vol. (l)	2.3	5.0	4.9	10.8
Usable vol. (l)	1.1	3.5	2.8	7.8

3.3 Electric data

This data applys to radial piston pumps, gear pump, and dual circuit pumps.
The drive motor forms with the pump a closed not separable unity, see description sect. 1.

Connection	via 3+GND wire leads 1.5 mm² in the integrated terminal enclosure, see sect. 5.1 also
Cable gland	Thread M 16x1.5 or M 20x1.5. Cable gland is not scope of delivery
Protection class	IP 54 acc. to DIN EN 60529 / IEC 60529, applies to the complete hydraulic power unit as opposed to purely electrical equipment
Safety class	DIN VDE 0100 safety class 1
Insulation	Lay-out acc. to DIN VDE 0110

- up to 500V AC for 4 or 3 leads mains supply L1-L2-L3-N (3-phase mains) with the star point connected to ground
- up to 300V AC for 4 or 3 leads mains supply L1-L2-L3 (3-phase mains) with the star point not connected to ground (e.g. foreign markets)
- up to 300V AC for 1-phase + ground L-N mains supply

Type	Nom. voltage and Combination U_N (V)	Mains frequency f (Hz)	Mains frequency P_N (kW)	Revolutions n_{nom} (rpm)	Nom. current I_N (A)	Start current ratio I_A / I_N	Power factor cos φ	Insulation material classification
HC 14	400/230 Y△	50	0.18	1380	0.60 / 1.05	2.9	0.69	
	460/265 Y△	60	0.21	1650	0.55 / 0.95	3	0.72	B
	500 Y 4)	50	0.18	1370	0.54	2.7	0.7	
HC 12	400/230 Y△	50	0.25	2860	0.65 / 1.15	4	0.78	
	460/265 Y△	60	0.3	3420	0.6 / 1.04	4	0.8	B
	500 Y 4)	50	0.25	2840	0.54	4	0.8	
HCW 14	230 ⊥	50	0.18 5)	1390	1.8	2.8	0.86	
	110 ⊥	60	0.18	1690	3.7	3	0.97	B
HCW 12	230 ⊥	50	0.25 5)	2700	2.2	3.2	0.95	
HC 24	400/230 Y△	50	0.55	1390	1.6 / 2.8	4.4	0.75	
	460/265 Y△	60	0.66	1670	1.5 / 2.5	5	0.8	B
	500 Y 4)	50	0.55	1410	0.84	4	0.74	
HC 22	400/230 Y△	50	0.75	2680	1.75 / 3.0	5.7	0.85	
	460/265 Y△	60	0.9	3216	1.65 / 2.95	6	0.85	B
	500 Y 4)	50	0.75	2700	1.4	5	0.85	
HCW 24	230 ⊥	50	0.37	1350	3.0	3	0.95	F
HCW 22	230 ⊥	50	0.55	2720	4.1	3.5	0.96	
HC 34	400/230 Y△	50	1.1	1410	2.7 / 4.7	5.3	0.81	F
	460/265 Y△	60	1.3	1690	2.8 / 4.8	5	0.83	
	500 Y 4)	50	1.1	1410	2.2	5.3	0.81	B
HC 32	400/230 Y△	50	1.5	2850	3.3 / 5.7	6.3	0.85	F
	460/265 Y△	60	1.8	3430	3.4 / 5.9	5.8	0.88	
	500 Y	50	1.5	2850	2.7	6.3	0.85	B
HCW 34	230 ⊥	50	0.75 5)	1370	5.5	2.4	0.93	F
	110 ⊥	60	0.86	1650	12.5	2.7	0.97	
HC 44	400/230 Y△	50	2.2	1405	4.8 / 8.3	4.8	0.85	B
	460/265 Y△	60	2.6	1725	4.9 / 8.5	4.9	0.87	
HC 42	400/230 Y△	50	2.2	2870	4.5 / 7.8	4.5	0.88	B
	460/265 Y△	60	2.6	3444	4.5 / 7.8	4.5	0.89	
HC 48	400/230 Y△	50	3	1410	6.6 / 11.5	6.6	0.84	B
	460/265 Y△	60	3.6	1730	6.6 / 11.5	6.6	0.86	
HC 46	400/230 Y△	50	3	2880	6.2 / 10.5	6.2	0.87	B
	460/265 Y△	60	3.6	3456	6.2 / 10.8	6.2	0.88	
HCW 44	230 ⊥	50	1.5	1375	10.1	3.3	0.94	B
	110 ⊥	60	1.5	1650	21	3.3	0.94	

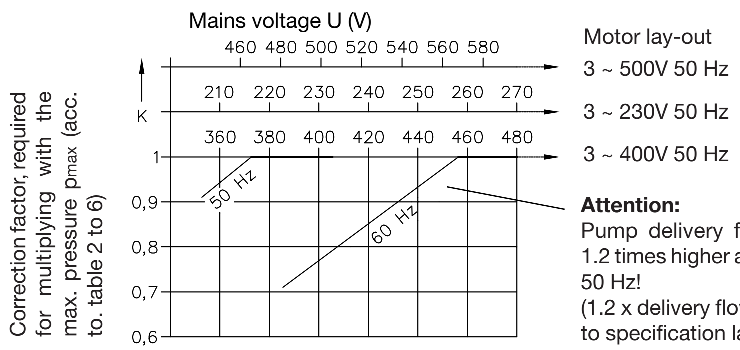
Voltage ranges

Operation with under-voltage is possible, but observe the notes in "Performance restrictions"!

Nominal voltage		Perm. tolerances for mains supply 50 Hz	60 Hz
Standard	3 ~ 400V 50 Hz 3 ~ 230V 50 Hz 3 ~ 500V 50 Hz	± 10%	± 5%
	1 ~ 230V 50 Hz	± 10%	---
	1 ~ 110V 60 Hz	---	± 5%
Special voltage	3 ~ 200V 50/60 Hz 2) 1 ~ 100V 50/60 Hz 2) 1 ~ 220V 60 Hz 3)	± 10%	± 10%

Performance restrictions

The correction factor for the lowest expected voltage has to be selected for the intended application location.



Attention:
Pump delivery flow is 1.2 times higher as with 50 Hz!
(1.2 x delivery flow acc. to specification label)

1) max. permanent load 500V +15%, acc. to the supplier of the wire leads

2) Special voltage; designed for mains supply in Japan, but may be used for others, e.g. for mains 3 ~ 220V 60 Hz in the perm. voltage limits.
(The max. permissible pressure for this version is reduced in the range of < -5% ... -10%).

3) Special voltage; currently available: HCW 14(12), HCW 22, HCW 34, other sizes on request

4) Fixed connection at the winding head

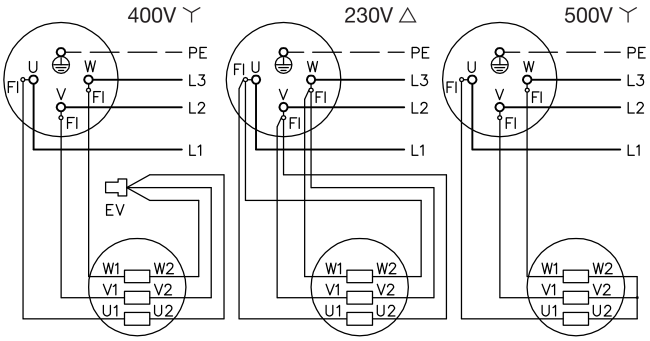
5) Nom. lay-out S3-40%

Connection pattern

Version for 3-phase mains

Connection of L1, L2, L3 and PE customer furnished

Internal connection, ex works



FI = blade terminal

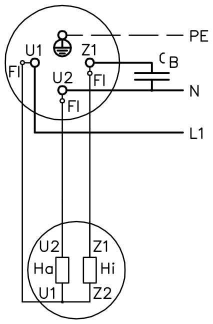
EV = insulated crimp connector

Version for 1-phase mains 1)

230 V 50 Hz ⊥

Connection of L1, N, PE and C_B customer furnished

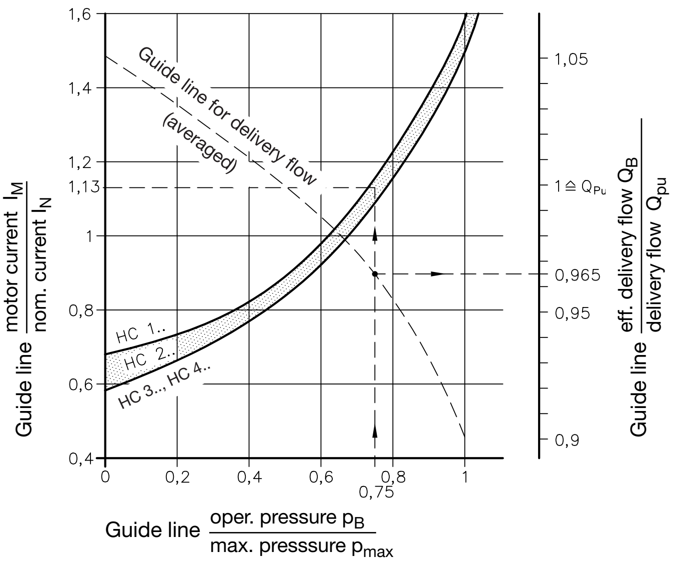
Internal connection, ex works



I_M - p_B - operation curve

These hydraulic power packs are intended for intermittent service S3. It is therefore possible to load the motor above its nominal performance rating for short periods. This will cause the power consumption to rise on 140 to 160 % of I_N during max. operation pressure ($p_B = p_{max}$).

Versions for 3-phase mains type HC1.. to HC 4..



Example: HC 24/1,1

p_B = 300 bar actual operation pressure (Pressure setting of the safety valve)

Given nom. data, table sect. 2.1 and 2.2

p_{max} = 400 bar

Q_{pu} = 1.06 lpm

I_N = 1.6/2.8 A with 400/230V 50 Hz

Resulting in: $\frac{p_B}{p_{max}} = \frac{300}{400} = 0{,}75$

This results roughly estimated in

I_M / I_N = 1.13 or the current consumption of the motor

I_M = 1.13 x 1.6 ≈ **1.8 A**

and the approx. delivery with

Q_B/Q_{pu} = 0.965 to Q_B = 0.965 · 1.06 ≈ **1 lpm**

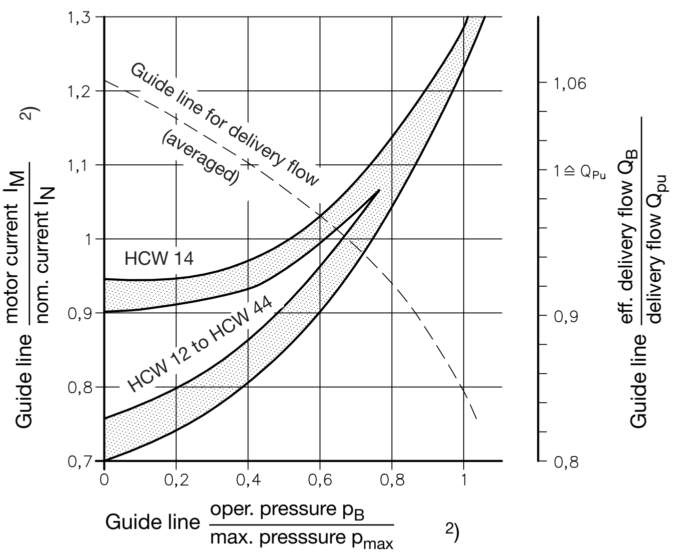
Reference current I_{ref}

The reference current I_{ref} will differ to the nom. current I_N (see sect. 3.3) in dependence of the capacity of the connected capacitor C_B.

Type	I_N	C_B	$I_{ref.}$
HCW 14	1.8	(6)	
		8	2.1
		12	2.5
HCW 12	2.2	(6)	
		12	2.2
		16	2.6
HCW 24	3.0	(12)	
		16	3.3
		24	4.6

Type	I_N	C_B	$I_{ref.}$
HCW 22	4.1	(12)	
		16	4.4
HCW 34	5.5	(25)	
		40	6
HCW 44	10.1	(60)	

Versions for 1-phase mains type HCW1.. to HCW 4..



The voltage of the capacitor will be in the following range:

Type	p_B/p_{max} = 0 (unloaded)	p_B/p_{max} = 1 (max. load)
HCW 14	480 ... 490V	410 ... 420V
HCW 24	480 ... 490V	410 ... 420V
HCW 12	390 ... 400V	330 ... 340V
HCW 22	440 ... 450V	370 ... 380V
HCW 34	425 ... 430V	360 ... 370V
HCW 44	430 ... 440V	360 ... 370V

Type	$\frac{I_M}{I_N} \left(\frac{I_M}{I_{ref.}}\right)$
HC 24/0.27	approx. 0.9
HC 24/0.42	approx. 1.0
HC 22/0.52	approx. 1.1
HCW 24/0.27	approx. 0.85
with C_B = 16 µF (C_B = 24 µF not required)	
HC 42..	approx. 2.1
HC 46..	approx. 2.5

1) The required capacitor is to be customer furnished and should be mounted on a suitable spot. Wax paper capacitors should be used. Connection should be at U2 and Z1, see connection pattern. No start-up against pressure!

2) There is a reduced current ratio, divergently to the curve below, for types listed in the adjoining table at operating pressure (p_{max} = 700 bar). This is caused by the high motor output.

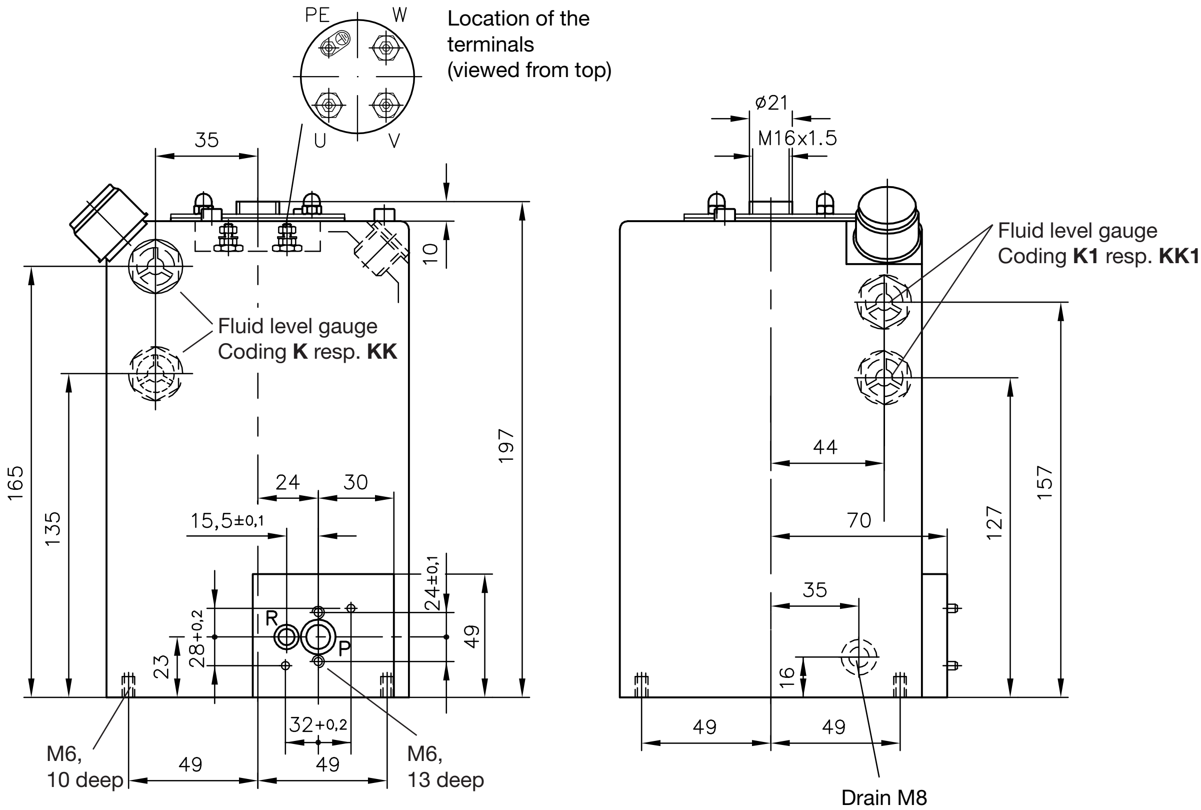
Current ratio: $\frac{I_M}{I_N}$ or $\left(\frac{I_M}{I_{ref}}\right)$

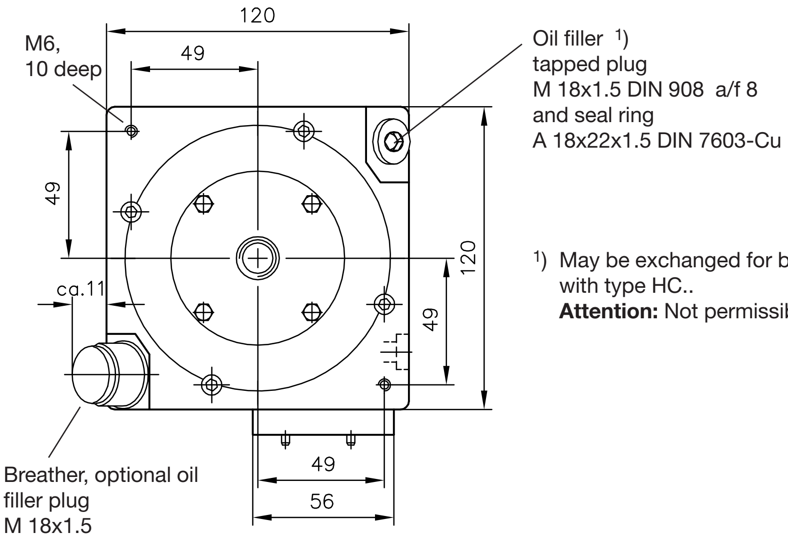
4. Unit dimensions

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

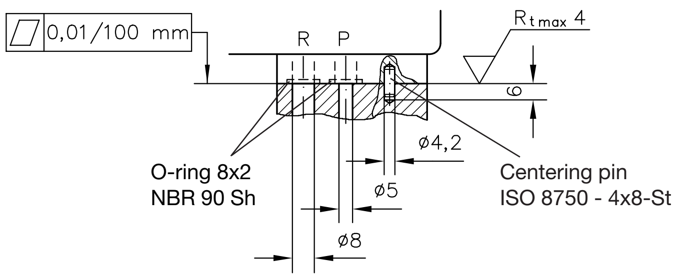
4.1 Basic pump

Type HC(W) 14 and HC(W) 12

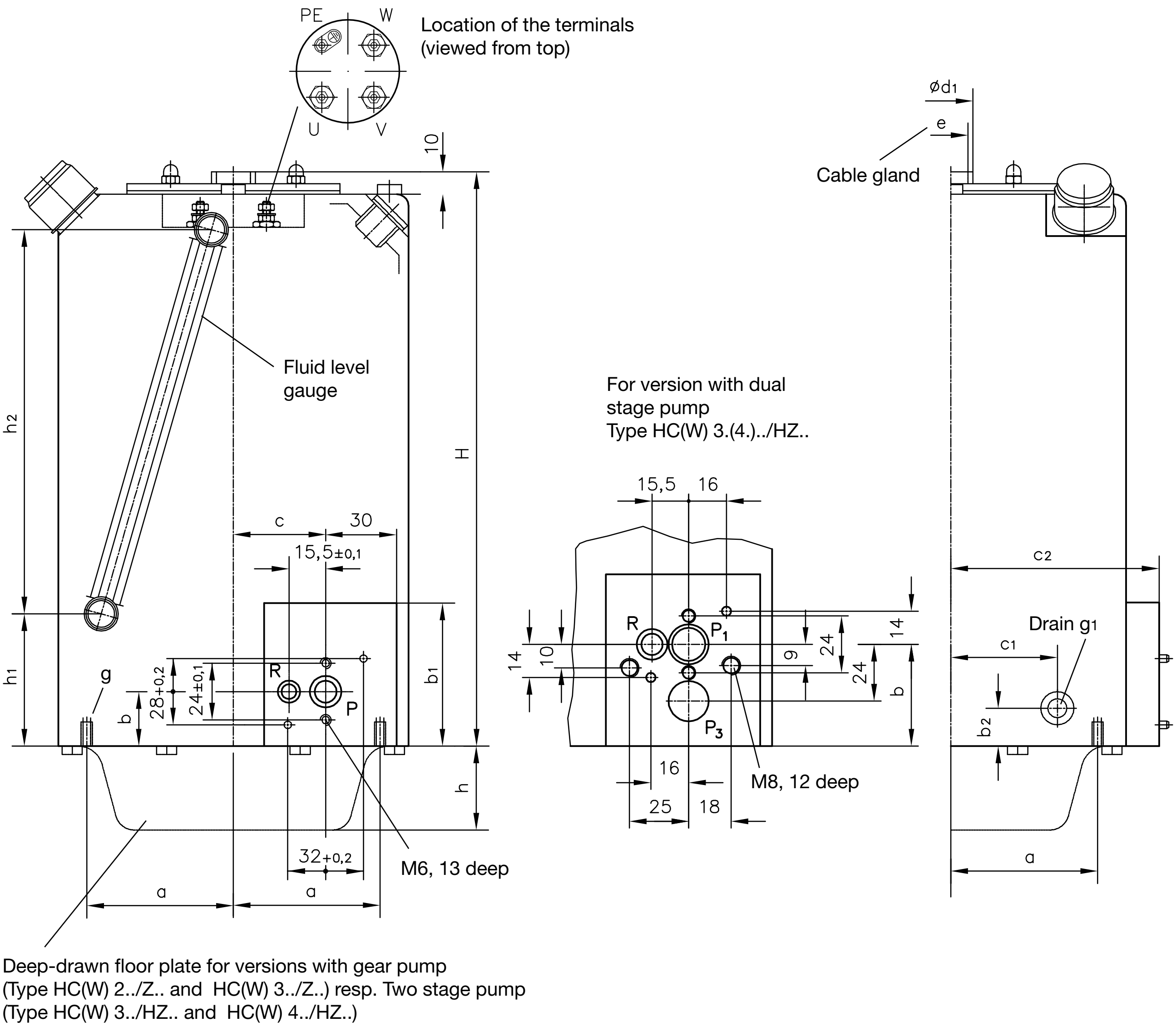


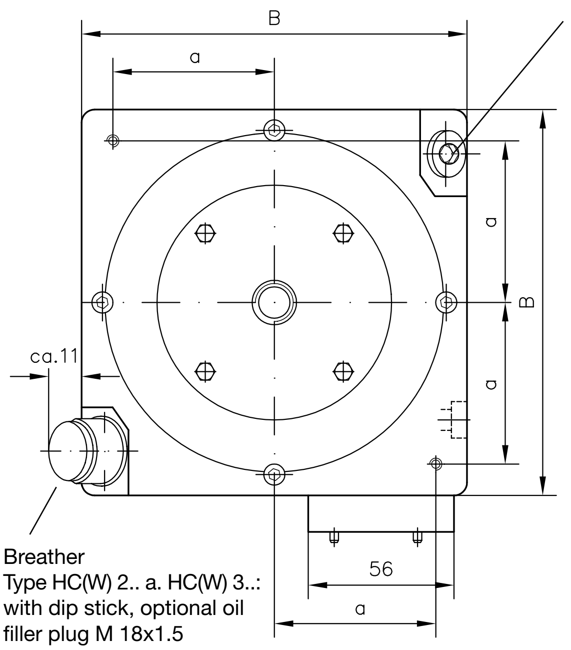


[1]) May be exchanged for breather with type HC..
Attention: Not permissible with type HC..L!



Type HC(W) 2.. to HC(W) 4..





Oil filler plug [1]
Type HC(W) 2.. and HC(W) 3..:
tapped plug M 18x1.5 DIN 908 a/f 8 and seal ring A 18x22x1.5 DIN 7603-Cu
Type HC(W) 4..:
tapped plug G 3/4 (BSPP) DIN 908 a/f 12 and seal ring A 27x32x2 DIN 7603-Cu

[1] May be exchanged for breather with type HC..
Attention:
Not permissible with type HC..L !

Breather
Type HC(W) 2.. a. HC(W) 3..:
with dip stick, optional oil filler plug M 18x1.5

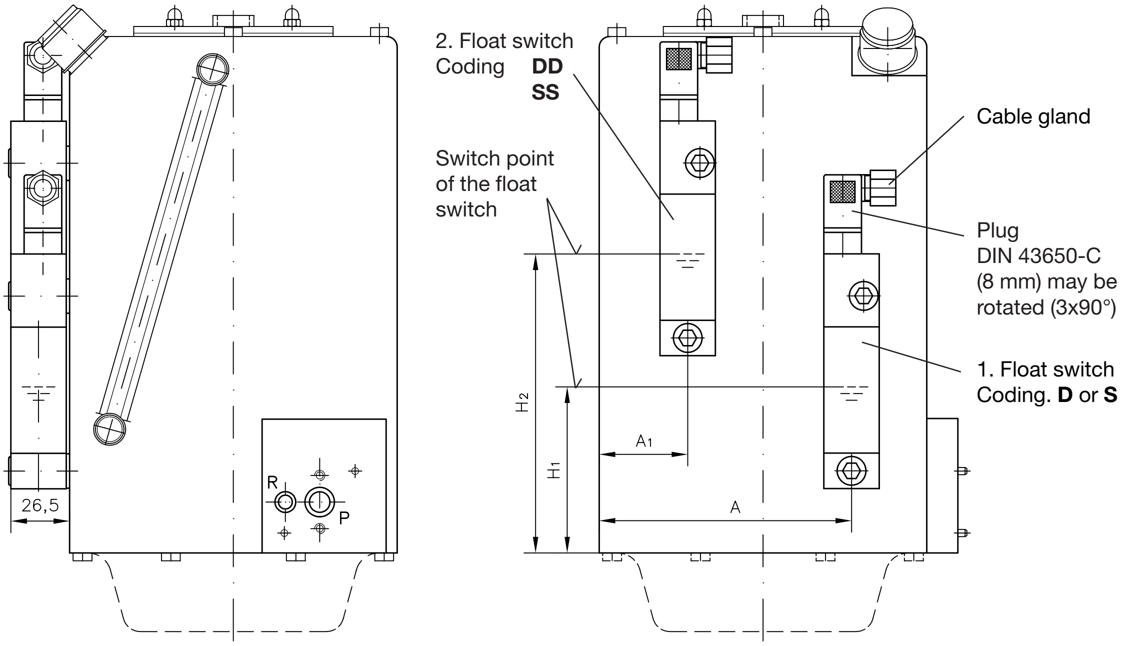
Type HC(W) 4..:
Breather plug, optional oil filler plug G 3/4 (BSPP)

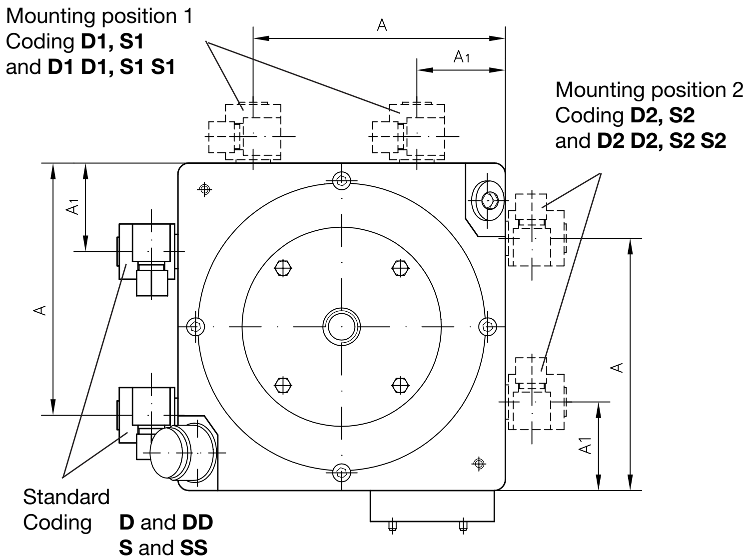
Type	H	B	a	b	b_1	b_2	d_1	e
HC(W) 2..	243	148	62	23	49	16	21	M 16x1.5
HC(W) 3../..(/Z..)	300	184	78	30	59	17	21	M 16x1.5
HC(W) 3../HZ..	300	184	78	51	70	17	21	M 16x1.5
HC(W) 4..	372	230	100	51	82	17	23	M 20x1.5

Type	c	c_1	c_2	g	g_1	h	h_1	h_2
HC(W) 2..	39	45	85	M 6, 10 deep	M 8	---	44.5	173.5
HC(W) 2../Z..	39	45	85	M 6, 10 deep	M 8	43	44.5	173.5
HC(W) 3..	52	60	102	M 8, 12 deep	G 1/4	---	88	213
HC(W) 3../Z... HC(W) 3../HZ..	52	60	102	M 8, 12 deep	G 1/4	approx. 68	88	213
HC(W) 4..	65	80	124	M 8, 12 deep	G 1/4	--	102	249
HC(W) 4../HZ..	65	80	124	M 8, 12 deep	G 1/4	45	102	249

4.2 Optional equipment

Float switch (Coding **D.., S..**)
Vertical version

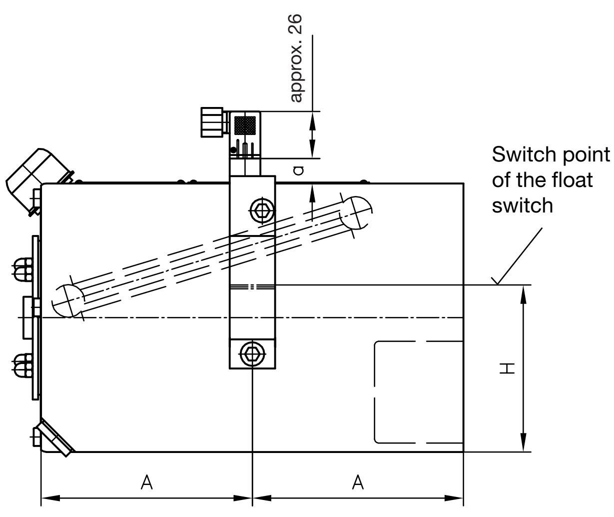




Type	A	A_1	H_1	H_2
HC(W) 1..	95	25	56	96
HC(W) 2..	114	40	75	135
HC(W) 3..	132	40	86	146
HC(W) 4..	155	40	108	188

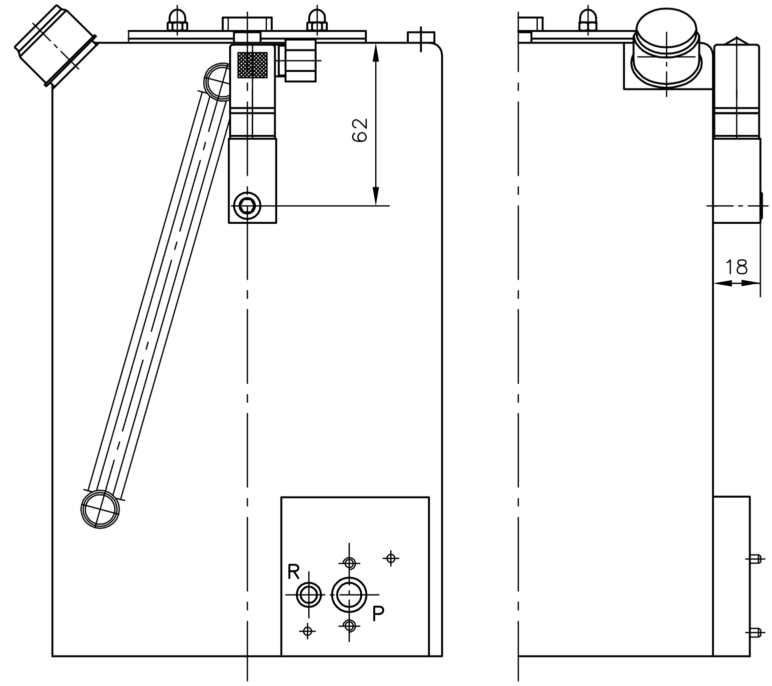
For missing spec, see page 13 and 14!

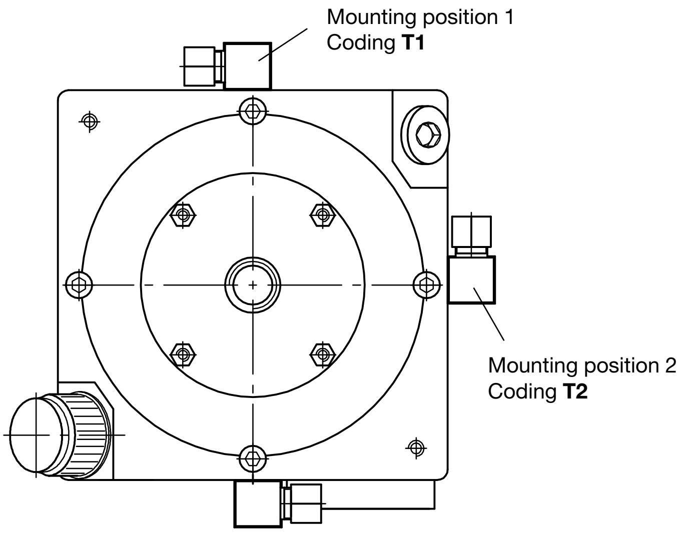
Horizontal version



Type	A	H	a
HC(W) 1..	93,5	53	2.7
HC(W) 2..	121,5	92	13.7
HC(W) 3..	150	112	- 2.3
HC(W) 4..	186	137	- 23.3

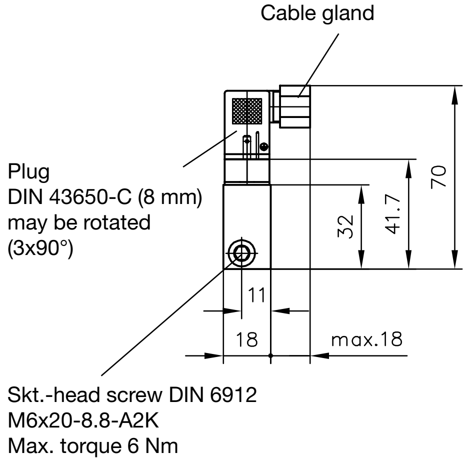
Temperature switch (Coding **T**)

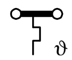




Technical data:

Temperature switch



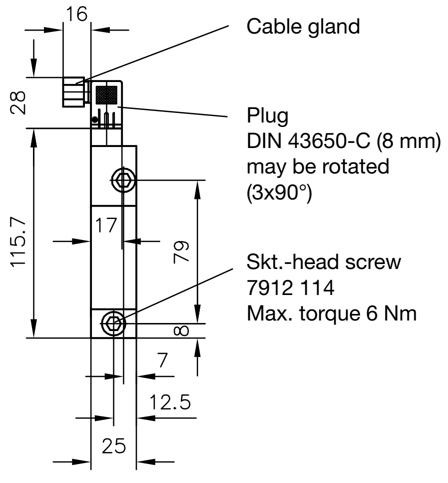


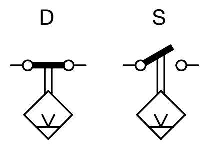
Technical data:
MICROTHERM-Bimetallic switch
T10V 80°C +- 5K U112 P102 L510 NC-contact
AC: 250V 50/60Hz 3,5A; DC: 42V 1A

For individual orders:
Temperature switch, order No. 7912 000
Float switch, complete “D” order No. 7912 100/1a
Float switch, complete “S” order No.. 7912 100/1b

A winding protection switch is integratred with type HCW 44:
MICROTHERM-bimetallic switch T11 100°C +- 5K U112 NC-contact AC: 250V 50/60Hz 3A;
DC: 42V 1.2A

Float switch



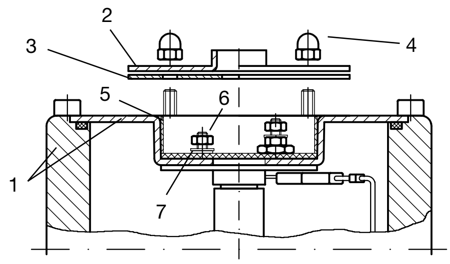


Technical data:
Float switch material PA
Float material NBR
Function: D - NC-contact (open when level drops)
S - NO-contact (closed when level drops)
Perm. switching load: 230V DC/AC 0.5A 30VA
Max. perm. temperature 90°C
Mounting thread M8

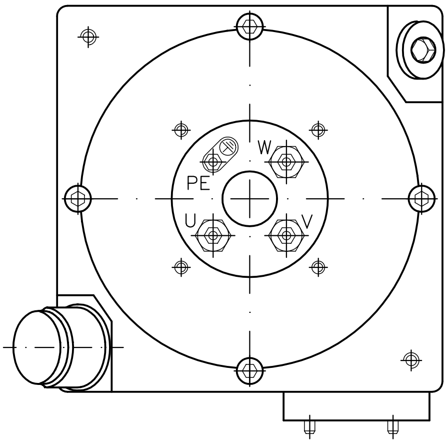
5. Appendix

5.1 Electrical port

Versions for 3-phase mains type HC
Type HC 1., HC 2. and HC 3.



The motor is connected for Y for 400V or △ for 230V 3 ~ ex-works on the under side of the bearing plate. See connection pattern in sect. 3.3. The connection ex-works is according to the ordered specification. A later conversion from Y to △ by the customer is possible, see B 7900.
Industrial standard wire leads (3+GND) should be utilized for mains supply connection. The cross sectional area should be 1.5 mm² as minimum.



① Remove parts No. 4, 2, and 3 from the bearing plate

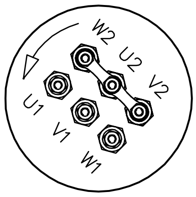
② Connect the individual leads equipped with crimped eyelets to the terminals U, V, W and PE.
The cable gland type M 16x1.5 (type HC(W) 1(2, 3)..) resp. M 20x1.5 (type HC(W) 4..) is to be furnished by the customer.

Attention: Absolute care has to be taken that the insulation strip 5 remains in its intended location! The flawless working of the grounding conductor has to be tested (DIN VDE 0100)!

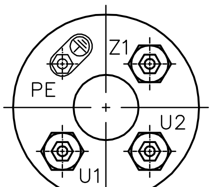
③ Reinstall parts No. 3, 2, and 4 and tighten cable gland.

	Type	HC(W) 1(2, 3)..	HC(W) 4..
1	Bearing plate	7900 203/1	7900 403
2	Terminal cover	7900 205	7900 405
3	Seal	7900 206	7900 406
4	Cap nut	DIN 934-M5-8-A2K	DIN 934-M5-8-A2K
5	Insulation strip	7900 210	7900 410
6	Nut	DIN 1587-M4-8-A2K	DIN 1587-M4-8-A2K
7	Washer	ISO 7089/7090-4,3-140HV-A2K	ISO 7089/7090-4,3-140HV-A2K

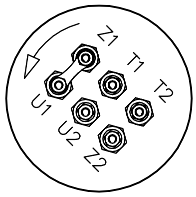
Type HC 4.
Illustration Y 3x400V 50Hz



Version for 1-phase mains type HCW
Type HCW 1., HCW 2., HCW 3.



HCW 4.



The terminals U1, U2, Z1(Z2), and PE are accessible as described under ① ... ③ above for the 3-phase mains version. The motor is internally connected ex-works, like described in sect 3.3. An alternation is neither required nor possible.

Only with type HCW 4: Terminals T1 and T2 are for the winding protection switch (temperature switch). For data, see page 16

5.2 Run-down

A certain pressure rise will occur due to pump motor run-down, if the pump is directly connected to a hydraulic cylinder via a pipe, such as e.g. in the typical connection pattern for clamping equipment (connection block B...) and if the power unit is switched off by a pressure switch as soon as a pre-selected pressure is achieved. The extent of this additional pressure rise depends on the pre-selected pressure, the volume of the connected consumers and the pump delivery rate. If such pressure rises are undesired, it will be necessary to reset the pressure limiting valve to match the shut-off point of the pressure switch. The result will be that all excess delivery of the pump during run-down will be conducted to the tank via the pressure limiting valve.

Procedure for matching is as follows:

1. Fully open the pressure limiting valve.
2. Adjusting the pressure switch on highest value (turning the adjustment screw clockwise up to the stop).
3. Start the pump (pressure gauge and all consumers connected) and turn up the pressure limiting valve until the pressure gauge shows the desired final operation pressure.
4. Turn back the pressure switch until the pump is switched off at the preset pressure (see 3.)
5. Lock pressure switch and pressure limiting valve in position.

The effect of excessive run-down pressure may also be minimized by utilizing an accumulator or providing additional volume in the consumer line. If the compact hydraulic power pack is running under full load, i.e. the preset pressure is close to the maximum permissible pressure as listed in sect. 2.1 and 2.2, then effectively no run-down will occur, as the pump will stop almost immediately after shut-off.

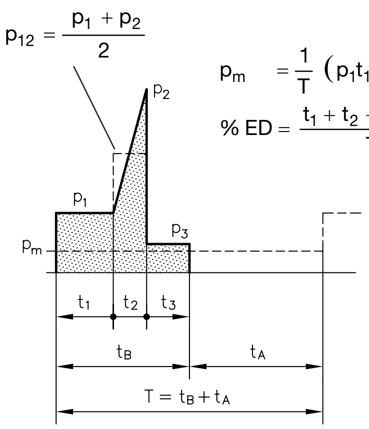
5.3 Built-up of heat

The persistent service temperature to expect for the HC compact hydraulic power pack depends largely on the local operating conditions. A simple coherence valid for all operating conditions does not exist. The following determination of the most likely expected inertia excess temperature or the permissible relative duty cycle is only a rough guide line and does only apply to circuits without any further throttling devices (cycle steps including starting against pressure limiting valves, pressure control valves or throttling valves). A test for evaluating the persistent service temperature should be undertaken under the in-tended load conditions and duty cycles (monitoring the oil temperature), if such throttle devices are utilized and / or the load period is above 30 % per cycle. The persistent service temperature to be expected can be determined by multiplying the excess temperature $\Delta\vartheta_B$ with a factor representing the throttling losses when these can be roughly evaluated in percent (see curve at the bottom of this page).
A recalculation of the expected persistent service temperature is often super-fluous as the relative duty cycles are below 10...15% ED in most applications. This also applies if the averaged pressure figure p_{aver} is extremely low due to prolonged periods of stand-still.

$$\vartheta_{fluidB} \approx \Delta\vartheta_B + \vartheta_U$$

$$\%ED = \frac{t_B}{t_B + t_A} \cdot 100$$

$\vartheta_{fluid\ B}$ (°C)	=	Persistent service temperature of the oil filling (max. approx. 80°C)
$\Delta\vartheta_B$ (K)	=	Inertia excess temperature depending on load, see rough calculation
ϑ_U (°C)	=	Ambient temperature in the surrounding area of the compact hydraulic power pack
p_{aver} (bar)	=	Calculated average pressure per duty cycle $T = t_B + t_A$ tA (representing the load conditions only)
t_B (s)	=	Load period per cycle
t_A (s)	=	Period of standstill per cycle
$t_{1,2,3..}$ (s)	=	Periods for pressure $p_{1,2,3...}$ within the load period t_B
$p_{1,2,3..}$(bar)	=	Pressure during periods $t_{1,2,3...}$ within the load period t_B
% ED (-)	=	Relative load period per cycle



$$p_m = \frac{1}{T}\left(p_1t_1 + p_2t_2 + p_3t_3 + ...\right)$$

$$\%\ ED = \frac{t_1 + t_2 + t_3 + ...}{T} \cdot 100$$

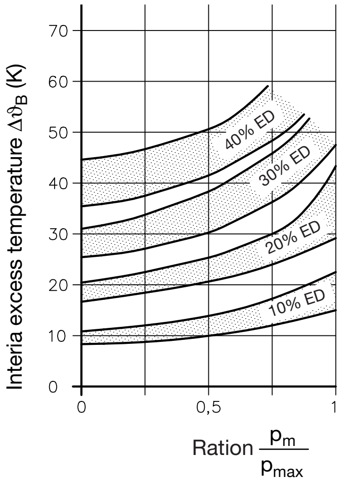
Example:	HC 24/1,1 (p_{max} = 400 bar)		
Given	p_1 = 80 bar	t_1 = 5s
	p_{12} = 80→350 bar	t_2 = 2s
	p_3 = 40 bar	t_3 = 3s
	Cycle period T = 30s	

Calculation $p_m = \frac{1}{30}\left(80 \cdot 5 + \frac{80+350}{2} \cdot 2 + 40 \cdot 3\right) \approx 31\,\text{bar}$ (only averaged figure)

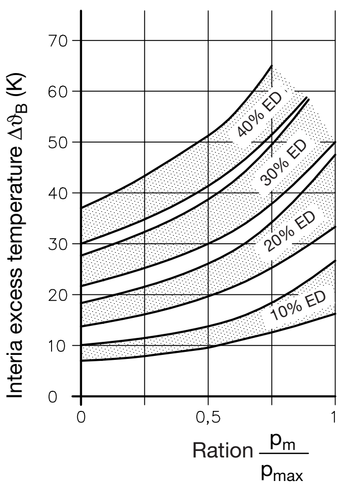
$$\frac{p_m}{p_{max}} \approx 0{,}1$$

$$\%\ ED = \frac{5+2+3}{30} \cdot 100 = 33\%$$

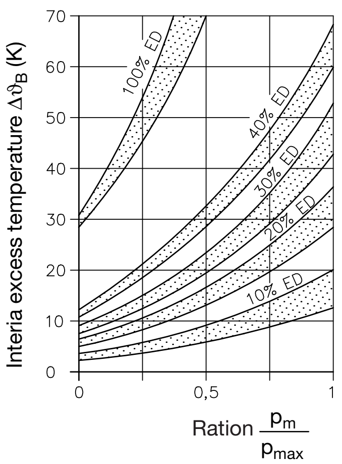
HC 14 to **HC 34**
HC(W) 2../Z.. and **HC(W) 34/Z..**

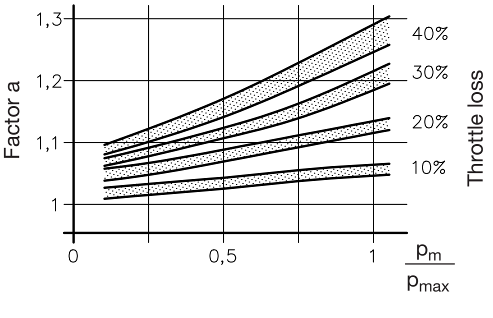


HC 12 to **HC 32**



HC 44 to **HC 46**





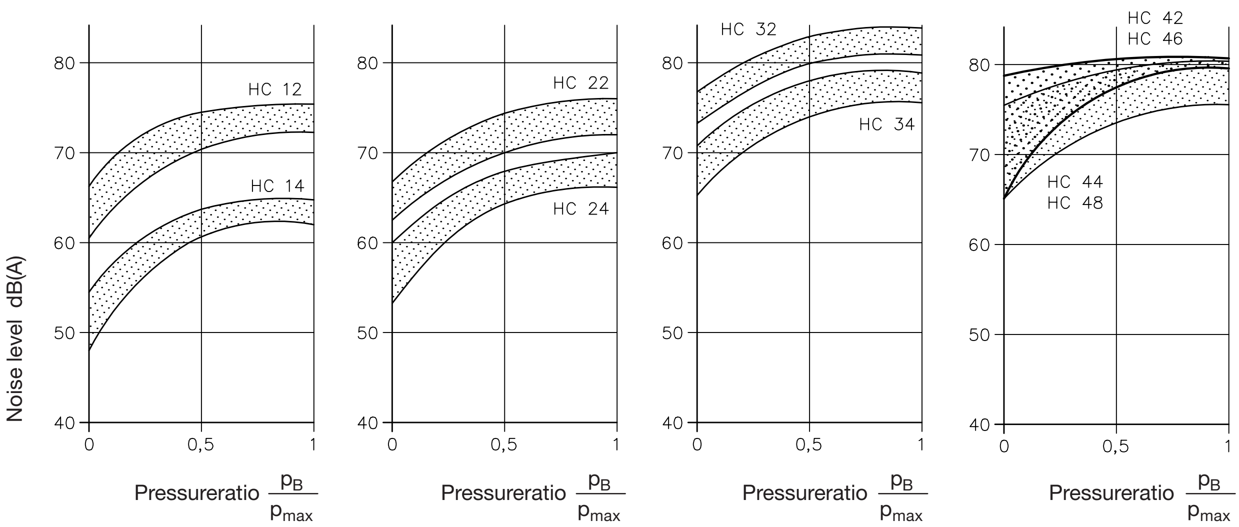
A persistent service temperature range $\Delta\vartheta_B \approx 30 ... 35$ K (Kelvin) results from the diagram above.
Additional throttle losses can appear by permanently or intermittently adding of throttles, sequence valves, pressure reducing valves or flow control valves. A additional built-up of heat with factor a ($\Delta\vartheta_B = a \cdot \Delta\vartheta_B$) will occur if x% throttling losses (estimated, guideline approx. 20% ... 30%) exist. An ambient temperature of 25°C and throttling losses of 30 % (a ≈ 1.05) will result in a persistent service temperature $\vartheta_{fluid\ B} \approx ((30...35) \cdot 1.05) + 25 \approx 56 ... 62°C$.

5.4 Running noise

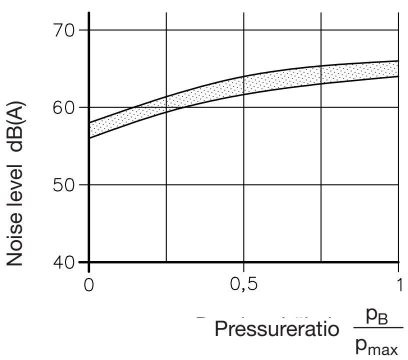
The indicated ranges of the noise level are determined under realistic conditions (with corresponding spreads). Compact hydraulic power pack with lower delivery flows tend as a rule to the lower, those with higher deliveries to the upper limit. The ranges change fluently into each other.
The running noise may be increased by local, unfavorable installation conditions. Mounting the hydraulic power pack on resonance capable machinery covers or in the corners of rooms where noise is directed back should be avoided.
The compact hydraulic power pack should be mounted on "silent blocks" or other damping devices to prevent or minimize the conduction of body sound onto other sound radiating machinery parts. Pipes to the consumers should be connected via short hoses to the hydraulic power unit. The silent blocks should be only opposed to lateral loads, if possible. Further details may be found in the technical information of the manufacturer of these silent blocks.

Conditions during the tests:	Workshop, ambient sound level approx. 42 dB(A) Point of measurement 1m above the floor Distance to the unit 1m Pump standing on sound deadening material, thickness 50 mm
Measuring instrument:	Precision sound level meter, conforming DIN IEC 651 class 1

Radial piston pump type HC 12 ... HC 48



Gear pump Type HC 24../Z.. ... HC 48../Z..



5.5 Notes to ensure EMC (electromagnetic compatibility)

Non permissible spikes are emitted (EN 60034-1 Abs. 19) when hydraulic power packs (inductive motor acc. to EN 60034-1 sect. 12.1.2.1) are connected to a system (e.g. power supply acc. to EN 60034-1 sect. 6).
Tests regarding the conformity with EN 60034-1 sect. 12.1.2.1 and/or VDE 0530-1 are not required.
Electro-magnetic fields may be generated during switching the motor On/Off. This effect can be minimzed by means of a filter e.g. type 23140, 3 • 400V AC 4 kW 50-60 Hz (Co. Murr-Elekronik, D-71570 Oppenweiler).

5.6 Connection blocks (Overview)

The hydraulic power packs can be delivered together with connection blocks as well as with additional directional valves to form a hydraulic power pack unit which is completely assembled for immediate use (see example on page 1).
For technical data, dimensions and further examples refer to the specified pamphlets.

Pamphlet	Coding	Port threads DIN ISO 228/1 (BSPP)	Pressure range from...to (bar) 1)	Flow (lpm)	Integrated funct. elements 12)			Brief notes concerny the connection block	Suitable directional valve banks for direct mounting 1)
					Pressure limiting valve	Idle circulation valve	Return filter		
D 6905 C	**C5** **C6**	G 1/4 G 3/8	700 700	12 28	no no	no no	no no	Simple connection block	No possibility for mounting
D 6905 B	**B../...-...**	G 1/4 to G 1/2	450 (700)	8 ... 25	yes	no	no	For single acting lifting or clamping devices 1) 2)	
D 6905 A/1	**A1/..** to **A4/..**	G 1/4	(0) ... 700 in steps	12	yes	no	no	Most frequently used connection block with pressure limiting valve	(1a) (1b)
	A13/.. to **A43/..**	G 3/8		18	yes	no	no		(2)
	A51/.. and **A61/..**	G 3/8		18	yes	no	no	More seldomly used for HK 3)	(3)
	AS(V)1/.. to **AS(V)4/..**	G 1/4	(0) ... 450 in steps	18	yes	yes	no	With idle circulation valves acc. to D 7490/1	(1a) (1b)
	AL11(12)..	G 1/4	51 ... 350 in steps	12	yes 4)	yes 4)	no	Automatic idle circulation 4) (accumulator charging valve)	(1a) 8)
	A..F../.. **AS..F../..** **AM..F../..** **AK..F../..** **AL21F../..** **AL21D../..**	G 1/4 to G 1/2 depending on type and connection side	(0) ... 700 in steps depending on type	15 ... 33 depend. on filler size	yes 5)	yes 6)	yes 7)	With return filters 12 µm nom. 50%/30 µm abs. or pressure resistant 10 µm (β_{10} = 75) with AL21D.. and idle circulation valves, see 6)	(4) 8)
	AP1.. and **AP3..**	G 1/4	5 ... 700	20	yes	yes 9)	no	Proportional pressure limiting valve	(1a) (1b)
D 6905 TÜV	**AX, ASX, APX**	G 1/4	80 ... 450	6 ... 10	yes	no	no	Pressure limiting valve with unit approval	
D 7230	**SKC11..** to **SKC14..**	G 1/4 and G 3/8	200...400 10)	12 ... 20	yes	yes 11)	no	Integrated directional spool valve	
D 7450	**SWC1**	G 1/4	315	12	yes	yes 11)	no	Integrated directional spool valve	Add-on spool valves D 7450
D 6905 A/1	**NA**	G 1/4	700	12	yes 4)	yes 4)	no	Two stage valve	---
	AN	G 1/4	350	12	yes	yes	yes	Two stage valve	(1a) (1b)
	C30	G 1/4 and G 3/8	700	12	no	no	no	Intermediate block for dual circuit valve	Connection blocks A .. acc. to D 6905 A/1
	SS to **VV**	---	450	20	no	yes	no	Idle circulation for P1 and/or P3	
	V1/.. to **S4/..**	---	450	20	yes	no	no	The second pressure stage can be activated arbitrarily	(1a) (1b)

1) It should be kept in mind that the directional valve banks which can be directly mounted may have a max. permissible pressure below 700 bar.
2) Should be used for intermittent service only
3) The valves are directing radially to the outside
4) Hydraulic cut-off function acts as pressure limitation also
5) Depending on type also with additional proportional pressure limiting valve
6) Idle circulation valve acc. to D 7490/1 with AS..., acc. to D 7470A/1 with AK... and AM..., with automatic idle circulation (accumulator charging valve) with AL21...
7) With pressure resistant filter at AL21...D
8) Directional spool valve banks type SWR... are not ideally suited for mounting onto blocks type AL11(12) or AL21.., as the their always apparent leakage would provoke permanent activation. This effect could be minimized by using an accumulator.
9) May be used as idle circulation valve if the prop. solenoid is deenergized (approx. 5 bar)
10) Depending on actuation and flow pattern
11) For directional spool valves with internal connection P→R in idle position
12) Pressure limiting valves acc. to D 7000E/1, 2/2-way directional valves acc. to D 7490/1, optional with additional check valve acc. to D 7445

(1a)	BWN(H)1F...	acc. to	D 7470 B/1
	BWH2F...	acc. to	D 7470 B/1
	BVZP1F...	acc. to	D 7785 B
(1b)	VB01(11)F...	acc. to	D 7302
	SWR(P)1F...	acc. to	D 7450
	SWR2F...	acc. to	D 7451
	SWS2F...	acc. to	D 7951
(2)	BWH3F...	acc. to	D 7470 B/1
(3)	VB11G... and VB21G...	acc. to	D 7302
(4)	BWN(H)1F...	acc. to	D 7470 B/1
	BWH2F...	acc. to	D 7470 B/1
	BVZP1F...	acc. to	D 7785 B
	VB01(11)F...	acc. to	D 7302
	SWR(P)1F...	acc. to	D 7450 8)
	SWR2F...	acc. to	D 7451 8)
	SWS2F...	acc. to	D 7951 8)