Compact hydraulic power pack type HK 4 and HKF 4

Fan cooled, for continuous and intermittent service; single, double or triple circuit pump

Flow Q_{max} = 17.0 cm³/rev
Operating pressure p_{max} = 700 bar

Additional compact hydraulic power packs	
type HK 2	D 7600-2
type HK 3	D 7600-3
type HKL 3, HKLW 3	D 7600-3L
type KA 2	D 8010
type KA 4	D 8010-4
type HC	D 7900
type MPN	D 7207
type NPC	D 7940

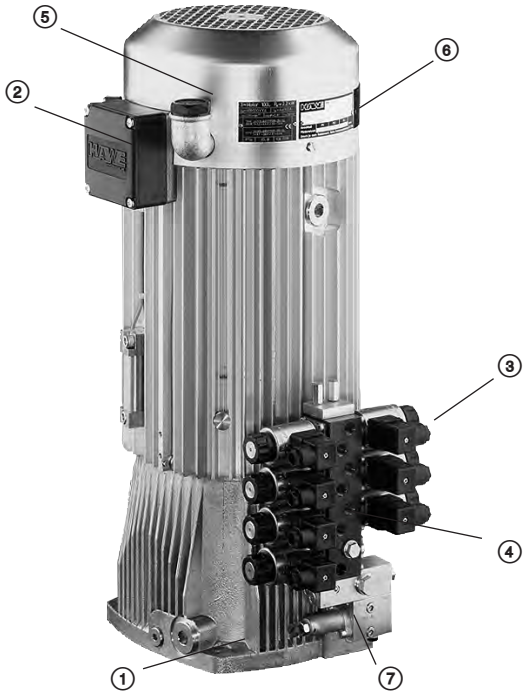
1. Design and general information

1.1 Basic design

The compact hydraulic power pack type KA serves to supply pressurized fluid for intermittently or short-term operated hydraulic circuits.
The basic hydraulic power pack consists:

- the tank (available in different sizes)
- the drive motor (available for different voltages and power requirements)
- the radial piston or gear pump directly driven by the motor shaft

The compact style obtained with this design represents an essential advantage opposite conventional units.
Complete turn-key solutions can be easily arranged via a wide range of connection blocks (see D 6905 ++) and directly mountable valve banks (see photo).
There is a wide field of applications for theses compact power packs within tool machines, jig assemblies and general mechanical engineering.
The power pack is suited for operation modes S2 (short time service) and S3 (intermittent service). The load can be up to 1.8 of the nom. power rating during these operation modes.



① Tank with pressed in stator
② Electrical connection of motor and monitoring devices (temperature / fluid level)
③ Electrical connection of valves and monitoring devices (e.g. pressure switch)
④ Ports, hydraulic connection to the consumers
⑤ Oil filler neck and breather filter
⑥ Type plate for hydraulic power pack and electric motor
⑦ Main connection pedestal for the connection of a valve bank

Table of contents

2. Available versions

2.1 Motor and tank section

Type coding key of the basic power pack (see also sect. 2.2 pump section)

Order examples:

HK 43 T /1 - H 0,7 - A 1/380 - 3x400/230V 50Hz
HKF 44 9 DT /1 P1 M - Z 11,3 - C 6 - 3x400/230V 50Hz - G 1/4 x 300

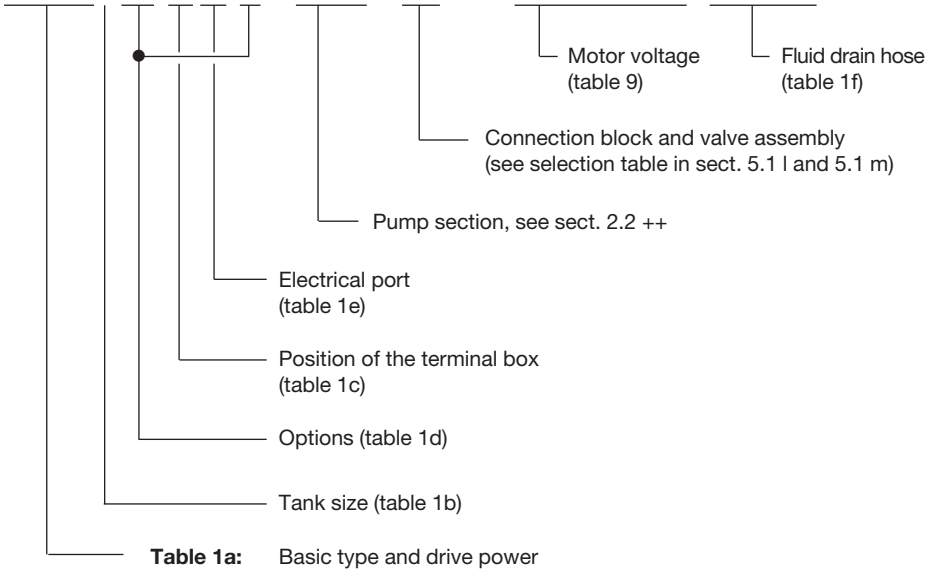


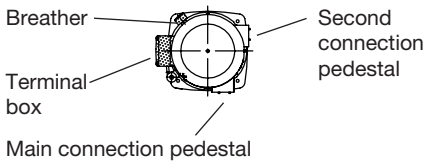
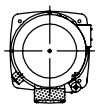
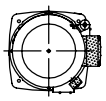
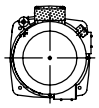
Table 1a: Basic type and drive power
Note: A actual power consumption is load dependent and can be up to 1.8 x nominal power.

	Coding	Power (kW) (50/60 Hz)	Speed (min^{-1}) (50/60 Hz)	Note
Basic type	**HK 43** **HK 43 V**	1.5 / 1.8	1395 / 1675	With integrated fan Basic types HK 4.V and HKF 4.V feature a moulded stator, see notes in sect. 5.1 e
	HK 44 **HK 44 V**	2.2 / 2.6	1405 / 1700	
	HK 48 **HK 48 V**	3.0 / 3.6	1410 / 1730	
	HKF 43 **HKF 43 V**	1.5 / 1.8	1395 / 1675	With additional blower (motor speed independent) – approx. 25% increased cooling for temperature critical applications, see sect. 5.1 g Basic types HK 4.V and HKF 4.V feature a moulded stator, see notes in sect. 5.1 e
	HKF 44 **HKF 44 V**	2.2 / 2.6	1405 / 1700	
	HKF 48 **HKF 48 V**	3.0 / 3.6	1410 / 1730	

Table 1b: Tank size

	Basic type HK	Basic type HKF	Coding	Filling volume V_{fill} (l)	Usable filling volume V_{usable} (l)	Note
Tank size	●	-	-	5.8	1.9	Do not select when generating a new system - discontinued!
	●	-	**8**	8.0	4.3	
	●	●	**5**	6.8/6.6	2.5/1.8	Second value for type HK 48 and HKF 48
	●	●	**9**	10.0/9.0	5.7/5.5	
	-	●	**2**	15.4	11.1	Only available in combination with type HKF 48

Table 1c: Installation position
Orientation of pump upper housing section incl. terminal box

Standard	/1	/2	/3	/4
Alternative orientation/connection with type HKF (pump motor and independent blower motor connected separately, see sect. 4.3)	/5	/6	/7	/8
				

Attention:
- The 4 codings for position of the terminal box influence also the orientation of the upper housing (finned) incl. fluid level gauge, breather etc. (see also dimensional drawings in sect. 4.2)
- The alternative orientation/connection (coding /5 to /8) means, that pump motor and blower motor are individually connected (see sect. 4.3). This is intended for applications where the pump is operated in on/off-mode where the blower is running even while the pump motor is not energized.

Table 1d: Options

	Coding	Note
Options	no codling	without optional equipments
	S	Fluid level gauge with float switch (NO-contact)
	D	Fluid level gauge with float switch (NC-contact)
	D-D	Fluid level gauge with float switch (NC-contact) **Note:** 1. Switch point = Usable filling volume (see table 1b) – 2 liters Only with type HK 4.9, HKF 4.9 and HKF 482
	A	Fluid level gauge with float switch (NC-contact) like D, indiv. electrical connection, see sect. 3.3 und 4.2; only in combination with alternative orientation/connection, acc. to table 1c coding /5 to /8
	T	Temperature switch (switch point 80°C)
	T60	Temperature switch (switch point 60°C)
	W, W60	Temperature switch, like T, T60, indiv. electrical connection (also available in combination with AW, AW 60, WW 60, AWW 60); only in combination with alternative orientation/connection, acc. to table 1c coding /5 to /8
	L	Additional leakage port G 3/4 (BSPP) at the secondary connection pedestal, see sect. 4.3. and 5.1 i **Note:** Only with single- and dual-circuit pumps, coding H, Z, HH, HZ, ZZ acc. to sect. 2.2 ++
	R	Fan shroud with additional protection against coarse debris
	M	with filler neck G 1 1/4 (BSPP)
	MA	like M, but with additional drain G 1/4 (BSPP) in the pump bottom cover, only available for pump combinations H, HH, HH-H, Z (size 1 to Z 11,3)

Note: When float and temperature switch are combined they can be connected either separately (e.g. coding D-T, S-T) or in series (e.g. coding DT) in the terminal box. For more information, see page 19.

Table 1e: Electrical connection

	Coding	Note
Means of electrical connection	no coding	Standard (Terminal box)
	P1, P2	Plug Co. HARTING, differing orientation see sect. 4.2
	E, P1E, P2E	Electrical connection with additional interference suppression in the terminal box or at the plug Co. HARTING

Table 1f: Fluid drain hose

Coding	Description
no coding	Tapped plug G 1/4, additional: drain G 3/4, see sect. 4.2
G 1/4 x 300	Fluid drain hose approx. 300 mm with ball cock
G 1/4 x 500	Fluid drain hose approx. 500 mm with ball cock
G 1/4 W x 300	Fluid drain hose approx. 300 mm with elbow and ball cock
G 1/4 W x 500	Fluid drain hose approx. 500 mm with elbow and ball cock

2.2 Pump section

2.2.1 Single circuit pump

Order example: HKF 482 DT/1 - **Z 24** - A 1/150 - 3x400/230 V 50 Hz
HK 44/1 - **H 7,2** - C 5 - 3x400/230 V 50 Hz

H - Radial piston pump
Z - Gear pump
IZ - Internal gear pump (only with type HKF)

Table 2: Single circuit pumps with 3~phase motor
Note: The delivery flow rating Q_{pu} is a guide line figure, based on nom. rev. rating that will be slightly reduced dep. on load (see curves in sect. 3.3). For notes regarding pressure p_{max} and p_1 (see sect. 3.3, table 10).
The max. perm. hydraulic work $(pV_g)_{max}$ for version **Z** and **IZ** with gear pump has to be reduced by 10%.
The perm. pressure p_{max} correspond to motors 3~400/230V 50 Hz.
For other voltage: $p_{max} = (pV_g)_{max}/V_g$. For $(pV_g)_{max}$ (see sect. 3.3, table 10)

Basic type	Delivery flow coding			H 0,9	H 1,25	H 1,4	H 1,5	H 1,8	H 2,08
	Geom. displace V_g (cm^3/rev)			0.64	0.88	1.07	1.15	1.29	1.46
	Piston diameter (mm)			6	7	6	8	6	7
	Number of pump elements			3	3	5	3	6	5
HK 43	Delivery Q_{pu}	(lpm)	50 Hz	0.90	1.22	1.50	1.60	1.80	2.04
HKF 43			60 Hz	1.08	1.47	1.79	1.91	2.15	2.44
	Perm. pressure p_{max}	(bar)		700	700	700	700	700	620
	Continuous operation S1 p1	(bar)		680	500	410	390	340	300
HK 44	Delivery Q_{pu}	(lpm)	50 Hz	0.89	1.21	1.48	1.58	1.77	2.01
HKF 44			60 Hz	1.06	1.45	1.77	1.89	2.13	2.41
	Perm. pressure p_{max}	(bar)		700	700	700	700	700	700
	Continuous operation S1 p1	(bar)		700	700	700	700	690	610
HK 48	Delivery Q_{pu}	(lpm)	50 Hz	0.92	1.25	1.53	1.63	1.83	2.08
HKF 48			60 Hz	1.10	1.50	1.83	1.95	2.20	2.49
	Perm. pressure p_{max}	(bar)		700	700	700	700	700	700
	Continuous operation S1 p1	(bar)		700	700	700	700	700	700

Basic type	Delivery flow coding			H 2,45	H 2,5	H 2,6	H 3,2	H 3,6	H 4,2
	Geom. displace V_g (cm^3/rev)			1.75	1.79	1.91	2.29	2.58	2.98
	Piston diameter (mm)			7	10	8	8	12	10
	Number of pump elements			6	3	5	6	3	5
HK 43	Delivery Q_{pu}	(lpm)	50 Hz	2.45	2.50	2.66	3.20	3.60	1.16
HKF 43			60 Hz	2.93	2.99	3.19	3.83	4.31	4.98
	Perm. pressure p_{max}	(bar)		510	500	470	390	350	300
	Continuous operation S1 p1	(bar)		250	250	230	190	170	150
HK 44	Delivery Q_{pu}	(lpm)	50 Hz	2.41	2.46	2.63	3.15	3.55	4.10
HKF 44			60 Hz	2.90	2.95	3.15	3.78	4.25	4.92
	Perm. pressure p_{max}	(bar)		700	560	650	550	390	420
	Continuous operation S1 p1	(bar)		510	500	470	390	350	300
HK 48	Delivery Q_{pu}	(lpm)	50 Hz	2.49	2.54	2.71	3.25	3.66	4.24
HKF 48			60 Hz	2.99	3.05	3.25	3.91	4.39	5.09
	Perm. pressure p_{max}	(bar)		700	560	700	700	390	560
	Continuous operation S1 p1	(bar)		670	560	620	520	390	400

Continuation: Single circuit pump table 2

Basic type	Delivery flow coding			H 4,3	H 5,0	H 5,1	H 5,6	H 6,5	H 6,0
	Geom. displace V_g (cm^3/rev)			3.03	3.58	3.51	4.03	4.58	4.30
	Piston diameter (mm)			13	10	14	15	16	12
	Number of pump elements			3	6	3	3	3	5
HK 43	Delivery Q_{pu}	(lpm)	50 Hz	4.22	5.00	4.90	5.62	6.39	6.00
HKF 43			60 Hz	5.05	5.98	5.86	6.73	7.66	7.18
	Perm. pressure p_{max}	(bar)		300	250	260	220	200	210
	Continuous operation S1 p1	(bar)		150	120	130	110	100	100
HK 44	Delivery Q_{pu}	(lpm)	50 Hz	4.16	4.92	4.83	5.54	6.30	5.91
HKF 44			60 Hz	4.99	5.91	5.79	6.65	7.56	7.09
	Perm. pressure p_{max}	(bar)		330	350	290	250	220	290
	Continuous operation S1 p1	(bar)		300	250	260	220	200	210
HK 48	Delivery Q_{pu}	(lpm)	50 Hz	4.30	5.09	4.98	5.27	6.51	6.10
HKF 48			60 Hz	5.16	6.10	5.98	6.87	7.81	7.32
	Perm. pressure p_{max}	(bar)		330	560	290	250	220	390
	Continuous operation S1 p1	(bar)		330	330	290	250	220	280

Basic type	Delivery flow coding			H 7,0	H 7,2	H 8,3	H 8,6	H 9,5	H 9,9
	Geom. displace V_g (cm^3/rev)			5.04	5.16	5.8	6.0	6.7	7.0
	Piston diameter (mm)			13	12	14	13	15	14
	Number of pump elements			5	6	5	6	5	6
HK 43	Delivery Q_{pu}	(lpm)	50 Hz	7.04	7.19	8.16	8.44	9.37	9.79
HKF 43			60 Hz	8.42	8.61	9.77	10.11	11.21	11.72
	Perm. pressure p_{max}	(bar)		180	170	150	150	130	130
	Continuous operation S1 p1	(bar)		90	90	80	70	70	60
HK 44	Delivery Q_{pu}	(lpm)	50 Hz	6.94	7.09	8.04	8.32	9.23	9.65
HKF 44			60 Hz	8.32	8.51	9.65	9.99	11.08	11.58
	Perm. pressure p_{max}	(bar)		250	240	210	210	190	180
	Continuous operation S1 p1	(bar)		180	170	150	150	130	130
HK 48	Delivery Q_{pu}	(lpm)	50 Hz	7.16	7.32	8.31	8.59	9.54	9.97
HKF 48			60 Hz	8.59	8.79	9.97	10.31	11.44	11.96
	Perm. pressure p_{max}	(bar)		330	390	290	330	250	290
	Continuous operation S1 p1	(bar)		230	230	200	200	180	170

Basic type	Delivery flow coding			H 10,9	H 11,5	H 13,1
	Geom. displace V_g (cm^3/rev)			7.64	8.06	9.17
	Piston diameter (mm)			16	15	16
	Number of pump elements			5	6	6
HK 43	Delivery Q_{pu}	(lpm)	50 Hz	10.66	11.24	12.79
HKF 43			60 Hz	12.76	13.46	15.31
	Perm. pressure p_{max}	(bar)		120	110	100
	Continuous operation S1 p1	(bar)		60	50	50
HK 44	Delivery Q_{pu}	(lpm)	50 Hz	10.51	11.08	12.61
HKF 44			60 Hz	12.61	13.30	15.13
	Perm. pressure p_{max}	(bar)		160	160	140
	Continuous operation S1 p1	(bar)		120	110	100
HK 48	Delivery Q_{pu}	(lpm)	50 Hz	10.85	11.44	13.02
HKF 48			60 Hz	13.02	13.73	15.62
	Perm. pressure p_{max}	(bar)		220	250	220
	Continuous operation S1 p1	(bar)		150	150	130

Continuation: Single circuit pump table 2

Basic type	Delivery flow coding			Z 2	Z 2,7	Z 3,5	Z 4,5	Z 5,2	Z 6,5
	Geom. displace V_g (cm³/rev)			1.5	2.0	2.5	3.1	4.0	4.5
	Size gear pump			1	1	1	1	1	2
HK 43	Delivery Q_{pu}	(lpm)	50 Hz	2.1	2.8	3.5	4.3	5.6	6.3
HKF 43			60 Hz	2.5	3.3	4.2	5.2	6.7	7.5
	Perm. pressure p_{max}	(bar)		170	170	170	170	170	170
	Continuous operation S1 p1	(bar)		170	170	170	140	110	100
HK 44	Delivery Q_{pu}	(lpm)	50 Hz	2.1	2.8	3.4	4.3	5.5	6.2
HKF 44			60 Hz	2.5	3.3	4.1	5.1	6.6	7.4
	Perm. pressure p_{max}	(bar)		170	170	170	170	170	170
	Continuous operation S1 p1	(bar)		170	170	170	170	170	170
HK 48	Delivery Q_{pu}	(lpm)	50 Hz	2.1	2.8	3.6	4.4	5.7	6.4
HKF 48			60 Hz	2.6	3.4	4.3	5.3	6.8	7.7
	Perm. pressure p_{max}	(bar)		170	170	170	170	170	170
	Continuous operation S1 p1	(bar)		170	170	170	170	170	170

Basic type	Delivery flow coding			Z 6,9	Z 8,8	Z 9	Z 9,8	Z 11,3	Z 12,3
	Geom. displace V_g (cm³/rev)			4.9	6.2	6.0	6.5	7.9	8.5
	Size gear pump			1	1	2	1	1	2
HK 43	Delivery Q_{pu}	(lpm)	50 Hz	6.8	8.6	8.4	9.1	11.0	11.9
HKF 43			60 Hz	8.2	10.4	10.0	10.9	13.2	14.2
	Perm. pressure p_{max}	(bar)		170	150	150	140	110	110
	Continuous operation S1 p1	(bar)		90	70	70	70	60	50
HK 44	Delivery Q_{pu}	(lpm)	50 Hz	6.7	8.5	8.3	8.9	10.9	11.7
HKF 44			60 Hz	8.1	10.2	9.9	10.7	13.0	14.0
	Perm. pressure p_{max}	(bar)		170	170	170	170	160	150
	Continuous operation S1 p1	(bar)		170	140	150	140	110	110
HK 48	Delivery Q_{pu}	(lpm)	50 Hz	7.0	8.8	8.5	9.2	11.2	12.1
HKF 48			60 Hz	8.3	10.6	10.2	11.1	13.5	14.5
	Perm. pressure p_{max}	(bar)		170	170	170	170	170	170
	Continuous operation S1 p1	(bar)		170	170	170	170	150	140

Basic type	Delivery flow coding			Z 14,4	Z 16	Z 21	Z 24
	Geom. displace V_g (cm³/rev)			9.9	11.0	14.5	17.0
	Size gear pump			1	2	2	2
HK 43	Delivery Q_{pu}	(lpm)	50 Hz	13.8	15.3	20.2	23.7
HKF 43			60 Hz	16.5	18.4	24.2	28.4
	Perm. pressure p_{max}	(bar)		90	80	60	50
	Continuous operation S1 p1	(bar)		40	40	30	30
HK 44	Delivery Q_{pu}	(lpm)	50 Hz	13.6	15.1	19.9	23.4
HKF 44			60 Hz	16.3	18.2	23.9	28.1
	Perm. pressure p_{max}	(bar)		130	110	90	70
	Continuous operation S1 p1	(bar)		90	80	60	50
HK 48	Delivery Q_{pu}	(lpm)	50 Hz	14.1	15.6	20.6	24.1
HKF 48			60 Hz	16.9	18.7	24.7	29.0
	Perm. pressure p_{max}	(bar)		170	170	170	150
	Continuous operation S1 p1	(bar)		120	110	80	70

Continuation: Single circuit pump table 2

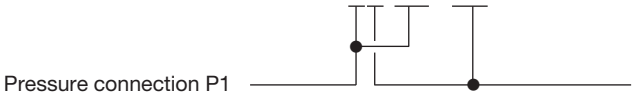
Basic type	Delivery flow coding			IZ 7,5	IZ 9,1	IZ 11,9	IZ 16,2	IZ 19,2	IZ 22,9
	Geom. displace V_g (cm³/rev)			5.4	6.4	7.9	10.9	13.3	15.8
	Size gear pump			2	2	2	2	2	2
HKF 44	Delivery Q_{pu}	(lpm)	50 Hz	7.4	8.8	10.9	15.0	18.3	21.7
			60 Hz	8.9	10.6	13.0	18.0	21.9	26.1
	Perm. pressure p_{max}	(bar)		230	200	160	110	90	80
	Continuous operation S1 p1	(bar)		170	140	110	80	70	60
HKF 48	Delivery Q_{pu}	(lpm)	50 Hz	7.7	9.1	11.2	15.5	18.9	22.4
			60 Hz	9.2	10.9	13.5	18.6	22.7	26.9
	Perm. pressure p_{max}	(bar)		250	250	250	240	200	160
	Continuous operation S1 p1	(bar)		220	180	150	110	90	70

2.2.2 Dual circuit pump with joint connection pedestal

a) Versions Radial piston pump - radial piston pump, coding **HH**
Radial piston pump – gear pump, coding **HZ**

Order examples 1: HK 44 ST/1 - **HH 3,6 / 6,5** - SS - A 1/250 - 3x400/230 V 50 Hz

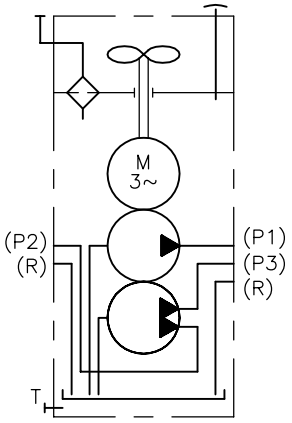
Order examples 2: HK 449 DT/1 P - **HZ 1,5 / 8,8** - AN 21 F 2 C 50 - C 315 - 3x400/230 V 50 Hz



Pressure connection P1
Radial piston pump **H** acc.
to table 3

Pressure connection P3:

Radial piston pump **H** or
gear pump **Z**
acc. to table 4



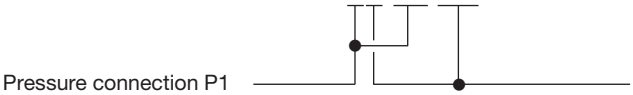
Available combinations

Coding	P1	P3	Examples
HH	3 pump elements	3 pump elements	HH 0,9 / 0,9
HZ	3 pump elements	gear pump size 1	HZ 1,25 / 11,3
	3 pump elements	gear pump size 2	HZ 0,9 / 16
	5 pump elements	gear pump size 1	HZ 2,08 / 9,8
	5 pump elements	gear pump size 2	HZ 1,4 / 8,8
	6 pump elements	gear pump size1	HZ 1,8 / 6,9
	6 pump elements	gear pump size 2	HZ 5,0 / 21

Table 3: Pressure connection P1
Note: The delivery flow rating Q_{pu} is a guide line figure, based on nom. rev. rating that will be slightly reduced dep. on load (see sect. 3.3). For notes regarding pressure p_{max} and p_1 (see sect. 3.3, table 10).
The max. perm. hydraulic work $(pV_g)_{max}$ for version **HH** and **HZ** with gear pump has to be reduced by 10%.

Basic type	Delivery flow coding	H 0,9	H 1,25	H 1,4	H 1,5	H 1,8	H 2,08
	Geom. displace V_g (cm³/rev)	0.64	0.88	1.07	1.15	1.29	1.46
	Piston diameter (mm)	6	7	6	8	6	7
	Number of pump elements	3	3	5	3	6	5
	Delivery flow coding	**H 2,45**	**H 2,5**	**H 2,6**	**H 3,2**	**H 3,6**	**H 4,2**
	Geom. displace V_g (cm³/rev)	1.75	1.79	1.91	2.29	2.58	2.98
	Piston diameter (mm)	7	10	8	8	12	10
	Number of pump elements	6	3	5	6	3	5
	Delivery flow coding	**H 4,3**	**H 5,0**	**H 5,1**	**H 5,6**	**H 6,5**	**H 6,0**
	Geom. displace V_g (cm³/rev)	3.03	3.58	3.51	4.03	4.58	4.30
	Piston diameter (mm)	13	10	14	15	16	12
	Number of pump elements	3	6	3	3	3	5
	Delivery flow coding	**H 7,0**	**H 7,2**	**H 8,3**	**H 8,6**	**H 9,5**	**H 9,9**
	Geom. displace V_g (cm³/rev)	5.04	5.16	5.85	6.05	6.72	7.02
	Piston diameter (mm)	13	12	14	13	15	14
	Number of pump elements	5	6	5	6	5	6
	Delivery flow coding	**H 10,9**	**H 11,5**	**H 13,1**			
	Geom. displace V_g (cm³/rev)	7.64	8.06	9.17			
	Piston diameter (mm)	16	15	16			
	Number of pump elements	5	6	6			

Order examples 1: HK 44 ST/1 - **HH 3,6/6,5** - SS - A 1/250 - 3x400/230 V 50 Hz
Order examples 2: HK 449 DT/1 P - **HZ 1,5/8,8** - AN 21 F 2 C 50 - C 315 - 3x400/230 V 50 Hz



Pressure connection P1
Radial piston pump **H** acc. to table 3

Pressure connection P3:
Radial piston pump **H** or gear pump **Z** acc. to table 4

Table 4: Pressure connection P3
Radial piston pump **H** or gear pump **Z,** for available combinations, see above.

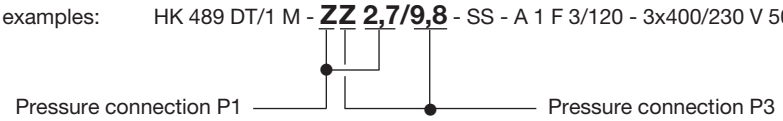
Note: The delivery flow rating Q_{pu} is a guide line figure, based on nom. rev. rating that will be slightly reduced dep. on load (see sect. 3.3). For notes regarding pressure p_{max} and p_1 (see sect. 3.3, table 10).

Basic type	Delivery flow coding	**H 0,9**	**H 1,25**	**H 1,5**	**H 2,5**	**H 3,6**	**H 4,3**
	Geom. displace V_g (cm^3/rev)	0.64	0.88	1.15	1.79	2.58	3.03
	Piston diameter (mm)	6	7	8	10	12	13
	Number of pump elements	3	3	3	3	3	3
	Delivery flow coding	**H 5,1**	**H 5,6**	**H 6.5**			
	Geom. displace V_g (cm^3/rev)	3.51	4.03	4.58			
	Piston diameter (mm)	14	15	16			
	Number of pump elements	3	3	3			

Basic type	Delivery flow coding	**Z 2**	**Z 2,7**	**Z 3,5**	**Z 4,5**	**Z 5,2**	**Z 6,5**
	Geom. displace V_g (cm^3/rev)	1.5	2.0	2.5	3.1	4.0	4.5
	Size gear pump	1	1	1	1	1	2
	Delivery flow coding	**Z 6,9**	**Z 8,8**	**Z 9**	**Z 11,3**	**Z 12,3**	**Z 9,8**
	Geom. displace V_g (cm^3/rev)	4.9	6.2	6.0	7.9	8.5	6.5
	Size gear pump	1	1	2	1	2	1
	Delivery flow coding	**Z 14,4**	**Z 16**	**Z 21**			
	Geom. displace V_g (cm^3/rev)	9.9	11.0	14.5			
	Size gear pump	1	2	2			

b) Version gear pump **-** gear pump **ZZ**

Order examples: HK 489 DT/1 M - **ZZ 2,7/9,8** - SS - A 1 F 3/120 - 3x400/230 V 50 Hz



Pressure connection P1 — Pressure connection P3

Table 5: Pressure connection P1 und P3:
Dual circuit pump with 3-phase motor, gear pump - gear pump **ZZ**

Note: The delivery flow rating Q_{pu} is a guide line figure, based on nom. rev. rating that will be slightly reduced dep. on load (see sect. 3.3). For notes regarding pressure p_{max} and p_1 (see sect. 3.3, table 10).
The perm. pressure p_{max} correspond to motors 3~400/230V 50 Hz.
For other voltage: $p_{max} = (pV_g)_{max}/V_g$. For $(pV_g)_{max}$ (see sect. 3.3, table 10).
The max. perm. hydraulic work $(pV_g)_{max}$ for version **Z** and **IZ** with gear pump has to be reduced by 10%.

Available combinations

ZZ 2,7 / 5,2	**ZZ 3,5 / 5,2**	**ZZ 5,2 / 11,3**
ZZ 2,7 / 8,8	**ZZ 4,5 / 4,5**	**ZZ 6,9 / 11,3**
ZZ 2,7 / 9,8	**ZZ 4,5 / 9,8**	**ZZ 8,8 / 8,8**
ZZ 2,7 / 11,3	**ZZ 4,5 / 11,3**	**ZZ 11,3 / 11,3**

Basic type	Delivery flow coding	**ZZ 2,7**	**ZZ 3,5**	**ZZ 4,5**	**ZZ 5,2**	**ZZ 6,9**	**ZZ 8,8**
	Geom. displace V_g (cm^3/rev)	2.0	2.5	3.1	4.0	4.9	6.2
	Size gear pump	1	1	1	1	1	1
	Delivery flow coding	**ZZ 9,8**	**ZZ 11,3**				
	Geom. displace V_g (cm^3/rev)	6.5	7.9				
	Size gear pump	1	1				

2.2.3 Dual circuit pump with separate connection pedestal

Order examples 1: HKF 449 DT/1 **- Z 4,5 - Z 4,5** - AL 21 D 10 - E/70/90
Order examples 2: - AL 21 D 10 - E/90/100 - 3x400/230 V 50Hz
HK 43 DT/1M **- H 0,9 - H 1,5** - A 1/150
- AS 1 F1/260 - 3x400/230 V 50Hz
HKF 449 DT **- H 0,9 - Z 16** - AA 1/160
- AL 21 F 3 VM - E/85/100 -7/70 - 3x400/230 V 50Hz

Pressure connection P1 — Pressure connection P2, see table 7

Table 6: Pressure connection P1
Dual circuit pump with 3-phase motor, radial piston pump **H**, gear pump **Z**

Note: The delivery flow rating Q_{pu} is a guide line figure, based on nom. rev. rating that will be slightly reduced dep. on load (see sect. 3.3). For notes regarding pressure p_{max} and p_1 (see sect. 3.3, table 10).
The perm. pressure p_{max} correspond to motors 3~400/230V 50 Hz.
For other voltage: $p_{max} = (pV_g)_{max}/V_g$. For $(pV_g)_{max}$ (see sect 3.3, table 10).
The max. perm. hydraulic work $(pV_g)_{max}$ for version **H-H**, **H-Z** or **Z-Z** with gear pump has to be reduced by 10%.

Available combinations

Coding	P1	P2	Example
H-H	3 pump elements	3 pump elements	H 0,9 - H 0,9
H-Z	3 pump elements	gear pump size 1	H 1,25 - Z 11,3
	3 pump elements	gear pump size 2	H 0,9 - Z 16
	5 pump elements	gear pump size 1	H 2,08 - Z 9,8
	5 pump elements	gear pump size 2	H 1,4 - Z 8,8
	6 pump elements	gear pump size 1	H 1,8 - Z 6,9
	6 pump elements	gear pump size 2	H 3,2 - Z 21
Z-Z	gear pump size 1	gear pump size 1	Z 4,5 - Z 4,5

Basic type	Delivery flow coding	**H 0,9**	**H 1,25**	**H 1,4**	**H 1,5**	**H 1,8**	**H 2,08**
	Geom. displace V_g (cm³/rev)	0.64	0.88	1.07	1.15	1.29	1.46
	Piston diameter (mm)	6	7	6	8	6	7
	Number of pump elements	3	3	5	3	6	5
	Delivery flow coding	**H 2,45**	**H 2,5**	**H 2,6**	**H 3,2**	**H 3,6**	**H 4,2**
	Geom. displace V_g (cm³/rev)	1.75	1.79	1.91	2.29	2.58	2.98
	Piston diameter (mm)	7	10	8	8	12	10
	Number of pump elements	6	3	5	6	3	5
	Delivery flow coding	**H 4,3**	**H 5,0**	**H 5,1**	**H 5,6**	**H 6,5**	**H 6,0**
	Geom. displace V_g (cm³/rev)	3.03	3.58	3.51	4.03	4.58	4.30
	Piston diameter (mm)	13	10	14	15	16	12
	Number of pump elements	3	6	3	3	3	5
	Delivery flow coding	**H 7,0**	**H 7,2**	**H 8,3**	**H 8,6**	**H 9,5**	**H 9,9**
	Geom. displace V_g (cm³/rev)	5.04	5.16	5.85	6.05	6.72	7.02
	Piston diameter (mm)	13	12	14	13	15	14
	Number of pump elements	5	6	5	6	5	6
	Delivery flow coding	**H 10,9**	**H 11,5**	**H 13,1**			
	Geom. displace V_g (cm³/rev)	7.64	8.06	9.17			
	Piston diameter (mm)	16	15	16			
	Number of pump elements	5	6	6			

Z	Coding for gear pump, see table 5

Available combinations
Z 2,7 - Z 5,2 | **Z 4,5 - Z 4,5** | **Z 8,8 - Z 8,8** | **Z 11,3 - Z 11,3**

Table 7: Pressure connection P2
Dual circuit pump with 3-phase motor, gear pump **Z**

Note: The delivery flow rating Q_{pu} is a guide line figure, based on nom. rev. rating that will be slightly reduced dep. on load (see sect. 3.3). For notes regarding pressure p_{max} and p_1 (see sect. 3.3, table 10).
The perm. pressure p_{max} correspond to motors 3~400/230V 50 Hz.
For other voltage: $p_{max} = (pV_g)_{max}/V_g$. For $(pV_g)_{max}$ (see sect. 3.3, table 10).
The max. perm. hydraulic work $(pV_g)_{max}$ for version **H-H**, **H-Z** or **Z-Z** with gear pump has to be reduced by 10%.

Basic type	Delivery flow coding	**H 0,9**	**H 1,25**	**H 1,5**	**H 2,5**	**H 3,6**	**H 4,3**
	Geom. displace V_g (cm³/rev)	0.64	0.88	1.15	1.79	2.58	3.03
	Piston diameter (mm)	6	7	8	10	12	13
	Number of pump elements	3	3	3	3	3	3
	Delivery flow coding	**H 5,1**	**H 6,5**				
	Geom. displace V_g (cm³/rev)	3.51	4.58				
	Piston diameter (mm)	14	16				
	Number of pump elements	3	3				

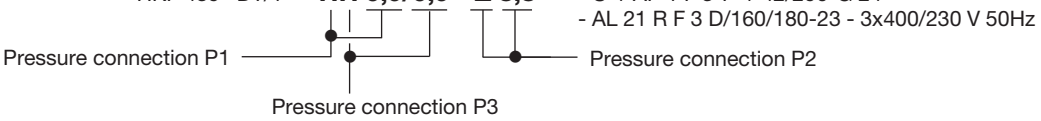
Basic type	Delivery flow coding	**Z 2**	**Z 2,7**	**Z 3,5**	**Z 4,5**	**Z 5,2**	**Z 6,5**
	Geom. displace V_g (cm^3/rev)	1.5	2.0	2.5	3.1	4.0	4.5
	Size gear pump	1	1	1	1	1	2
	Delivery flow coding	**Z 6,9**	**Z 8,8**	**Z 9**	**Z 9,8**	**Z 11,3**	**Z 12,3**
	Geom. displace V_g (cm^3/rev)	4.9	6.2	6.0	6.5	7.9	8.5
	Size gear pump	1	1	1	1	1	2
	Delivery flow coding	**Z 14,4**	**Z 16**	**Z 21**	**Z 24**		
	Geom. displace V_g (cm^3/rev)	9.9	11.0	14.5	17.0		
	Size gear pump	1	2	2	2		

2.2.4 Triple circuit pump

Order example 1: HK 43 ST/1 **- HH 1,6/1,6 - H 1,6** - C 30-A 1 F 1/450
Order example 2: - A 1 F 1/450 - 3x400/230 V 50Hz

HK 449 DT/1 **- HH 3,3/0,83 - Z 9,8** - SS A 1/250 - G 24
- A 1 F2/100 - 3x400/230 V 50Hz

HKF 489 DT/1 **- HH 0,9/0,9 - Z 8,8** - U 4-AP 1 F 3-P 4-42/290-G 24
- AL 21 R F 3 D/160/180-23 - 3x400/230 V 50Hz



Available combinations

Coding	P1	P3	P2	Order example
HH-H	2 pump elements	2 pump elements	2 pump elements	HH 1,6/1,6 - H 2,8
	2 pump elements	2 pump elements	gear pump size 1	HH 1,6/1,6 - Z 8,8
HH-Z	3 pump elements	3 pump elements	gear pump size 1	HH 4,3/4,3 - Z 11,3
	3 pump elements	3 pump elements	gear pump size 2	HH 6,5/3,6 - Z 16

Table 8: Pressure connection P1 and P3

Note: The delivery flow rating Q_{pu} is a guide line figure, based on nom. rev. rating that will be slightly reduced dep. on load (see sect. 3.3). For notes regarding pressure p_{max} and p_1 (see sect. 3.3, table 10).
The perm. pressure p_{max} correspond to motors 3~400/230V 50 Hz.
For other voltage: $p_{max} = (pV_g)_{max}/V_g$. For $(pV_g)_{max}$ (see sect. 3.3, table 10) .
The max. perm. hydraulic work $(pV_g)_{max}$ for version **HH-H** or **HH-Z** with gear pump has to be reduced by 10%.

Basic type	Delivery flow coding	**H 0,6**	**H 0,83**	**H 0,9**	**H 1,0**	**H 1,25**	**H 1,5**
	Geom. displace V_g (cm^3/rev)	0.43	0.58	0.64	0.76	0.88	1.15
	Piston diameter (mm)	6	7	6	8	7	8
	Number of pump elements	2	2	3	2	3	3
	Delivery flow coding	**H 1,6**	**H 2,4**	**H 2,5**	**H 2,8**	**H 3,3**	**H 3,6**
	Geom. displace V_g (cm^3/rev)	1.19	1.72	1.79	2.02	2.34	3.6
	Piston diameter (mm)	10	12	10	13	14	12
	Number of pump elements	2	2	3	2	2	3
	Delivery flow coding	**H 3,8**	**H 4,3**	**H 4,4**	**H 5,1**	**H 5,6**	**H 6,5**
	Geom. displace V_g (cm^3/rev)	2.69	3.03	3.06	3.51	4.03	4.58
	Piston diameter (mm)	15	13	16	14	15	16
	Number of pump elements	2	3	2	3	2	3

Table 9: Pressure connection P2

Note: The delivery flow rating Q_{pu} is a guide line figure, based on nom. rev. rating that will be slightly reduced dep. on load (see sect. 3.3). For notes regarding pressure p_{max} and p_1 (see sect. 3.3, table 10).
The perm. pressure p_{max} correspond to motors 3~400/230V 50 Hz.
For other voltage: $p_{max} = (pV_g)_{max}/V_g$. For $(pV_g)_{max}$ (see sect. 3.3, table 10).
The max. perm. hydraulic work $(pV_g)_{max}$ for version **HH-H** or **HH-Z** with gear pump has to be reduced by 10%.

Basic type	Delivery flow coding	**H 0,9**	**H 1,25**	**H 1,5**	**H 2,5**	**H 3,6**	**H 4,3**
	Geom. displace V_g (cm^3/rev)	0.64	0.88	1.15	1.79	2.5	3.03
	Piston diameter (mm)	6	7	8	10	12	13
	Number of pump elements	3	3	3	3	3	3
	Delivery flow coding	**H 5,1**	**H 5,6**	**H 6,5**			
	Geom. displace V_g (cm^3/rev)	3.51	4.03	4.58			
	Piston diameter (mm)	14	15	16			
	Number of pump elements	3	3	3			

Basic type	Delivery flow coding	**Z 2**	**Z 2,7**	**Z 3,5**	**Z 4,5**	**Z 5,2**	**Z 6,9**
	Geom. displace V_g (cm^3/rev)	1.5	2.0	2.5	3.1	4.0	4.9
	Size gear pump	1	1	1	1	1	1
	Delivery flow coding	**Z 8,8**	**Z 9,8**	**Z 11,3**	**Z 12,3**	**Z 16**	
	Geom. displace V_g (cm^3/rev)	6.2	6.5	7.9	8.5	11.0	
	Size gear pump	1	1	1	2	2	

3. Additional parameters

3.1 General

Nomenclature: Constant delivery pump

Design: Valve controlled radial piston pump or gear pump or internal gear pump

Direction of rotation:
- Radial piston pump - any
- Gear pump - counterclockwise
- Internal gear pump - counterclockwise
- Type HKF- counterclockwise
- (switch two of the three conductors (at 3-phase versions), when there is no flow)

Speed range:
Radial piston pump H: 200 ... 3500 min^{-1}
Gear pump Z 1,1 ... Z 6,9: 650 ... 3500 min^{-1}
Z 8,8, Z 9,8, Z 11,3; Z 14,4: 650 ... 3000 min^{-1}
Z 6,5, Z 9, Z 12,3 ... Z 24: 650 ... 3500 min^{-1}
Internal gear pump IZ 7,5 ... IZ 22,9: 200 ... 3600 min^{-1}

Installed position: Vertically

Mounting: see dimensional drawings, sect. 4.1

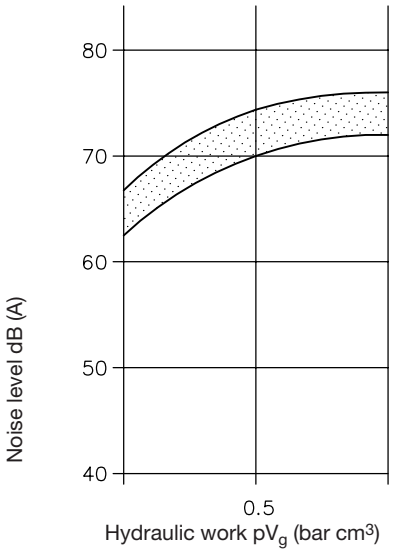
Mass (weight) (without fluid):

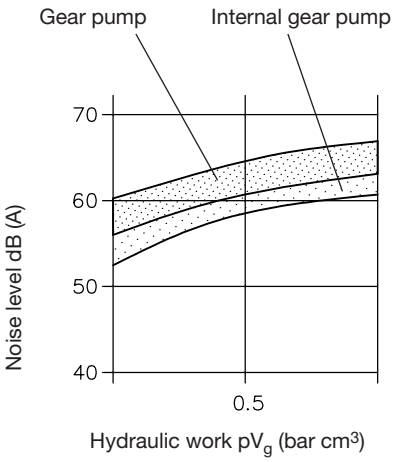
	H HH H-H HH-H	Z, IZ	H-Z HH-Z	ZZ Z-Z
HK 4.	29	25.5	28.5	26.5
HK 4.8	34	30.5	33.5	31.8
HK 4.5, HKF 4.5	29.8	26.3	27.6	29.3
HK 4.9, HKF 4.9	34.4	30.9	33.9	32.2
HKF 482	39.2	36.1	40.1	37.3
HKF 482	39.2	36.1	40.1	37.3

Mass (weight) of connection block and valve bank: see respective pamphlet

Hydraulic connection: via directly mounted connection blocks, see table in sect. 5.1 l
Basic pump: For connection hole pattern, see sect. 4.3

Running noise — Radial piston pump





3.2 Hydraulic

Pressure	Delivery side (outlet ports P) depending on pump design and delivery flow, see sect. 2.2 ++ Suction side (inside the tank): ambient pressure. Not suitable for charging.
Starting against pressure	Versions with 3~phase motor will start-up against pressure p_{max}!
Pressure fluid	Hydraulic oil conforming DIN 51 524 part 1 to 3; ISO VG 10 to 68 conforming DIN 51 519 Opt. operation range: Radial piston pump H: 10 ... 500 mm^2/s Gear pump Z: 20 ... 100 mm^2/s Viscosity range: min. approx. 4; max. approx. 800 mm^2/s Also suitable are biologically degradable pressure fluids 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).
Temperature	Ambient: approx. -40 ... +60°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 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	See tank size in sect. 2.1, table 1b

3.3 Electrical

The following data apply to radial piston and to gear pumps
The drive motor is part of the pump and can not be removed, see description in sect. 1.

Connection	Versions with plug Co. HARTING: cable 1.5 mm^2 The cable gland M 20x1.5 is customer furnished for versions with terminal box
Protection class	IP 65 acc. to IEC 60529 **Note:** The breather filter has to be protected from migrating moisture.
Safety class	DIN VDE 0100 safety class 1
Insulation	Lay-out conf. EN 60 664-1 ● up to 500 V AC nom. phase voltage (wire-wire) for 4-wire AC-mains L1-L2-L3-PE (3~phase mains) **with** earthed star connection point. ● up to 300 V AC nom. phase voltage (wire-wire) for 3-wire AC-mains L1-L2-L3 (3~phase mains) **without** earthed star connection point.
Suppressor	Type RC3R
Coding E, PE	Oper. voltage 3x 575 V AC Frequency 10 ... 400 Hz Max. power 4.0 kW

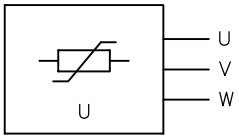


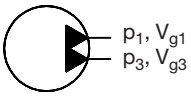
Table 10: Motor data

Type	Nom. voltage and mains frequency U_N (V), f (Hz)	Nominal power P_N (kW)	Nom. speed n_N (rpm)	Nom. current I_N (A)	Start current ratio I_A / I_N	Power factor cos φ	Max. hydraulic work $(pV_g)_{max}$ (bar cm³)
HK 43, HKF 43	3x400/230 V 50 Hz	1.5	1395	3.1/5.4	4.2	0.91	900
	3x460/265 V 60 Hz	1.8	1670	2.8/5.2	4	0.9	900
	3x400/230 V 50 Hz UL	1.5	1395	3.1/5.4	4.2	0.91	900
	3x460/265 V 60 Hz UL	1.8	1670	2.8/5.2	4	0.9	900
	3x500 V 50 Hz	1.5	1405	2.2	3.8	0.85	900
	3x600 V 60 Hz	1.8	1686	2.2	3.8	0.85	900
	3x200 V 50 Hz	1.1	1440	5.2	6.9	0.8	720
	3x220 V 60 Hz	1.3	1730	4.7	6.9	0.87	720
HK 44, HKF 44	3x400/230 V 50 Hz	2.2	1375	4.6/8.0	5.4	0.9	1250
	3x460/265 V 60 Hz	2.6	1650	4.6/8.0	5	0.9	1250
	3x400/230 V 50 Hz UL	2.2	1375	4.6/8.0	5.4	0.9	1250
	3x460/265 V 60 Hz UL	2.6	1650	4.6/8.0	5	0.9	1250
	3x500 V 50 Hz	2.2	1405	3.9	4.8	0.85	1250
	3x600 V 60 Hz	2.6	1686	3.9	4.8	0.85	1250
	3x200 V 50 Hz	2.2	1420	10.7	5.4	0.78	990
	3x220 V 60 Hz	2.6	1705	9.4	5.4	0.85	990
HK 48, HKF 48	3x400/230 V 50 Hz	3	1420	6.3/11.0	6.3	0.83	2600
	3x460/265 V 60 Hz	3.6	1704	6.3/11.0	6.3	0.83	2600
	3x500 V 50 Hz	3	1420	5	6	0.83	2600
	3x600 V 60 Hz	3.6	1704	5	6	0.83	2600
	3x200 V 50 Hz	3	1420	12	6.5	0.83	2000
	3x220 V 60 Hz	3.6	1700	12.5	6.5	0.89	2000

Note:

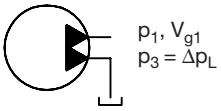
- The current consumption of the motor depends strongly on its load. The nominal figures apply strictly to one operating point only.
  Up to 1.8 of the nominal power of the motor can be exploited during load / no load operation (= operation mode S2 and S3). The increased heat built-up under these conditions gets intensively radiated during the idle or stand-still periods.
- The respective current consumption can be estimated via the middled and max. figures for the hydraulic work $(pV_g)_m$ and $(pV_g)_{max}$.
- The respective load is determining for the current consumption of dual circuit pumps. The hydraulic work of the individual circuits have to be determined and added up.

All pressure outlets pressurized:



Dual circuit pumps $(p \cdot V_g)_{calc.} = p_1 V_{g1} + p_3 V_{g3}$

One pressure outlet is pressurized, the other one in idle circulation mode:



Dual circuit pumps $(p \cdot V_g)_{calc.} = p_1 V_{g1} + \Delta p_L V_{g3}$

- Tension tolerances: ±10% (IEC 38), at 3 x 460/265V 60 Hz ±5%
  It is possible to use the power pack with reduced voltage, but this will cause a reduced performance, see sect. 5.1e !
- The max. perm. hydraulic work $(pV_g)_{max}$ for version **Z**, **HH**, **HZ**, **H-H**, **H-Z**, **HH-Z**, **ZZ** and **Z-Z** with gear pump has to be reduced by 10%.

Auxiliary blower
Coding **HKF**

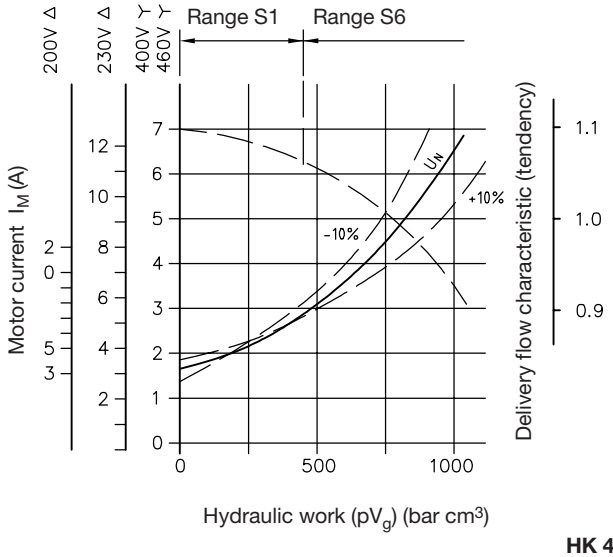
Motor data

U_N	P_N(W)	Revolutions (rpm)	Protection class
3x400/230V 50 Hz ⅄△	110	2680	IP 44
3x460/265V 60 Hz ⅄△	160	2950	IP 44

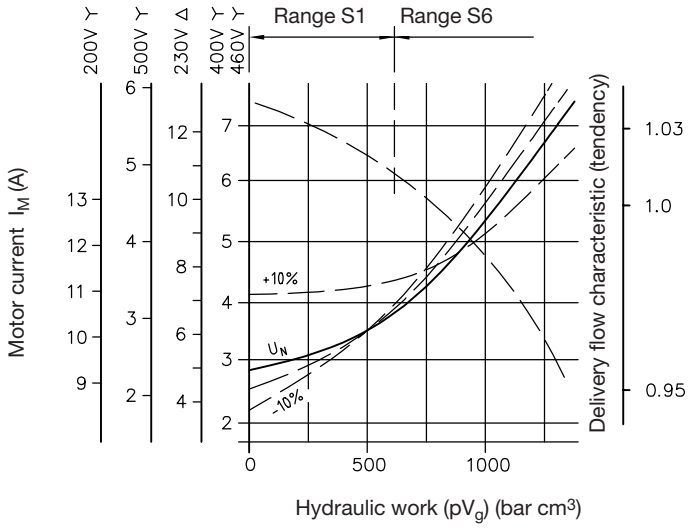
Temperature range -10°C ... +50°C
Electrical connection Inside the terminal box or via plug Co. HARTING (see sect. 4.3)

Current consumption

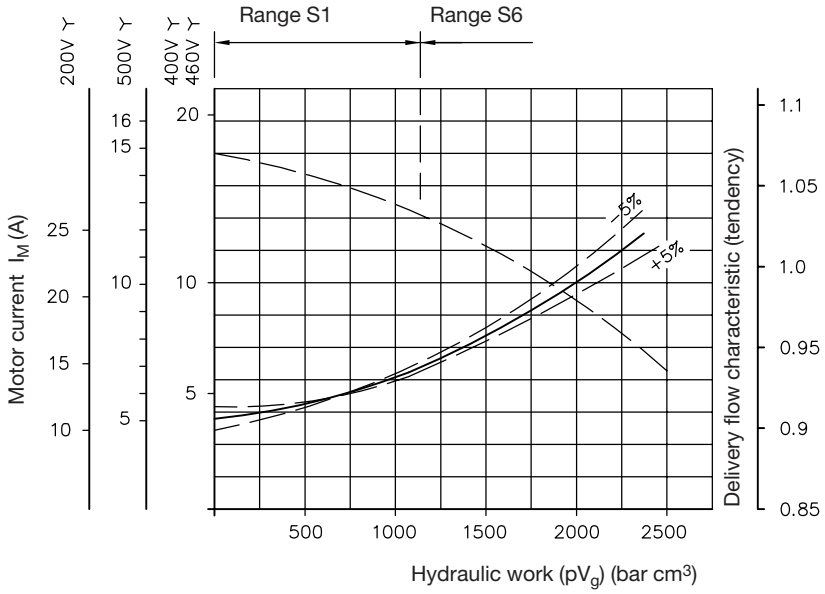
HK 43
HKF 43



HK 44
HKF 44



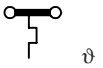
HK 48
HKF 48



Temperature switch
Coding **T, T60**
W, W60

Technical data:
Bimetallic switch

Trigger point	80°C ± 5K (coding T, W) 60°C ± 5K (coding T60, W60)
Max. voltage	AC: 250 V 50/60 Hz 2.5 A; DC: 42 V 1.2 A
Nom. current (cos φ ~ 0.6)	1.6 A
Max. current at 24 V DC (cos φ = 1)	1.5 A
Electrical connection	see sect. 4.3
Switching hysteresis	30 K ± 15K



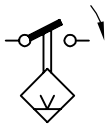
Float switch
Coding **D, S, A**

Technical data:

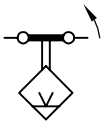
Max. switched power DC/AC	30 VA
Max. current DC/AC	0.5 A (cos φ = 0.95)
Max. voltage	230 V DC
Electrical connection	see sect. 4.3

Coding **D, S, A**
(Type HK4.5, HK4.9, HKF4.)

S
(NO-contact)



D, A
(NC-contact)



A protective circuitry has to be employed at inductive loads!

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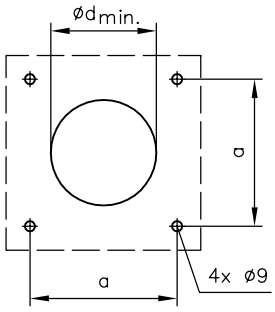
4. Dimensions

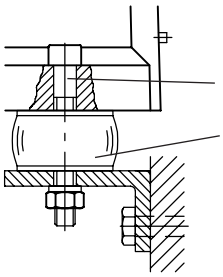
All dimensions in mm, subject to change without notice!

4.1 Mounting hole pattern



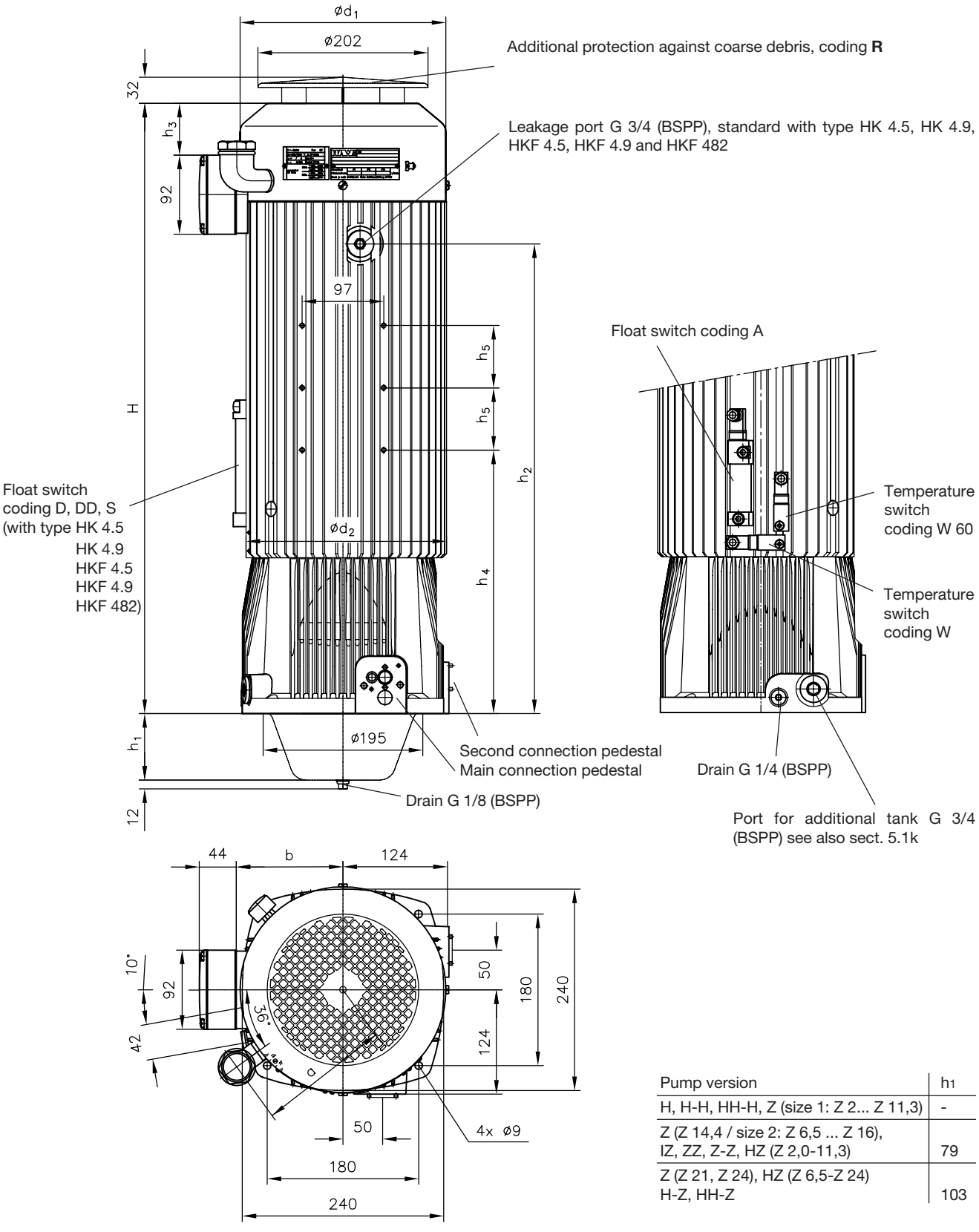
	a	d_{min}
HK 4 HKF 4	180	200 (h_1 > 0)

Recommended mounting



4.2 Basic pump

All dimensions in mm, subject to change without notice!

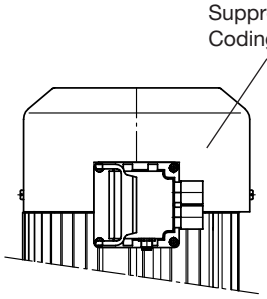


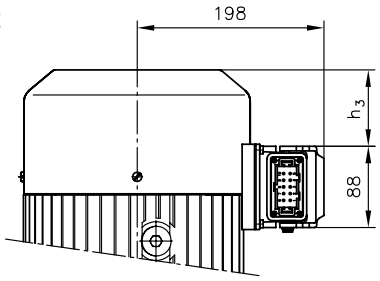
Pump version	h1
H, H-H, HH-H, Z (size 1: Z 2... Z 11,3)	-
Z (Z 14,4 / size 2: Z 6,5 ... Z 16), IZ, ZZ, Z-Z, HZ (Z 2,0-11,3)	79
Z (Z 21, Z 24), HZ (Z 6,5-Z 24) H-Z, HH-Z	103

Basic type	H	h_2	h_3	h_4	h_5	d_1	d_2	a	b
HK 4	460	-	30	-	-	219	174	135	158
HK 4.8	580	-	30	-	-	219	174	135	158
HK 4.5	483	345	30	-	-	246	198	148	167
HK 4.9	603	465	30	337	74	246	198	148	167
HKF 4.5	513	345	80	-	-	246	198	148	167
HKF 4.9	633	465	80	337	74	246	198	148	167
HKF 4.2	833	648	80	337	74	246	198	148	167

Options

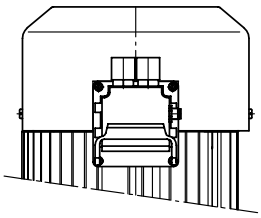
Plug Co. HARTING (for version with terminal box, see page 16)
Coding **P1**





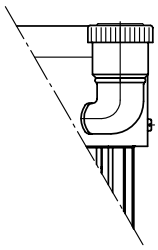
	h_3
HK 4	50
HKF 4	80

Coding **P2**



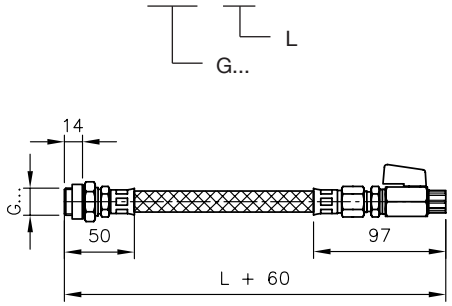
Filler neck **M**

G 1 1/4 -
Filler neck

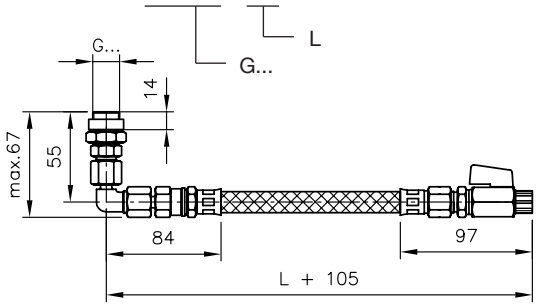


For fluid drain hose

Coding **G 1/4 x 300**
G 1/4 x 500



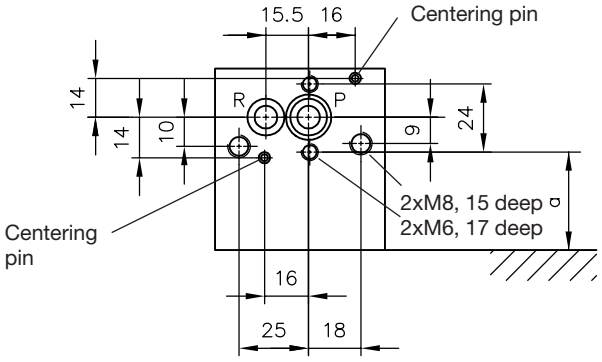
Coding **G 1/4 W x 300**
G 1/4 W x 500



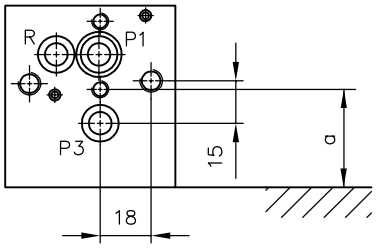
4.3 Electrical and hydraulic connections

Hydraulical

Single circuit pump (main connection pedestal.)
Dual circuit pump with additional connection pedestal (main and second connection pedestal)
Triple circuit pump (second connection pedestal)

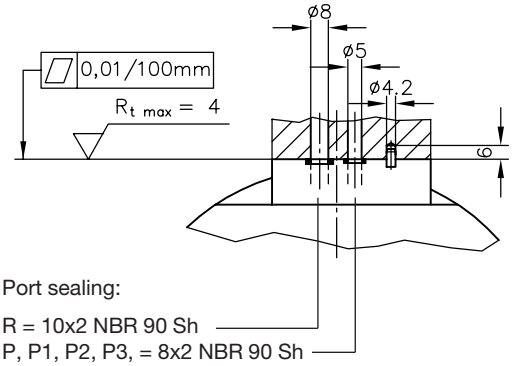


Dual circuit pump with joint connection pedestal (main connection pedestal)
Triple circuit pump (main connection pedestal)

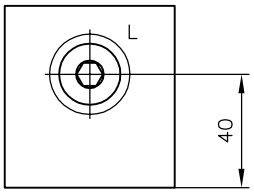


	a
HK 4, HKF 4 main connection pedestal	31
HK 4, HKF 4 second connection pedestal	25

Hole dimensions for customer furnished connection block

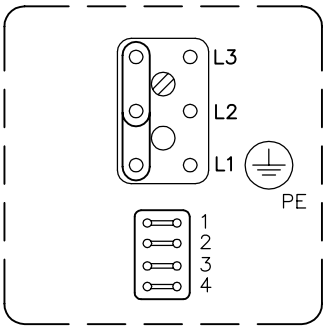


Leakage port (second connection pedestal), coding L

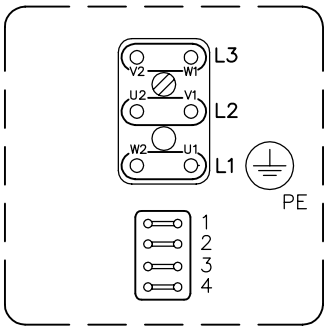


Electrical

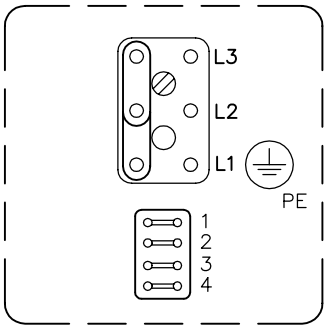
Circuitry for terminal box
Type HK
3-phase motor, ⅄-pattern



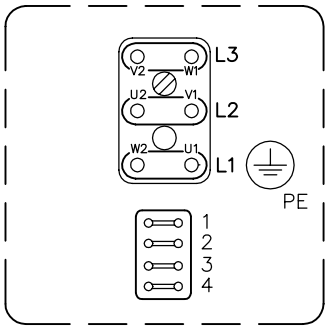
3-phase motor, △-pattern



Type HKF
3-phase motor, ⅄-pattern
Terminal box orientation
/1, /2, /3, /4 (see table 1c)

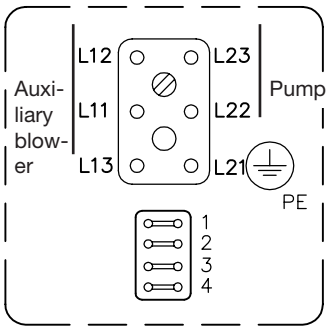


3-phase motor, △-pattern



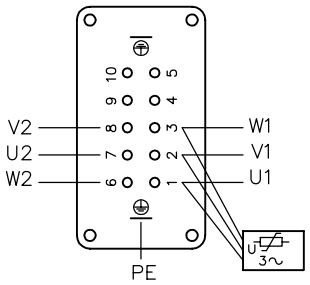
Type HKF
3-phase motor ⅄-or △-circuitry
ex-works

Terminal box orientation
/5, /6, /7, /8 (see table 1c)

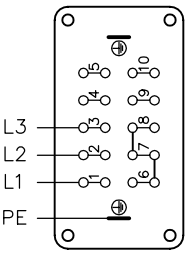


Plug Co. HARTING HAN 10 E
Coding **P1, P2**

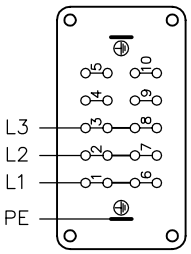
Type HK



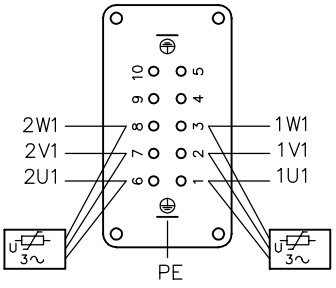
Plug (female) insert,
viewed from rear side ⅄-pattern !
Bridges are customer furnished



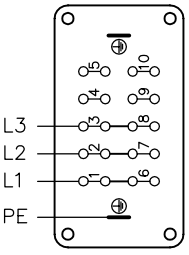
Plug (female) insert,
viewed from rear side △-pattern !
Bridges are customer furnished



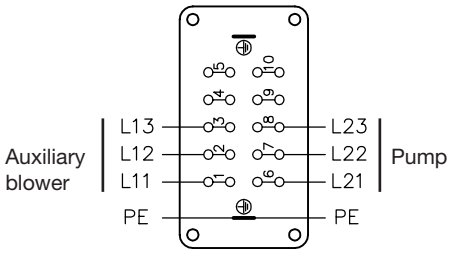
Type HKF



Plug (female) insert,
viewed from rear side
⅄-or △-circuitry ex-works
Terminal box orientation
/1, /2, /3, /4 (see table 1c)

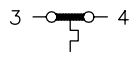


Plug (female) insert,
viewed from rear side
⅄-or △-circuitry ex-works
Terminal box orientation
/5, /6, /7, /8 (see table 1c)



Circuity for terminal box

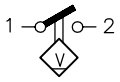
Temperature switch
Coding **T, T60**



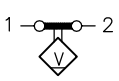
Float switch

Coding **S, D**

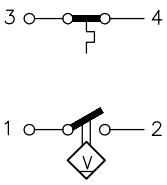
S (NO-contact)



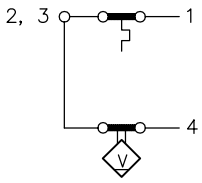
D (NC-contact)



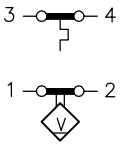
Coding **S-T**



Coding **DT**

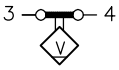


Coding **D-T**

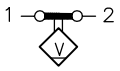


Coding **D-D**

1. Switch point

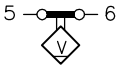


2. Switch point

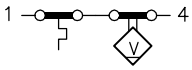


Coding **D-DT**

1. Switch point

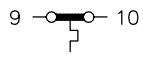


2. Switch point



Circuity for plug Co. HARTING

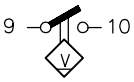
Temperature switch
Coding **T, T60**



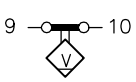
Float switch

Coding **S, D**

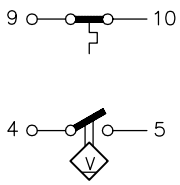
S (NO-contact)



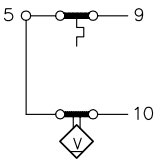
D (NC-contact)



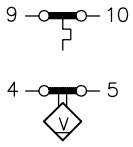
Coding **S-T**



Coding **DT**

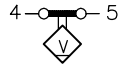


Coding **D-T**

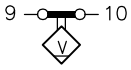


Coding **D-D**

1. Switch point

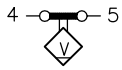


2. Switch point

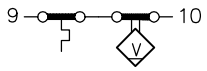


Coding **D-DT**

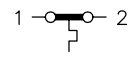
1. Switch point



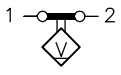
2. Switch point

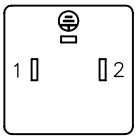


Temperature switch
(connected indiv.)
Coding **W, W60**



Float switch
(connected indiv.)
Coding **A**





Plug conf.
DIN EN 175 301-803 C
(8 mm)

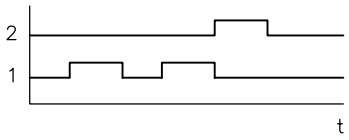
5. Appendix

5.1 Notes regarding selection

The following shows how to select a suitable hydraulic power pack with directly mounted valves. Usually an optimum solution is found when the following iteration steps have been passed.

a) Creation of a function diagram

The necessary or desired functions (hydraulically actuated) are the base for the function diagram.



b) Specification of pressure and flow

- Dimensioning and selection of the hydraulic consumers according to the required forces
- Calculation of the individual flows depending on the desired speed profiles

  Note:
  Take into account the necessary time for return for spring loaded clamping cylinders!

  The return time of spring loaded clamping cylinders at time sensitive clamping applications, can often be even more long, than the time for clamping. In these cases, the strengths of the return spring exclusively determines the return times here. They force the piston back to its idle position opposed by the back pressure caused by valves and pipes. This has to be taken into account when dimensioning hoses, tubes and valves.
- Calculation of the individual necessary operation pressures
- Calculation of the max. necessary (pump) delivery flow – Q (lpm)
- Calculation of the max. necessary operating (system) pressure – p_{max} (bar)

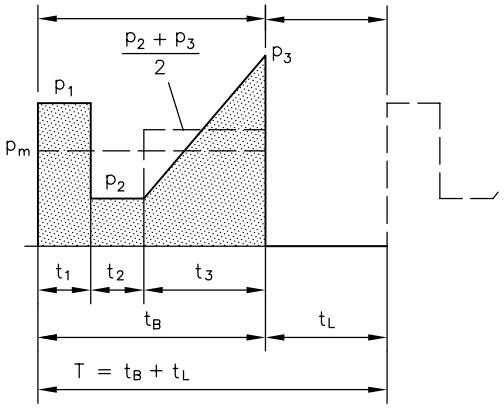
$$Q\ (lpm) = 0.06 \cdot A\ (mm^2) \cdot v\ \left(\frac{m}{s}\right)$$

$$p\ (bar) = \frac{10 \cdot F(N)}{A\ (mm^2)}$$

Q - flow
p - pressure
A - area
v - speed
F – force

c) Creation of the hydraulic circuit diagram

- Criteria:
  - Single circuit system
  - Accumulator charging operation
  - Dual circuit system with independently operated hydraulic circuits
  - Dual circuit system with one joint hydraulic circuit (e.g. press brakes or hydraulic tools with high-/low pressure or handling systems with rapid traverse and creeping)
  - Utilization of a hydraulic accumulator for brief support of the pump delivery



d) Creation of a time/load-diagram based on the function diagram

- The operation mode of the hydraulic power pack is selected according to this time/load-diagram
  - Calculation of the relative duty cycle %ED
  - S1 – permanent operation (detailed evaluation for compact power packs required)
  - S2 – Short time operation
  - S3 – ON/OFF service
  - S6 – Permanent operation with intermittent load

e) Selection of a hydraulic power pack

- Selection of the basic type based on the power supply
  - 3~phase mains type KA
- Motor selection
  - Voltage tolerances:
    ±10% (IEC 38), at 3 x 460/265 V 60 Hz ±5%
  - A 3~phase motor for 400 V 50 Hz can be used also at mains 460 V 60 Hz without any restrictions.
    1~phase motors can be used only at mains where the nom. voltage and frequency specifications are apparent.
  - Operation with reduced voltage is possible, but there will be performance restrictions
    $p_{max\ red} = p_{max} * k$
    p_{max} (bar) – max. operating pressure according to the selection tables
    $p_{max\ red}$ (bar) – reduced max. operating pressure
    k – correction factor (diagram)
- Version with a moulded stator
  Intended for use in hydraulic circuits, where the hydraulic oil is anticipated to content max. 0.3% water.
- electrical connection
  - Terminal box
  - Plug Co. HARTING

f) Calculation of the hydraulic work

- Calculation average pressure
- Calculation of average hydraulic work (average pressure x delivery flow)
- Calculation of max. hydraulic work (max. pressure x delivery flow)

g) Determining the heat built-up

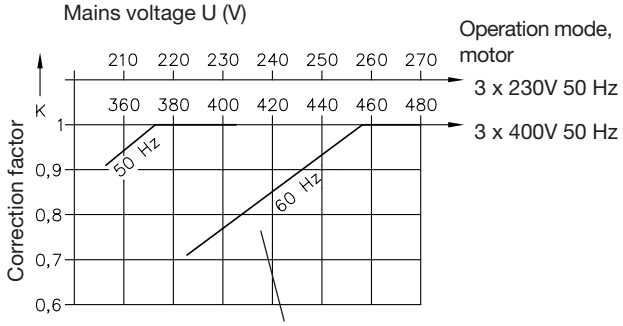
Attention: Observe the max. perm. fluid temperature of 80°C! The persistent service temperature is reached after approximately one hour of operating time.

Influence-factors:

- Pressure distribution during the load duration (middled pressure)
- share of the idle period
- additional throttle losses, when exceeding usual figures (approx. 30%) of back pressure for pipes and valves. These influences only have to be taken into account if they are effective for a longer period within the operating cycle (load duration). This may be when e.g. working against the pressure limiting valve (loss 100%).

- Selection of the pump layout (radial piston pump, gear pump, pump combination)
- Selection of the pump delivery coding taking into account the respective perm. operating pressure of the design and selection of basic type and motor size
- Assessing the noise level acc. to the diagrams in sect. 3.1

Relative duty cycle $\%ED = \frac{t_B}{t_B + t_L} \cdot 100$



Note:
Pump delivery flow 1.2 x higher than at 50 Hz operation!

The two most essential parameter, middled hydraulic work of the pump ($p_m V_g$) and load duration per operating cycle (%ED) are usually sufficient for a rough re-check of the expected persistent fluid service temperature.

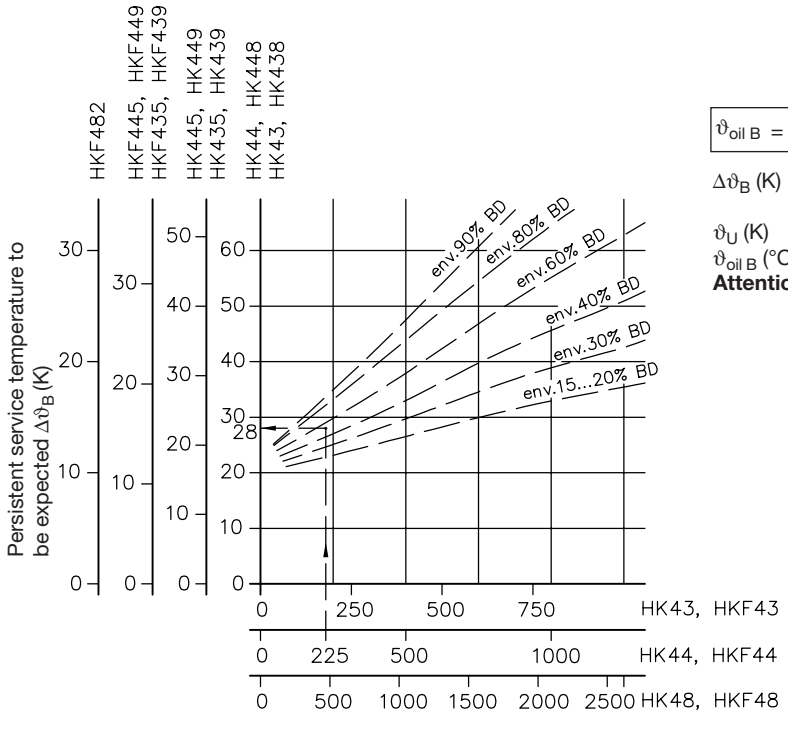
p_m (bar) = Calculated, middled pressure per cycle during the load duration $t_B = t_1 + t_2 + t_3 + ...$

$$p_m = \frac{1}{t_B}\left(p_1 \cdot t_1 + p_2 \cdot t_2 + \frac{p_2 + p_3}{2} \cdot t_3 + ...\right)$$

$p_m V_g$ = Middled performance

V_g = geom. displacement acc. to the tables in sect. 2.2 ++

$$pV_{g\ max}\ (\text{bar cm}^3) = p_{max} * V_g$$



$\vartheta_{oil\ B} = \Delta\vartheta_B + \vartheta_U$

$\Delta\vartheta_B$ (K) - Persistent over temperature, estimated via opposite curve

ϑ_U (K) - Ambient temperature in the installation area

$\vartheta_{oil\ B}$ (°C) - Persistent service temperature of the oil filling

Attention: Observe max. perm. Fluid temperature 80°C!

h) Determining the max. current consumption

see curves in sect. 3.3
For setting of the motor protective switch, see sect. 5.2 c

i) Additional leakage return port

For significant, leakage return flow at operation temperature, e.g. chucks of lathes. This leakage return flow is routed in such a way that the transported heat is dissipated via the fan.

This leakage return flow is integral part of the finned housing with type HK 4.5, HK 4.9, HKF 4.5, HKF 4.9 and HKF 482. An additional leakage return port at the second connection pedestal is available with all other versions, coding **L** acc. to table 1d.

j) 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:

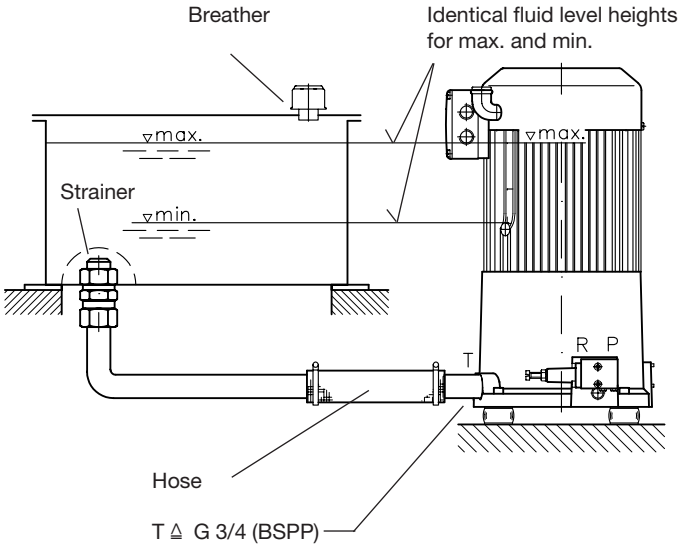
1. Fully open the pressure limiting valve.
2. Adjusting the pressure switch on highest value (turning the adjustment screw clockwise up to the stop).
3. Start the pump (pressure gauge and all consumers connected) and turn up the pressure limiting valve until the pressure gauge shows the desired final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

k) Auxiliary tanks

It is possible to increase the usable volume by connecting an auxiliary tank at port T. It should be used for volume compensation only. These tanks are to be customer furnished. The reflow pipe from the consumer circuit has to be connected at port R (connection pedestal)!
The connection pipe has to be dimensioned sufficiently. The connection should be either by means of a hose only or with fittings for pipe 22x1.5 and a piece of hose to decouple the noise.

Note: Do not use for pump delivery flows higher than 12 lpm !



l) Selection of a connection block

A connection block is mandatory for the hydraulic connection of the hydraulic power pack.

Type	Description	Pamphlet
A, AL, AM, AK, AS, AV, AP	For single circuit pumps with pressure limiting valve and the possibility for direct mounting of directional valve banks Optional: - pressure resistant filter or return filter - idle circulation valve - accumulator charging valve - prop. pressure limiting valve	D 6905 A/1
AN, AL, NA, C30, SS, VV	For dual circuit pumps with pressure limiting valve and where directional valve banks can be directly mounted in some cases Optional: - accumulator charging valve - two stage valve - idle circulation valve	D 6905 A/1
AX	For single circuit pumps with pressure limiting valve (type approved) and the possibility for direct mounting of directional valve banks for use at accumulator charged systems Optional: - pressure resistant filter or return filter - idle circulation valve	D 6905 TÜV
B	For single circuit pumps for actuating single acting cylinders with pressure limiting valve and drain valve Optional: - throttle valve	D 6905 B
C	For single circuit pumps with ports P and R for direct piping	D 6905 C

m) Selection of the directional valve banks

The direct mounting of directional valves to the connection blocks type A enables creation of compact hydraulic units without additional piping.

Type	Description	Pamphlet
VB	Directional seated valves up to 700 bar	D 7302
BWN, BWH	Directional seated valves up to 450 bar	D 7470 B/1
BVH	Directional seated valves up to 400 bar	D 7788 BV
BVZP	Directional seated valves up to 450 bar	D 7785 B
SWR, SWS	Directional spool valves up to 315 bar	D 7451, D 7951
BA	Valve bank for the combination of different directional valves with connection hole pattern NG 6 acc. to DIN 24 340-A6	D 7788
NBVP	Directional seated valves	D 7765 N
NSWP	Directional spool valves	D 7451 N
NSMD	Clamping modules (Directional spool valve with pressure reducing valve and feedback signal)	D 7787
NZP	Intermediate plate with connection hole pattern Ng 6 acc. to DIN 24 340-A6	D 7788 Z

5.2 Assembly and installation notes

Attention: The compact hydraulic power pack has to be installed and connected by a qualified technician, who is familiar with and works according to the generally accepted engineering standards and the latest legal regulations and standards.

The following guidelines and standards have to be taken into account:

- VDI 3027 "Initial operation and maintenance of hydraulic systems"
- DIN 24 346 "Hydraulic systems"
- ISO 4413 "Hydraulic fluid power -- General rules relating to systems"
- D 5488/1 Pressure fluids - notes for selection
- B 5488 General operating manual for the assembly

a) Identification

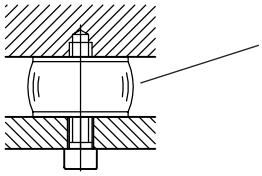
see type plate or selection table in section 2++

b) Installation and mounting

- Installation

  ⚠ The hydraulic power pack incl. the solenoids of the directional valves can become hot during operation → Risk of injury!

  Care has to be taken that fresh air can be drawn in and the warm air can escape.
  Modifications of any kind (mechanical, welding or soldering works) must not be performed.
- Installation position dep. on version
- For dimensions, see sect. 4.2
- For mounting hole pattern, see sect. 4.1
- Recomended mounting



Silent bloc ∅40x30 /M8 (65 Shore)

- Mass (weight) for the basic power pack without valve assembly and fluid
  For mass (weight) of connection block and valve bank, see respective pamphlets

	H HH H-H HH-H	**Z, IZ**	**H-Z**	**ZZ Z-Z**
HK 4.	29	25.5	28.5	26.5
HK 4.8	34	30.5	33.5	31.8
HK 4.5, HKF 4.5	29.8	26.3	27.6	29.3
HK 4.9, HKF 4.9	34.4	30.9	33.9	32.2
HKF 482	39.2	36.1	40.0	37.3

c) Electrical connection and setting of the protective motor switch

- For connection of the electric motor, see sect. 4.3
- For connection of the float and fluid level switch, see sect. 4.3

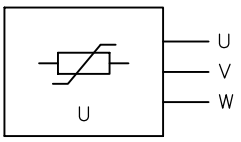
  Note: The temperature switch will trigger at a fluid temperature of approx. 95°C.

  Note: The signal has to be delayed sufficiently (time lag relay) if the lay-out of the system features an operation cycle where the pump is emptied below the min. level and replenished by the reflow from the consumer within one cycle.
- Adjustment of the protective motor switch
  - S1-operation mode (for pressure <= p_1)
    The protective motor switch should be set for the corresponding current, required to achieve the adjusted pressure of the pressure limiting valve (see I_M-(pV)calc.- curve sect. 3.3), however not higher than the nom. current I_N.
    This motor protection covers only a possible mechanical blockade of the motor.
  - S 6- operation mode (for pressure <= p_{max})
    In most cases it is sufficient, to set the response current to approx. (0.85...0.9) of I_N. This makes sure that on one hand the bimetallic switch does not trigger too early during normal operation but on the other hand the oil temperature doesn't rise too high due to a prolonged response time after the pressure limiting valve is in action.
  - Test the setting of the motor protective switch during a test run. Temperature switches, float switches and pressure switches are further safety measures against malfunctions.

d) Notes to ensure EMC (Electromagnetic compatibility)

No impermissible spikes are emitted (EN 60034-1 sect. 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 minimized by means of a filter e.g. type 23140, 3 · 400V AC 4kW 50-60 Hz (Co. MURR-ELEKRONIK, D-71570 Oppenweiler)

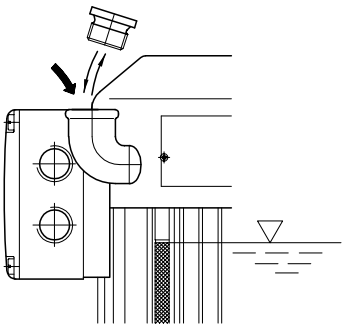
There is an optional suppressor (coding E, P1E or P2E, see sect. 2.1, table 1e), which can be directly mounted either at the terminal box or at the plug Co. HARTING (see table 1e)



e) Putting into operation

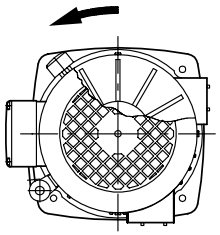
- Check, whether the compact hydraulic power pack is professionally connected.
  - Electrically: Power supply, controls
  - Hydraulically: Piping, hoses, cylinders, motors
  - Mechanically: Fastening at the machine, the frame, and the rack
- A protective motor switch should be employed to safeguard the electric motor. For current setting, see sect. 5.2 c
- The pressure fluid to top-up the power pack should have passed the system filter or be fed via a filter unit always.
  Only mineral oils conforming DIN 51524 part 1 to 3, type HL or HLP, with a viscosity of ISO VG 10 to 68 acc. to DIN 51519 are suited for use with this power pack.

  Note:
  The water content must not exceed 0.1% (Danger of short-cut!).
  Also suitable are biologically degradable pressure fluids 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) i.e. fluids type HEPG and HETG are not suitable! The compact hydraulic power pack has to be topped-up to the max. marking of the fluid level gauge/dip-stick.



- Filling and usable volume

	Basic type HK	HKF	Coding	Filling volume $V_{filling}$ (l)	Usable filling vol. V_{usable} (l)
Tank size	●	-	**-**	5.8	1.9
	●	-	**8**	8.0	4.3
	●	●	**5**	6.8/6.6	2.5/1.8
	●	●	**9**	10.0/9.0	5.7/5.5
	-	●	**2**	15.4	11.1



- Direction of rotation
  - Radial piston pump - any
  - Gear pump - counterclockwise
  - Internal gear pump- counterclockwise
  - Type HKF- counterclockwise
    (Direction of rotation can only be detected by checking the delivery flow - the connection of 2 of the 3 leads have to be changed at 3-phase versions, when there is no flow)
- Initial operation and bleeding
  The pump cylinders will be bled automatically if the pump is switched on and off several times while the connected directional valves are switched into a switching position where idle circulation is provided, if possible with your circuitry (see circuit diagram).
  Another way is to install a pipe fitting with a short piece of pipe and prolonged by a translucent tube. The other end of the tube should be put into the filler neck (breather removed), held firmly and sealed with a non-fluffing cloth. Now switch on the pump and let it run until no more bubbles are visible. Next after the pump cylinders are bled any air dragged into the system should be removed by opening the bleeder screws at the consumers (if provided) until no more bubble are detected or by operating all functions of the circuitry without load until all cylinders, motors, etc. move steadily and without any hesitation.
- Pressure limitation and pressure reducing valves
  Do not a make any changes of the pressure setting without simultaneously checking the pressure with a pressure gauge!
- Directional valves
  Solenoid valves apparent are to be connected to the controls according to the hydraulic wiring diagram and functional diagram.
- Accumulator charged systems
  Accumulators have to be filled with appropriate equipment according to the pressure specifications of the hydraulic wiring diagram. The respective operating manuals have to be taken into account.

5.3 Servicing

The hydraulic power packs type MP and the valves being directly mounted onto the hydraulic power pack are almost maintenance free. Only the fluid level should be checked regularly depending on operation conditions.
The fluid should be replaced every year as a general rule, but more frequently if tests show aging or contamination, filters (pressure or return) have to be replaced accordingly.

Attention: Prior to maintenance and repair works the system has to be:
- depressurized (hydraulic side). This applies especially to systems with hydraulic accumulators
- cut-off or deenergized

Repairs and spare parts
- Repairs (replacing service items) are possible by competent craftsmen. The motor can‘t be repaired or replaced by the customer. Therefore if the motor is defect, the complete pump should be returned to our facilities for an overhaul. There are spare parts lists available, pls. state your pump type acc. to the type plate either on the pump or on the cover plate.

5.4 Declaration of conformity

⚠ Letter of conformity acc. to EC directive 2006/95/EC

„Electrical equipment designed for use within certain voltage limits“
The compact power packs are manufactured in conformity with EN 60 034 (IEC 34 – VDE 0530) and VDE 0110.

Notes conforming EC directive machinery safety 2006/42/EC, appendix II, section 1 B:
The partly completed machinery are produced conforming the harmonized standards EN 982 and DIN 24 346. The setting in operation is forbidden until it is verified that the machine where the partly completed machinery is utilized fulfils the requirements in safety of Machinery Directive incl. appendix.