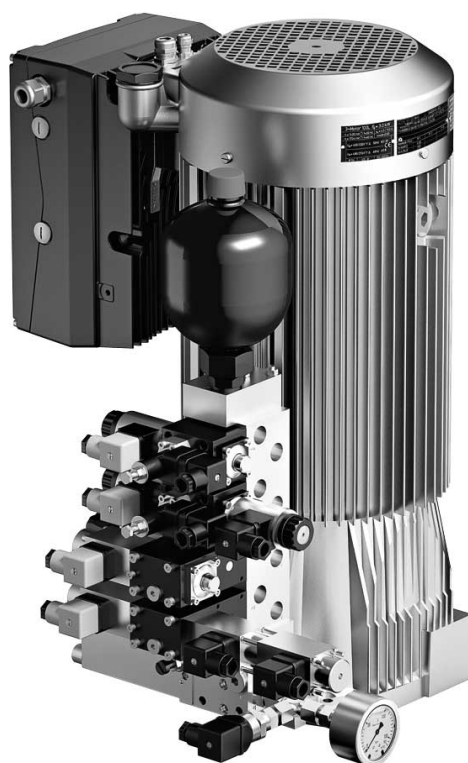


Compact hydraulic power pack type HKF 4 with frequency converter

Product documentation



Operating pressure p_{\max} :	700 bar
Geometric displacement V_{\max} :	8.5 cm ³ /rev
Usable volume V_{use} :	5.7 l



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Contents

1	Overview of compact hydraulic power pack type HKF 4 with frequency converter.....	4
2	Available versions, main data.....	5
2.1	Motor and container.....	5
2.2	Converter.....	8
2.3	Pumps, possible combinations of pump/motor/converter.....	9
2.4	Software options.....	11
2.4.1	Software option S00.....	11
2.4.2	Software option S01.....	11
3	Parameters.....	12
3.1	General.....	12
3.2	Hydraulic.....	12
3.3	Electrical.....	12
4	Dimensions.....	14
5	Installation, operation and maintenance information.....	15
5.1	Intended use.....	15
5.2	Assembly information.....	15
5.3	Operating instructions.....	16
5.4	Maintenance information.....	16
6	Layout instructions.....	17
6.1	Selection of pump, motor and frequency converter.....	17
6.2	Selection of the tank size.....	21
6.3	Estimation of oil heating.....	21
6.4	Design of the hydraulic accumulator (software option S01).....	22
6.5	Selection of the pressure sensor.....	22
7	Explanations.....	23
7.1	Einbauerklärung.....	24
7.2	Declaration of conformity.....	25

1 Overview of compact hydraulic power pack type HKF 4 with frequency converter

Compact hydraulic power packs are a type of hydraulic power pack. They are characterised by a highly compact design, since the motor shaft of the electric motor also acts as the pump shaft.

The ready-for-connection compact hydraulic power pack type HKF includes an electric drive that runs in oil. The stator is securely attached to the housing (tank). The mounted frequency converter adapts the motor speed and thus the delivery flow to the operating conditions

Features and benefits:

- suitable for continuous operation S1
- External fan for optimum use of power
- Environmentally friendly thanks to low oil filling volume; low cost of disposal and low hydraulic fluid costs
- Long lifetime and excellent reliability when using radial piston pumps
- Tailored range of valves and range of accessories from modular system

Intended applications:

- Endurance test bench construction
- Clamping systems on lathes
- Material test benches



*Compact hydraulic power pack type
HKF 4 with frequency converter*

2 Available versions, main data

Order coding example:

HKF 44	5	U	DT	/1	- H 6,0	- A1/150...	- U 4,0	- D	- S00	- 3 x 400 V 50 Hz	- G 1/4 x 300
											Oil drain hose Table 1f Oil drain hose
										Connection voltage Table 1e External fan connection voltage	
									Software version Chapter 2.4		
								Delta circuit			
							Converter size Chapter 2.3				
					Pump version Chapter 2.3						
				Converter position Table 1c Converter position							
				Additional options Table 1d Additional options							
			Converter								
	Tank size Table 1b Tank size										

Basic type and motor power [Table 1a Basic type and motors](#)

2.1 Motor and container

The motors integrated in the hydraulic power packs are specially designed for efficient operation with frequency converters. A converter is required for the power supply, a direct mains connection is not possible. The motors are wired in delta circuit to the converter.

Table 1a Basic type and motors

Basic type	Nominal power (kW)	Rated speed (rpm)
HKF 43	1.5	1395
HKF 44	2.2	1405
HKF 48	3.0	1420

i NOTE

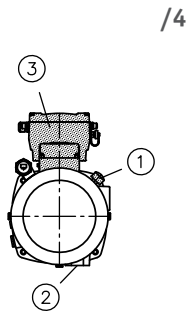
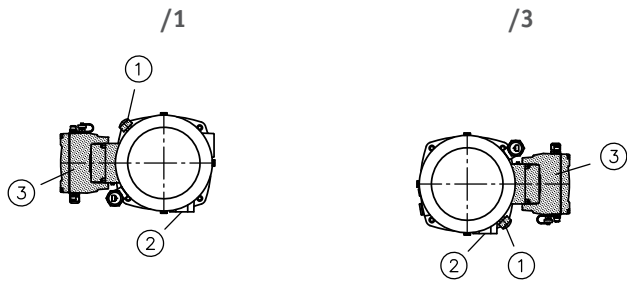
The actual power consumption depends on the load and can be up to 1.8 x nominal power.

Table 1b Tank size

Coding	Fill volume V_{fill} (l)	Usable volume V_{usable} (l)
HKF 43 / HKF 44		
5	6.8	2.5
9	10	5.7
HKF 48		
5	6.6	1.8
9	9.0	5.5

Table 1c Converter position

Coding	Comment
/1	Series
/3	180° offset in anticlockwise direction
/4	270°



- 1 Air filter
- 2 Main connection base
- 3 Converter

i NOTE

The converter positions cover the entire finned tube top, including the oil level gauge, air filter, etc. (see [Chapter 4, "Dimensions"](#)).

Table 1d Additional options

Coding	Comment
without designation	Without additional equipment
S	Level switch (N/O contact)
D	Level switch (N/C contact)
A	Level switch (N/C contact) like coding D, separate electrical connection, see Chapter 3.3, "Electrical" and Chapter 4, "Dimensions"
T	Temperature switch (switching point 80°C)
T60	Temperature switch (switching point 60°C)
W W60	Temperature switch, like coding T, coding T60, separate electrical connection (also available in combination AW, AW 60, WW 60, AWW 60)
L	additional drain port at the second connection base G 3/4, see Chapter 3.2, "Hydraulic" and Chapter 6, "Layout instructions" ("Additional drain return port")
R	Fan cover for additional protection against coarse dirt
M	with G 1 1/4 filling reduction
MA	Like coding M, additional drain plug G 1/4 in pump base, only for pump combination H, Z

Table 1e External fan connection voltage

Coding	Nominal power (W)	Rotation speed (rpm)	Protection class
3 x 400 50 Hz √	110	2680	IP 44
3 x 460 60 Hz √	160	2950	IP 44

Table 1f Oil drain hose

Coding	Description
No designation	Tapped plug
G 1/4 x 300	Oil drain hose approximately 300 mm with ball valve
G 1/4 x 500	Oil drain hose approximately 500 mm with ball valve
G 1/4 W x 300	Oil drain hose approximately 300 mm with bracket and ball valve
G 1/4 W x 500	Oil drain hose approximately 500 mm with bracket and ball valve

2.2 Converter

Inveor M series converters (standard version) from Kostal are used.

Table 2 Converter

Coding	Nominal power (kW)	Nominal current (A)	Size
U 2.2	2.2	5.6	B
U 4.0	4.0	9.5	B
U 7.5	7.5	17.8	C

Connection voltage: 3 x 400 VAC -10 % ... 480 VAC +10 %

Power frequency: 50/60 Hz \pm 6 %

The converters have an RS485 interface for programming and parameterization. The PC interface cable can be ordered with the material number 6217 0293-00.

The converter contains two M12 sockets for analogue and digital input/output signals, for example, to connect a pressure sensor.

2.3 Pumps, possible combinations of pump/motor/converter

Single-stage external gear, internal gear and radial piston pumps are available. For the areas of application, refer to Table 3 and the diagrams in [Chapter 6.1, "Selection of pump, motor and frequency converter"](#). Other single-stage pumps according to [D 7600-4](#) are possible, but must be requested separately.

Table 3 Pump/motor/converter combinations

	Min. flow rate (660 rpm, 22 Hz)	Nominal flow rate (1500 rpm, 50 Hz)	Max. flow rate (3450 rpm, 115 Hz)
Type Z 5.2	2.7 lpm	6.3 lpm	13.8 lpm
External gear pump $V_g = 4.25 \text{ cm}^3$			
HKF 43, U 2.2, Z 5.2	85 bar	95 bar	55 bar
HKF 44, U 4.0, Z 5.2	150 bar	165 bar	105 bar
HKF 44, U 7.5, Z 5.2	200 bar	200 bar	160 bar
	Min. flow rate (660 rpm, 22 Hz)	Nominal flow rate (1500 rpm, 50 Hz)	Max. flow rate (3450 rpm, 115 Hz)
Type Z 11.3	5.3 lpm	12.5 lpm	27.7 lpm
External gear pump $V_g = 8.5 \text{ cm}^3$			
HKF 44, U 4.0, Z 11.3	75 bar	85 bar	55 bar
HKF 44, U 7.5, Z 11.3	100 bar	115 bar	80 bar
HKF 48, U 7.5, Z 11.3	140 bar	155 bar	100 bar
	Min. flow rate (210 rpm, 7 Hz)	Nominal flow rate (1500 rpm, 50 Hz)	Max. flow rate (3450 rpm, 115 Hz)
Type IZ 9.1	0.7 lpm	9.4 lpm	20.8 lpm
Internal gear pump $V_g = 6.4 \text{ cm}^3$			
HKF 43, U 2.2, IZ 9.1	45 bar	60 bar	40 bar
HKF 44, U 4.0, IZ 9.1	100 bar	110 bar	70 bar
HKF 44, U 7.5, IZ 9.1	135 bar	155 bar	105 bar
HKF 48, U 7.5, IZ 9.1	185 bar	200 bar	135 bar

	Min. flow rate (150 rpm, 5 Hz)	Nominal flow rate (1500 rpm, 50 Hz)	Max. flow rate (3450 rpm, 115 Hz)
Type H 1.4	0.1 lpm	1.6 lpm	3.5 lpm
Radial piston pump Vg = 1.07 cm³			
HKF 43, U 2.2, H 1.4	275 bar	375 bar	230 bar
HKF 44, U 4.0, H 1.4	480 bar	665 bar	425 bar
HKF 44, U 7.5, H 1.4	700 bar	700 bar	700 bar
	Min. flow rate (150 rpm, 5 Hz)	Nominal flow rate (1500 rpm, 50 Hz)	Max. flow rate (3450 rpm, 115 Hz)
Type H 6.0	0.3 lpm	6.3 lpm	14 lpm
Radial piston pump Vg = 4.3 cm³			
HKF 43, U 2.2, H 6.0	70 bar	95 bar	55 bar
HKF 44, U 4.0, H 6.0	120 bar	165 bar	105 bar
HKF 44, U 7.5, H 6.0	135 bar	230 bar	160 bar
HKF 48, U 7.5, H 6.0	185 bar	310 bar	205 bar
	Min. flow rate (150 rpm, 5 Hz)	Nominal flow rate (1500 rpm, 50 Hz)	Max. flow rate (3450 rpm, 115 Hz)
Type H 10.9	0.5 lpm	11.3 lpm	25 lpm
Radial piston pump Vg = 7.64 cm³			
HKF 43, U 2.2, H 10.9	40 bar	50 bar	30 bar
HKF 44, U 4.0, H 10.9	65 bar	90 bar	60 bar
HKF 44, U 7.5, H 10.9	75 bar	130 bar	90 bar
HKF 48, U 7.5, H 10.9	105 bar	175 bar	115 bar

2.4 Software options

Two software options are available for the HKF power packs with frequency converter:

S00: Software with standard control and positioning options of the frequency converter

S01: Model-based control software for pressure reduction

2.4.1 Software option S00

Option S00: The converter is equipped with the software supplied by Kostal.

The following operating modes are possible:

- Frequency control mode – the frequency (and thus the rotation speed of the hydraulic power pack) is set by means of an internal or external setpoint.
- PID process control – an internal PID controller controls a process variable (for example, the pressure) by adjusting the frequency.
- Fixed frequencies – 7 different frequencies can be set based on 3 digital input signals.

For detailed information on parameterization, refer to the Kostal operating and maintenance manual (www.kostal-industrie-elektrik.com).

The frequency converters used are specially adapted and parameterized for use in the hydraulic power packs. The stored parameter configuration depends on the hydraulic power pack design and ensures safe operation (refer to limits [Chapter 6.1, "Selection of pump, motor and frequency converter"](#)).

i NOTE

Serious damage is possible in case of incorrect settings. For this reason, a number of parameters are locked for the customer. Improper changes to the presettings invalidate all warranty claims. However, should there be a need to change these settings, consult HAWE.

The following parameters can be adjusted by the customer:

Designation	Parameter no.	Restriction	Note
Run-up time 1	1,051	Set to minimum run-up time, can be changed.	Longer run-up times can lead to inadequate control dynamics.
Run-up time 2	1,053		
Operating mode (including subordinate parameters)	1,100	None	Central setting for one of three possible operating modes. Incorrect setting leads to malfunction.

2.4.2 Software option S01

In the software option S01, the hydraulic power pack operates with a model-based constant pressure control. This means that the control system adjusts the flow rate so that the pressure remains constant within the control range of +/-10 bar.

All parameters are adapted to the application at delivery. No adaptations need to be made.

Operation with software option S01 always requires a pressure sensor with a 4-20 mA output signal. The connection is made at the interface -10X4 (terminal X5.17), for example, with the sensor cable 8317 8071-00.

This always requires an accumulator that prevents pressure drops during acceleration of the hydraulic power pack.

When ordering the hydraulic power pack, the following information is required in addition to the order coding:

- system pressure
- Accumulator size
- Min. flow rate
- Max. flow rate
- Measuring range of the pressure sensor

For further information about selecting the components, refer to [Chapter 6, "Layout instructions"](#).

3 Parameters

3.1 General

General information

Hydraulic fluid

Hydraulic oil: according to DIN 51 524 Part 1 to 3; ISO VG 10 to 68 according to DIN 51 519
 Viscosity range: min. approx. 4; max. approx. 800 mm²/s
 Optimal operating range: approx. 10 to 500 mm²/s
 Also suitable for biologically degradable pressure fluids type HEPG (polyalkylene glycol) and HEES (synthetic ester) at operating temperatures up to approx. +70°C.

Temperatures

Environment: approx. -40 to +60°C, oil: -25 ... +80°C, pay attention to the viscosity range.
 Start temperature: down to -40°C is permissible (observe start viscosities!), as long as the steady-state temperature is at least 20 K higher during subsequent operation.
 Biologically degradable hydraulic fluids: note manufacturer specifications. With consideration for the seal compatibility, not above +70°C.

Protection class

IP 65 according to IEC 60529

3.2 Hydraulic

The hydraulic connections are described in [D 7600-4](#).

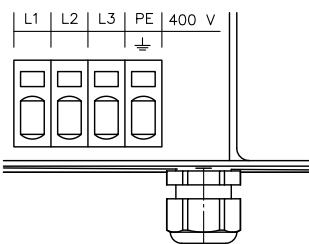
3.3 Electrical

Connection of the power supply for the hydraulic power pack:

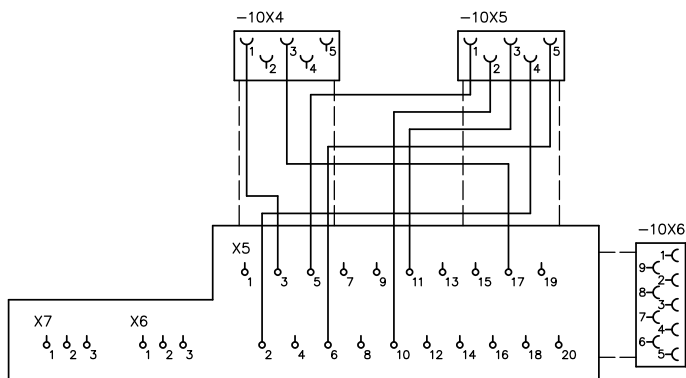
i NOTE

Only electricians may make the electrical connection.

The electrical connection is made in the frequency converter.



Additional connections to the frequency converter:



For detailed information on the terminal connections, refer to Kostal operating and maintenance manual.

Important connections:

-10X5 (terminal X5.10)	Hardware release
-10X4 (terminal X5.17)	Analogue input signal, for example, for pressure reduction
-10X6	RS485 interface for programming

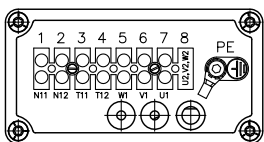
Connection of the power supply for the external fan:

Mains phase L3 - terminal 8

Mains phase L2 - terminal 7

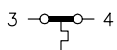
Mains phase L1 - terminal 6

PE protective conductor



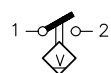
Connection of the level and temperature switches:

Coding **T, T60**

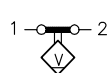


Coding **S, D**

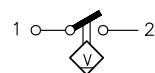
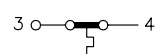
S (N/O contact)



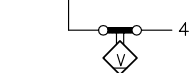
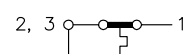
D (N/C contact)



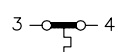
Coding **S-T**



Coding **DT**



Coding **D-T**

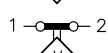


Coding **D-D**

1. Switching point



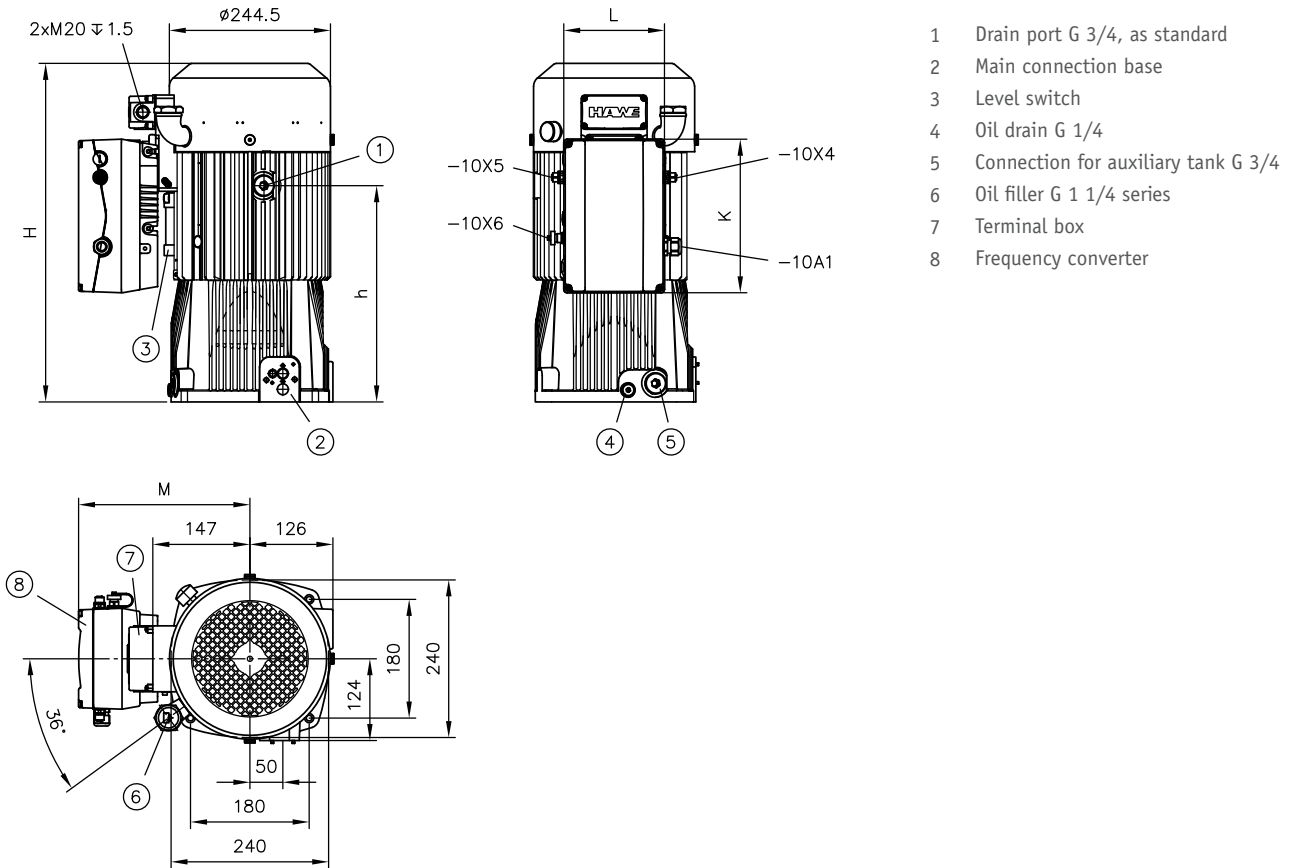
2. Switching point



4 Dimensions

All dimensions in mm, subject to change.

HKF4 with frequency converter



- 1 Drain port G 3/4, as standard
- 2 Main connection base
- 3 Level switch
- 4 Oil drain G 1/4
- 5 Connection for auxiliary tank G 3/4
- 6 Oil filler G 1 1/4 series
- 7 Terminal box
- 8 Frequency converter

Port	Function
-10A1	Supply voltage
-10X4	Pressure sensor
-10X5	Hardware release
-10X6	- PC interface

Tank size	H	h
5	513.5	328
9	633.5	448

Converter size	K	L	M
B	270	189	275
C	307	223	317

All other dimensions are described in the publication [D 7600-4](#).

5 Installation, operation and maintenance information

Also refer to publication [D 7600-4](#).

5.1 Intended use

These hydraulic components is intended exclusively for hydraulic applications (fluid technology).

The user must observe the safety measures and warnings in this documentation.

Essential requirements for the product to function correctly and safely:

- All information in this documentation must be observed. This applies in particular to all safety measures and warnings.
- The product must only be assembled and put into operation by qualified personnel.
- The product must only be operated within the specified technical parameters. The technical parameters are described in detail in this documentation.
- The operating and maintenance manual of the components, assemblies and the specific complete system must also always be observed.

If the product can no longer be operated safely:

1. Remove the product from operation and mark it accordingly.
- ✓ It is then not permitted to continue using or operating the product.

5.2 Assembly information

The product must only be installed in the complete system with standard and compliant connection components (screw fittings, hoses, pipes, fixtures etc.).

The product must be shut down correctly prior to dismantling (in particular in combination with hydraulic accumulators).



DANGER

Risk to life caused by sudden movement of the hydraulic drives when dismantled incorrectly!

Risk of serious injury or death.

- Depressurise the hydraulic system.
- Perform safety measures in preparation for maintenance.

5.3 Operating instructions

Note product configuration and pressure / flow rate

The statements and technical parameters in this documentation must be strictly observed.
The instructions for the complete technical system must also always be followed.

i NOTE

- Read the documentation carefully before usage.
- The documentation must be accessible to the operating and maintenance staff at all times.
- Keep documentation up to date after every addition or update.

⚠ CAUTION

Risk of injury on overloading components due to incorrect pressure settings!

Risk of minor injury.

- Always monitor the pressure gauge when setting and changing the pressure.

Purity and filtering of the hydraulic fluid

Fine contamination can significantly impair the function of the hydraulic component. Contamination can cause irreparable damage.

Examples of fine contamination include:

- Metal chips
- Rubber particles from hoses and seals
- Dirt due to assembly and maintenance
- Mechanical debris
- Chemical ageing of the hydraulic fluid

i NOTE

Fresh hydraulic fluid from the drum does not always have the highest degree of purity. Under some circumstances the fresh hydraulic fluid must be filtered before use.

To ensure smooth operation, pay attention to the cleanliness level of the hydraulic fluid.
(also see cleanliness level in [Chapter 3, "Parameters"](#))

Other applicable document: [D 5488/1](#) Oil recommendations

5.4 Maintenance information

Conduct a visual inspection at regular intervals, but at least once per year, to check if the hydraulic connections are damaged. If external leakages are found, shut down and repair the system.

Clean the device surface of dust deposits and dirt at regular intervals, but at least once per year.

6 Layout instructions

The design of the hydraulic power packs takes place in three or five steps:

- 1 Selection of pump, motor and frequency converter
- 2 Selection of the tank size
- 3 Estimation of oil heating
- 4 Design of the accumulator (with software option S01)
- 5 Selection of the pressure sensor (with software option S01)

6.1 Selection of pump, motor and frequency converter

The diagrams below are available for selecting the pump, motor and frequency converter.

Enter the possible operating points (pressure/flow rate) in the diagrams and select a curve that is closest to all operating points and covers the entire flow rate range. On the curve, you can read off the hydraulic power pack type, pump and converter size.

The curves must not be extrapolated; the minimum and maximum delivery flows shown apply.

Diagram 1: Combinations up to $p = 35 - 95$ bar

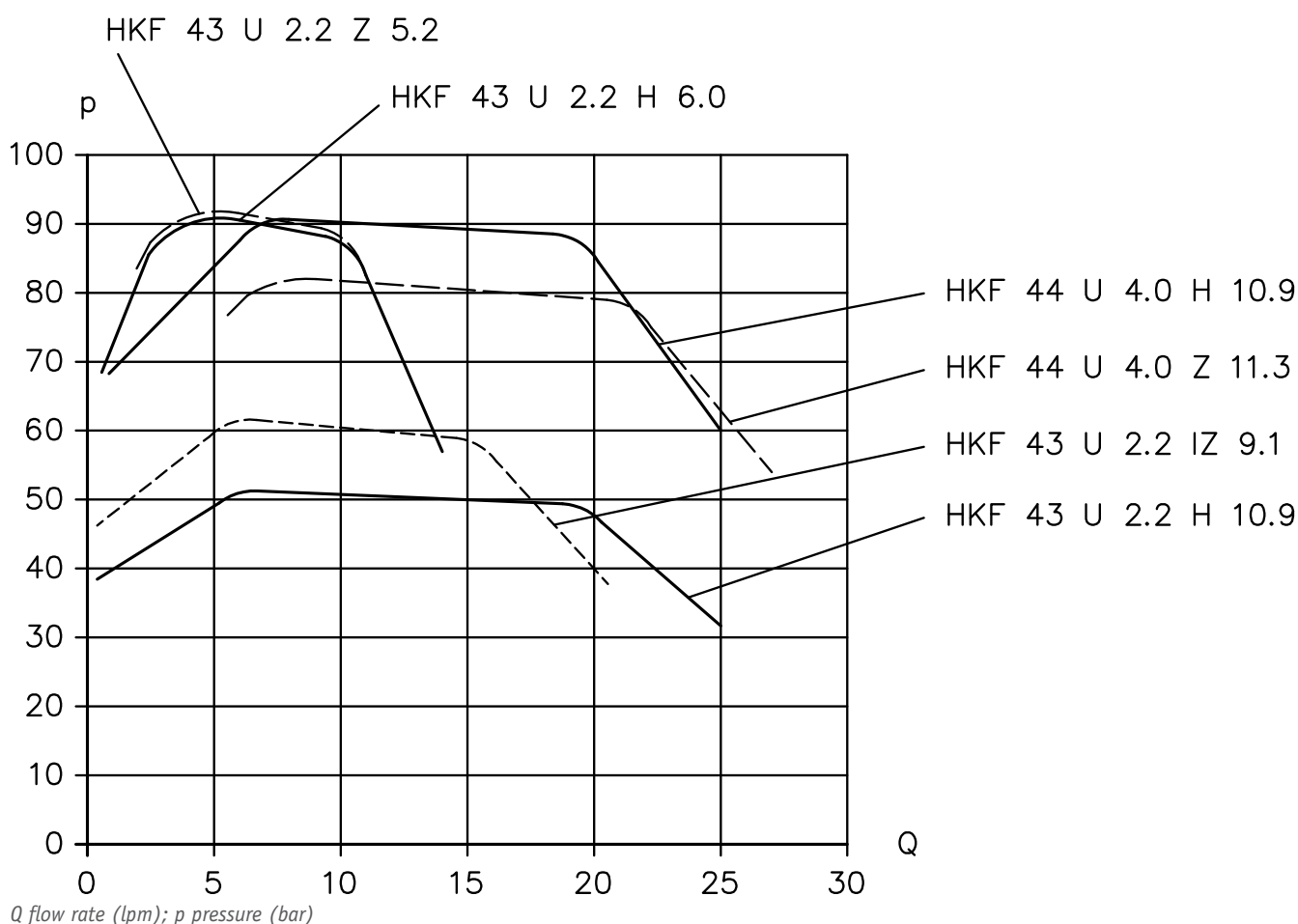


Diagram 2: Combinations up to $p = 75 - 160$ bar

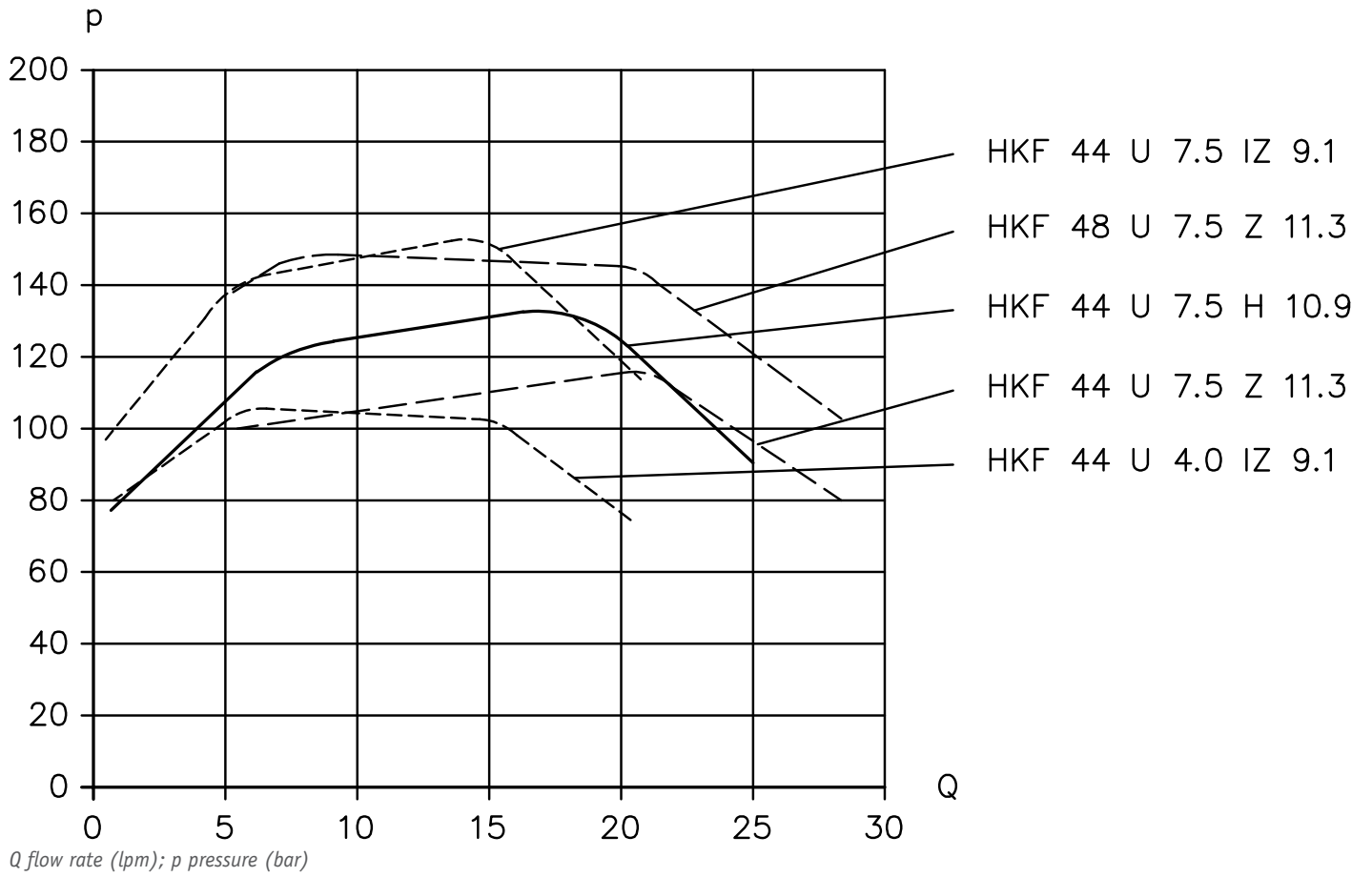


Diagram 3: Combinations up to p = 100 - 200 bar

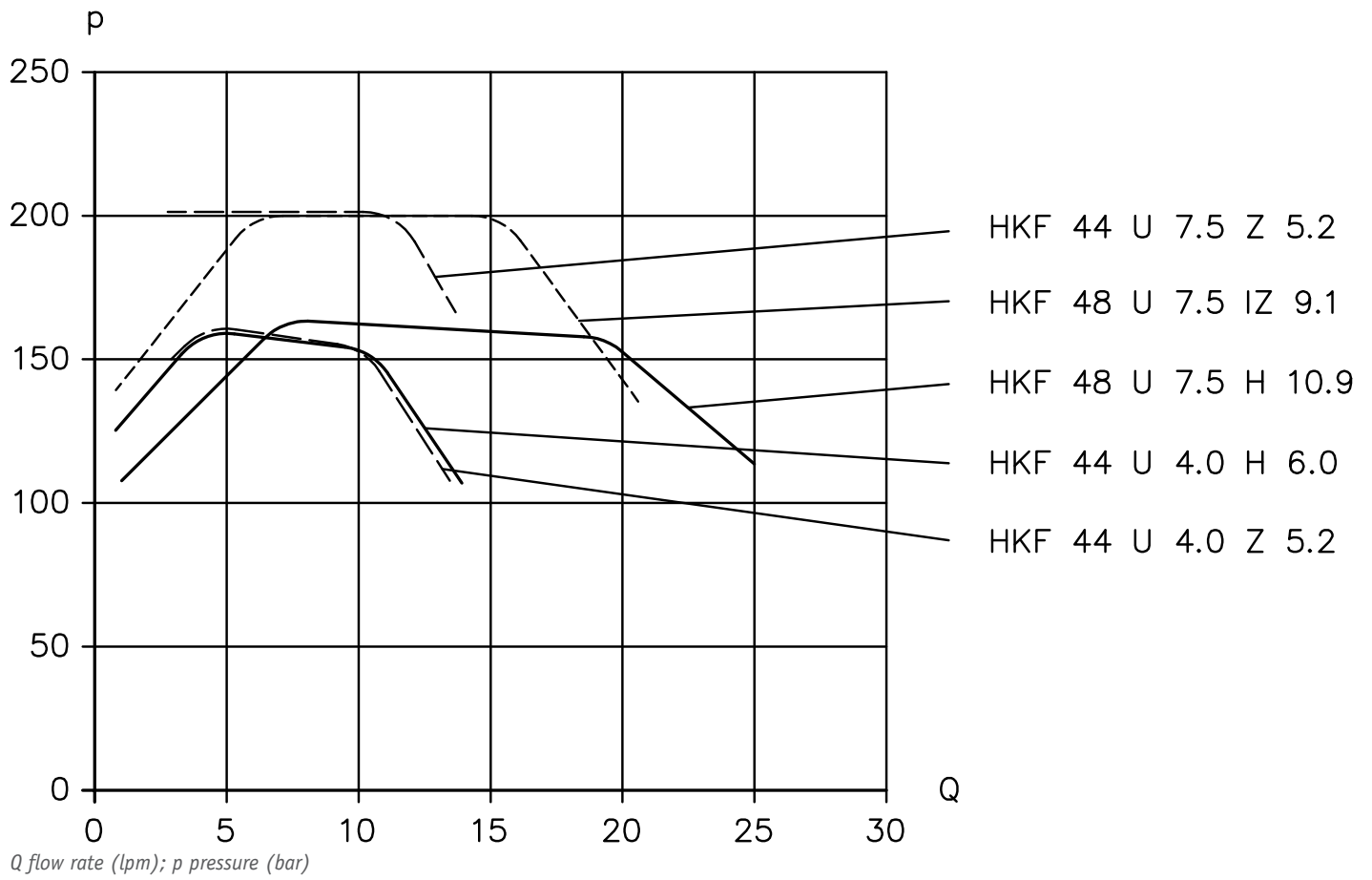
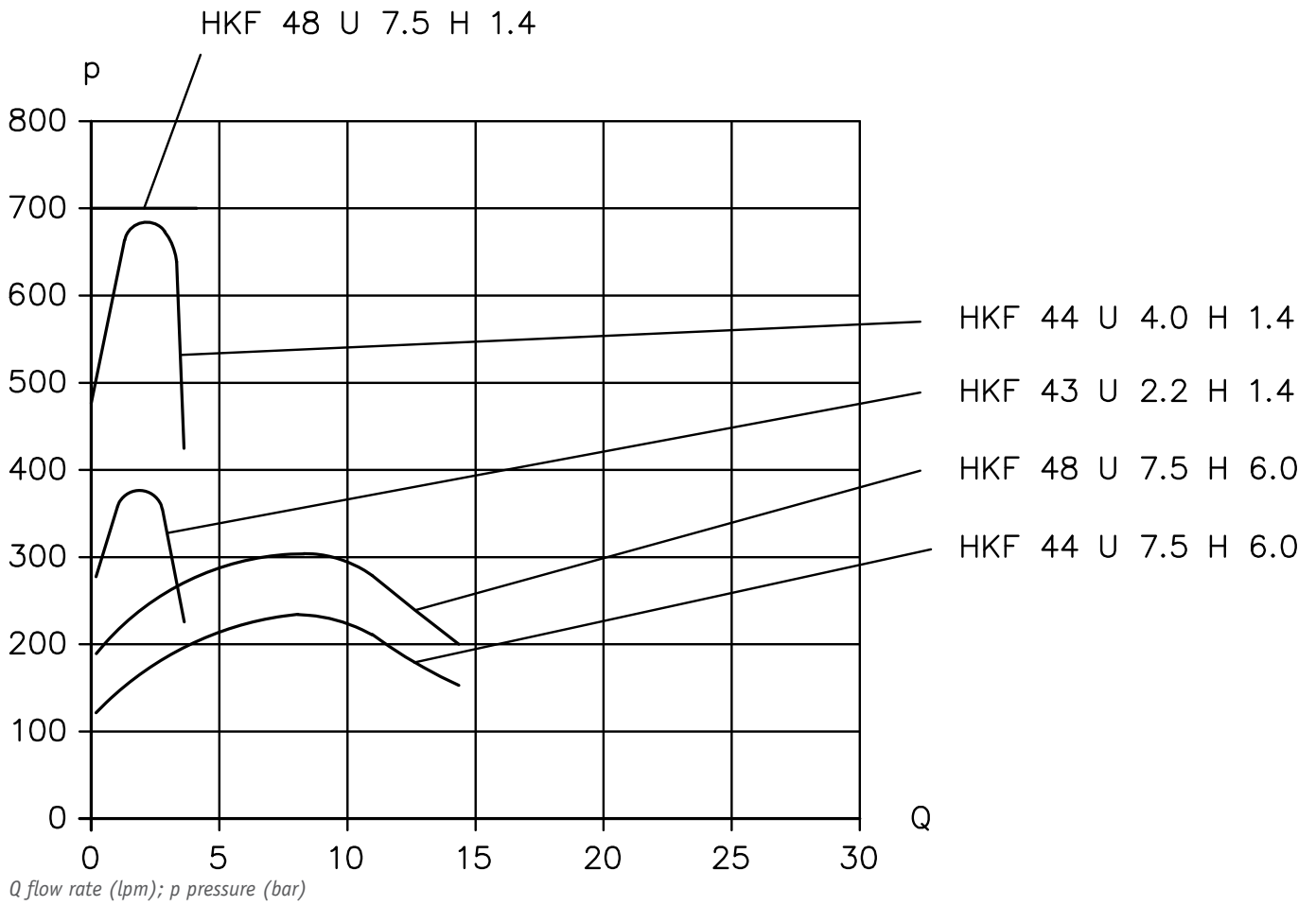


Diagram 4: Combinations up to p = 140 - 700 bar



6.2 Selection of the tank size

Select the tank size so that the tank's operational volume corresponds to the volume of all cylinders and lines plus a safety factor of 1.5. With an average output volume over 2 lpm you should generally choose tank size 9.

6.3 Estimation of oil heating

Calculate the average power in the typical operating cycle. That is, with the pressures and flow rates per time interval

p_1 [bar], Q_1 [lpm], t_1 [s]

p_2 [bar], Q_2 [lpm], t_2 [s]

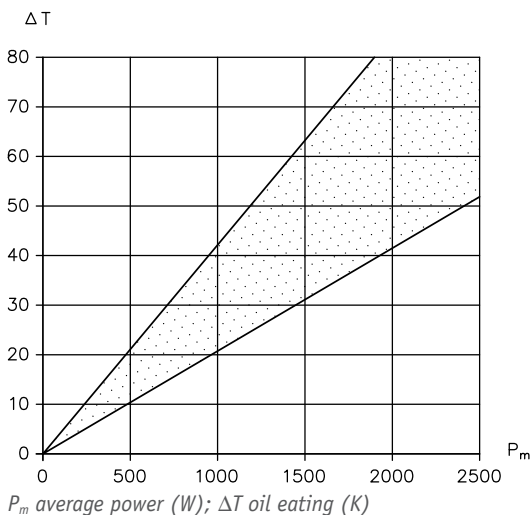
p_3 [bar], Q_3 [lpm], t_3 [s]

....

the resulting average power is:

$$P_m \text{ [W]} = (p_1 * Q_1 * t_1 + p_2 * Q_2 * t_2 + p_3 * Q_3 * t_3 + \dots) * 1.7 / (t_1 + t_2 + t_3 + \dots)$$

The oil heating ΔT [K] can then be found in the diagram:



The actual oil temperature T_{oil} [°C] is then calculated by adding the ambient temperature T_{Amb} [°C]:

$$T_{oil} \text{ [°C]} = T_{Amb} \text{ [°C]} + \Delta T \text{ [K]}$$

The hydraulic power pack must not exceed the oil temperature 80°C. The maximum permitted oil temperature can be lower and depends on the application.

6.4 Design of the hydraulic accumulator (software option S01)

With software option S01, a model-based pressure reduction is programmed in the converter. In order to keep the pressure constant even with a rapid change of the flow rate demand, a hydraulic accumulator is required.

The table shows the recommended accumulator types according to the publication [D 7969](#) based on the system pressure and the maximum occurring flow rate jumps $Q_{\max} - Q_{\min}$.

P _{System}	Q _{max} - Q _{min}							
	2 lpm	4 lpm	6 lpm	8 lpm	10 lpm	12 lpm	14 lpm	16 lpm
40 bar	AC 202	AC 322	AC 603	AC 603	AC 603	AC 1002	AC 1002	AC 1002
60 bar	AC 202	AC 322	AC 603	AC 1002	AC 1002	AC 1002	AC 1414	AC 1414
80 bar	AC 322	AC 603	AC 603	AC 1002	AC 1002	AC 1414	AC 1414	AC 2001
100 bar	AC 322	AC 603	AC 1002	AC 1002	AC 1414	AC 2001	AC 2001	AC 2001
120 bar	AC 322	AC 603	AC 1002	AC 2001	AC 1414	AC 2001	AC 2001	AC 2825
140 bar	AC 603	AC 1002	AC 1002	AC 1414	AC 2001	AC 2001	AC 2825	AC 2825
160 bar	AC 603	AC 1002	AC 2001	AC 2001	AC 2001	AC 2825	AC 2825	not possible
180 bar	AC 603	AC 1002	AC 2001	AC 2001	AC 2825	AC 2825	not possible	not possible
200 bar	AC 603	AC 1002	AC 2001	AC 2001	AC 2825	AC 2825	not possible	not possible

The accumulator preload should be 20 bar below the system pressure. However, it may not exceed the max. pre-load pressure in [D 7969](#).

6.5 Selection of the pressure sensor

The pressure measurement in the software option S01 is performed by a pressure sensor with an output signal of 4-20 mA.

Following pressure sensors according to [D 5440 T/1](#) are available:

Type coding	for max. system pressure
DT2-1	Up to 100 bar
DT2-2	100 – 250 bar
DT2-4	250 – 400 bar
DT2-6	400 – 600 bar

HAWE Hydraulik SE, Postfach 11 55, 85605 Aschheim/München

Declaration of Incorporation within the meaning of the Machinery Directive 2006/42/EC, appendix II, No.1 B

Compact power pack type HK(L) and HKF
acc. to our **documentation D 7600-2, D 7600-3, D 7600-3L, D 7600-4 and D 7600-4FU**
(latest release)

- is an incomplete machine (acc. to article 2g), which is exclusively intended for installation or assembly of another machinery or equipment.
The specific technical documents, necessary acc. to appendix VII B, can be prepared any time and transmitted in electronic form to the responsible national authority on request.
Risk assessment and analysis are implemented according to appendix I of the Machinery Directive.
The dept. Product, Application & Service is authorized to compile the specific technical documents necessary acc. to appendix VII B.

HAWE Hydraulik SE, Dept. Product, Application & Service, Einsteinring 17, D-85609 Aschheim/Munich

The following basic safety and health protection requests acc. to appendix I of this guideline do apply and are complying with:

- *Chapter 1.1.2, 1.1.3, 1.1.5, 1.2 (complete chapter), 1.3.1, 1.3.2, 1.3.4, 1.3.6, 1.3.7, 1.5.1, 1.5.2, 1.5.3, 1.5.4, 1.5.5, 1.5.6, 1.5.8, 1.5.9, 1.5.16, 1.6.3, 1.7.1, 1.7.3, 1.7.4 and 1.7.4.3.*

The incomplete machine also fulfills below shown EU-Directives:

*2014/35/EU:2014-02-26 Directive of electrical equipment designed for use within certain voltage limits
2014/68/EU:2014-05-15 Pressure equipment Directive (applicable if an accumulator is used)*

Following harmonized guidelines have been used:

*EN 12100-1:2011-03 Safety of machinery - General principles for design
EN ISO 4413:2011-04 Hydraulic fluid power - General rules and safety requirements for systems and their components
EN 60204-1:2014-10 Safety of machinery - Electrical equipment of machines - Part 1: General requirements*

We assume that the delivered equipment is intended for the installation into a machine.

- Putting in operation is forbidden until it has been verified that the machine, where our products shall be installed, is complying with the Machinery Directive 2006/42/EC.
This Declaration of Incorporation is void, when our product has been modified without our written approval.

Aschheim, 2019-02-12



Dipl.-Ing. M. Knobloch (Direktor, Produkt, Application and Service)

7.2 Declaration of conformity

Declarations of conformity for the converters can be found on the manufacturer's website: <https://www.kostal-industrie-elektrik.com/>

Further information

Additional versions

- Compact hydraulic power pack type HK 4 and HKF 4: D 7600-4
- Compact hydraulic power pack type KA and KAW size 2: D 8010
- Compact hydraulic power pack type KA and KAW size 4: D 8010-4
- Compact hydraulic power pack type HC and HCW: D 7900
- Compact hydraulic power pack type MPN and MPNW: D 7207
- Direct current compact hydraulic power pack type NPC: D 7940