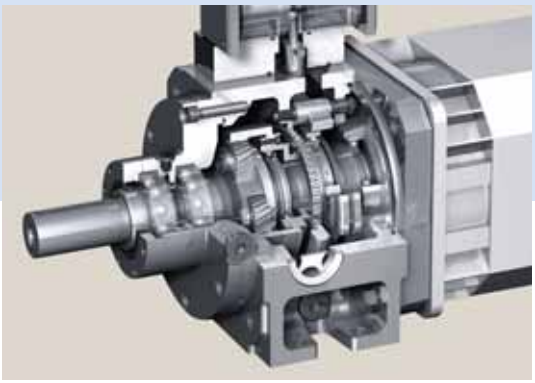
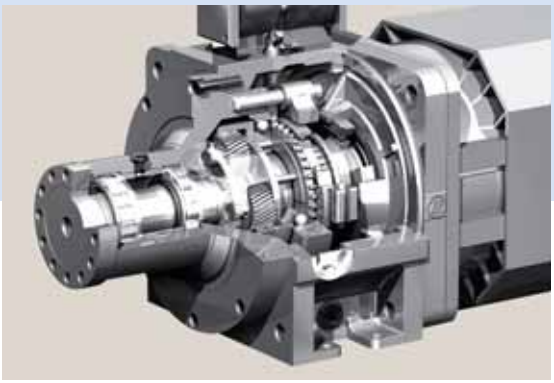
Power and Dynamics

Two-Speed Gearbox for Machine Tools

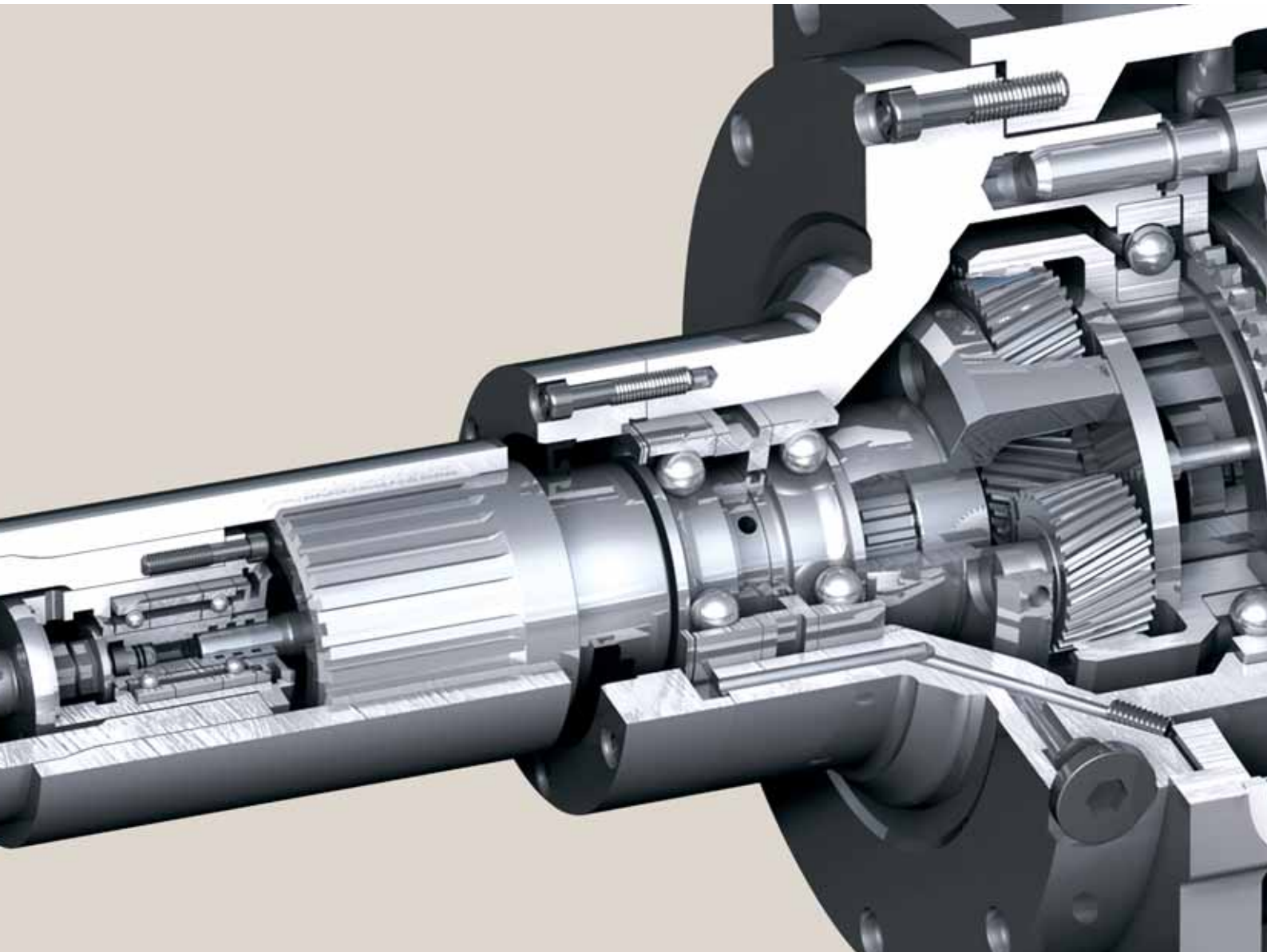
ZF-Duoplan 2K120 INLINE
Direct Mounting to Spindle



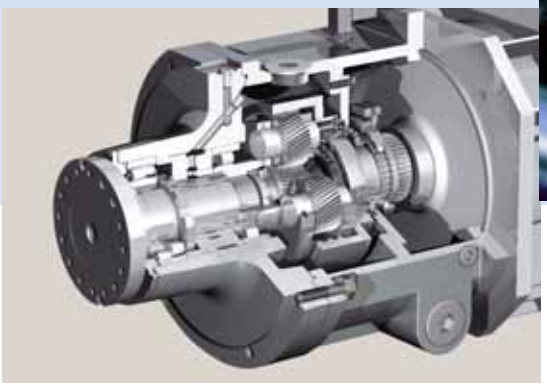
ZF-Duoplan 2K250 Standard
for Belt Drives

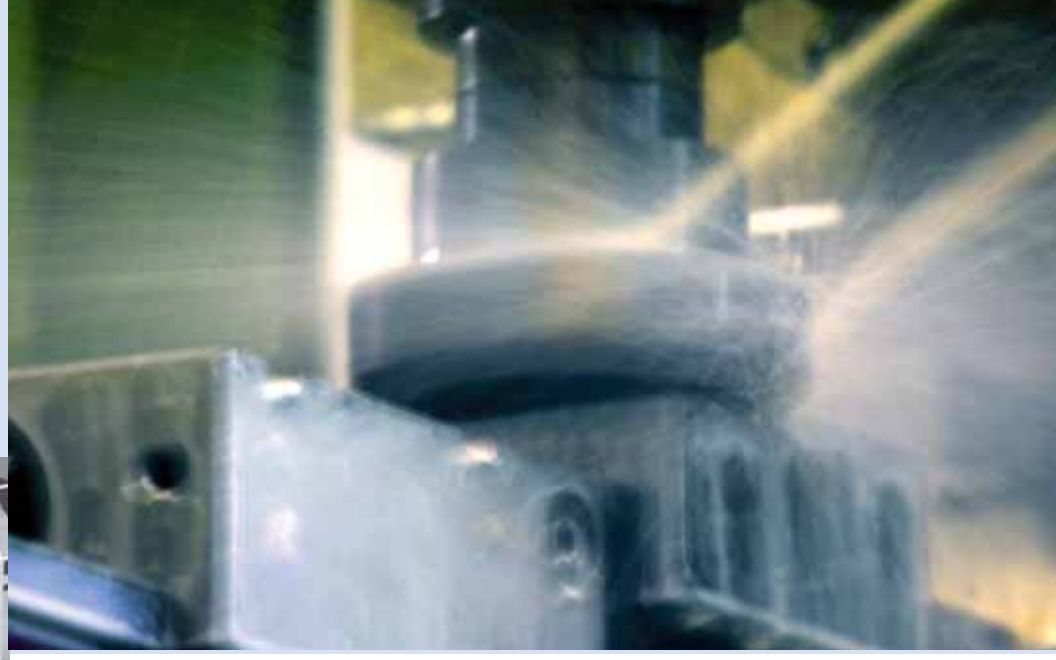


ZF-Duoplan 2K250 TSC (Through-Spindle-Cooling)
Allows cutting liquids like emulsions, hydraulic oils and air-oil mixtures to be passed through the gearbox and spindle, directly to the tool



ZF-Duoplan 2K800 Standard
for Belt Drives





Precision in movement

The ZF Friedrichshafen division Special Driveline Technology is able to offer you a wide range of machine drives, brakes and clutches for applications in engineering as well as customer specific drive solutions.

Our development and production activities are focused on servo-assisted drives for automation engineering, two-speed drive gearboxes for machine tools as well as customer-specific drives, such as for printing machines, robot applications and elevator gearboxes.

Our innovative standard products range from low backlash servogearboxes (ZF-Servoplan), and high precision robust two-speed gearboxes (ZF-Duoplan) to hysteresis clutches and brakes for non-contact web control (ZF-Tiratron).

ZF-Duoplan
Two-speed gearbox
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ZF Douplan - Two-speed gearboxes

Application

The ZF Duoplan two-speed gearbox is mainly used in machine tool main-spindle drives, test-benches and applications where high torque is needed.
By way of example, the gearbox can be used in turning machines (horizontal B3/B5), machining centers (vertical V1/V3) thanks to its variable installation position (see page 10). The gearbox is also suitable for use in many systems in which torque increase and/or speed reduction is required.

Benefits

Machine tools are designed to be universal so that they can process different materials. This requires both high cutting speeds for soft materials as well as high cutting forces for hard materials requirements which a two-speed gearbox can fulfill, since it can either retain high motor speeds (i = 1:1) or multiply the motor torque (e.g. ratio i = 4.00) and reduce the speeds, both by the same factor.

Flexible

The cutting power is therefore constant and remains available across a wide speed range. This flexibility can only be economically achieved by using a gearbox.

ZF-Duoplan Standard

Wide bearing base for high cantilever force

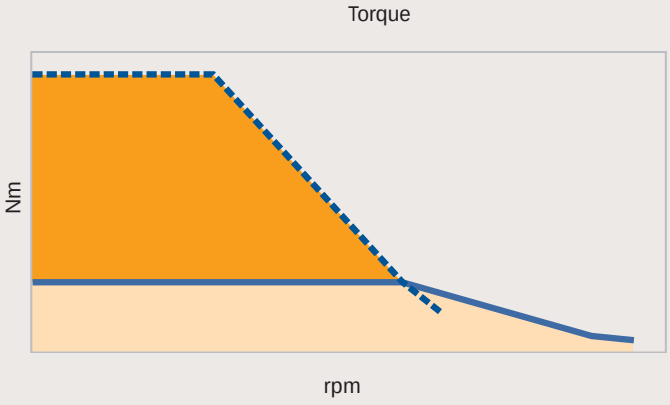
Direct Mounting to Spindle (INLINE + TSC)

This gearbox is mounted directly to the spindle. No more belt drives are used. The gearbox is dedicated for today's high speed requirements in machine tools.

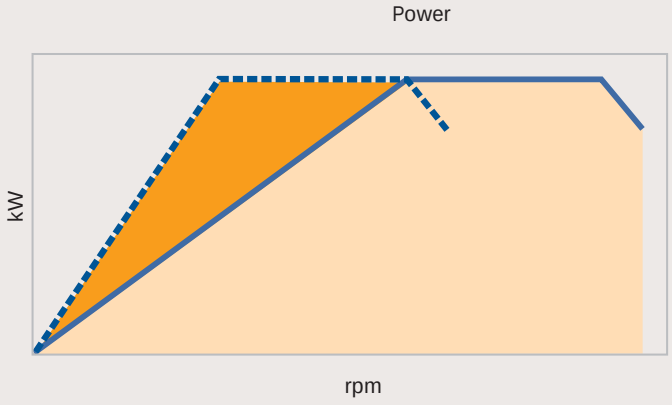
Torque-power curve

Speed ranges with constant power of up to 1:20 can be achieved for the spindle with the gearbox, depending on the controllable range of the motor. This provides high torque at low speeds on the one hand and high power at high speeds on the other, allowing the cutting power of modern tools to be fully utilized.

Torque - Power Curve - e.g. ZF-Duoplan 2K250



400% increased motor torque.



Doubled constant power range.

1) Motor-gearbox in i_2 = 1.00 or motor without gearbox

2) Motor-gearbox in i_2 = 4.00

Machining Center

ZF-Duoplan - Design

Design
ZF developed the ZF-Duoplan gearbox as a single-stage planetary design with a shift mechanism, hereby meeting today's high demands of low noise operation.

In contrast to conventional spur gearboxes in lay-shaft design, this planetary gearbox has the distinct advantage of allowing an extremely compact and space-saving design since the power is distributed among 4 or 5 planetary gears.

In addition, the four resp fire simultaneously meshing planetary gears with helical gearing also assure low-noise operation at high speeds.

Misalignments and concentricity issues are ideally concentrated by the floating design of the sun gear. Thus such a planetary gearbox is much less sensitive to tolerances.

The motor-gearbox unit is commonly fixed to the machine frame or bed by using the gearbox foot mount. (Available for 2K120, 2K250 and 2K300 only).

Each gearbox also has available an output side pilot for flange mounts.

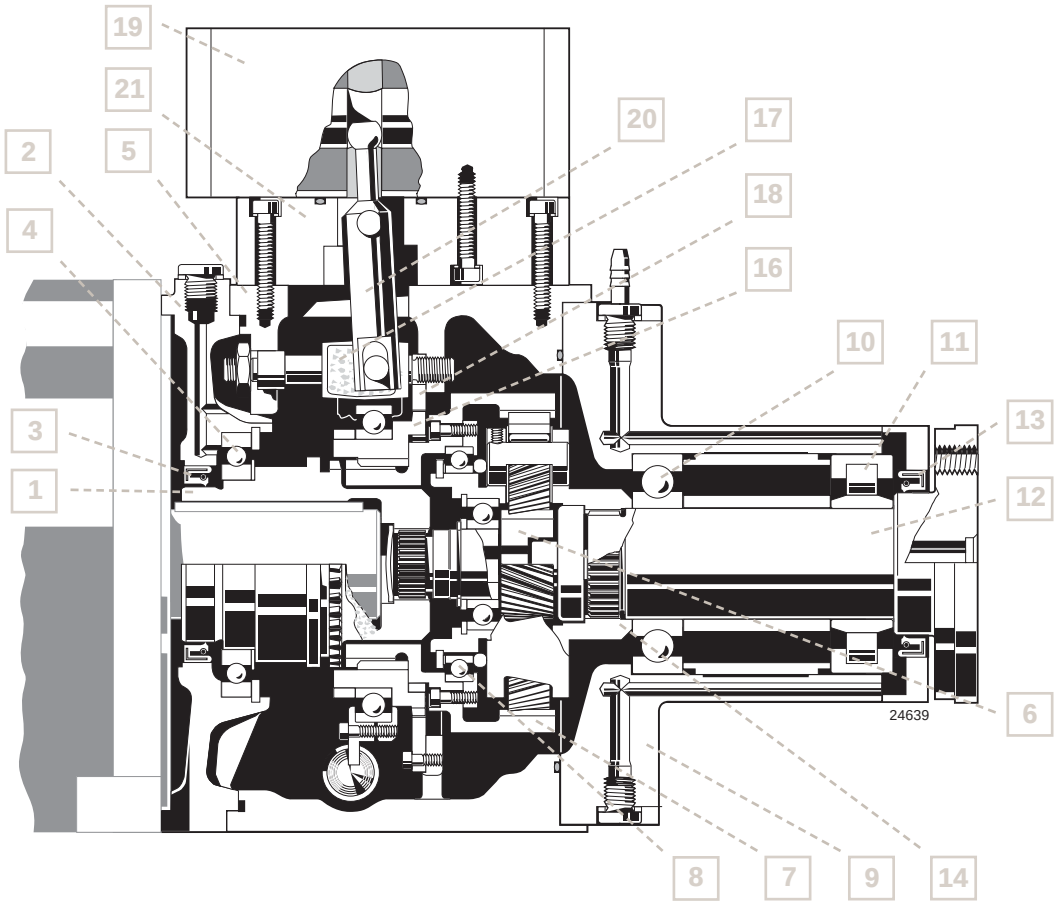
For each application there is an ideal choice of output bearings with a wide bearing base.

A range of output housing variants cater to different spindle drive designs: e.g. ZF-Duoplan STANDARD with wide bearing base for belt drives with high cantilever forces, ZF-Duoplan INLINE with short output housing and angular contact bearings for direct drive and ZF-Duoplan TSC (Through-Spindle-Cooling) to facilitate the transfer of cutting liquids like emulsions, hydraulic oils and air-oil mixtures with up to 140 bars of pressure at a flow rate of 35 l/min through the gearbox and spindle, directly to the tool.

ZF-Duoplan INLINE

Short output housing for direct mounting to spindle

ZF-DUOPLAN 2K120 Standard



Main components of the gearbox:

Adapter parts:

1: Drive hub

2: Adapter plate

3: with radial shaft seal

4: and hub bearing

Housing:

5: Gearbox housing

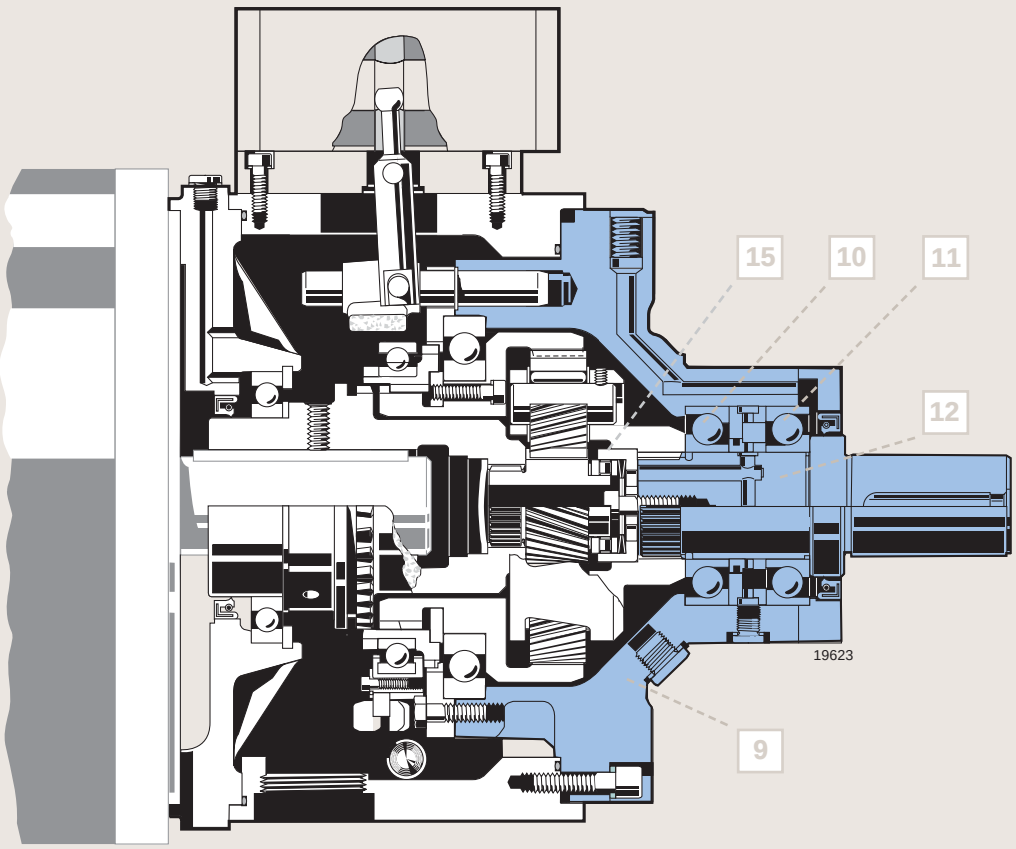
Input:

6: Sun gear

7: Ring gear

8: Ring gear bearing

ZF-DUOPLAN 2K250 INLINE



Output:

9: Output housing

10+11: Output bearings

12: Output shaft

13: Radial shaft seal

14: Plantetary carrier

15: Axial bearing with cup springs

Gear shift mechanism:

16: Sliding sleeve

17: Gear shift fork

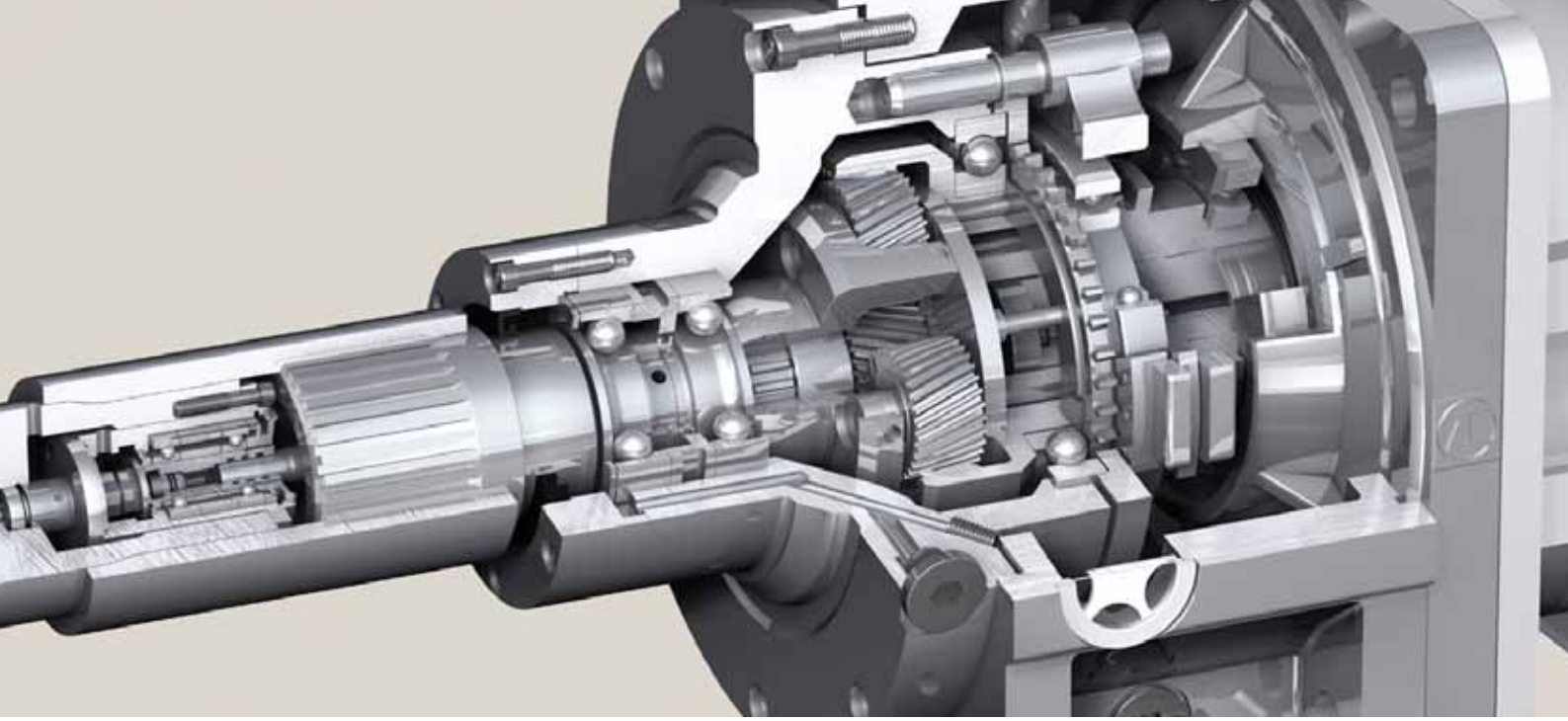
18: Brake disc

Shift unit:

19: Solenoid

20: Gear shift shaft

21: Adapter plate



Adapter parts:

1: Keyless hub

6: Sun gear

22: Counter holder

23: Clampig rings

24: Pressure piece with bushing

Output:

12: Output shaft

TSC:

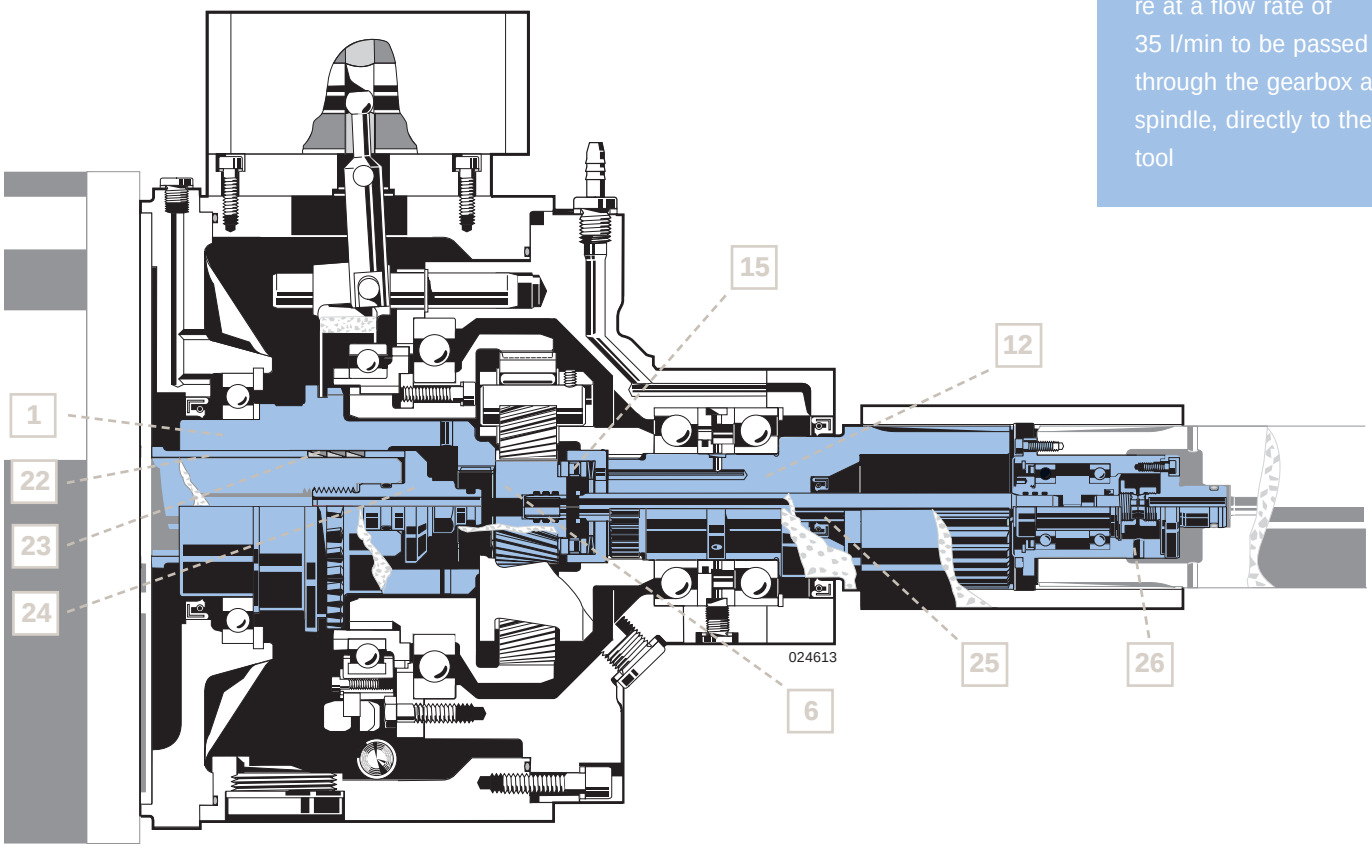
25: Pipe

26: Rotary union joint

ZF-Duoplan TSC

Through-Spindle-Cooling: Allows cutting liquids like emulsions, hydraulic oils and air-oil mixtures with up to 140 bars of pressure at a flow rate of 35 l/min to be passed through the gearbox and spindle, directly to the tool

ZF-DUOPLAN 2K250 TSC



Technical Data:

Gearbox Sizes:

		i	2K120 2K 121	2K250	2K300	2K800 2K801/2K802 standard	2K800 2K801/2K802 with STW	2K2100 standard without output	2K2100 with STW
Nominal data:									
Motor frame size			100/112	132	160	180/200/225	180/200/225	225/280	225/280
Nominal power	(kW)		19	39	47	84	84	120	120
Nominal speed	(rpm)		1 500	1 500	1 500	1 000	1 000	500	500
Nominal input torque (continuous operation S1)	(Nm)		120	250	300/250***	800	800	2 100	2 100
Output torque	(Nm)	1.00	120	250	300/ -	800	989	2 100	2 932
	(Nm)	3.16	379	-	-	-	-	-	-
	(Nm)	3.17	-	792	951/ -	-	-	-	-
	(Nm)	3.19	-	-	-	2 552	3 154	-	-
	(Nm)	4.00	480	1 000	1 200/ -	3 200	3 955	8 400	11 726
	(Nm)	4.91	589	-	- / -	-	-	-	-
	(Nm)	5.50	-	1 375	- / 1 375	-	-	-	-
Maximum data:									
Maximum torque in Nm (intermitted loading S6 cycle duration 10 min, ED. max. 60 %)									
Input	(Nm)		140	400	400	900	900	*	*
Output (max. accelerating torque)	(Nm)	1.00	140	400	400	900	1 112	-	-
	(Nm)	3.16	442	-	-	-	-	-	-
	(Nm)	3.17	-	1 268	1 268	-	-	-	-
	(Nm)	3.19	-	-	-	2 871	3 549	-	-
	(Nm)	4.00	560	1 600	1 600	3 600	4 450	-	-
	(Nm)	4.91	687	-	-	-	-	-	-
	(Nm)	5.50	-	2 200	2 200	-	-	-	-
Max. perm. input speed	(rpm)		-	-	-	5 000	5 000	3 500	3 500
in reduction ratio i ≠ 1	(rpm)	≠1	8 000	6 300	6 300	-	-	-	-
for direct drive i = 1[2]	(rpm)	1[2]	12 000 [3]	10 000 [3][4]	10 000 [3][4]	-	-		-
Max. vibration value	(mm/s)		2.0	1.4	1.4	3.0	3.0	5.0	*
reduced	(mm/s)		1.2	1.0	1.0				
INLINE	(mm/s)		1.0	1.0	1.0				
reduced	(mm/s)		0.7	0.7	0.7				
at reference speed	(rpm)		6 000	5 000	5 000	4 000	4 000	3 000	*
Max. axial force in reduction	(N)	3.16	-	-	-	-	-	-	-
ratio in counter clockwise (ccw) operation	(N)	3.17	-	3 090	3 710	-	-	-	-
running and max. input torque	(N)	3.19	-	-	-	-	-	-	
See permissible axial force for motor shaft	(N)	4.00	-	3 964	4 756	-	-	-	
	(N)	4.91	-	-	-	-	-	-	
	(N)	5.50	-	5 288	5 288	-	-	-	
Mass moment of inertia[1]	(J in kgcm^2)	1.00	110	270	270	1 956	*	*	*
Output		4.00	144	570	570	1 766	*	*	*
Input			9	36	36	110	*	*	*
Operating data:									
Oil fill volume in dm^3	Horizontal (B5)		1.0/1.4	1.5	2.8	---------- Recirculating lubrication ----------			
Approx. oil fill in dm^3. Oil level in middle of oil sight glass is most accurate reading	Vertical (V1/V3)		---------- Recirculating lubrication only ----------						
Oil grade for:									
splash lubrication	HLP 68 as per ISO VG 68								
recirculating lubrication	HLP 46 as per ISO VG 46								
rec. lub. with heat exchanger	HLP 32 as per ISO VG 32								
recirculating lubrication with DSL**	HLP 22 as per ISO VG 22								
	for V1 and V3 installation positions oil recirculating system ist mandatory								
Oil change interval	5 000 hours								
Oil temperature	max. 120°C permitted depending on application, installation position, lubrication and cooling								
Weight:									
Standard	(approx. kgs)		30	62	70	110	325	130	400
Electrical connection:									
for shift unit:									
Power consumption	(Watts)		120	120	120	85	85	85	85
Supply voltage at shift unit	(Volts)		24+/- 10%	24+/- 10%	24+/- 10%	24+/- 10%	24+/- 10%	24+/- 10%	24+/- 10%
Current supply at 24V	(Amps)		5	5	5	5	5	5	5

Operator is free to define bearing load and lifetime. See installation drawings or page 13 for bearing data.

1) Mass moments of inertia for other ratios on request.
2) admissible with oil cooler, otherwise $n_{max.}$ for reduction ratio.
3) max. speed only permitted with oil connection at port K (see pages 16, 17 for oil recirculation systems connections).
4) max. speed only permitted with integrated oil channel versions

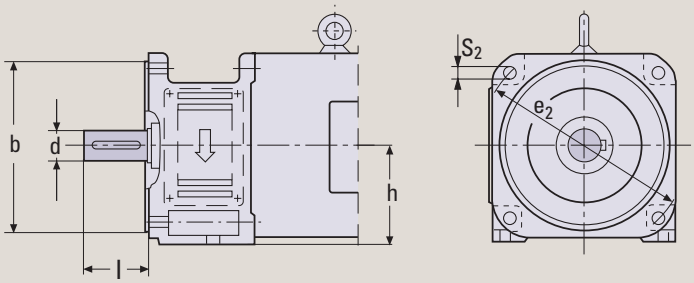
* on request
** DSL=Dry Sump Lubrication
*** i = 5.5 = reduced input torque

Standard Motor Connection Dimensions

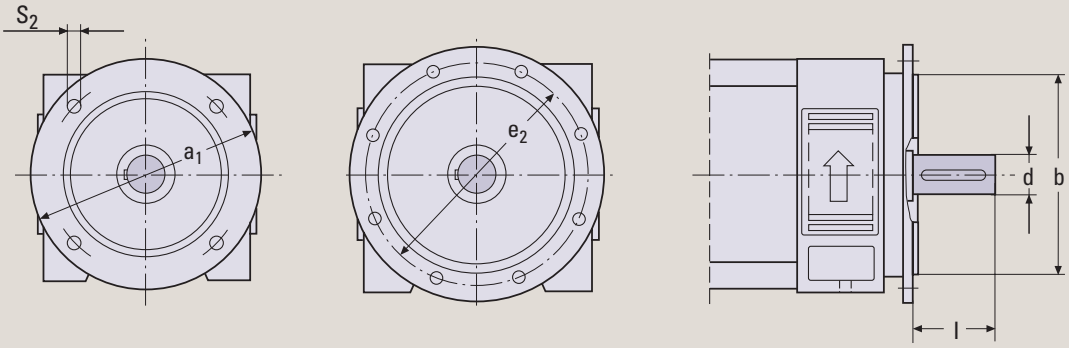
Gearbox sizes:

	2K120	2K121	2K250	2K300	2K800	2K801	2K802	2K2100	2K2100
Motor frame size:	100	112	132	160	180	200	225	225	280
Standard motor connection dim.	EN 50347: 2001								
h	100	112	132	160	180	200	225	225	280
d	38	38	42	55	60	65	75	75	90
l	80+/-0.1	80+/-0.1	110-0.2	110-0.2	140+/-0.2	140+/-0.2	140+/-0.2	140+/-0.2	170+/-0.2
b	180	230	250	300	300	350	450	450	550
e_2	215	265	300	350	350	400	500	500	600
a_1	-	-	-	-	400	450	550	550	660
s_2	14	15	18	18	19	19	19	19	24

2K120 / 2K121 / 2K250 / 2K300



2K800 / 2K801 / 2K802 / 2K2100

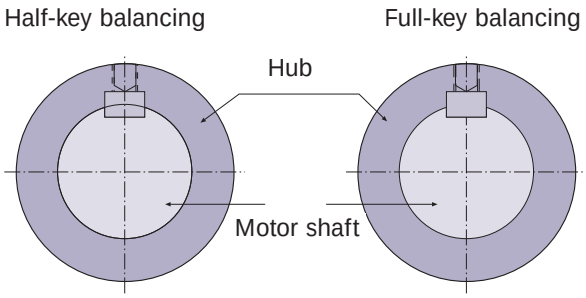


Motor output shafts with standard fitted key

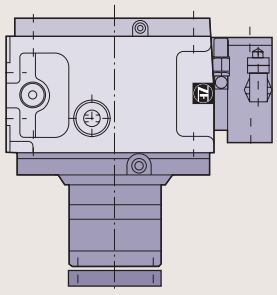
Gearbox sizes ZF-Duoplan	Shaft diameter [mm]	Fitted key b x h [mm]	Fitted key length [mm]
2K 120/121	38	10x8	70
	32	10x8	70
	42	12x8	90
2K250	42	12x8	90
	48	14x9	90
	55	16x10	90
2K300	55	16x10	90
	48	14x9	90
	42	12x8	90
	60	18x11	110
2K800/801	60/65	18x11	110
2K802/2K2100	75	20x12	125
	80	22x14	150

See DIN ISO 8821

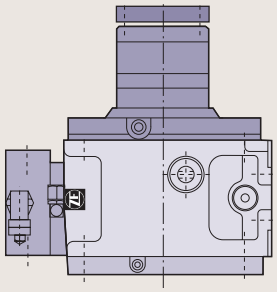
For half-key balancing the key type B is standard. For a full-key balanced motorshaft both types can be used. Application with smooth motorshaft without keyway on request.



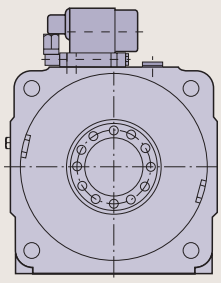
Installation positions

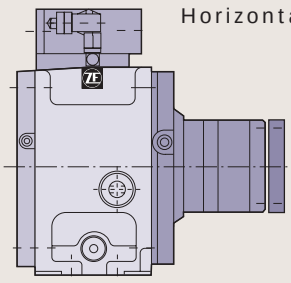


Vertical V1

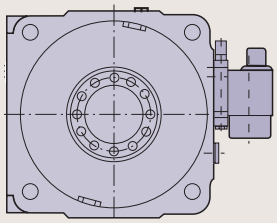


Vertical V3





Horizontal B5



Horizontal B5
Shift unit on right side (view from output).

Gearbox rotated along longitudinal axis
(für 2K120 / 2K250 / 2K300)

Output / Motor interface

Gearbox sizes:

ZF Duoplan	2K120	2K121	2K250	2K300	2K800	2K801	2K802	2K2100
Gearbox Output								
Ø 100	+	+						
Ø 118			+	0				
Ø 130			0	+				
Ø 38	0	0						
Ø 42			0	0				
Ø 55			0	0				
Ø 65					0	0	0	
Ø 180					+	+	+	
Ø with STW					0	0	0	+
Ø without					0	0	0	0
Ø 38 INLINE	0	0						
Ø 42 INLINE			0	0				
Ø 70 TSC *	0	0	0	0				

\+ = Standard
0 = Option

* Version for Through-Spindle-Cooling to facilitate the transfer of cutting liquids like emulsions, hydraulic oils and air-oil mixtures without dissolving or abrasive additives, with up to 140 bars of pressure at a flow rate of 35 l/min through the gearbox and spindle, directly to the tool.

Output

There is a choice of two different output variants. The standard long bearing base output flange version is used for belt drives, allowing high cantilever forces. For the 2K300 an extended output version is optional for even higher belt forces. Further options include short output housings as ZF-Duoplan INLINE for space saving direct drives. This version is supplied as a standard with angular contact bearings. ZF-Duoplan TSC (Through-Spindle-Cooling) allows cutting liquids like emulsions, hydraulic oils and air-oil mixtures with up to 140 bars of pressure at a flow rate of 35 l/min through the gearbox and spindle, directly to the tool.

The STW (spur gearbox with fixed ratio as spindle drive) option is used for high output torque drives in conjunction with 2K800 and 2K2100.

There are two output variants to choose from. Output flanges are standard.
Output shafts or STW (spur gearbox with fixed ratio directly onto spindle) are available as an option.

Motor connection

The hubs are generally fitted with a keyway for power transmission.
It should be noted that the hub must be balanced in the same way as the motor.

There are two types of balancing: Half-key and full-key. In the case of full-key balancing, the motor shaft is balanced with a fitted key, the hub without. The length of the fitted key is unimportant in this instance. In the case of half-key balance, however, the keyway is filled out with a balance compensator. The shape, length, and position of the keyway must be adapted. For this reason, it is necessary to provide ZF with details of the motor - including the relevant dimensions and balancing type - when ordering.

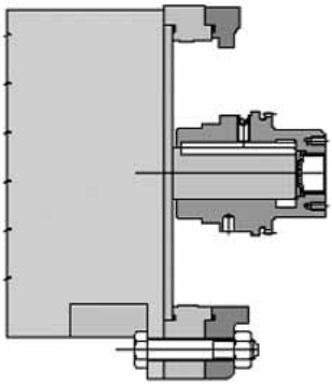
For straight motor shaft a keyless hub with clamping ring is mandatory.To this end and in accordance with DIN 332-2, the motor shaft must feature a centering bore with a thread.

If the motor connection dimensions do not permit direct mounting to the ZF-Duoplan, an adapter plate or adapter ring is required.These adapter parts can be included in the supply on request, depending to motor manufacturer.

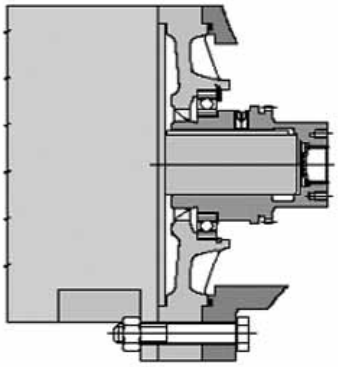
Note

For motor-gearbox units that are fixed in the machine with the gearbox output housing/flange only, no preload support on motor B-side is permitted.

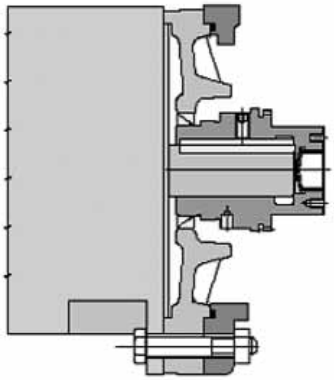
Possible Connections



Open Design
(with/without adapter ring)



Closed Design
(with hub bearing and shaft seal)



Closed Design
(with shaft seal)

Gearbox interface:

Open design
The open version gearbox is without adapter plate. Sealing with motor shaft seal.

Closed design (with hub bearing and shaft seal)
There is a version with ball bearing available for certain motors. The hub in this version is also fixed by the bearing to prevent axial hub movement, rsp. present axial forces from the helical gearing onto the motor shaft (see technical data page 8). Assembly onto spindle motor is made easier due to a fixed hub position as supplied by the factory.

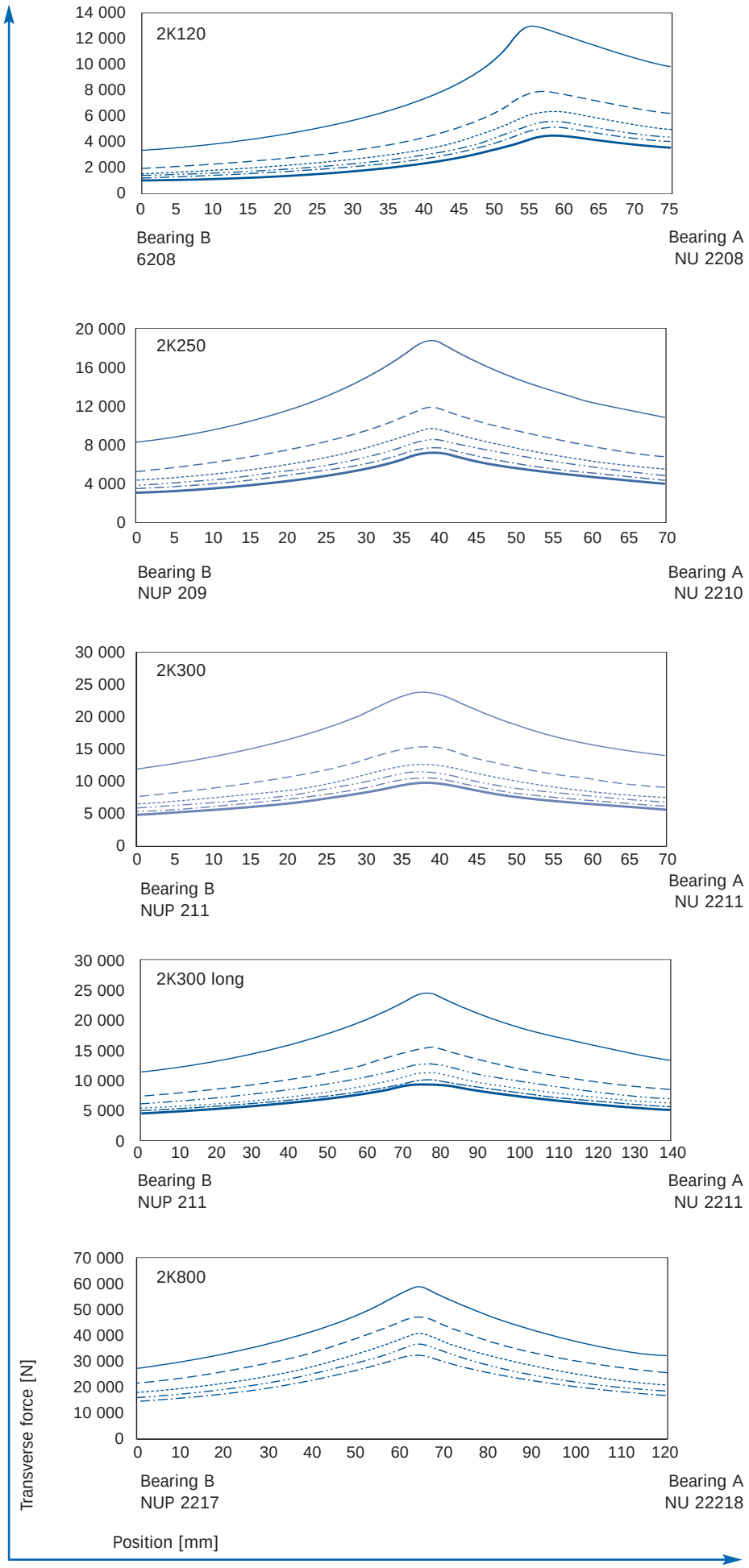
Closed Version (with shaft seal)
This version incorporates an adapter plate with shaft seal, which means that the gearbox forms a compact, closed unit.

Adapter Ring
The adapter ring allows adaptation to different dimensions. A shaft seal is required on the motor shaft.

Input flange: (2K250 / 2K800 / 2K2100)
Besides the classic motor - gearbox - adaptation (motor shaft, key way, hub) we offer - on request - a gearbox with input flange to mount a pulley, clutch or similar (as shown on page 29).

Output bearings
The output bearings vary depending on the type and level of load on the output shaft. Cylindrical roller bearings are used to cope with high radial forces, e.g. in belt pulley drives. In contrast, angular-contact ball bearings are suitable for coaxial drives, low radial backlash or axial forces. The flexible design of the output housings and shafts allows a range of selections.

Versions and Lifetime Calculation based on XY-method



2K120/2K121

nab/out =	325 rpm
nab/out =	1 500 rpm
nab/out =	3 000 rpm
nab/out =	4 500 rpm
nab/out =	6 000 rpm
nab/out =	9 000 rpm

2K250 / 2K300 / 2K300 long

nab/out =	325 rpm
nab/out =	1 500 rpm
nab/out =	3 000 rpm
nab/out =	4 500 rpm
nab/out =	6 300 rpm
nab/out =	8 000 rpm

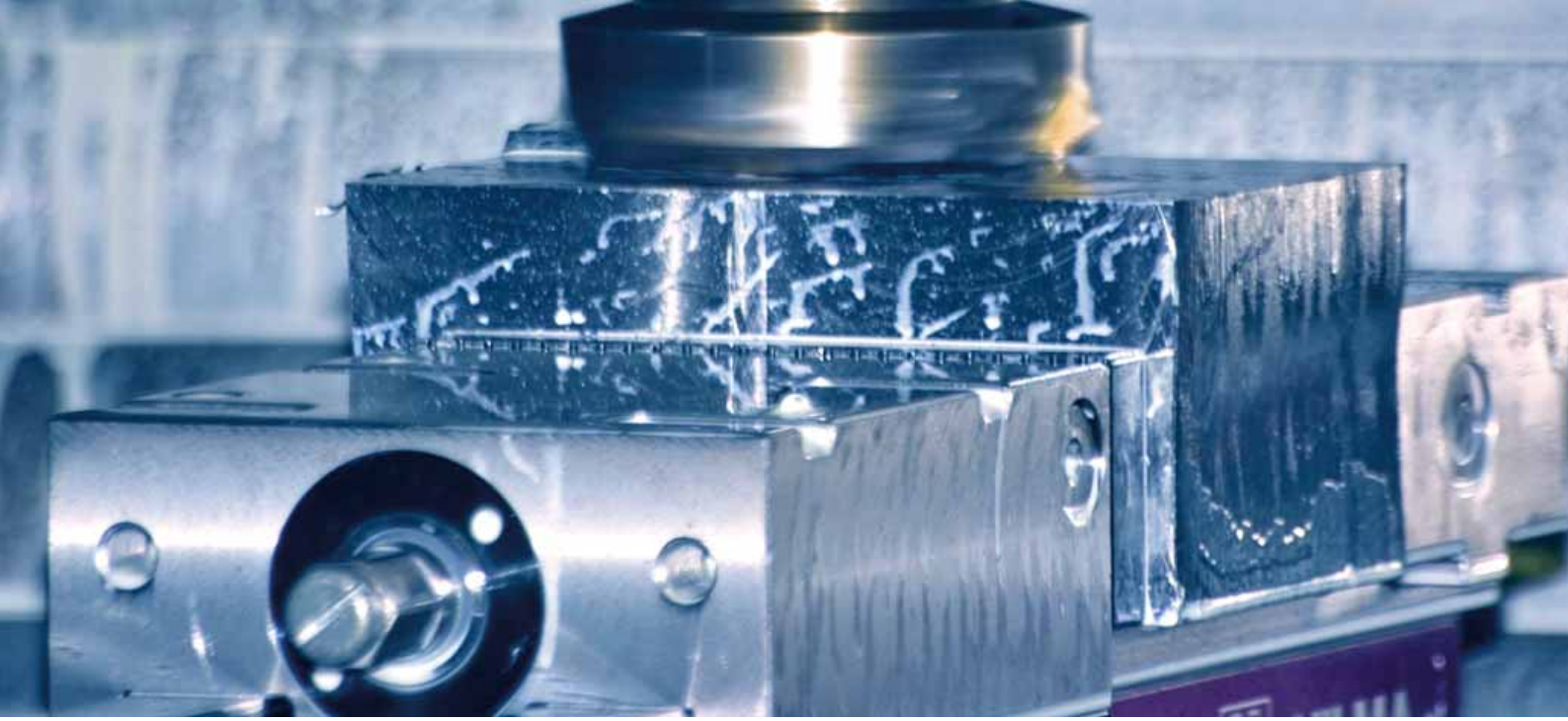
2K800

nab/out =	500 rpm
nab/out =	1 000 rpm
nab/out =	2 000 rpm
nab/out =	3 000 rpm
nab/out =	4 000 rpm

PermittedCantilever Forces

For standard bearing service life = 36,000 hours

Note:
Take into account the motor manufacturer's permitted cantilever forces.



Torsional backlash

Three backlash classes in reduction mode are available:

Class 3*:
Normal torsional backlash ≤ 30 arcmin

Class 2:
Reduced torsional backlash ≤ 20 arcmin

Class 1:
Especially reduced torsional backlash ≤ 15 arcmin

*Torsional backlash in 2K800, 2K801, 2K802 and 2K2100 Class 3: Normal torsional backlash ≤ 40 arcmin

Application and Examples

For Workpiece Processing with Constant Cutting Force
Class 3*: ≤ 30 arcmin
Only for turning machine drives involving workpiece processing with constant cutting force.

a) For turning machine drives when cutting is uninterrupted while the workpiece is being processed or in the case of predominant facing involving cutting speed adjustment.
b) Boring mills
c) Milling machines and machining centres

For Extreme Milling Work
Class 2: ≤ 20 arcmin
For milling machines and machining centres used to execute extreme milling work, e.g. tool side milling cutters with very coarse index/division (interrupted cutting), workpieces made from tough material, milling of ribbed workpieces.

Highly-dynamic Machine Tools
Class 1: ≤ 15 arcmin
As class 2; except in lightweight highly-dynamic machine tools incorporating components with high internal elasticity; designed to prevent resonance vibration.

Lubrication

Splash type lubrication
The standard gearbox version B5 has splash type lubrication. Splash type lubrication is suitable for intermittent operation. In this instance, frequent gear changes, varying speeds and idle time (e.g. due to retooling) are a prerequisite.

Recirculating lubrication
The 2K120 / 2K121 / 2K250 and 2K300 gearboxes (vertical V1 and V3 installation positions) require recirculating lubrication. In this instance, the type of recirculating lubrication depends on the operating temperature levels required.
The 2K800 / 2K801 / 2K802 and 2K2100 gearboxes must always be operated with recirculating lubrication (refer also to installation drawings).

Forced recirculating lubrication
Some applications require a very low operating temperature level. Forced recirculating lubrication is recommended in such instances. Figures on page 16/17 show the possible oil inlet and outlet positions on the gearbox. Please refer to the relevant installation drawings for detailed dimensions.

Standard recirculating lubrication in V1/B5 with oil tank installation
The oil inlet is attached in place of the oil drain plug. The oil flow rate is approx. 1.5 l/min. In the case of V3 vertical installation position, the lubrication oil can be supplied in either radial direction or centrally.

The tank of the pump unit must be ventilated. Oil back pressure in the return pipe to the gearbox must be avoided (Ø min. 20 mm). The tank capacity should be at least ten times the recirculating oil quantity. A 60 µm filter and a pressure limitation valve should also be used as a safeguard.

Recirculating lubrication with heat exchanger
A heat exchanger is installed in the recirculating lubrication system to assure additional temperature reduction. For best cooling results without any influence on lubrication, various connection parts for different installation positions and operating modes are provided.

In order to achieve an optimal temperature development of the gearbox and to enable the max. speeds, an integrated oil channel version is offered (oil port connection see pages 16/17, ordering code see pages 34).

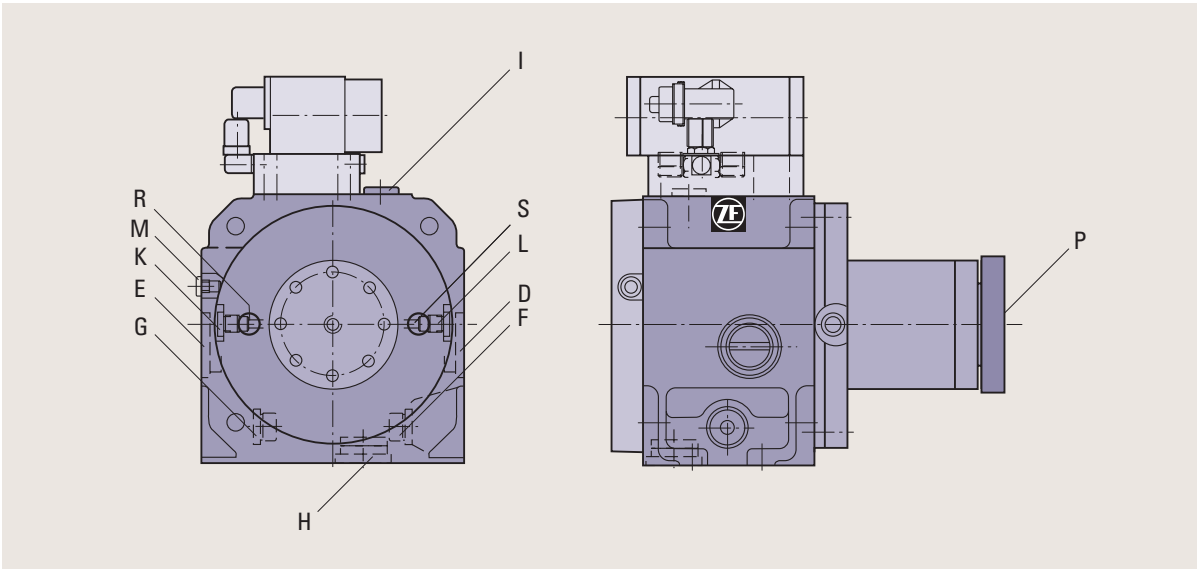
Note
For continuous operation in direct drive one gear change per hour is mandatory with a short turn in reduction ratio. If this is impossible please request special solution.

Connections for recirculating lubrication
2K120, 2K121

Installation position:	Oil inlet *	Max. pressure	Oil outlet *
V1 (closed version)	M (0.5 dm³/min)	0.5 bar	D/E
	K/R and/or L/S (1.0 dm³/min)	0.5 bar	
V1 (open version)	K/R and/or L/S (1.5 dm³/min)	0.5 bar	D/E
B5	G (1.5 dm³/min)	1.5 bar	D/E
	F (1.5 dm³/min)	1.5 bar	
B5 turned, right *	I or F (1.5 dm³/min)	1.5 bar	H
V3	P (1.5 dm³/min)	1.5 bar	H
	or K/R and/or L/S (1.5 dm³/min)	0.5 bar	

*View toward gearbox output:
D/G = Mainly counter clockwise rotation
E/F = Mainly clockwise rotation

Note:
For applications using max. speeds of 12 000 rpm, it is mandatory to use port K and/or L with 1.5 dm³/min. In addition an oil recirculating system using an oil chiller with > 0.3 kW capacity and oil volume >15 litres is necessary.



Connections for recirculating lubrication
2K250, 2K300

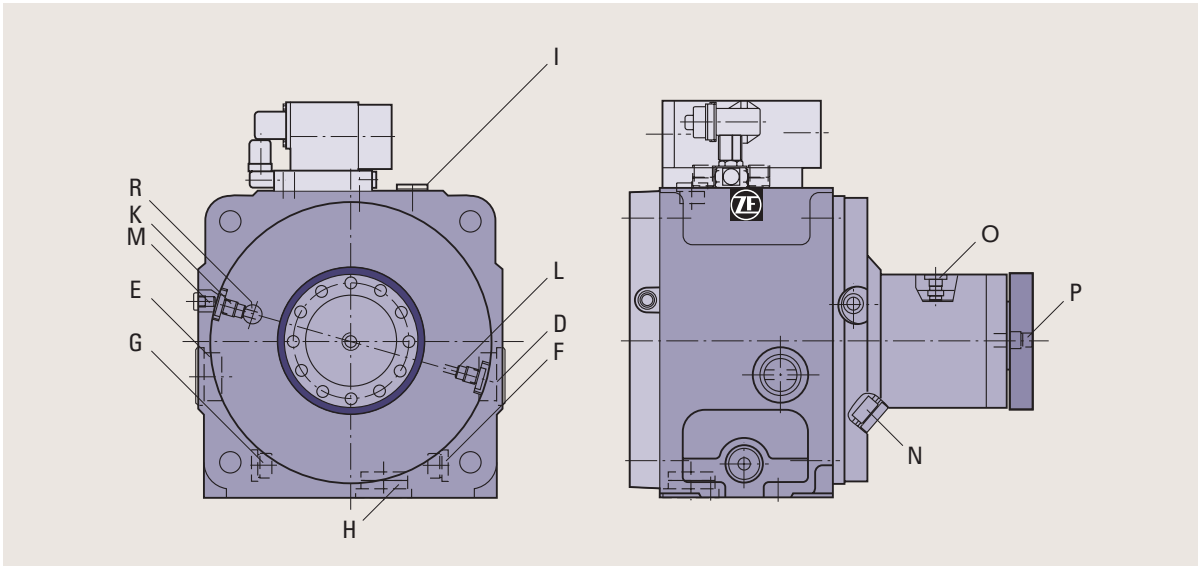
Installation position:	Oil inlet *	Max. pressure	Oil outlet *
V1, V3 (closed version)	**M** (0.5 dm³/min) **K or R** (1.0 dm³/min) **L** additional possible	0.5 bar 0.5 bar 1.5 bar	**D/E**
V1, V3 (open version)	**K or R** (1.5 dm³/min) **L** additional possible	0.5 bar 1.5 bar	**D/E**
B5	**G** (1.5 dm³/min) **F** (1.5 dm³/min)	1.5 bar 1.5 bar	**D/E**
B5 turned, right *	**I or F**	1.5 bar	**H**
V3	**P** (1.5 dm³/min) **or K/R** (1.5 dm³/min) **L** additional possible	1.5 bar 0.5 bar 1.5 bar	**H**

*View toward gearbox output:
D/G = Mainly anti-clockwise rotation
E/F = Mainly clockwise rotation

In V1/V3 recirculation lubrication necessary, connection O optional (0.5 dm³/min)

Note:
For applicatoins using max. speeds of 10 000 rpm port K or R is mandatory. In addition an oil recirculating system using an oil chiller > 0.3 kW and oil volume >15 litres is necessary.

The integrate oil channe version is available for 2K250/300 (see note page 34). This permits a gearbox operation without oil level, however a safety check of oil supply needs to be included in the oil system.



Accessories
Special versions

Oil-air heat exchanger with oil pump for reducing the gearbox temperature
The gearbox can be operated with maximum temperature of 120 °C without any problems; however, increased temperature effect in the machine tool is undesirable in some cases, or constant conditions are required.

There is a choice of two cooling systems: 0.3 kW and 0.6 kW cooling capacity at 1.8 dm^3/min oil flow rate. To increase the oil circulation quantity and the thereby achievable oil temperature reduction, an additional tank with 19 liters capacity is made available for the cooling system. Here, the standard container of the pump is replaced by the additional tank.

Two oil pumps are available with cooling capacity 1.8 or 3.4 dm^3/min volume.

Temperature reduction depends on output loads, speeds, direction of rotation, oil volume rate, oil viscosity and ports for recirculating.

For all V1/V3 installation position applications an oil recirculating system in mandatory. For B5 horizontal mounting it is recommended. (See installation drawings pages 20 to 32 and operating instructions).

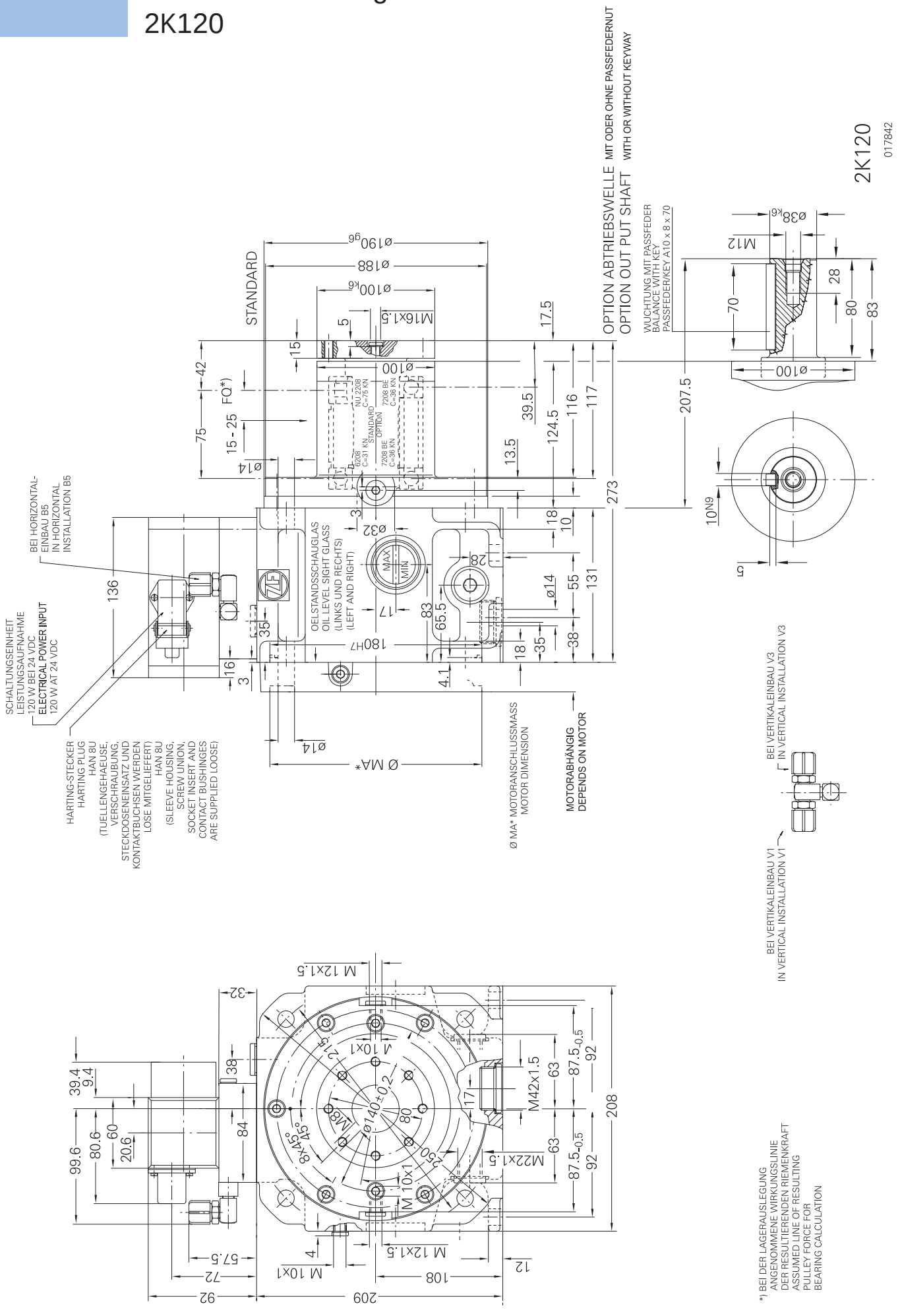
The available integrated oil channel version for 2K250/300 permits a dry sump lubrication, avoiding splash energy loss and thus achieving lower temperatures. Further this eliminates rotational direction dependent tempe rature development. Using a recirculating system the oil is hereby carried directly to the components requiring lubrication.

Special versions
ZF offers gearbox technology for your innovative and specific demands.
Please do not hesitate to contact us.

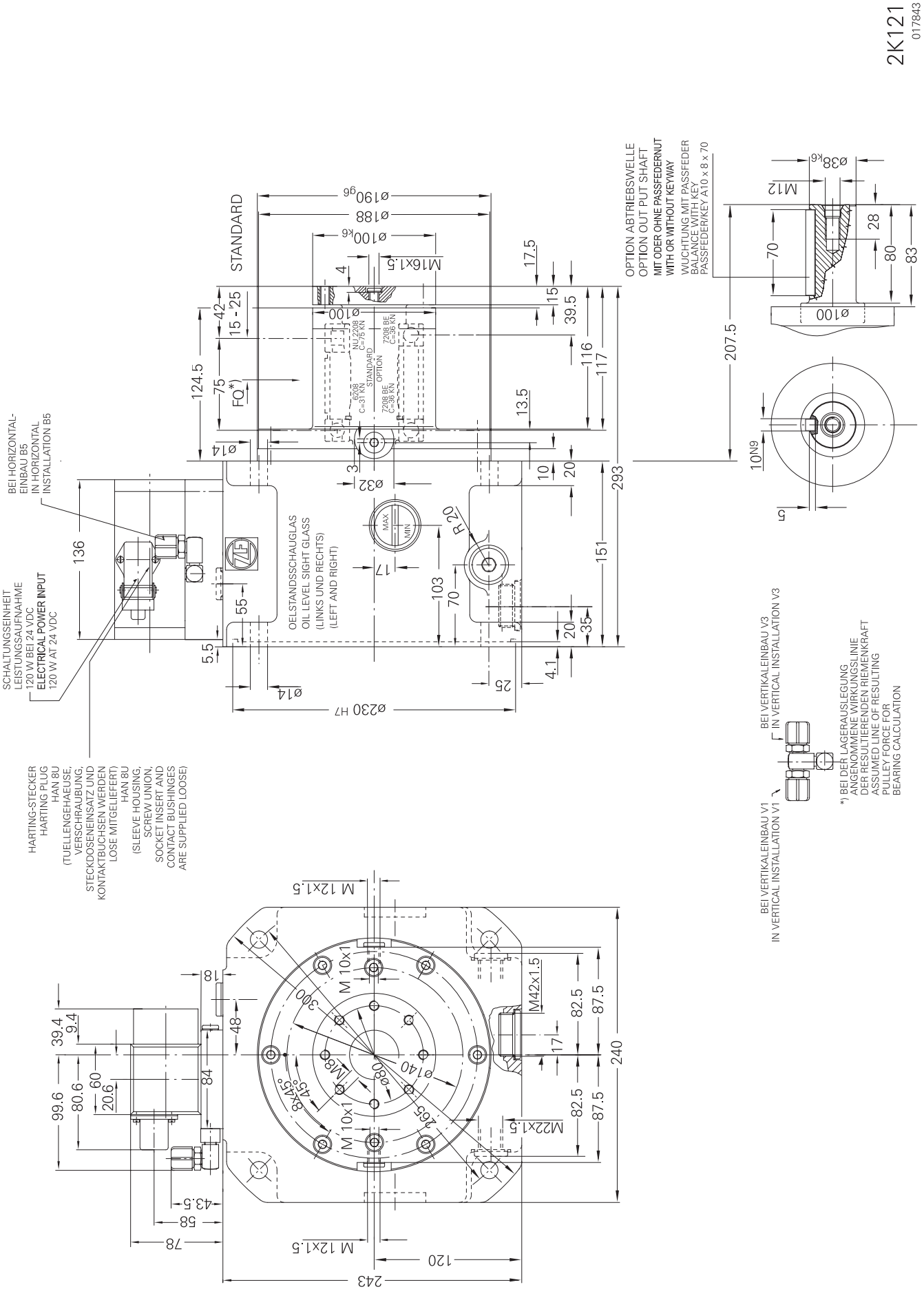
Installation Drawings

2K120	P. 20
2K121	P. 21
2K120/121 INLINE TSC	P. 22
2K250	P. 23
2K300	P. 24
2K250/300 INLINE TSC	P. 25
2K800	P. 26
2K801	P. 27
2K802	P. 28
Options 2K800/801/802	P. 29
2K2100	P. 30
Oil Pump	P. 31
Heat Exchanger TL1/TL4	P. 32

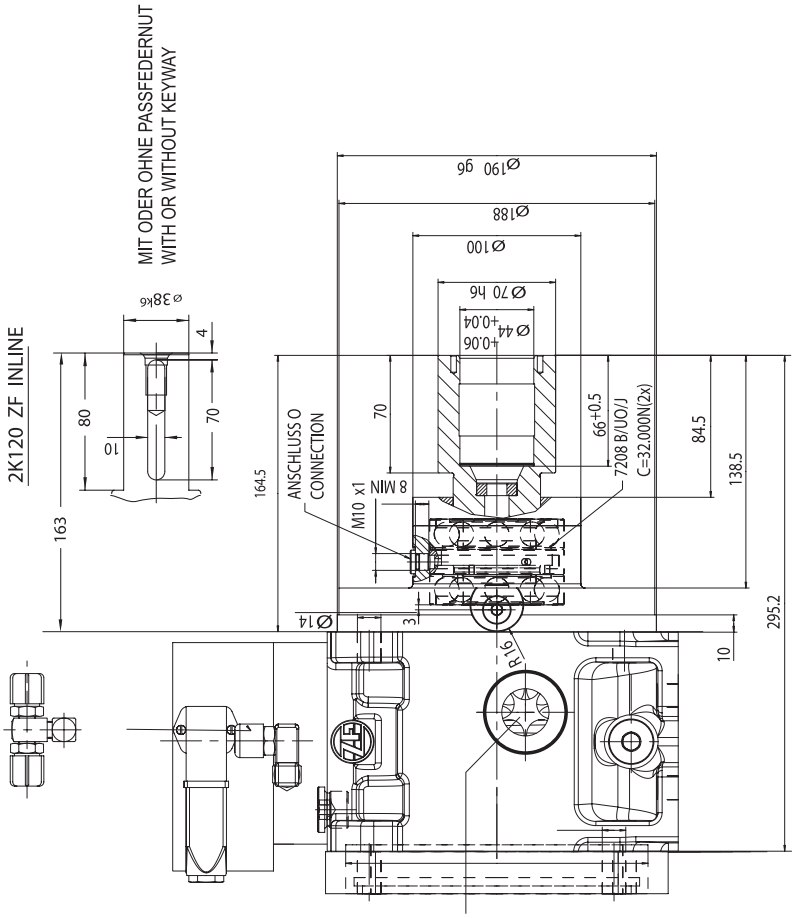
Installation Drawing: 2K120

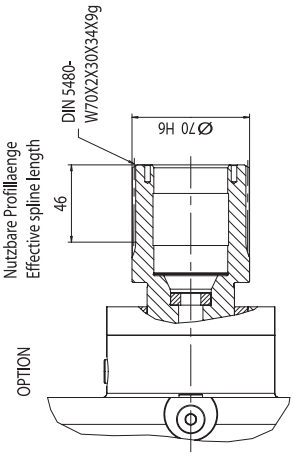


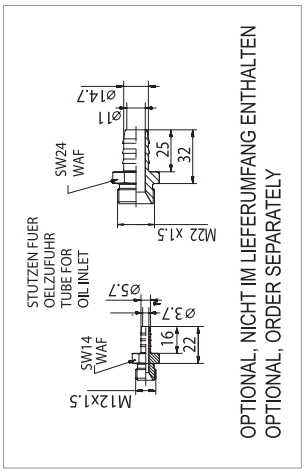
Installation Drawing:
2K121



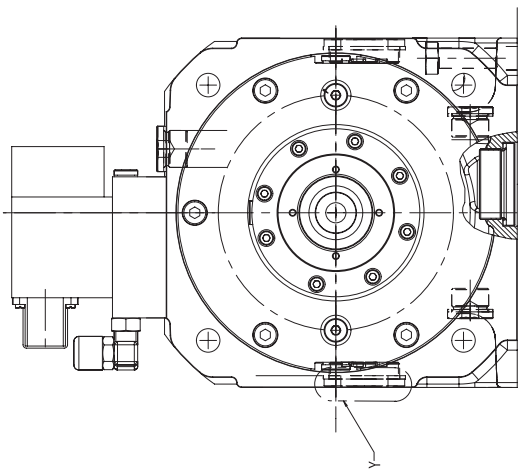
Installation Drawing:
2K120/121 INLINE + TSC

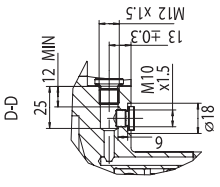


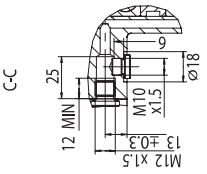


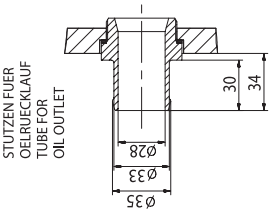


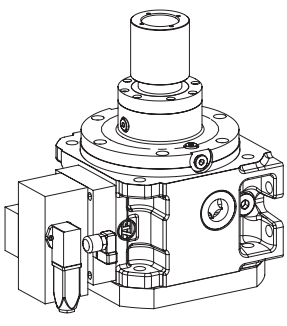
Dimensions of basic gearbox see installation drawing p. 20/21



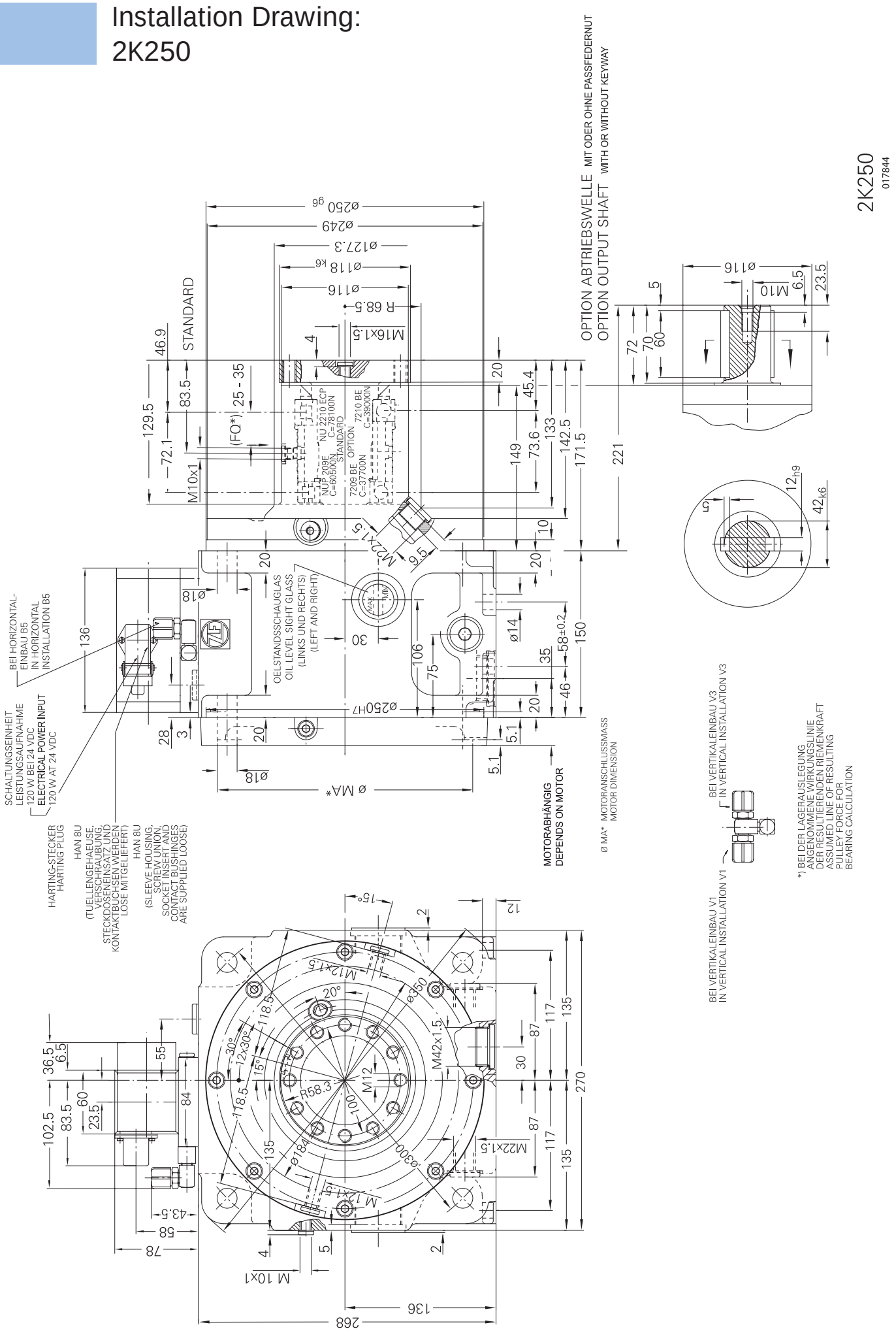




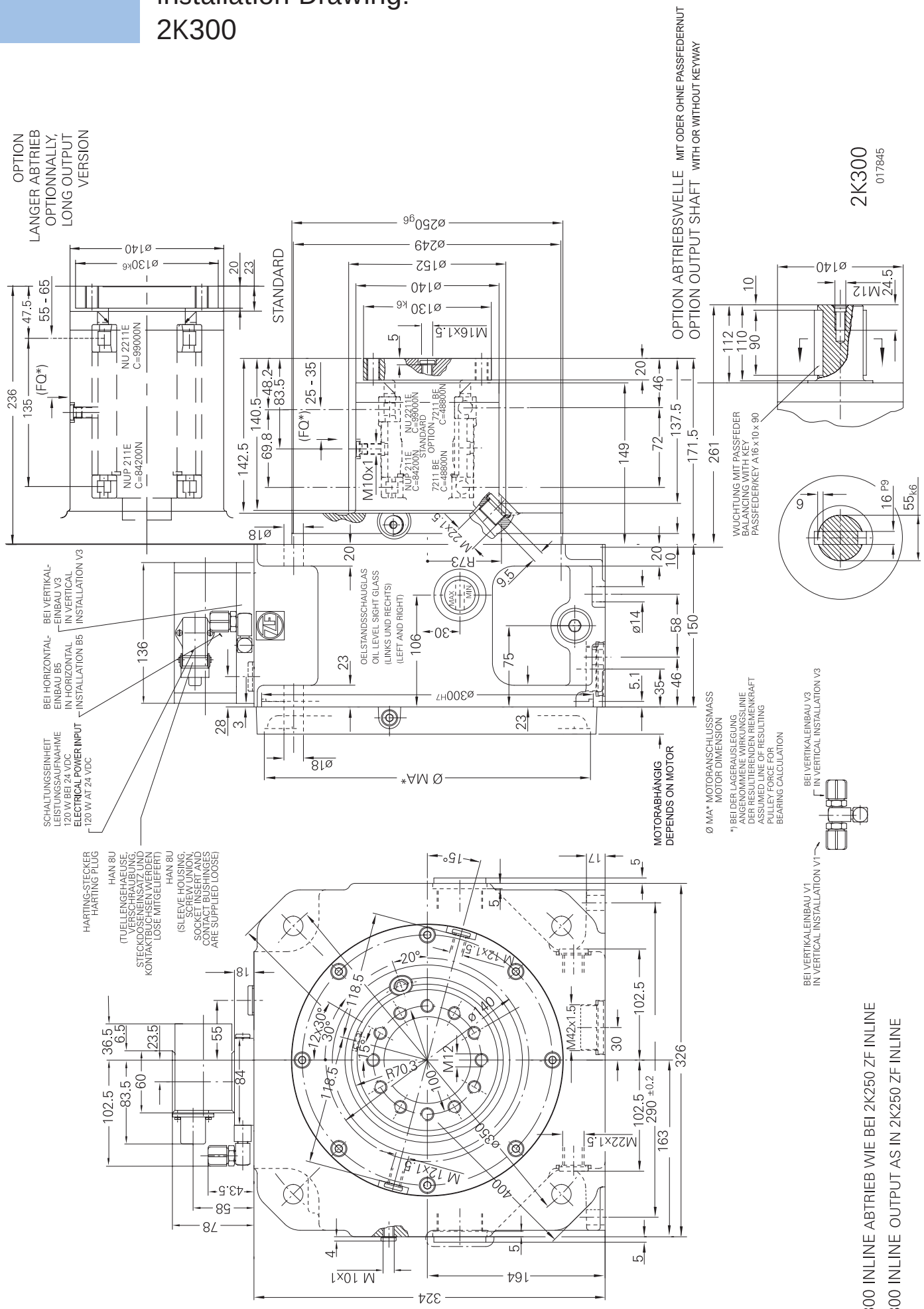




Installation Drawing: 2K250



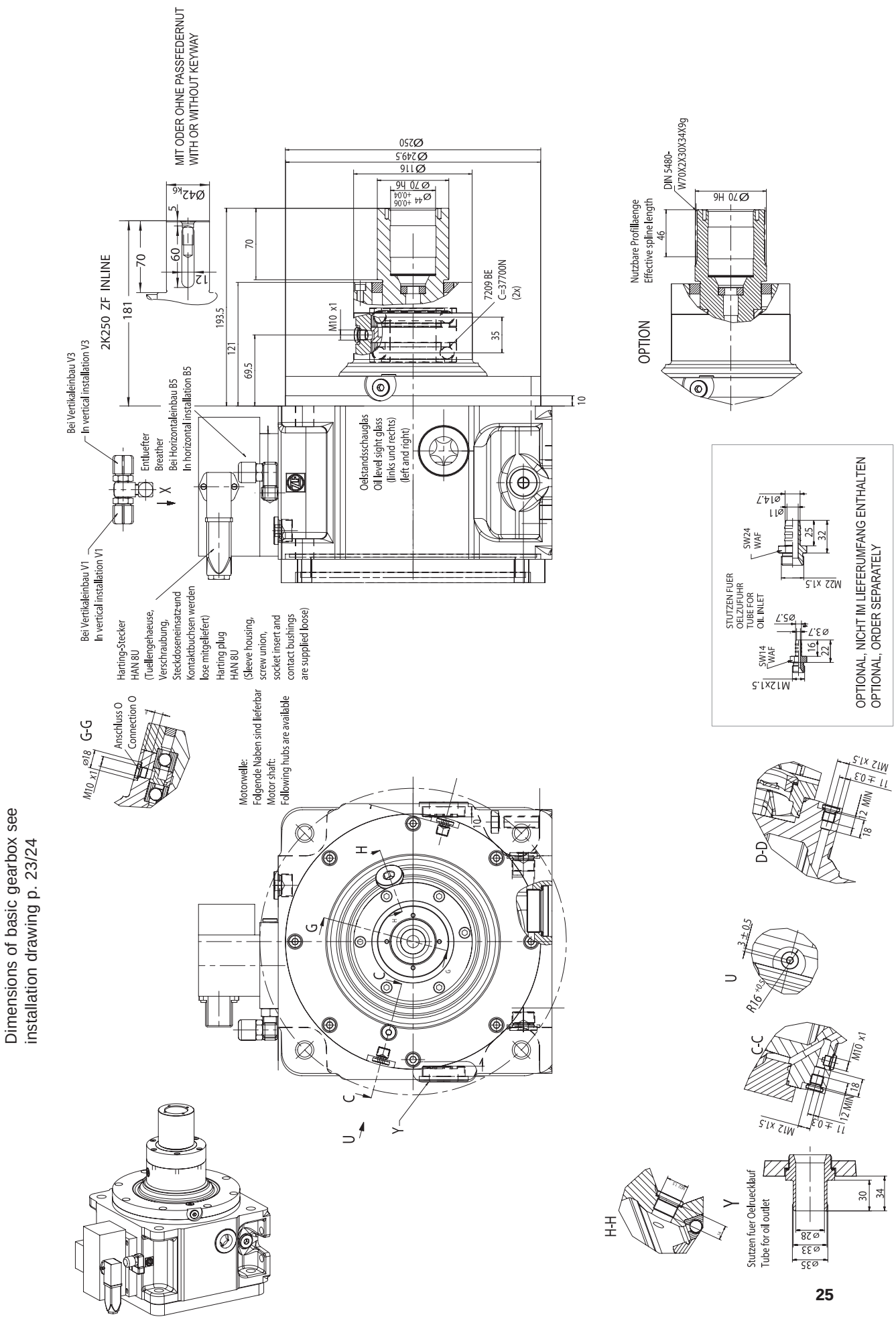
Installation Drawing: 2K300



2K300 INLINE ABTRIEB WIE BEI 2K250 ZF INLINE

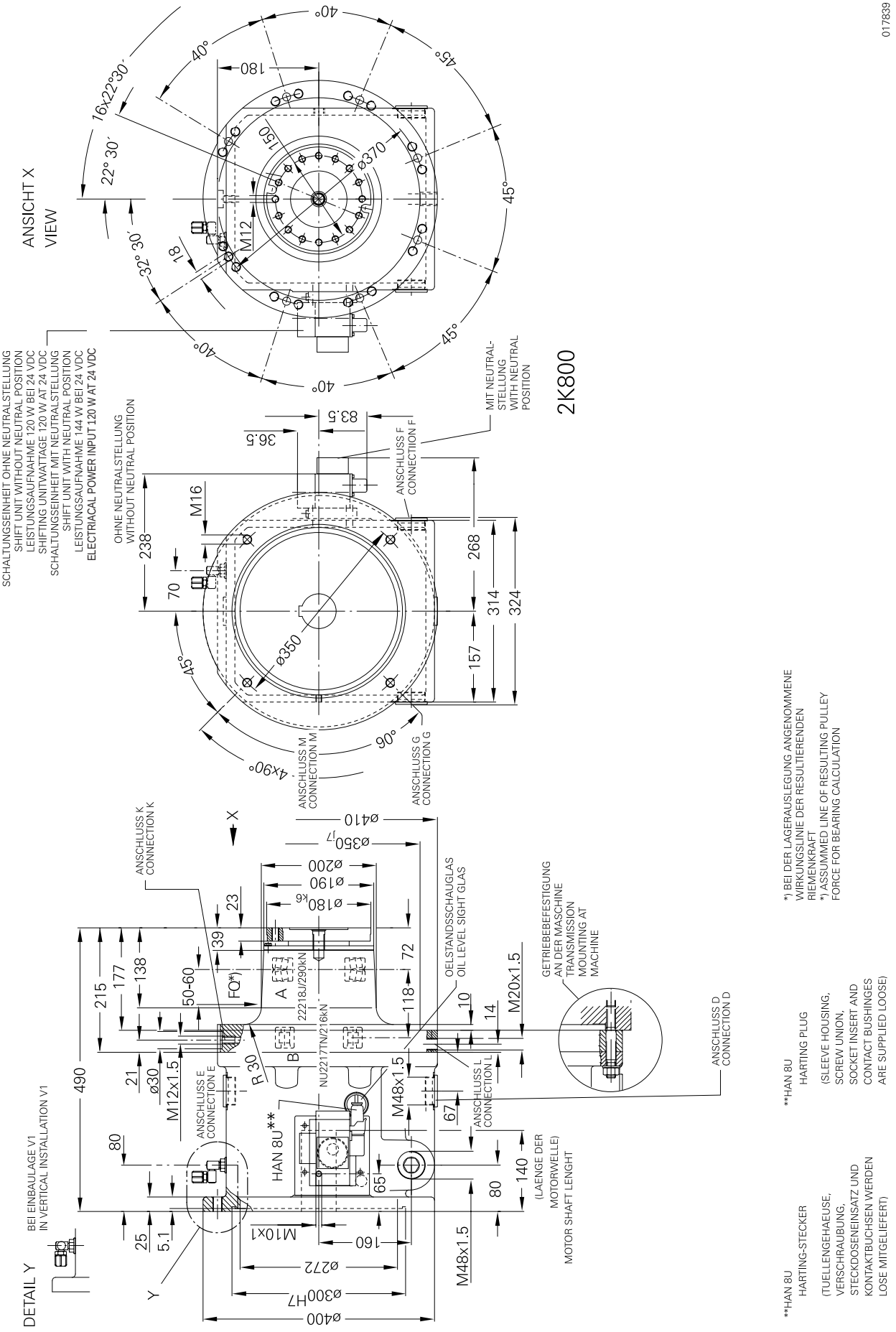
2K300 INLINE OUTPUT AS IN 2K250 ZF INLINE

Installation Drawing:
2K250/300 INLINE, 2K250/300 TSC

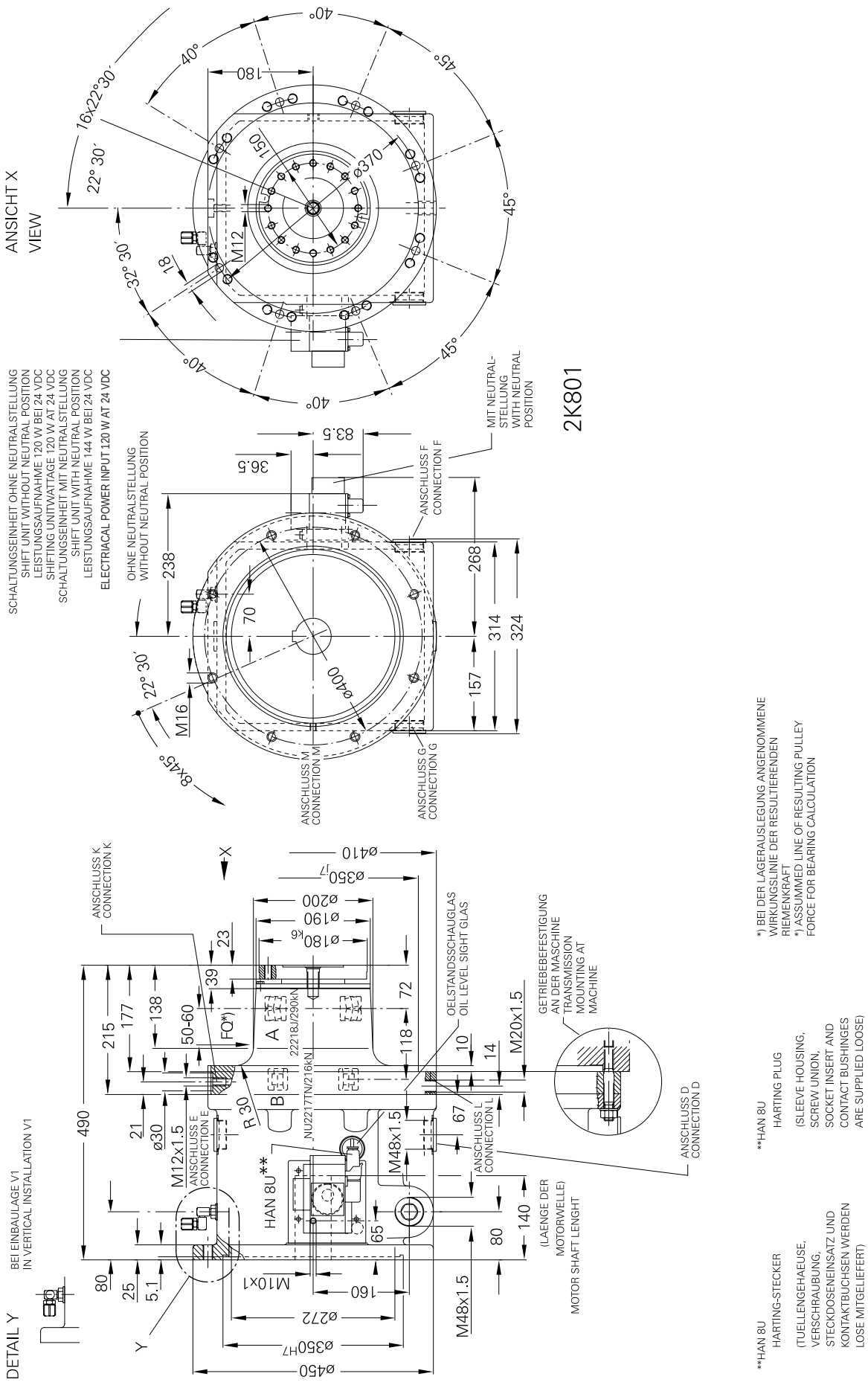


Dimensions of basic gearbox see installation drawing p. 23/24

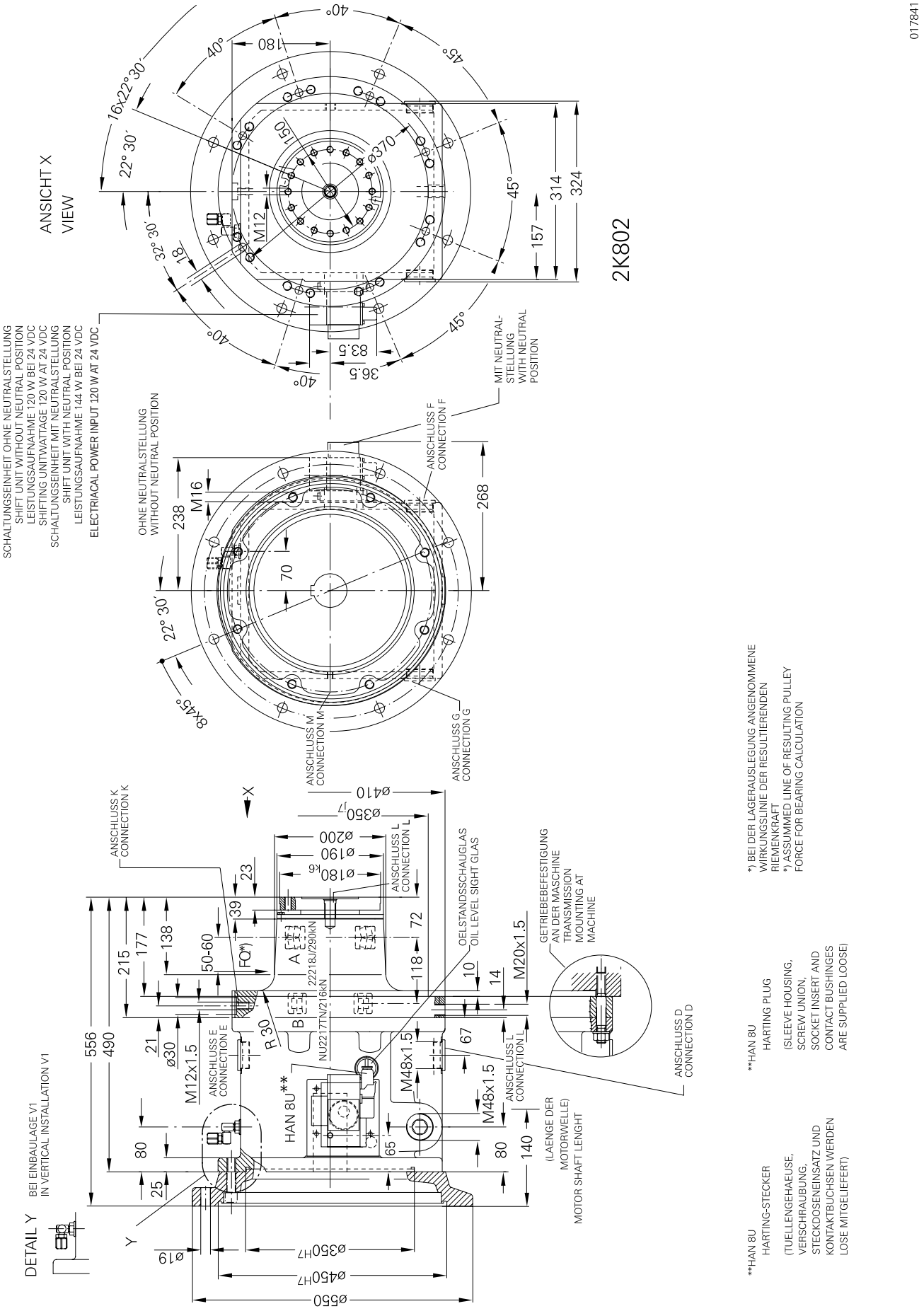
Installation Drawing: 2K800



Installation Drawing:
2K801

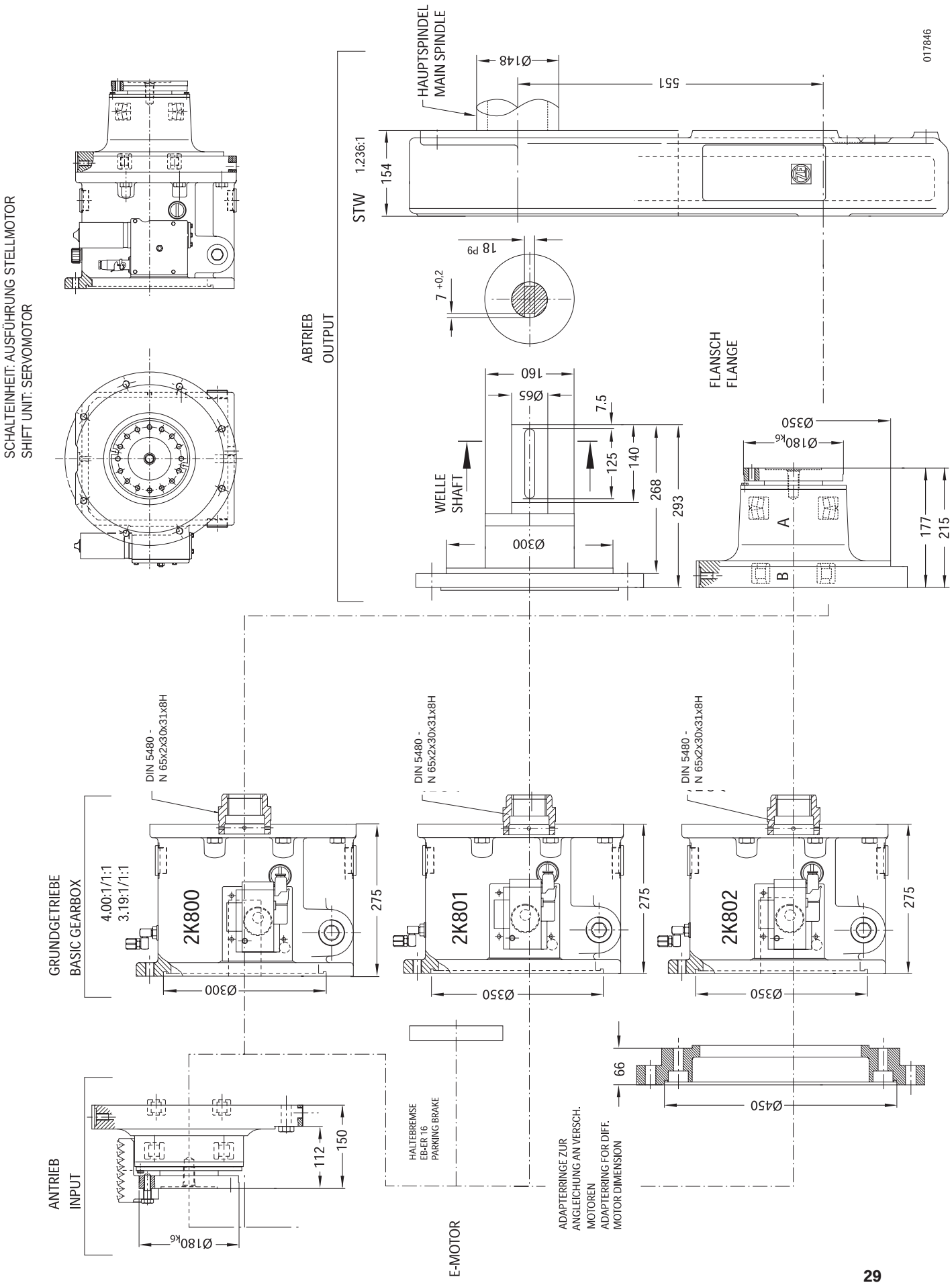


Installation Drawing:
2K802



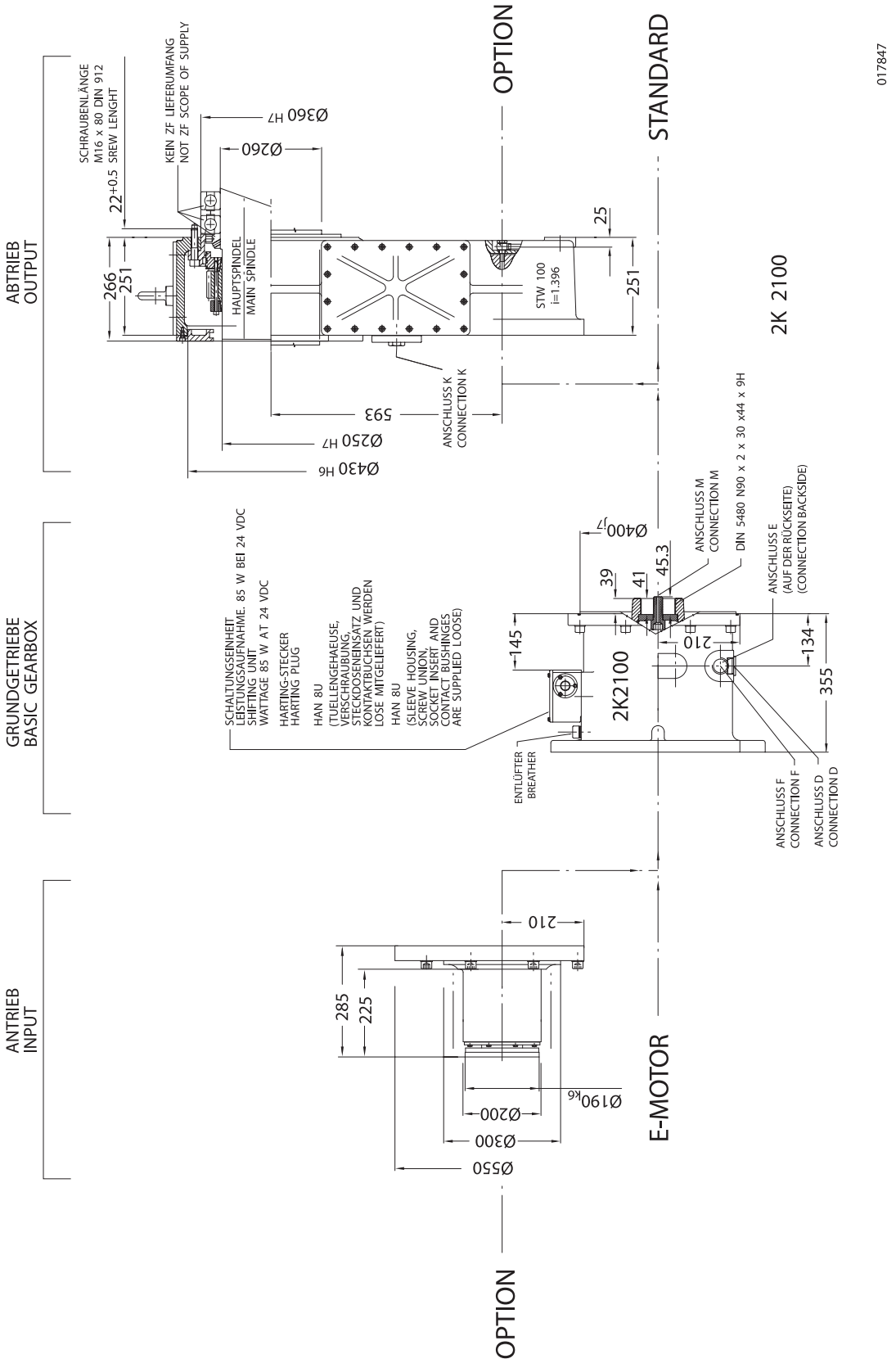
017841

Installation Drawing:
Options for 2K800, 2K801, 2K802

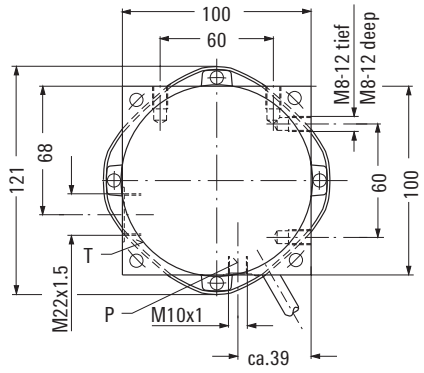


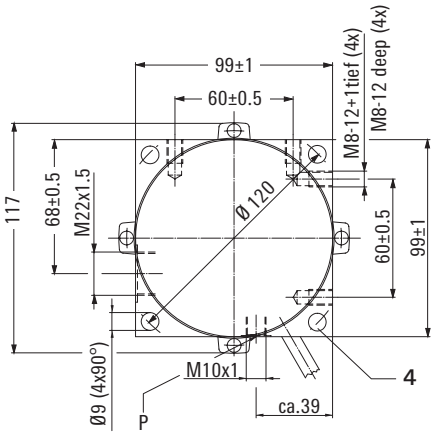
Installation Drawing: 2K2100

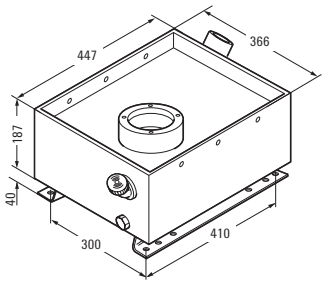
Technical support on request



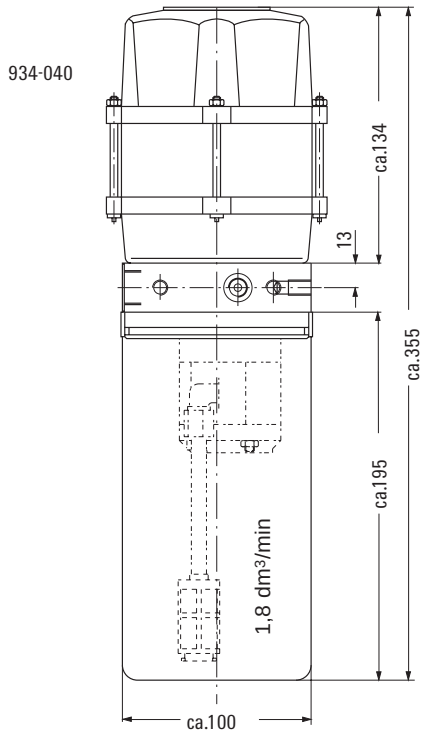
Installation Drawing: Oil Pump

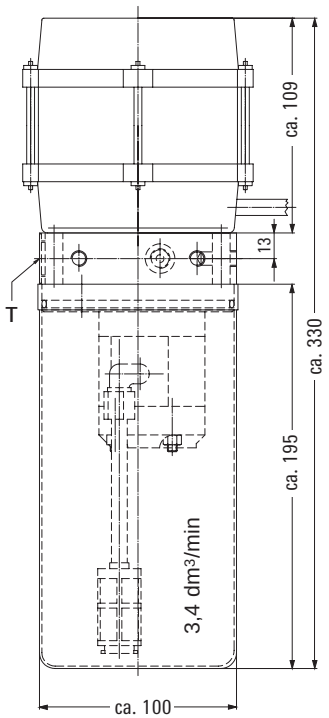


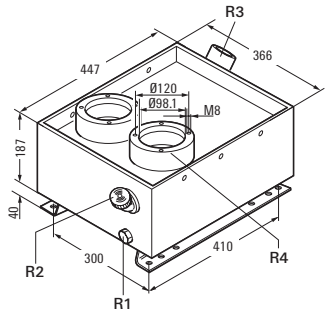




Tank volume 19 l
for 1 pump





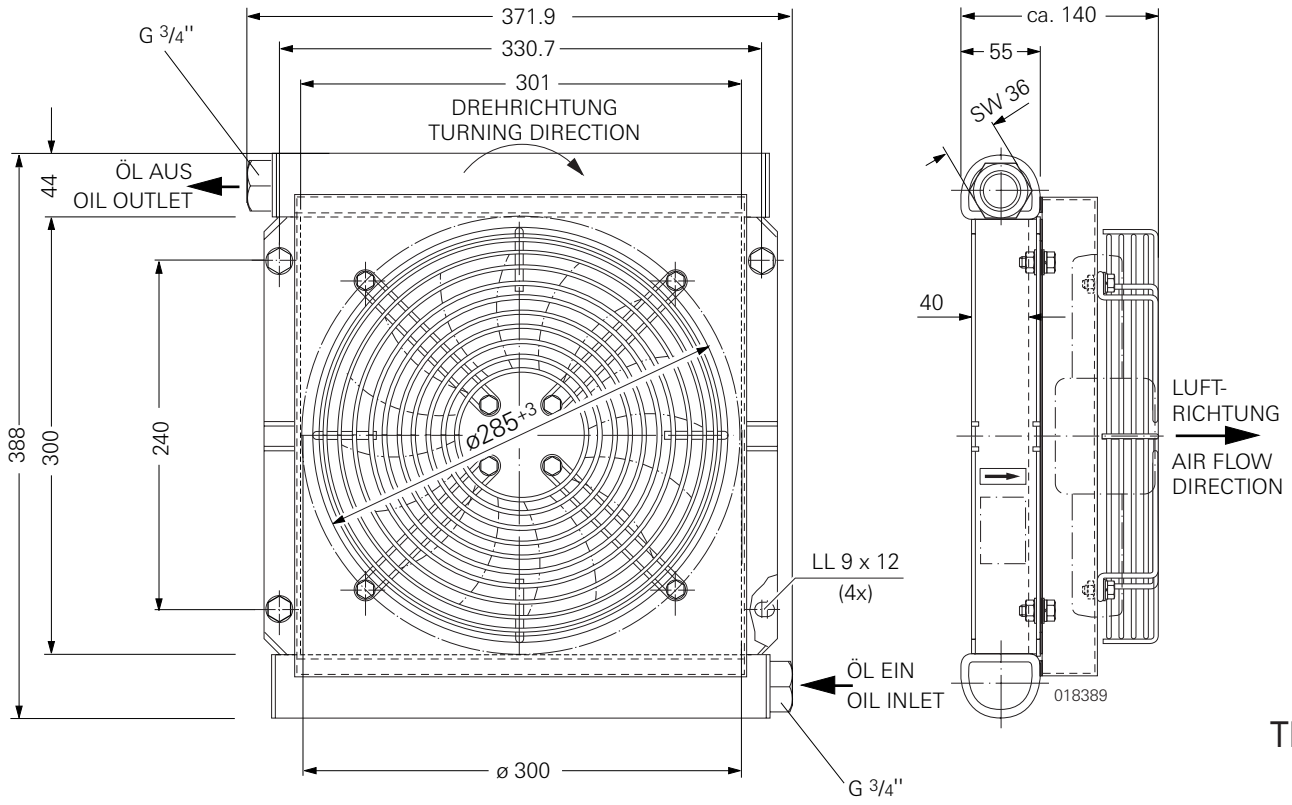


Tank volume 19 l
for 2 pumps

Technical Data

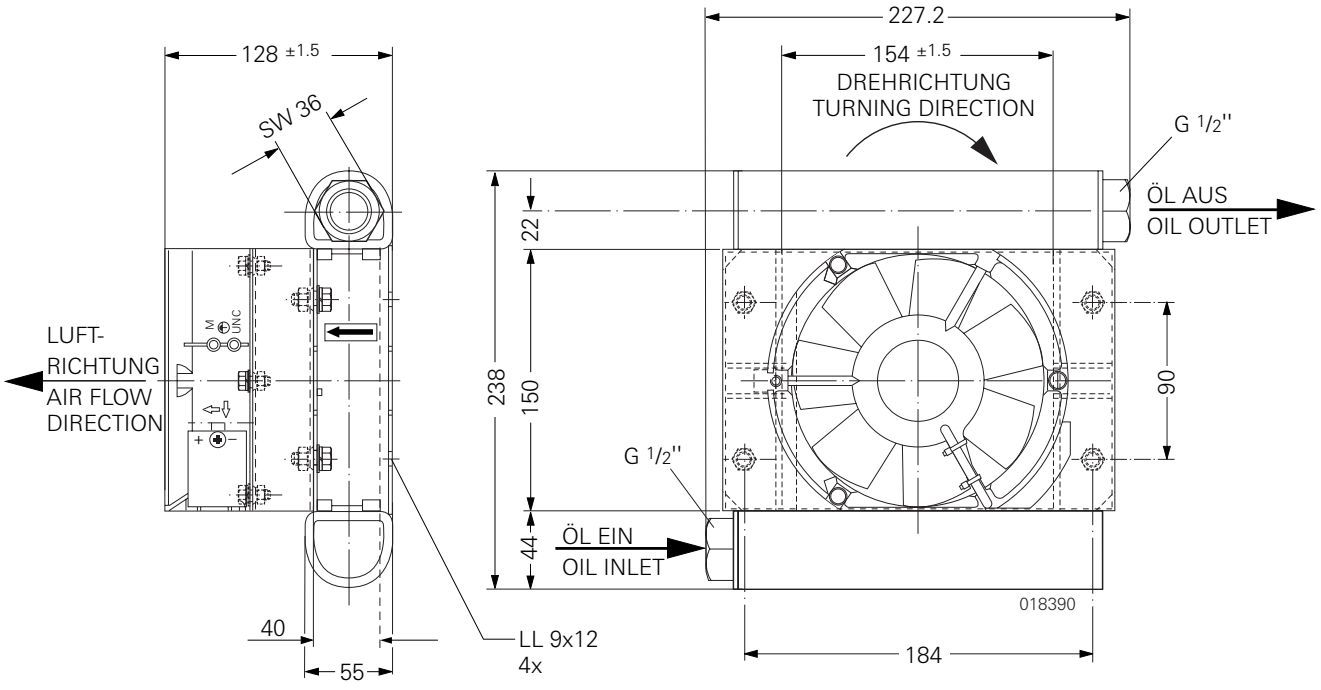
	Pump with 1.8 dm³/min	Pump with 3.4 dm³/min
Nominal voltage:	115 V AC 50/60 Hz switchable 230 V AC 50/60 Hz	400 V AC 50/60 Hz
Nominal speed:	3 000 / 3 600 rpm	2 850 / 3 420 rpm
Nominal power:	100 W	
Operating mode:	S1 (100 % ED)	
Degree of protection:	IP 44	
Temperature class:	F	
Winding shield contacts:	160° C connected and fitted	
Cable length:	1000 +/- 30 mm (9-pole)	
Running capacitor:	C_B = 25 µF (not included in scope of supply)	-----
Delivery rate:	0.61 cm³/rev	1.21 cm³/rev
Nominal pressure:	> 2 bar	> 6.5 bar
Intake filter:	Fineness 100 µm	

Installation Drawing:
Heat Exchanger TL1/TL4



TL-4

Fan: Nominal voltage 24 V
Nominal performance 113 W



TL-1

Fan: Nominal voltage 24 V
Nominal performance 41 W

ZF-Duoplan Standard, INLINE, TSC

Ordering numbers for gearbox types 2K120/2K121

Special versions

2	L	G					–						–				
1	2	3	4	5	6	7	–	8	9	10	11	12	–	13	14	15	16

Note:
- **Standard = Bold type**
- Option = Normal type

1) RWDR = Radial shaft seal
* motor-specific, on request

Two-speed gearbox	
Motor balancing:	
without keyway* central thread mandatory	1
Full-key	**4**
Half-key*	5
Gearbox interface (s.P. 12):	
Open without hub	0
Open with hub	**2**
Closed with hub and hub bearing and RWDR[1]) *	3
Closed with hub and RWDR[1]) *	4
Open with hub and adapter ring *	5
Gearbox type:	
for motor frame size/ratio	
100/i_1 = 4. 00	**12**
100/i_1 = 3. 16	13
100/i_1 = 4. 91	09
112/i_1 = 4. 00	**11**
112/i_1 = 3. 16	14
112/i_1 = 4. 91	08
Output bearings:	
Cylindrical roller / ball bearings	**3**
Angular-contact ball bearings	4
Gearbox output:	
a_1 = 38 mm	B
a_1 = 100 mm	**C**
a_1 = 38 mm smooth, without Keyway	L
a_1 = 38 mm (2K120/2K121) INLINE	P
a_1 = 38 mm smooth, without Keyway (2K120/2K121) INLINE	G
a_1 = 70x 70 mm (2K120/2K121) INLINE, TSC	U
a_1 = 70x 70 mm, DIN5480 INLINE, TSC	W
Installation position:	
V1/ V3 / B5 / B5 (rotated around longitudinal axis to the right side)	**C**
V3 Central lube oil supply in output shaft/Radial lube oil supply in bearing housing	B
Motor shaft diameter "d"	
without hub	0
28 mm	1
32 mm	2
38 mm	**3**
42 mm	4
48 mm	9
Torsional backlash on gearbox output:	
Normal backlash max. 30 arcmin	**1**
Reduced backlash max. 20 arcmin	3
Minimal reduced backlash max. 15 arcmin	4
Reduced vibration (1.2 mm/s ZF-Duoplan) (0.7 mm/s INLINE)	S

ZF-Duoplan Standard, INLINE, TSC

Ordering numbers for gearbox types 2K250/2K300

Note:
- **Standard = Bold type**
- Option = Normal type

1) RWDR = Radial shaft seal
* motor-specific, on request

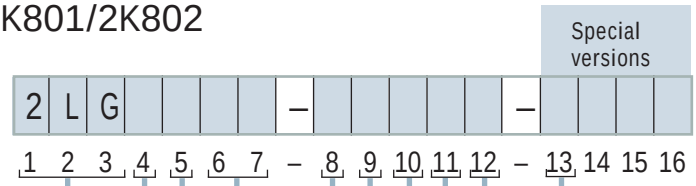
2	L	G					–						–				
1	2	3	4	5	6	7	–	8	9	10	11	12	–	13	14	15	16

Special versions

Two-speed gearbox	
Motor balancing:	
without keyway*, central thread mandatory, motor shaft diameter max. d=55 mm	1
Full-key	**4**
Half-key*	5
Gearbox interface (s.P. 12):	
Open without hub	0
Open with hub	**2**
Closed with hub and hub bearing and RWDR[1]) *	3
Closed with hub and RWDR[1]) *	4
Open with hub and adapter ring *	5
Input flange D= 118 only for 2K250 Standard	9
Gearbox type:	
for motor frame size/ratio	
132/i_1 = 4. 00	**15**
132/i_1 = 3. 17	16
132/i_1 = 5. 50 (not for TSC)	17
160/i_1 = 4. 00	**20**
160/i_1 = 3. 17	21
160/i_1 = 5. 50 (not for TSC)	22
Output bearings:	
Cylindrical roller / ball bearings	**3**
Angular-contact ball bearings	4
Gearbox output:	
a_1 = 118 mm (2K250)	**F**
a_1 = 130 mm (2K300)	**J**
a_1 = 42 mm (2K250)	K
a_1 = 42 mm smooth without keyway	L
a_1 = 55 mm smooth without keyway	N
a_1 = 55 mm smooth without keyway, INLINE	H
a_1 = 55 mm (2K300)	M
a_1 = 42 mm INLINE	P
a_1 = 130 mm wide bearing base	R
a_1 = 70x 70 mm INLINE, TSC	U
a_1 = 70x 70, DIN 5480 INLINE, TSC	W
a_1 = 42mm smooth without keyway INLINE	G
Installation position:	
B5	**D**
V1 / V3 / B5 (turned around longitudinal axis to the right side)	C
V3 Central lube oil supply in output shaft/Radial lube oil supply in bearing housing	B
Motor shaft diameter "d"	
2K250 2K300	
without hub	0
42 mm 55 mm	**1**
48 mm 48 mm	2
55 mm 42 mm	3
60 mm 60 mm	4
Torsional backlash on gearbox output:	
Normal backlash max. 30 arcmin	**1**
Reduced backlash max. 20 arcmin	3
Minimal reduced backlash max. 15 arcmin	4
Reduced vibration (1.0 mm/s ZF-Duoplan) (0.7 mm/s INLINE)	S
Integrated oil channel version for max. speeds and dry sump lubrication (for B5 please order V1 version).	M

ZF-Duoplan Standard

Ordering numbers for gearbox types 2K800/2K801/2K802



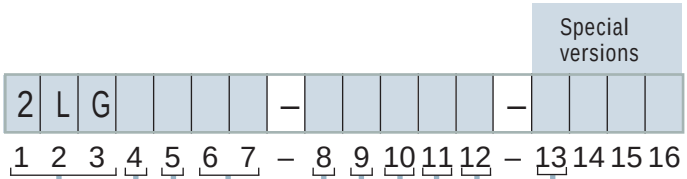
Note:
- **Standard = Bold type**
- Option = Normal type

1) RWDR = Radial shaft seal
* motor-specific, on request

Two-speed gearbox	
Motor balancing:	
Full-key	**4**
Half-key*	5
Gearbox interface (s.P. 12):	
Open without hub	0
Open with hub	**2**
Closed with hub and RWDR[1]) *	4
Open with hub and adapter ring *	5
Input flange (Ø= 180 k6)	9
Gearbox type:	
for motor frame size/ratio	
180/i_1 = 4. 00 spigot diameter 300	**50**
180/i_1 = 3. 19 spigot diameter 300	51
200/i_1 = 4. 00 spigot diameter 350	**60**
200/i_1 = 3. 19 spigot diameter 350	61
225/i_1 = 4. 00 spigot diameter 450	**70**
160/i_1 = 3. 19 spigot diameter 450	71
Holding brake:	
without holding brake	**1**
with holding brake	2
Gearbox output:	
without	N
a_1 = 65 mm	H
a_1 = 180 mm	**J**
a_1 = 180 mm wide bearing base	R
STW	S
Installation position:	
V1/ B5	**C**
V3	B
Motor shaft diameter "d"	
without hub	0
60 mm	**1**
65 mm	**2**
75 mm	**3**
80 mm	4
70 mm	5
Torsional backlash on gearbox output:	
Normal backlash max. 40 arcmin	**1**
Neutral shift position	N
Shifting unit servomotor	A

ZF-Duoplan Standard

Ordering numbers for gearbox types 2K2100



Note:
- **Standard = Bold type**
- Option = Normal type

1) RWDR = Radial shaft seal
* motor-specific, on request

Two-speed gearbox	
Motor balancing:	
Full-key	**4**
Half-key*	5
Gearbox interface (s.P. 12):	
Open without hub	0
Open with hub	**2**
Closed with hub and RWDR[1]) *	4
Open with hub and adapter ring *	5
Input flange (Ø= 190 k6)	9
Gearbox type:	
for motor frame size/ratio	
spigot diameter 450; FF500	**80**
spigot diameter 400; Special motor	82
spigot diameter 350; FF400	84
spigot diameter 550; FF600	86
spigot diameter 680; FF740	88
Holding brake:	
without holding brake	**1**
Gearbox output:	
without	**N**
STW	S
a1 = Ø 90 x 140; keyway; 2 x 25 x 14 x 125	H
a1 = Ø 90 x 140; smooth	G
Installation position:	
V1/ B5	**C**
V3 Central lube oil supply in output shaft	B
Torsional backlash on gearbox output "d"	
without hub	0
75 mm x 140	**1**
80 mm x 170	2
90 mm x 170	3
95 mm x 170	4
Torsional backlash on gearbox output:	
Normal backlash max. 40 arcmin	**1**
Neutral shift position	**N**

Request for Quotation

For quickest response please provide the following data to us by
Fax: ++49/(0)7541/77-2379 or
E-Mail: industrial-drives@zf.com

1. Motor

motor brand:

type:

size:

nominal power (kW):

max. torque (Nm):

motor operating speed n_1 to n_2 (rpm) at constant power:

max. speed (rpm):

motor shaft diameter d (mm):

motor shaft length l (mm):

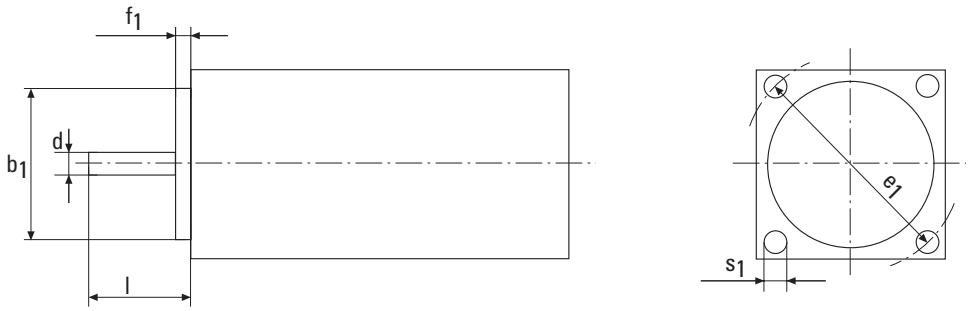
pilot diameter b_1 (mm):

pilot width f_1 (mm):

pcd e_1 (mm):

hole diameter s_1 (mm):

fitting key l x b x h (mm):



☐ Motor shaft with keyway ☐ Motor shaft without keyway

☐ Motor shaft with shaft seal ☐ Motor shaft without shaft seal

☐ Full-key balanced motor shaft ☐ Half-key balanced motor shaft

2. ZF-Duoplan type:

☐ 2K120 ☐ 2K300 ☐ 2K802

☐ 2K121 ☐ 2K800 ☐ 2K2100

☐ 2K250 ☐ 2K801

	Standard	*Option*
Gearbox interface	☐ open	☐ with adapter plate, hub bearing and shaft seal
		☐ with adapter plate and shaft seal
		☐ with adapter ring
		☐ with input flange (2K250 / 2K800 / 2K2100)
Ratio i_1	☐ 4.00	☐ 3.1 ☐ 5.5 (2K250 / 2K300) ☐ 4.91 (2K120 / 2K121)
Installation position	☐ B5 ☐ B5 rotated longit.axis to right	☐ V1 ☐ V3
Holding brake	☐ without	☐ with (only available for 2K800 / 2K801)
Output bearings	☐ Cylindrical roller bearings	☐ Angular-contact ball bearings
Lubrication system	☐ Splash type lubrication	☐ Recirculating lubrication with oil tank
	☐ Integrated oil channel system	☐ Recirculating lubrication with heat exchanger
	☐ Dry sump lubrication	
Gearbox output	☐ Gearbox with output flange	☐ Gearbox with output shaft

☐ 100 mm (2K120 / 2K121)
☐ 118 mm (2K250)
☐ 130 mm (2K300)
☐ 180 mm (2K800 / 2K801 / 2K802
☐ STW (2K800 / 2K801 / 2K802 / 2K2100)

☐ 38 mm (2K120 / 2K121) INLINE
☐ 42 mm (2K250)
☐ 42 mm (2K250 / K300) INLINE
☐ 55 mm (2K300)
☐ 65 mm (2K800 / 2K801 / 2K802)
☐ 70 mm (2K120 TSC / 2K121 TSC 2K250 TSC / 2K300 TSC)
☐ 70 mm DIN 5480 (2K120 TSC / 2K121 TSC 2K250 TSC / 2K300 TSC)
☐ Gearbox for direct mounting without output (2K800 / 2K801 / 2K802 / 2K2100)

Torsional backlash at gearbox output

☐ < 30 arcmin
☐ < 40 arcmin (2K800 / 2K801 / 2K802/2K2100)
☐ < 20 arcmin
☐ < 15 arcmin

Planned annual quantity:

Order-No.:

Application:

Subject to technical change without notice. For installation investigation purposes, please request installation drawings; only the data contained therein is binding. Please check out our homepage: www.zf.com/industrial-drives

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