

**Assembly / Instruction Manual
ZPB(D)**

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1 General advice

► This instruction manual is part of the delivery and must be read before working with the pump! Please ensure this advice is followed at all times and keep the manual near the pump.

ADVICE

No liability is assumed for damage or disruption to process resulting from NOT using and non-observance of this instruction manual. For further development **Beinlich Pump Systems** reserve the right to modify single parts or complete units, while retaining the same characteristics, to improve product quality.

1.1 Pump Selection

The correct selection (version) of type and construction size depending of the application is crucial for a trouble-free and safe operation of the pumps. Owing to the great numbers of various applications and pump versions, the technical specifications in the present document are of general nature.

Performance of the units/pumps depends amongst others on size, type, pressure requirement as well the viscosity range.

Please consult **Beinlich Pump Systems** for an exact selection.

1.2 Product information about the pump

The full type designation is specified in the technical data sheet or the order confirmation. The works serial No. comprises the contract No. and a consecutive serial No. (e. g. 03 / 2456). It is imprinted directly on the rating plate or on the pump.

1.3 Technical data sheet

The technical data sheet is a part of our sales order confirmation and should contain all important technical details as agreed between the purchaser and manufacturer.

1.4 Permitted use

The pump/pump unit is designed only for the field of application listed in the technical data sheet of our order confirmation.

Differing operating conditions will necessitate new contractual agreements.

2 Safety and Advice Symbols

► It is essential to fully adhere to the safety advice in this instruction manual as indicated by:



Warning of mechanical danger, e.g. working on rotating parts



Warning for correct pump operation and maintenance

► The delivered pump must be checked immediately for possible transport damage. If necessary, installation and start-up may have to be postponed. The customer is responsible for the correct installation. Correct performance of the pump as well as the fulfilment of any potential warranty claims depends on the adherence to safety rules.

Make sure that you do not start-up damaged goods!

Read the instruction manual carefully before starting installation, assembly or maintenance. Assembly, installation and start-up as well as repair and maintenance should be done only by qualified professionals with consideration given to:

- this instruction manual,
- all other paperwork which is connected to this project, user manuals and schematics,
- all current domestic and internationally applicable regulations and accident precautions.



Assembly and maintenance work is only permitted if the system is taken completely off-line! The unit must be protected against any accidental switch-on!

3.1 Safety instructions relevant to the plant operator

- If hot or cold machine components involve hazards, they must be guarded against accidental contact on site.
- Guards for moving parts (e. g. coupling) must not be removed from the machine while in operation.
- Any leakage of hazardous (e. g. explosive, toxic, hot) fluids (e.g. from the shaft seal) must be drained away so as to prevent any risk to persons or the environment. Statutory regulations are to be complied with.
- Hazards resulting from electricity are to be prevented (see for example, the VDE Specifications and the bye – laws of the local power supply utilities).



Stripping down the pump within the warranty period is only allowed after consulting with **Beinlich Pump Systems**.

3.2 Safety instructions relevant to maintenance, inspection and assembly work

It shall be the plant operator's responsibility to ensure that all maintenance, inspection and assembly work is performed by authorised and qualified personnel who have adequately familiarised themselves with the subject matter by studying this manual in detail.

Any work on the machine shall only be performed when it is at a standstill, it being imperative that the procedure for shutting down the machine described in this manual is followed.

On completion of work all safety and protective facilities must be re-installed and made operative again.

Prior to restarting the machine, the instructions relevant to "Initial commissioning" must be observed.

3.3 Use in hazardous areas

Please see the addendum to this instruction manual "use in hazardous areas".

3.4 Unauthorised modes of operation

The reliability of the machine delivered will be only guaranteed if it is used in the manner intended, in accordance with section 1 of this manual. The limit values specified in the data sheet must under no circumstances be exceeded.

4 Storage

► Please consider the following:

- store indoors only
- ambient temperature should be 25°C / 77°F, relative humidity max. 80%
- the unit should be protected against UV-rays and direct sunshine
- it must not be stored near aggressive or corrosive substances
- the pump shaft should be turned 1 to 2 rotations to make sure the internal parts are lubricated by the medium
- the units have to be protected against mechanical force or external load

5 Mechanical construction

5.1 Pump casing

The pump consists of a front plate and a so-called combination plate. Depending on the particular type, it also contains a pressure relief valve and one side of the drive shaft and driven shaft bearing assembly. In the case of the disk or plate design, the gear wheels are enclosed by a so-called adapter in the shape of a plate, the thickness of which corresponds approximately to the width of the gear wheel.

5.2 Gear wheels

Gear wheels have an involute gearing. Straight-toothed spur gears are generally used in feed pumps. Owing to their greater smoothness of running, helical-toothed spur gears are given preference in high speed - lube oil pumps in the low pressure range. The gear wheels are generally connected to the shaft by a fitting key. In many cases, shafts and gear wheels are designed as pinions. Materials, surface hardnesses, wear-resistant coatings and gearing quality will depend on the customer's sales order.

5.3 Shafts, bearings and lubrication

The pump shafts are mounted in plain bearing bushes. The bearing points must be adequately lubricated by the pumped fluid.



The pump must always receive fluid and may never be allowed to run dry.

The running play on the sliding surfaces is rated so as to constantly guarantee an adequate lubrication film. The lower the viscosity of a fluid to be pumped, the closer the running play must be kept in order to achieve a favourable volumetric efficiency of the pump. However, this also necessitates a cleaner fluid in order to achieve high operating reliability and as long a pump service life as possible.

6 Start-up – preparatory work

- ▶ The pump should only be started if:
 - the type code agrees with the order confirmation.
 - it is free of breakage and damage.
 - in particular the shaft sealing, plugs and covers are not damaged.
 - no leakage is visible.
 - there is no corrosion or other evidence of incorrect storage.
 - all packing has been removed completely.

All connection ports and drive shafts should be free of protective components (e.g. plugs) and contamination.



IMPORTANT

The lip seals of the shaft seal ring must NOT come into contact with any kind of solvent >> material damage possible

7 Assembly - / Instruction Manual ZPD

7.1 Fitting position any / user defined

7.2 Direction of rotation

The designation "S" and "D" as well the direction arrow are stamped on the back plate or near the connection ports!!!

The pumps are available in "R", CW (right), "L" CCW (left) rotation (seen on drive shaft!) and "L+R", bi-directional.



ATTENTION

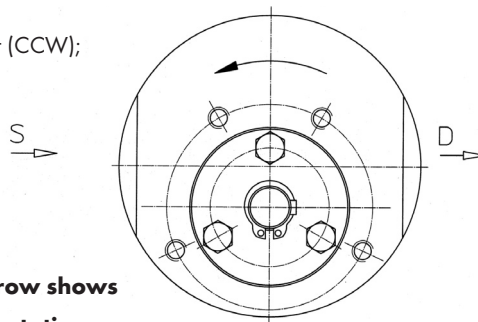
The pump must be used in the stated direction!

i.e. direction "L" left (CCW);
seen on drive shaft

S = Suction port

D = Pressure port
(Discharge)

**The attached arrow shows
the direction of rotation–
NOT the flow direction!**



7.3 De-aeration The pumps are self-bleeding. Only the shaft sealing system may require de-aeration.



Warning

Do not bleed or loosen the bleed screw during high pressure operation of the pump.

7.4 Drive The standard ZPD must not be subject to radial forces!! The drive should preferably connect by an elastic coupling (we recommend Starex/Softex). If using a belt drive or a gear wheel drive you MUST have a support-bearing to avoid potential radial/axial forces. The clutch or pulley must be used with ISA-fit H7, and should never be installed using hammer blows, as this will destroy the pumps running characteristics.

7.5 Connections BSP inlet threads or flanges (please check the type description!)
Due to the danger of contamination, compounds such as hemp and sealing cements should NOT be used.

7.6 Suction in conditions on gear wheel pumps
The inlet pressure p_1 depends on the shaft sealing system used.
The inlet-pressure should not exceed a vacuum of 200 mm Hg or 3 m WS below atmosphere pressure. Bent pipes with small radiuses, constricting pipes and closable valves are to be avoided.

7.7 Shaft sealing systems & pre-pressures

lip seal ring / block chamber:	4 bar (60 psi)
packing gland seal:	50 bar (725 psi)
mechanical contact seal:	15 bar (218 psi)
magnetic coupling:	20 bar (290 psi) (others on inquiry)

7.8 Viscosity All pumps are matched to a viscosity range! The rated viscosity should be at working temperatures within the recommended speed range.

7.9 Speed range recommendation (without pre-pressure; $p_1 = 0$ bar)

7.9.1 Fluid without fillers

Viscosity (cPs)	recommended speed (rpm)			
	Body size 1	Body size 2	Body size 3	Body size 4
up to 1000	1000	900	800	725
up to 2000	800	725	600	600
up to 5000	600	500	450	450
up to 10000	≤ 500	≤ 400	≤ 350	≤ 350

7.9.2 Fluid with fillers

Viscosity (cPs)	recommended speed (rpm)			
	Body size 1	Body size 2	Body size 3	Body size 4
up to 1000	1000	900	800	600
up to 2000	800	725	600	400
up to 5000	600	500	450	300
up to 10000	≤ 500	≤ 400	≤ 350	≤ 200

- 7.10 Temperature** see type description. The minimum and the maximum temperature depends on the sealing material
- 7.11 Heating and cooling units**
Some units are made with heating cartridges, heating jackets or heating ports and will be heated up or cooled down electrically, with liquid or with agas medium.
- 7.12 Filtration**
We recommend using a suitable sized filter with a filtration of 25 µm. Before starting, the whole system has to be cleaned very carefully of all foreign objects such as dust from casting, fittings, contaminants, etc. and afterwards be flushed with filtered oil.
- 7.13 Integral pressure relief valve**
V1 = external relief of the over-flow. The pipe work must be connected unpressurised back to tank
V2 = internal relief back to the suction side
The pressure adjustment of both versions must be made by the adjustment screw after loosening the lock nut.

8 Requirement of Returns



ATTENTION

Only cleaned, liquid-free pumps can be accepted by us for maintenance or repair. We reserve the right to send back contaminated pumps at the expense of the customer.
To speed up a potential breakdown situation we would ask customers to complete an available non conformity report and to send it back with the pump! Please ask Beinlich Pumps for the report form.

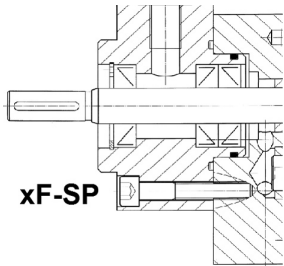
9 Shaft sealing systems

- It is possible to have combinations of different shaft sealing systems, e.g. block chamber with mechanical contact seal. These need to be maintained or checked in particular ways.

9.1 Radial lip seal ring, standard, no description in order code

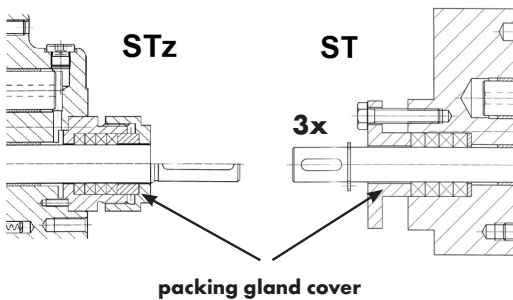
The radial lip seal ring is maintenance free. If it leaks, it has to be renewed. If the drive shaft is worn it must be replaced too, because an effective seal will no longer be possible. In this condition a new lip seal ring will be damaged immediately.

9.2 Block chamber; type code description: 2F-SP / 3F-SP



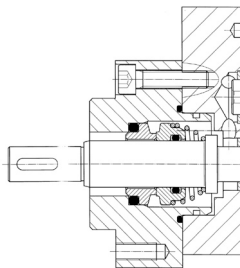
With two or three lip seal rings. The block chamber should be monitored to ensure the fluid level is constant and should be topped up as necessary. Changes in the block chamber fluid level indicates wear on the lip seal ring and/or the drive shaft! If the drive shaft is worn it must be replaced too, because an effective seal will no longer be possible. In this condition a new lip seal ring will be damaged immediately.

9.3 Stuffing box; type code description: ST / STz



The packing gland cover **MUST NOT** be tightened too hard. A small out flow is required to reduce frictional heat. If the leakage increases during prolonged running it is necessary to tighten the three bolts evenly (ST), or tighten the gland nut 1/6 of a turn (STz) to reduce the leakage. In the ST version, ensure that the packing gland cover is tightened down evenly! If an adjustment of the bolts or the gland nut is no longer possible only one black packing ring needs to be renewed. A complete change of all the rings is not normally necessary. If the drive shaft shows scoremarks, it has to be changed to make sure that it will be sealed after installing the new packing rings. The joints of each packing ring must be installed at a 90° angle to each other. The correct sequence of the rings is two black rings in the centre with two white rings on either side.

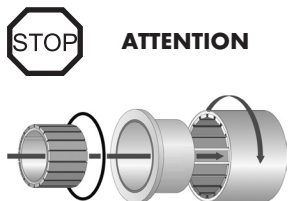
9.4 Mechanical contact seal; type code description: GL



Maintenance is simply a visual inspection for leakage. A small perspiration is typical. If the mechanical contact seal is leaking it has to be renewed. During repair please double check the pump bearing clearances.

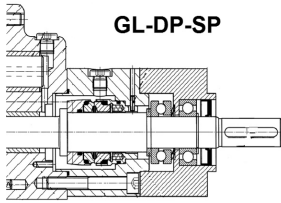
9.5 Mag-drive; type code description: MAG

The magnetic coupling is maintenance free. The medium will be sealed hermetically by the canister. Maintenance is simply a visual inspection for leakage.



The operator **MUST** follow the safety advice when using a magnetic coupling. During the assembly of the motor to the pump consideration must be given to the attractive forces of the magnetic coupling! Furthermore we recommend the use of a cooling pump when using a mag-drive larger than 80 Nm to reduce the heat build-up. (Please see also the user manual of the mag-drive manufacturer **DST**)

9.6 Special features for "KIG" version: GL-DP-SP



GL-DP-SP

To be used with fluids containing fillers. Any axial and radial forces will be absorbed by the roller bearings. These bearings need to be cooled and lubricated via the block chamber.

Please consider the maintenance advice for the mechanical contact seal and the block chamber.

10 Maintenance and Repair

10.1 General advice

Beinlich radial piston pumps are maintenance-free under normal conditions. A continuous check of the technical parameters is recommended. The use of corresponding control equipment such as working hour counter, pressure and temperature switches, etc. should be made in relation to general requirements. During on-going maintenance of the unit please consider the following:

- check that all connection bolts and pipe-work is tightened correctly and if not that they are retightened.
- inspect the alignment of the coupling. Check the flexible component for wear.
- check for leaks, especially the shaft sealing.

10.2 Disassembly and assembly

10.2.1 General Rules

Before disassembly the unit has to be protected against inadvertent start-up. The isolator valves must be closed and the pump must have cooled/warmed to ambient temperature.

10.2.2 Disassembly of the unit

1. interrupt power supply
2. remove all extra connections / piping

3a. unit on a base plate (FB):

- 3a.1. remove coupling cover; disconnect motor; remove motor from base plate by decoupling the motor from the pump;

- 3a.2. loosen suction and pressure connections

- 3a.3. remove pump from ground plate

3b. unit with bell housing (FcV/FcB):

- disconnect motor
- remove motor

- 3b.1. loosen suction and pressure connections

- 3b.2. disassemble pump with bell housing from motor

10.2.3 Disassembly of the pump

Please use sectional drawing. Please check the alignment of each part relative to the other.

We recommend to mark the parts and number serially.

1. remove shaft sealing system (see 10.2.4)
2. un-screw hexagonal socket screws from the back plate
3. pull away from pump shaft with gear
4. remove wear plates (if built-in) please consider the position of the pressure-slot. Then remove the bushings (also with the pressure-slot)
5. remove middle plate
6. remove the drive shaft with the gear

10.2.4 Disassembly of the shaft sealing system

	block chamber (2F-SP / 3F-SP)	stuffing box		mechanical contact seal (GL)	mag-drive (MAG)
		ST	STz		
1	remove circlip	un-screw the 3 bolts of the cover	remove central taper	un-screw shaft seal carrier	un-screw canister
2	remove lip seal rings	remove packing rings	remove packing rings	remove cover carefully with the built in mechanical contact seal	undo safety screw on the inner rotor
3	-	-	-	undo set screw on the ring-unit	draw off the inner rotor
4	-	-	-	pull away the ring unit from the drive shaft	remove mag-flange

Please perform the disassembly carefully! Because of risk of breakage please do not use any significant force!

10.2.5 Assembly of the pump / sub-system

Assembly should be carried out in accordance with general good practice mechanical engineering guidelines! Seals should be checked for damage before use and if necessary renewed. PTFE seals should be renewed routinely. All old sealant must be removed completely. The assembly should be carried out in the reverse order to the disassembly (please see also 10.2.4).

10.3 Spare parts

When ordering spare parts please use:

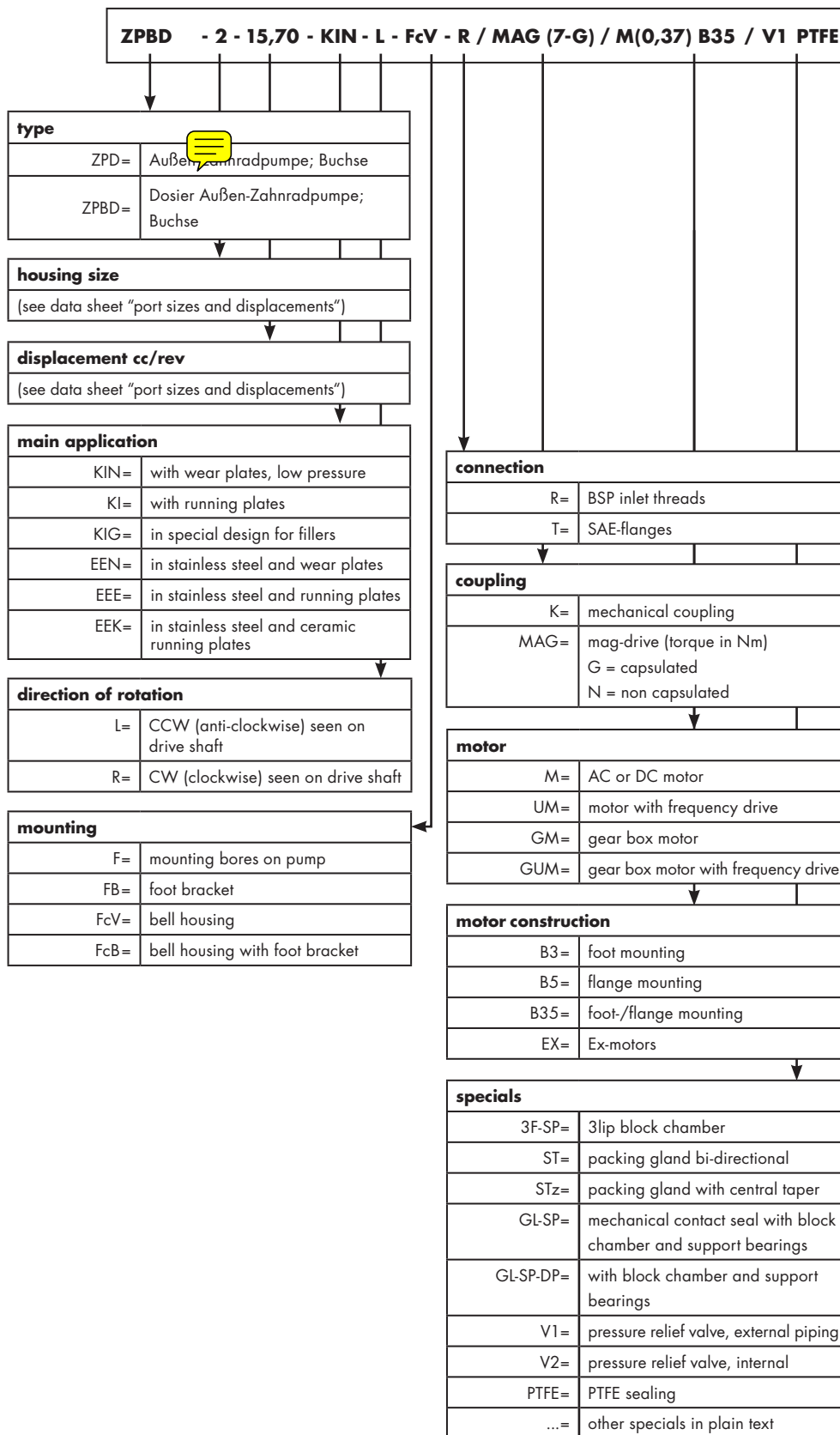
- order number (on type plate)
- article number (on type plate)
- part number from parts list
- quantity required

We only accept liability for warranty on original **Beinlich Pump Systems** parts. We recommend keeping a complete spare pump for 24/7 operations to have a spare available during return or repair. When ordering spare parts please use our parts list in conjunction with the sectional drawing. We would like to point out expressly that the use of non **Beinlich Pump Systems** spare parts and equipment is not authorised! The installation and use of such parts can negatively affect designed and specified performance. This can jeopardise the safe use of our pumps and/or sub-systems.

Beinlich Pump Systems does not accept any liability or warranty for any losses incurred by using non original spare parts and/or original equipment .

10.4 Further documentation

All relevant information can be found in the technical data sheet and the order confirmation.



12

Port sizes and displacements

type size	theoretical displacement	former size	Design										
			ZDP / ZPA BSP connection		ZPD / ZPA SAE connection		ZPD connection in middle plate		ZPBD BSP connection		ZPBD SAE connection		
			inlet	outlet	inlet	outlet	inlet	outlet	inlet	outlet	inlet	outlet	
	cc/rev												
1-0,1	0,1	102	G 1/2"	G 1/2"	-	-	-	-	-	-	-	-	-
1-0,12	0,1	102	G 1/2"	G 1/2"	-	-	-	-	G 1/2"	G 1/2"	-	-	-
1-0,25	0,3	104	G 1/2"	G 1/2"	-	-	-	-	G 1/2"	G 1/2"	-	-	-
1-0,3	0,3	108	G 1/2"	G 1/2"	-	-	-	-	G 1/2"	G 1/2"	-	-	-
1-0,5	0,5	108	G 1/2"	G 1/2"	-	-	-	-	G 1/2"	G 1/2"	-	-	-
1-0,73	0,7	110	G 1/2"	G 1/2"	-	-	-	-	G 1/2"	G 1/2"	-	-	-
1-0,87	0,9	112	G 1/2"	G 1/2"	-	-	-	-	G 1/2"	G 1/2"	-	-	-
1-1,17	1,2	115	G 1/2"	G 1/2"	-	-	-	-	G 1/2"	G 1/2"	-	-	-
1-1,46	1,5	120	G 1/2"	G 1/2"	-	-	-	-	G 1/2"	G 1/2"	-	-	-
1-1,9	1,9	123	G 1/2"	G 1/2"	-	-	-	-	G 1/2"	G 1/2"	-	-	-
1-2,5	2,5	130	G 1/2"	G 1/2"	-	-	-	-	G 1/2"	G 1/2"	-	-	-
1-3,2	3,2	145	G 1/2"	G 1/2"	-	-	-	-	G 1/2"	G 1/2"	-	-	-
1-3,8	3,8	150	G 1/2"	G 1/2"	-	-	-	-	G 3/4"	G 1/2"	-	-	-
1-4,4	4,4	60	G 1/2"	G 1/2"	-	-	-	-	G 3/4"	G 1/2"	-	-	-
1-5,1	5,1	170	G 1/2"	G 1/2"	-	-	-	-	G 3/4"	G 1/2"	-	-	-
1-5,7	5,7	180	G 1/2"	G 1/2"	-	-	-	-	G 3/4"	G 1/2"	-	-	-
1-7,3	7,3	195	G 1/2"	G 1/2"	-	-	-	-	G 3/4"	G 1/2"	-	-	-
1-9,54	9,5	-	-	-	-	-	-	-	G 3/4"	G 1/2"	-	-	-
1-11,1	11,1	-	-	-	-	-	-	-	G 3/4"	G 1/2"	-	-	-
1-12,72	12,7	-	-	-	-	-	G 3/4"	G 1/2"	G 3/4"	G 1/2"	-	-	-

2-6,3	6,3	208	G 3/4"	G 3/4"	SAE 3/4"	SAE 3/4"	-	-	-	-	-	-	-
2-7,8	7,8	210	G 3/4"	G 3/4"	SAE 3/4"	SAE 3/4"	-	-	-	-	-	-	-
2-9,3	9,3	212	G 3/4"	G 3/4"	SAE 3/4"	SAE 3/4"	-	-	-	-	-	-	-
2-11,8	11,8	215	G 3/4"	G 3/4"	SAE 3/4"	SAE 3/4"	-	-	G 1"	G 1"	SAE 1"	SAE 1"	SAE 1"
2-15,7	15,7	220	G 3/4"	G 3/4"	SAE 3/4"	SAE 3/4"	-	-	G 1"	G 1"	SAE 1"	SAE 1"	SAE 1"
2-19,6	19,6	225	G 3/4"	G 3/4"	SAE 3/4"	SAE 3/4"	-	-	G 1"	G 1"	SAE 1"	SAE 1"	SAE 1"
2-23,6	23,6	230	G 3/4"	G 3/4"	SAE 3/4"	SAE 3/4"	-	-	G 1 1/4"	G 1"	SAE 1 1/4"	SAE 1"	SAE 1"
2-27,5	27,5	235	-	-	-	-	-	-	G 1 1/4"	G 1"	SAE 1 1/4"	SAE 1"	SAE 1"
2-31,5	31,5	240	-	-	-	-	-	-	G 1 1/4"	G 1"	SAE 1 1/4"	SAE 1"	SAE 1"
2-35,4	35,4	245	-	-	-	-	-	-	G 1 1/4"	G 1"	SAE 1 1/4"	SAE 1"	SAE 1"
2-39,3	39,3	250	-	-	-	-	G 1"	G 1"	G 1 1/4"	G 1"	SAE 1 1/4"	SAE 1"	SAE 1"
2-43,3	43,3	255	-	-	-	-	G 1 1/4"	G 1"	G 1 1/4"	G 1"	SAE 1 1/4"	SAE 1"	SAE 1"

(S) = helical toothed gears

if nothing else declared: SAE 3000 PSI

- = not available

* = to be determined with project

type size	theoretical displacement	former size	Design									
			ZDP / ZPA BSP connection		ZPD / ZPA SAE connection		ZPD connection in middle plate		ZPBD BSP connection		ZPBD SAE connection	
			inlet	outlet	inlet	outlet	inlet	outlet	inlet	outlet	inlet	outlet
cc/rev												
3-17,3	17,3	325	G 1 1/4"	G 1 1/4"	SAE 1"	SAE 1"	-	-	-	-	-	-
3-22,0	22,0	332	G 1 1/4"	G 1 1/4"	SAE 1"	SAE 1"	-	-	-	-	-	-
3-25,0	25,0	336	G 1 1/4"	G 1 1/4"	SAE 1"	SAE 1"	-	-	-	-	-	-
3-29,4	29,4	340	G 1 1/4"	G 1 1/4"	SAE 1"	SAE 1"	-	-	G 1 1/2"	G 1 1/2"	SAE 1 1/2"	SAE 1 1/2"
3-37,4	37,4	350	G 1 1/4"	G 1 1/4"	SAE 1"	SAE 1"	-	-	G 1 1/2"	G 1 1/2"	SAE 1 1/2"	SAE 1 1/2"
3-45,4	45,4	360	G 1 1/4"	G 1 1/4"	SAE 1"	SAE 1"	-	-	G 1 1/2"	G 1 1/2"	SAE 1 1/2"	SAE 1 1/2"
3-53,0	53,0	370	G 1 1/4"	G 1 1/4"	SAE 1"	SAE 1"	-	-	G 1 1/2"	G 1 1/2"	SAE 1 1/2"	SAE 1 1/2"
3-60,0	60,0	380	G 1 1/4"	G 1 1/4"	SAE 1"	SAE 1"	-	-	G 2"	G 1 1/2"	SAE 2"	SAE 1 1/2"
3-72,0	72,0	395	G 1 1/4"	G 1 1/4"	SAE 1"	SAE 1"	G 1 1/4"	G 1 1/4"	G 2"	G 1 1/2"	SAE 2"	SAE 1 1/2"
3-80,1	80,1		-	-	-	-	-	-	G 2"	G 1 1/2"	SAE 2"	SAE 1 1/2"
3-93,5	93,5		-	-	-	-	G 1 1/2"	G 1 1/2"	G 2"	G 1 1/2"	SAE 2"	SAE 1 1/2"
3-106,8	106,8		-	-	-	-	G 1 1/2"	G 1 1/2"	G 2"	G 1 1/2"	SAE 2"	SAE 1 1/2"
3-120,0	120,0		-	-	-	-	G 2"	G 1 1/2"	G 2"	G 1 1/2"	SAE 2"	SAE 1 1/2"
3-140,0	140,0		-	-	-	-	SAE 2"	SAE 1 1/2"	-	-	-	-

4-44,4	44,4	406	G1 1/2 or G2"	G1 1/2 or G2"	SAE 2"	SAE 2"	-	-	-	-	-	-
4-57,9	57,9	408	G1 1/2 or G2"	G1 1/2 or G2"	SAE 2"	SAE 2"	-	-	-	-	-	-
4-67,0	67,0	409	G1 1/2 or G2"	G1 1/2 or G2"	SAE 2"	SAE 2"	-	-	-	-	-	-
4-74,5	74,5	410	G1 1/2 or G2"	G1 1/2 or G2"	SAE 2"	SAE 2"	-	-	-	-	-	-
4-89,3	89,3	412	G1 1/2 or G2"	G1 1/2 or G2"	SAE 2"	SAE 2"	-	-	-	-	-	-
4-101,0	101,0	414	G1 1/2 or G2"	G1 1/2 or G2"	SAE 2"	SAE 2"	-	-	-	-	-	-
4-110,0	110,0	415	G1 1/2 or G2"	G1 1/2 or G2"	SAE 2"	SAE 2"	-	-	-	-	SAE 3"	SAE 2"

type size	theoretical displacement	former size	Design									
			ZDP / ZPA BSP connection		ZPD / ZPA SAE connection		ZPD connection in middle plate		ZPBD BSP connection		ZPBD SAE connection	
			inlet	outlet	inlet	outlet	inlet	outlet	inlet	outlet	inlet	outlet
4-122,0	122,0	416	G1 1/2 or G2"	G1 1/2 or G2"	SAE 2"	SAE 2"	-	-	-	-	SAE 3"	SAE 2"
4-131,0	131,0	417	G1 1/2 or G2"	G1 1/2 or G2"	SAE 2"	SAE 2"	-	-	-	-	SAE 3"	SAE 2"
4-149,0	149,0	420	G1 1/2 or G2"	G1 1/2 or G2"	SAE 2"	SAE 2"	-	-	-	-	SAE 3"	SAE 2"
4-166,8	166,8	423	G1 1/2 or G2"	G1 1/2 or G2"	SAE 2"	SAE 2"	-	-	-	-	SAE 3"	SAE 2"
4-184,6	184,6	425	G1 1/2 or G2"	G1 1/2 or G2"	SAE 2"	SAE 2"	-	-	-	-	SAE 3"	SAE 3"
4-223,0	223,0	430	-	-	-	-	-	-	-	-	SAE 3"	SAE 3"
4-236,0	236,0	430-S	-	-	-	-	-	-	-	-	SAE 3"	SAE 3"
4-280,0	280,0	435-S	-	-	-	-	-	-	-	-	SAE 3"	SAE 3"
4-316,0	316,0	440-S	-	-	SAE 3"	SAE 3"	-	-	-	-	SAE 3"	SAE 3"
4-354,0	354,0	445-S	-	-	SAE 3"	SAE 3"	-	-	-	-	SAE 4"	SAE 3 1/2"
4-400,0	400,0	450-S	-	-	SAE 3"	SAE 3"	-	-	-	-	SAE 4"	SAE 3 1/2"
4-434,0	434,0	455-S	-	-	SAE 3"	SAE 3"	-	-	-	-	SAE 4"	SAE 3 1/2"
4-472,0	472,0	460-S	-	-	SAE 3"	SAE 3"	-	-	-	-	SAE 4"	SAE 3 1/2"
4-517,0	517,0	465-S	-	-	SAE 3"	SAE 3"	-	-	-	-	SAE 4"	SAE 3 1/2"

5-289,0	289,0	-	-	-	-	-	*	*	-	-	SAE 4"	SAE 4"
5-372,0	372,0	-	-	-	-	-	*	*	-	-	SAE 4"	SAE 4"
5-450,0	450,0	5-450	-	-	-	-	*	*	-	-	SAE 5"	SAE 5"
5-550,0	550,0	-	-	-	-	-	*	*	-	-	SAE 5"	SAE 5"
5-570,0	570,0	-	-	-	-	-	*	*	-	-	SAE 5"	SAE 5"
5-600,0	600,0	-	-	-	-	-	*	*	-	-	SAE 5"	SAE 5"
5-650,0	650,0	-	-	-	-	-	*	*	-	-	SAE 5"	SAE 5"
5-670,0	670,0	-	-	-	-	-	*	*	-	-	SAE 5"	SAE 5"
5-700,0	700,0	-	-	-	-	-	*	*	-	-	SAE 5"	SAE 5"
5-745,0	745,0	-	-	-	-	-	*	*	-	-	SAE 5"	SAE 5"
5-750,0	750,0	-	-	-	-	-	*	*	-	-	SAE 5"	SAE 5"
5-840,0	840,0	-	-	-	-	-	*	*	-	-	SAE 5"	SAE 5"
5-850,0	850,0	-	-	-	-	-	*	*	-	-	SAE 5"	SAE 5"
5-900,0	900,0										SAE 5"	SAE 5"

6-550,0	550,0	6-550	-	-	-	-	*	*	*	*	*	*
6-650,0	650,0	6-650	-	-	-	-	*	*	*	*	*	*
6-770,0	770,0	6-770	-	-	-	-	*	*	*	*	*	*
6-900,0	900,9	6-900	-	-	-	-	*	*	*	*	*	*
6-1150,0	1.150,0	6-1150	-	-	-	-	*	*	*	*	*	*

7-1100,0	1.100,0	7-1150	-	-	-	-	*	*	*	*	*	*
7-1400,0	1.400,0	7-1400	-	-	-	-	*	*	*	*	*	*
7-1600,0	1.600,0	7-1600	-	-	-	-	*	*	*	*	*	*

8-2100,0	2.100,0	8-2100	-	-	-	-	*	*	*	*	*	*
8-2300,0	2.300,0	8-2300	-	-	-	-	*	*	*	*	*	*
8-2600,0	2.600,0	8-2600	-	-	-	-	*	*	*	*	*	*

(S) = helical toothed gears

- = not available

if nothing else declared: SAE 3000 PSI

* = to be determined with project

subject to alternations

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systems

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