URSTA hydraulik

OPERATING INSTRUCTIONS

GEAR PUMPS

Gear pump combinations
single-flow and multiple-flow

TGL 10859

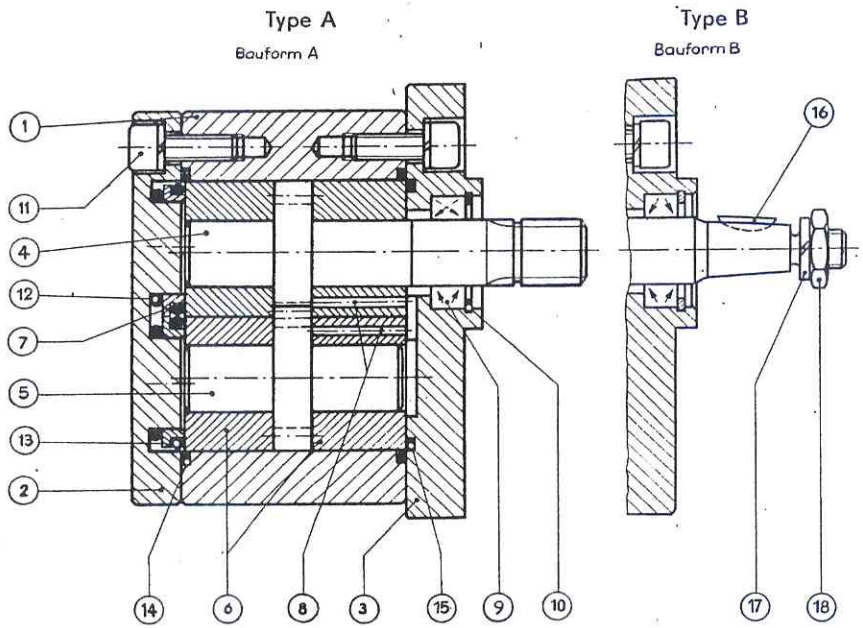


Fig. 3 Gear pumps A and B

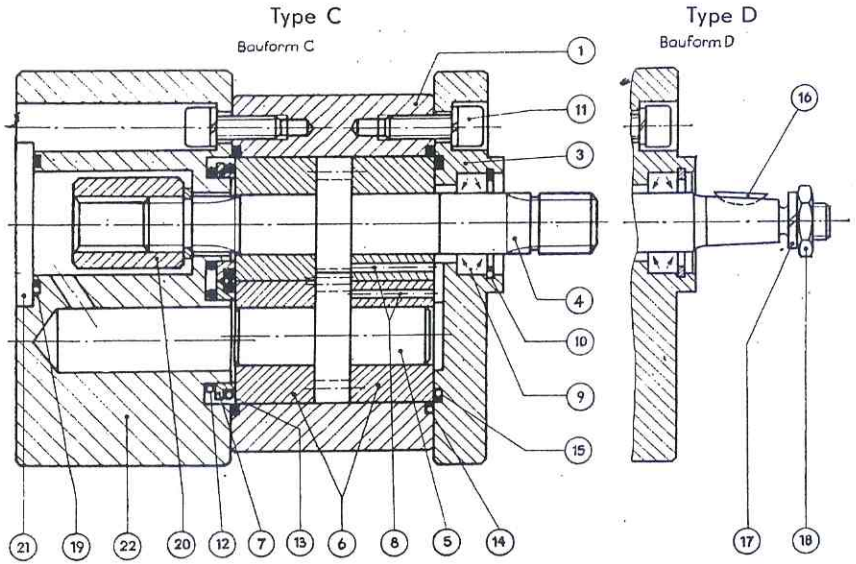


Fig. 4 Gear pumps C and D

1 Housing
2 Cover
3 Mounting plate
4 Driving shaft
5 Pinion shaft
6 Bearing bush
7 Back-up ring
8 Leakage hole
9 Shaft seal
10 Locking ring
11 Fillister-head screw
12 O-ring
13 O-ring
14 O-ring
15 O-ring
16 Plate spring
17 Spring ring
18 Hexagon nut
19 O-ring
20 Coupling — in case of equal sizes — (shear pin coupling in case of unequal sizes)
21 Centring for next pump
22 Connecting plate

1. Technical description

ND 160 gear pumps are hydraulic pressure generators with a constant volume of displacement and an axial clearance compensation. They are manufactured in types having a rated flow from 1.6 to 100 l/min.

1.1. Gear pumps type A according to TGL 10 859, single flow

In a housing (1) that is open to either side and that is made of a high-tensile, anodized light-metal alloy there are four axially moving and flattened slide bearing bushes (6) in which the driven shaft (4) and the pinion shaft (5) are mounted, see Fig. 3.

The housing face ends are closed on the drive side by the mounting plate (3) which centers the gear pump when installed, and on the other side by the cover (2) having pressure areas for the axial clearance compensation. Both plates are also made of anodized light-metal.

The pair of bearing bushes pointing to the cover are pressure-loaded. Thus, the rubbing surfaces of the bearing bushes are forced against the end faces of the pinion.

The slide bearings and the end rubbing faces of the bearing bushes are lubricated by the fluid.

The gear pump type A is driven via the splined shaft profile of the driving shaft (positive connection). It is to be noted that the driving shaft must not be loaded neither radially (drive by means of gear, V-belt pulley or chain wheel etc.) nor axially. Any axial load on the driving shaft affects the action of the hydraulic power for clearance compensation and results in a failure of the gear pump, while radial load results in a heavy wear of the bearing and considerably reduces the life.

Laterally in the housing there are the connecting holes for the suction and discharge lines.

On the driving end, gear pumps of type A can be combined with gear pumps of the types C and D.

1.2. Gear pumps, type B TGL 10 859, single flow

This design is similar to gear pumps of type A, the driving shaft excepted. In this case the drive is transmitted via a driving shaft with a tapered end and a threaded journal (non-positive connection under preliminary stress by means of a nut).

Gear pumps of type B cannot be connected with other gear pumps.

1.3. Gear pumps, type C TGL 10 859 for multi-flow combinations

These gear pumps are designed according to the same construction principle as gear pums, type A TGL 10 859.

The driving shaft is provided with a spline shaft profile (positive connection). On the connecting plate end, gear pumps of type C can be combined with gear pumps of the types A and C; on the driving end with gear pumps of the types C and D.

In this case two or more individual pumps are axially interlinked to form a multi-flow gear pump which consists of:

- one or several gear pumps of the type C used as interlinkable (combinatorial) pumps, so-called primary pumps, and
- one gear pumps of type A as the last single pump connected, the so-called secondary pump.

For connecting the individual pumps, a primary pump has a connecting plate (22) instead of the cover — in certain cases a connecting and an intermediate plate — together with the coupling (20) and the centering element (21) for the following gear pump. See Fig. 4.

It is possible to combine gear pumps having similar or different discharge flows in such a way that two or three-flow combinations are achieved. In combinations comprising four or five discharge flows, the 4th pump must be smaller than the 3rd pump by at least one rating and the 5th pump by at least two ratings. The gear pump delivering the highest discharge flow or, in case of equivalent discharge flows, the pump with the highest working pressure, is the first pump on the drive end. Each of the following gear pumps has either the same or smaller ratings than that which is upstream.

1.4. Gear pumps, type D TGL 10 859 for multi-flow combinations

This design is similar to that of type C gear pumps, the driving shaft excepted. In this case it has a tapered shaft end and a threaded journal (non-positive connection under preliminary stress by means of a nut).
On the connecting plate end, gear pumps of type D can be connected with gear pumps of type A and C; on the driving end, however, they cannot be combined with other gear pumps.

1.5. Gear pumps, type E TGL 10 859 for combinations with gear pumps according to TGL 17-747 407

The construction principle corresponds to that of the gear pump, type C.
On the connecting plate end, the gear pump of type E can be combined with an ND 6.3 gear pump of the types

ACW TGL 17-147 407 or
ADW TGL 17-747 407

1.6. DSRK design gear pumps

for use on deck

A version of B 1.6 and B 2.5 as well as A 4 to A 100 gear pumps which is sea water resistant, corresponds to TGL 10 850-S (single flow) and meets the requirements of the DSRK (German Ship's Revision and Classification).

Note: Rated pressure = continuous working pressure p_d = 100 kgf/cm². Max. working pressure ($p_{b\,max}$) according to chapter 2.1.

For use in rooms below deck

Standard design of the gear pumps types A, B, C and D, TGL 10 859, single or multi-way flow, which needs an additional DSRK acceptance run.

Rated pressure = continuous working pressure p_d = 160 kgf/cm²

Max. working pressure ($p_{b\,max}$) according to chapter 2.1.

When ordering, these designs should be particularly specified and have to be confirmed by the manufacturers.

1.7. Gear pump combinations TGL 10 859 with electric motor

These combinations consist of the following units:

- gear pump TGL 10 859 with single or multi-way flows
- intermediate flange M, TGL 10 859, as a connecting part between the gear pump and the VEM standard KMR motor, which comprises — (see Figs. 5.1. and 5.2.)

  coupling flange (23) — connecting member between the pump mounting plate and the motor flange (hollow, cast light-metal part)

  coupling sleeve (24) — on the motor shaft end (with a feather groove)

  driving sleeve (25) — on the gear pump drive shaft (with internal splines, and internal taper groove for feather key, resp.)

  coupling disk (26) — power transmission member in which the dogs of the sleeves engage

  The three-piece coupling in the interior of the coupling flange compensates coaxial variations between the shaft end of the motor and the driving shaft of the gear pump. An aperture in the coupling flange permits dismounting the coupling.
- KMR motor, VEM standard motor with cage rotor of the series M.

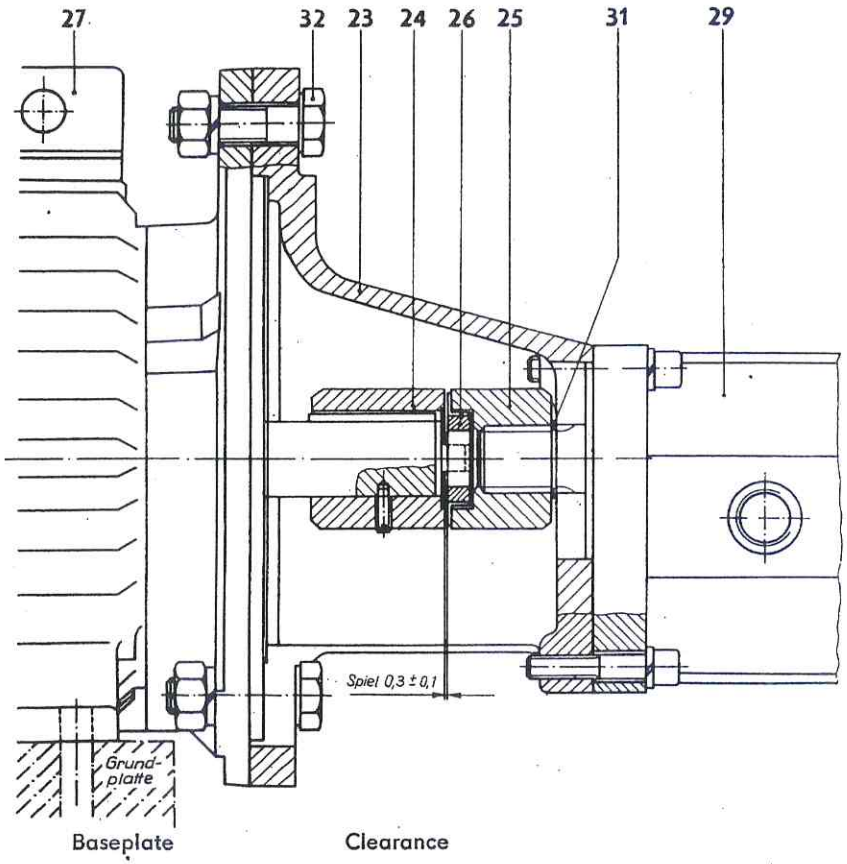


Fig. 5.1 Gear pump combination
(Intermediate flange M —.— 1 with gear pump, type A or C)

23 Coupling flange
24 Coupling sleeve
25 Driving sleeve
26 Coupling disk
27 KMR motor, design M 201
28 KMR motor, design M 301/302
29 Gear pump, type A or C, TGL 10 859

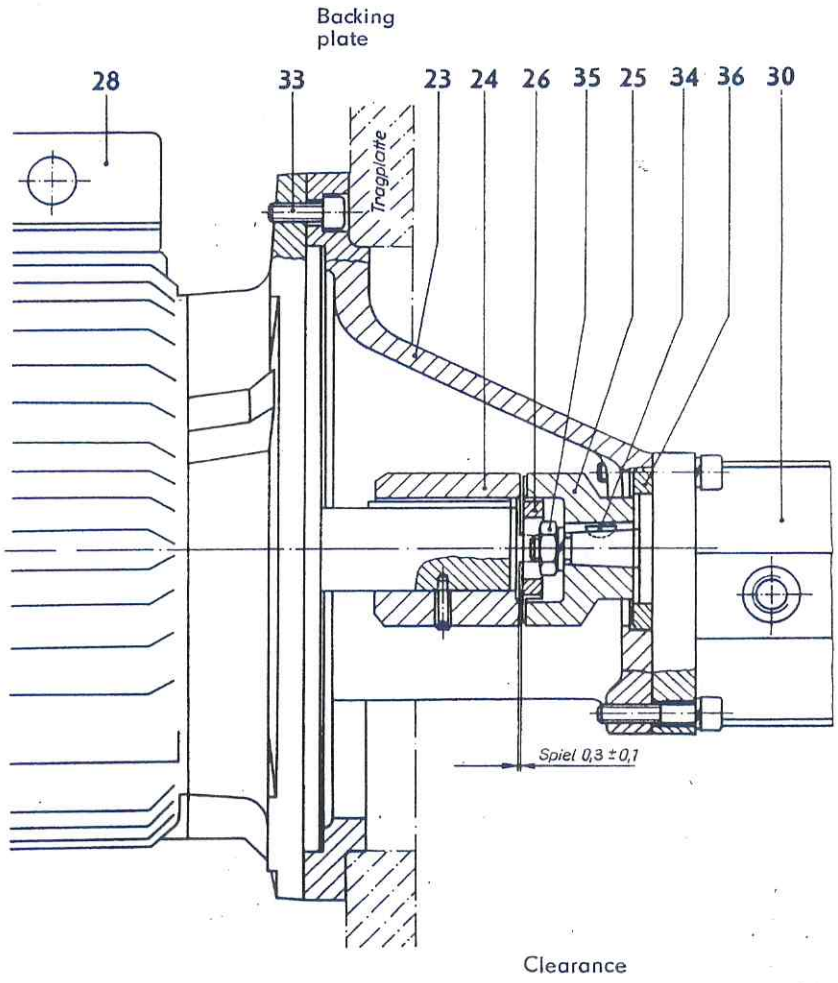


Fig. 5.2 Gear pump combination
(Intermediate flange M —·— 2 with gear pump, type B or D)

30 Gear pump, type B or D, TGL 10 859
31 Snap ring
32 Screwed connection with M 201
33 Screwed connection with M 301/302
34 Plate spring
35 Nut with taper connection
36 Centring ring

2. Specifications

of gear pumps, types A, B, C, D and E

Rating = rated discharge flow l/min	Size	Rated pressure = pressure at continuous operation kgf/cm²	Working pressure max[1] kgf/cm²	Range of speeds[2] r. p. m.	Torque max kgfm	Rated output[3] kW
1.6	1	160 with DSRK design 100	200 with DSRK design 160	750 ... 3 500	1.0	0.8
2.5					1.3	1.0
4	2				1.9	1.4
6.3					3.0	2.2
10	3			500 ... 3 000	5.0	3.7
16					7.5	5.6
25					12.0	8.9
40	4				19.0	14.1
63	5			500 ... 2 500	28.0	20.8
100					44.0	32.8

[1] The permissible load ratios are referred to in chapter 2.1.

The maximum working pressure of multi-flow gear pumps also depends on the maximum torque that can be transmitted by the first primary pump (See Table).

[2] The maximum speed of multi-flow gear pumps — for all ratings — is 2500 r. p. m.

[3] If driven by an electric motor, in any case a driving power is recommended which is by 10 per cent higher than those stated in this Table or in the characteristics given in TGL 10 859. The power ratings stated in this Table as well as in the TGL 10 859 characteristics are valid for a fluid temperature of 50 °C and a viscosity of 36 cSt. If the viscosity is a higher one, a higher driving power will become necessary.

Rated speed

n_n = 1,450 r. p. m.

Sense of rotation

Right-hand or left-hand rotation according to the arrow on the face end of the centring collar of the gear pump. The gear pump should only be operated in the direction shown. How to find out the sense of rotation: Look towards the face end of the driving shaft.

The right-hand sense of rotation is considered as the standard design; in the design with the left-hand sense of rotation the suction and pressure connections are on the other side.

Load on the driving shaft

Neither radial **nor** axial loading of the driving shaft (4) is permissible.

Pressure in the suction line

p_{abs} = 0.5 to 6 kgf/cm²

Under starting conditions (start without load) $p_{abs} \geqq 0{,}2$ kgf/cm² is for a short time permissible.

Fluid:

Hydraulic fluid (mineral oil which is free from resin, acid and water) having a viscosity ranging from 12 to 1500 cSt, as well as the fire-resistant hydraulic fluid SH 50 (applicable, however, for sizes 10 to 100 and with a restricted range of use only).

Fluid temperature — Viscosity

The permissible fluid temperatures depend an the fluid used. When operating the gear pump within the permissible temperature range the viscosity range should be andhered to.

Working temperature — 15 to + 70 °C
max. + 80 °C for 5 min/hr.

Working viscosity 12 to 1000 cSt.

Starting temperature ≧ — 30 °C

Starting viscosity ≦ 1500 cSt

At starting temperatures from — 15 to — 30 °C and/or starting viscosities from 1000 to 1500 cSt the gear pump should be allowed to run warm without any load till the working viscosity is obtained. The speed for warming-up must be smaller than or equal to the rated speed.

If the pump is often started under these extreme conditions we recommend to extend the suction line to immediately before the gear pump.

For hydraulic fluids having a high flash-point special regulations apply.

Fluids recommended

H 22 R	TGL 17542/01	preferably used as a winter fluid
H 68 R	TGL 17542/01	preferably used as a summer fluid
HLP 22	TGL 17542/03	preferably used as a winter fluid
HLP 46	TGL 17542/03	preferably used as a summer fluid

SH 50 M 31 300 hydraulic fluid with a high flash-point

Abroad: All foreign fluids an a mineral oil basis may be used provided that they are recommended by the makers for comparable hydraulic units.

Conditions for the use of SH 50

Applicable for sizes from 10 to 100 only
Speed n = 1450 r. p. m.

Other speeds to be agreed upon with the manufacturers

Working pressure max., $p_{max} = 63$ kgf/cm²

Pressure in the suction line, $p_{abs} = 0.8$ to 1.5 kgf/cm²

Fluid temperature from + 10 to + 50 °C

Water content of the SH 50 fluid: 48 to 60 per cent

Filtering: liquid filter according to TGL 21 541 with a fineness of 63 µm used as return line filter.

When changing the shaft seal the sliding surface (of the seal lips) on the drive shaft of the gear pump has to be repolished.

Guaranty

If SH 50 hydraulic fluid is used a waranty restriction will become valid with regard to the guaranty terms stated by the manufacurers. Therefore, please contact the manufacturers in this matter.

Ambient temperature — 40 to + 80 °C

Filter requirements Liquid filter according to TGL 21 541, with a fineness or ≦ 63 µm
Micro-S-Filter, with a fineness ≦ 63 µm

— **Installation position** with individual pumps — any position, with multi-flow pumps — see assembly instructions

— **Other specifications** Please learn further technical details from Standard TGL 10 859.

— The terms used correspond to Standard TGL 20 703.

2.1. Directions for use

2.1.1. Depending on the working conditions of the hydraulic system, the lowest p_d value is permissible as continuous working pressure, whereas the lowest $p_{b\,max}$ value is permissible as maximum working pressure, cf. diagrams.

Pressure in dependence on the speed
Pressure in dependence on the fluid working temperature
Pressure in dependence on the fluid working viscositiy
Pressure in dependence on the load period
Pressure in dependence in the switching frequency

given in Standard TGL 10 859.

2.1.2 Start under load

A start of gear pumps from the standstill and under a hydrostatic pressure of the hydraulic system which is ≧ 40 kgf/cm² will be permissible for
sizes (NG) ranging from 10 to 100

provided that the following conditions are adhered to:

Speed	1450 ± 100 r. p. m.
Kind of drive	arbitrary
Working pressure	max. 120 kgf/cm²
Suction line pressure	0.5 to 5 kgf/cm², absolute
Fluids	Hydro 50—10 according to TGL 17 542 or Einheitsöl 36 accrdg. to MLS 15 280
Fluid temperature	from + 10 to + 50 °C
Viscositiy	from 50 to 400 cSt
No. of gear pump starts	30 per hour as a maximum
Angular acceleration	50 to 40 rad · s⁻²

2.2. Gear pumps — multi-flow type

— Depending on the working conditions

the required driving power is given by the sum of the coupling efficiencies of the individual pumps

for multi-flow type gear pumps.

— For gear pumps with several flows and with separate circuits the use of different fluids within the circuits is possible. The fluid of the individual circuits is separated within multi-flow type gear pumps by shaft seals positioned between the individual pumps.

2.3. Gear pump combinations with electric motor

— The rated speed of the individual motor types sometimes differs from the gear pump speeds stated in the characteristics of TGL 10 859. In order to determine the rate of flow and the driving power at the rated motor speed, respectively, the values found in the characteristics of TGL 10 859 have to be linearly interpolated.

— The nominal rating of the motor shall be higher by at least 10 per cent than the driving power found in the characteristics for the highest working pressure during the operating cycle of the gear pump.

— KMR motor specifications

Size/rating:	depending on the driving power required for the rate of flow and working pressure envisaged
Synchronous speed:	1500 r. p. m. (preferred range) 750; 1000; 3000 r. p. m. (exceptional range)
Working voltage:	220/380 V up to size 132 380/660 V from size 160
Frequency:	50 c. p. s.
Protective system:	IP 44
Types:	M 201; M 301; M 302

3. Directions for installation

3.1. Preservative removal

— Remove the anti-corrosive paint from the spline shaft profile, complete gear pump combinations with motor excepted.

— No preservative is to be removed from the interior.

— Do not remove the plugs from the feed and discharge holes before starting pipe assembly, otherwise contamination will occur.

3.2. Assembly of single and multi-flow gear pumps

— Check the drive design
Gear pumps of the sizes 1.6 and 2.5 and with a spline shaft profile drive (types A and C) are preferably used for driving units running in oil, whereas for driving units which do not run in oil the design with the tapered shaft end (types B and D) are used.

— Installation position

single-flow gear pumps: any position

multi-flow gear pumps: in case of two-way flow – any position, in case of three, four or five-way flow — vertical installation with drive on top; deviations from the vertical smaller than or equal to 30 degress are permissible.

— The driving motor and the gear pump must form an oscillating unit.

— The direction of rotation of the gear pump drive is shown by the arrow on the face end of the mounting plate.

— Turning the driving shaft by hand is difficult or even impossible.

— The gear pump is mounted by means of 4 fillister-head screws (hexagonal socket-head bolts) of TGL 0-912-8.8.

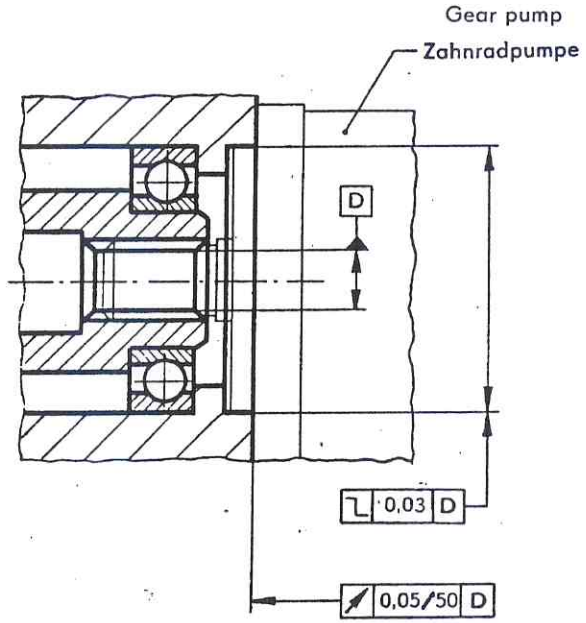


Fig. 6 Rigid coupling

— When attaching the gear pump take care that the spline shaft profile of the driving shaft smoothly enters the splined hub. A mating of the spline shaft profile without clearance is not permissible.

— Knocking the pump or the driving shaft is not allowed since otherwise this will damage the gear pump bearings.

Rigid couplings

In the case that a rigid coupling is being used make sure that appropriate tolerances are given to the length of the hub to avoid axial thrust on the driving shaft of the gear pump. Thrust exerted by the hub will in any event involve functioning troubles of the gear pump.

When attaching the gear pump with a rigid coupling (see Fig. 6) take care that with regard to their coaxial position the shaft of the driving unit and the shaft of the gear pump will not be off centre by more than 0.03 mm. Also make sure that the axial runout between the mounting surface of the gear pump and the shaft of the driving unit will not exced 0.05/50, as otherwise the gear pump will fail.

Movable couplings (compensating couplings)

A locking ring according to TGL 0-471 is to be inserted in the annular groove of the driving shaft, see Fig. 7.

If the tolerance requirements stated for rigid couplings cannot be met, we recommend to use flexible thrust roller couplings, TGL 21 612, or flexible claw clutches, TGL 23 252, or morable IWKN 06601 couplings (see Fig. 7).

IWKN 06601 couplings are preferably installed in a housing where a continuous wetting of the coupling with oil or its running in oil is ensured.

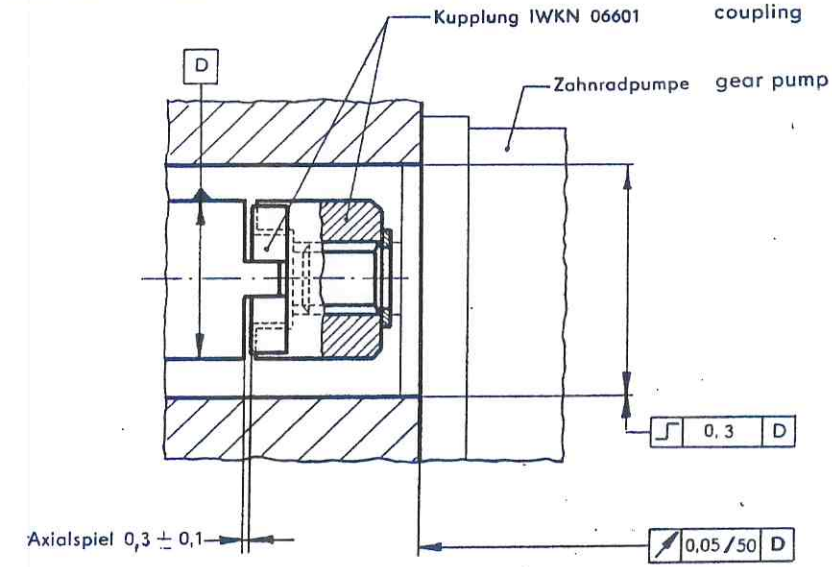


Fig. 7 Movable coupling

Other commercial couplings compensating the off-centre position are permitted to be used.

When installing movable IWNK 06601 couplings an axial off-centre position between the shaft of the driving unit and the driving shaft of the gear pump $\leqq$ 0.30 mm, and an end face runout between the mounting surface for the gear pump and the shaft of the driving unit $\leqq$ 0.05 mm can be compensated. The larger the positional error, the shorter the life of the coupling. Furthermore, the end play of 0.3 $\pm$ 0.1 mm (see Fig. 7) must be adhered to under all circumstances.

Thermal expansion during operation and the length tolerances of the pump driving shaft, especially with repaired gear pumps, have to be considered.

Connection of the coupling with the gear pump in case of series LK or LKK can take place prior to the attachment of the gear pump to the driving unit, whereas in case of MK, SK or SKK series this is done subsequently (as for as no centring ring is used), because in couplings of the MK, SK and SKK series the outside diametres of the driving sleeves are larger than the centring collar of the gear pump.

When using LKK and SKK couplings, the tightening torque for the nut of the tapered connection is $2.3 + {}^{0.2}$ kgfm.

For demounting the LKK and SKK couplings a pulling device should be used. Knocking is **not** permissible.

Flexible couplings

To dampen radial and torsional vibrations caused by the driving unit (especially with combustion engines) we recommend the use of flexible couplings.

3.3. Mounting instructions for gear pump combinations with an electric motor

— Types/Mounting position:

Type M 201 horizontal installation (foot mounting) in case of single or two-flow gear pumps

Type M 301 horizontal installation (flange mounting) in case of single or two-flow gear pumps

Type M 302 vertical installation (flange mounting) in case of single, two, three, four and five-flow gear pumps, motor on top

— Combinations with a motor type M 201 are completely bolted, merely the foot has to be attached to the system by means of 4 appropriate screws, a vibration-free foot rest being required.

— In combinations with a motor type M 301 or M 302, the intermediate flange is connected with the motor flange by two separately inserted, countersunk screws, the fastening holes of the motor flange being open in the "as delivered" condition. Following the insertion of a complete combination into the wall of the machine, the backing plate, etc., the complex connection (flange mounting) must be accomplished with 4 screws in case of motors up to size 180 or with 8 screws in case of motors of size 200 and greater. When fixing, the two separately inserted connecting screws must not be removed. The 4 or 8 screws required for the respective unit do not belong to the scope of delivery.
Intermediate flanges of the types M 1.12 and M 5.12 are excepted from this. These intermediate flanges are bolted to the motor, using the four mounting holes of the motor flange. This kind of flange connection with the wall of the machine, the backing plate, etc. is achieved by means of 4 screws that have to be inserted into the particular outer circle of holes.

— For flange mounting (types M 301 and M 302) a mounting collar is provided on the coupling flange (fit h 12) which has a radius of 2 mm at the transition zone. Therefore, the mating bore in the unit should have a corresponding chamfer or diameter.

— The sense of rotation of the gear pump is shown by an arrow marked on the circumferential surface of the intermediate flange.

— If required by the conditions of the system, the angular position of the gear pump relative to the motor type M 201 can be changed by loosening the bolting between the motor and the intermediate flange and turning the latter together with the pump

by 90 or 180 degrees (up to motor size 160), or
by 45, 90, 135, or 180 degrees (from motor size 180).

With the motor types M 301 or M 302 turning will be practicable only under certain conditions, since the two separately inserted mounting screws have to be loosened and bolting of the combination after shifting is not feasible.

— When attaching a new gear pump to the intermediate flange take care that with pump rating ranging from 4 to 100 the driving shaft must bear a locking ring according to TGL 0-471, whereas with the ratings 1.6 and 2.5 the shaft has to bear a plate spring meeting the requirements of TGL 9499.

— If a 1.6 or 2.5 gear pump shall be replaced then, before securing the new gear pump to the intermediate flange, the centring ring of the latter must be slipped over the centring collar of the pump. Following this a driving sleeve is to be pushed on the pump driving shaft (cone) and the hexagon nut (with a snap ring placed) to be tightened with a tightening torque of $2.3 + {}^{0.2}$ kgf.

— Moreover, with any attachment of a new gear pump an axial clearance of 0.2 to 0.4 mm has to be ensured between the coupling disc and the driving sleeve. This clearance is achieved by shifting the coupling sleeve axially on the shaft butt of the motor. Prior to shifting, the threaded pin in the coupling sleeve has to be loosened.

— If the electric motor has to be exchanged and if, moreover, it is an obsolete KR or KRA motor which is to be replaced by a new KMR type motor, then the size of the hitherto used intermediate flange is, in many cases, not usable any longer. Consequently, the intermediate flange type M must be inserted which is suitable for the KMR type and which is made according to TGL 10 859.

3.4. Hydraulic system

— Safeguard the pump and the hydraulic system against excessive working pressures by using a relief valve that is arranged near the pump.

The opening pressure of the relief valve is allowed to exceed the maximum working pressure $p_{b\,max}$ mentioned under 2.1. by a maximum of 10 kgf/cm².

Piping

— Steel pipes which are pure in metal and free from impurities are the prerequisite for a troublefree operation of the hydraulic units. After welding,

bending and fitting, the pipes must be freed from scale, sand, corrosion and welding residues.

For the pressure and suction lines, seamless steel pipes are allowed only, meeting the requirements of TGL 9012, TGL 9013 or TGL 14 100.

When using ferrule fittings in compliance with TGL 0-2353 seamless precision steel pipe according to TGL 14 100, having a strength of 35 kgf/mm² will be required.

For socket-welded fittings with spherical seal members according to TGL 8277 use:

seamless steel pipes meeting the requirements of TGL 9012 and TGL 9013.

- With regard to the connecting elements between the gear pump and the piping we recommend:

  for sizes from 4 to 40 — pipe fittings according to TGL 0-2353 and TGL 8277, respectively; these do not belong to the scope of delivery;

  for sizes 63 and 100 — IWKN flanged couplings, straight or angled; they have to be ordered separately. For the pressure line connection we recommend to use size 35.

  Requirements:

  For the attachment of straight flanged couplings fillister head screws M 10 x 40 according to TGL 0-912, having a quality of at least "8.8", should be used.

  The material of the welded-on collar of IWK flanged couplings: C 15

- When using the gear pumps under extreme conditions, mainly with high-viscosity fluids or low fluid temperatures, or with a speed higher than 2000 r. p. m., we recommend to employ the next larger size of suction pipe so that the pressure in the suction line $\geqq$ 0.5 kgf/cm² can be maintained.

  In these cases the suction line has to be reduced to the prescribed size immediately upstream the gear pump.

- Pipe fittings — TGL 0-2353:

  Remove the plugs from the gear pump. Secure the male end connections with gaskets by screwing them into the mating threaded ports of the gear pump.

  Cut the pipes at a right angle and deburr them carefully. Oil all parts. Place the cap nut and the ferrule on the pipe. The tapered portion of the ferrule must point to the cap nut. Make sure that all parts are clean! Press the end of the pipe against the support in the male end connection. Tighten the cap nut with great strength. After this, loosen the cap nut again and inspect the seat of the ferrule. The ferrule must have cut a uniformly shaped annular groove into the pipe. When loosening the nut, the ring mostly relaxes in such a way that it can be turned on the pipe. After inspection tighten the cap nut again. For series assembly use a cutting device.

- **Pipe fittings — TGL 8277 — and IWKN flanged couplings**

  Cut the pipes at a right angle and deburr them carefully. Place cap nut and flange, respectively, on the pipe. Weld spherical bush and weld-on collar, resp., to the pipe. Clean the piping carefully. Remove the plug from the gear pump. Screw in the male end connection and secure the piping to the connection and the IWKN flanged coupling of the gear pump, respectively.

  When using an IWKN flanged coupling make sure that an O-ring seal is inserted.

- Install and connect the suction line carefully, so that no air will be taken in.

- Install the piping in a vibration-free manner by employing appropriate supports. Prevent stresses occurring in the piping from being transferred to the housing of the gear pump.

3.5. Filtering

The system shall be assembled in such a way that when pouring the fluid into the tank and when operating the system the fluid always passes a filter having a fineness of $\leqq$ 63 μm.

3.5.1. Filters recommended:

- Liquid filters according to TGL 21 541 — full flow filtration installed in the gear pump return line, fineness $\leqq$ 63 μm.

Under the below-mentioned operating conditions the installation of a positive filter, i. e. a liquid filter according to TGL 21 541 with a fineness of $\leqq$ 63 μm, in the return line is absolutely necessary:

- at high speeds
- at low viscosities
- when starting under load
- when working with the hard-to-inflame hydraulic fluid SH 50

Gear pump size	Micro-S-filter type	Micro-S-filter thread for suction line
1.6	MS 10	M 18 × 1.5[1]
2.5	MS 10	M 18 × 1.5[1]
4	MS 10	M 18 × 1.5[1]
6.3	MS 25	M 18 × 1.5[1]
10	MS 25	M 22 × 1.5
16	MS 63	M 26 × 1.5[2]
25	MS 63	M 26 × 1.5[2]
40	MS 100	M 42 × 1.5
63	MS 200	M 42 × 1.5
100	MS 200	M 42 × 1.5

3.5.2. Micro-S-filter — partial flow filtration, are to be installed in the suction line of the gear pump or in the return line of the system.

Fineness of filter: $\leqq$63 μm

Type according to the adjoining Table.

[1]) from Jan. 1, 1975: M 22 × 1.5

[2]) from Jan. 1, 1975: M 27 × 2

- If the rated speed is exceeded, the next larger size of filter should be chosen in accordance with the higher flow rate.
- Micro-S-filters cannot be used for hard-to-inflame hydraulic fluids SH 50.

3.6. Labour safety measures

According to the provisions of the ASAO 530/1 § 6 the following should be provided for:

Fire protecting and extinguishing means, such as shields, special extinguishers, etc., if there will be a fire hazard in the case of an unwilled leakage of the hydraulic fluid.

With respect to labour safety the following measures shall be noted:
The operators shall be instructed according to the labour safety regulations on connection with these operating instructions.
For gear pump combinations with electric motor the following is to be observed:
The location of the pump combination shall be selected such that it will not be within the traffic or working area, i. e. within the area in which the factory traffic and public traffic take place or within the area in which the operation proper of the pump combination and the adjacent units of the system is done.
If under certain circumstances the pump combination has to be installed in the traffic or working area let the window of the intermediate flange point downward (in the way as it is supplied) if possible, or arrange it in such a way that an accidental access to the coupling will be prevented. If such an arrangement is not possible, the window of the intermediate flange should be covered by a guard clamped to it, or the whole intermediate flange should be enclosed.

4. Putting into operation

- Put the gear pump into operation with open valves only.
- Check the direction of rotation which must be the same as shown by the arrow marked on the gear pump. A rotation in the wrong direction will make the gear pump fail within a short period!
- Connect the terminals of the gear pump combination with motor so that the direction of rotation shown on the intermediate flange (arrow) will be ensured. If required, make a short no-load test run (for a maximum of 2 seconds), thus you can check the direction of rotation on the coupling, or remove the discharge line from the pump to check the correct direction of flow.
- Rinse the system by making use of a separate pump unit and a clean fluid, before you put the gear pump into operation for the first time. Rinsing time depends on the degree of contamination, that will say, on the results of the filter inspections.
- With the fluid filled into the tank through a positive filter having a fineness of $\leqq 63\ \mu m$ the hydraulic system is to be run in with a very reduced working pressure.
  In doing so, vent the system properly.
- Clean the filter after every 15 minutes. The running-in period may be considered terminated when after two subsequent filter inspections no residues are found. Further filter cleaning is done in dependence on the specific application of the system.
- Take care that under extreme working conditions — fluid temperatures ranging from — 15 to — 30 °C and/or viscosities ranging from 1.000 to 1.500 cSt. the pump will warm-up according to chapter 2.
- High vibratory loads may interrupt the lubricating film of the sliding surfaces of the gear pump bearings and may, thus, be the cause for its failure. Such cases need special measures to be taken in order to dampen the vibration, e. g. change of the driving speed, attachment of vibration absorbers, increase of the gear box strength, etc.

  Normal rates of vibration are:

  acceleration $\leqq$ 30 m/s²
  frequency = 0.5 to 6 kHz

5. Maintenance

- Single or multi-flow gear pumps are lubricated by the fluid. Therefore, no maintenance is required.
- When using motor-driven gear pump combinations, maintenance only means inspection of the coupling parts which have to be examined for wear after longer periods of running. For the electric motors the maintenance prescribed by VEM Kombinat Elektromaschinenbau will be valid.
- The perfectness of the support and tightness of the piping should be inspected regularly.
- In any hydraulic system the fluid is subjected to an increasing contamination due to abrasion, wear particels, dust, ageing products of the fluid and condensed water.
  The non-compounded hydraulic fluid on a mineral oil basis should be changed if it has reached the following analytical values:

Content of resin		3.5 %
Neutralisation number	(NZ)	0.6 mg KOH/g
Saponification number	(VZ)	1.6 mg KOH/g

  As found by experience, troubles will occur when these values are exceeded. Under normal working conditions this means a change after about 3.000 to 6.000 working hours.

Attention!

Only hydraulic fluids of the same grade are allowed to be used for blending or topping up the tank in case of leakage. Blending of different fluids (e. g. mineral and synthetic oils) may cause heavy damages to the hydraulic system.

- With every change of the hydraulic fluid the whole system including the fluid tank should be thoroughly rinsed with Spülöl R 16 (Rinsing Oil R 16), or with the type of fluid which then will be used. Any subsequent rinsing with kerosine or benzine should be omitted as otherwise remaining residues will reduce the ageing resistance of the fluid considerably.
- Don't clean the fluid tank with fluffy rags or waste cotton!
- Experience has shown that condensed water is little by little formed and collected in the fluid tank due to temperature variations. If the condensed water enters the hydraulic circle it will lead to an early failure of the devices. Therefore, the water which has separated has to be drained off the tank from time to time.
- Depending on the operating conditions continually check the fluid for freedom of water (turbidity), freedom of air (milky shade), and other impurities.
- The above statements hold good for fluids on a mineral oil basis, only. For synthetic fluids the manufacturers' instructions are binding.

6. Storage

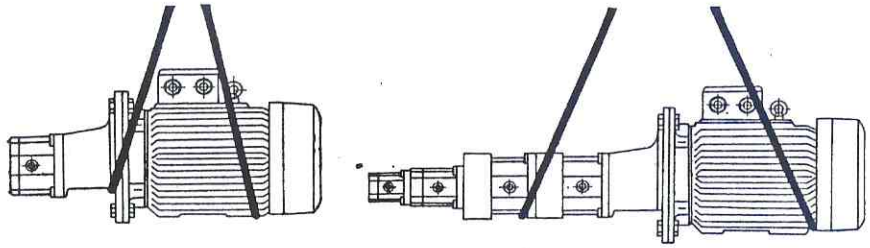
— Store the gear pumps in clean and dry rooms. The relative air humidity shall not exceed 70 per cent. Gases promoting corrosion are to be kept away from storage rooms.

— The manufacturer provides for a preservation of the gear pumps which will be sufficient for a storage period of 12 months. A 12 months preservation also applies to gear pumps that have been repaired by contractional repair shops.

7. Handling instructions

Observe the ABAO being in force, especially ABAO 17/2 — General Provisions for Transport and Handling — as well as ASAO 908 — Hoisting Machinery and Lifting Tackles — when handling and mounting gear pump combinations with motor.

— When fixing a rope for hoisting a gear pump combination note the following Figures.



Figs. 8.1. and 8.2. Fixing of a rope for lifting gear pump combinations.

— Never use the eye bolt of the motor for rope fixing and lifting complete gear pump combinations.

— It is not permitted to store a gear pump combination on the ventilation cap of the motor. On principle, combinations with M 201-type motors have to be stored standing on their feet, M 301 and M 302-types lying on prismatic or troughed surfaces.

8. Protective system

Provided with the protective system according to ABAO 3/1.

9. Scope

— These operating instructions are valid for single-flow and multi-flow gear pumps as well as for gear pump combinations ND 160 with electric motors according to TGL 10 859 which are series-manufactured by VEB Industriewerke Karl-Marx-Stadt, a factory affiliated to VEB Kombinat ORSTA-Hydraulik.

— Demands placed on our series-manufactured product which are beyond the frame of these operating instructions or which restrict them in any way, necessitate the special agreement with the manufacturer.

— The scope of delivery of single-flow and multi-flow gear pumps as well as of gear pump combinations with electric motors is fixed in the relevant contract of delivery.

Claims as to the scope of delivery cannot be derived from these operating instructions.

— In the case that objections should arise during the period of guaranty they are to be reported to the manufacturer taking into consideration the legal regulations.

— The guaranty supplied is part of these operating instructions.

— Single-flow and multi-flow gear pumps as well as gear pump combinations with electric motors should be submitted to a contractional repair shop approved by the manufacturer. (See list of contractional repair shops).

10. Trouble shooting

The following pages will inform you how to detect and remedy failures.

— Prerequisites for repairs made by the user are experts who know the functioning and the structure of the gear pump.

— Repair work on the system as well as the demounting of units necessitate that the complete system is switched off and in a non-pressurized condition. Exceptions of this are the adjustment of the relief valves and flow tests.

10.1. No delivery by the gear pump

	Possible cause	Remedy
10.1.1.	Plug was not removed from the suction connection	— Remove it.
10.1.2.	Suction line leaks	— Tighten the pipe fittings — (In the case of sizes 63 and 100) check if the O-ring is inserted in the flanged coupling of the suction connection. — Press air into the suction line (which has been immersed in water or has been painted with a soap solution). The formation of bubbles will show the leaky spot.
10.1.3.	Suction line is too short	— Stick to the depth of immersion of the suction line into the fluid according to TGL Standard.
10.1.4.	Fluid level in the fluid tank is too low	— Replenish the filled hydraulic system until the required fluid level is reached. Use the sight glass.
10.1.5.	Underpressure in the suction line is too high	— Select a larger inside diameter of the suction line. — Reduce the flow resistance in the suction line (less bends, shorter length, smaller suction head).

		— Use a fluid with a lower nominal viscosity. — Clean the suction line filter. — Replace the hose used as suction line by a pipe (Hoses contract in curves). — Pre-heat fluid tank if extreme working conditions exist.
10.1.6.	Wrong sense of rotation of the drive	— Check whether the direction of rotation of the drive agrees with the gear pump direction of rotation required. — In the case of motor drive change terminals.
10.1.7.	Drive interrupted due to broken coupling	— Replace coupling by a new one.

10.2. Gear pump works, but no or insufficient pressure is built up

	Possible cause	Remedy
10.2.1.	Pressure gauge does not work	— Check pressure gauge and pressure gauge line. — Open pressure gauge valve.
10.2.2.	Relief valve open	— Set the pressure limiting range — Check if (disc of) the valve jams. — Shut it.
10.2.3.	Fluid bleed-off circuit of the system is open	— Correct wrong setting of the directional valve.
10.2.4.	Directional solenoid valve does not operate	— Check if the magnets function. — Check electric supply line if there is an undervoltage. — Check electric supply line for a defect. — Check return spring. — Replace directional valve if valve spool jams.
10.2.5.	Piping fails	— Check piping including fittings and clear the fault.
10.2.6.	Gear pump takes air in	— See 10 4.
10.2.7.	Delivery drop of the gear pump	— See 10.3.
10.2.8.	Driving power is too low	— Compare the driving power of the machine with the power delivered by the gear pump, see characteristics given in TGL 10859. — Watch speed and working pressure. — For high fluid viscosities a higher driving power is needed. — If driven by an electric motor the motor rating must exceed the driving power required by the pump by at least 10 per cent. — Eliminate overloading due to repeated pressure peaks (peaks due to switching).

10.3. Drop of the gear pump delivery (or drop of pressure)

	Possible cause	Remedy
10.3.1.	Pump fails	— Check cleanness of fluid (change fluid, if necessary). — In the case of a movable coupling, check the axial play prescribed (0.3 ± 0.1), but take into consideration the heat expansion during operation — In the case of a rigid coupling, check if the splined hub presses in axial direction. (Do not permit that it is in touch with the snap ring or with the end of the splined shaft profile.) — Check the position of the drive with respect to the centring of the gear pump, deviations from the permissible values are to be corrected. — Check the drive for radial loading of the gear pump driving shaft, insert drive bearing, if necessary. — Check the operating conditions. (Fluid temperature, viscosity, max. working pressure, period of loading). — Measure pressure peaks by means of an oscillograph (intertia of the pressure gauge).
10.3.2.	Speed on drive end is too low	— Measure speed and increase it according to the flow required.
10.3.3.	Insufficient suction effect of the pump	— See 10.1
10.3.4.	Fluid temperature is too high and viscosity too low, respectively	— Use a fluid with a viscosity which corresponds to the working conditions. — Allow temperature to drop according to 10.6.
10.3.5.	Very heavy axial or radial vibrations	— Dampen vibrations by changes made on the driving unit. — Stabilize the system. — Use several individual pumps instead of one multi-flow gear pump. — Change driving speed. — Check pipe connections for deformations.

10.4. Foam is formed in the fluid tank

	Possible cause	Remedy
10.4.1.	Suction line is leaking	— See 10.1.2.
10.4.2.	Suction line is too short or fluid level in the fluid tank is too low	— See 10.1.3. and 10.1.4.

10.4.3.	Suction line in the fluid tank is too close to the return line	— Increase the distance in the tank, observe regulations for TGL tanks.
10.4.4.	Underpressure in the suction line is too high	— See 10.1.5.
10.4.4.	Shaft seal of the gear pump is leaky	— Check and change shaft seal, if necessary (See 10.5.1.).

10.5. Fluid leakage on the driving shaft

	Possible cause	Remedy
10.5.1.	Shaft seal leaks due to wear	— Insert new shaft seal, use talcum (on the outer diameter) and heat-resistant bearing grease (between the seal lips). Note! Prior to this put polished protection sleeve over the splined shaft profile. — Check if the rubber quality is WS 1.057 — Protect sealing lips from damages, even the finest ones. — In case of multi-flow gear pumps, loosen the screw connection of the interlinked individual pumps, withdraw the coupling and check the shaft seal. — When using the SH 50 fluid polish the driving shaft (wear marks) prior to inserting the new shaft seal.
10.5.2.	Shaft seal is leaky due to an increased fluid leakage in the gear pump	— See 10.3.

10.6. Fluid temperature is too high

	Possible cause	Remedy
10.6.1.	Heat balance of the system is incorrect	— Re-check heat balance taking into consideration heat emitting surfaces as well as the kind of cooling. — Provide for cooling (with thermostatic regulation).
10.6.2.	Fluid tank or piping in the immediate vicinity of the heat emitting driving machine	— Change position, provide a dissipative system for the tank and piping.
10.6.3.	Fluid quantity is too small for the circuit (insufficient capacity of the tank)	— Increase volume of the tank. Rule: Tank volume equals 3 to 4 times the rate of flow (l/min). — If it is impossible to increase the volume, provide for cooling or dissipation.
10.6.4.	Fluid continuously flows away through the relief valve	— Adjust valve.
10.6.5.	Undue heating of the gear pump	— See 10.3.1.

10.7. Generation of a loud noise

	Possible cause	Remedy
10.7.1.	Gear pump takes air in ("cracking" sounds)	— See 10.4.
10.7.2.	Suction noise due to cavitation in the suction line	— Increase the inside diameter of the suction line. — Reduce bends in the suction line.
10.7.3.	Suction line filter has clogged	— Clean the filter.
10.7.4.	Mechanical noise coming from the driving unit	— Check, if necessary, with the gear pump disengaged.
10.7.5.	Coupling noise due to damaged or imperfectly aligned coupling	— Check. — Align driving unit or replace coupling. — Put the coupling which was run in dry conditions into oil (closed housing).
10.7.6.	Heavy vibration	— See 10.3.5.

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