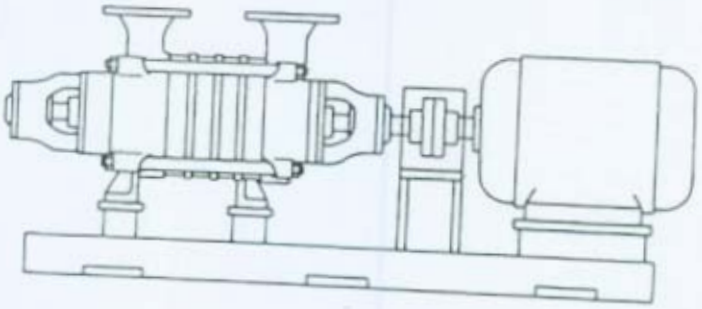
SULZER

INSTRUCTIONS DE SERVICE
BETRIEBSANLEITUNG
OPERATING INSTRUCTIONS

MB



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1964

INDEX

1. GENERAL REMARKS.....

2. SERVICE DATA.....

3. DESCRIPTION.....

4. INSTALLATION.....

5. PIPEWORK / AUXILIARY FACILITIES.....

6. SERVICE.....

7. MAINTENANCE.....

8. REPAIRS.....

Anlagen zu C.-Nr.: Documentation for order no.:	93 229 (80 805/2-411.0066)	Bei Rücksprache unbedingt angeben Always quote this number

Typ:
Type: MB 65 - 7

Bestell-Angaben:
Customer's data: FOSTER WHEELER
Item-No.: 1538-11

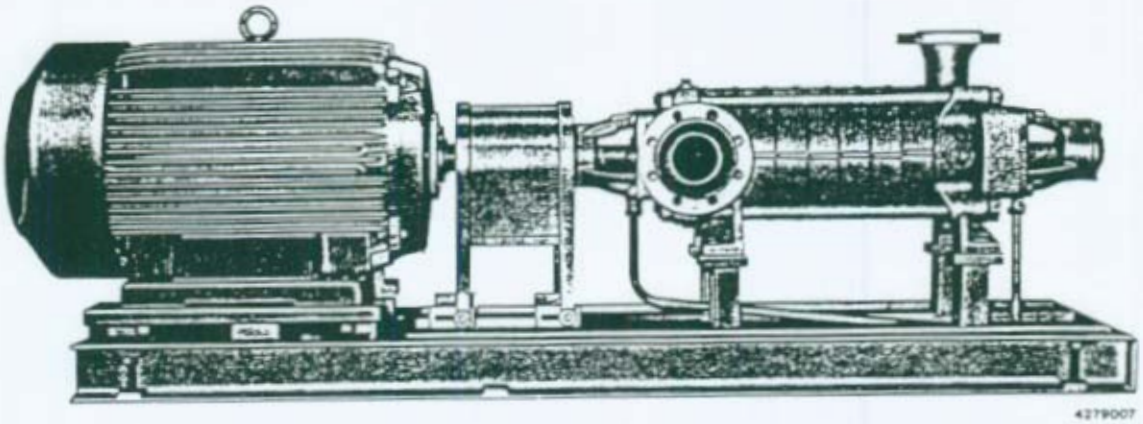
Zeichnungen	Drawings	
Aufstellungsplan	Installation plan	2-U 4211.52-033
Schnittzeichng. - Pumpe	Sect. drawing - pump	SE 402 - 1 - 01
Teileliste - Pumpe	List of parts - pump	TP 93 229
Schnittzeichng.-Wellendichtung	Sect. drawing - shaft seal	SE 402 - 1 - 01
Teileliste - Wellendichtung	List of parts - shaft seal	TP 93 229
R + I Schema	P + I Diagramm	-
Zirkulationsschema	Circulation layout	-
Kühlschema	Cooling layout	-
Sonderunterlagen	Special documents	-
Kennlinie	Performance curve	D 4200.45.01/1

Zubehör	Accessories	
Kupplung	Coupling	N-Eupex A 125
Mindestmengeneinrichtung	Minimum flow regulation	TDL 094
Antriebsmaschine	Driver	E-Motor
Ölversorgungsanlage	Oil supply system	-
Ölpumpe	Oil pump	-
Ölkühler	Oil cooler	-
Ölfilter	Oil strainer	-
Getriebe / Regelkupplung	Gear unit / Gear type coupling	-
Mech.Wellendichtung / Zubehör	Mech. seal / Accessories	-
		-
		-
Spez. Armaturen	Spec. Armature	-
Sondervorschriften	Spec. Instructions	-

2. SERVICE DATA - SERVICE CONTROL

2.1 Data		
Serial No.		93 229
Position No.		1538-11
Medium delivered		hot water
Capacity	m^3/h	25
Minimum capacity	m^3/h	1,5
Differential head	m FS	257
NPSH R	m	1,9
Differential pressure	bar	24,10
Suction pressure	bar	0,39
Discharge pressure	bar	24,49
Pumping temperature (PT)	°C	102
Specif. grav. at PT	kg/m^3	956,8
Pump input	kW	26,5
Speed	1 / min.	2930
Impeller diameter	mm	170
2.2 Lubrication		
Type of grease (according to DIN 51 825)		NLGI Class 3
Lubrication frequency and quantity of grease		see 7.3
2.3 Cooling		-
Cooling water	m^3/h	
Pressure normal / max.	bar	
Temperature outlet max.	°C	
2.4 Heating		-
Heat exchanging medium		
Pressure normal / max.	bar	
Temperature entry max.	°C	
2.5 Flushing / Sealing (shaft seal)		-
Flushing / Sealing medium		
Quantity min.	m^3/h	
Pressure	bar	
Temperature of flushing medium	°C	
2.6 Flushing (wear ring)		-
Flushing medium		
Quantity	m^3/h	
Pressure	bar	
2.7 Quench		-
Quench medium		
Quantity	m^3/h	
Pressure	bar	
2.8 Safety technical limit data		
Max. allowable working pressure	bar	30
Max. allowable working temperature	°C	102

3. DESCRIPTION OF THE PUMP



Pumps of the series MB are horizontal, multi-stage centrifugal pumps for boiler feed- and booster plants.

These pumps are suitable for all clean liquids in the temperature range from -20°C to +180°C and for working pressures up to 40 bar (special designs in chrome-steel excepted, see data sheet).

The materials correspond to the pumped liquid specified in the order. If this pump should ever be used for other liquids and temperatures, please refer to the manufacturer.

The casing elements are sealed by means of O-rings and held together by external tie bolts. The antifriction bearing of the rotor is grease lubricated.

The impellers have closed vane channels and are sealed by casing wear rings against the casing elements. The guiding of the flow into the following stage is obtained with stationary diffusers.

The stuffing box housings contain the shaft seals, which are soft packings or mechanical seals according to working requirements. For normal applications the stuffing box housings have no cooling chamber, but for special applications they have cooling-/heating chamber, see 2.3 and 2.4.

As connecting element to the driver a flexible coupling according to DIN 740 (design-terms) is used; these coupling must be able to absorb small axial, radial and angular shaft displacements.

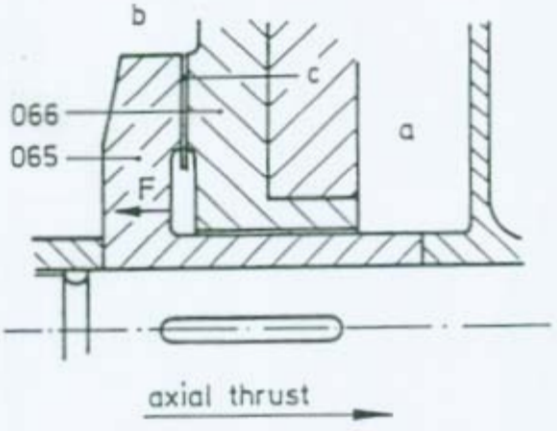
Taking up of axial thrust - balance disk

General

- During operation of the pump an axial thrust towards suction side will be exerted on the rotor, as the area on the impeller back shroud, subjected to liquid pressure, is greater than on the front side, which is interrupted by the impeller eye. With multi-stage pumps the forces will be added according to number of stages and considerable axial load results. These axial forces are absorbed by the hydraulic balancing device.

Working principle

- The balancing device consists of a balance disk rotating with the shaft and of a balance counter disk, which is integrated in the casing. The pressure difference between pump inside "a" (discharge pressure) and balance chamber "b" (inlet pressure + pipe resistance-balance pipe) causes a liquid flow from "a" to "b". The pressure difference causes at the balance disk an axial force "F", which is opposite to the pump axial thrust. So the rotor shifts in the direction of the axial force "F". Some liquid flows into the balance chamber through the clearance "c" generated from this movement. During operation an automatic balance will be given between axial thrust and counter-force "F", so that the bearings need not to absorb axial forces. The balance only works perfectly when no pressure builds up in the balance chamber as a result of inflowing liquid.



Balance pipe

WARNING: If the instructions concerning layout of balance pipe are not observed, severe damage at the pump will result.

- To avoid pressure building up in the balance chamber, the liquid must be piped away. The balance chamber has a piping connection, the position of which is indicated on the outline drawing.
- The piping layout depends on the working conditions:

  e.g. - feed back to tank
  - feed back to suction casing
  - open atmospheric drain

The statement on outline drawing is decisive for the pump supplied.

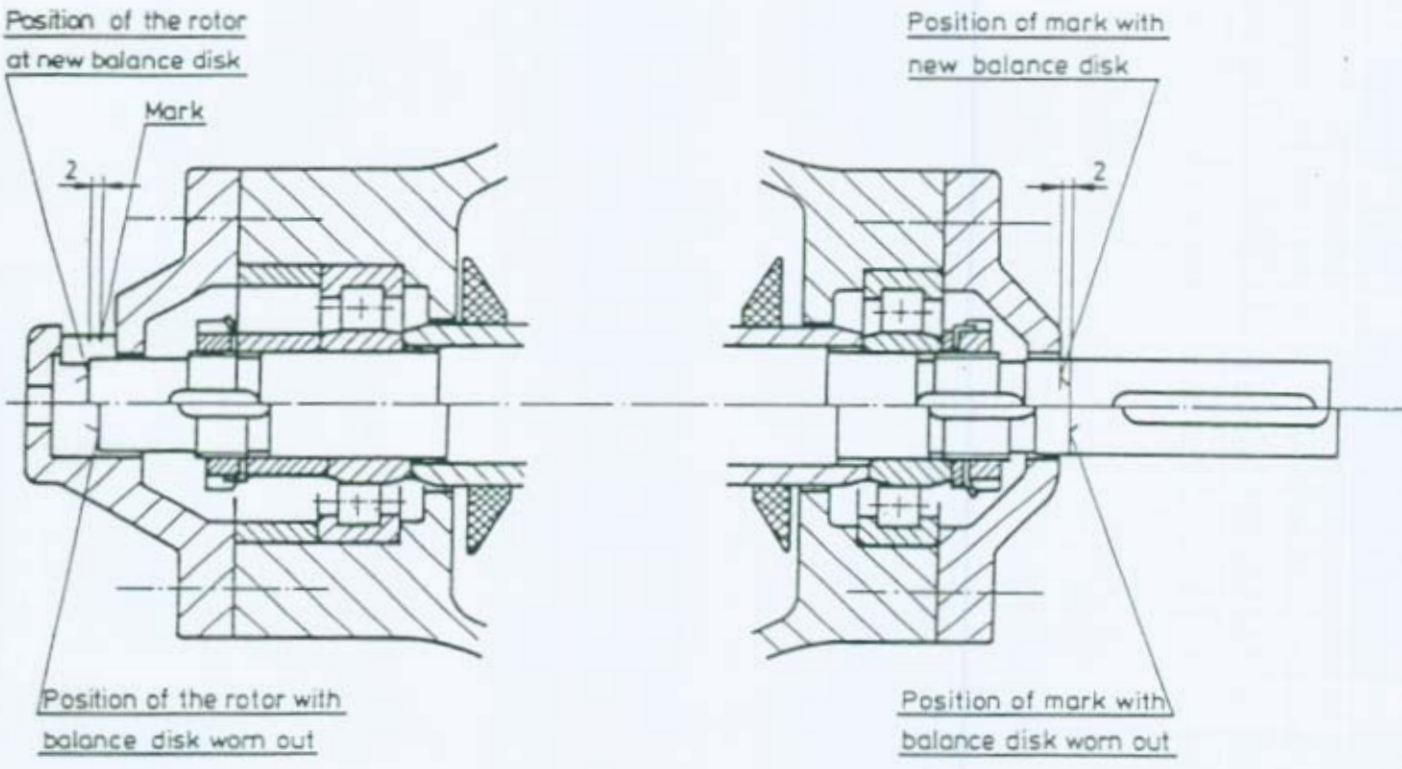
- In case of longer balance pipe please ensure by selection of the correspondent nominal bore that piping resistance does not exceed 0,8 bar.
- In the piping a shutoff device should be installed for isolation in case of repairs which must be open before operation and must be secured against unauthorized closure.

Indication of rotor position

- The balance disks will wear out due to the high flow speed in the clearance "c". So the rotor gradually shifts towards the suction side. The balance disks must be renewed before the impellers touch the casing.
- The balance disks are worn out and must be renewed, if the rotor has shifted approx. 2 mm towards the suction side.

Checking - with size 32 - 80: by aid of a mark on the shaft on the coupling side bearing cover. See figure.

- with size 100-150: by aid of a mark on the bearing cover at the non-drive end. See figure.



Size 100 and 150

Size 32 to 80

4. INSTALLATION OF THE PUMP

4.1 CONSTRUCTION (see outline drawing/installation plan)

4.1.1 Main measures, connections, position of clamping screws etc. can be gathered from the outline drawing.

4.1.2 In the case of installation and repair work suitable lifting devices must be available. Good light and sockets for portable lamps are important. The pump should also be accessible from all sides.

4.1.3 Select installation place and type in a way that few running and stop vibrations occur which reduce the life of a pump.

4.1.4 From the connection at the baseplate drain pan a pressureless delivery pipe for leackage of the shaft seal, drain of the pump and ancillary pipes has to be provided.

4.1.5 In order to protect the pump interior covers and plugs of connecting branches/ threaded borings are not to be removed before the assembly of the pipings. The pump has to be covered during possibly still necessary construction work.

4.1.6 Bedplates or other necessary masonry have to be finished, set and dry. Abrade and clean bedplate. Alle preparatory works which are necessary for the assembly have to be finished. In the case of big units suitable doors and apertures have to be provided for the transport to the assembly place.

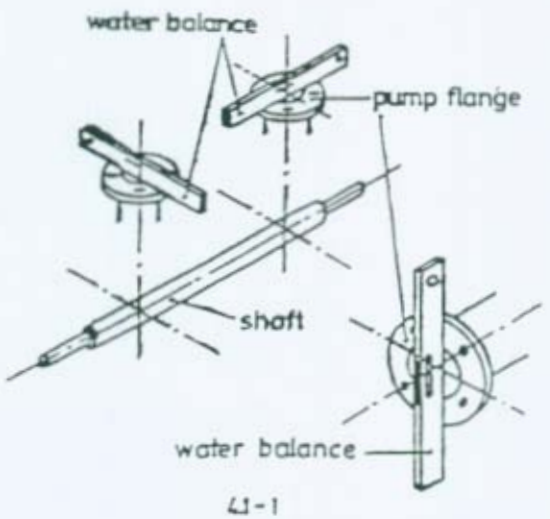
4.1.7 Installation of pump and driver.

4.1.7.1 Insert foundation bolts in fastening holes of baseplate and unscrew nuts for some rotations. Place baseplate with assembled pump and driver on foundation. Align pump horizontally by using steel shims of various thicknesses. For baseplates up to a length of 1600 mm 3 shim positions will be sufficient: one shim each alongside the plate, at right and left hand in the area of the driver, one at the narrow side in the area of the pump. Check with mechanical level installation to pump axis direction and at a horizontal flange. Flanges have to be vertical at the lateral branches. See sketch 4.1-1. Allowable deviation 0,5 mm max on 1 m.

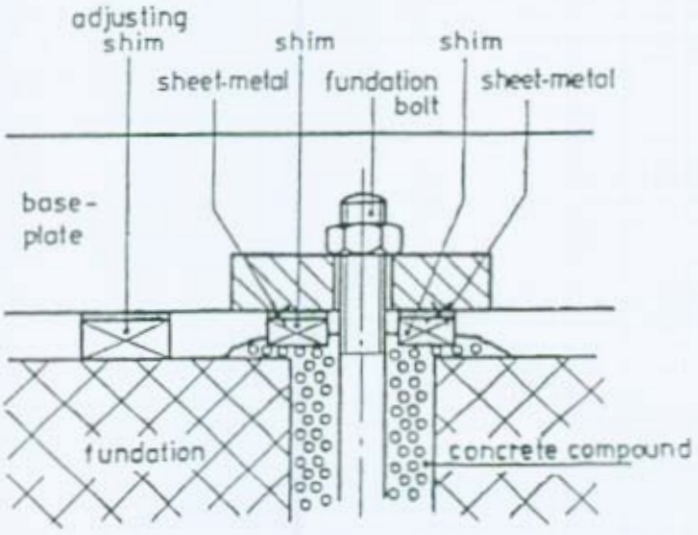
4.1.7.2 Concrete stone bolts, whereby the pouring out has to be massed a little over the hole. Align final steel supports at left and right side beneath the stone bolts on the massed, but not yet set concrete. The supports must be so high, that only a little tolerance remains between baseplate and support. Fill up the remaining space with one or two thin planparallel shims, which must be available in different thickness (see sketch 4.1-2).

4.1.7.3 After hardening of concrete tighten stone bolts. Control again horizontal installation. If the pump's position has changed it has again to be aligned.

4.1.7.4 After having aligned grout baseplate with concrete (no swell concrete). After hardening alignment of coupling can be effected as described in 4.2. In the case of separate baseplates for pump and driver because of tension-free connection of pipings install first of all pump and align afterwards driver.



4.1-1



4.1-2

4.2 Alignment of coupling

4.2.1 Before aligning the coupling check, in uncoupled position, direction of rotation of driver according to direction arrow on the pump.

4.2.2 Elastic couplings require a careful alignment of the shaft centres which can be obtained by laying thin sheets under the engine. Negligence during alignment leads to destruction of coupling and to damage of pump's and driver's bearings.

4.2.3 In special cases assembly and alignment have to be effected according to the coupling manufacturer's instructions. For example a prescribed distance between the coupling halves has to be observed during alignment. See installation plan and instructions referring to the coupling in the installation.

4.2.4 Alignment of couplings without spacer piece is sufficient when a precision ruler at the coupling periphery rests parallel to the shaft on the whole coupling latitude at several points of the peiphery. The prescribed coupling distance has to be checked at several opposite places with a thickness gauge (see fig. 4.2-1).

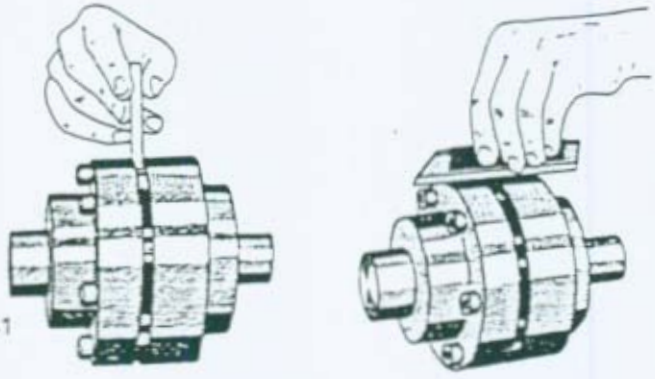


fig. 4.2-1

4.2.5 If a more exact alignment is demanded (in case of operation at speeds > 3600 1/min. and couplings with spacer piece obligatory) this has to be effected with dial gauges in radial and axial direction (see fig. 4.2-2). Admissible axial tolerance in diameter max. 0,05 mm, but if possible ≦ 0,03 mm (measure as far at the outside as possible). Admissible radial tolerance in diameter max. 0,1 mm, but if possible ≦ 0,05 mm.

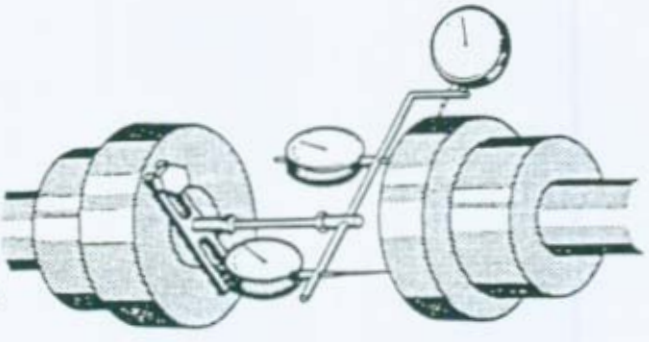


fig. 4.2-2

4.2.6 In case of higher operation temperatures (beginning with about 130°C) precision alignment has to be checked under hot running conditions. If deviations about the admissible dimensions described in § 4.2.5 are noticed, find out reasons and eliminate them. In most cases inadmissible high forces and moments onto the pump branches are to suppose, which arise by extension of the abutting pipings. See also 5.1.2.1.

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5. PIPINGS/AUXILIARY FACILITIES

5.1 Suction and discharge piping

5.1.1 General remarks

Tube diameters are already determined during the construction planning. Many different factors which are not known to the pump manufacturer have to be taken into account. Generally the liquid's speed in the suction piping should amount to about 2 m/s and in the discharge piping to 3 m/s. (If often appears for example that the nominal width of the suction piping has to be designed larger than the nominal width of the pumps's suction branch.) Therefore we only want to give some practical advices which have to be taken into account when assembling pipings.

5.1.2 Assembly

5.1.2.1 Prop pipings in a way that the branches are not strained undue as a result of forces and moments caused by pipe weight and heat stress. (Install extension arc.) Connecting flanges have to be parallel to pump flanges.

5.1.2.2. Assemble horizontal pipings for feed service steadily decreasing and for suction service steadily increasing and without ballonets.

5.1.2.3 Design branches in a favorable way with regard to flow. The transition from small pipe diameters to larger ones has gradually to be effected. Rule: total length of conical transition piece = 5 - 7 times nominal width difference.

5.1.2.4 Observe in the case of flange connections that gaskets are centered through the flange screws in order not to contract the pipe section.

5.1.2.5 Observe especially in the case of suction/feed pipe that irregular transitions and short bends enlarge the pipe resistances. Large pipe resistance means decrease of entry pressure at suction branch. If the pressure is too low this leads to cavitation at impeller entrance.

5.1.2.6 In the case of the installation of several pumps for each pump has to be provided its own suction pipe. Except are reserve pumps with parallel connection which can have a common suction piping because always only one pump is in service.

5.1.3 Cleaning of pipings

5.1.3.1 Before starting-up pipings and feed tanks have carefully to be cleaned from all pollutions and foreign substances. In the case of welding structures globules and icicles have to be removed.

5.1.3.2 In order to prevent foreign bodies in the pipework (scale, globules, etc.) from penetrating into the pump, which is likely to happen shortly after commissioning, it is useful to insert a tapered strainer * made of stainless steel into the feed pipe. The effective area of passage of this strainer must be at least 1,5 to 2 times the pipe diameter. If the feed pressure decreases at the pump, the strainer must be removed and cleaned. After a certain running-in period, when there is no more dirt, the strainer can be removed.

* This strainer consists of a supporting strainer (plate with round holes Rv 6,3 to DIN 24041) to which a wire screen with narrow openings (e.g. wire cloth 0,315 x 2 to DIN 4189) is fixed by spot welding.

5.1.4 Compression test

5.1.4.1 Pipings have to be checked whether they are sealed. Compression tests have to be effected according to official instructions.

5.1.5 Fittings

5.1.5.1 Fittings which have to be installed must have the nominal width of the pipings. If the nominal width of the pump branches is smaller conical transitions between fittings and pump have to be installed. The shutt-off valve in the feed pipe is not allowed to be directly in front of the pump branch so that the there developing flow turbulence does not continue to the pump's suction room. In order to avoid ballonets the shut-off valve has to be installed in a way that the handwheel spindle shows sidewards or downwards.

5.2 Auxiliary facilities serve for the control of the pump (measuring instruments for pressure, temperature, etc.) and for the maintenance of the service (cooling, heating, flushing, sealing, etc.). All this depends on the requirements of the type and place of application. The outline drawing shows the design of the pump supplied.
If applicable for the pump supplied consider the following information when installing auxiliary facilities which have not been installed in the works:

- Manometers are mounted on manometer supports and are connected to the measuring points at the pump branches or adjacent pipings by using measuring pipings Ø 8 and inserting a loop. In order to guarantee stop and ventilation, appropriate valves have to be arranged in front of the instruments.
- Thermometers have directly to be inserted at the measuring point. The insertion depth of the sensitive element in the liquid must amount to a minimum of 40 mm. In case of pressures of more than 16 bars a protective tube according to DIN 43 763 has to be used.
- Drain of the pump can be effected via an extending piping into the collecting tank of the baseplate or into a leakage liquid collecting pipe. You have to place shut-off valves in the drain pipings which have at least to correspond to the nominal pressure of the pump casing.
- Leakage liquid of the mechanical seal can also be passed via an extending piping into the collecting tank of the baseplate or into a leakage liquid collecting pipe.
- Cooling has to be effected as indicated in the installation plan or in a separate drawing.
  Lay cooling pipings in such a way that feed is effected at the deepest point and discharge at the highest point of the cooling chamber. You have to place regulating valves in the feed pipings and flow indicators in the drain pipings in case of a closed system. In case of an opened system the drain pipings have to be led via a drain funnel.
- Heating has to be effected as indicated in the installation plan or in a separate drawing.
  Heating pipings have to be laid in such a way that the feeding is effected at the highest point. Place regulating valves in the feed pipings. Drain has to be effected into a collecting pipe or via a steam separator.
- Flushing or sealing of mechanical seals has to be effected according to the information given in the installation plan or in a separate drawing. If pipings are led to a heat exchanger, to a pressure-transmitter or to a sealant tank a venting possibility should be provided at the highest point of the pipework lines. In case of thermosiphon circulation a minimum piping diameter of 3/4", better 1", has to be selected. The flow line must be laid in a continually rising way and is not allowed to have sharp bends (Q-parts).
- Quench installation depends on mechanical seal design if subsequent cooling or flushing will be required (compare paragraph 2.7 and 7.2).

Attention! According to DIN 24 295 this comment has to be part of each operating manual.
Technical comment on safety of pumps operated for some time in the partical load range.
The following information does not apply for pumps which will never be operated in partial load range.

- Minimum flow equipment

In the partial load range at pumping near Q = 0, nearly the total pump power will be given as heat energy to the low capacity. If this capacity lies under a certain minimum flow quantity (see 2.1), the reheating of liquid proceeds until evaporation, and severe damage will occur at balance device and at impellers and wear rings, which lead to a deadlocking of the pump. To avoid this, it is necessary that always a certain quantity of liquid can drain. For multi-stage pumps with hydraulic balance of axial thrust, the following two situations result:

1. Balance quantity is sufficient. That means, in case of a relative low driving capacity and favorabel feed conditions, the balance quantity is sufficient as minimum flow to be discharged. If this should be the case at the pump supplied, it is specially indicated on data sheet under 2.1, that the minimum flow is the same as the balance quantity. Then the balance piping may not be led to suction casing, but it has to be led back to the feed tank.

2. Balance quantity is not sufficient. It is necessary to install a device just after the pump in the discharge piping, which guarantees even at closed pressure valve the maintenance of a minimum flow. Following devices have approved in practice:

   a) Free-running recirculating check valve causes an automatic opening of minimum flow piping at throttling the capacity, while a throttle installed limits the minimum quantity which is to be discharged. The contrary happens on increasing the capacity. The minimum flow piping is directly flanged at the free-running recirculating check valve.

   b) Constant Bypass. Between pump and shut-off device in the discharge piping a bypass is connected, which leads to the feed tank, too. In the piping a throttle device is installed, which determines the quantity of flow through. But at this execution it must be considered, that the bypass quantity flows also at opened discharge piping, that diminues the efficiency of the pump. It must be set one point against the other, if the procuring of a free-running recirculating check valve is worth while.

- Minimum flow piping or bypass

Minimum flow piping is not in the scope of supply of pump manufacturer, but must be provided by the customer. The piping has always to be led back into the feed tank. It is necessary to install a shut-off valve in the minimum flow piping for shut-off and separating in case of repairs, which, however, must be locked in open condition before start-up. If a parallel operation of several pumps is intended, for which a common minimum flow-collecting piping is used, in addition recirculating check valves have to be installed in the feed pipings of the particular pumps.

Separate pipings must be laid if besides the minimum flow also the balance flow should be led back to feed tank.

6. SERVICE

6.1 START-UP

6.1.1 Before the first start-up (at grease lubrication § a. not required)

a. Flush bearing frame with light oil (not petroleum) and let it drip out. Fill up lubricating oil up to the midst of oil gauge. If existing, fill up storage tank of constant-level-oiler too (compare lubricant table).

b. Check alignment of coupling.

c. Check shaft seals (see 7.2).

d. Filling up of the pump

in case of feeding service	in case of suction service
Open shut-off device in suction piping	Open completely shut-off device in suction piping
Deaerate/Casing and mech. seal (if existing)	Deaerate/Casing and mech. seal (if existing)
Turn slowly pump rotor	Fill up pump (suction piping must have a foot valve)
Close ventilation when liquid delivered flows without bubbles	Turn slowly pump rotor
	Close ventilation when liquid delivered flows without bubbles

e. At filled-up pump, check the direction of rotation and a regular running low of the rotor by means of short-time switch-on of the driver (see direction arrow on coupling side).

f. If existing, open valve in the minimum flow piping and block. (See also 5.2 - minimum flow piping).

g. If balance piping has been laid to feed tank, open valve in this pipe and block.

6.1.2 Start-up of the pump and operation (max. number of start-up = 12 per hour)

a. If existing, start auxiliary equipments (e.g. sealing pressure), open valves in the auxiliary pipings (only open quench piping after start-up), vent pressure gauge (see also 5.2).

b. Start-up at pressureless system

- Close shut-off device in discharge piping (minimum flow must be guaranteed)
- Start-up driver
- Open slowly shut-off device in discharge piping until differential pressure has diminued to the value indicated in data sheet

c. Start-up at existing system pressure (condition is a non-return valve in discharge piping)

- Start-up driver when shut-off device is open

Warning: The differential pressure must not considerably fall below design point, also not at plants with fluctuating system pressure.

Attention: Pressure gauge at discharge side indicates differential pressure plus inlet pressure.

d. Observe ammeter. The ampere value indicated on duty plate of motor must not be exceeded.

6.2 SHUT-DOWN

a. If a non-return valve is installed in discharge piping, the shut-off device in discharge piping can stay open in case of a short shut-down.
In case of longer shut-down, of repairs, of a non-existing non-return valve, it is absolutely necessary to close the shut-off device in discharge piping.

b. If existing: close quench piping.

c. Stop driver; when doing this pay attention to the fact that the rotor smoothly runs down.

d. If the pump works in suction service and if it is not to stay ready for start-up, the shut-off device in the suction piping has to be closed too.

e. If existing: close valves in the auxiliary pipings except of cooling water which is only to be stopped after cooling of the pump.

f. In case of frost danger and a long service stop drain pump casing and cooling chambers and conserve them, if necessary.

6.3 Control of operation

6.3.1 Check of operating point (design point)

Take particularly into account during first start-up.

- Find out speed.
- Read pressure gauge (discharge side). Deduct inlet pressure (pressure gauge/suction side).

  After calculation this value (pressure) has to correspond at a certain speed to the head mentioned on the pump's rating plate.

$$\text{Head (m)} = \frac{\text{pressure (bar)} \cdot 10\,200}{\text{density of liquid (kg/m3)}}$$

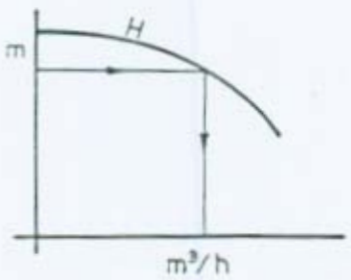
$$\text{Pressure (bar)} = \frac{\text{head (m)} \cdot \text{density of liquid (kg/m3)}}{10\,200}$$

- Pressure not to be below the value mentioned as otherwise the max. admissible capacity is exceeded and the flow can be interrupted.

6.3.2 Determination of flow

The flow can be determined on the pump's characteristic curve sheet on the basis of the head (m) which can be calculated with the pressure (see 6.3.1).

- First of all find out the value calculated for the head on the characteristic curve sheet. * Then determine intersection of horizontal line with curve H. Finally the appropriate capacity can be read.



* If the characteristic curve sheet only includes the pressure of one stage divide head by number of stages of the pump supplied.

7. MAINTENANCE

7.1 PUMP

7.1.1 Control quiet, vibration-free running of pump unit in service. Pay attention to normal running noises. In the case of unknown noises and faults stop at once. Ascertain reason and eliminate.

7.1.2 Control now and then alignment of coupling, eliminate at once alterations in order to avoid large engine damage.

7.1.3 Control auxiliary facilities during service (if present):

Measuring instruments:	Pressure, temperature, ampere at regular intervals
Cooling:	Flow and temperature
Heating:	Temperature, pressure
Flushing/sealing:	Pressure, temperature, (quantity)

7.1.4 In the case of reserve pumps start these now and then in order to have the complete guarantee of an immediate service readiness. In the case of a long stop drain off liquid pumped (and cooling water if present), conserve pump.

7.1.5 If pump performance decreases without having changed something of the pipings or without change of the resistances in the pipings as a result of fouling the performance decreased can be explained by wear of pump interior parts. The pump has to be repaired.

7.1.6 The pressure in the balance chamber should always be constant. If balance pressure compared with pressure at new condition increases of 2-3 bar, the balance equipment must be checked for damage. In the most cases it is necessary to renew parts of balance equipment.
But the balance pressure increase can also be explained by the increased piping resistance of the balance piping due to fouling.

7.1.7 Check indication of rotor position in regular intervals (at least monthly). (Only in case of pumps with balance disks. See also 3. "Description - indication of rotor position.)

7.1.8 It is recommended to record in a service book operation data and information about relubrications, repairs or other things.

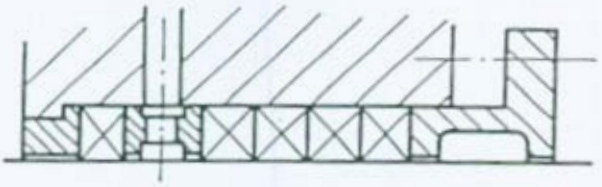
7.2 STUFFING BOX

7.2.1 Design

Depending on liquid and operating conditions, the packed stuffing box is arranged in different ways. (Arrangement of the pump supplied see sectional drawing or separate drawing of the shaft seal.)

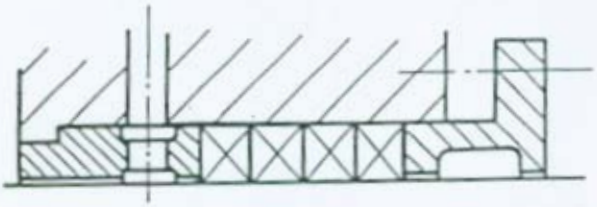
Normal design

The whole packing space is filled with soft packing rings. The over-pressure at the shaft seal must be 0,1-02, bar min. The liquid must have lubricating qualities and be absolutely clean.



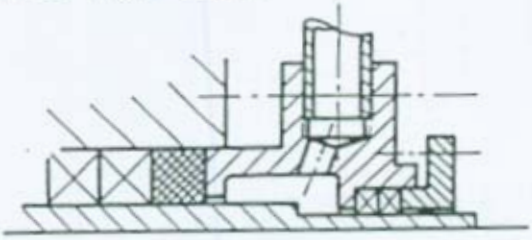
Design with lantern ring

A lantern ring supplied with seal fluid is integrated in the middle of the packing space. Sealing will be necessary when over-pressure at the shaft seal is ≦ 0,1 bar and when the liquid has bad lubricating properties. Sealing pressure: 1 bar min. over the pressure at shaft seal.



Design with lantern ring bush

To keep dirty liquid off the packing rings there is integrated a lantern ring bush supplied with clean flushing liquid at the base of the packing. Sealing pressure: 1 bar min. over pressure at shaft seal.



Design with cooling of stuffing box gland

Cooling of stuffing box gland is necessary to avoid vapor generation at hot liquid (e.g. water over 110°C) due to pressure release at the shaft seal. Quantity and pressure (approx. 0,05 m³/h at 0,2 bar) must be adjustable by a regulating apparatus. Mixing temperature cooling water/leakage max. 40°C.

7.2.2 Mode of operation

The function of the stuffing box depends on passing on to all sides the pressure which is exerted on it (internal pressure of liquid) and thereby filling up the hollow space between stuffing box housing and shaft sleeve except a little radial gap. Thereby the leakage between stationary and movable part will be throttled very much. For a satisfactory function a good lubrication and heat transmission is necessary.

7.2.3 Packing

The pumps will always be delivered in packed condition. If a first start-up cannot be executed within 12 weeks the packing rings have to be removed and repacking has to be performed shortly before beginning of the test runs.

Before packing clean shaft sleeve and stuffing box chamber and ascertain a perfect surface of shaft sleeve. Also check true-running accuracy of shaft sleeve and keep the following values:

shaft seal pressure ≦ 25 bar	true-running = 0,05 mm	surface roughness	= N5
" " " > 25 - 50 bar	= 0,03 mm	"	= N4
" " " > 50 - 100 bar	= 0,02 mm	"	= N4

As preformed packing rings recommended for after-packing, keep sufficient stock in hand. At self-manufacture with normal commercially used packing cord keep the following dimensions:

packing chamber hight - mm	normal commercially used cord mm	Zoll	deform to h x b (mm)	
6	5	3/16"	6 x 4,1	
8	7	5/16"	8 x 6,1	
10	9,7	3/8"	10 x 9,5	= form dimensions (form can be procured from SULZER)
12,5	12 (11)	7/16"	12,5 x11,5(9,7)	
16	15	5/8"	16 x 14	
20	18	3/4"	20 x 16,2	

Cut length = ϕshaft sleeve + 1,3 packing thickness x 3,14

Push preformed packing rings one after the other with the stuffing box gland into the packing chamber, whereby the sectional planes have to be shifted 90° against each other. At installation of a lantern ring insert only so many packing rings in front of the lantern ring, that the sealing liquid bore remains free. See drawing of shaft seal.
Tighten stuffing box gland at standstill at unfilled pump uniformly, not slanting. Check uniform distance between gland flange and stuffing box housing on all sides with measuring instruments. Then loosen stuffing box gland and put on hexagon nut only by hand.

7.2.4 Surveillance

A limited leakage of the packed stuffing box is necessary for its operation for lubrication and cooling. A leakage quantity of about 1 l/h (conforms to about 1 drop per second) up to about 15 l/h (thin liquid thread approx. 2 mm ϕ) can be considered as normal at a leakage temperature up to max. 60°C.

Only for pumps with pressures < 10 bar at the shaft seal
At higher leakage loss tighten stuffing box gland evenly, not inclined and not too strong. If the leakage is too high in spite of retightening and the leakage gets inadmissible warm, renew all packing rings.

Warning at pumps with pressures > 10 bar at the shaft seal
A retightening of the stuffing box gland at operating pump leads to failure of shaft seal. If leakage loss is too high, new repacking is required.

Every new packed stuffing box has a running-in time, during which it has to be chekced often-times. A little bit higher leakage decreases itself after the running-in time.
If, for attaining the operating conditions required auxiliary equipments such as

- sealing
- cooling
- heating

are necessary, observe data under 2. (see also 5.2).

7.2.5 Packing material

The packing ring material has to be selected according to the liquid pumped and to the operation data. The following can be fit for general rule:

Liquid pumped	Packing material
Hot and cold water, hydrocarbons, oils, alkalis, foodstuff	synth. fibres/with PTFE impregnation
All industrial applications, soiled liquid	Graphite, PTFE incorporated Aramid fibre or graphit-treated teflon silk

7.3 Bearings/lubrication

7.3.1 The pumps are fitted with grease-lubricated antifriction bearings. It is not necessary to regrease the bearings between the overhauls or inspections (at the latest after 8.000 operating hours or every two years). When overhauling the pump remove bearings, rinse them thoroughly and check them for further usability. Clean also the interior of the bearing frame of any grease residues.

7.3.2 Before refitting the antifriction bearings coat their inside with a little grease. Fill only 1/4 to 1/3 of the free bearing space and of the bearing covers with grease.

7.3.3 Recommended lubricants (according to DIN 51 825 NLGI Class 3)

AGIP	AGIP GR MU 3	ESSO	BEACON 3
ARAL	ARAL Fett HL 3	MOBIL OIL	MOBILUX 3
BP	BP ENERGREASE LS 3	SHELL	Shell Alvania Fett R 3
Castrol	CASTROL SPHEEROL AP 3	SUNOCO	SUN MULTI DUTY GREASE 3
CHEVRON	Chevron Dura-Lith Grease 3	TEXACO	Multifak 3 Glissando FO 21
ELF	ELF R.M. FETT 3		

8. REPAIR

If a pump should be overhauled, it is practical to procure the necessary spare parts (parts subject to wear) in good time to avoid longer periods of standstill.
When ordering spare parts give exact description of the part (position-No. and designation), pump type and manufacturer's No. (see duty plate of the pump).

8.1 Dismantling

8.1.1 Preliminary works

- Close suction- and discharge valves and secure them against unauthorized opening
- Secure driver against start-up
- Drain pump
- Remove coupling guard and seaparte coupling halves
- Remove any instruments and ancillary pipes

8.1.2 Dismantling of discharge-side bearing

- Remove bearing cover and bearing fastening
- Loosen bearing frame and draw it off together with antifriction bearing, remove antifriction bearing and distance sleeve
- Remove deflector

8.1.3 Dismantling of shaft seal and hydraulic balance device (Disk/counter disk)

- Loosen outer parts of shaft seal (stuffing box gland or cover of mechanical seal respectively) from stuffing box housing and remove them
- Draw off stuffing box housing, remove remaining seal parts from the housing

For size 32, 40 and 150
- Push the balance counter disk out of the seat by means of a puller screw and draw it off. Thereby pushing the following parts off the shaft: balance disk, shaft(protection)sleeve (in case of mechanical seal with the rotating seal parts mounted on it) internal rings of antifriction bearing and bearing distance sleeve

For size 65, 80 and 100
- Draw off balance disk and counter disk using a device (as shown on the sketch on the next page). Sleeves mounted on the shaft will also be pushed off

8.1.4 Dismantling of the hydraulic pump part

- Remove tie bolts
- Loosen discharge casing by applying careful rubber hammer blows using levels between tie bolt brackets and remove
- Draw off impeller, remove key
- Remove casing segment
- Repeat this procedure for each succeeding stage
- Wear rings and diffusers can be pushed out of the casing segments

8.1.5 Dismantling of the suction-side bearing

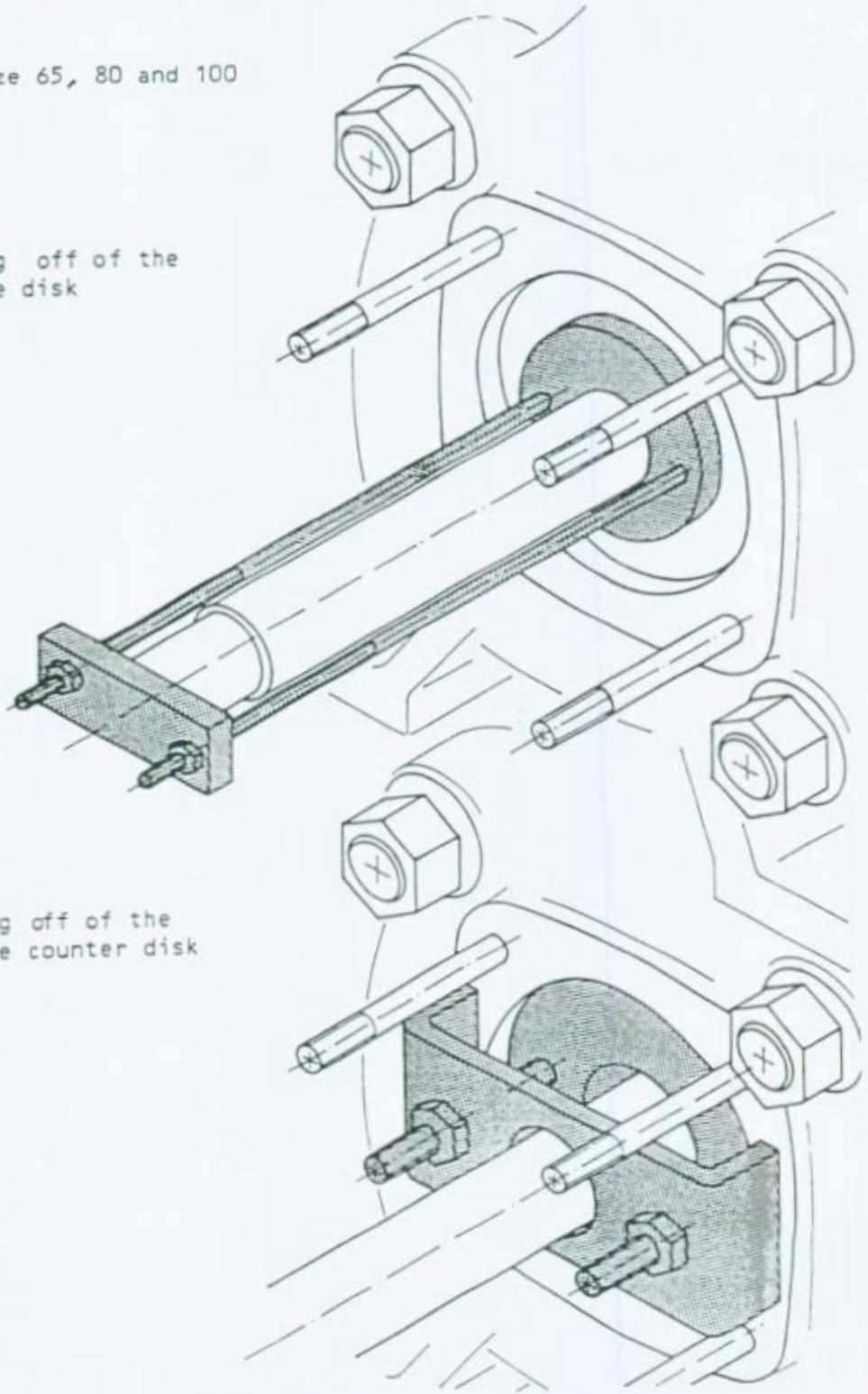
- Pull off coupling half.
- Remove bearing cover and bearing fastening.
- Loosen bearing frame, draw it off together with antifriction bearing, remove antifriction bearing.
- Remove deflector.

8.1.6 Dismantling of shaft seal

- Proceed in the same manner as at discharge side, then remove shaft from suction casing.
- Draw shaft(protection)sleeves (in case of mechanical seal with the rotating seal parts mounted on it) off the shaft, thereby removing the internal ring of antifriction bearing.

for size 65, 80 and 100

Drawing off of the balance disk



Drawing off of the balance counter disk

8.2 Checking of the internal parts

Check all parts for wear, remachine or renew them, if necessary.

8.2.1 Impeller, clearances

Check impellers for corrosion damage and erosion, renew them if necessary. Determine clearances, exchange wear rings if necessary.

The permissible clearance between impeller and wear ring is given in the table below.

Diameter at the impeller sealing clearance	MB 32	MB 40	MB 65	MB 80	MB 100	MB 150	
diametral clearance (with new parts)		0,2 0,3		0,3 0,5		0,4 0,5	1) 2)
max. diametral clearance (with worn parts)		0,4 0,6		0,6 0,8		0,7 0,9	1) 2)

1) cast iron or soft nitrided steel 2) stainless steel

Attention: To guarantee the position of the impellers in the pump, the front sides of impeller hubs must not be remachined.

It is recommended to check the impellers particularly for balancing quality. To this the impellers have to be checked particularly on a balancing machine concerning the residual unbalance. Balancing quality according to VDI 2060, ISO 1940, Q = < 2,5.

The assembled rotor will not be balanced as a unit, as the bending line on balancing of these rotors can differ from the bending line resulting on influence of hydraulic axial and radial supporting forces at gaps with lateral flow through.

8.2.2 True running of the shaft

Mount shaft between centres and test it for true running (max. permissible 0,02 mm). Shafts with a run-out up to 3 times of the permissible value can be straightened in cold or warm condition. Shafts with a higher run-out can usually no longer be used. (Don't re-align at pumps which are exposed during operation to temperatures higher than 100°C.)

8.2.3 Shaft seal components

8.2.3.1 Mechanical seal

- The front sides of sealing rings must not show any scoring, relap them if necessary. In case of deep grooves or crazing renew sealing rings
- Check shaft sleeves for perfect surface, especially at the seat of the rotating unit; if necessary regrind* or renew them

8.2.3.2 Soft packing

- Check shaft(protection)sleeve for grooves and remachine* it if necessary, as long as the new diameter is not more than 1 mm under the nominal dimension. Adpat packing rings to the new dimensions

8.2.4 Antifriction bearing

- Rinse bearing with light oil and renew them in case of damage

8.2.5 Balance disk

- If position indication of rotor had already shown a derivation, replace the disk

8.2.6 Rotor

- Assemble the rotor and check true running (max. permissible run-out 0,03 mm)

* Not valid for sleeves with finished surfaces!

8.3 Reassembly

8.3.1 Preliminary works

- Clean pump parts
- Prepare lubricants (e.g. oil, molykote, Never Seez)
- For O-rings only use glycerine or "Klüber PROBA 270" paste
- Always renew sealing rings and gaskets

8.3.2 Assembly of the hydraulic pump part

- Mark the seat of the first impeller on the shaft (starting from shaft end; dimension "A" + width of antifriction bearing + length of shaft-(protection)sleeve and distance sleeve)
- Insert key, push impeller and distance sleeve onto the shaft
- Insert diffuser into the first stage casing (with foot), (secure it against rotation with dowel), put gasket on outer spigot
- Push shaft suction-end first with impeller into the stage casing
- Mount the next impeller starting from discharge-end, push on the next pre-assembled stage casign/diffuser
- Mount the further stages in the same way
- Push discharge casing with the built-in last diffuser onto the spigot of the stage casing.
- Attach the suction casing and evenly compress the whole pump part with tie bolts

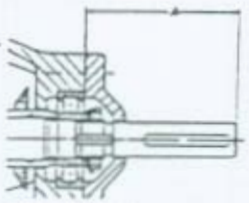
8.3.3 Assembly of the suction-side shaft seal and bearings

- Push shaft(protection)sleeve (in case of mechanical seal together with the rotating seal parts mounted on it) and internal ring of antifriction bearing on the shaft
- Fit the stuffing box housing together with sealing ring to the suction casing
- Push stuffing box gland or cover of mechanical seal respectively onto the shaft (together with the stationary parts of shaft seal) and deflector
- Mount bearing frame together with the integrated outer ring of antifriction bearing and tighten it with suction casing.

8.3.4 Checking position of rotor

- Fit bolting of antifriction bearing (washer, lock washer, bearing nut)
- Tighten bearing nut, until dimension "A" (from internal ring of bearing to shaft end) as achieved (see sectional drawing and table)

Size	32	40	65	80	100	150
Dim. "A"	80	88	94	113	161	173



8.3.5 Assembly of balancing/shaft seal/bearing-discharge side

- Mount balancing parts, if available (counter-disk, disk or bushing - piston respectively)
- Push shaft(protection)sleeve onto the shaft (in case of mechanical seal together with the rotating seal parts mounted on it)
- Fit the stuffing box housing with gasket onto the discharge casing
- Push stuffing box gland or cover of mechanical seal respectively onto the shaft (together with the stationary parts of shaft seal) and deflector
- Mount bearing frame, bolt it to discharge casing
- Mount and secure antifriction bearing according to sectional drawing
- Grease bearing at suction- and discharge end (see 7.3)
  Bolt on bearing cover. Shaft seal: insert packing or fasten cover of mechanical seal respectively

8.3.6 Final assembly

- Fit coupling half
  in cold condition: for cast iron with bore $\leq$ 100 mm,
  for steel with bore $\leq$ 50 mm
  in warm condition: (even, dry warming up to approx. 80°C in an oven)
  for cast iron with bore > 100 mm,
  for steel with bore > 50 mm
- Connect ancillary pipes and instruments
- Couple driver
- Mount coupling guard

Besteller : SULZER ESPANA S.A. | Kunden-Positions Nr.: | Sulzer Comm. Nr.: 1 1 1- 93229
Besteller Nr.: | Stückzahl Pumpen: 4

S U L Z E R - I N F O R M A T I O N E N ----------> ANWENDER - INFO

Teile-Nr.	Stck	.. Benennung und Abmessung ..	.. Werkstoff ..	sonst Kenndat.	Artikel- Nummer ..	BEMERKUNG ..
020.00	1	SAUGGEHÄUSE-KPL	0.6025		104.058.487.200	Suction casing
021.00	1	DRUCKGEHÄUSE-KPL	0.6025		104.049.677.201	Discharge casing
022.00	1	STUFENGEHÄUSE KPL	0.6025		104.051.496.202	Stage casing
022.01	5	STUFENGEHÄUSE KPL	0.6025		104.049.662.202	Stage casing
030.00	1	STOPFBUCHSGEHÄUSE-SGS	0.6025		104.049.667.200	Stuffing box housing
030.01	1	STOPFBUCHSGEHÄUSE DRS	0.6025		104.049.668.200	Stuffing box housing
041.00	6	LAUFRAD D 170	0.6025		104.049.674.000	Impeller
041.01	1	LAUFRAD D 170	0.6025		104.049.673.000	Impeller
065.00	1	ENTLASTUNGSSCHEIBE	0.6025		104.049.659.000	Balance disc
066.00	1	ENTLAST.GEGENSCHEIBE	0.6025		104.049.660.000	Balance counter-disc
080.00	6	LEITRAD	0.6025		104.049.675.000	Diffuser
080.01	1	LEITRAD-LETZTE-STUFE	0.6025		104.049.676.000	Diffuser, last stage
091.00	1	WELLE D 32X975	1.0503		104.058.323.006	Shaft
100.00	1	LAGERKÖRPER-SGS	0.6025		104.049.665.000	Bearing frame
100.01	1	LAGERKÖRPER-DRS	0.6025		104.049.666.000	Bearing frame
140.00	2	SPRITZRING D 38/75X8	NBR 75		104.051.304.000	Deflector
164.00	2	ZYLINDERROLLENLAGER NU 306	ST	DIN 5412	017.742.003.061	Cylindr. roller bear.
301.00	1	HÜLSE D 32/42X58	0.6030		104.049.652.000	Sleeve
301.01	1	HÜLSE D 30/41X19	0.6030		104.049.651.000	Sleeve
306.00	2	WELLENSCHUTZHÜLSE D 32/42X153	0.6030		104.060.509.002	Shaft sleeve
320.03	1	RING D 62/71,8X18,5	0.6030		104.062.062.001	Ring
325.00	8	SCHEIBE A 25	1.0330	DIN 125	015.500.205.630	Washer
325.01	2	STÜTZSCHEIBE S 30X42X2,5	FED.STAHL	DIN 988	015.503.100.305	Supporting disc
330.00	2	STOPFBUCHSBRILLE	0.6025		104.020.966.000	Stuffing box gland
340.00	1	LAGERKAPPE	0.6025		104.049.664.000	Bearing cover
340.01	1	LAGERKAPPE	0.6025		104.049.663.000	Bearing cover
430.00	7	O-RING 218X5,3	EPDM-70 (3957)		021.703.021.809	O-ring seal
430.01	2	O-RING 145X3,55	EPDM-70 (3957)		021.702.014.509	O-ring seal
430.02	1	O-RING 103X3,55	EPDM-70 (3957)		021.702.010.509	O-ring seal
430.03	2	O-RING 31,5X2,65	EPDM 70		021.701.003.109	O-ring seal
440.00	10	PACKUNGSRING D 42/58X6,1	GRAFIT-PTFE		104.944.012.951	Packing ring

	Erzeugnis	Typ/Baugrösse	Zeichnungs - Nummer	Teileliste - Nr.	Datum : 21.09.92
SULZER WEISE			SE 402-1-01		Name :
-7520 Bruchsal	KREISELPUMPE	MB 65-7	NR.10	TP 93229	Seite : 1

Besteller : SULZER ESPANA S.A. Kunden-Positions Nr.: Sulzer Comm. Nr.: 1 1 1- 93229
Besteller Nr.: Stückzahl Pumpen: 4

S U L Z E R - I N F O R M A T I O N E N

Teile-Nr.	Stck	.. Benennung und Abmessung ..	.. Werkstoff ..	sonst Kenndat.	Artikel- Nummer .. BEMERKUNG ..
450.00	4	VERBINDUNGSSCHRAUBE D 24X550	1.0503		104.049.648.605 Tie bolt
460.00	8	SECHSKANTMUTTER M 24	1.1181.05	DIN 934-M	015.201.012.740 Hexagon nut
462.00	2	NUTMUTTER KM 6	1.0044	DIN 981	015.201.803.510 Slotted nut
510.00	2	SICHERUNGSBLECH MB 6	1.0330	DIN 5406	015.507.500.201 Lock washer
593.00	1	STOPFEN R 3/8	LUPOLEN	WN 593	104.959.300.386 Plug

SULZER

n_s 21,6

	Zeichng. Nr.	Mod. Nr. 1½	Mod. Nr. 2½
Lo. 1. Stufe MBA	3-051797	51797	
Laufrad, 1. Stufe	3-049673	49673	
Laufrad	3-049674	49674	
Leitrad	3-049675	49675	
Leitrad, le. Stufe	3-049676	49676	
Spaltwand			

No. D 4200.45.01/1

Grandeur – Baugröße – Size

MB 65

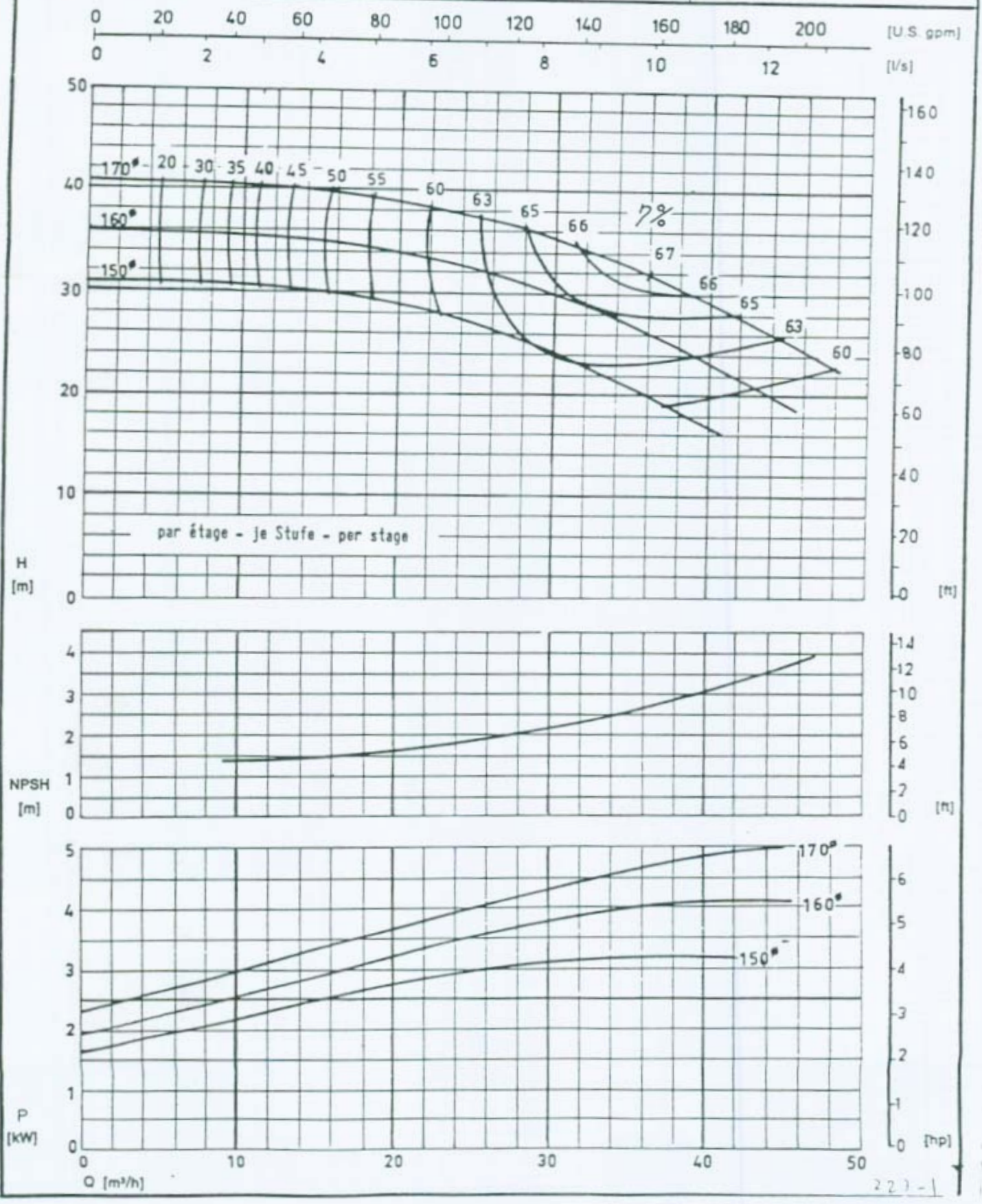
Dia. de grain maxi. / Max. Korngröße / Max. grain size: 7 mm

Bride aspiration / Saugstutzen / Suction branch: DN / NW 80 / ND

Vitesse / Drehzahl / Speed: 2950 1/min

Sens de rotation / Drehrichtung / Rotation: à droite / rechts / clockwise — vu côté accouplement / v. Antrieb / facing coupling

Bride refoulement / Druckstutzen / Discharge branch: DN / NW 65 / ND



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Installation and maintenance instructions for Flender N-EUPEX couplings Types A, B and H

1. General information

1.1 N-EUPEX couplings are suitable for clockwise and counter clockwise rotation as well as for reversing operation.
1.2 Mounting of coupling parts on the shaft ends to be connected is optional.
1.3 A remaining gap between coupling part and shaft collar can be filled by a sleeve; but this is not essential for proper functioning of the coupling.
1.4 To ensure that plastic elements can be replaced without moving connected machines (possible only with type A) the dimension listed in table II must be taken into account.
1.5 If required, we supply N-EUPEX couplings with finished bores, ready for mounting.

2. Safety precautions

2.1 Rotating parts should be guarded by the purchaser to prevent accidents.
2.2 When delivered outside Germany the safety regulations valid in the respective countries must be adhered to.

3. Attaching the finish bores

3.1 The maximum bore diameters D given in brochure K 420 (from Flender) must not be exceeded in any case.
3.2 For the manufacturing of the finish bores the outer diameter and the front surface are the basis for the alignment.
3.3 The tolerances for the bores are: ≤ 50 = J7; > 50 = H7.
The tolerance JS 9 is valid for the keyway in the coupling hub.

4. Fastening of the locking screw at vertical position of the shaft

4.1 Allotment of the locking screws to the bore diameters: Table I

bore-Ø over		10	12	17	22	30	38	44	50	58	65	75	85	95	110	130	150	170	200	230
bore-Ø until		10	12	17	22	30	38	44	50	58	65	75	85	95	110	130	150	170	200	230
N-EUPEX-size	thread for locking screw																			
58, 68, 80	M6																			
95, 110	M8																			
125, 140, 160	M10																			
180, 200	M12																			
over 225	M8	M10	M12				M16								M20			M24		

4.2 At the sizes 58, 68, 80, 95 and 110 the threads for the locking screws are to be placed 180° staggered in regard to the keyway, the same applies to the parts 9 of the sizes 125 and 140.
4.3 Tightening of the locking screws with hexagon pin spanner only according to DIN 911, without extension tube.

5. Mounting

5.1 Before assembly the shaft ends and coupling parts must be carefully cleaned.
5.2 The coupling parts ought to be mounted with special mounting devices. The shaft ends must not protrude at the inner sides of the hubs.
5.3 Heating of the coupling parts may facilitate the mounting. In this case the plastic elements must be removed from part 1 before heating.

5.4 Part 6 of type "H" is marked "0" on one face. This side must be screwed to part 5.

5.5 Push the coupling parts together taking care to observe dimension S_1 resp. S_2 according to table II.

5.6 Check screw connections. Tightening torques according to table II.

6. Alignment see operating instruction of pump 4.2

Type A
Sizes 110 to 350

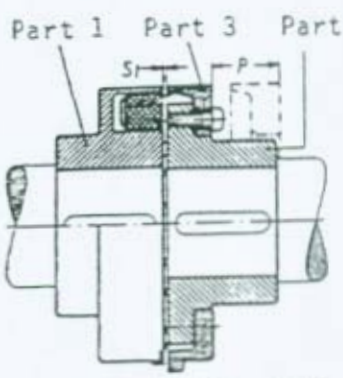


Fig. 1

Type B
Sizes 58 to 280

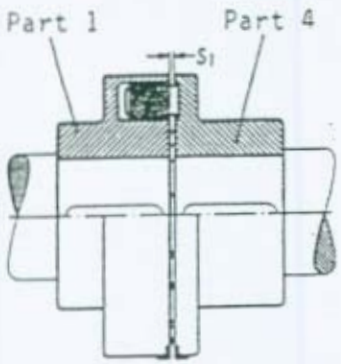


Fig. 2

Sizes 400 to 710
Type A

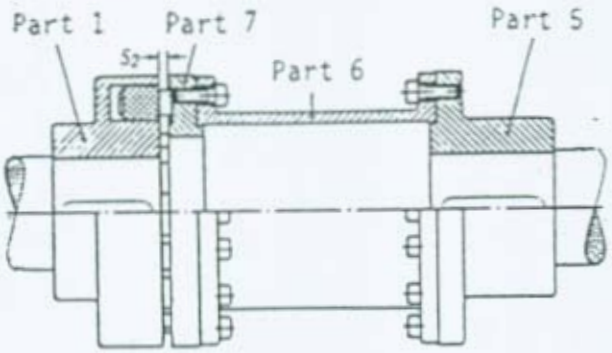


Fig. 3

Sizes 80 to 250
Type H

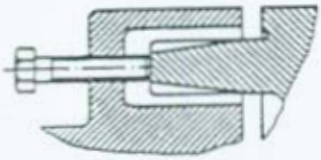
7. Start-up

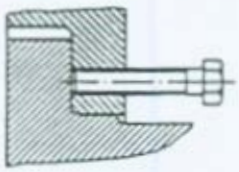
7.1 Before start-up the alignment and the gap dimension S_1 resp. S_2 must be checked and, if necessary, corrected. Furthermore all screw connections must be checked. Tightening torques see table II.

8. Maintenance

8.1 N-EUPEX couplings do not require any regular maintenance except for an occasional check on the torsional play between the driving and the driven halves. When N-EUPEX couplings are used in drives which do not require a minimum of torsional play in the coupling, the plastic elements can be allowed to wear down to 2/3 of their original thickness before they need replacing.

Size 225 - 400
Fig. 4.1





Size 440 - 710
Fig. 4.2

9. Replacing of plastic elements

9.1 Uninterrupted torque transmission and reliability of operation cannot be guaranteed unless original N-EUPEX elements are used.

9.2 With the exception of type B the plastic elements can be replaced without moving connected machines.

9.2.1 Type A: After loosening the screw connections 2/3, part 3 can axially be moved and the plastic elements are freely accessible. In order to ease the moving of the coupling parts, part 1 of coupling sizes 225-400 is provided with tapped holes for forcing screws. At size 400 and following sizes these tapped holes are located in coupling part 3 (see Fig. 4.1 and 4.2).

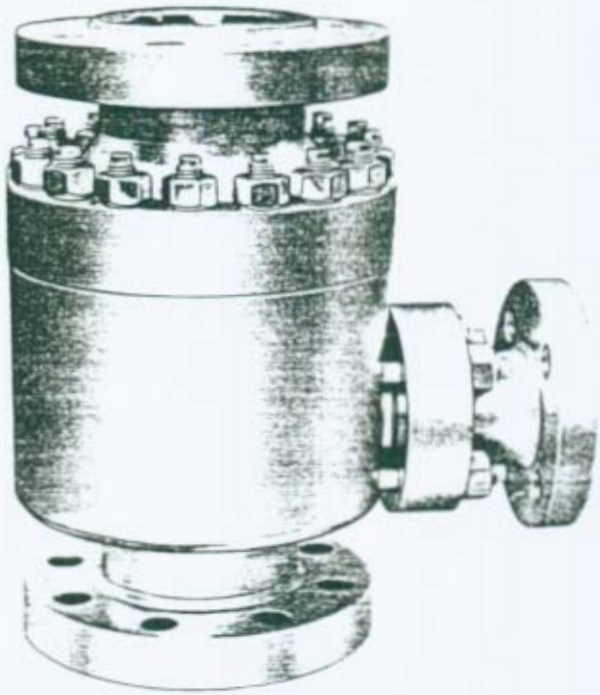
9.2.2 Type H: After loosening the screw connections the parts 5 and 7 in part 6 are pressed out of their centerings by means of tapped holes, Part 7 then is pushed into part 1 as far as possible. After this part 6 can be disassembled radially. Pull part 7 out of part 1. Now the plastic elements are freely accessible.

9.3 The reassembly after the replacing of the plastic elements is effected in reverse order. Before another start-up the paragraphs 4., 5., 6. and 7. must be taken into account.

Table II

Coupling size	S_1 mm	S_2 mm	perm. deviation S_2 mm	Tightening torque T_A and width over flats S_w for screws DIN 912 P mm	Part 2/3 Part 8/10 Part 5/6 Part 10/22 Part 6/7 Part 10/32 Nm	S_w mm
58	2.. 4					
68	2.. 4					
80	2.. 4	5	+1		10	
95	2.. 4	5	+1		10	5
110	2.. 4	5	+1	33	14	6
125	2.. 4	5	+1	38	17,5	6
140	2.. 4	5	+1	43	29	8
160	2.. 4	6	+1	47	35	8
180	2.. 6	6	+1	50	44	8
200	2.. 6	6	+1	53	67,5	10
225	2.. 6	6	+1	61	89	10
250	3.. 8	6	+1	69	145	14
280	3.. 8			73	185	14
315	3.. 8			78	200	14
350	3.. 8			83	260	17
400	3.. 8			88	340	17
440	5..10			99	420	17
480	5..10			104	550	19
520	6..12			115	670	19
560	6..12			125	710	19
610	6..12			135	1450	22
660	6..12			145	1450	22
710	6..12			155	1450	22

SULZER	Soupape de retenue à recirculation automatique Mindestmengenrückschlagventil Automatic Recirculating Check Valve	TDL	B 0251.401/2



Cette soupape de retenue à recirculation automatique est installée sur des pompes centrifuges pour assurer la décharge automatique du débit minimum requis.

Indépendant de la température, le champ d'application du type TDL, comportant un élément Vortex, s'étend à des pressions différentielles (pression de décharge) Δp jusqu'à 40 bar, pressions nominales aux brides PN 16 jusqu'à PN 400.

La soupape est composée d'un demi-corps inférieur et d'un demi-corps supérieur ainsi que des brides de raccordement principales. La tubulure horizontale de débit minimum et la tubulure de démarrage sont disposées à l'opposé d'une de l'autre. La soupape de retenue proprement dite et les dispositifs de réglage et d'étranglement travaillant mécaniquement constituent les pièces internes du système.

La soupape de retenue à recirculation automatique protège les pompes centrifuges et, en particulier, les pompes alimentaires contre la surchauffe interne en maintenant automatiquement le débit minimum indispensable à la bonne marche de la pompe. Si le débit de la pompe se trouve réduit à un minimum donné, le clapet de retenue se déplaçant axialement en fonction du débit actionne la douille de commande par l'intermédiaire d'un levier de commande. Par le relâchement d'un élément cette douille assure une recirculation silencieuse du débit minimum à pression réduite à travers la tubulure de débit minimum étant ramenée vers la bâche d'aspiration. La douille de commande s'ouvre linéairement d'autant plus que le clapet de retenue se ferme. Par suite de cette commande modulée la somme de débit et débit minimum reste à peu près constante.

Selon DBP 1072887 (brevet d'invention déposé), le clapet de retenue commandé par ressort et jouant le rôle d'un piston différentiel, évite, grâce à sa fréquence propre très élevée, les coups de bélier nuisibles à la pompe. Selon DBP 1078445, il empêche, par son profil convenablement étudié, la formation d'un écoulement pulsatoire et rend stable les courbes caractéristiques débit/pression instables sous charge partielle.

Les pièces du corps sont en acier forgé et pourvues d'un chemisage en acier au chrome au droit du clapet de retenue. Tous les éléments mobiles et de guidage sont fabriqués dans des aciers alliés.

La soupape de retenue à recirculation automatique doit être montée directement sur la tubulure de refoulement de la pompe. Elle ne nécessite aucun entretien spécial. Le débit minimum et le débit d'ouverture peuvent être adaptés aux diverses conditions de service.

Les brides sont normalement usinées selon DIN, mais elles peuvent aussi être fournies usinées selon ANSI, BS ou avec des bouts à souder.

Les détails techniques et limites spécifiques ont été indiqués dans les feuilles techniques correspondantes.

Dieses Mindestmengen-Rückschlagventil wird eingesetzt zur selbsttätigen Abführung des Mindestförderstromes von Kreiselpumpen.

Der Verwendungsbereich der Bauart TDL mit 1 Vortex-Entspannungsstufe erstreckt sich temperaturunabhängig auf einen Differenzdruck (Entspannungsdruck) Δp bis 40 bar, Flanschen-Nenndruck PN 16 bis PN 400.

Das Ventil besteht aus Gehäuseober- und -unterteil mit den jeweiligen Hauptanschlußflanschen. Der Mindestmengenstutzen und wahlweise auch der Anfahrstutzen sind seitlich gegenüberliegend horizontal angeordnet. Im Inneren befinden sich der Rückschlagkegel sowie die mechanisch arbeitende Steuer- und Drosseleinrichtung.

Das Ventil schützt Kreiselpumpen, insbesondere Kesselspeisepumpen, vor innerer Überhitzung, indem es den zur Betriebssicherheit der Pumpe notwendigen Mindestförderstrom selbsttätig aufrechterhält. Bei Unterschreiten einer bestimmten Durchsatzmenge betätigt der im Förderstrom geführte Rückschlagkegel, bei einer eingestellten Hubhöhe über einen Hebel die Steuerbuchse, die nach Freigabe einer Entspannungsstufe geräuscharm den stark druckreduzierten Mindestförderstrom über den Mindestmengenstutzen zum Zulaufbehälter abführt. Die Steuerbuchse öffnet linear um so mehr, wie der Rückschlagkegel in Schließlage geht. Infolge dieser modulierten Steuerung bleibt die Summe aus Förderstrom und Mindestmenge annähernd konstant.

Der als Differentialsteuerkolben ausgebildete federbelastete Rückschlagkegel hat gemäß DPS 1072887 eine so hohe Eigenfrequenz, daß die gefürchteten Hammerschläge vermieden werden. Er wirkt gemäß DPS 1078445 durch seine günstige Drosselkurve einer pulsierenden Strömung entgegen und stabilisiert im Teillastbereich labile Pumpenkennlinien.

Die Gehäuseteile sind aus Schmiedestahl und im Bereich des Rückschlagkegels mit Chromstahl ausgekleidet. Alle beweglichen Teile und Führungen bestehen aus legierten Stählen geeigneter Paarung.

Das Mindestmengen-Rückschlagventil ist unmittelbar auf den Pumpen-Druckstutzen aufzubauen. Eine besondere Wartung ist nicht erforderlich. Mindestförderstrom und Schaltpunkt können den jeweiligen Betriebsverhältnissen angepaßt werden.

Die Flanschen werden normal nach DIN ausgeführt, sind aber auch nach ANSI, BS oder mit Schweißenden lieferbar.

Die technischen Details und spezifischen Grenzwerte sind in den entsprechenden technischen Blättern angegeben.

This automatic recirculating check valve is used for the automatic elimination of the minimum flow of centrifugal pumps.

The TDL design with a 1-stage Vortex element is suitable, independent of temperatures, for differential pressures (relief pressure) Δp up to 40 bar, nominal pressures at flanges PN 16 up to PN 400.

This valve consists of an upper and a lower casing half and the main connecting flanges. The horizontal minimum flow branch, and, alternatively, also the start-up branch are arranged laterally on opposite sides. Check valve, pilot valve and mechanically operated Vortex valve form its internals.

This valve protects centrifugal pumps, in particular boiler feed pumps, from internal overheating by automatically maintaining the minimum flow required for the safe operation of the pump. When flow is reduced below a specific minimum and a predetermined switching point is achieved, the check valve disc which moves axially with the flow actuates the control bushing via a lever. After release of an element this bushing quietly removes the pressure-reduced minimum flow via the minimum flow branch to the suction tank. The control bushing directly opens, so much the more the valve disc closes. As a result of this modulated control the sum of flow and minimum flow nearly remains constant.

According to DPB 1072887 (German Federal Patent), the spring loaded valve disc designed as a differential piston has such a high frequency that water hammer is avoided. According to DBP 1078445 it further has a favourable throttling curve thus preventing flow pulsation and at the same time stabilizing unstable pump characteristic curves in the partial load range.

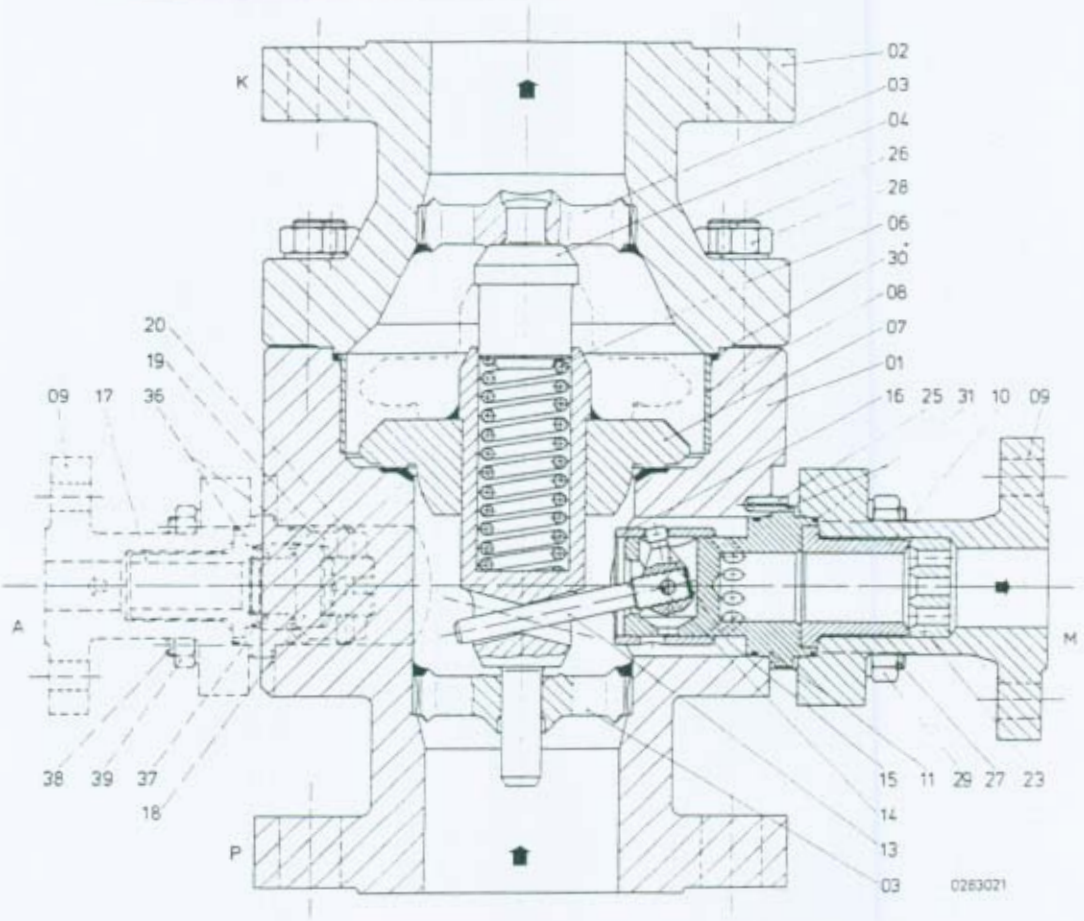
Casing parts are made of forged steel and lined with chrome steel in the valve disc area. All moving parts and guides are made of suitably alloyed steels.

The automatic recirculating check valve is mounted on the pump discharge branch. It does not require any special maintenance. Minimum flow and switching point can be adapted to the various service conditions.

The flanges are normally rated to DIN, they can, however, also be supplied to ANSI, BS or with welding ends.

The technical details and specific limit values have been given in the corresponding technical sheets.

SULZER	Soupape de retenue à recirculation automatique Mindestmengenrückschlagventil Automatic Recirculating Check Valve	TDL	S 0251.401/2



Nomenclature

01 Demi-corps inférieur
02 Demi-corps supérieur
03 Palier de guidage
04 Broche-guide
*06 Ressort
07 Clapet de retenue avec tige
08 Chemise annulaire
09 Tubulure latérale
*10 Chemise
*11 Tête de commande
*13 Levier
*14 Pivot
*15 Bras de levier
*16 Coulisseau à manchon
*17 Chemise de clapet d'entranglement en vortex
*18 Clapet d'entranglement en vortex
*19 Pièce intermédiaire
*20 Goujon prisonnier
23 Disque perforé
25 Douille de serrage
26 Vis
27 Vis
28 Ecrou
29 Ecrou
*30 Joint torique
*31 Joint torique
*36 Joint torique
*37 Joint torique
38 Vis
39 Ecrou

P Bride (côté pompe)
K Bride (côté chaudière)
M Tubulure de débit minimum
A Tubulure de démarrage manuel

Teileverzeichnis

01 Gehäuseunterteil
02 Gehäuseoberteil
03 Führungssteg
04 Führungsbolzen
*06 Schraubenfeder
07 Rückschlagkegel mit Schaft
08 Futterring
09 Seitenstutzen
*10 Buchse
*11 Steuerkopf
*13 Hebel
*14 Lagerbolzen
*15 Hebelarm
*16 Steuerbuchse
*17 Vortexdrosselbuchse
*18 Vortex-Einsatz
*19 Zwischenhalter
*20 Stift
23 Lochscheibe
25 Spannhülse
26 Schraube
27 Schraube
28 Mutter
29 Mutter
*30 O-Ring
*31 O-Ring
*36 O-Ring
*37 O-Ring
38 Schraube
39 Mutter

P Flansch (Pumpenseite)
K Flansch (Kesselseite)
M Mindestmengenstutzen
A Anfahrstutzen

Index of Parts

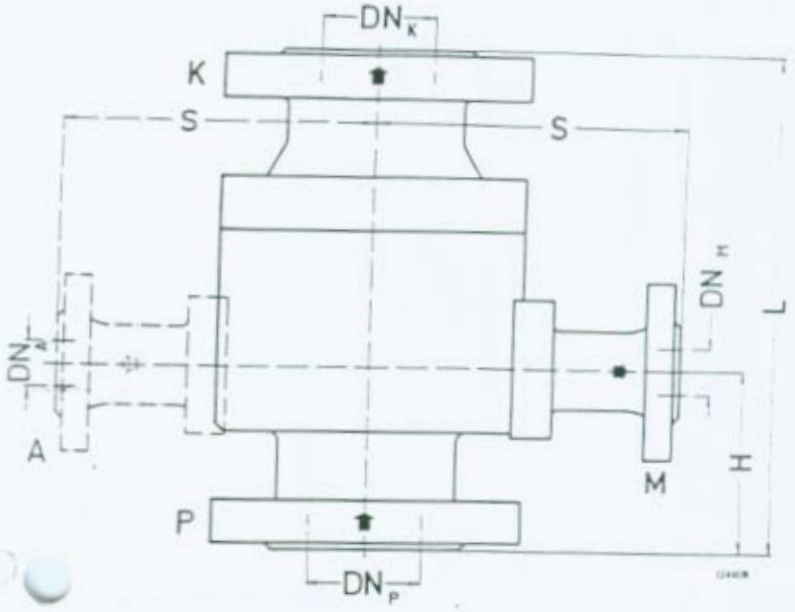
01 Lower casing half
02 Upper casing half
03 Ring guide
04 Guide bolt
*06 Spring
07 Check valve disc with piston
08 Liner
09 By-pass branch
*10 Bushing
*11 Control head
*13 Lever
*14 Pivot pin
*15 Crank arm
*16 Control bushing
*17 Vortex throttle bushing
*18 Vortex insert
*19 Connecting link
*20 Pin
23 Perforated disc
25 Guide pin
26 Screw
27 Screw
28 Nut
29 Nut
*30 O-ring
*31 O-ring
*36 O-ring
*37 O-ring
38 Screw
39 Nut

P Flange (pump end)
K Flange (boiler end)
M Minimum flow branch
A Manual start-up branch

*) Pièces de rechange recommandées / empfohlene Ersatzteile / recommended spare parts

SULZER

Soupape de retenue à recirculation automatique
Mindestmengenrückschlagventil
Automatic Recirculating Check Valve
TDK, TDL, TDM



P = Bride (côté pompe)
P = Flansch (Pumpenseite)
P = Flange (pump end)

K = Bride (côté chaudière)
K = Flansch (Kesselseite)
K = Flange (boiler end)

M = Tubulure de débit minimum
M = Mindestmengenstutzen
M = Minimum flow branch

A = Tubulure de démarrage manuel
A = Anfahrstutzen
A = Manual start - up branch

Abmessungen (ANSI)*

Taille Größe Size	DN_P/DN_K inches	PN[1] p.s.i.	DN_M inches	DN_{Mmax} inches	DN_A inches	L mm	S mm	H mm
073 U	1½	150	½	1	½	200	155	75
075 U		300				260	190	90
076 U		600				260	190	90
077 U		900				300	200	110
078 U		1500				310	215	120
083 U	2	150	½	1	½	230	163	90
085 U		300				300	185	115
086 U		600				300	193	110
087 U		900				340	203	130
088 U		1500				350	283	130
093 U	2½	150	1	1½	1	290	174	110
095 U		300				340	199	125
096 U		600				340	220	125
097 U		900				380	220	140
098 U		1500				400	250	145
103 U	3	150	1	1½	1	310	191	115
105 U		300				380	220	140
106 U		600				380	240	140
107 U		900				410	250	150
108 U		1500				450	275	165
113 U	4	150	1½	2	1½	350	211	125
115 U		300				430	240	155
116 U		600				430	248	155
117 U		900				450	266	160
118 U		1500				520	300	190
123 U	5	150	1½	2	1½	400	266	135
125 U		300				500	290	175
126 U		600				500	300	175
127 U		900				525	310	185
128 U		1500				650	341	235
133 U	6	150	2	2½	2	480	295	165
135 U		300				550	320	190
136 U		600				550	335	190
137 U		900				585	350	200
138 U		1500				700	370	250
153 U	8	150	2½	3	2½	600	360	200
155 U		300				650	390	215
156 U		600				650	400	215
157 U		900				675	400	225
158 U		1500				850	450	295
163 U	10	150	3	4	3	730	435	240
165 U		300				775	460	260
166 U		600				800	478	270
167 U		900				800	478	270
168 U		1500				950	550	330
173 U	12	150	4	5	4	850	530	280
175 U		300				900	550	300
176 U		600				1050	650	360
177 U		900				1050	650	360
178 U		1500				1050	700	400

imensions en millimètres (sans engagement)
aße in Millimetern (unverbindlich)
imensions in millimeters (not binding)

*) Dimensions se réfère aussi à l'exécution avec bouts d'arbre
*) Abmessungen auch gültig fur Ausführung mit Schweißenden
*) Dimensions also refers to design with welded ends

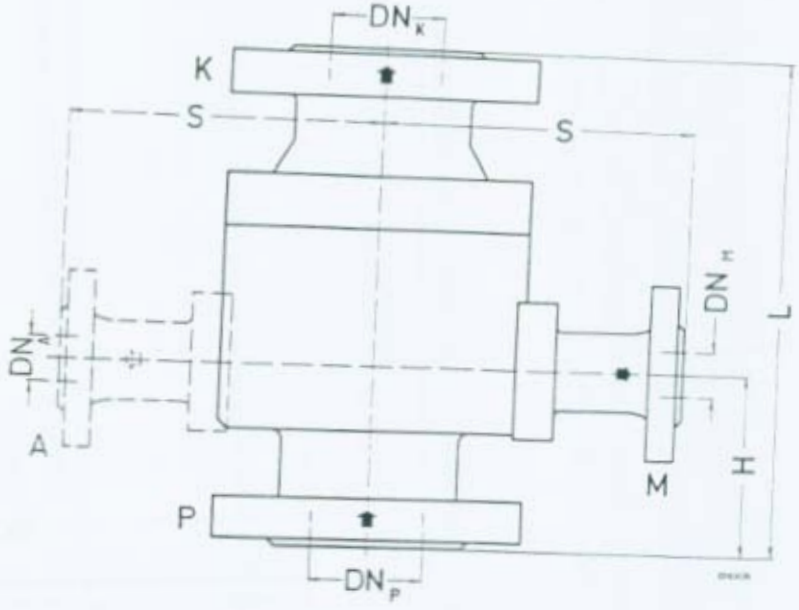
1) PN également valable pour DN_M et DN_A
1) PN gilt auch fur DN_M und DN_A
1) PN also valid for DN_M and DN_A

SULZER

Soupape de retenue à recirculation automatique
Mindestmengenrückschlagventil
Automatic Recirculating Check Valve

TDK, TDL, TDM

M
0251.001/1



P = Bride (côté pompe)
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M = Tubulure de débit minimum
M = Mindestmengenstutzen
M = Minimum flow branch

A = Tubulure de démarrage manuel
A = Anfahrstutzen
A = Manual start - up branch

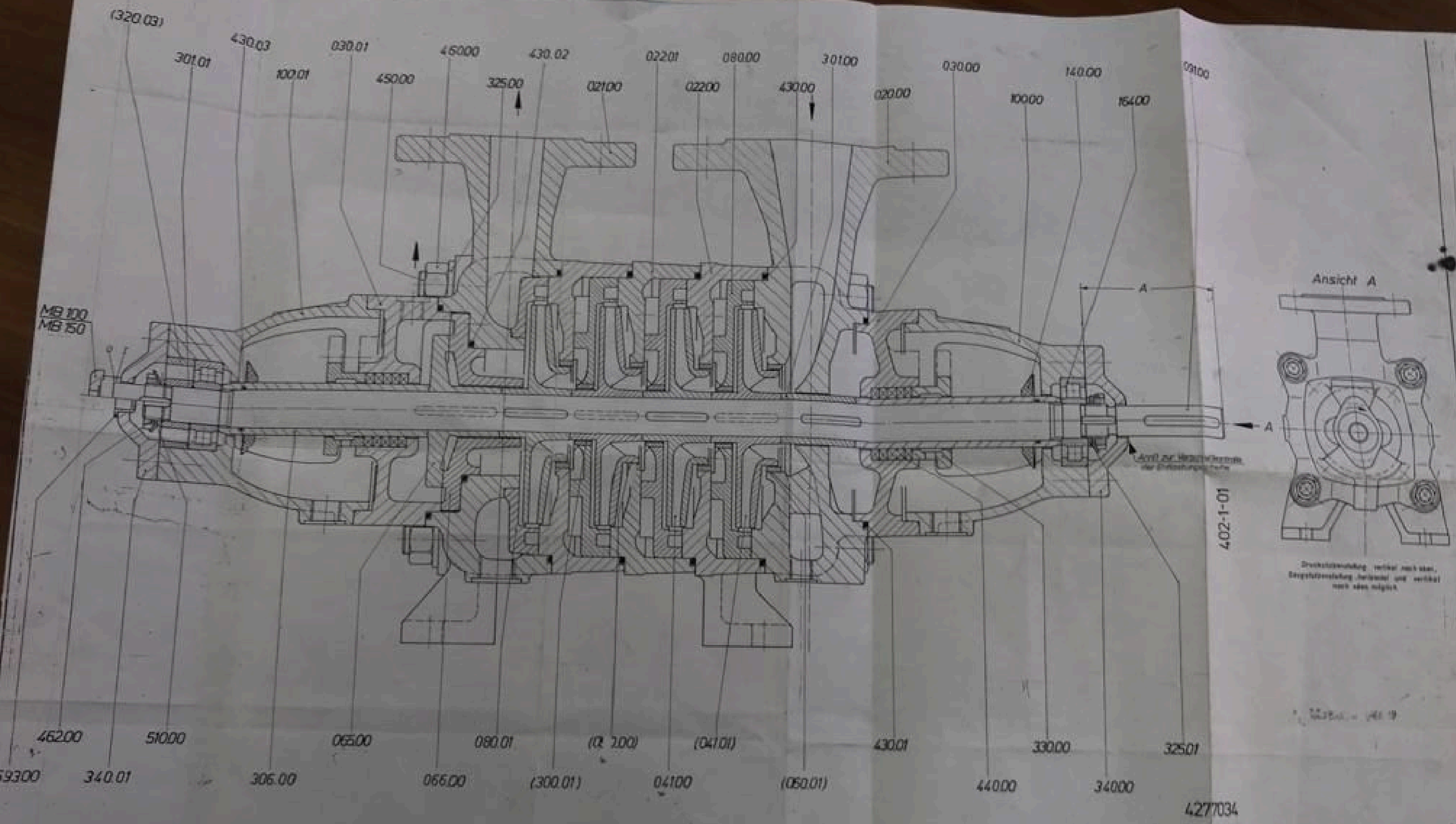
Abmessungen (DIN)*

Taille Größe Size	DN_P/DN_K mm	PN[1] bar	DN_M mm	DN_{Mmax} mm	DN_A mm	L mm	S mm	H mm
071/72/73/74 075/076/77 078	40	10-16-25-40 64-100-160 250	15	25	15	200 260 300	155 190 215	75 190 120
081-82-83-84 085 086-087 088	50	10-16-25-40 64 100-160 250	15	25	15	230 300 300 350	163 185 193 223	90 115 110 130
091-92-93-94 095 096-097 098	65	10-16-25-40 64 100-160 250	25	40	25	290 340 340 400	184 219 227 260	110 125 125 145
101-102-103-104 105 106-107 108	80	10-16-25-40 64 100-160 250	25	40	25	310 380 380 450	191 230 240 265	115 140 140 165
111-112-113-114 115 116-117 118	100	10-16-25-40 64 100-160 250	40	50	40	350 430 430 520	221 250 266 300	125 155 155 190
121-122-123-124 125 126-127 128	125	10-16-25-40 64 100-160 250	40	50	40	400 500 500 600	266 280 291 321	135 175 175 215
131-132-133-134 135 136-137 138	150	10-16-25-40 64 100-160 250	50	65	50	480 550 550 700	295 320 325 360	165 190 190 250
151-152-153-154 155 156-157 158	200	10-16-25-40 64 100-160 250	65	80	65	600 650 650 800	360 390 400 450	200 215 215 275
161-162-163-164 165 166-167 168	250	10-16-25-40 64 100-160 250	80	100	80	730 775 775 900	435 440 458 530	240 260 260 310
171-172-173-174 175 176-177 178	300	10-16-25-40 64 100-160 250	100	125	100	850 900 1050 1050	530 550 650 700	280 300 360 360

Dimensions en millimètres (sans engagement)
Maße in Millimetern (unverbindlich)
Dimensions in millimeters (not binding)

*) Dimensions se réfère aussi à l'exécution avec bouts d'arbre
*) Abmessungen auch gültig für Ausführung mit Schweißenden
*) Dimensions also refers to design with welded ends

1) PN également valable pour DN_M et DN_A
1) PN gilt auch für DN_M und DN_A
1) PN also valid for DN_M and DN_A



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MB Größe	A (mm)
32	80
40	88
65	96
80	113
100	161
150	173

4-stufig gezeichnet

neue Ausführung ab 1.5.77

Ausführung MB 150 zugefügt

Ausführung MB 100 zugefügt

Spaltringe geändert

MB 32, 40, 65, 80, 100, 150

Kreiselpumpe

SULZER WEISE

SE 402-1-01

Besteller : SULZER ESPANA S.A. Kunden-Positions Nr.: Sulzer Comm. Nr.: 1 1 1- 93229
Besteller Nr.: Stückzahl Pumpen: 4

S U L Z E R - I N F O R M A T I O N E N ----------> ANWENDER - INFO

Teile-Nr.	Stck	.. Benennung und Abmessung ..	.. Werkstoff ..	sonst Kenndat.	Artikel- Nummer .. BEMERKUNG ..
450.00	4	VERBINDUNGSSCHRAUBE D 24X550	1.0503		104.049.648.605 Tie bolt
460.00	8	SECHSKANTMUTTER M 24	1.1181.05	DIN 934-M	015.201.012.740 Hexagon nut
462.00	2	NUTMUTTER KM 6	1.0044	DIN 981	015.201.803.510 Slotted nut
510.00	2	SICHERUNGSBLECH MB 6	1.0330	DIN 5406	015.507.500.201 Lock washer
593.00	1	STOPFEN R 3/8	LUPOLEN	WN 593	104.959.300.386 Plug

Besteller : SULZER ESPANA S.A. Kunden-Positions Nr.: Sulzer Comm. Nr.: 1 1 1- 93229
Besteller Nr.: Stückzahl Pumpen: 4

S U L Z E R - I N F O R M A T I O N E N ----------> ANWENDER - INFO

Teile-Nr.	Stck	.. Benennung und Abmessung ..	.. Werkstoff ..	sonst Kenndat.	Artikel- Nummer ..	BEMERKUNG ..
020.00	1	SAUGGEHÄUSE-KPL	0.6025		104.058.487.200	Suction casing
021.00	1	DRUCKGEHÄUSE-KPL	0.6025		104.049.677.201	Discharge casing
022.00	1	STUFENGEHÄUSE KPL	0.6025		104.051.496.202	Stage casing
022.01	5	STUFENGEHÄUSE KPL	0.6025		104.049.662.202	Stage casing
030.00	1	STOPFBUCHSGEHÄUSE-SGS	0.6025		104.049.667.200	Stuffing box housing
030.01	1	STOPFBUCHSGEHÄUSE DRS	0.6025		104.049.668.200	Stuffing box housing
041.00	6	LAUFRAD D 170	0.6025		104.049.674.000	Impeller
041.01	1	LAUFRAD D 170	0.6025		104.049.673.000	Impeller
065.00	1	ENTLASTUNGSSCHEIBE	0.6025		104.049.659.000	Balance disc
066.00	1	ENTLAST.GEGENSCHEIBE	0.6025		104.049.660.000	Balance counter-disc
080.00	6	LEITRAD	0.6025		104.049.675.000	Diffuser
080.01	1	LEITRAD-LETZTE-STUFE	0.6025		104.049.676.000	Diffuser, last stage
091.00	1	WELLE D 32X975	1.0503		104.058.323.006	Shaft
100.00	1	LAGERKÖRPER-SGS	0.6025		104.049.665.000	Bearing frame
100.01	1	LAGERKÖRPER-DRS	0.6025		104.049.666.000	Bearing frame
140.00	2	SPRITZRING D 38/75X8	NBR 75		104.051.304.000	Deflector
164.00	2	ZYLINDERROLLENLAGER NU 306	ST	DIN 5412	017.742.003.061	Cylindr. roller bear.
301.00	1	HÜLSE D 32/42X58	0.6030		104.049.652.000	Sleeve
301.01	1	HÜLSE D 30/41X19	0.6030		104.049.651.000	Sleeve
306.00	2	WELLENSCHUTZHÜLSE D 32/42X153	0.6030		104.060.509.002	Shaft sleeve
320.03	1	RING D 62/71,8X18,5	0.6030		104.062.062.001	Ring
325.00	8	SCHEIBE A 25	1.0330	DIN 125	015.500.205.630	Washer
325.01	2	STÜTZSCHEIBE S 30X42X2,5	FED.STAHL	DIN 988	015.503.100.305	Supporting disc
330.00	2	STOPFBUCHSBRILLE	0.6025		104.020.966.000	Stuffing box gland
340.00	1	LAGERKAPPE	0.6025		104.049.664.000	Bearing cover
340.01	1	LAGERKAPPE	0.6025		104.049.663.000	Bearing cover
430.00	7	O-RING 218X5,3	EPDM-70 (3957)		021.703.021.809	O-ring seal
430.01	2	O-RING 145X3,55	EPDM-70 (3957)		021.702.014.509	O-ring seal
430.02	1	O-RING 103X3,55	EPDM-70 (3957)		021.702.010.509	O-ring seal
430.03	2	O-RING 31,5X2,65	EPDM 70		021.701.003.109	O-ring seal
440.00	10	PACKUNGSRING D 42/58X6,1	GRAFIT-PTFE		104.944.012.951	Packing ring

	Erzeugnis	Typ/Baugrösse	Zeichnungs - Nummer	Teileliste - Nr.	Datum : 21.09.92
SULZER WEISE			SE 402-1-01		Name :
-7520 Bruchsal	KREISELPUMPE	MB 65-7	NR.10	TP 93229	Seite : 1

1-/22
1

2. SERVICE DATA - SERVICE CONTROL

2.1 Data		
Serial No.		93 229
Position No.		1538-11
Medium delivered		hot water
Capacity	m^3/h	25
Minimum capacity	m^3/h	1,5
Differential head	m FS	257
NPSH R	m	1,9
Differential pressure	bar	24,10
Suction pressure	bar	0,39
Discharge pressure	bar	24,49
Pumping temperature (PT)	°C	102
Specif. grav. at PT	kg/m^3	956,8
Pump input	kW	26,5
Speed	1 / min.	2930
Impeller diameter	mm	170
2.2 Lubrication		
Type of grease (according to DIN 51 825)		NLGI Class 3
Lubrication frequency and quantity of grease		see 7.3
2.3 Cooling		-
Cooling water	m^3/h	
Pressure normal / max.	bar	
Temperature outlet max.	°C	
2.4 Heating		-
Heat exchanging medium		
Pressure normal / max.	bar	
Temperature entry max.	°C	
2.5 Flushing / Sealing (shaft seal)		-
Flushing / Sealing medium		
Quantity min.	m^3/h	
Pressure	bar	
Temperature of flushing medium	°C	
2.6 Flushing (wear ring)		-
Flushing medium		
Quantity	m^3/h	
Pressure	bar	
2.7 Quench		-
Quench medium		
Quantity	m^3/h	
Pressure	bar	
2.8 Safety technical limit data		
Max. allowable working pressure	bar	30
Max. allowable working temperature	°C	102