Description and directions for use of the KAMEWA propeller

KAMEWA AB

Box 1010

S-681 01 KRISTINEHAMN, Sweden

TELEPHONE: 0550-84000

(Off office hours): 0550-84092

MOBIL TEL.: 010-310307

TELEX: 660 50

TELEGRAM: VERKSTADEN KRISTINEHAMN.

Introduction

This instruction manual describes the functioning and servicing of the propeller equipment as completely as possible though every detail is not covered. Also some optional equipment is described.

The KaMeWa propeller is equipped with hydraulically movable blades which can be remotely controlled. By varying the pitch of the propeller blades, the vessel can be driven ahead or astern at any desired speed from full to dead slow or brought to a quick stop without changing the direction of rotation of the propulsion machinery.

The propeller equipment consists of propeller, propeller shafts, and oil distribution box as well as any intermediate shafts.
In addition, a hydraulic system is included, which supplies oil under pressure for the pitch setting and a manoeuvring system for remote control of the pitch and, if desired, the engine rpm.

When ordering spareparts the name of the vessel, the building yard, newbuilding number and KMW-number must be specified.

Technical data XF propeller

General data

Name of the vessel ..... C.S.S. "JOHN P. TULLY"
Building yard ..... Bel-Aire
Newbuilding number 302
KMW-number 9876

Propeller

Hub size 86 XF/4W
Diameter ..... 2500 ..... mm
Number of blades 4
Material in hub ..... Bronze
Material in blades ..... Bronze

Shaft coupling

Make ..... SKF
Type OK-260-HB

Oil distribution box

Type ..... 121 F

Weights (approx.):

Propeller hub with blades ..... 3700 ..... kg
Propeller blade (each) ..... 374 ..... kg
Propeller shaft ..... 4100 ..... kg

Hydraulic oil

refer to chapter "Oil recommendations"

Quantity of oil required (approx.):

Upper oil tank ..... 45 ..... lit.
Lower oil tank ..... 650 ..... lit.
Propeller hub ..... 105 ..... lit.
Total system ..... 1100 ..... lit.

Hydraulic pumps

refer to drawing "Hydraulic diagram"

Pressure filters

Make ..... EPE
Type ..... 100 L 140
Mesh size ..... 25 ..... µ

Auxiliary servomotor filter

Make ..... EPE
Type ..... 100 D 32
Mesh size ..... 25 ..... µ

Blade sealing ring

O-ring dimension ..... 478x6-1 ..... mm

Tightening torques

Blade screw ..... 2550 Nm ..... (260 .... kpm)
Shaft flange screw .. 2600 Nm ..... (260 .... kpm)
Hub cone screw .... 450 Nm ..... (45 .... kpm)

During sea trials the safety valve in the hydraulic system was set to a pressure of ..... bar

(Can be checked by reading the hub pressure gauge, when the propeller pitch is in its mechanical end position.)

Maximum allowed propeller rpm at running with safety springs

During sea trials maximum propeller rpm at running with safety springs has been established to ..... rpm

DRAWING INDEX Bel-Aire 302

Encl	Description	Drawing No
0.1	Main assembly and marking drawing	927 790 A
4.1	Propeller hub, assembly	935 060 B
4.2	Instuction for tightening of screw	586 431 A
4.3	Instruction for locking of screw	915 981 A
4.4	Instruction for locking of hub cone screw	579 871 A
4.5	Instruction for lifting of propeller blade	935 064 A
4.6	Locking plate	579 881 A
5.1	Shafting arrangement	927 727 A
5.2	Valve rod	927 794 A
5.3	Protection cover,mounting instruction	907 473 A
6.1	Oil distribution box, assembly	916 100 AC
6.2	Auxiliary servomotor	916 102 A
6.3	Control equipment	927 840 A
7.1	Hydraulic diagram	927 761 ABC
7.2	Hydraulic unit 240 H	927 767 A
7.3	Valve unit	908 846 A
7.4	Electric diagram	927 783 A
8.1	Calculation and diagram for pitch/box scale	18 316
8.2	P/D-n diagram, free running	22 139
14.1	Mounting tool for SKF-coupling	518 200 A
14.2	Lifting tool for hub	586 583 A
14.3	Lifting tool for propeller blade	935 057 A

LIST OF ADDRESSES KAMEWA LICENSEES, REPRESENTATIVES AND SERVICE STATIONS

Country	Representative (R) Licensee (L) Service Station (S)		Address	Telephone	Telex No. Cable
Argentina	Compania Sueco-Argentina SACI	(R)	Tacuari 143 1071 BUENOS AIRES	37/2423 37/3670 37/7012	012-1370 AR SUEC SUECARG - BAIRES
Australia	Boving & Co (Anz) Pty Ltd	(R) (S)	St. James Building 121 William Street MELBOURNE Vic. 3000	62-2185 62-2186	31925 BOVINGCO
Belgium	S.A. A Johnson & Co. N.V. Marine Division	(R) (S)	Box 1 Oudaan 22-24 B-2000 ANTWERP	031/32 15 22 031/32 05 89	31445
Brazil	Sonave S.A.	(R) (S)	Av. Rio Branco, 50 8.° Andar 20.000 RIO DE JANEIRO	233-8250 253-2028	2123330 SONA BR RIO
	Kamyr do Brasil Technica de Celulosa Ltda	(L)	Caixa Postal 14046 80.000 CURITIBA PR	41-246 48 31	415408 KAMY BR
Bulgaria					
Canada	Axel Johnson Inc.	(R) (S)	225 Montée de Liesse MONTREAL, Quebec, H4T 1P5	514/738-9431	5826889 AJOHNSONCO/MTL
	Axel Johnson Inc.	(S)	Western Alloys & Metals Ltd Marine Products Division 1475 Boundary Road VANCOUVER B.C.	604/291-2341	04-354532
Chile	Garrido, Garcia Burr & Co. S.A. Commercial	(R)	Casilla No. 3284 SANTIAGO DE CHILE	30157	34-0117 MATCO
China	A Johnson & Co. H.A.B.	(R)	S-103 75 STOCKHOLM	08/22 05 00	17100 JOHNSONS STH
Denmark	A Johnson & Co. A/S	(R)	Jägersborg Allé 14-16 DK-2920 CHARLOTTENLUND	01/634000	27234 JOHNSONS
	Aalborg Vaerft A/S	(L) (S)	Postboks 661 DK-9100 AALBORG	16 33 33	69705 YARD
Egypt					
Finland	A Johnson & Co. Oy	(R)	Lönnrotsgatan 35 D 00180 HELSINKI 18	601155	12-3107 AJCO SF
France	Ets. A Johnson & Cie.	(R) (S)	48/50 Rue Albert F 75013 PARIS	01/583.46.21	270384 AJANDCO
Germany	A Johnson & Co. GmbH	(R)	Glockengiesserwall 17 Postfach 103340 D-2000 HAMBURG 1	040/32991	2161046 JOHNSONS
	A Johnson & Co. GmbH	(R) (S)	Hermann-Böse-Strasse 35 D-2800 BREMEN 1	0421/34 31 00 0421/34 20 41	244814 JOHNSONS
Great Britain	Boving & Co. Ltd.	(R) (S) (L)	Villiers House 41-47 Strand LONDON, WC2N 5LB	01/839-2401 01/839-2403	28444 BOVING G
Greece	A Johnson & Co (Hellas) Ltd	(R)	P O Box 3321 Kolonaki ATHENS-139	01/79 05 27 01/79 04 76	216924 KABA GR
Hungaria					
Iceland	Smith & Norland H/F	(R)	P O Box 519 REYKJAVIK	28300 28322	2055 ELEKTROSMITH
Italy	Avesta S.p.A. Acciai Inossidabili	(R)	Viale Lancetti 36 Casella Postale 16001 I-20158 MILANO	02/68 08 41-4	330398 AVESTACCIAI
	KaMeWa Mr. G. Illiano	(S)	La Spezia (contact via KaMeWa, Kristinehamn, Sweden)		
	Franco Tosi Industriale S.p.A.	(L)	Piazza Monumento 12 20025-LEGNANO	0331/54 76 90 0331/54 11 12	43/36661 FRANTOSI

The hydrodynamics of the propeller

On a fixed pitch propeller, or a controllable pitch propeller in normal position for going ahead, the blades are parts of screw surfaces with a certain pitch. The function of the propeller can also be compared with that of a screw with as many threads as the number of propeller blades. When a screw is threaded into a nut, the screw moves a distance corresponding to the pitch of the threads during one turn.

A propeller rotating one turn moves a shorter distance than the pitch, the propeller is said to work with a certain slip. This can be explained by the fact that a screw works in a fixed nut, while a propeller works in water, which is a non-rigid medium. When the propeller is rotating, an excess pressure is generated on the side of the blades facing astern, the pressure side or face. On the side of the blades facing ahead, the suction side or back, a corresponding underpressure is generated. The resulting force in the longitudinal direction of these pressure fields is the force that makes the vessel advance through the water. The tangential forces in the plane of the propeller disc together with friction forces on the blades generate the shaft torque which the engine must supply. At a stop or astern manoeuvre when the propeller rpm or pitch is reversed, the suction and pressure sides change places and consequently an underpressure is obtained on the blade face and an excess pressure on the blade back. The propeller will then give a force astern, braking the vessel or taking it astern.

A propeller can have a large or small blade area, i e blades of varying width — the higher the power and rpm the broader the blades in relation to the propeller diameter. If the blades are too narrow there is a risk of cavitation. The cause and consequence of cavitation should be explained in more detail.

On a working propeller, high water speeds will occur locally around the blades, especially if the water flowing into the propeller has been disturbed by the hull.

According to the laws of physics a high water speed means a low pressure, and at a very low pressure the point is reached at which the water boils at normal seawater temperature. This kind of "cold boiling" is called cavitation because of the "cavities" i e the bubbles, that are formed in the water. These bubbles mainly contain water vapour. Cavitation is a very common phenomenon with ships' propellers and takes place in the flow around the blades, especially in those parts of the propeller disc behind the stern post or the shaft brackets, were the load on the blades is heavy. When the bubbles are carried by the water flow to a place on the propeller blades with a higher pressure, the bubbles suddenly collapse.

This can be heard as hard, metallic bangs, normally at irregular intervals. The collapsing bubbles hammer on the blade surfaces and after some time cavitation damage occurs.

A fixed propeller is designed for a certain speed of the vessel. If the vessel does not reach this speed due to e g bad weather or fouling, the rpm are reduced and the full engine output cannot be utilized.

The controllable pitch propeller can be adjusted to various operating conditions with only minor alterations of the blade pitch angle. Consequently, even at large variations of power the rpm can be kept constant, which is necessary if a shaft generator is installed. Although the controllable pitch propeller allows considerable variations in load, the tendency to cavitation is increased in relation to the divergence from the design pitch.

Increased pitch leads to more cavitation on the suction side of the blades, decreased pitch may result in cavitation on the pressure side. All propellers work with a certain amount of cavitation on the suction side. This is unavoidable but cavitation on the suction side seldom causes damage on the blades.

Decreased pitch due to increased load and unchanged engine power, as e g during head wind, towing cr trawling, means increased cavitation but this will not lead to damage on the propeller.

Usually the relation between propeller pitch and rpm is controlled by the combinator in the control stand. For machinery with shaft generators the rpm must be kept constant and all changes of power must be made only through changing the pitch when the shaft generator is used. The propeller is designed with consideration to this but there is still a certain minimum pitch under which the propeller should not be operated continuously. At low pitches the inflow angle of the water against the outer part of the blades is such that cavitation may occur on the pressure sides of the blades. This type of cavitation can lead to erosion damage at prolonged operation. This erosion damage will, however, be rather limited.

It is difficult to state an exact lower limit for the pitch since many factors will have an effect, the hull form, the load of the vessel, wind and sea etc. The cavitation is easy to distinguish by a characteristic noise as from a flow of pebbles, thrown on the plating. The noise can normally be most clearly heard in the steering gear room. As a rule it is possible at full rpm to go down to 85 % of the design pitch corresponding to 70—75 % of the designed output without risk of pressure side cavitation.

In many cases two or more engines are connected to *one* propeller shaft. When low power is required, one engine can be disconnected. In order to give full power the remaining engine(s) must be operated at full rpm and the pitch must be reduced. If this kind of operation is normal the design of the propeller blades is adapted accordingly — otherwise the information in the previous paragraph is applicable.

During all manoeuvres, e g berthing etc., constant rpm can be used without pitch limitations.

When deciding on the number of blades for a propeller, vibration and noise must be taken into consideration. Normally the tendency to vibrations will decrease with increasing number of blades. This is, however, not a general rule, as different kinds of vibration impulses react in different ways when the number of blades is changed. This mainly depends on the irregular wake field in which the propeller is working. When the number of blades is changed from 4 to 5 the vibration impulses in the longitudinal direction decrease on most single screw vessels while the transverse forces increase. An increase in the number of blades usually also means a small decrease in the propeller efficiency.

For controllable pitch propellers 3 or 4 blades are most usual, but CP propellers may also have 5 blades.

The diameter of the propeller is usually chosen so that the highest possible efficiency can be obtained (optimum diameter). Increasing power or thrust means a larger diameter, and increasing rpm or ship's speed means a smaller one. Very often the propeller diameter is limited by the space available in the propeller well and the question is then of determining the rpm to give the best efficiency i e "optimum rpm". The calculations of the optimum diameter or the optimum rpm are usually carried out based on the results obtained from a systematic test with model propellers.

A fixed pitch propeller must change its direction of rotation when going astern, i e the engine must be stopped and restarted or — with steam turbine operation — the driving taken over by an astern turbine with lower output than the main turbine.

A controllable pitch propeller is reversed by turning the blades, while the direction of rotation remains unchanged.

Thus it is not necessary to stop the engines and a more rapid manoeuvre can be obtained. The changed angle of the blades means a somewhat lower efficiency compared with a fixed propeller working astern, but this is more than compensated for, by the fact that the rpm can be kept high

and the full power of the engine can be absorbed. At crash stop considerably shorter stopping distance and time can be obtained.

Fixed pitch propellers on single screw vessels are normally designed as right hand propellers, i e when going ahead the propeller rotates in a clockwise direction (to the right seen from the stern). A fixed pitch right hand propeller rotates anti-clockwise (left) when going astern. The propeller will then cause a pressure distribution on the after body which forces this to port and the bow is turned to starboard. (Rule: the stern moves as if the propeller "rolls" on the sea bottom).

In order to give the same effect for astern manoeuvres a controllable pitch propeller, always rotating in the same direction, must be designed as a left hand propeller. The KaMeWa propellers on single screw propeller vessels are therefore usually designed as left hand propellers.

The steering ability of the vessels depends on how the propeller works. The following rules apply.

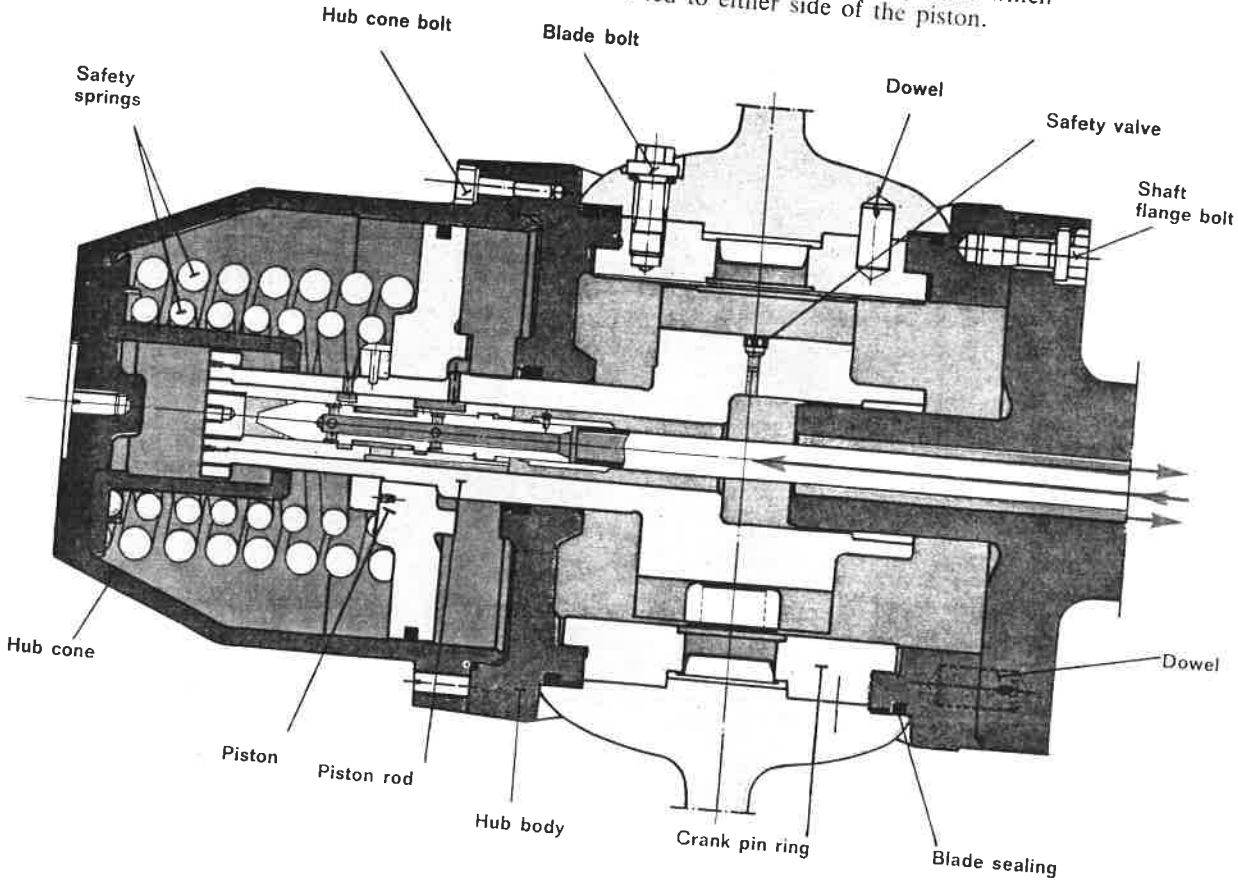
1. Only the speed of the vessel and the thrust of the propeller are important for the magnitude of the rudder force, independent of how the thrust is generated. This means that for a given speed and thrust the same rudder force is obtained with a CP propeller working at low pitch and full rpm as with a fixed pitch propeller working at its constant pitch and reduced rpm.
2. When the propeller thrust is zero, i e when the propeller neither drives nor brakes the vessel a considerable rudder effect is still obtained, provided that the vessel has steering speed.
3. With a reversed fixed pitch propeller as well as with a CP propeller at zero or astern pitch, the rudder force is usually zero. This is applicable at a crashstop manoeuvre, when the vessel is first braked strongly, and then gradually less as the speed of the vessel decreases. During braking the water flow towards the rudder is blocked and the rudder force is zero or very small.

If it is desired to maintain the manoeuverability and not to stop the vessel as quickly as possible, the pitch must not be taken down to zero abruptly as the rudder will be blocked. Instead the pitch must be gradually reduced as the speed of the vessel is reduced.

Functioning of the KaMeWa XF-hub

Functioning principle

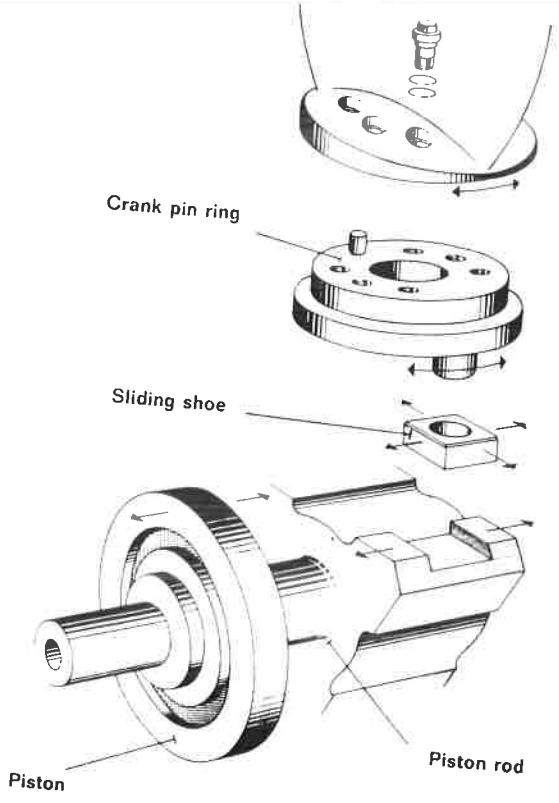
In the propeller hub there is a servomotor, which turns the propeller blades. The servomotor consists of a piston rod with a piston, which moves axially when pressure oil is led to either side of the piston.



How the movements of the piston affect the blade pitch

The piston rod is equipped with four or five "ears" depending on the number of propeller blades. Each ear has a transverse slot in which a shoe slides. The eccentric crank pin fits into the hole of the sliding shoe. The crank pin ring is supported in a bearing which is built in into the hub body.

When the piston rod moves, the crank pin ring rotates with the circular movement transmitted via the piston, piston rod slot — sliding shoe and crank pin. Then the propeller blade, which is bolted to the crank pin ring, turns.



Pressure oil for the servomotor piston

In order to feed oil to and from the different sides of the piston, there is a regulating valve with pin and sleeve. The regulating valve pin is screwed onto the hollow valve rod that extends between the oil distribution box and the piston rod inside the shaft hole. Pressure oil is supplied via the valve rod to the regulating valve pin. The valve rod with the regulating valve pin moves axially. The sleeve of the regulating valve is mounted on the piston rod.

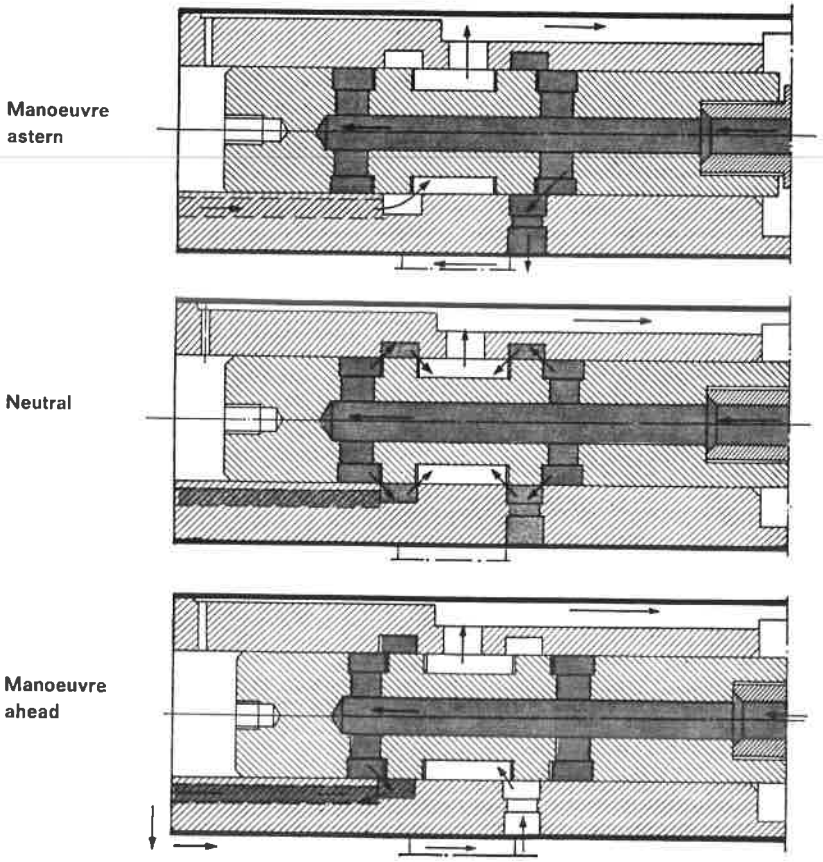
When the regulating valve pin assisted by the valve rod moves astern, pressure oil is fed to the fore end of the piston at the same time as a valve port at the aft face of the piston opens to the outer side of the valve rod. Then the piston rod moves astern and changes the blades towards astern.

When the regulating valve pin moves ahead pressure oil is supplied to the aft of the piston at the same time as the valve port for return oil opens fore of the piston. Then the piston rod moves ahead and changes the blade pitch towards ahead.

When the blades are not changing pitch i e when the pin of the regulating valve is in neutral position in the sleeve, the covering in the valve ports is so shaped, that there is a constant flow from pressure to return from both sides of the piston. (The regulating valve is underlapped). Consequently the regulating valve causes an immediate pitch changing as soon as the valve rod is actuated.

The pin of the regulating valve has a stroke limited by the sleeve. The fore and aft movement of the valve rod with the regulating valve pin is limited by a catch to the distance required to open and close the valve ports. As a consequence the pin can not be forced to move any further or less than the piston rod moves. The piston rod therefore, follows the movements of the valve rod. Each, fore or aft movement of the valve rod is followed by a corresponding movement of the piston rod that in turn, changes the blade pitch.

Return oil at low pressure flows through the hollow propeller shaft, outside the valve rod to the oil distribution box.



Hub body

As mentioned above there is a bearing for each propeller blade and crank pin ring in the hub body. The bearing absorbes the forces from the blade and the moment produced by thrust and engine torque.

All movable parts in the hub work in oil. Oil is added or drained via the two connections in the hub body chamber. The hub body chamber is connected to the return oil pressure through an orifice. Should the pressure for some reason be too high a safety valve opens to the return line.

Blade sealing ring

A blade sealing ring is attached to the bearing and situated in a groove in it. The blade sealing ring prevents water entering the hub and oil leaking out of the hub.

The blade sealing ring consists of an O-ring, which seals against the underside of the propeller blade and against the hub body.

Dimension of the O-ring, see "Technical data".

Joints

The propeller blade is attached to the crank pin ring and the hub to the propeller shaft by bolts.

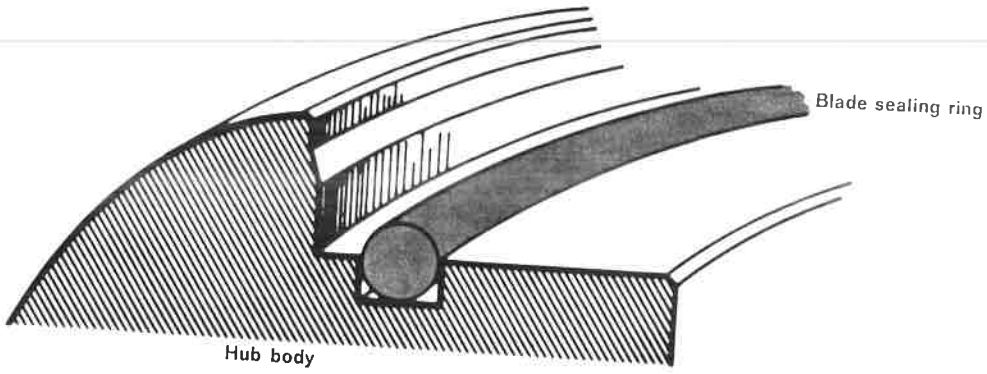
The bolts have heads for a hexagonal spanner and underneath the heads are O-rings for sealing.

The bolts must be tightened with a dynamometric wrench.

For the tightening torque, see "Technical data".

The bolts are locked with plates, which are tack welded into the flanges.

To absorb the torque there are dowels between the propeller shaft and the hub as well as between the crank pin ring and the blade.



Shafts

The shafts are made of steel. They are hollow to allow room for the valve rod with pressure oil for the hub. Parts, which are in contact with sea water are protected by corrosion resistant material.

The shafts are connected with one or more couplings of either the SKF-OK type or the flange type.

The performance specifications and the dimensions of the shafts and type of coupling are given with the drawing "Shafting arrangement".

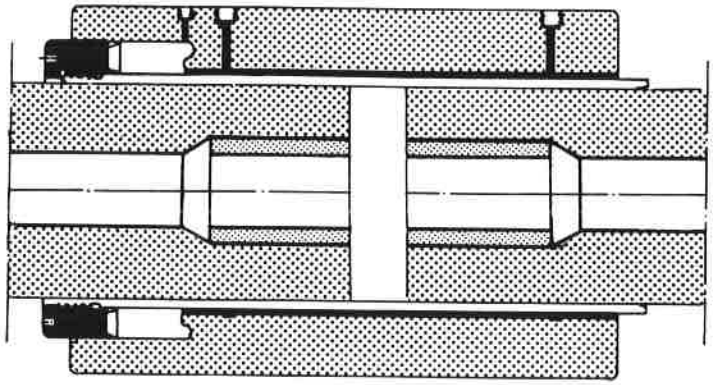
Propeller shaft

At the aft end of the propeller shaft there is a flange in which holes are drilled. These holes are for the bolt joint that connects the propeller hub to the shaft. The shaft flange is equipped with dowels transmitting the torque between the shaft and propeller hub.

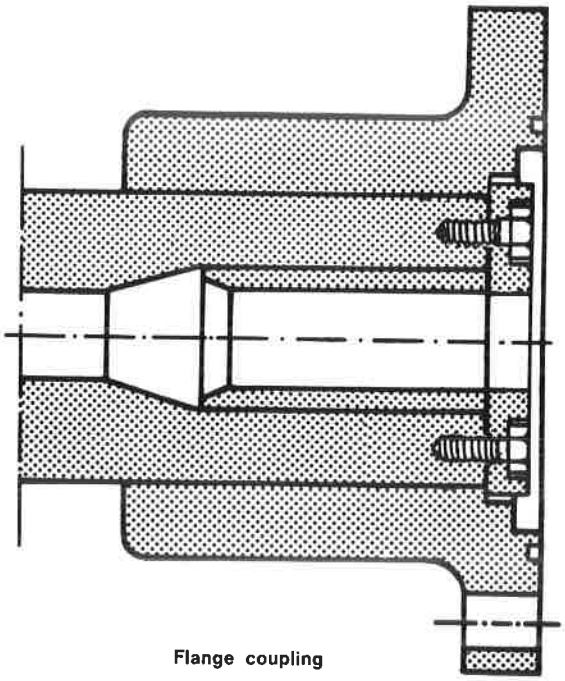
Oil distribution box shaft

(it is missing on the box at the fore end of gear)

Where the oil distribution box is mounted on the shaft, the shaft diameter is increased. This larger diameter has a radial boring for directing oil into the valve rod. The larger diameter also has a slot through the shaft. There is a sleeve for guiding the fore end of the valve rod into the hollow shaft near the inlet for high pressure oil.



SKF — OK — coupling



Flange coupling

Valve rod

The valve rod in the hollow shafting consists of a steel pipe. The pressure oil flows to the propeller hub within the valve rod. The return oil flows through the hollow shaft, outside the valve rod, back to the oil distribution box.

The regulating valve pin, which has already been described together with the propeller hub, is located at the aft end of the valve rod. The pin of the regulating valve has a stroke limited by the liner. To make it possible to insert or remove the pin these components are bayonet mounted, which means that the pin must be turned 90° after insertion into the liner.

The valve pin, in the sleeve of the intermediate shaft which is described in connection with the OD-box is fastened to the fore end of the rod. In the valve pin there is a hole for the inflow of pressure oil and a square hole for the carrier key. The carrier key draws the valve rod ahead or astern when manoeuvring.

Dismantling

OD-box on intermediate shaft

The valve rod can, almost without exception, only be dismantled astern. First the carrier key has to be removed from the OD-box. Then the hub-cone is dismantled. When withdrawing the liner of the regulating valve, the valve rod also follows.

OD-box on the fore end of the gear

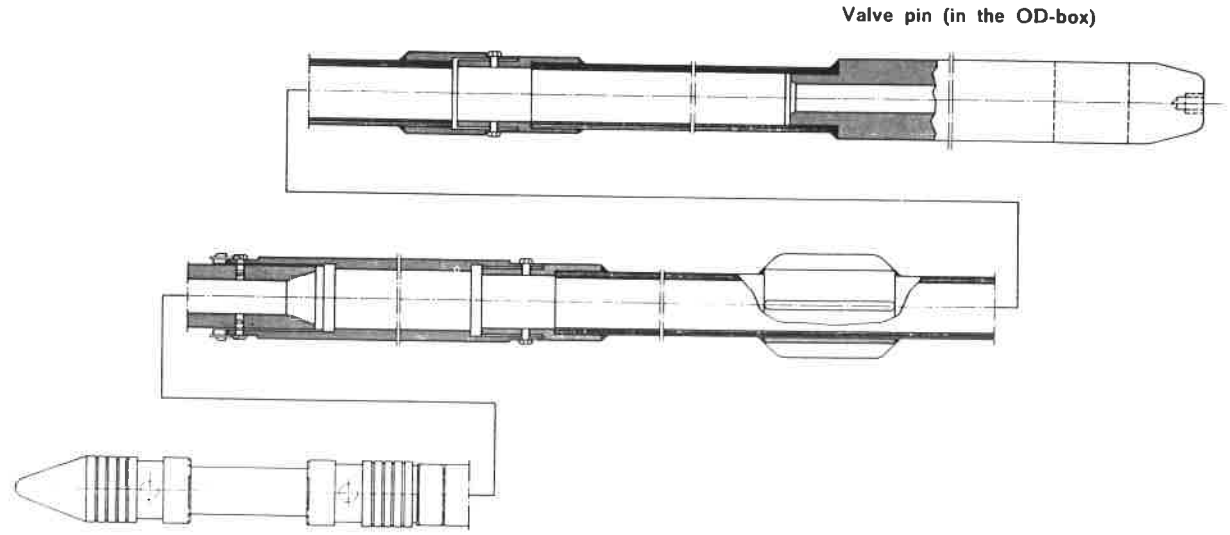
It is possible to dismount the valve rod astern as above. If space is available in the engine room it is also possible to dismount the valve rod ahead.

First the carrier key and the fore end cover has to be removed from the OD-box. By turning the valve rod 90° the bayonet is loosened and the valve rod can be dismantled.

Handle the valve rod carefully to prevent bending. It is recommended to support it at several points along its length. When dismantling very long rods it is advisable to disconnect the rod at its joints.

Mounting

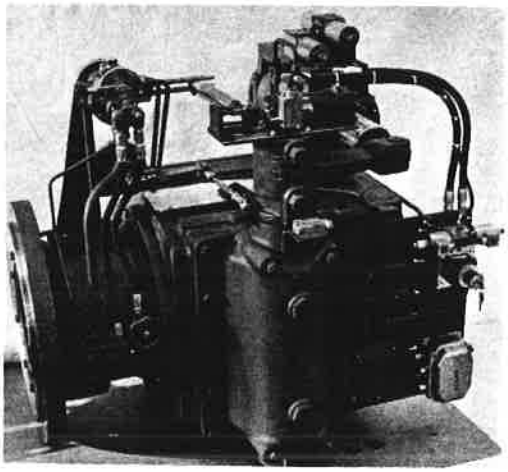
After mounting, which is done in the reverse order, all joints must be tightened so hard that the locking screws can be mounted and locked. Before fitting the inspection cover on the OD-box, check that the sliding ring with the valve rod can be easily moved within the limits of the stroke set by the catches.



Functions of the oil distribution box on the fore end of the gear

The OD-box has two functions: to convey pressure oil into the valve rod and to lead return oil out from the hollow shafting, and also, via the auxiliary servo motor, it controls the movement of the valve rod that directs the high pressure oil to the desired hub piston-rod face. For the first of these two functions the OD-box is provided with connections for pressure oil, return and draining pipes and with a high pressure seal for high pressure oil and low pressure seal for return oil.

Operation of the auxiliary servo motor causes axial movement of the valve rod via a yoke, the sliding shoes and the sliding ring with carrier key. The movement of the auxiliary servo motor is regulated from the bridge pneumatically or electrically.

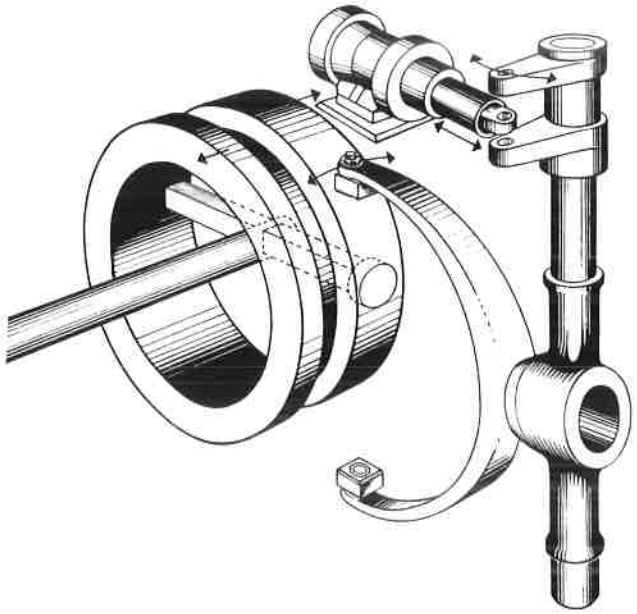


The auxiliary servomotor

With the pneumatic control system the auxiliary servo motor is hydraulically operated by the telemotor receiver.

On the electric control system the telemotor receiver is replaced by an electrically operated hydraulic valve.

The oil pressure in the auxiliary servo motor line always acts on the small area side of the auxiliary servo motor piston while the larger area side of the piston will be connected either to pressure or return depending on desired movement ahead or astern.



Transmission of the movement from the auxiliary servo motor to the valve rod

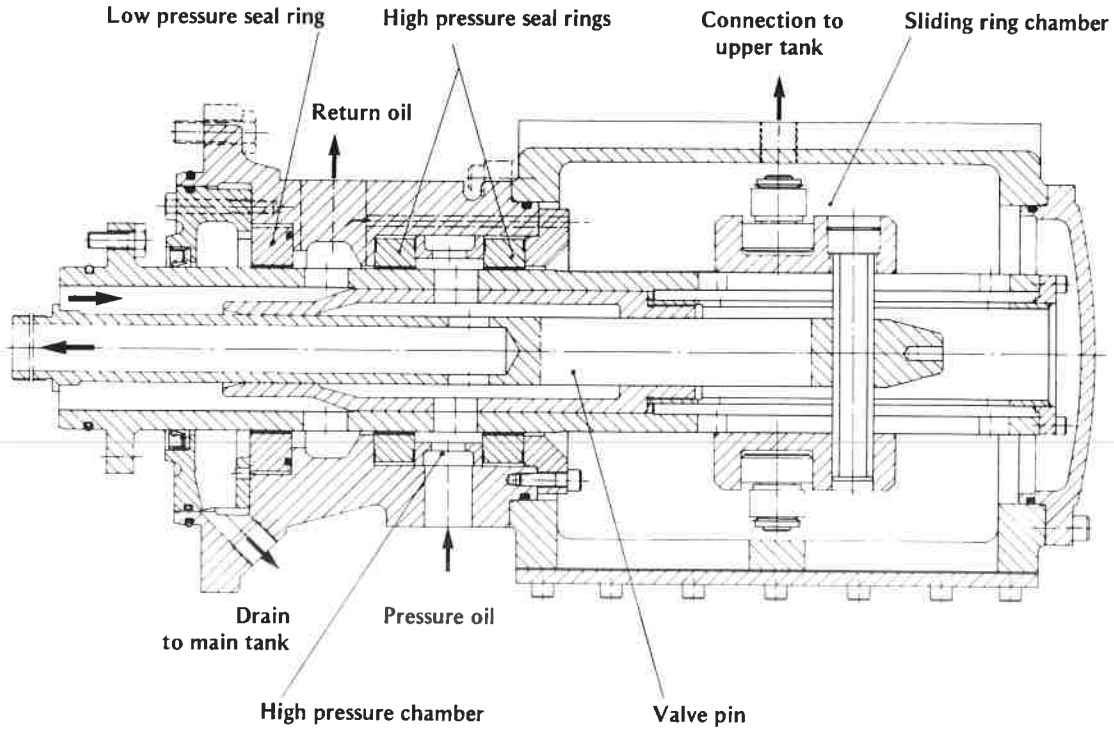
An OD-box shaft with an axial slot in its fore part is installed on the gear shaft. The sliding ring fits around the shaft. The sliding ring is connected to the valve pin at the fore end of the valve rod by the key that passes through the axial slot in the shaft. This slot allows axial movement of the key, valve rod and sliding ring. The cylinder of the auxiliary servo motor is connected to a yoke.

Two sliding-shoes on the yoke rid in an annular groove in the sliding ring. Operation of the auxiliary servo motor moves the sliding ring, key and valve rod fore and aft, causing a corresponding movement of the hub piston to change the pitch of the propeller blades,

How pressure oil enters the valve rod

Pressure oil comes from the hydraulic unit and is led into the annular high pressure chamber, which is formed by the space between two sealing rings.

From the high pressure chamber the oil flows through a radially drilled hole in the shaft, through the sleeve for the valve pin and into the valve rod.



Sealings

One low pressure ring seals against the return oil and against the oil leaking from the high pressure seal.

Oil leaking through the low pressure ring is collected in the aft end of the OD-box and is drained to the lower tank.

The sealing consists of a steel ring lined with babbits and a rubber ring.

Hydraulic system

The propeller blades are hydraulically operated. The following equipment is therefore included:

Oil tanks
Pumps
Valve unit
Filters
Gauges

For a diagram of the hydraulic system, see page 7:34. Detail numbers mentioned below refer to page 7:34.

For your vessel refer to drawing "Hydraulic diagram".

It is essential always to maintain the hydraulic system in its best condition. The oil recommendations have to be followed as well as the directions in the chapter "Service and maintenance".

Oil tanks

There are two oil tanks in the system; one upper and one lower and sometimes also a storage tank.

Lower oil tank (1)

The lower oil tank is generally built between the frames in the double bottom of the vessel. The pumps suck oil from the lower oil tank. Return oil is drained to it as well as drain oil from the OD-box and valves. The lower tank has to be checked regularly. It must be refilled when the oil level is under the lower mark.

Upper oil tank (2)

The upper oil tank is connected to the OD-box and consequently also to the propeller hub. The oil tank provides a static oil pressure to the sliding ring chamber in the OD-box and to the hub. This pressure is greater than the external water pressure. So water is prevented from entering the system when the pumps are stopped.

Pumps

Main pumps (3)

The oil pressure of the propeller system is supplied by two pumps. They are positioned near the lower tank. The capacity of the two pumps together is chosen so that a quick pitch adjustment can be obtained. However, the capacity of one pump is enough to manoeuvre the blades at normal pitch rate. One of the pumps is selected as main pump, the other pump runs unloaded. When the main pump for some reason does not give pressure or stops, the unloaded pump is automatically connected. During operation in open sea one of the pumps may be shut down and connected to stand-by start in case the connected pump should fail.

Topping up pump (4) (optional)

A topping-up pump always ensures that the upper tank is filled so that an excess pressure is mainted in the hub. The topping up pump starts automatically when the main pumps are shut down.

Filters

In the pressure pipe from each pump there is a filter (5). An indicator on the exterior of the casing provides information about excessive contamination of the filter element. Each filter is provided with a switch thus a connection to a warning lamp and/or alarm eg in the control room is possible.

Futhermore there is a filter (16) in the pressure pipe to the auxiliary servo motor system (the auxiliary servo motor filter).

For type of filters and mesh sizes, see "Technical data".

VALVE UNIT

The valve unit is mounted on the OD-box or separately and consists of the following valves

Check valve
Sequence valve
Safety valve
Pressure maintaining valve
Reducing valve
By pass valve
Unloading valve

Check valves (7)

The function of the check valves is to prevent the oil from flowing back through the pump, which is stopped or unloaded.

Sequence valve (10)

The oil flows from the check valves to the sequence valve. Between the check valves and the sequence valve pressure oil is tapped and led to the auxiliary servo-motor system.

The hub pressure varies greatly depending on the combination of rpm and pitch. With an astern manoeuvre the hub pressure can be zero and during an ahead manoeuvre with full rpm, it can be at its maximum. The auxiliary servo-motor system needs a certain oil pressure and the sequence valve serves to prevent the pressure falling below this.

Safety valve (8)

The total oil flow normally circulates through the underlap in the regulating valve of the propeller hub. Under special circumstances e g when handmanoeuvring from the OD-box, the regulating valve is shut at extreme full ahead or full astern. A relief valve is provided to prevent overloading. When the valve opens it discharges to the tank and the system is protected from any dangerously high pressures.

To balance the forces acting on the propeller blades the regulating valve is automatically adjusted in the propeller hub. This is necessary to keep the pitch in a set position or to adjust the pitch.

If the safety valve is set to a value which is too low, the necessary pressure for setting the propeller blades can't be obtained. The safety valve opens instead and the oil drains to the lower tank with the result that no manoeuvring takes place. The opening pressure of the safety valve is set on the trial trip to a value which is above the minimum pitch setting pressure. The position of the valve must not be changed, it must be locked.

Pressure maintaining valve (9)

The return oil from the propeller and the OD-box passes through a pressuremaintaining valve. The function of this valve is to always keep a certain pressure in the return pipe and therefore also in the propeller hub. When the pumps are working the return oil is led from the hub through the valve via the return pipe to the lower tank. Because the sliding ring chamber has an overpressure, the movable parts of the OD-box always work in oil and the upper tank is always fed with oil from a connection in the sliding ring chamber.

Reducing valve (11)

As mentioned above the pressure oil to the auxiliary servo-motor system is taken from a connection up stream the sequence valve. Because the hub pressure varies, there is a reducing valve located in this pipe in order to obtain a constant working pressure for the auxiliary servo-motor system.

By pass valve (12)

The by pass valve connects the high pressure chamber in the OD-box to the return pipe. After a break down in the hydraulic system making pitch operation impossible, the by pass valve is opened thus the oil in the hub servo motor is drained and the safety springs change the propeller pitch to full ahead.

Normally the valve must be closed and locked. Only when using the safety springs it is allowed to open the valve. In some cases this valve is omitted from the valve unit and placed directly in the piping.

For propellers of type S1 an hydraulic stand-by servo motor in the OD-box shaft is used as "taking home device" instead of the safety springs (see section 6). In such a design the by pass valve is excluded.

Unloading valve (6).

When the main pump is running the pressure oil flows via the pilot valve 18 to the pilot section of the unloading valve, which opens. The discharge from the pump is directed back to the tank and the pump runs unloaded. If the main pump for some reason should fail the pressure applied to the unloading valve drains. The unloading valve then closes and the oil from the pump is directed to the propeller hub.

The unloaded pump could also be used as a booster during manoeuvering. By putting the pitch rate selector 19 on "high" the valve 18 could be controlled by the remote control system (see section 8). Then the unloading valve is drained and the unloaded pump connected to the system as soon as a pitch change is taking place. The setting times is thus reduced to about half the normal value. The stand-by function for the main pump is the same in both modes.

For some propeller types the unloading valve is not integrated into the valve unit but placed in the pressure pipe of the unloaded pump.

Pressure gauges

The hydraulic system is equipped with pressure gauges showing the following pressures:

Auxiliary servo-motor pressure
Hub pressure
Main pump pressure
Unloaded pump pressure
Return oil pressure

The auxiliary servo-motor pressure ought to be adjusted to between 20—25 bar and then locked.

The hub pressure varies between zero and the value found during sea trials.

The main pump pressure gauge shows the same pressure as the hub pressure but not below the minimum pressure to which the sequence valve is adjusted.

Generally the hub pressure is some what lower than the pump pressure. During pitch setting the pressure can either decrease or increase. This is quite normal.

Unloaded pump pressure gauge shows either zero or the same pressure as the main pump.

Return oil pressure, 1.5 bar. This pressure may be increased during pressure tests on the propeller hub.

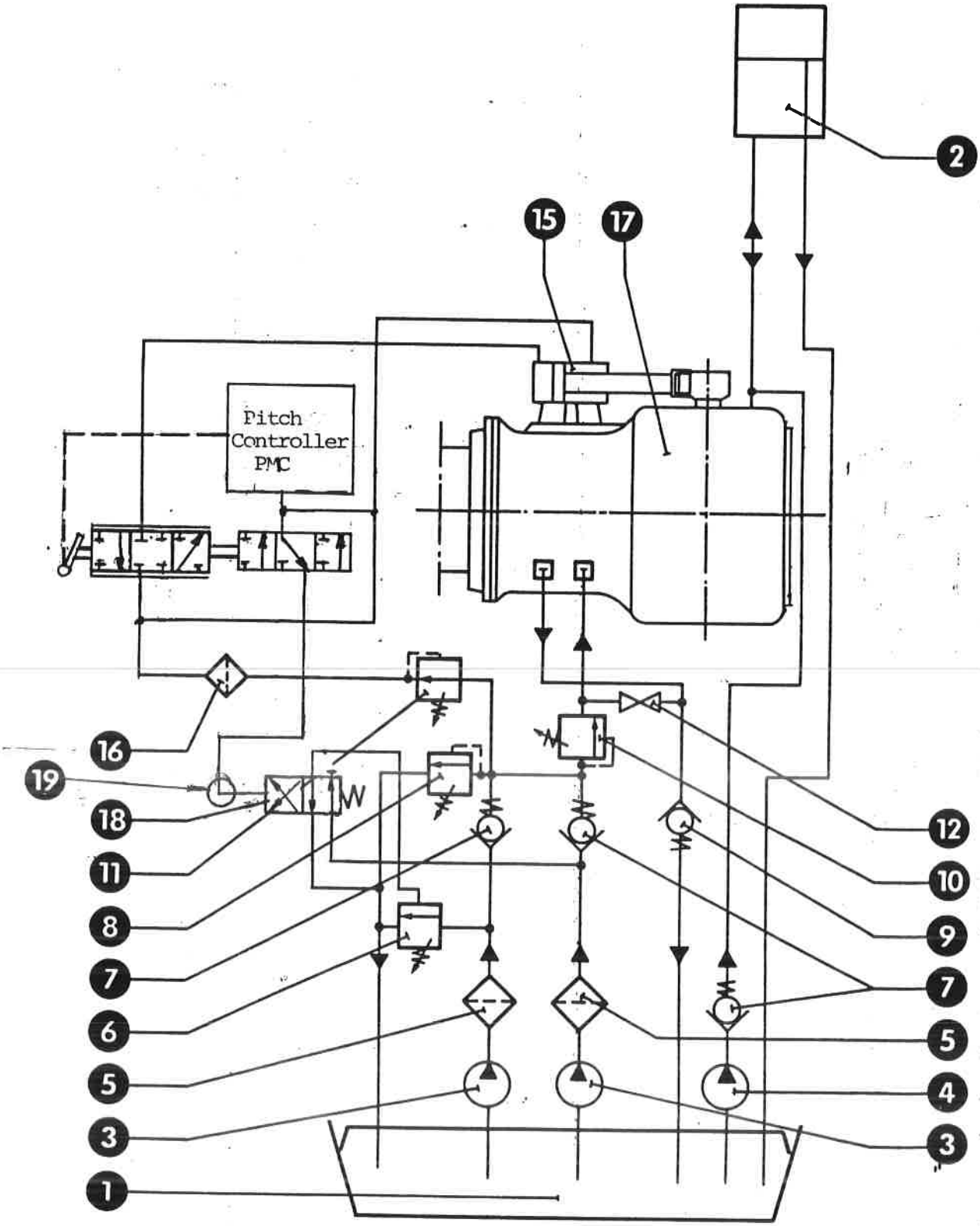
Cooler

When circumstances require a cooler can be used. It is located in the return pipe.

Hydraulic diagram

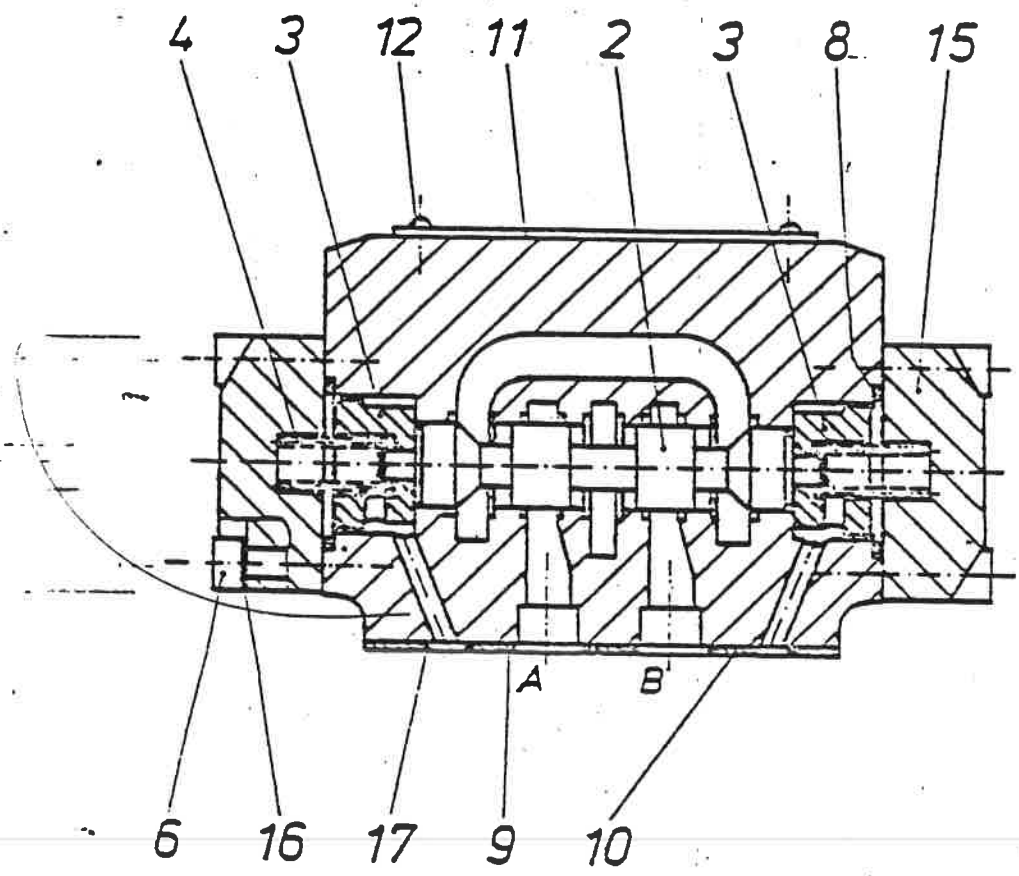
1. Lower tank
2. Upper tank
3. Main pump
4. Topping up pump
5. Pressure oil filter
6. Unloading valve
7. Check valve
8. Safety valve
9. Pressure maintaining valve
10. Sequence valve
11. Reducing valve
12. By pass valve

15. Auxiliary servo motor
16. Auxiliary servo motor filter
17. Oil distribution box
18. Pilot valve, unloading
19. High/normal, pitch rate selector


Pitch
Controller
PMC
2
15
17
16
19
18
11
8
7
6
5
3
1
12
10
9
7
5
4
3

VALVES IN VALVE MANIFOLD 240

Pilot valve	(V2)	Towler	4 501 3245
Cartridge	(V1-V5)	Towler	3 501 3526
Sequence valve	(V3)	Towler	
Safety valve	(V4)	Towler	
Pressure regulating valve	(V5)	Towler	908 841
Reducing valve	(V6)	Rexroth	26 582
Pilot valve	(V7)	Wandfluh	NG 6 ISO



a	h	m	r	v	
c	g		p	u	
d	f	k	o	t	
e			n	s	
Datum Anz Mittig	Datum Anz Mittig	Datum Anz Mittig	Datum Anz Mittig	Datum Anz Mittig	

Stck 79 Benennung

Zeichnungs-Nr. 4 501 3245

Stückliste 4 600 8194

W4_ DF 03 C1 P07

(V2)

Werkstoff

Rohteil-Maß

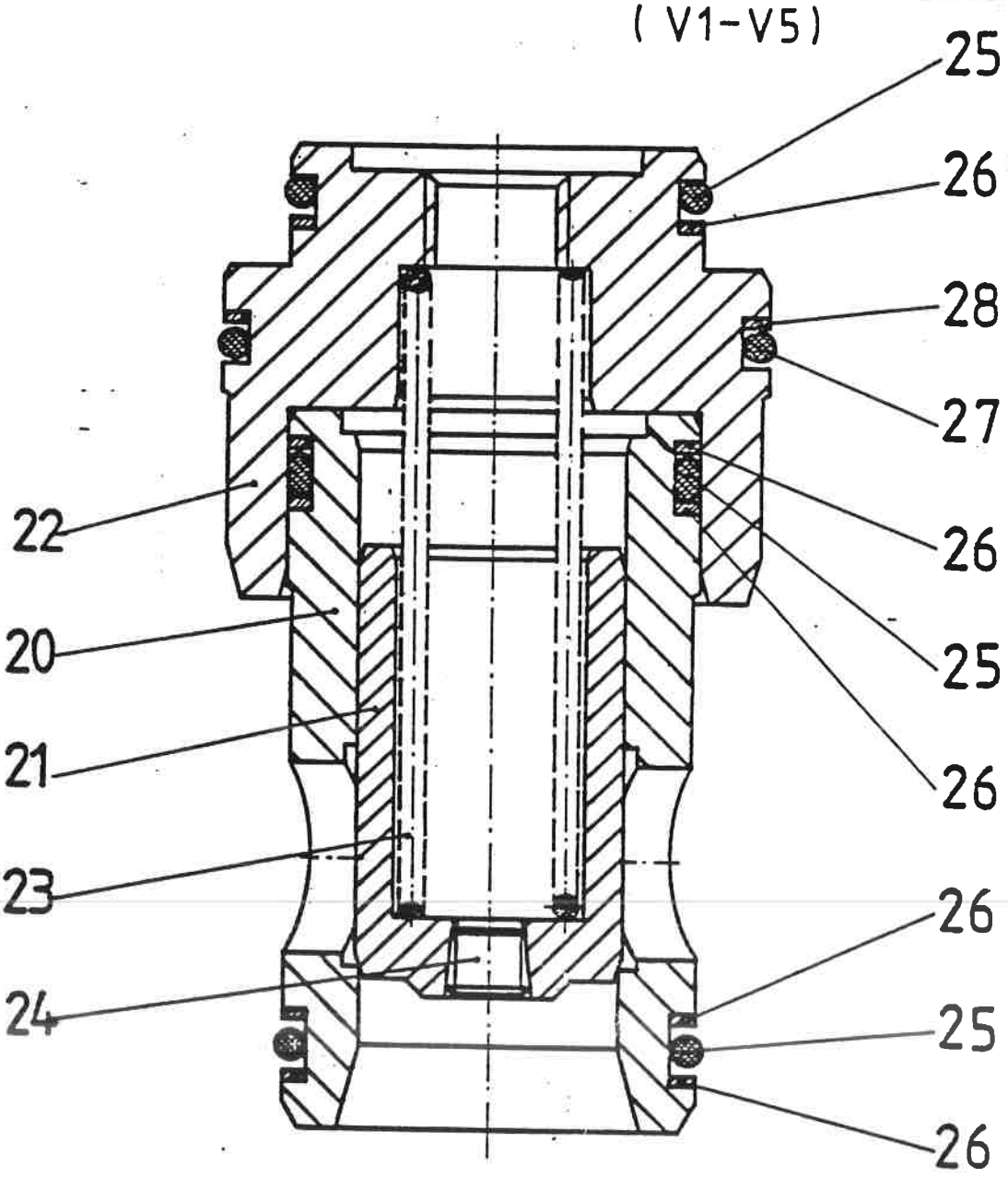
Gewicht

Maßstab 1:1

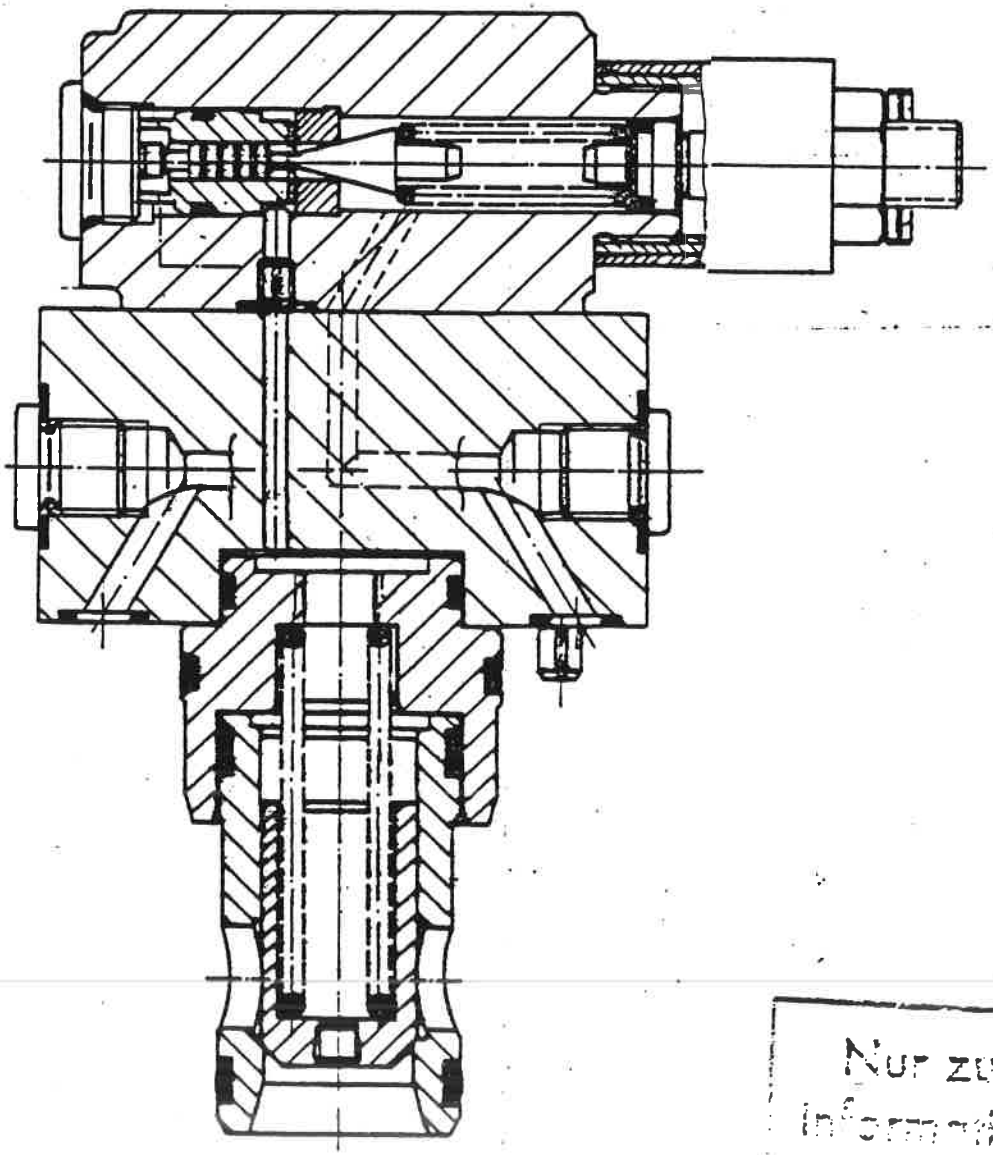
Ersatz für

TOWLER	DIN Cartridge Dichtungen			35013526
	NG16...63	DIN 24 342	350 bar	0282

(V1-V5)



Pos.	Stückz	Benennung	NG 16	NG 25	NG 32	NG 40	NG 50	NG 63
25	3	O-Ring	2-020	2-122	2-129	2-225	2-229	2-236
26	5	Stützring	8-020	8-122	8-129	8-225	8-229	8-236
28	1	Stützring	8-024	8-129	8-139	8-232	8-236	8-246
27	1	O-Ring	2-024	2-129	2-139	2-232	2-236	2-246



Nur zur Information

16. April '92

d	h	m	r	v
c	g	l	p	u
b	f	k	o	t
a	e	j	n	s

Datum	And Mittig	Datum	And Mittig	Datum	And Mittig	Datum	And Mittig	Datum	And Mittig

Kom Nr	Stck		Tag	Name
		gez	17.81	
		gep		

HOLLER hydraulics

Zchngs Nr

Stuckliste

DNL A 1012 E25 B

(V3)

Werkstoff

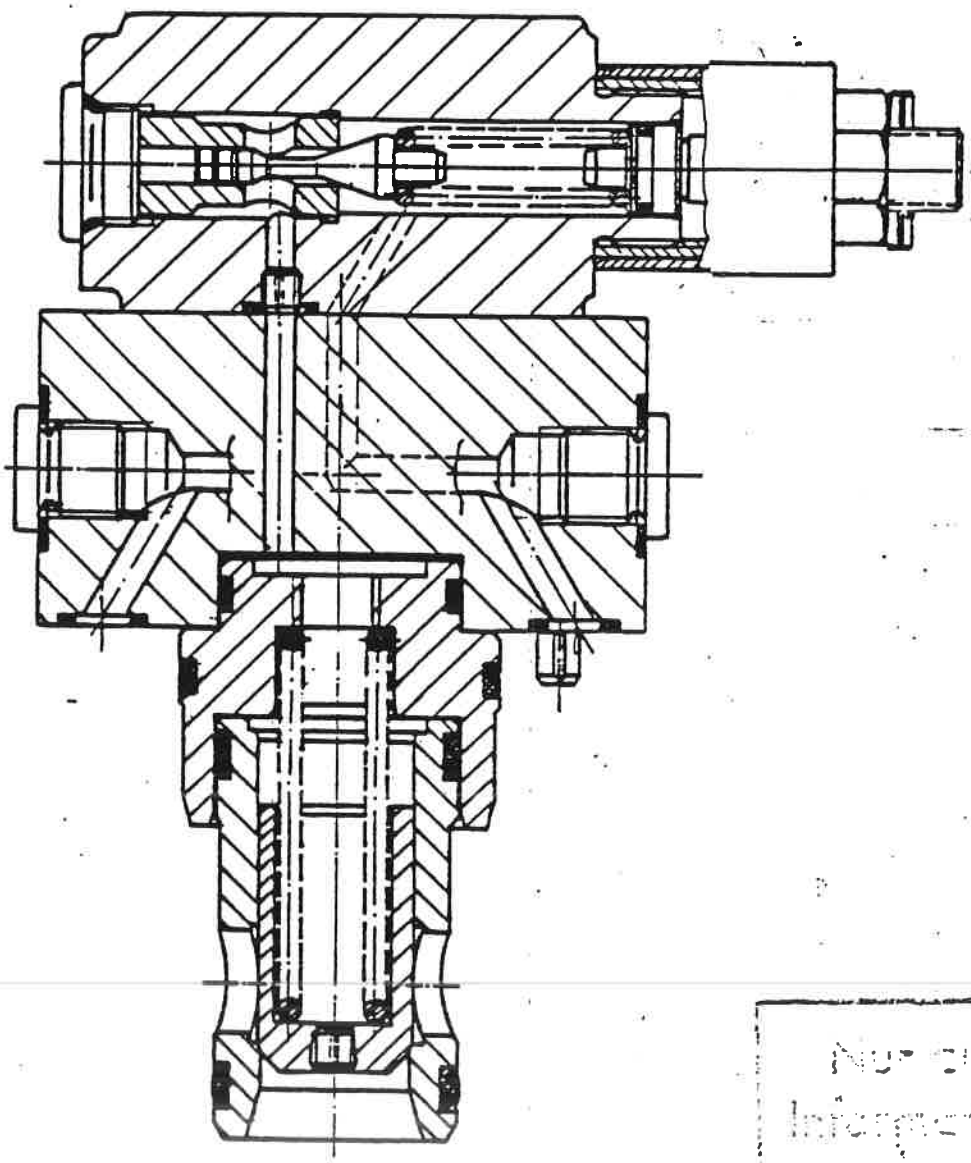
Rohteil / DIN

Gewicht

Maßstab 1:1

Ersatz für

Ersetzt durch



Nur zur Information
Unterliegt nicht dem Änderungsdienst

1. Juni 1992

d				h				m				r				v							
c				g				l				p				u							
b				f				k				o				t							
a				e				j				n				s							
	Datum	Änd. Mittlg.		Datum	Änd. Mittlg.		Datum	Änd. Mittlg.		Datum	Änd. Mittlg.		Datum	Änd. Mittlg.		Datum	Änd. Mittlg.						

Kom. Nr.	Stck.		Tag	Name
		gez.	11.11.11	
		gep.		

SCHUELER TOELLER hydraulics

Zchngs. Nr.

Stückliste

Werkstoff

Rohteil / DIN

Gewicht

Maßstab 1:1

Ersatz für

Ersetzt durch

Toleranzen für Längenmaße ohne Toleranzangabe DIN 7168

Nennmaßbereich	Toleranz „mittel"
über 0,5 bis 3 mm	± 0,1 mm
über 3 bis 6 mm	± 0,1 mm
über 6 bis 30 mm	± 0,2 mm
über 30 bis 120 mm	± 0,3 mm
über 120 bis 315 mm	± 0,5 mm
über 315 bis 1000 mm	± 0,8 mm

DSD A 1012 E2SB

21

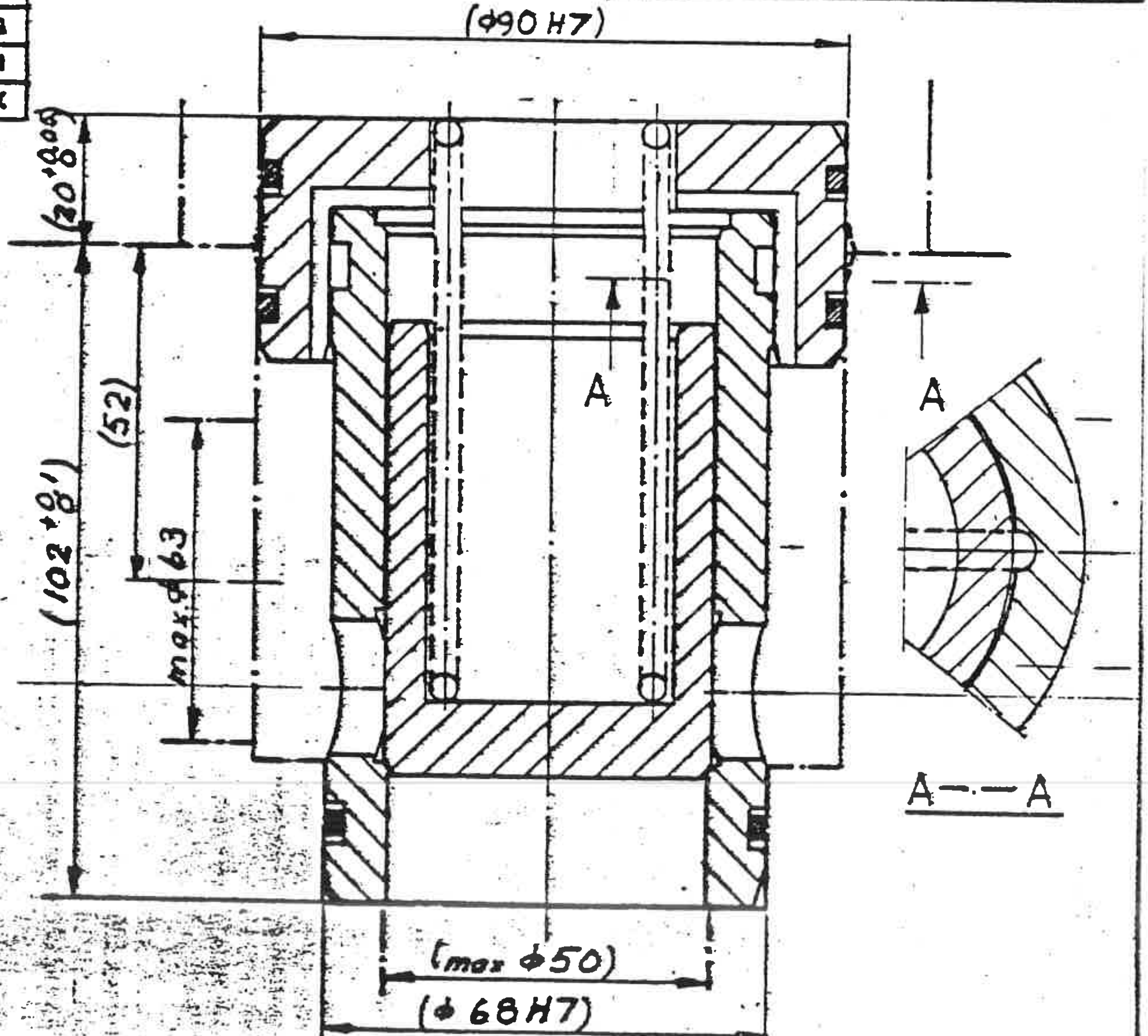
(V4)

40

Utf. Design
A
B
C
D
E
F
G
H
K

Tillåtna måttavvikelser när tolerans ej direkt utsatts på bearbetade detaljer SMS 715 Medel enligt tabell nedan. För rundningsradier, fasor och vinkelmått följs SMS 715 Medel enligt separat standardblad.
Machining tolerances for linear dimensions unless otherwise specified.

Basmått Basic size	Måttavvikelser Tolerances	Basmått Basic size	Måttavvikelser Tolerances
— 3	±0,1	(1000)— 2000	±1,2
(3)— 6	±0,1	(2000)— 4000	±2
(6)— 30	±0,2	(4000)— 8000	±3
(30)— 120	±0,3	(8000)—12000	±4
(120)— 315	±0,5	(12000)—16000	±5
(315)—1000	±0,8	(16000)—20000	±6



Detalj nr Item No.	Ant. No. off	Benämning Description	Färdig dimension Finished dimension	Referens Reference	Material Material	Modellnr Patt. No.	Ämnesdim. Blank size

Ant. No. off sats | Anläggning Plant | Best. nr/Ml. el. Prod.nr Order No./MI. or Prod. No.

Ytjämnhet enligt SMS 672 Ra μm / Surface texture ISO/R 1302 Ra μm ✓ ✓ ✓

Utförd av Drawn: Hh | Kontr. Checked

KAMEWA

KaMeWa-propeller
Pressure reg. valve (V5)
Tryckuppehållningsventil (V5)
TOWLER
C1CA E50/0 S00 x 524 1,5 Bar

Skala Scale: 1:1 | Översiktsritn. Master drg.

Föreg. ritn. Previous drg.: 908785 | Tillk. ritn. Future drg.

Datum Date: 821129 | Ang. | AM/S02

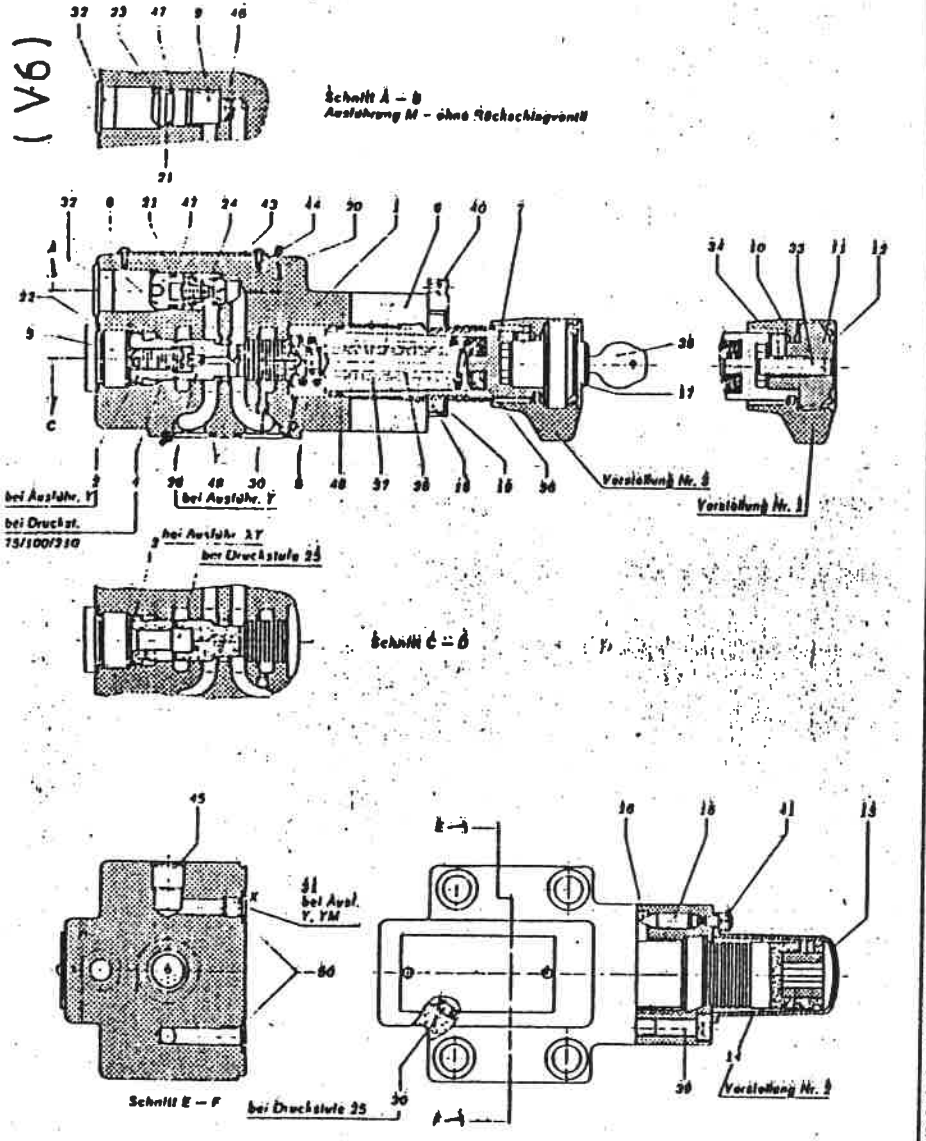
908841 | Utf. Design | Ändr. Chang.

REXROTH
HYDRONORMA
Positionierung

Direktgesteuertes Druckreduzierventil
Typ DR 10 D
Ersatzteilliste

RD 26582 – E

Druckausgabe: 10.79



Pos	Benennung		Teile-Nr
1	Gehäuse		–
2	Kolben		–
3	Verschlußschraube M22x1,5	DIN 908	003 570
4	Kolben		124 620
5	Federteller		122 285
6	Flansch		124 621
7	Pinole		120 722
8	Büchse		131 212
9	Stapfen		131 213
10	Drehknopf		122 287
11	Mitnehmer		120 727
12	Kappe		120 721
13	Mitnehmer		123 699
14	Kappe		120 719
15	Schraube		124 534
16	Keil		120 728
17	Schloß		122 293
18	Führung		120 725
19	Kappe		122 760
20	Kegel		122 338
21	Stellring 11x14x6,5		008 526
22	Dichtring A 22x27	DIN 7603	004 643
23	Kerbstift 3x30	DIN 1473	005 054
24	Druckfeder 10/0,8x41,3/3	DIN	006 678
28	Düse		006 113
30	Gewindestift M4x5	DIN 551	003 683
31	Verschlußschraube M8x1	DIN 908	003 443
32	Verschlußstapfen		005 213
33	Gewindestift M6x30	DIN 913	007 476
34	Zylinderstift 6x10	DIN 7	007 474
35	Schlüssel		006 980
36	Paßscheibe 7x20x1		007 012
36	Paßscheibe 7x20x0,5		007 013
36	Paßscheibe 7x20x0,1		007 014
37	Druckfeder 16/1,2x68/9	DIN 2076	007 145
37	Druckfeder 16,5/1,6x68/10	DIN 2076	007 008
38	Druckfeder 9/2,25x65/18	DIN 2076	007 007
39	Zylinderschraube M6x35	DIN 912	003 025
40	Zylinderschraube M4x10	DIN 912	003 001
41	Kreuztochschraube M3x8	DIN 404	007 481
43	Typenschild DIN 176 17		–
44	Halbrundniet Ø3x8	DIN 1476	005 106
45	Verschlußschraube A 1/4"	DIN 908	003 455
46	O-Ring 3x1,5	Perbunan	004 240
46	O-Ring 3x1,5	Viton	004 443
47	O-Ring 10x2	Perbunan	004 250
47	O-Ring 10x2	Viton	004 446
48	O-Ring 24x3	Perbunan	007 475
48	O-Ring 24x3	Viton	007 480
49	O-Ring 16x3	Perbunan	004 270
49	O-Ring 16x3	Viton	006 763
50	O-Ring 8,3x2,4	Perbunan	004 247
50	O-Ring 8,3x2,4	Viton	006 762

	DR 10 DP1-10/ 25 Y	DR 10 DP1-10/ 75 Y	DR 10 DP1-10/150 Y	DR 10 DP1-10/210 Y	DR 10 DP2-10/ 25 Y	DR 10 DP2-10/ 75 Y	DR 10 DP2-10/150 Y	DR 10 DP2-10/210 Y	DR 10 DP3-10/ 25 Y	DR 10 DP3-10/ 75 Y	DR 10 DP3-10/150 Y	DR 10 DP3-10/210 Y	DR 10 DP1-10/ 25 XY	DR 10 DP1-10/ 75 XY	DR 10 DP1-10/150 XY	DR 10 DP1-10/210 XY	DR 10 DP2-10/ 25 XY	DR 10 DP2-10/ 75 XY	DR 10 DP2-10/150 XY	DR 10 DP2-10/210 XY	DR 10 DP3-10/ 25 XY	DR 10 DP3-10/ 75 XY	DR 10 DP3-10/150 XY	DR 10 DP3-10/210 XY	DR 10 DP1-10/ 25 YM	DR 10 DP1-10/ 75 YM	DR 10 DP1-10/150 YM	DR 10 DP1-10/210 YM	DR 10 DP2-10/ 25 YM	DR 10 DP2-10/ 75 YM	DR 10 DP2-10/150 YM	DR 10 DP2-10/210 YM	DR 10 DP3-10/ 25 YM	DR 10 DP3-10/ 75 YM	DR 10 DP3-10/150 YM	DR 10 DP3-10/210 YM
													wird nicht als Ersatzteil geliefert																							
													wird nicht als Ersatzteil geliefert																							
3	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
4	–	1	1	1	–	1	1	1	–	1	1	1	–	1	1	1	–	1	1	1	–	1	1	1	–	1	1	1	–	1	1	1	–	1	1	1
5	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
6	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
7	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
8	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
9	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
10	1	1	1	1	–	–	–	–	1	1	1	1	1	1	1	1	–	–	–	–	1	1	1	1	1	1	1	1	–	–	–	–	1	1	1	1
11	1	1	1	1	–	–	–	–	1	1	1	1	1	1	1	1	–	–	–	–	1	1	1	1	1	1	1	1	–	–	–	–	1	1	1	1
12	1	1	1	1	–	–	–	–	1	1	1	1	1	1	1	1	–	–	–	–	1	1	1	1	1	1	1	1	–	–	–	–	1	1	1	1
13	–	–	–	–	1	1	1	1	–	–	–	–	–	–	–	–	1	1	1	1	–	–	–	–	–	–	–	–	1	1	1	1	–	–	–	–
14	–	–	–	–	1	1	1	1	–	–	–	–	–	–	–	–	1	1	1	1	–	–	–	–	–	–	–	–	1	1	1	1	–	–	–	–
15	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
16	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
17	–	–	–	–	1	1	1	1	–	–	–	–	–	–	–	–	1	1	1	1	–	–	–	–	–	–	–	–	1	1	1	1	–	–	–	–
18	–	–	–	–	1	1	1	1	–	–	–	–	–	–	–	–	1	1	1	1	–	–	–	–	–	–	–	–	1	1	1	1	–	–	–	–
19	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
20	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
21	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
22	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
23	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
24	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
28	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
30	2	1	1	1	2	1	1	1	2	1	1	1	2	1	1	1	2	1	1	1	2	1	1	1	2	1	1	1	2	1	1	1	2	1	1	1
31	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
32	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
33	1	1	1	1	–	–	–	–	1	1	1	1	1	1	1	1	–	–	–	–	1	1	1	1	1	1	1	1	–	–	–	–	1	1	1	1
34	1	1	1	1	–	–	–	–	1	1	1	1	1	1	1	1	–	–	–	–	1	1	1	1	1	1	1	1	–	–	–	–	1	1	1	1
35	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
36	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
36	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
36	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
37	1	–	–	–	1	–	–	–	1	–	–	–	1	–	–	–	1	–	–	–	1	–	–	–	1	–	–	–	1	–	–	–	1	–	–	–
37	1	–	1	1	1	–	1	1	1	–	1	1	1	–	1	1	1	–	1	1	1	–	1	1	1	–	1	1	1	–	1	1	1	–	1	1
38	–	–	1	–	–	–	1	–	–	–	1	–	–	–	1	–	–	–	1	–	–	–	1	–	–	–	1	–	–	–	1	–	–	–	1	–
39	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
40	–	–	–	–	–	–	–	–	2	2	2	2	–	–	–	–	–	–	–	–	2	2	2	2	–	–	–	–	–	–	–	–	2	2	2	2
41	–	–	–	–	1	1	1	1	–	–	–	–	–	–	–	–	1	1	1	1	–	–	–	–	–	–	–	–	1	1	1	1	–	–	–	–
43	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
44	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
45	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
46	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
46	–	1	1	1	–	1	1	1	–	1	1	1	–	1	1	1	–	1	1	1	–	1	1	1	–	1	1	1	–	1	1	1	–	1	1	1
47	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
47	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
48	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
48	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
49	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
49	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
50	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
50	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1

Bestellbeispiel: Typ DR 10 DP 3 – 10/75 Y
1 Drehknopf Pos. 10
Teile-Nr. 122 287

(Bei Bestellung immer komplette Typenbezeichnung des Gerätes angeben!)

Nachdruck verboten – Änderungen vorbehalten

Postfach 340 · D 8770 · G·L· ROTH·G·M·B·H·LOHR AM MA (BRD) Telefon 161 · Telex 06-89 418

Wandfluh
3714 Frutigen
Schweiz

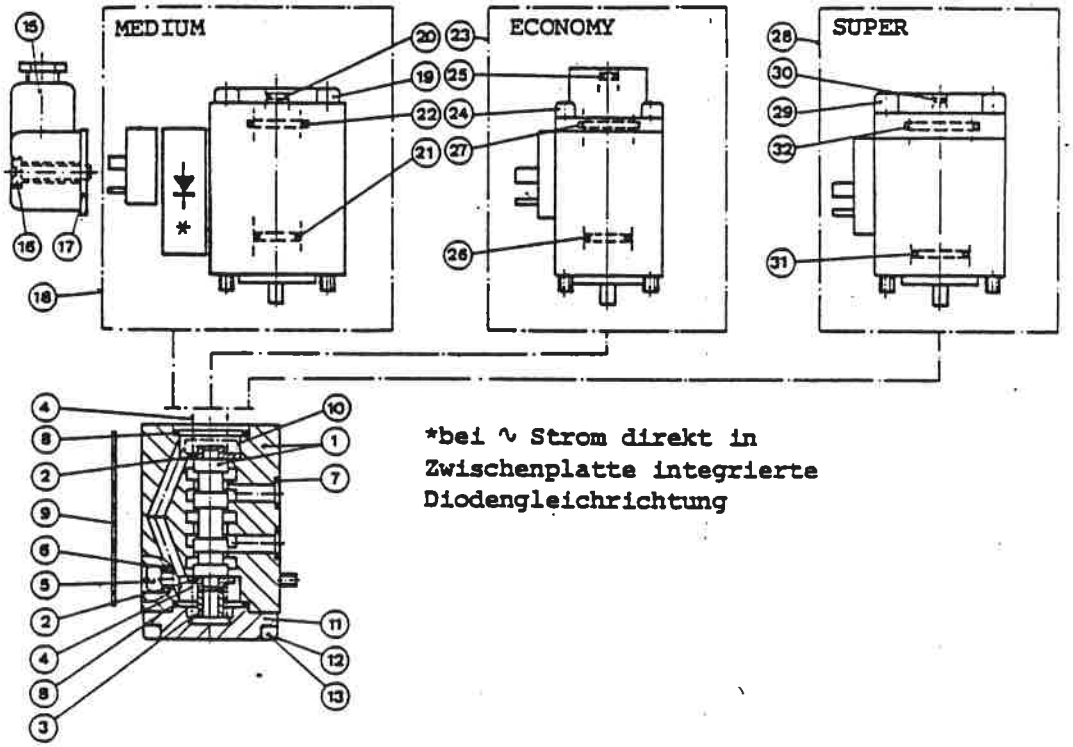
Magnetschieber-Ventile
4/2-wege in Impulsausführung
4/3-wege mit federzentr. Mittelstellung
4/2-wege mit Federrückstellung

NG6 ISO

Typenbezeichnung	
ECONOMY	Z,D,J
MEDIUM	Z,D,J
SUPER	Z,D,J

ERSATZTEILLISTE

(V7)



*bei ∿ Strom direkt in Zwischenplatte integrierte Diodengleichrichtung

Position	A.4Z6. M	A.4Z6. E	A.4Z6. S	A.4D6. M	A.4D6. E	A.4D6. S	A.4J6. M	A.4J6. E	A.4J6. S	Gegenstand
1	1	1	1	1	1	1	1	1	1	Ventilkörper und Kolben
2	2	2	2	2	2	2	1	1	1	Scheibe
3	-	-	1	-	-	2	-	-	-	Distanzbüchse (nur bei ∿ Strom)
4	2	2	2	2	2	2	2	2	2	Feder
5	4	4	4	4	4	4	4	4	4	Zyl. Schraube M5x45(DIN912)
6	4	4	4	4	4	4	4	4	4	Distanzhülse
7	4	4	4	4	4	4	4	4	4	O-Ring di 9,25x1,78(PRP012)
8	2	2	2	2	2	2	2	2	2	O-Ring di 23,52x1,78 (PRP021)
9	1	1	1	1	1	1	1	1	1	Typenschild
10	-	-	-	-	-	-	1	1	1	Rasterung komplett
11	1	1	1	-	-	-	-	-	-	Deckel
12	-	4	-	-	-	-	-	-	-	Zyl. Schraube M4x10 (DIN912)
13	4	-	4	-	-	-	-	-	-	Zyl. Schraube M5x16 (DIN912)
14	1	1	1	1	1	1	1	1	1	Satz O-Ringe(Pos.7,8) zu Ventilkörper
15	1	1	1	2	2	2	2	2	2	Stecker komplett Gdm209
16	1	1	1	2	2	2	2	2	2	Schlitzschraube
17	1	1	1	2	2	2	2	2	2	Gummidichtung
18	1	-	-	2	-	-	2	-	-	Ersatzmagnet AMII...(inkl.Pos.19)
19	4	-	-	8	-	-	8	-	-	Zyl. Schraube M5x60 (DIN912)
20	1	-	-	2	-	-	2	-	-	O-Ring di 4x1 (Hecker)
21	1	-	-	2	-	-	2	-	-	O-Ring di 14,0x1,78(PRP015)
22	1	-	-	2	-	-	2	-	-	O-Ring di 18,77x1,78(PRP018)
23	-	1	-	-	2	-	-	2	-	Ersatzmagnet SM35...(ohne Pos.24)
24	-	4	-	-	8	-	-	8	-	Zyl. Schraube M4x63 (DIN912)
25	-	1	-	-	2	-	-	2	-	O-Ring di 5x2 (Hecker)
26	-	1	-	-	2	-	-	2	-	O-Ring di 13x1,5 (Hecker)
27	-	1	-	-	2	-	-	2	-	O-Ring di 17x2 (Hecker)
28	-	-	1	-	-	2	-	-	2	Ersatzmagnet SM45...(inkl. Pos.29)
29	-	-	4	-	-	8	-	-	8	Zyl. Schraube M5x65 (DIN912)
30	-	-	1	-	-	2	-	-	2	O-Ring di 2,6x1,2 (Hecker)
31	-	-	1	-	-	2	-	-	2	O-Ring di 16x2 (Hecker)
32	-	-	1	-	-	2	-	-	2	O-Ring di 21x2 (Hecker)

BESTELLSCHLUESSEL

a) Massblatt-Nr.
b) Position und Stückzah
c) Ventiltyp,Spannung und Stromart

BESTELLBEISPIEL

2 Scheiben,2 Federn und
1 Satz O-Ringe zu Wandfl
Medium,NG6,24V Gleichstr
Typ AM4Z60a-24V=

BESTELLANGABE

a) 1-145/4
b) 2 Stück Pos.2
   2 Stück Pos.4
   1 Stück Pos.14
c) AM4Z60a-24V=

WANDFLUH AG

Präzisionshydraulik
CH-3714 Frutigen 2
Schweiz

Tel. 033 71 13 65
Telex 92 21 30
Telegr.:Hydrowandfluh

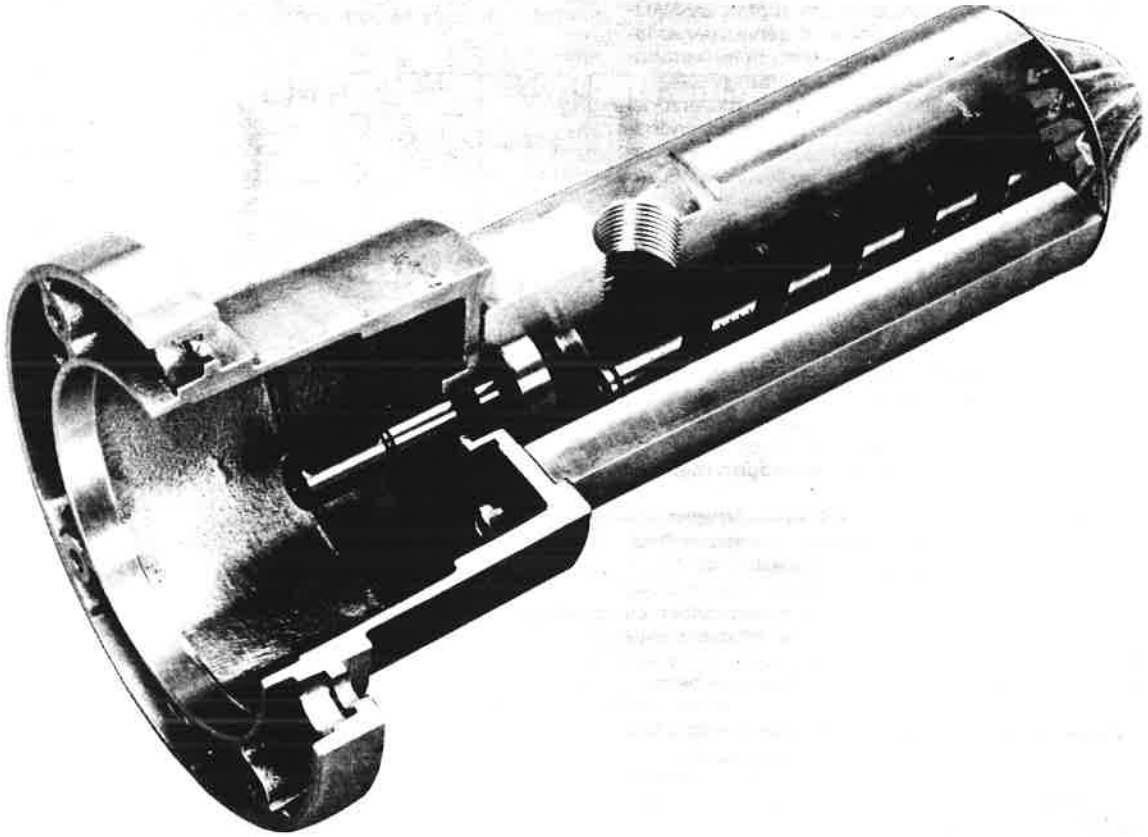
Datum Januar 1981

Massblatt Nr. 1-145/4

Aenderungen vorbehalten

Registraturnummer

1.2-50/4



C.P.P. PUMPS
MODEL E4F038N
SERIAL Nº 276641 # 2
276642 # 1

IMO E4

Installation och skötsel
Instruction Manual
Betriebsanleitung

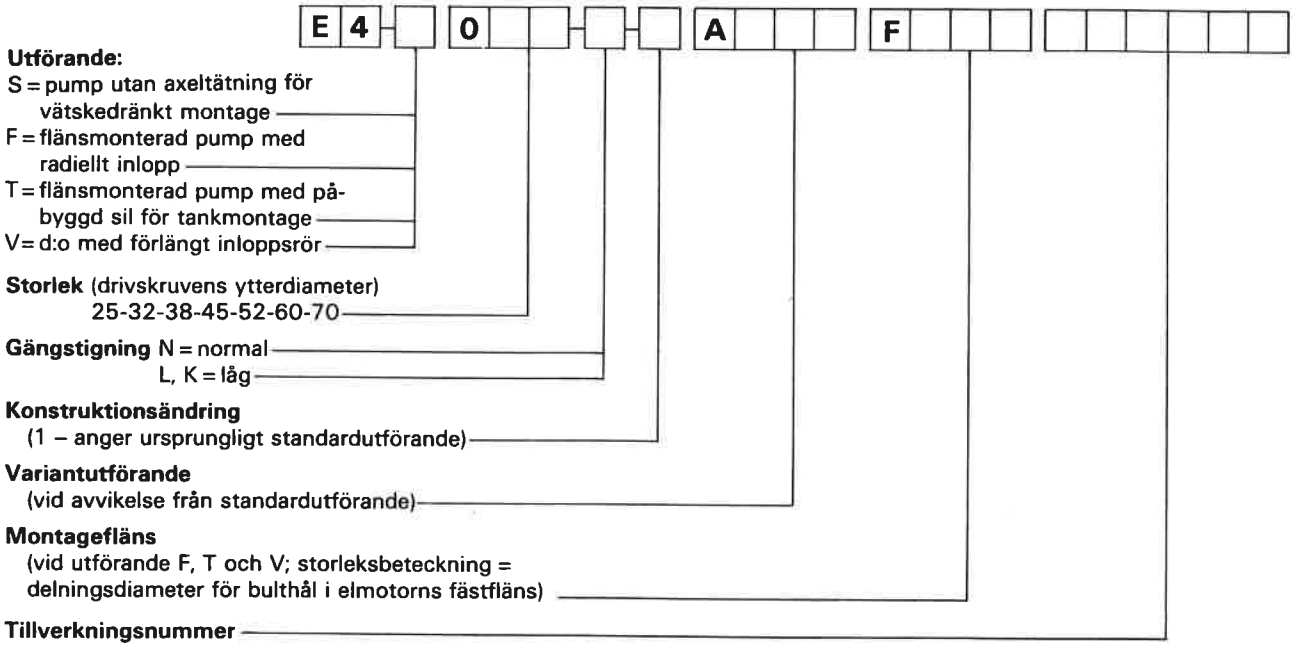
Allmänt

Denna instruktion gäller för följande E4-pumpar i standardutförande: E4S, E4F, E4T och E4V.

E4S – pump med påbyggd inloppssil; utan axeltätning för installation nedsänkt i vätsketanken, sammanbyggd – utan elastisk axelkoppling – med dimensionsanpassad elmotor i vätskedränkt/-kylt utförande.

E4F, E4T, E4V – pump sammanbyggd med ett cirkulärt kopplingshus – för montering via elastisk axelkoppling till torrt uppställd, flänsförsedd elmotor enligt IEC.

Varje pump förses vid tillverkningen med en skylt med följande uppgifter för fullständig identifiering av pumpen enligt



Exempel

E4T038N1 A141 123456 – pump för tankmontage, i storlek 38 med normalstigningsskruvsats, i variantutförande: pump försedd med montagefläns med mått motsvarande IMO pump typ B4T 038 för montering till elmotor via separat motormellanstycke.

Konstruktionsbegränsningar

Tillåtna arbetsdata för E4-pumpen, tryck och temperatur, sammanhänger med viskositet, varvtal, vätska, drivningssätt m.m. Med hänsyn till dessa pumpningsförhållanden kan begränsning av tillåtna arbetsdata vara nödvändiga, vilket framgår av E4-pumpens produktbeskrivning. Under inga förhållanden får nedanstående konstruktionsbegränsningar överskridas:

Max. utloppstryck 7.0 MPa

Inloppstryck

max. undertryck 20 kPa

max. övertryck enligt följande tabell:

	Varvtal				
	24	29	48	58	r/s
Storlek	1450	1750	2900	3500	r/min
025, 032	400	350	200	160	kPa
038 – 070	300	270	140	90	kPa

Pumpningstemperatur max. 90° C
min. 0° C

Installation

Uppställning

E4-pumpen kan monteras i vilket läge som helst. Om möjligt bör dock tillses att rördragningen utformas så att tilloppsledningen tillsammans med pumpen bildar ett vätskelås, dvs. att pumpen vid stillestånd förblir fylld med vätska.

E4-pumpen har god sugförmåga, men allmänt kan sägas att vid en väl utförd installation skall eftersträvas att pumpen får så liten sughöjd som möjligt. Helst bör pumpen monteras så att den arbetar med tillrinning. Tilloppsledningen bör vara kort och rak så att onödiga strömningsförluster ej uppkommer. En vertikal tilloppsledning, som vid stillestånd kan tömmas på vätska, medför att pumpen efter start måste arbeta viss tid innan ledningen åter har fyllts med vätska. Detta kan, om ovannämnda vätskelås saknas och dessutom pumpen måste startas mot tryck, t.ex. om den startar mot en belastad backventil, leda till pumphaveri eller att axeltätningen förstörs på grund av otillräcklig smörjning. Därför finns på pumpen, diametralt mot utloppet, en proppad anslutning (propp nr 463 i Figur 1) för montering av en s.k. startventil med vars hjälp pumpen kan avluftas på trycksidan under start. En backventil i inloppet till tilloppsledningen, som förhindrar att ledningen töms på vätska vid stillestånd, rekommenderas ej då därigenom strömningsförlusterna ökar.

Pumpens kopplingshus har intill motormontageflänsen ett hål för dränering av eventuellt läckage från axeltätningen. Tillse vid horisontell uppställning av pumpaggregatet att denna borrning befinner sig på kopplingshusets lägsta punkt. Uppsamling och återledning av läckaget till tank bör utföras.

Pumpaggregatet med utförande E4F, E4T och E4V skall alltid monteras på stabilt underlag med kraftiga grundbultar och placeras så att pumpen blir lätt åtkomlig för tillsyn. Monte-

Tillsyn under drift

Korrekt vald för sitt driftsfall och igångkörd utan anmärkning kräver E4-pumpen knappast någon tillsyn. Silar och filter i systemet skall rengöras i intervaller som bestäms av erfarenheten. Vid enstaka tillfällen kan det vara skäl att också kontrollera axelkopplingens gummielement beträffande förslitning.

Periodisk tillsyn

Vid anläggningens normala översynstillfällen, varierande mellan 3–5 år, kan det vara lämpligt att byta pumpens axeltätning och kullager.

Felkällor

Följande störningar under igångkörning och under drift är i de flesta fall lätta att avhjälpa:

Fel rotationsriktning

- Vid trefasmotorer omkastas ett par av de elektriska anslutningsledningarna.

Pumpen ger för låg volymström

- Avstängningsventilerna i till- och utloppsledningarna är ej helt öppna.
- Överströmningsventilen är inställd på för lågt tryck.
- Igensatt sil eller annat hinder i tilloppsledningen så att för litet vätska kommer fram till pumpen.

För lågt tryck

- Kontrollera rörsystemets täthet.
- För lågt mottryck i utloppsledningen. Kan eventuellt bero på att pump med för liten volymström valts.
- Överströmningsventilen inställd på för lågt tryck (vid parallelldrift med två eller flera pumpar skall pumparnas överströmningsventiler vara inställda för samma öppningstryck).
- Pumpen försliten.

Drivmotorn har svårt att starta eller visar benägenhet att stanna genom att motorskyddet löser ut.

- För högt mottryck.
- För kall och därigenom mer trögfluten vätska än som avsetts. Om överströmningsventilen inställes för ett lägre tryck minskar effektbehovet på grund av överströmningen genom ventilen. Motorn avlastas därvid och får större möjlighet att undgå överbelastning. Genom överströmningen stiger vätsketemperaturen och därmed blir vätskan mindre trögfluten och överströmningsventilens öppningstryck kan efter hand justeras till normalt värde.
- För svag motor för rådande förhållanden.
- Motorskyddet för lågt inställt.

Pumpen arbetar med bullrande ljud

- Tilloppsledningen för lång eller klen i förhållande till volymström och viskositet.
- Igensatt sil eller stängd ventil i tilloppsledningen.
- För stor sughöjd.
- Luftinläckning genom otätheter i tilloppsledningen.
- Uppriktningsfel mellan pump- och motoraxel.
- Skadad axelkoppling.
- Försliten eller skadad pump.

Läckage vid axeltätningen

- Anledning till läckage i axeltätning kan vara åldrade gummidetaljer eller skadade tätningsytor på grund av förorenad vätska, torrkörning eller uppriktningsfel mellan pump och motor.

Demontering – besiktning – hopsättning

I följande avsnitt anger siffror inom parentes pumpdetaljernas komponentnummer enligt Figur 1 och Figur 2.

Demontering

För fullständig demontering av pumpen rekommenderas följande arbetsföljd:
Instruktionen förutsätter att pumpen demonterats från elmotor eller drivanordning och anslutningsledningar.

1. Avlägsna kopplingshalvan från pumpaxeln efter det att stoppskruven mot kilen lösgjorts. Stoppskruven är åtkomlig genom öppningen (∅ 29 mm) på kopplingshuset (501). OBS! För att underlätta återmontering, notera kopplingshalvans läge på pumpaxeln.
2. Avlägsna kilen från axeltappen.
3. Demontera inloppsdelen (551) och packningen (556), alternativt silen (489), genom att lossa skruvarna (453) respektive (382).
4. Ställ pumpen vertikalt med axeltappen uppåt och låt den stöda mot skruvsatsens/pumphusets bakplan.
5. Lossa skruvarna (451) som håller kopplingshuset (501) till pumpen. Lyft försiktigt av kopplingshuset med axeltätningen (509) så att axeltätningen ej skadas. Demontera axeltätningen (509) ur kopplingshuset – tryck i riktning mot kopplingshusets pumpsida.
6. Spårringen (514) som håller kullagret (122) till pumphuset (401) demonteras varefter drivskruven (102) tillsammans med kullagret och löpskruvarna (202) kan dragas ut ur pumphuset.
7. Kullagret (122) demonteras från drivskruven (102) sedan spårringen (124) och brickan (124A) avlägsnats. Observera att kullagret kan skadas genom slag på lagerringar och kulhållare. Montage/demontagekrafter får aldrig ledas genom rullkropparna. Rengör kullagret med lacknafta.

Besiktning

Först när pumpen demonterats är det möjligt att besiktiga och kontrollera pumpen ordentligt.
Vissa slitagetyper är ibland ej möjliga att upptäcka genom kontrollmätning. Förslitningar som ger upphov till radiella och axiella spel konstateras lättare.

- Axialspelet mellan skruvarna får ej vara större än 0,2 mm.
- Radialspelet skruvar/hölje får ej vara större än 0,2 mm.

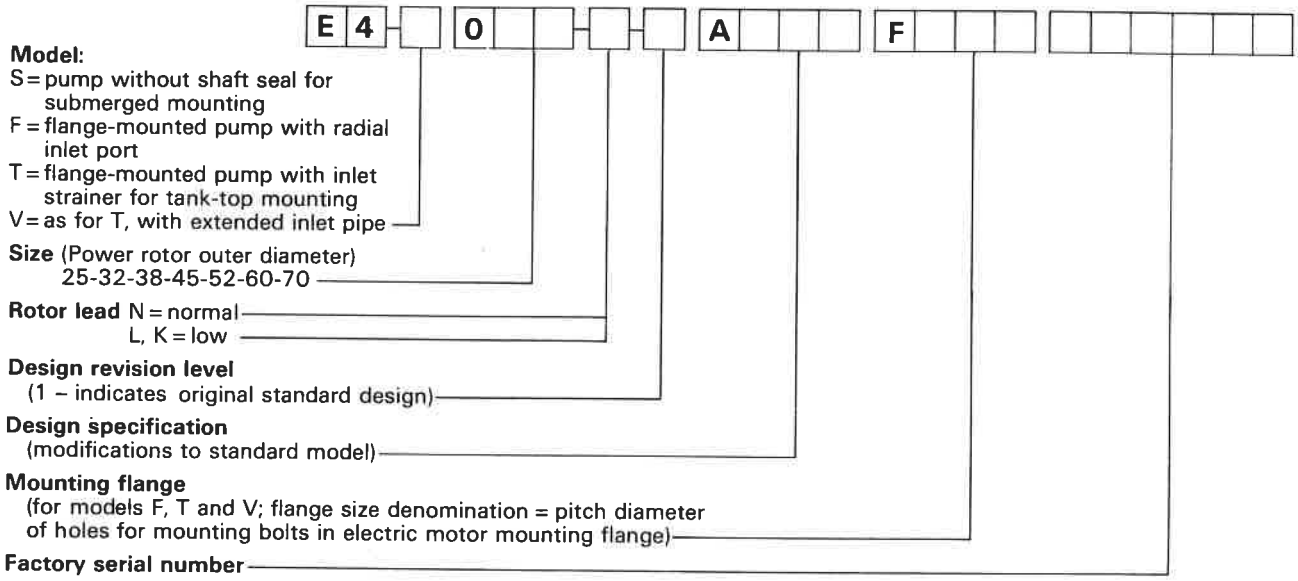
Är pumpen så sliten att den inte längre förmår "hålla trycket" lönar det sig vanligtvis inte att byta ut skruvsatsen eller pumphuset, då förslitning i den ena detaljen ofta givit skador i den andra detaljen. I detta fall rekommenderas utbyte av pumpenheten.
Mindre repor på skruvsats och i hölje kan justeras genom slipning och skavning.
Vid besiktning av skruvsatsen skall speciell uppmärksamhet riktas mot driv- och löpskruvars axiallagerplan, A enligt figur 3. Axeltätningen (509) och planpackningarna (506) och (556) besiktigas noga beträffande förslitning och bytes om så erfordras.

Hopsättning

Vid hopsättning av pumpen rekommenderas omvänd arbetsföljd enligt avsnitt "Demontering".
Kullagret monteras genom att med en skruv (gänga M5 eller M8) i det gängade hålet i axeltappen på drivskruven dra kullagret i läge med hjälp av en monteringshylsa, som ansätts mot lagrets innerring.
Vid montering av skruvsatsen är det viktigt att drivskruv och löpskruvar kommer i samma läge till varandra som tidigare. Därför har drivskruvsgängan på ytterdiametern vid utloppsändan ett filat märke, B enligt fig. 3. Denna märkta drivskruvsgänga skall passa in i de gängspår på löpskruvarna som märkts på motsvarande sätt.
Radialtätningens gummiläpp skadas lätt av vassa kanter och

General

These instructions are valid for the following standard-model E4-pumps: E4S, E4F, E4T and E4V.
E4S pump with built-on inlet strainer; without shaft seal for in reservoir submerged installation, mounted – without flexible shaft coupling – to a dimensionally suited in fluid submerged/by fluid cooled electric motor.
E4F, E4T and E4V – pump with an integral circular coupling casing – for mounting of the pump with a flexible shaft coupling to a free standing flanged IEC electric motor.
Before leaving the factory, each pump is plated with a unique identification code as follows:



Example:
E4T 038N1 A141 123456 – tank-top mounted pump size 38 with normal lead rotors in model variant: pump with a mounting flange, with dimensions corresponding to flange of IMO pump type B4T 038, for assembly with the electric motor via a motor connecting frame.

Limitations on rated performance parameters

Rated performance parameters for the E4 pump, pressure and temperature, are related to viscosity, speed, fluid, type of driver and similar factors. Limitations to performance parameters may be required, depending on these pumping conditions. Such limitations are listed in the E4 pump product description. The following design limitations must be strictly observed in all installations:

Max. discharge pressure 7.0 MPa
Inlet pressure
max. negative pressure 20 kPa
max. positive pressure acc. to following table

Size	Speed 24 1450	29 1750	48 2900	58 3500	r/s r/min
025, 032	400	350	200	160	kPa
038 – 070	300	270	140	90	kPa

Pumping temperature max. 90° C
Min. 0° C

Installation

Pump erection

The E4-pump can be installed in any position. Whereever possible, pipe runs should be configured to ensure that the inlet pipe and pump together form a fluid trap; i.e. when stationary the pump remains filled with fluid.
Although the E4 pump has excellent suction capability, in a correctly configured installation the pump should have as low a suction lift as possible. Preferably, the pump should be installed to operate with flooded inlet. The inlet line should be as short and straight as possible, to prevent unnecessary friction losses. A long vertical inlet line from which the fluid drains away when the pump is stationary means that when the pump is restarted it will have to run for some time before the line is primed with fluid. This situation may, if the pump does not form the above-mentioned fluid trap and must also be started against pressure, for instance if the pump is started against a check valve under load, result in pump failure or failure of the shaft seal as a result of poor lubrication. For this purpose, a plugged port (plug No. 463 in Fig. 1) is fitted on the pump, diametrically opposite the outlet port, for the installation of a starter valve through which the pump is vented during start-up. The installation of a check valve in the inlet to the inlet line to prevent the fluid draining from the line is not recommended, as such action will increase pressure losses.
The pump coupling casing has near its motor mounting flange a drain for possible shaft seal leakage. Make sure in horizontal installations that the drain is on the lowest part of the coupling casing.The leakage should be collected and run back to the tank.
Pump units E4F, E4T and E4V should always be secured to a firm foundation using heavy foundation bolts, with access for inspection and maintenance. Installation on top of a tank can cause vibrations and noise unless the tank design is heavily reinforced.
Pump unit E4S should be secured to a vibration damping foundation isolated from the fluid tank structure. In most cases a solid and heavy unit generates less noise than a lighter unit.

Alignment

Models E4F, E4T and E4V are supplied with a coupling casing whose mounting flange size is suited for the IEC electric motor stated in the order. No special alignment is required for installing the electric motor to this coupling casing as the mounting flange and motor guides will provide sufficient accuracy in the alignment between pump and motor.
Alignment accuracy for model E4S, see section "Shaft coupling".

Flow rate too low
- Shut-off valves in the inlet and discharge pipes are not fully open.
- Bypass valve is adjusted for too low a pressure.
- Clogged strainer or other blockage in the inlet pipe preventing sufficient fluid from reaching the pump.

Pressure too low
- Check pipe system for leaks.
- Too low back pressure in delivery pipe. May be caused by the selection of a pump with insufficient flow rate.
- Bypass valve set for too low a pressure (in installations with two or more pumps operating in parallel, all bypass valves should be set to the same opening pressure).
- Pump worn.

Drive motor is difficult to start or the motor protector tends to trip and stop the motor.
- Excessive back pressure.
- Fluid colder and more viscous than expected. Setting the bypass valve at a lower pressure will reduce the energy consumed in pumping due to overflow. This will take load off the motor and allow a wider margin of safety for overloading caused by the viscosity of the fluid. Due to the overflow the fluid temperature will rise resulting in a less viscous fluid. Reset the bypass valve to normal pressure when the fluid becomes less viscous.
- Motor under-dimensioned for the prevailing conditions.
- Motor protector set to trip too early.

Pump running noisily
- Inlet pipe too long or too small in relation to flow rate and fluid viscosity.
- Strainer clogged or valve closed in inlet pipe.
- Suction lift too high.
- Air entering the system through leaks in the inlet pipe.
- Poor alignment between pump and motor shafts.
- Damaged shaft coupling.
- Worn or damaged pump.

Leakage at shaft seal
- Leakage at the shaft seal may be caused by aged rubber components or damage to sealing surfaces caused by impurities in the fluid or by dry running, or poor alignment of pump and motor.

Disassembly – Inspection – Assembly

The numbers in brackets in the following section refer to the component numbers of pump parts as illustrated in Fig. 1 and Fig. 2.

Disassembly

The following sequence is recommended when disassembling the pump. The instruction presumes that the pump has been separated from its drive motor and inlet/ delivery pipes.

1. Remove coupling half from pump shaft after losening key locking screw. Locking screw is accessible through the opening (dia. 29 mm) on the coupling casing (501). Before removal: mark position of coupling half on pump shaft.
2. Remove key from pump shaft.
3. Remove inlet chamber (551) and joint (556), or strainer (489), by backing off screws (453) or (382).
4. Position pump vertically with shaft pointing upwards and resting on the rear end of the rotor set/pump casing.
5. Back off screws (451) securing coupling casing (501) to pump casing (401). Withdraw carefully the coupling casing with the shaft seal (509) from pump casing (401) without damaging the shaft seal. Remove shaft seal (509) from coupling casing – push in direction towards pump mounting flange.
6. Remove ball bearing retaining ring (514) and withdraw power rotor (102), with ball bearing (122), and idler rotors (202) from the pump casing.
7. Remove ball bearing retaining ring (124) and washer (124A) and withdraw ball bearing (122) from power rotor. Do not damage ball bearing by knocking on the ball races or the ball retainer. Forces used to mount or remove the ball bearing must not be led through the balls. Clean the ball bearing using white spirit.

Inspection

Proper inspection and checks can only be carried out on the pump when it is disassembled. Some types of wear are frequently impossible to detect by measuring. Wear resulting in radial and axial run-out is easier to detect.

- Axial play between rotors should not exceed 0.2 mm.
- The radial play between rotor/ casing should not exceed 0.2 mm.

If the pump is worn to such an extent that it is no longer able to maintain the pressure, it is not normally worthwhile replacing the screw set or casing, as wear on one part has often damaged the other. Replacement of the pump unit is recommended in such cases.
Small scratches on the screw set and casing can be adjusted by grinding and scraping.
When inspecting the rotor set: carefully check condition of the rotor axial thrust bearing surfaces – A in Fig. 3. Check shaft seal (509) and joints (506) and (556) carefully for signs of wear and replace where necessary.

Assembly

Reverse the procedure described under "Disassembly" above for assembling the pump. Before assembly clean all components.
For mounting ball bearing (122) on the power rotor use a hollow tube pressing on the inner race. A suitably long screw (thread M5 or M8) with a nut and a washer – to act on the hollow tube – mounted in the power rotor shaft end may be used to press the ball bearing into position.
When installing the screw set, it is important that the power rotor and idler rotors are refitted in the same relative positions. For this purpose, a nick has been filed on the power rotor thread on the outer diameter at the discharge end – B in Fig. 3. This marked power rotor thread should be fitted into the female thread on the idler rotors marked in the same manner.
The use of tape on the power rotor keyway is recommended to prevent damage to the lip of the shaft seal when mounting the coupling casing (501) with the shaft seal to the pump. Also use tape to achieve a smooth transition at the collar for the shaft coupling. The seal will glide more smoothly onto the shaft, if the latter is oiled.

Shaft seal

When replacing and/ or inspecting the shaft seal, the sequence according to items 1 – 5 of section "Disassembly" is recommended.

Reference torques

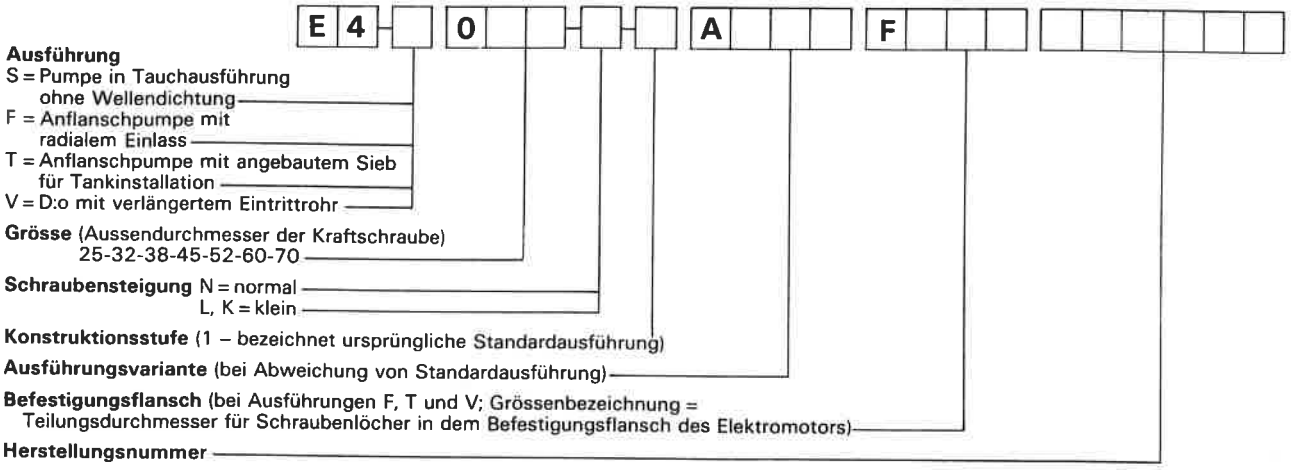
Please refer to the torques listed below for tightening screws in the E4 pump and screws for mounting of the SAE counter flange to ensure a reliable joint.

Torque Nm	Pump size 025	032	038	045	052	060	070
Screw 382*	Do not overtorque and damage strainer (489)						
Screw 451	20	20	20	20	20	20	20
Screw 453*	8.3	8.3	8.3	20	20	40	40
Screw 455	8.3	8.3	8.3	20	20	40	40
Screws** for SAE counter-flange:							
Outlet	–	–	–	–	–	55	55
Inlet	–	–	–	–	69	168	168

* To be locked with Loctite Nutlock Type 242. For screw (453) on pump E4V only.
** For screws in material and with lengths according to the E4 pump product description.

Allgemeines

Diese Anleitung gilt für folgende E4-Pumpen in Standardausführung: E4S, E4F, E4T und E4V.
E4S – Pumpe mit angebautem Eintrittsieb; ohne Wellendichtung für Installation direkt im Fördermedium, zusammengebaut – ohne elastische Wellenkupplung – mit dimensionsangepasstem Elektromotor in Medium installierter und gekühlter Ausführung.
E4F, E4T und E4V – Pumpe mit einem runden Kupplungsgehäuse zusammengebaut – für Montage mit elastische Wellenkupplung an einen freien aufgestellten, elektrischen Flanschmotor gemäss IEC.
Jede Pumpe wird bei der Herstellung mit einem Schild versehen, das Angaben für eine vollständige Identifikation enthält, und zwar:



Beispiel
E4F 038N1 A141 123456 – Pumpe für Tankmontage, in Grösse 38 mit Normalsteigungsschraubensatz, in Variantenausführung: Pumpe mit Montageflansch mit Massen entsprechend IMO Pumpe Typ B4T 038 für Montage an Elektromotor via separate Motorlaterne.

Konstruktionsbegrenzungen

Zulässige Betriebsdaten für die E4-Pumpe, Druck und Temperatur, sind abhängig von Viskosität, Drehzahl, Fördermedium, Antriebsart usw. Mit Rücksicht auf diese Pumpenverhältnisse können Begrenzungen der zulässigen Betriebsdaten notwendig sein, was aus der Produktbeschreibung der E4-Pumpe hervorgeht. Unter allen Umständen müssen nachstehende Konstruktionsbegrenzungen sorgfältig beachtet werden:

Max. Arbeitsdruck 7.0 MPa
Zulaufdruck
max. Unterdruck 20 kPa
max. Ueberdruck laut folgender Aufstellung:

	Drehzahl				
	24	29	48	58	r/s
Grösse	1450	1750	2900	3500	r/min
025, 032	400	350	200	160	kPa
038 – 070	300	270	140	90	kPa

Fördertemperatur max. 90° C
min. 0° C

Installation

Aufstellung

Die E4-Pumpe kann in jeder beliebigen Stellung installiert werden. Bei der Rohrverlegung ist jedoch nach Möglichkeit darauf zu achten, dass die Zulaufleitung zusammen mit der Pumpe einen Flüssigkeitsverschluss bildet, d.h. dass sie bei Stillstand mit Flüssigkeit gefüllt bleibt.
Die E4-Pumpe besitzt gute Saugfähigkeit, aber allgemein gilt trotzdem, dass bei einer sorgfältig durchgeführten Installation eine möglichst geringe Saughöhe für die Pumpe anzustreben ist. Nach Möglichkeit sollte die Pumpe mit Zulauf installiert werden. Die Zulaufleitung ist möglichst kurz und gerade auszuführen, um unnötige Strömungsverluste zu vermeiden. Eine senkrechte Zulaufleitung, die bei Stillstand von Flüssigkeit entleert wird, führt mit sich, dass die Pumpe nach dem Anfahren eine gewisse Zeit arbeiten muss, bevor die Leitung erneut mit Flüssigkeit gefüllt ist. Dies kann, wenn die Pumpe nicht den obengenannten Flüssigkeitsverschluss bildet und ausserdem gegen Druck angefahren werden muss, z.B. beim Anfahren gegen ein belastetes Rückschlagventil, zur Pumpenhavarie oder zu beschädigter Wellendichtung aufgrund Schmierungsmangel führen. Deshalb hat die Pumpe, diametral zum Austrittsanschluss, einen verschlossenen Anschluss (Verschlussschrauben Nr. 463 in Abb. 1) zum Anbau eines sog. Startventils, mit dessen Hilfe die Pumpe während dem Anfahren auf der Druckseite entlüftet werden kann. Ein Rückschlagventil im Eintritt der Zulaufleitung, das ein Entleeren der Leitung von Flüssigkeit verhindert, wird jedoch nicht empfohlen, da dieses zu einer Erhöhung der Strömungsverluste führt.
Das Kupplungsgehäuse der Pumpe hat beim Motorbefestigungsflansch eine Bohrung für Drainage einer eventuellen Leckage der Wellendichtung. Bei horizontaler Aufstellung des Pumpenaggregates soll darauf geachtet werden, dass diese Bohrung auf dem niedrigsten Punkt des Kupplungsgehäuses placiert ist. Auflesen und Rückleitung der Läckage zum Tank soll ausgeführt werden.
Pumpenaggregate der Ausführungen E4F, E4T und E4V müssen immer auf einer stabilen Unterlage mit kräftigen Grundschrauben verankert und so aufgestellt werden, dass die Pumpe für Wartungszwecke gut zugänglich ist. Eine Installation auf einer Tankoberseite kann Vibrationen und störenden Lärm verursachen falls die Tankoberseite nicht kräftig verstärkt worden ist.
Pumpenaggregate der Ausführung E4S sollen auf eine vibrationsdämpfende Unterlage, und vom Tank isoliert montiert werden, um Vibrationsgeräusche zu vermeiden. Ein kompaktes schwereres Aggregat verursacht in dem meisten Fällen weniger Geräusch als ein kleineres Aggregat.

Ausrichten

In den Ausführungen E4F, E4T und E4V wird die E4-Pumpe mit einem Kupplungsgehäuse, dessen Befestigungsflansch zu dem in der Bestellung angegebenen Elektromotor angepasst ist. Bei Montage des Motors zu diesem Befestigungsflansch ist keine besondere Ausrichtung der Pumpe notwendig, da die Zentrierkanten des Kupplungsgehäuses und des Motors erforderliche Genauigkeit der Ausrichtung zwischen Pumpe und Motor gewährleisten.
Die Forderungen an dem Ausrichten bei Ausführung E4S, siehe Abschnitt "Wellenkupplung".
Wo die E4-Pumpe mit Vorderdeckel (Variantenausführungen A140 und A141 – für Montage an separate Motorlaterne) statt dem obengenannten Kupplungsgehäuse geliefert wird – gelten folgende Forderungen bezüglich entgegengesetzten Montageflächen.
Radialschlag max. 0,2 mm
Parallellitätsabweichung max. 0,1 mm

Eine maximale Lebenslänge der Pumpe setzt eine korrekte Ausrichtung voraus.

Wellenkupplung

Bei direktem Ankuppeln an einen Antriebsmotor der Pumpenausführungen E4F, E4T und E4V muss immer eine elastische Wellenkupplung verwendet werden. Diese Wellenkupplung muss die Fähigkeit besitzen, während des Betriebes sowohl axiale als auch radiale Bewegungen aufzunehmen. Zulässiges Axialspiel zwischen den Kupplungshälften 1 – 3 mm. Die pumpenseitige Kupplungs-

strömung durch das Ventil. Hierdurch wird der Motor entlastet und hat grössere Möglichkeit, Überlastung aufgrund des zähflüssigen Öles zu vermeiden. Die Temperatur steigt durch die Überströmung und die Flüssigkeit wird dadurch dünnflüssiger. Der Öffnungsdruck des Überströmventils kann dann schrittweise auf Normalwert eingestellt werden.

- Der Motor ist für die vorherrschenden Verhältnisse unterbemessen.
- Der Motorschutzschalter ist auf einen zu niedrigen Wert eingestellt.

Starker Lärm von der Pumpe

- Zu lange oder unterbemessene Zulaufleitung im Verhältnis zu Fördermenge und Viskosität.
- Verstopftes Sieb oder geschlossenes Ventil in der Zulaufleitung.
- Zu grosse Saughöhe.
- Luft dringt durch Undichtigkeiten in der Zulaufleitung ein.
- Fehlerhafte Ausrichtung zwischen Pumpen- und Motorwellen.
- Schadhafte Wellenkupplung.
- Verschlissene oder schadhafte Pumpe.

Undichtigkeit an der Wellendichtung

- Undichtigkeit an der Wellendichtung kann in gealterten Gummiteilen, schadhaften Dichtflächen aufgrund verunreinigten Fördermediums oder Trockenlauf, oder Ausrichtungsfehler zwischen Pumpe und Motor zu suchen sein.

Zerlegen – Kontrolle – Zusammenbau

Eingeklammerte Ziffern im folgenden Abschnitt bezeichnen die Positionsnummern der Pumpenteile gemäss Abb. 1 und Abb. 2.

Demontage

Für vollständige Demontage der Pumpe wird nachstehende Reihenfolge empfohlen:
Die Instruktion setzt voraus, dass die Pumpe vom Elektromotor oder von der Treibanordnung und Anschlussleitungen demontiert wird.

1. Kupplungshälfte von der Pumpenwelle entfernen, nachdem die Stopfschraube bei der Passfeder gelöst worden ist. Die Stopfschraube kann durch die Öffnung (∅ 29 mm) am Kupplungsgehäuse (501) erreicht werden. OBS! Um Zusammenbau zu erleichtern, bitte die Lage der Kupplungshälfte an der Pumpenwelle beachten.
2. Passfeder von Wellenzapfen entfernen.
3. Zulaufkammer (551) mit Dichtung (556) bzw. Sieb (489) durch Lösen der Schrauben (453) bzw. (382) demontieren.
4. Pumpe senkrecht mit Wellenzapfen nach oben aufstellen und auf Hinterfläche des Schraubensatzes/Pumpengehäuses stützen.
5. Die Schrauben (451) die das Kupplungsgehäuse (501) an der Pumpe befestigen, lösen. Das Kupplungsgehäuse mit der Wellendichtung (509) vorsichtig heben, so dass die Wellendichtung nicht beschädigt wird. Radialdichtung (509) aus dem Kupplungsgehäuse demontieren – in Richtung der Pumpenseite des Kupplungsgehäuses drücken.
6. Spurring (514), der das Kugellager (122) am Pumpengehäuse (401) hält, demontieren, wonach die Kraftschraube (102) zusammen mit Kugellager und Seitenrotoren (202) aus dem Pumpengehäuse entfernt werden können.
7. Kugellager (122) von der Kraftschraube (102) demontieren, nachdem Spurring (124) und Scheibe (124A) demontiert worden sind. Bitte bemerken dass das Kugellager durch Schläge auf Lagerringe und Kugelhälter beschädigt werden kann. Montage/Demontagekräfte dürfen nie durch die Rollkörper geleitet werden. Kugellager mit Lackbenzin reinigen.

Sichtprüfung und Kontrolle

Eine Sichtprüfung und Kontrolle der einzelnen Teile ist erst nach vollständigem Zerlegen der Pumpe möglich. Bestimmte Verschleissarten lassen sich nicht immer durch eine Kontrollmessung entdecken, während Verschleisserscheinigungen, die ein radiales oder axiales Spiel verursachen, leichter festgestellt werden können.

- Das Axialspiel zwischen den Rotoren darf nicht mehr als 0,2 mm betragen.
- Das Radialspiel zwischen Rotoren und Gehäuse darf nicht mehr als 0,2 mm betragen.

Wenn die Pumpe so stark verschlissen ist, dass sie nicht länger den Druck halten kann, ist es normalerweise nicht sinnvoll, lediglich den Rotorensatz oder das Pumpengehäuse zu erneuern, da der Verschleiss des einen Teil meistens auch einen Verschleiss des anderen Teil hervorgerufen hat. In solchen Fällen empfiehlt sich ein Erneuern der gesamten Pumpeneinheit.
Mässige Reifen in Rotorensatz und Gehäuse können durch Schleifen oder Schaben beseitigt werden.
Bei Besichtigung des Schraubensatzes soll besondere Aufmerksamkeit auf das Axiallagerplan der Kraftschraube und der Seitenrotoren, A laut Abb. 3, gerichtet werden. Radialdichtung (509) und Dichtungen (506) und (556) sorgfältig kontrollieren und ggf. erneuern.

Zusammenbau

Der Zusammenbau der Pumpe ist gegenüber der Beschreibung im Abschnitt "Zerlegen" in umgekehrter Reihenfolge vorzunehmen.
Für die Montage des Kugellagers (122) auf die Kraftschraube soll eine Montagehülse verwendet werden die gegen den inneren Kugellagerring drückt. Eine genügend lange Schraube (Gewinde M5 oder M8) mit Mutter und Scheibe – auf die Montagehülse wirkend – am Wellenende der Kraftschraube montiert, soll für das Aufpressen des Kugellagers verwendet werden.
Beim Einbau des Rotorensatzes unbedingt darauf achten, dass Kraftschraube und Seitenrotoren die gleiche Einbaulage zueinander erhalten, wie vor dem Ausbau. Deshalb ist das Gewinde der Kraftschraube am auslaufseitigen Aussendurchmesser mit einer Feilkerbe, B laut Abb. 3, versehen. Dieses Gewinde muss mit den entsprechend gekennzeichneten Gewinde der Seitenrotoren in Eingriff kommen.
Die Gummilippe der Radialdichtung wird leicht von scharfen Kanten und Flächen beschädigt. Um die Wellendichtung bei der Montage zu schützen wird empfohlen, vor der Montage des Kupplungsgehäuses mit Wellendichtung, die Passfedernut der Kraftschraubenwelle mit Klebeband abzudecken und am Bund für die Wellenkupplung einen glatten Übergang mit Klebeband herstellen. Durch Einölen der Welle kann die Dichtung besser gleiten.

Wellendichtung

Beim Austausch und/ oder Besichtigung der Wellendichtung wird eine Reihenfolge laut Punkten 1 – 5 im Abschnitt "Zerlegen" empfohlen.

Anzugsmomente

Bei den E4-Pumpen müssen nachstehende Schrauben und Schrauben für Montage der SAE Gegenflansche der Pumpenanschlüsse mit dem angegebenen Drehmoment angezogen werden, damit eine lösungssichere Verbindung gewährleistet ist.

Anzugsmoment Nm	Pumpengrösse 025	032	038	045	052	060	070
Schraube 382*	Anziehen, ohne Sieb (489) zu verformen.						
Schraube 451	20	20	40	20	20	20	20
Schraube 453*	8.3	8.3	8.3	20	20	40	40
Schraube 455	8.3	8.3	8.3	20	20	40	40
Schrauben** für SAE Gegenflansch:							
Austritt	–	–	–	–	–	55	55
Eintritt	–	–	–	–	69	168	168

* Mit Loctite Typ 242 auf Gewinde sichern. Gilt Schraube (453) nur bei Ausführung E4V.
** Gilt für Schrauben aus Materialen und mit Längen laut Produktinformation der E4-Pumpe.

Detaljlista

Nr.	Benämning
102	Drivskruv
122	Kullager
	Spårring
+A	Stödring
J2	Löpskruv
382	Skruv
401	Pumphus
451	Skruv
451A	Bricka
453	Skruv
453A	Bricka
455	Skruv
463	Propp
463A	T-ring
489	Sil
489A	Distansring
491	Mutter
501	Kopplingshus
506	Packning
509	Axeltätning
514	Spårring
551	Inloppsdel
556	Packning

Parts List

No.	Denomination
102	Power rotor
122	Ball bearing
124	Retaining ring
124A	Back-up ring
202	Idler rotor
382	Screw
401	Pump casing
451	Screw
451A	Washer
453	Screw
453A	Washer
455	Screw
463	Plug
463A	T-ring
489	Strainer
489A	Distance ring
491	Nut
501	Coupling casing
506	Joint
509	Shaft seal
514	Retaining ring
551	Inlet chamber
556	Joint

Teilliste

Nr.	Bezeichnung
102	Kraftschraube
122	Kugellager
124	Sicherungsring
124A	Stützscheibe
202	Seitenrotor
382	Schraube
401	Pumpengehäuse
451	Schraube
451A	Scheibe
453	Schraube
453A	Scheibe
455	Schraube
463	Verschlusschraube
463A	T-Ring
489	Sieb
489A	Distanzring
491	Mutter
501	Kupplungsgehäuse
506	Dichtung
509	Wellendichtung
514	Sicherungsring
551	Zulaufkammer
556	Dichtung

Gruppsatser

E4 0 . . . Pumpenhet E4F/E4T/E4V = pump exkl. inloppsdel (inloppsdel enligt gruppsats G065)

E4S 0 . . . Pump E4S inkl. inloppsdel (inloppsdel enligt gruppsats G065)

G031 Lagerdetaljer, 122, 124, 124A, 514

G065 Inloppsdel för
- E4S: det. 382, 489, 489A (storlek 045)
- E4F: det. 453, 453A, 455, 551, 556
- E4T: det. 382, 489, 489A (storlek 045)
- E4V: det. 453, 453A, 489, 491, 551, 556

Group kits

Pump unit E4F/E4T/E4V = pump excl. inlet section (inlet section as per group kit G065)

Pump E4S incl. inlet section (inlet section as per group kit G065)

Bearing details, parts 122, 124, 124A, 514

Inlet section for:
- E4S: parts 382, 489, 489A (size 045)
- E4F: parts 453, 453A, 455, 551, 556
- E4T: parts 382, 489, 489A (size 045)
- E4V: parts 453, 453A, 489, 491, 551, 556

Gruppensätze

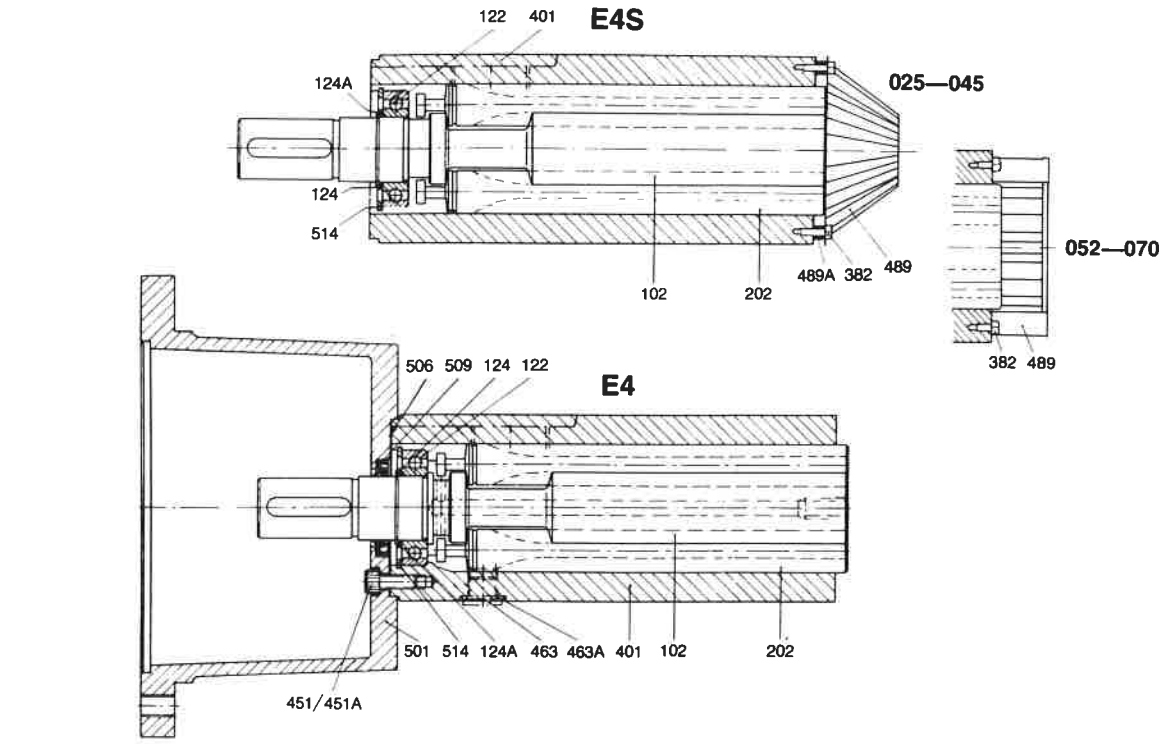
Pumpeneinheit E4F/E4T/E4V = Pumpe exkl. Zulaufteil (Zulaufteil gemäss Gruppensatz G065)

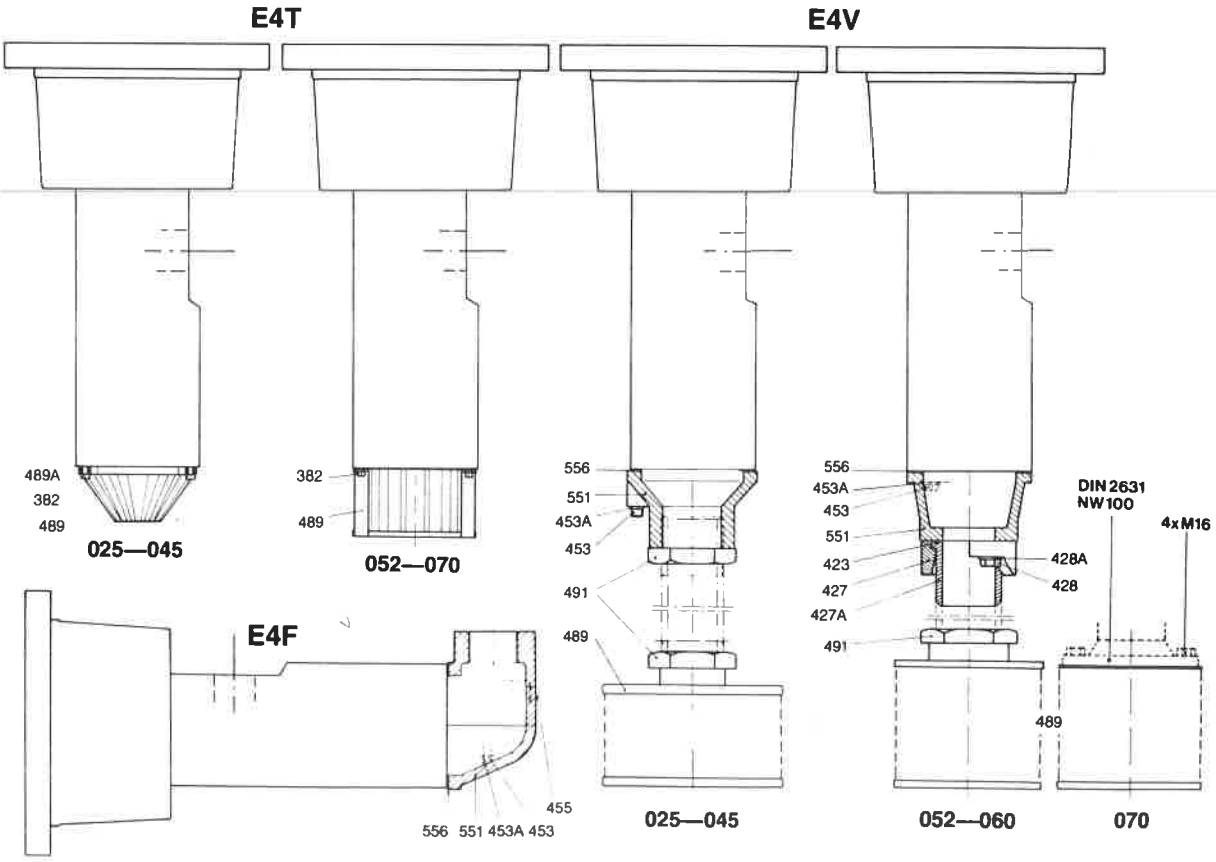
Pumpe E4S inkl. Zulaufteil (Zulaufteil gemäss Gruppensatz G065)

Lagerdetails, Pos. 122, 124, 124A, 514

Zulaufteil für:
- E4S: Pos. 382, 489, 489A (Grösse 045)
- E4F: Pos. 453, 453A, 455, 551, 556
- E4T: Pos. 382, 489, 489A (Grösse 045)
- E4V: Pos. 453, 453A, 489, 491, 551, 556

❶

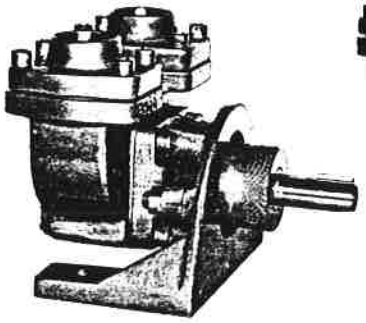

E4S
122
401
124A
025—045
124
514
102
202
489A
382
489
052—070
382
489
E4
506
509
124
122
501
514
124A
463
463A
401
102
202
451/451A


E4T
E4V
489A
382
489
025—045
382
489
052—070
556
551
453A
453
491
489
025—045
556
453A
453
551
423
427
427A
491
428A
428
052—060
DIN 2631
NW100
4xM16
489
070
E4F
455
556
551
453A
453

MONTERINGS- OCH SKÖTSELANVISNING
INSTALLATION AND MAINTENANCE INSTRUCTIONS 1197/A4

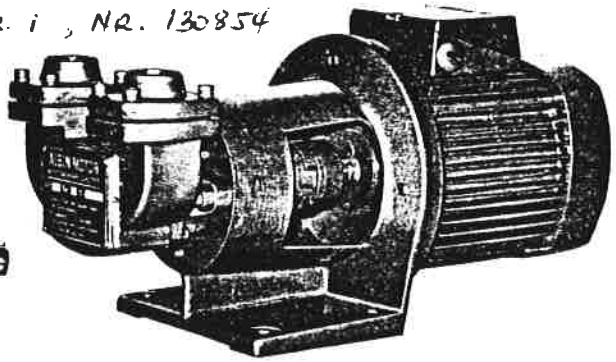
ALBIN Pumpar och Pumpaggregat
ALBIN Rotary Pumps and Pump Set RB1 - RB6

ALBIN
MODEL RB2-01A , SER. 1 , NR. 130854



RB-pump med vinkelkonsol.

RB-pump with bracket for foot mounting.



RB pumpaggregat komplett med pump, mellanstycke och elmotor.

RB-unit complete with pump, distance piece and electric motor.

ALBIN rotationspumpar

ALBIN rotationspumpar är underhållsfria. Alla lagringar smörjs av den pumpade vätskan. Pumparna kan monteras horisontellt eller vertikalt.

Utförandeformer

01A Pump med mekanisk plantätning

01E Pump med boxpackning

02A Pump med teniferbehandling och glidringstätning

03F Pump med teflonpackbox och ökade spel

Andra utförandeformer kan förekomma. Se prospekt eller utförandeförteckning.

ALBIN Rotary Pumps

ALBIN rotary pumps demand a certain amount of lubrication from the pumped medium, but need not actually be lubricated, and consequently require a minimum of attention. They can be mounted in horizontal or vertical position.

Pump versions

01A Pump with mechanical seal

01E Pump with stuffing box

02A Pump with mechanical seal and tufftrided parts

03F Pump with teflon stuffing box and increased clearances

Other pump versions exist. See leaflets or technical data sheet.

Rotationsriktning

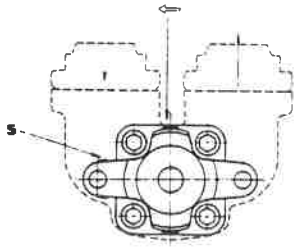
Som standard levereras pumpen alltid för vänsterrotation. Genom att lossa locket kring pumpaxeln och vrida det ett halvt varv apteras pumpen för högerrotation. Den övre pilen anger rotationsriktning. Se bild.

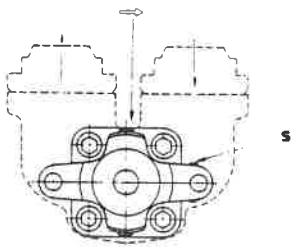
Direction of rotation

Standard pumps are always delivered for left-hand rotation. The pump can be altered for right-hand rotation by turning the cover a half-turn round the pump shaft. The upper arrow on the cover indicates direction of rotation. See picture.

Vänsterrotation
Left-hand rotation

S = Sugsida





Högerrotation
Right-hand rotation

S = Suction side

Montering av pump eller pumpaggregat

Vid anslutning av pump till drivaxel kontrolleras uppriktningen väl. Så även kopplingshalvornas spel - ca 2 mm.

I pumpaggregat med mellandel med fot sker uppriktningen automatiskt med hjälp av styrkanter för såväl motor som pump.

Installation of pump or pump set

When connecting the pump to the driving shaft check carefully the alignment. Check also the clearance between the coupling halves which should be approx. 2 mm (5/64").

In units with pedestal alignment is achived by means of guides.

4 Avlägsna O-ring 16 och montera ny sådan

5 Montera stoppring 19 och kontrollera att den ligger på sin plats i axelspåret, varefter den inre brickan 20 (med hålfasen mot stoppringen 19), fjäder 21 och den yttre brickan 20 monteras på axeln.

6 Dra försiktigt på en ny gummiring 22 (se till att den inte skadas av kilspåret). Sedan monteras rotorring 23. Gummiring 22 pressas därefter in på avsedd plats i rotorring 23. Akta rotorringens tätningsyta.

7 Innan glandmutter 33 skruvas fast monteras i denna en ny O-ring 17, varefter den nya statorringen 18 pressas fast i O-ring 17. Akta statorringens tätningsyta. Glandmuttern dras fast ordentligt.

8 Slutligen monteras kil 24 på plats och pumpkopplingshalvan drivs på axeln med lätta slag och låses med stoppskruv.

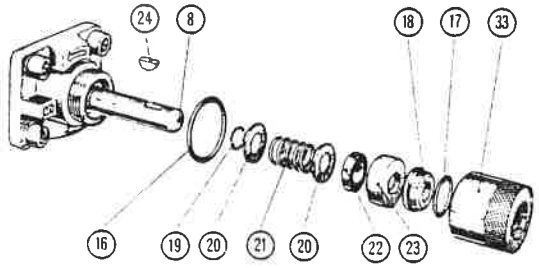
4 Remove the O-ring 16 and fit replacement

5 Fit retaining ring 19 and check that it is located in its groove and fit on the shaft the inner washer 20 (with the bevel against the retaining ring 19), the spring 21 and outer washer 20.

6 Slide a new rubber ring 22 carefully onto the shaft so that it is not damaged by the keyway. Fit the rotor ring 23 and press the rubber ring 22 into proper place of the rotor ring 23. Take care that the tightening surface of the rotor ring is not damaged.

7 Before the gland nut 33 is fitted, a new O-ring 17 is placed in the gland nut. Then the stator ring 18 is pressed into the O-ring 17. Take care that the tightening surface of the stator ring is not damaged. Fit and tighten gland nut properly.

8 Replace the key 24 and fit the pump coupling half on the shaft using light blows. Lock the coupling half by tightening the socket screw.



Sprängskiss av mekanisk plantätning Exploaded view of mechanical seal

Packbox E och F

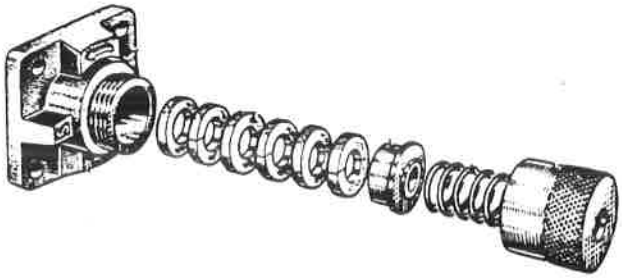
En fjäderbelastad, självansättande boxpackning försedd med impregnerade asbetspackningar. Tätningen är avsedd för vätskor med hög viskositet och som innehåller fasta föroreningar. Maximal arbetstemperatur med standardpackning 140° C och med teflonimpregnerad packning 250° C.

Vid byte av packningsfläta se till att glandet styr i locket så att det inte hänger upp sig. Vid felaktig montering elimineras glandets sammanpressande funktion och tätningen läcker.

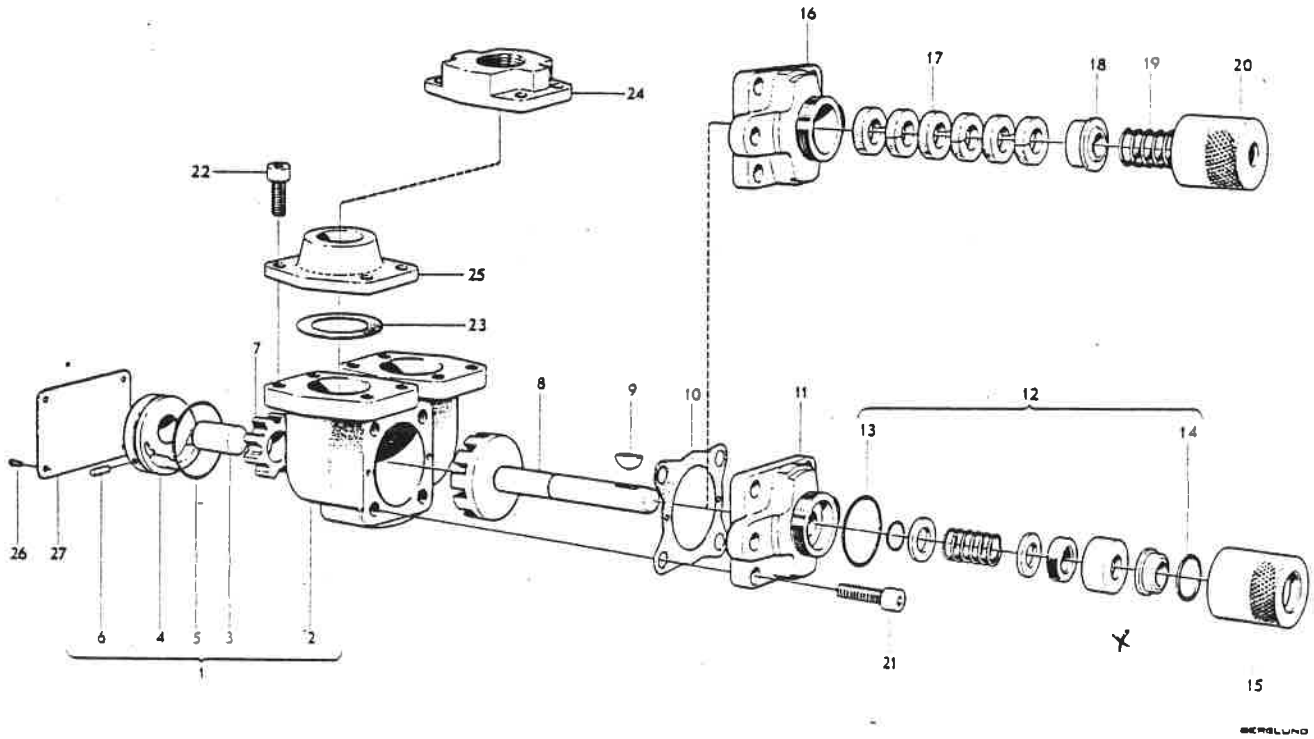
Stuffing box E and F

This is a spring-loaded self-adjusting stuffing box packing provided with impregnated asbestos packings. It is meant for liquids of high viscosity and containing solids. The maximum working temperature when fitted with standard packing is 140° C (285° F) and when fitted with teflon impregnated packing 250° C (480° F).

When changing packing see to it that the gland is fitted properly into the pump cover so that - in order to avoid leakage - its pressing function is not eliminated.



Sprängskiss av packbox Exploaded view of stuffing box



2R-242

	RB1-01A	RB2-01A	RB1-02A	RB2-02A	RB1-01E	RB2-02E	RB1-03F	RB2-03F	Benämning	Description
1	3849658	3849660	3849659	3849661	3849658	3849660	3849658	3849660	Pumphus, komplett	Pump body, assembly
2	3849666								Pumphus	Pump body
3	3846379	3846057	3846379	3846057	3846379	3846057	3846379	3846057	Axeltapp	Journal pin
4	3846377	3846058	3847569	3847574	3846377	3846058	3846377	3846058	Månskära	Crescent
5	35,1×1,6 A								O-ring	O-ring
6	CP 4h6×16								Cylindrisk pinne	Pin
7	3846381	3846056	3846381	3846056	3846381	3846056	3849127	3849129	Kugghjul	Gear
8	3846378	3846431	3847570	3847575	3846378	3846431	3849126	3849128	Rotor	Rotor
9	WK 4×16								Woodruffkil	Key
10	3846060						3875077		Packning 0,02 mm	Gasket 0.02 mm
	3846581						3875078		Packning 0,05 mm	Gasket 0.05 mm
	3846582						3875079		Packning 0,10 mm	Gasket 0.10 mm
11	3849667						—		Lock	Cover
12	3849069						—		Mekanisk tätning, komplett	Mechanical seal, assembly
13	26,2×3 A						—		O-ring	O-ring
14	19,2×3 A						—		O-ring	O-ring
15	3849065						—		Glandmutter	Gland nut
16	—				3849668				Lock	Cover
17	—				3842572		3879218/3875083		Packning	Gasket
18	—				3804136-2				Gland	Gland
19	—				3804127-2				Glandfjäder	Gland spring
20	—				3804136-1				Glandmutter	Gland nut
21	UC6S 5/16 UNC×22								Skruv	Screw
22	UC6S 5/16 UNC×22								Skruv	Screw
23	3846061								Packning	Gasket
24	3846059								Rörfläns	Threaded pipe-flange
25	3847434								Svetsfläns	Welding flange
26	CSK-B 2×5								Skruv	Screw
27	3849798								Skylt	Plate

Uppge alltid pumpens serie- och tillverkningsnummer vid beställning av reservdelar.
Always state the serial number of the pump when ordering spare parts.

EPE

Doppelfilter

Typenreihe:
100 D 10-32
ND 100 bar

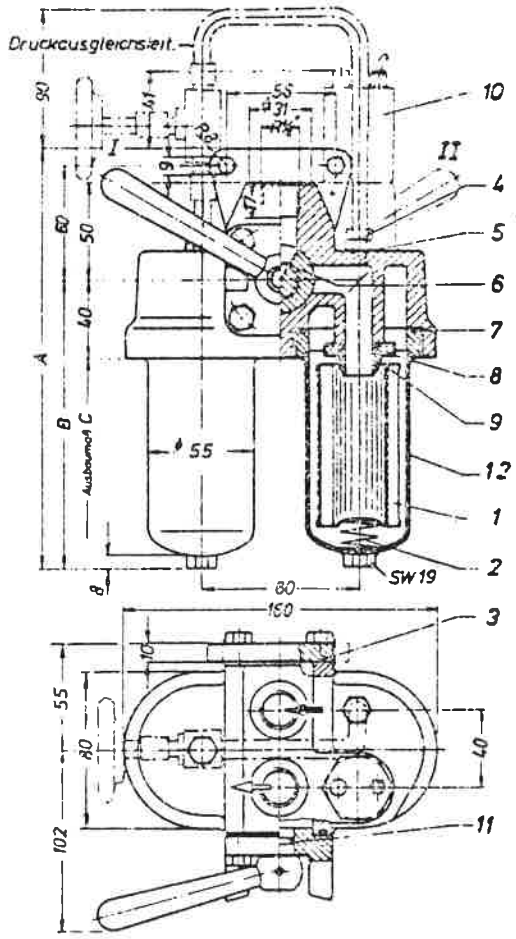
1. Allgemeines

Verwendung: Doppelfilter werden vornehmlich dort eingesetzt wo ein kontinuierlicher Betrieb erforderlich ist, oder eine längere Wartungszeit vermieden werden muß. Sie eignen sich für den Einbau in Druckleitungen.

Filteraufbau: Zwei Filtergehäuse, die im Filteroberteil eingeschraubt sind, umschließen die beiden Filterelemente. Ein Schaltorgan im Oberteil ermöglicht das Umschalten des Flüssigkeitsstromes vom verschmutzten auf das saubere Filtergehäuse ohne Querschnittverengung. Die Reinigung bzw. der Wechsel des Filtereinsatzes kann während des Dauerbetriebes, nach Abschrauben des Filtergehäuses vorgenommen werden. Das Filter kann zusätzlich mit Überdruckventil und Wartungsanzeige ausgerüstet werden.

Um ein Umschalten während des Betriebes bei mehr als 25 bar Arbeitsdruck zu ermöglichen, muß das Filter mit einer Druckausgleichsleitung versehen werden. In diesem Fall wird vor dem Umschalten ein Druckausgleich durch Öffnen und Schließen des Druckausgleichventils vorgenommen.

Hebelstellung I: Linkes Gehäuse in Betrieb.
Hebelstellung II: Rechtes Gehäuse in Betrieb.



Gehäuse: Stahl Oberteil: Aluguß

Siebbauart: Sternsiebeinsätze

Befestigung: Abschlußplatte mit 2 Bohrungen

2. Kenngrößen

Filterfeinheit:	100, 60, 40, 25 µm V2A-Gewebe 25, 10, 5 µm Papier
Betriebsdruck:	0,3 bis 100
Viskositätsbereich:	1 cSt bis 300 cSt
Druckmitteltemperatur:	- 10° C bis + 100° C
Magnet:	Permanent - Ringmagnet
Überdruckventil:	Öffnungsdruck Δp 5 bar
Wartungsanzeigen:	optisch oder opt.-elektrisch (techn. Daten siehe unter 6.)

4. Ersatzteile

Teil	Stck.	Benennung	
1	2	Filterelement	ø43,5×30,50,80
2	2	Feder	
3	2	O-Ring 70° Sh.	38 x 3
4	2	Sechskantschr. DIN 933	M 8 x 10
5	2	Dichtung WE DIN 7603	A 10 x 14
6	1	Überdruckventil	
7	2	O-Ring 70° Sh.	52 x 3
8	2	Magnet	ø40×ø22×10
9	2	O-Ring 70° Sh.	18 x 2,5
10	1	Wartungsanzeige	WO oder WE
11	1	O-Ring 70° Sh.	10 x 2,5
12	2	Filtertopf	

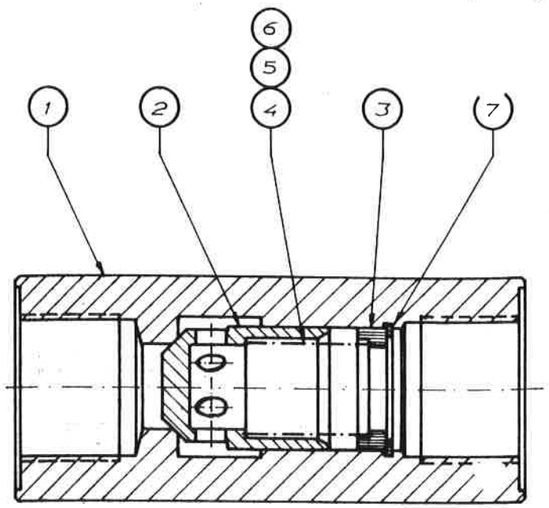
3. Geräteabmessungen

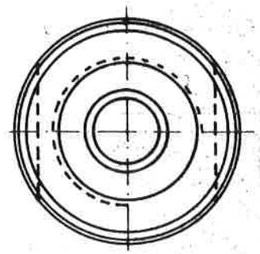
Type	Nenndurchfl. l/min	Filterfläche cm² Gewebe	Papier	Gewicht kg	A	B	C	V max. in m/sec
100 D 10 ...	10	80	125	3,8	169	101	130	1,0
100 D 18 ...	18	145	220	4,0	189	121	150	1,7
100 D 32 ...	32	255	390	4,2	219	151	180	3,0

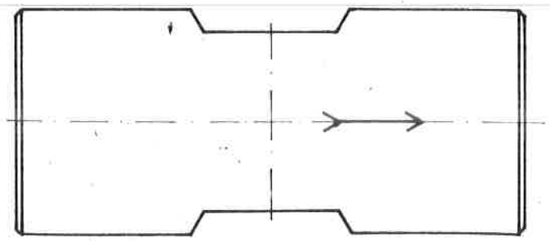
Änderungen vorbehalten!

K. & H. EPPENSTEINER GmbH & Co KG Filter u. Apparatebau
6834 Kotsch a. Rh. Goethestraße 22—24 · Telefon: 06202/6841 · Telex 0466319

5 210
Ausg. 2 / 77







Reg 12/70

A.B. HYDRON NR. M3-1115

Det.-nr	Ant.	Benämning	Material	Mod.-nr Ämne Dimension	Anm.
7	1	Säkringsring		SgH 22	
6	1	Tryckfjäder 4 bar		12337/4	Kracht-ritning
5	1	Tryckfjäder 1 bar		12676/4	Kracht-ritning
4	1	Tryckfjäder 0,2 bar		12766/4	Kracht-ritning
3	1	Styrning		M4-1113	
2	1	Kägla		M4-1112	
1	1	Ventilhus		M3-1114	

Konstr.	Ritad	Kop.	Kontr.	Stand.	Godk.	Skala 1:1	Ersätter	Ersatt av

AB HYDRON
Stockholm-Malmö

BACKVENTIL TYP R20 Kracht
CHECK VALVE
Sammanställning
ASSEMBLY

Dat. 73.04.26

Ritn.-nr 590573

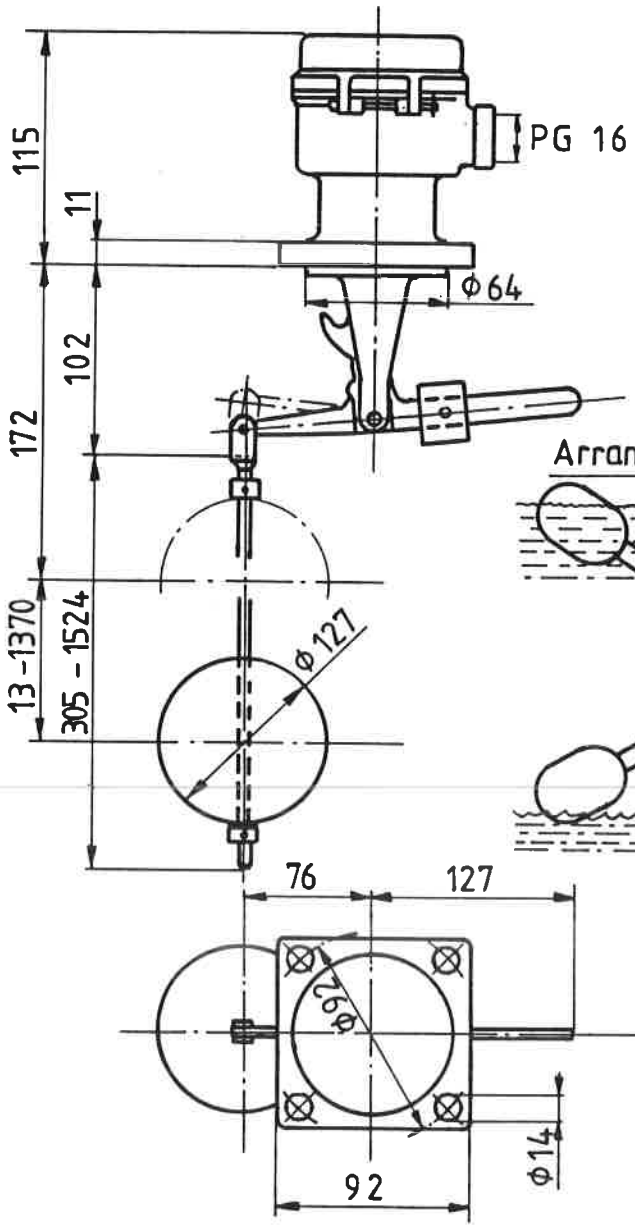
Nr	Ant.	Ändring och/eller medd.-nr	Datum	Inf.	Godk.	Nr	Ant.	Ändring och/eller medd.-nr	Datum	Inf.	Godk.

7059-43
A3-1.11
SMS 687

Utf Design
A
B
C
D
E
F
G
H
K

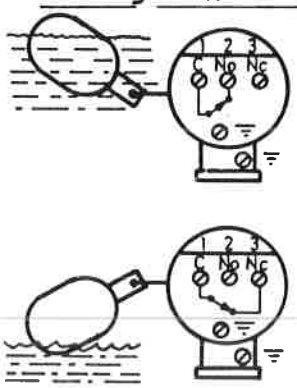
Tillåtna måttavvikelser när tolerans ej direkt utsatts på bearbetade detaljer SMS 715 Medel enligt tabell nedan. För rundningsradier, fasar och vinkelmått följs SMS 715 Medel enligt separat standardblad.
Machining tolerances for linear dimensions unless otherwise specified

Basmått Basic size	Måttavvikelser Tolerances	Basmått Basic size	Måttavvikelser Tolerances
— 3	±0.1	(1000)— 2000	±1,2
(3)— 6	±0.1	(2000)— 4000	±2
(6)— 30	±0.2	(4000)— 8000	±3
(30)— 120	±0.3	(8000)—12000	±4
(120)— 315	±0.5	(12000)—16000	±5
(315)—1000	±0.8	(16000)—20000	±6



AC : 250V ; 8A
DC : 250V ; 0,25A

Arrangement of terminal



	Standard Standard	Ytjämnhet enligt SMS 672 Ra µm Surface texture ISO/R 1302 Ra µm	Skala Scale —	Överordnad ritn. Master drg.
Uppgj. av Drawn Lal	Kontr. Checked	KaMeWa - propeller Nivågivare Mobrey typ S196/F07 Level switch	Föreg. ritn. Previous drg.	Tillk. ritn. Future drg.
KMW AB KARLSTADS MEKANISKA WERKSTAD			Datum Date 79 02 22	Reg. A4/ 502
			909 116	Utf. Design / Ändr. Revis.

This drawing must not be used for manufacturing purposes without our written permission neither is it to be handed over to nor in other way communicated to a third party. Infringement will lead to prosecution. KMW

CONTROL SYSTEM

NOT KAMEWA SUPPLY

KaMeWa
operating instructions for the bridge

Procedures before departure:

1. Order "Stand-by".
2. Order "KaMeWa Connected Propeller Shaft Stop".
3. Test the functioning of the propeller. Change the propeller pitch through its entire range by operating the controls. Note whether the remote indicators are responding to the pitch changes. Set the propeller to the "zero" pitch position.
4. Order "Propeller Shaft Running".

Operation

1. Move the operating handle ahead for forward speed. Move the operating handle astern for speed backwards.
2. a. For full engine power increase the lever reading. For equipment with load-control the lever can be set to position 10. Then the load-control automatically regulates the power to a value adjusted in the engine control room at the load limit setting potentiometer.
   b. On equipment without load control but with fixed combinator the lever reading should be increased until the overload lamp lights. Then reduce the lever reading till the lamp just goes out.
   c. On equipment with adjustable combinator the lever reading should be increased until the overload lamp lights. The pitch is then fine adjusted with the trimming wheel so that the lamp goes out.
3. On vessels equipped with a Combinator-Constant rpm change over valve, this must be switched over when full rpm is required independent of the pitch, e g when running in ice.

Test the manoeuvring before the ship goes into harbour, i e while the ship is still in clear water

General points about the KaMeWa Propeller:

The same turning tendency occurs when starting astern as ahead. Because of this the ship can swing by running the propeller alternatively ahead or astern.

A left running KaMeWa propeller tries to move the stern to port. A right running KaMeWa propeller tries to move the stern to starboard.

With multiple engine drive we must beware of the risk of cavitation damage on the blades. This will happen if one or two engines are disconnected and the propeller runs with low pitch, at full or near full rpm for a long time. All normal manoeuvring e. g. berthing etc. can be done without any risk of cavitation damage.

See also the chapter about "The hydrodynamics of the propeller".

KaMeWa
instructions for the engine-room staff

Procedures on the signal "Stand-by"

1 Start the hydraulic pumps — check the oil pressures.

2 Manoeuvre astern — ahead from the engine-room stand, or with the hand manoeuvre on the OD-box when an engine-room stand is not available.

Check that the pitch indicator is working. Set the pitch to zero-position. Change the hand manoeuvre back to the remote control.

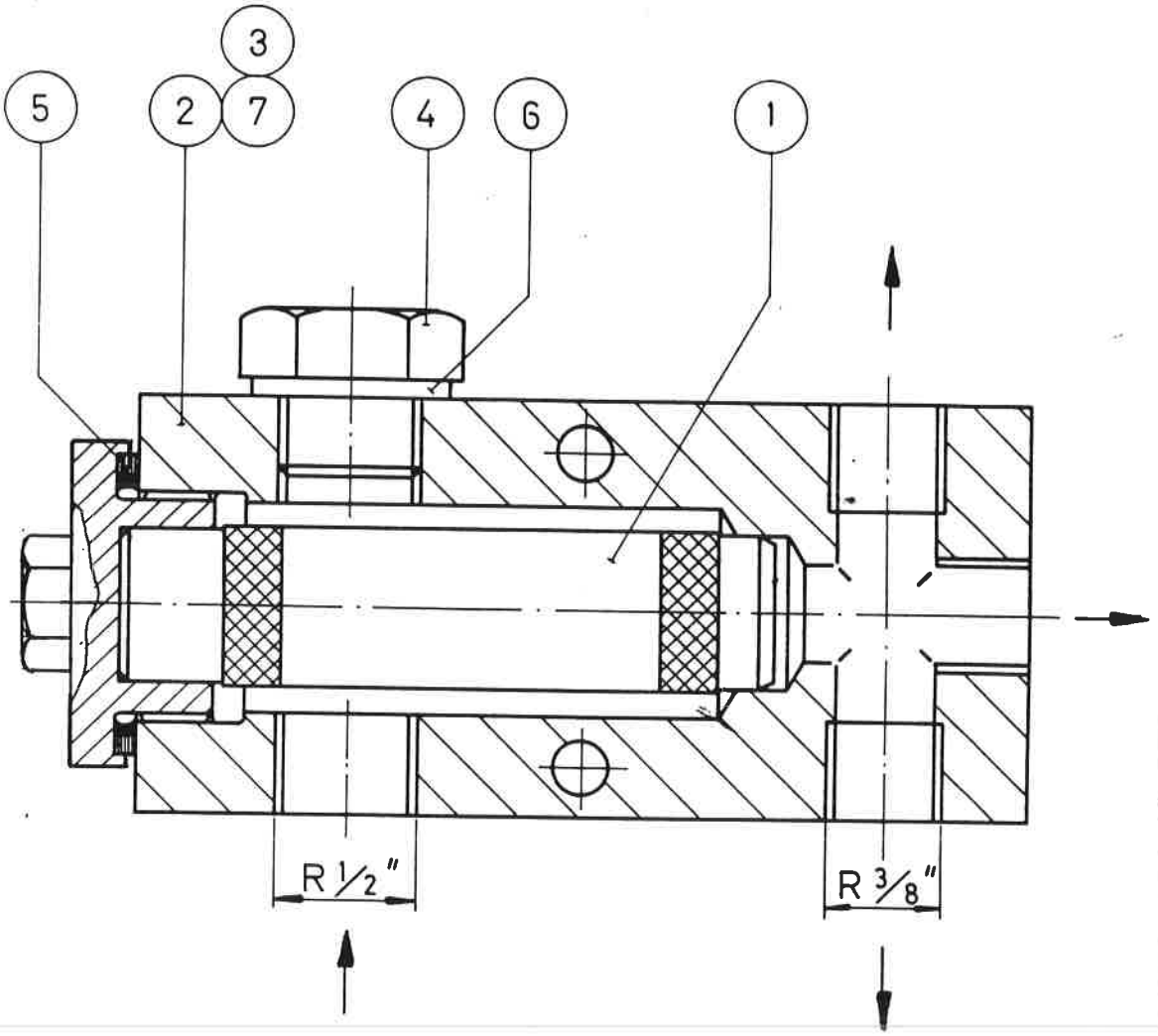
3 Put the change-over valve in position "Bridge".

4 Tell the bridge:
"Ready to start the propeller shaft".

5 For equipment with a shaftdriven pump check the oil pressure after starting the propeller shaft.

Procedures on the signal "Finished with engine"

1. Put the change over valve in position "Engine room".
2. Stop the oil pumps.



TILLVERKNINGSRITNING 566 191

Det.nr Item No	Ant. No. off	Benämning Description				
7	4	Nit 4x6	Rivet 4x6			
6	1	Tätningsbricka 21,5	Sealing-washer 21.5			
5	1	Tätningsbricka 33,8	Sealing-washer 33.8			
4	1	Propp 1/2"	Plug 1/2"			
3	1	Skylt	Plate			
2	1	Filterhus	Filter-casing			
1	1	Filterinsats	Filter			

KAMEWA

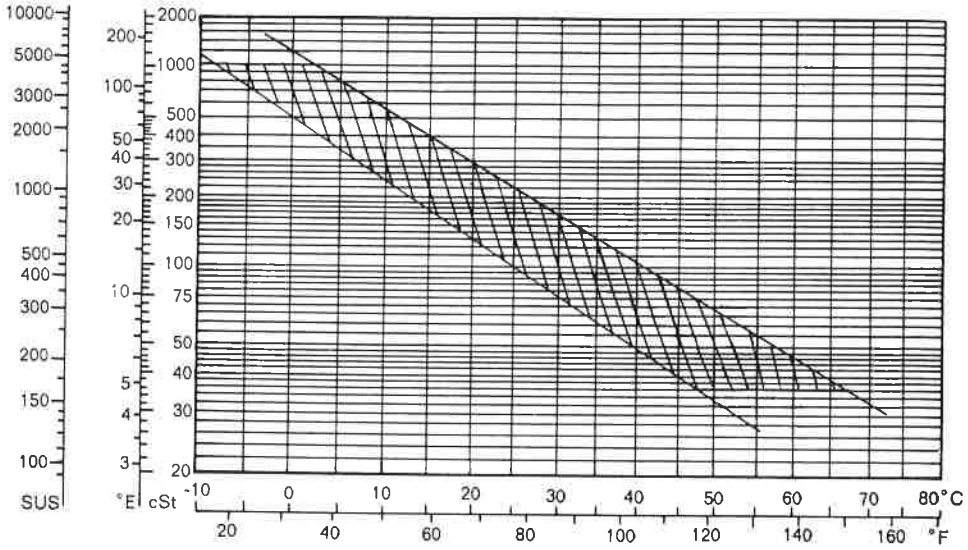
KaMeWa-propeller
1/2" oljefilter oil-filter
Sammanställning Assembly

Konstr. IP/Wom | Skala
Datum 73 12 05 | Reg. | S/502
513121

Bl. 452 • 12.69 2.000 ... 37500

Requirements for hydraulic oil

A solvent refined mineral oil of good quality, containing additives against foaming shall be used. The viscosity shall be within the limits in the diagram below. For work in tropical waters only, choose viscosity on the upper limit and for only arctic conditions on the lower limit. The viscosity of the oil shall be within the limits also after a long time of service.



Shearing stability (for oils containing VI-improvers) decrease of viscosity at 98,9°C after shearing 250 cycles	Max 20%	DIN 51382
Density (20°C)	Max 910 kg/m³	
Flash point (COC)	min 180°C	ASTM D 92
Emulsion test	30 min/3 ml	ASTM D 1401
Air release (50°C)	10 min	DIN 51381
Corrosion test on copper (3 h 100°C)	degree 2,	DIN 51759
Rust test (24 h)	0	ASTM D 665 B
Oxidation stability increase of neutralizing number after 1000 h, max	2.0 mg KOH/g oil	ASTM D 943
Influence on packing material (mat 70 NBR/769 Messrs Carl Freudenberg GmbH) after 100 h and 80°C		
Change in volume	—1 to +4%	DIN 53521+
Change in hardness	± 4 shore	DIN 53505

For steering propellers and thrusters the oil must also fulfil the following requirement.

Load carrying property (FZG gear test)	Load step 12	DIN 51354

Do not mix motor oil with other types of oil, even if they fulfil the requirements in this specification. Very small amounts of motor oil in e g turbine or hydraulic oils mean that the quality of these oils is considerably lowered.

The oil is changed when laboratory tests show that something of the following has happened

1. Too high neutralizing number
2. Too low remaining amount of EP-additives
3. Too high amounts of insoluble particles in the oil
4. The viscosity is not within the limits in the diagram above.

KaMeWa
operating instructions for the bridge

Procedures before departure:

1. Order "Stand-by".
2. Order "KaMeWa Connected Propeller Shaft Stop".
3. Test the functioning of the propeller. Change the propeller pitch through its entire range by operating the controls. Note whether the remote indicators are responding to the pitch changes. Set the propeller to the "zero" pitch position.
4. Order "Propeller Shaft Running".

Operation

1. Move the operating handle ahead for forward speed. Move the operating handle astern for speed backwards.
2. a. For full engine power increase the lever reading. For equipment with load-control the lever can be set to position 10. Then the load-control automatically regulates the power to a value adjusted in the engine control room at the load limit setting potentiometer.

   b. On equipment without load control but with fixed combinator the lever reading should be increased until the overload lamp lights. Then reduce the lever reading till the lamp just goes out.

   c. On equipment with adjustable combinator the lever reading should be increased until the overload lamp lights. The pitch is then fine adjusted with the trimming wheel so that the lamp goes out.
3. On vessels equipped with a Combinator-Constant rpm change over valve, this must be switched over when full rpm is required independent of the pitch, e g when running in ice.

Test the manoeuvring before the ship goes into harbour, i e while the ship is still in clear water

General points about the KaMeWa Propeller:

The same turning tendency occurs when starting astern as ahead. Because of this the ship can swing by running the propeller alternatively ahead or astern.

A left running KaMeWa propeller tries to move the stern to port. A right running KaMeWa propeller tries to move the stern to starboard.

With multiple engine drive we must beware of the risk of cavitation damage on the blades. This will happen if one or two engines are disconnected and the propeller runs with low pitch, at full or near full rpm for a long time. All normal manoeuvring e. g. berthing etc. can be done without any risk of cavitation damage.

See also the chapter about "The hydrodynamics of the propeller".

KaMeWa
instructions for the engine-room staff

Procedures on the signal "Stand-by"

1 Start the hydraulic pumps — check the oil pressures.

2 Manoeuvre astern — ahead from the engine-room stand, or with the hand manoeuvre on the OD-box when an engine-room stand is not available.

Check that the pitch indicator is working. Set the pitch to zero-position. Change the hand manoeuvre back to the remote control.

3 Put the change-over valve in position "Bridge".

4 Tell the bridge:
"Ready to start the propeller shaft".

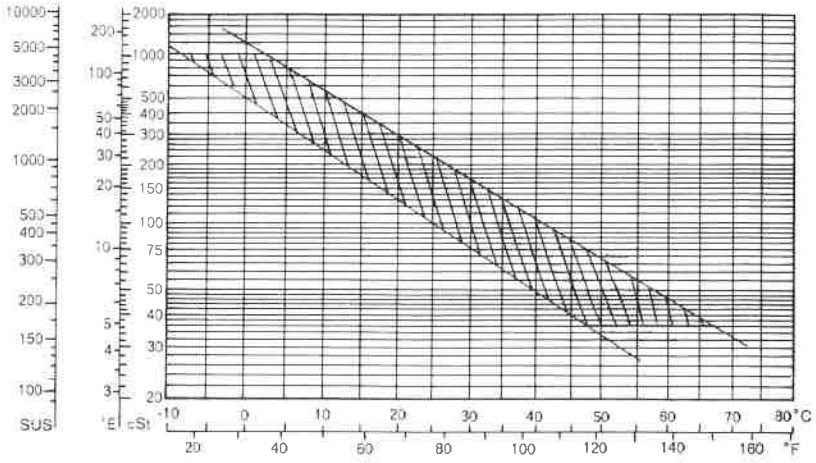
5 For equipment with a shaftdriven pump check the oil pressure after starting the propeller shaft.

Procedures on the signal "Finished with engine"

1. Put the change over valve in position "Engine room".
2. Stop the oil pumps.

Requirements for hydraulic oil

A solvent refined mineral oil of good quality, containing additives against foaming shall be used. The viscosity shall be within the limits in the diagram below. For work in tropical waters only, choose viscosity on the upper limit and for only arctic conditions on the lower limit. The viscosity of the oil shall be within the limits also after a long time of service.



Shearing stability (for oils containing VI-improvers) decrease of viscosity at 98,9°C after shearing 250 cycles	Max 20%	DIN 51382
Density (20°C)	Max 910 kg/m³	
Flash point (COC)	min 180°C	ASTM D 92
Emulsion test	30 min/3 ml	ASTM D 1401
Air release (50°C)	10 min	DIN 51381
Corrosion test on copper (3 h 100°C)	degree 2,	DIN 51759
Rust test (24 h)	0	ASTM D 665 B
Oxidation stability increase of neutralizing number after 1000 h, max	2.0 mg KOH/g oil	ASTM D 943
Influence on packing material (mat 70 NBR/769 Messrs Carl Freudenberg GmbH) after 100 h and 80°C		
Change in volume	—1 to +4%	DIN 53521 +
Change in hardness	± 4 shore	DIN 53505

For steering propellers and thrusters the oil must also fulfil the following requirement.

Load carrying property (FZG gear test)	Load step 12	DIN 51354

Do not mix motor oil with other types of oil, even if they fulfil the requirements in this specification. Very small amounts of motor oil in e.g. turbine or hydraulic oils mean that the quality of these oils is considerably lowered.

The oil is changed when laboratory tests show that something of the following has happened

1. Too high neutralizing number
2. Too low remaining amount of EP-additives
3. Too high amounts of insoluble particles in the oil
4. The viscosity is not within the limits in the diagram above.

Issue 3
Dec 1 1978

Servicing and maintenance

Daily

1. Check oil levels.
2. Check oil pressures.
3. Check the contamination reading for the pressure oil filters. Note! The filter elements must by cleaned before by-passing is indicated, see also fig. 1 below.

Every month

1. Check that all pipe connections and flanges are tight.
2. Clean auxiliary servomotor filters See fig. 2 and dwg.513121 in chapter
3. Clean pressure oil filters.
4. Check that all screws are fastened and locked.

1. Send an oil sample to the oil manufacturer for analysis. Change the oil when required.

At docking

1. Check the oil in the propeller hub chamber.
2. Pressure test the propeller hub and check the blade sealing rings.
3. Check the blade bolts with locking plates and that all outer bolts and screws are tightened and locked.
4. Check that the K-mark of the blades corresponds to the K-mark on the scale of the OD-box.
5. Change the sealing ring under one propeller blade.

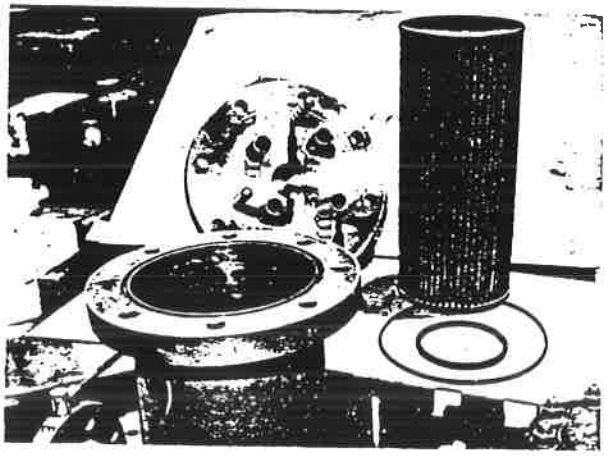


Fig. 1. EPE filter for main hydraulic system

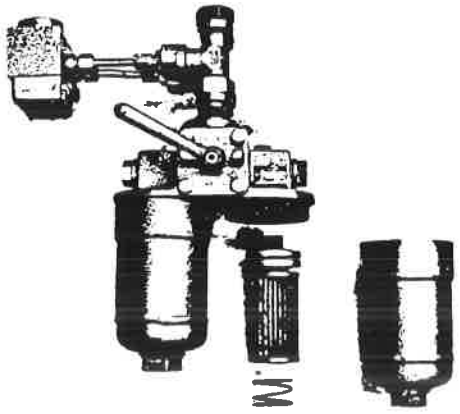


Fig. 2 EPE double filter

Service journal

Date	Service man	Functional dicturbances	Measures taken

Dismantling and Mounting

General rules

It is important to study the drawings and the instruction manual carefully before a dismantling operation.

It is of great importance that the parts which are to be dismantled, as well as the parts close by, are cleaned as much as possible before the dismantling takes place. Use a table or a tray to place the dismounted parts on. Protect the propeller equipment against moisture and impurities. Check before dismantling how every part is placed so that they can be re-assembled in the correct way.

Practically every component of the KaMeWa propeller is machined to great dimensional accuracy and smoothness. Handle them with great care. Heavy components must be lifted in loops, *not* in wires or chains. When it is necessary to use a wire or chain, inserts must be used. Use the special tools, which are delivered. Use only linen rags, *not* twist, when cleaning. For washing, use paraffin or fuel oil. Trichlorethylene must *not* be used as the rubber seals may be damaged. Lubricate the cleaned parts before re-assembling with the same oil as in the hydraulic system. Screws and bolts must be tightened with the prescribed torque when specified, (see "Technical data") and locked according to the instructions.

Propeller blade

Empty the oil from the propeller hub chamber if more than one blade is to be changed.

1. Turn the propeller until the blade to be removed is in a vertical position on top of the hub.
2. Cut away the tack-welds on the locking plates of the blade bolts with a chisel.
3. Loosen and dismantle the blade bolts with the special tools.
4. Install the blade removal tools and lift the blade stright out of the hub. Use a lead hammer if necessary. Be careful that the blade sealing ring under the blade flange is not damaged.
5. Before the blade is reinstalled inspect the bearing- and sealing surfaces under the blade flange and in the hub so that they are clean and free from scratches and wear and from foreign particles embedded in them.
6. Insert the new O-ring of the correct type. Lubricate the bearing- and sealing surfaces before installing the blade.
7. Install the blade. Mount the bolts which must be tightened with a torque according to the directions in "Technical data". Tightening tools are delivered.
8. Secure the bolts with locking plates, which must be tack-welded into the blade flange. See the special instructions in the supplementary list.
9. Fill the propeller hub chamber with oil and perform a pressure test.

Blade sealing ring

Change the O-ring in the blade sealing ring for one blade annually, eg during dry-dock painting or classifying or when docking for other reasons. The O-ring change has to be recorded. The following year change the O-ring under another blade and after a third year under a third blade and so on. Thus a continuous change of sealing rings is achieved and leakage from wear is avoided. If the O-ring seem to be damaged on inspection, the O-ring under all the blades must be changed.

Hub cone

Before dismantling the hub cone the propeller blade must be in position full ahead. The hub cone bolts can then be loosened without risk that the safety springs press out the hub cone.

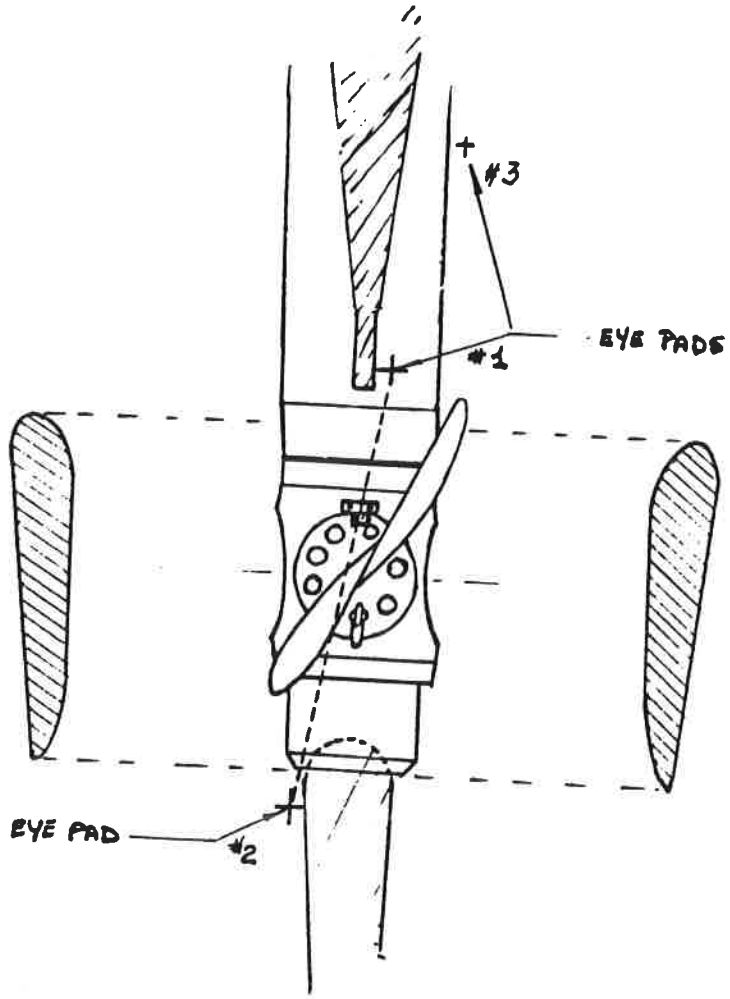
Use delivered jack screw to force the hub cone out from its guiding in the hub body. Before removing the hub cone bolts, the cone must be supported with a sling so that it does not topple when it is removed from the guiding.

Position a large container under the hub to collect the hub cone oil.

Safety springs

The safety springs in the propeller hub can be dismantled when the hub cone is removed.
By slacking off the locking nuts in the spring holders, the springs will be unloaded.
See also encl. 4,1, Hub assembly.

#1



Left hand rotation

INSTRUCTION FOR BLADE REMOVAL IN NOZZLE - 86 XF4/W

For left hand rotation only, right hand rotation opposite as shown

#1 PREPARATION -

- Eye pads to be welded to ship's hull and rudder as per sketch. Pads #1 and #2 to be mounted so as to make an imaginary line through the center of the hinge assembly. They should be mounted high enough on the hull to give adequate lift for blade handling.

/...2

#1 PREPARATION-Cont'd

- If hydraulics are available, propeller can be pitched full astern and locked in hand control. All bolts removed and dowel pin extracted. Blade can then be turned further astern using a chain block choked around blade foot until hinge mounting holes on blade are aligned with those on hub body. Without hydraulics, blade can be turned in this fashion from the full ahead position. It is advantageous at this time to crack blade from spigot during this turning operation.

- Lifting rod, shackle and eye to be mounted in threaded bolt hole. Items 1-2-3-4-5, drawing 935057

  NOTE:

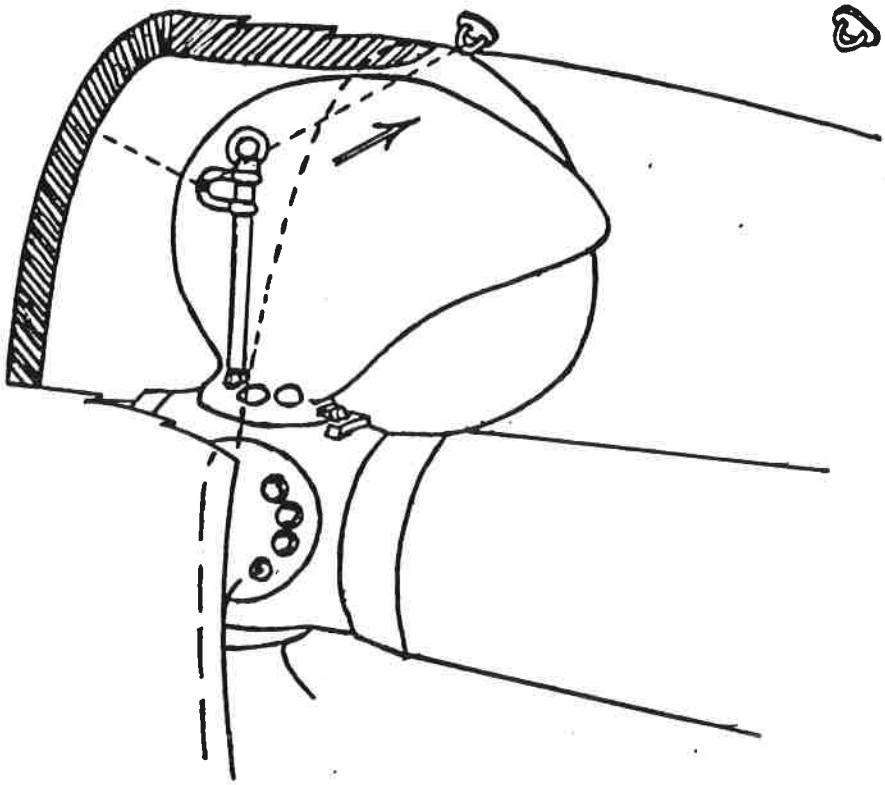
  If blade can not be tilted 90 degree due to interference with the sternframe casting, mount the shackle on top of the lifting rod as shown on following sketches. A spacer must then be made to fit between shackle eyes to prevent its collapsing when rod is tightened.

- Hinge assembly, items 6-7-8-10-11, drawing 935057 to be mounted on blade foot only. Free end of hinge to be used as a prying point to lift blade from spigot until blade foot height is sufficient to mount free end of hinge on hub body. Wood wedges to be inserted each side of blade to maintain this level during hinge mounting.

- Chain blocks hung from eye pads #1 and #2 and attached to shackle on lifting rod. Chain block hung from pad #3 for transfer purposes only.

/...3

#2

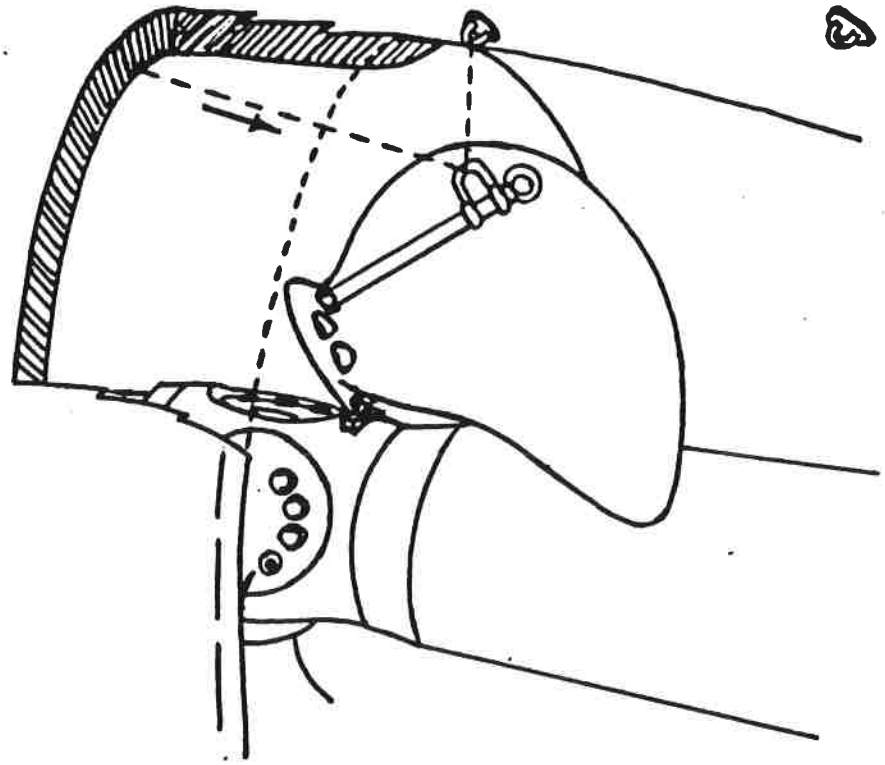


#2

- Tension is applied to chain block #1 (pulling forward) to lift blade foot from spigot. #2 block being used to check the rate at which blade will tilt forward on hinge assembly.

. . ./4

#3

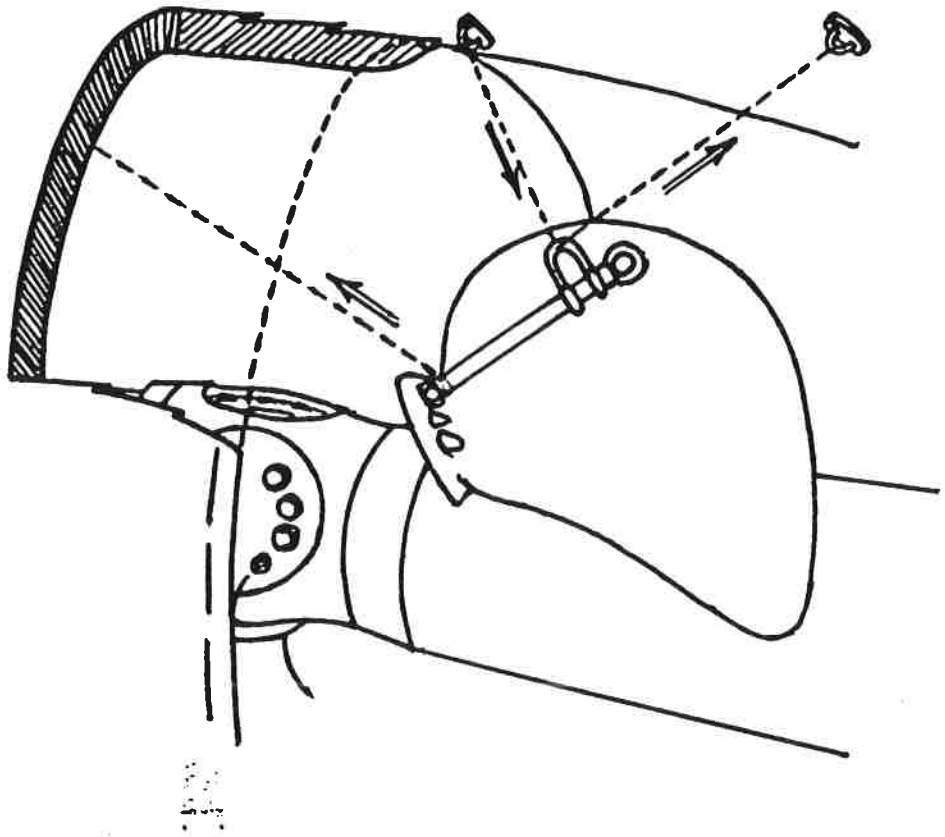


#3

- Blade is allowed to tilt further forward on hinge until lifting rod is approximately 45 degrees from the vertical, this being the approximate balance point of the blade. Both blocks #1 and #2 should be snubbed tight to create a lift in the vertical plane. Hinge can now be removed carefully - Noting the blades' balance during the dismounting of the hinge.

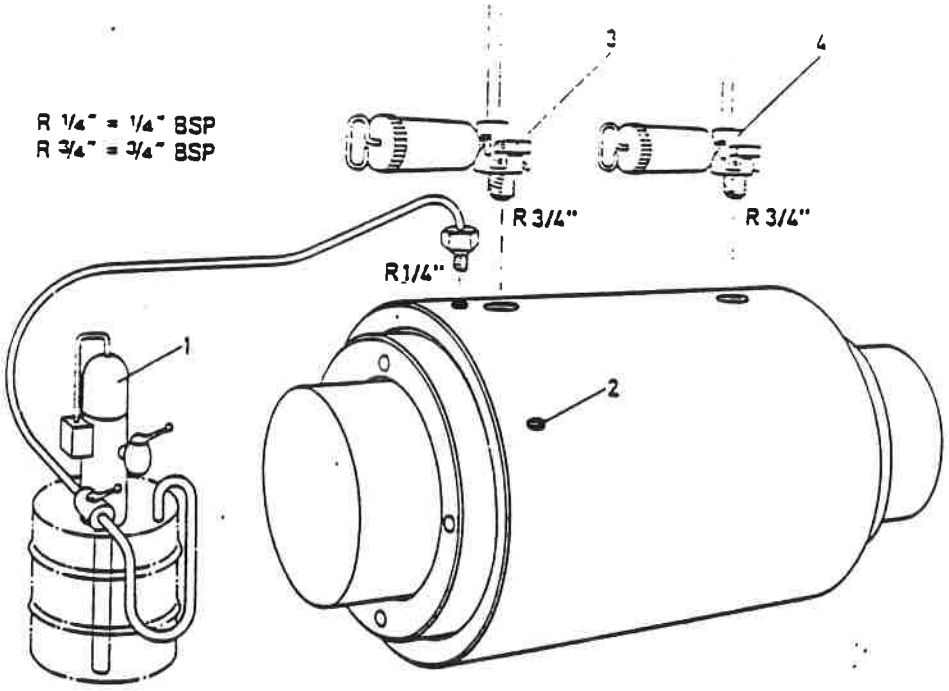
- Blade is not lifted vertically clear of pocket and allowed to hang from block #1.

/...5



#4

- Block #2 is now removed from shackle and choked at base of lifting rod. Transfer block #3 is attached to shackle and blade transferred clear of hub body. During this transfer operation, block #2 is used to lift the blade foot clear of hub body.



6 Slacken the vent hole screw 2. Apply a blast of compressed air to ensure that the sealing ring in the hydraulic nut is in the correct position (see "Disassembling the coupling", page 6). Connect the hydraulic pump 1 and pump oil into the hydraulic unit until air free oil escapes through the vent hole 2. Stop pumping and close the hole. Connect the injectors 3 and 4 and start injecting oil using injector 3. When oil emerges all around the periphery at the large end of the inner sleeve, start injection also with injector 4. After injecting oil with both injectors for a couple of minutes, start the hydraulic pump 1, thus driving up the outer sleeve. The injection of oil between the sleeves should be continued during the *entire* drive-up process in order to maintain the oil film. Drive-up is complete when the diameter of the outer sleeve has increased by the dimension Δ given on page 2. The dimension A_3 may be used as a rough indication of the position the sleeve must take to ensure this expansion. If, after the first drive-up, a note is made of the exact final position of the outer sleeve, it will be unnecessary to measure dimension Δ subsequently. Open the pressure reduction valve on the injectors to release the oil between the sleeves. This may take about ten minutes. The oil pressure in the hydraulic unit must not be reduced until this has been done. Disconnect the injectors and the pump, but let the oil remain in the hydraulic unit. Seal the oil ducts with the appropriate plugs. After the first mounting process, tighten the nut firmly; after that, the horizontal grub screws, see page 6, must be tightened.

Coat the exposed parts of the coupling seatings and the inner sleeve with rust preventive; this will also prevent moisture from penetrating beneath the coupling.

EQUIPMENT FOR MOUNTING AND DISMOUNTING

Hydraulic pump

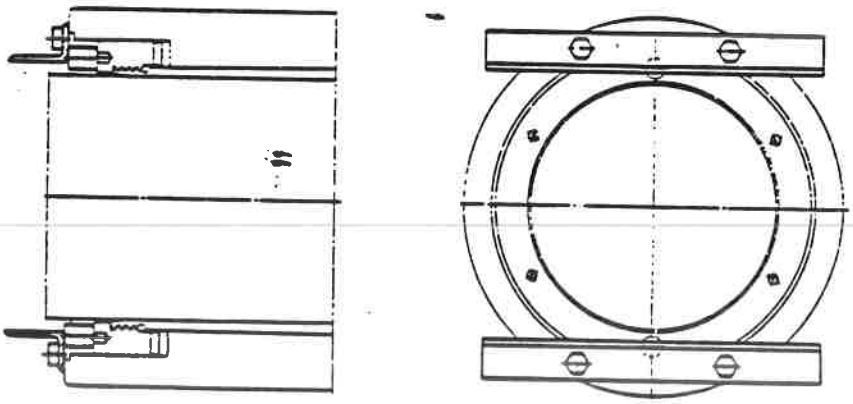
The outer sleeve is driven up by means of a hydraulic pump with a return valve and giving a working pressure of some 30 MPa (300 kg/cm^2). Either a manually operated pump or one power-driven, by motor or compressed air, may be used. Power-driven pumps are preferred with large couplings as they facilitate and expedite the mounting operation. Since pneumatic pumps can be connected to ordinary compressed air cylinders, this type is also suitable where there is no electricity or compressed air installation.

Oil injectors

To inject oil between the coupling sleeves, two SKF high pressure injectors 226400 B should be used. See "Product information 300" for further details.

Complete tool kits

Kits containing all the equipment required for mounting and dismounting the coupling is available from SKF. Kit No. 728237 for couplings OK 180 HB – OK 300 HB includes one handoperated hydraulic pump set, two injectors, hexagonal keys, envelope of spare parts for the injectors and one tool case. Kit No. 728238 can be used for sizes OK 300 HB – OK 490 HB. This kit contains a hydraulic pump set driven by compressed air which enables the coupling to be mounted more quickly.



Locating device for outer sleeve

All couplings for shafts with diameters over 170 mm are equipped with a detachable locating device, which prevents the outer sleeve from being driven up unintentionally on the inner sleeve during transport and when the coupling is being mounted or dismounted. The device is removed when the coupling has been positioned correctly on the shafts.

Oil

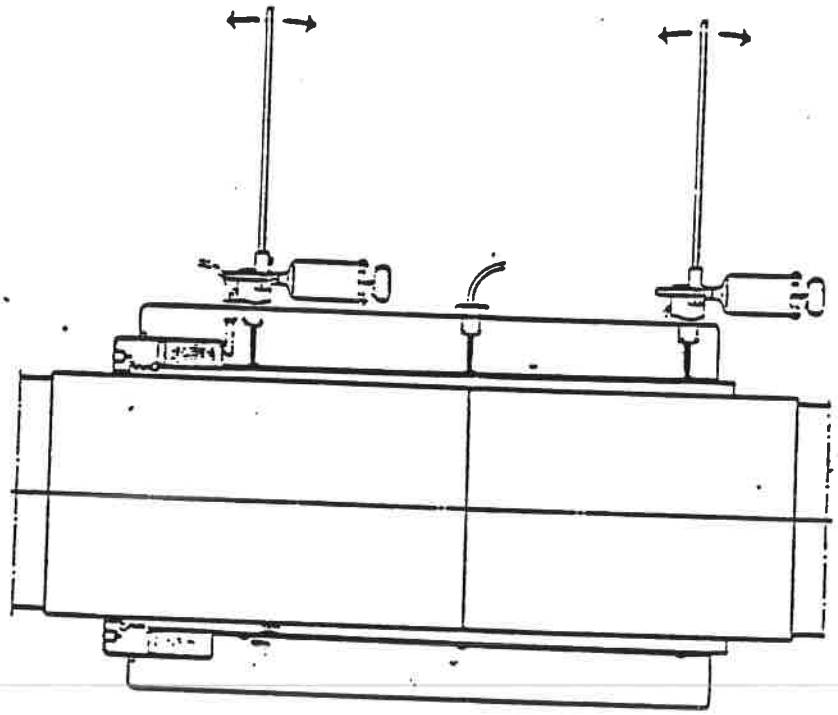
The oil to be used for the hydraulic pump and the injector should have a viscosity of 300 mm^2/s (300 cS) at the temperature of the coupling. If the oil used for mounting is too thick, there is a risk that it will remain between the sleeves, resulting in a considerably deteriorated grip. The adequate viscosity will generally be obtained with sufficient accuracy if the oil is chosen as follows:

Temperature range	Viscosity in SAE
0 – 10 °C	SAE 10
10 – 20 °C	SAE 20
20 – 30 °C	SAE 30
30 – 40 °C	SAE 40

INSTRUCTIONS FOR MOUNTING AND DISMOUNTING

of shaft coupling OK 260 HB 216030 used on the

hollow shafting in Bel-Aire 302



THE PRINCIPLE OF THE COUPLING

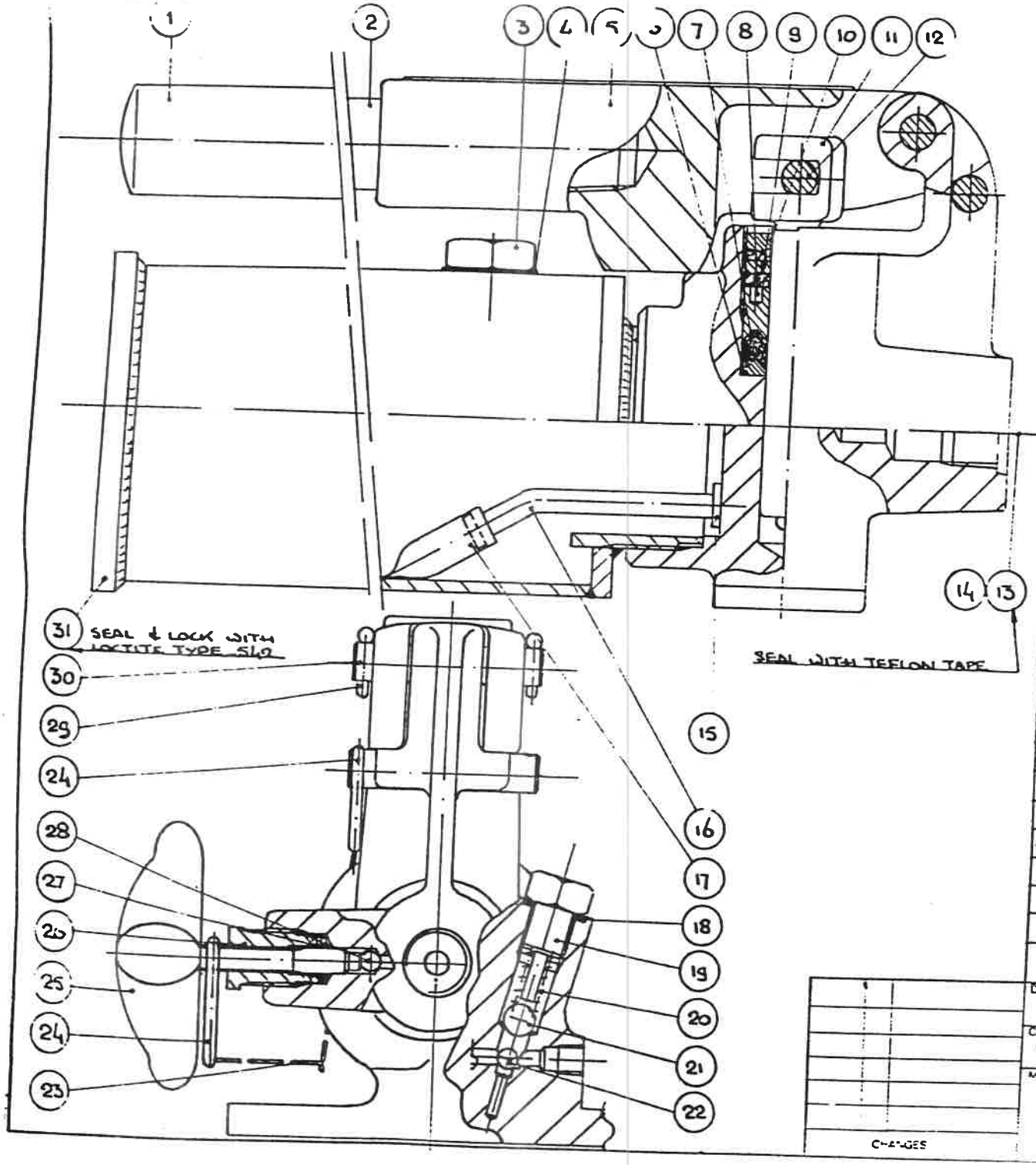
The OK-HB coupling consists basically of two sleeves of high quality steel, a thin inner sleeve and a thick outer sleeve. The outer surface of the inner sleeve is slightly tapered and the bore of the outer sleeve has a corresponding taper. The inner sleeve bore is somewhat larger than the diameter of the shafts, so that the sleeve can be passed over them with ease. The outer sleeve is then driven up the tapered inner sleeve using the hydraulic unit incorporated in the coupling; this action compresses the inner sleeve onto both shafts. To allow this drive-up, the friction of the matching tapered surfaces is first overcome by injecting oil at high pressure between them, where it forms a load carrying film separating the two components. When the outer sleeve has reached its correct position, the injection pressure is released and the oil drains off, restoring normal friction between the sleeves.

Dismounting the coupling is equally simple. Oil is injected between the coupling sleeves to overcome the friction. As a result of the taper, the compressive force has an axial component which causes the outer sleeve to slide down the taper, forcing the oil out of the hydraulic unit. By controlling the flow of this oil, the sleeve can be prevented from sliding too quickly.

INSTRUCTIONS FOR USE

LOW PRESSURE HAND OPERATED PUMP 729122

1983-08-10



REPAIR KIT : DKH-5011

POS	PART. NO	DESCRIPTION	NO REQ.
31	DSA 8104-900	RESERVOIR ASSY	1
30	P 76-63 C	PIN	2
29	S 1-58	COTTER PIN	2
* 28	B 1005-016	BALL	1
* 27	B 217-074	PACKING	2
* 26	MJ 11-1	PACKING NUT	1
25	DSA 8102-900	SPINDLE ASSY	1
24	DSA 8038-049	CHAIN RING	2
23	DSA 8005-450	CHAIN	1
* 22	B 1006-016	BALL	1
* 21	B 1009-016	BALL	1
* 20	S 1-183	SPRING	1
19	K 3-006	PLUG	1
* 18	B 159-167	COPPER WASHER	1
17	P 307-018	SCREEN	1
16	DSA 8103-900	PIPE ASSY	1
15	DSA 8004-038	ADAPTER	1
14	DPF 8063-094	REDUCER	1
13	PFZ 1616-1	COUPLER (KNEE)	1
12	P 75-57	PIN	1
11	P 16-31	PLUNGER	1
10	P 16-54	NUT	1
* 9	P 16-75	PACKING	3
8	P 16-55	NUT	1
* 7	S 1-53	CUP	4
* 6	S 1-52.2	CUP SPREADER	1
5	B 113-060-1	BEAM	1
* 4	DSR-8012-037	NYLON WASHER	1
3	DSA 8017-950	FILL PLUG ASSY	1
2	DSA 8004-070	HANDLE	1
1	B 525-550	GRIP	1

CHANGES

DR B.S. DATE 19-12-77

CH SCALE -

MATERIAL

DESCRIPTION HANDPUMP

NUMBER DHP 7002-21-99 SERVICE.

729122

SUBJECT:

LOW PRESSURE HAND OPERATED PUMP 729122

Date of issue: 83-08-10
Supersedes : old
Page number : 3 of 3
Approval : MB

E. REPLACEMENT PARTS LIST

728245-3	case
729122-1	handpump (sub-assembly: see drawing)
729831A	quick connection coupling 1/4" BSP
729832A	quick connection nipple 1/4" BSP
729834	3 m hose 1/4" BSP

F. REPAIR KIT

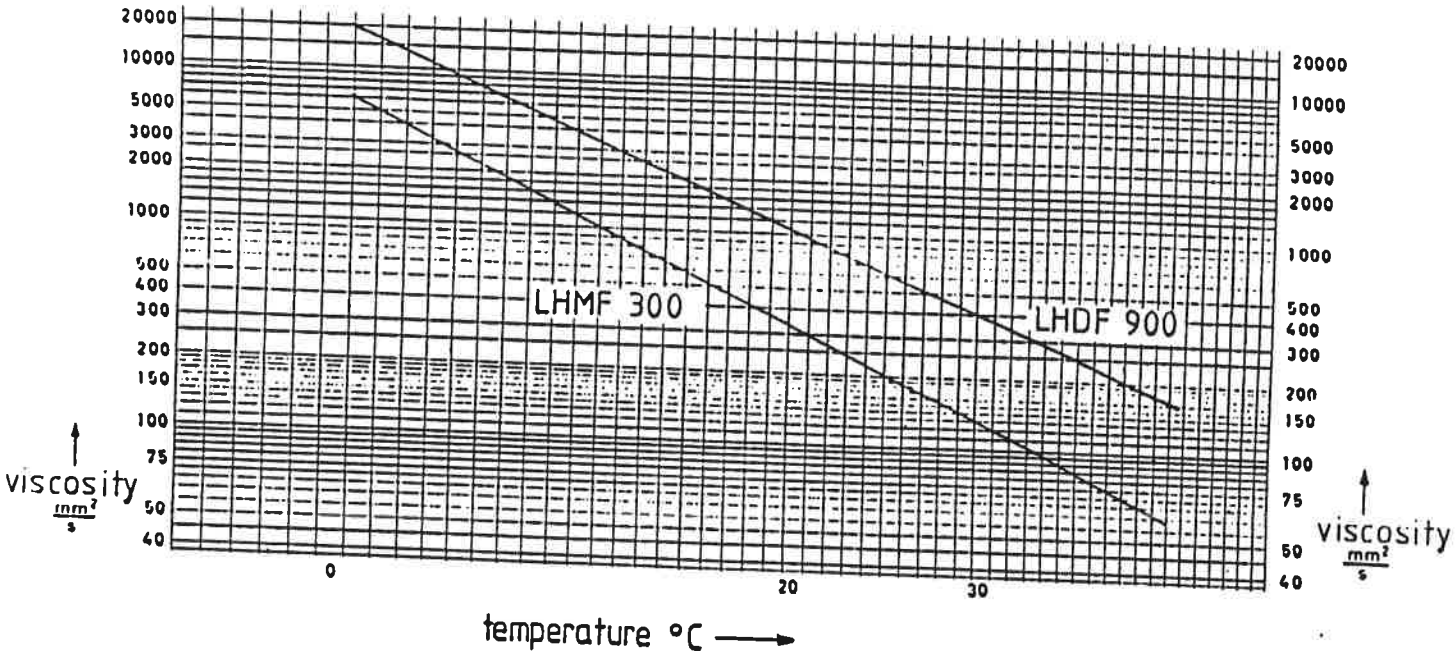
Available repair kit is DKH 8011.

For repair, see enclosed drawing.

SUBJECT:	Date of issue: 83-08-10 Supersedes : old Page number : 2 of 3 Approval :
LOW PRESSURE HAND OPERATED PUMP 729122	

D. OPERATING INSTRUCTIONS (Cont'd)

VISCOSITY VS TEMPERATURE DIAGRAM
FOR SKF FLUIDS LHMF300 AND LHDF900



To check the oil level and refill, unscrew the filling plug at the top. Always use a clean, uncontaminated oil.

Screw the 1/4" BSP nipple 729832A into the hydraulic nut, OK-coupling or connection hole to pressure joint. Connect the hose to the pressure joint by gently pulling the snap-ring of the quick connection coupling while pushing the quick connection coupling over the nipple 729832A. The hose can be disconnected in a similar manner.

Tighten the release valve on the right hand side of the pump and proceed to pump.
Maximum operating pressure is 50 MPa (7250 psi).

Pressure is released and oil returns to the container by opening the release valve.
NOTE: WHEN NOT IN USE FOR LONGER PERIODS THAN 30 DAYS, OPERATE PUMP WITH OPEN RELEASE VALVE SOME STROKES.

.../3

SUBJECT:	Date of issue: 83-08-10
LOW PRESSURE HAND OPERATED PUMP 729122	Supersedes : old Page number : 1 of 3 Approval : PMS

A. MAIN APPLICATION AREAS

- OK couplings (low pressure side) size OK 100 - OK 300.
- Hydraulic nuts and other applications for which a max. pressure of 50 MPa applies. This pump is being delivered with the OK coupling mounting kits 728236 and 728237.

B. DESCRIPTION

The pump 729122 consists of a handpump 729122-1, pressure hose 729834, quick coupling 729831A, quick connection nipple 729832A and case 728245-3.

C. TECHNICAL DATA

Mass	: 13 kg (28 lbs)
Length	: 450 mm (18 in.)
Width	: 170 mm (6.7 in.)
Height	: 130 mm (5.1 in.)
Volume/stroke	: 3.5 cm^3 (0.12 fl.oz.U.S.)
Oil container capacity	: 3,700 cm^3 (125 fl.oz. U.S.)
Pressure hose	: 3 m (9ft.10 in.) supplied with quick connector (external thread 1/4" BSP)
Maximum pressure	: 50 MPa (7250 psi)

D. OPERATING INSTRUCTIONS

This pump has been originally filled with SKF Mounting Fluid LHMF300 (viscosity of 300 mm^2/s at room temperature). For dismounting, SKF recommends the thicker Dismounting Fluid LHDF900 (viscosity of 900 mm^2/s at room temperature). These fluids contain anti-corrosives and are non-agressive to seal materials such as nitril rubber, Buna N (Perbunan), chrome leather, leather, PTFE, etc.

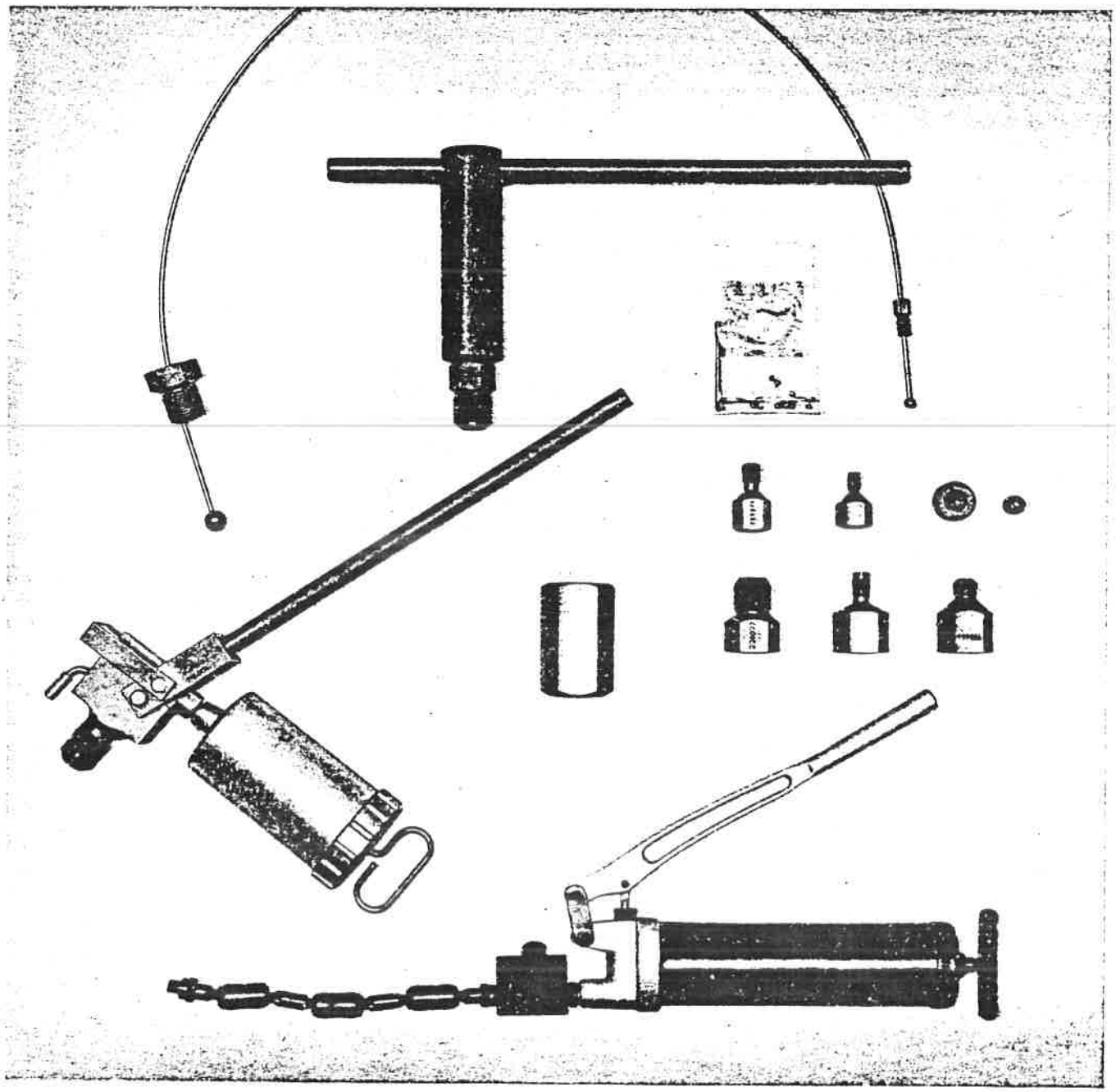
(Viscosity vs Temperature Diagram on next page)

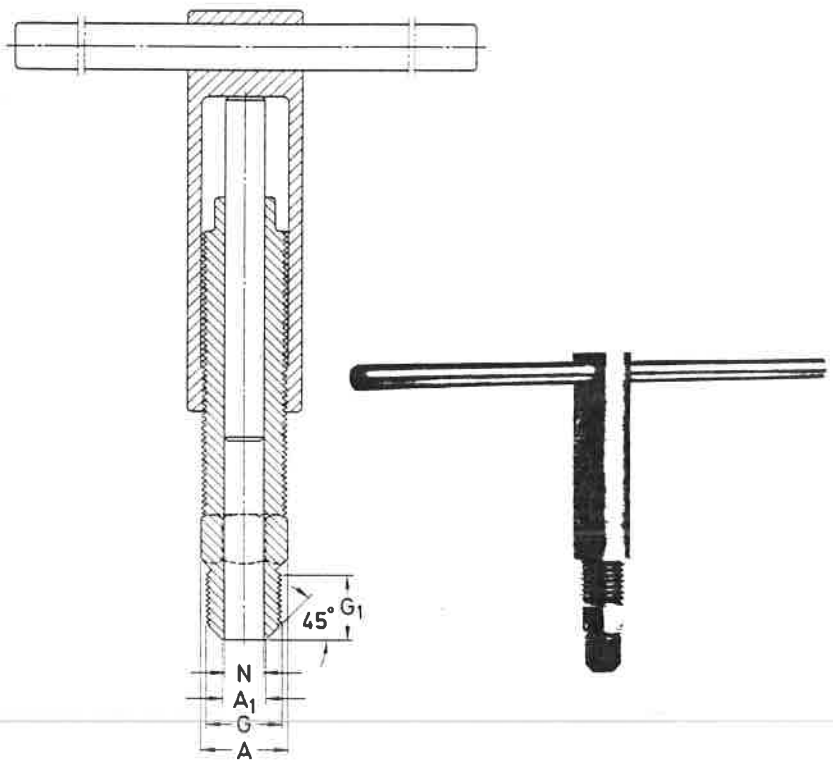
.../2

SKF

TSP 6028

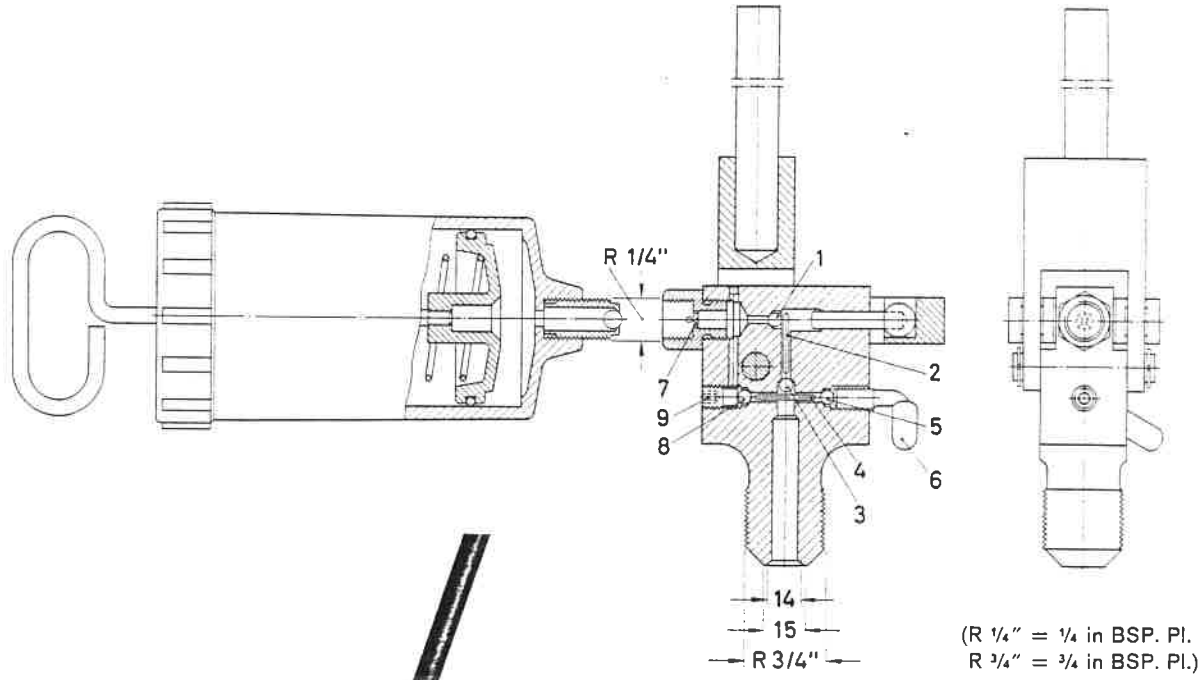
Oil injection equipment

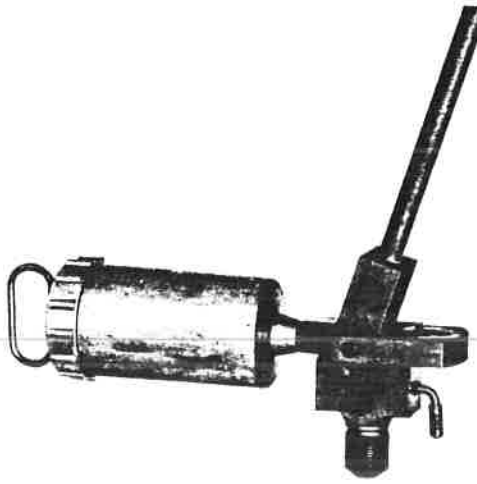




Oil injector No.	Thread G	Dimensions in mm G_1	A	A_1	N	Mass kg
226270	3/8 in BSP. Pl.	12	22	10	9	0.8
226271	3/4 in BSP. Pl.	22	30	15	14	2.1

Fig. 1 Oil injectors 226270 and 226271

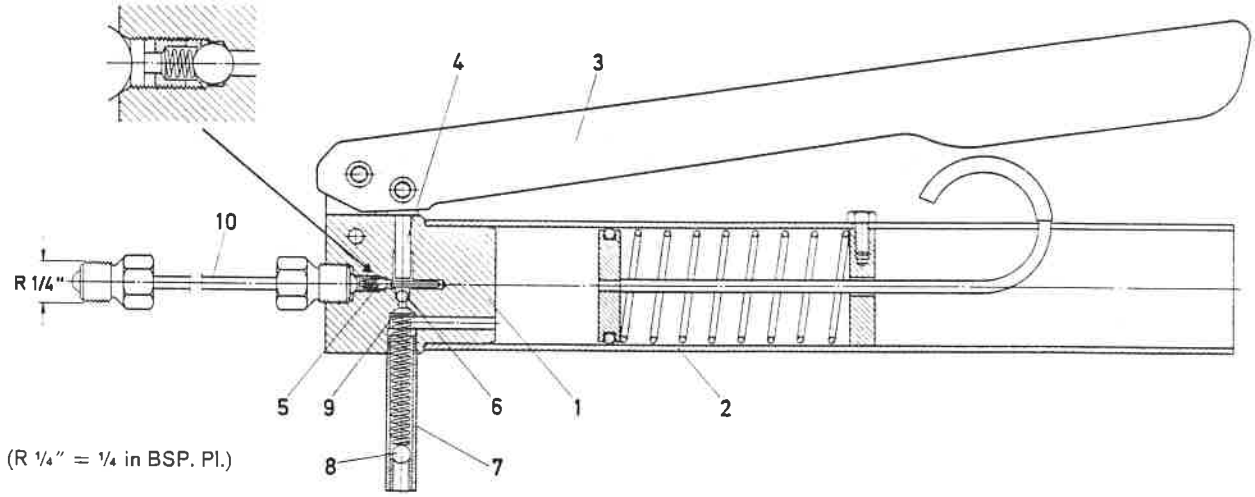


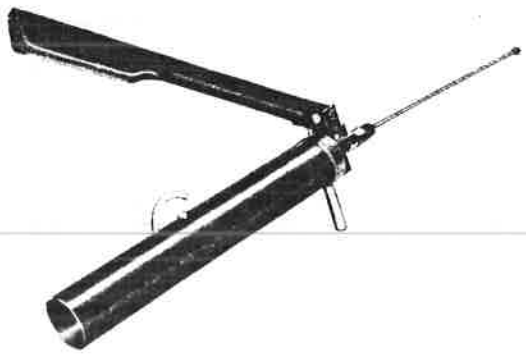


Technical data

Pressure capacity	300 MPa
Oil reservoir volume	200 cm³
Stroke volume	0.23 cm³
Diameter of pump plunger	6 mm
Mass	2.2 kg

Fig. 2 Oil injector 226400

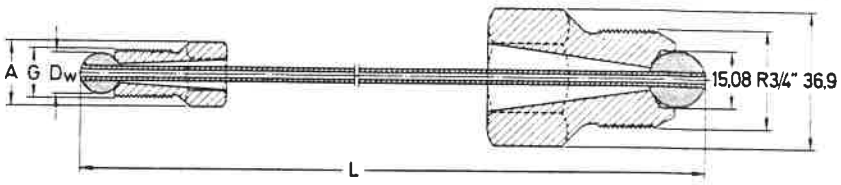




Technical data

Pressure capacity	300 MPa
Oil reservoir volume	100 cm^3
Stroke volume	0.25 cm^3
Diameter of pump plunger	5 mm
Length of high-pressure pipe	300 mm
Mass	1.5 kg

Fig. 3 Oil injector 727200



High-pressure pipe, No.	Thread G	Dimensions in mm A	D_w	L	Mass kg
721740	1/8 in BSP. Pl.	11.5	7.94	1000	0.3
227957	1/4 in BSP. Pl.	17.3	11.11	2000	0.4
227958	3/4 in BSP. Pl.	36.9	15.08	2000	0.55

(R 3/4" = 3/4 in BSP. Pl.)

Fig. 7 Flexible high-pressure pipes with ball nipples

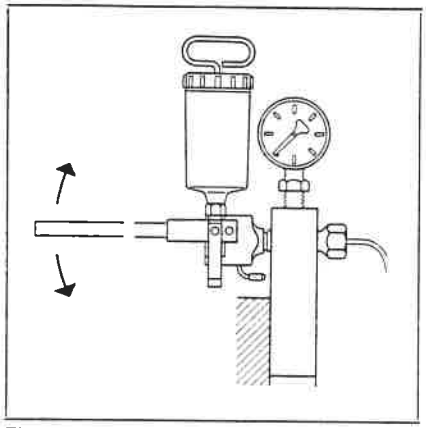


Fig. 8 Connection of injector 226400 via an injector adapter block

Flexible high-pressure pipes with ball nipples

Where the injector cannot be screwed directly into the component, oil is supplied by means of a high-pressure pipe connected to the injector by means of an adapter block, see fig. 8. The high-pressure pipe, fig. 7, is a narrow, thick-walled steel tube fitted with steel balls and threaded nipples at each end. The nipples hold the balls against the oil duct in the adapter block and in the component so that an effective seal is obtained. The relatively large freedom of movement of the pipe in the nipples facilitates connection.

Injector adapter blocks

Two designs of adapter block are available, 227982 and 1013523. As can be seen from fig. 9 and 10, the only difference between them is that design 1013523 has provision for a pressure gauge with 1/2 in BSP. Pl. thread.

Fig. 9 Injector adapter block 227982, mass 1.7 kg (R 3/4" = 3/4 in BSP. Pl.)

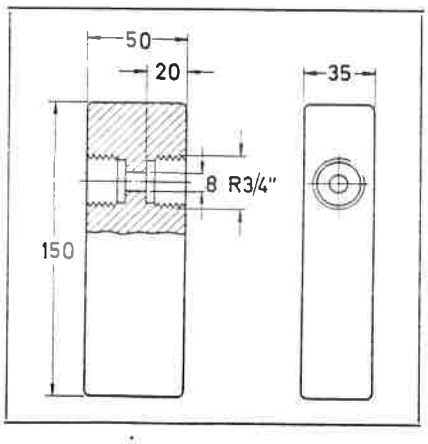
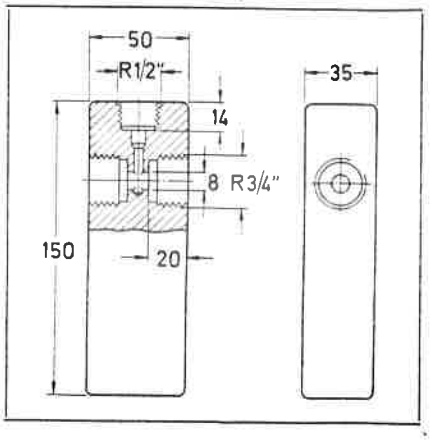
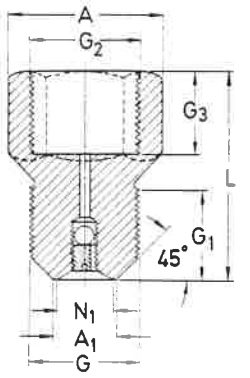


Fig. 10 Injector adapter block 1013523, mass 1.7 kg (R 1/2" = 1/2 in BSP. Pl.; R 3/4" = 3/4 in BSP. Pl.)





Valve nipple No.	Threads G, G_2	Dimensions in mm G_1	G_3	A	A_1	L	N_1	Mass kg
226272	3/8 in BSP. Pl.	12	9	25,4	10	30	9	0.05
226273	3/4 in BSP. Pl.	22	20	36,9	15	50	14	0.2

Fig. 13 Valve nipples

Valve nipples

Valve nipples, fig. 13, are used to retain oil under pressure in the components while the injectors, such as those described on pages 2 and 3, are being recharged. They are also used to retain the oil pressure if an injector is removed and used to inject oil in another duct in the same assembly.

Extension pipes

For thin-walled components, high-pressure pipe 227957 may be combined with a connection nipple, 234063, and an extension pipe, 234064 (fig. 14 and 15). The nipple may also be connected directly to a component having 1/8 in BSP. Pl. connection holes. The dimensions of the holes are given in fig. 16.

Fig. 14 Connection nipple 234063, mass 0.05 kg (R 1/4" = 1/4 in BSP. Pl.; R 1/8" = 1/8 in BSP. Pl.)

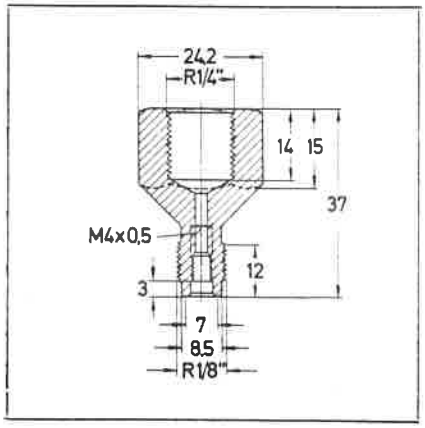
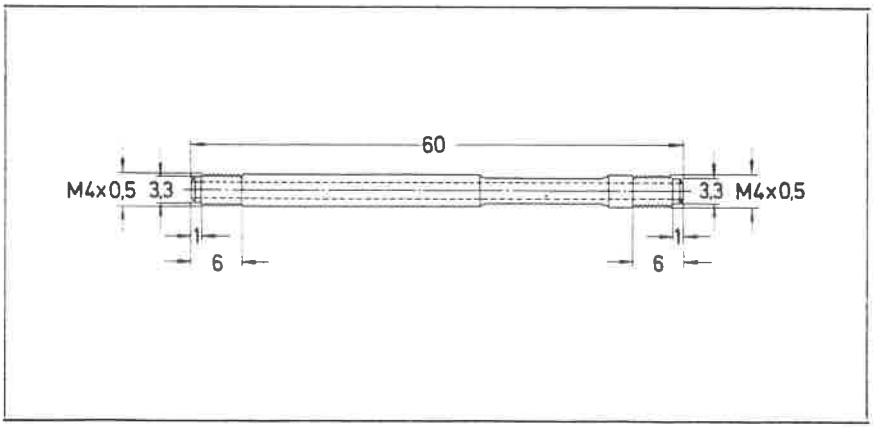
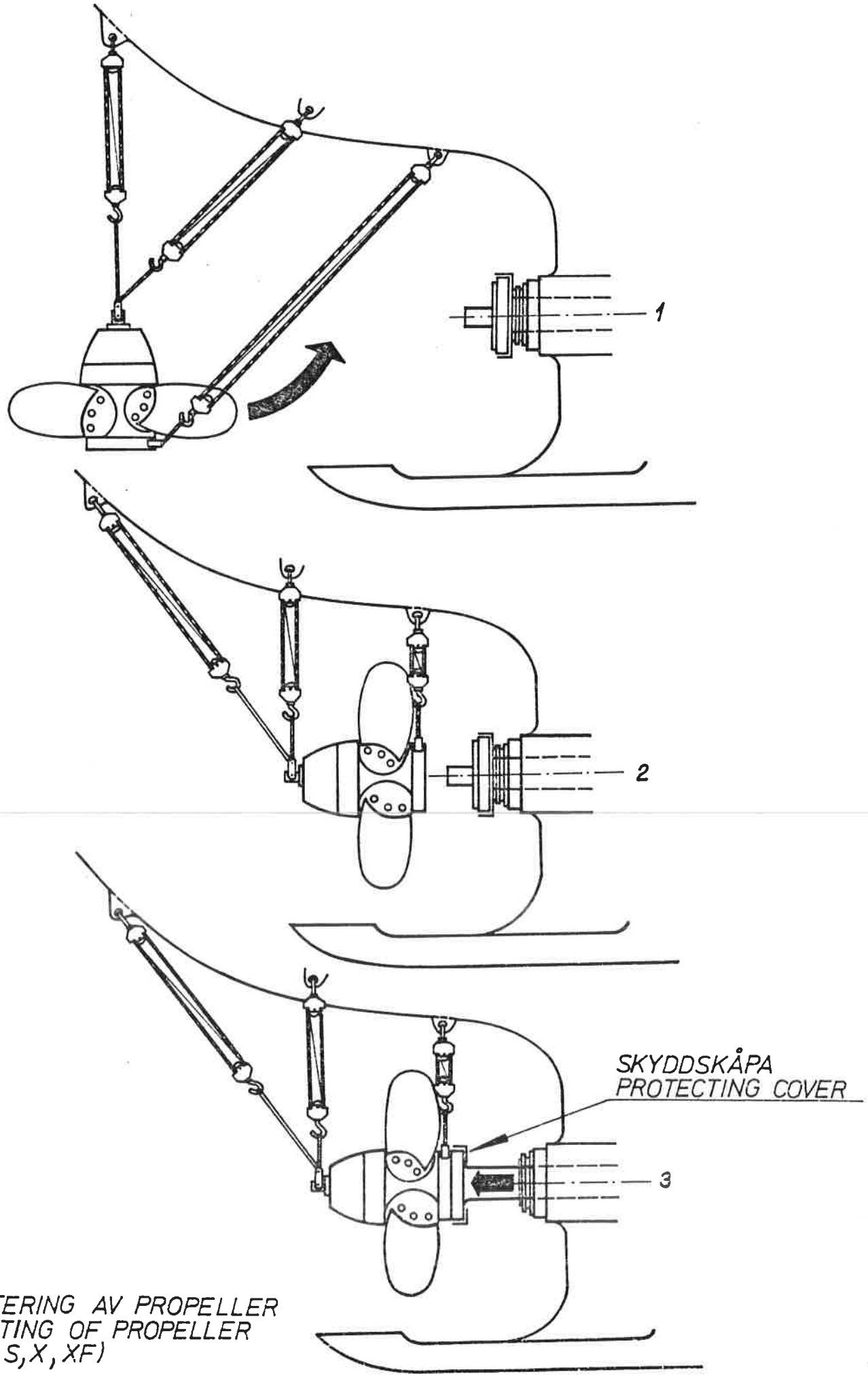
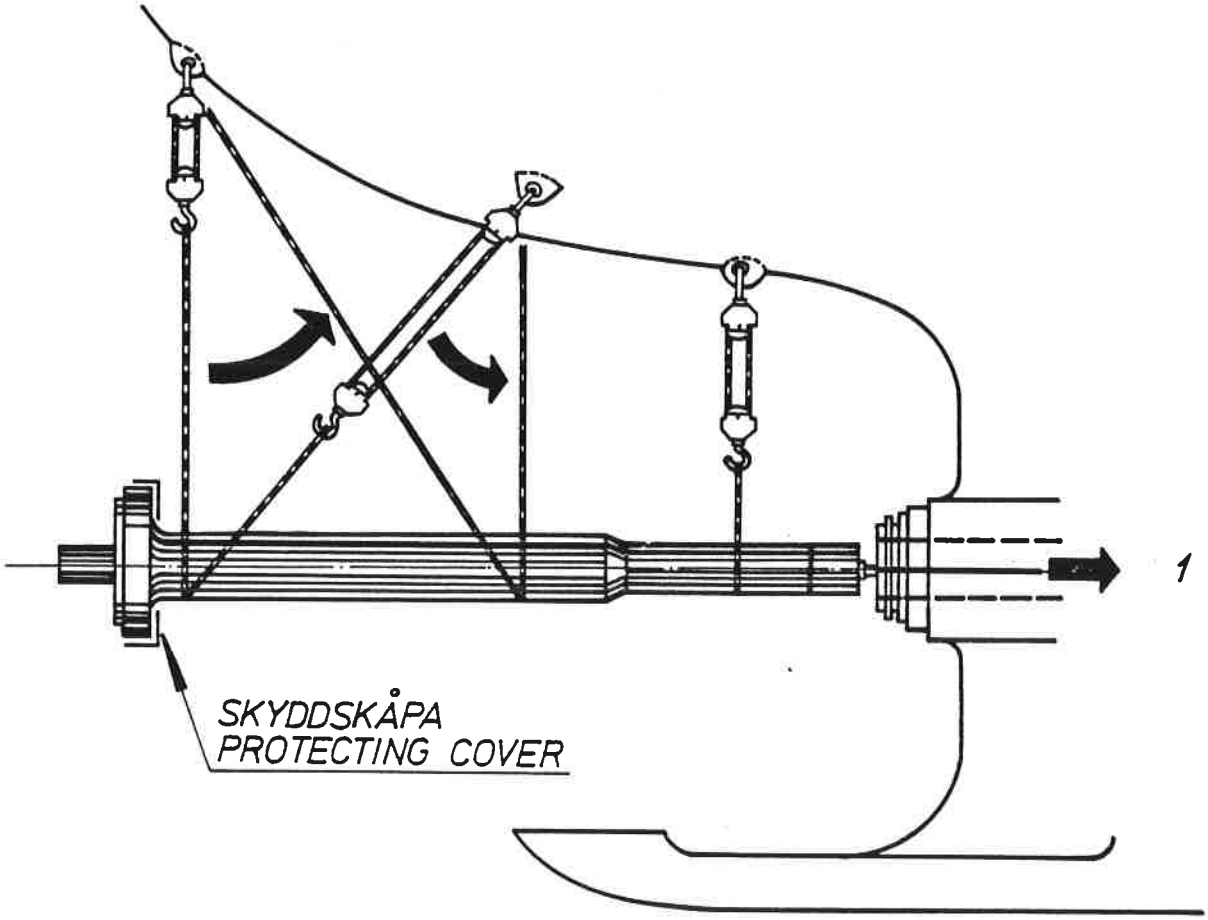


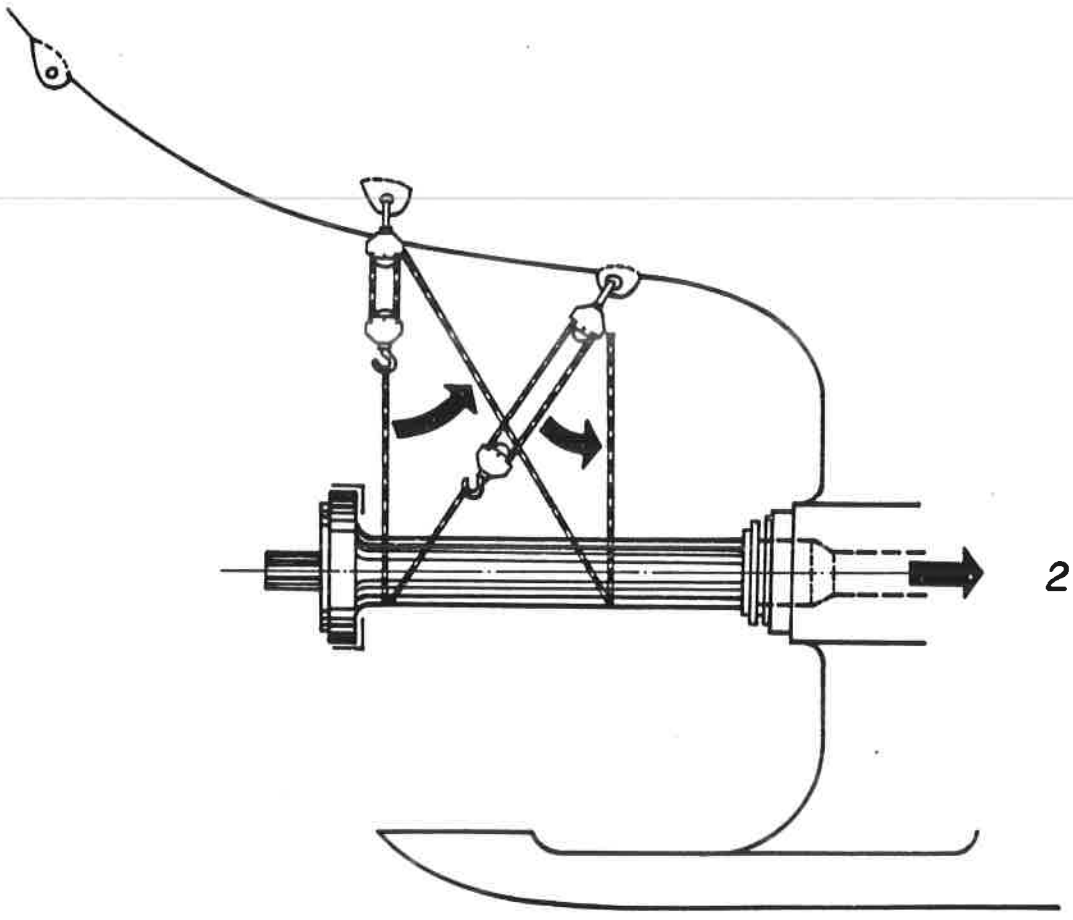
Fig. 15 Extension pipe 234064, mass 0.004 kg





MONTERING AV PROPELLER
MOUNTING OF PROPELLER
(HUB S, X, XF)





MONTERING AV PROPELLERAXEL
MOUNTING OF PROPELLER SHAFT
(HUB S,X,XF)

How to find a fault

Faults which may occur and how they can be corrected.

A. Low oil pressure

The oil pressure is set during the trial trip. If the oil pressure drops too far there is a risk that the pitch setting cannot be adjusted around zero-pitch. This risk is especially great at maximum rpm. The reason for too low an oil pressure may be:

1. The pump does not suck properly. Air leakage in the suction line or bad gland packing. Check also that the pump is working at the correct rpm.
2. Filter choked. Contamination in the main filter or in the auxiliary servomotor filter on the OD-box may cause a pressure drop. Clean according to the maintenance instructions.
3. The safety valve set too low. The valve is set during the trial trip and must be locked. The adjustment can be checked by setting the pitch in its extreme end position ahead or astern. The pressure is read on the gauge for the hub- or pump pressure. The propeller shaft must be stopped during such an inspection.
4. The piston of the safety valve has stuck. This may occur when the oil is very contaminated. The valve ought to be removed from the hydraulic unit before being taken to pieces and checked.
5. Too thin oil. Check that oil with the right viscosity is used, see "Oil recommendations".
6. Mechanical wear on the high pressure rings in the OD-box, the pin in the fore end of the valve rod or the regulating valve in the propeller hub. These parts normally have a very long operating time before wear and tear is noticed.

B. Leakage. Oil level in the lower tank sinks.

If the oil consumption rises the reason for the leakage must be investigated.

Possible reasons are:

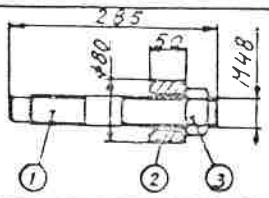
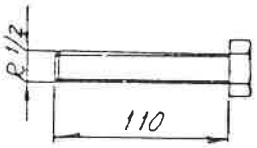
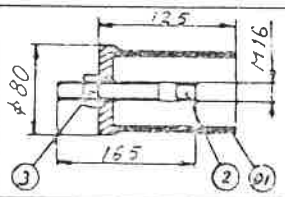
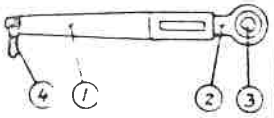
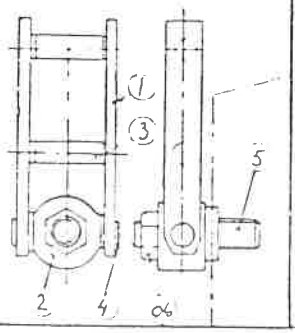
1. Blade sealing rings are worn. Check by studying the water surface above the propeller when the vessel is still. If there is a leak, oil spots can be seen on the water surface. If the oil comes from the propeller, the blade sealing rings ought to be changed during the next docking.
2. Leakage in the pipe system. Check all joints and fittings. Check if possible that the oil tank is tight so oil does not flow out into the keel. The top of the tank must be tight to prevent bilge water from entering.

C. Leakage. Oil level in the upper tanks falls.

When the hydraulic pumps are running the level in the upper tank is kept constant. When the pumps are stopped the oil level must not fall so fast, that the tank is emptied in less than 4 to 5 hours. If this occurs, leakage within the hydraulic system may be the reason and no oil is lost.

Possible leakage points are:

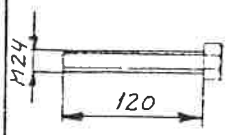
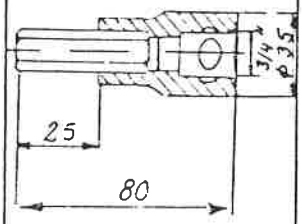
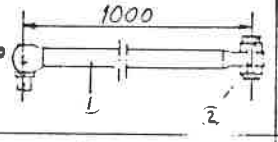
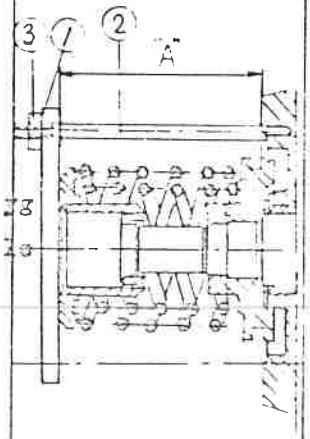
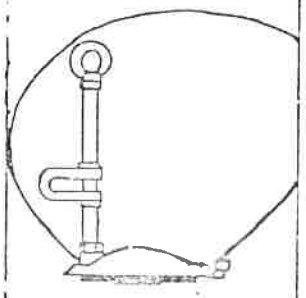
1. The check valves are loose or have seized. The valve cones must be inspected and ground in their seats.
2. The low pressure rings in the OD-box are worn. Check by loosening the pipes on the end covers of the box and measure the leakage.
3. The blade sealing rings are worn.

Nr No	Benämning Description	Skiss Sketch	Material	Antal No off	Märkning Marking: Ritn.nr. Dwg.nr.	Märkning Marking: Det Item	Placering Located
1	Montageskruv Erection screw		Stål Steel	4	577368	1-3	Propelleraxel-fläns - nav Propeller shaft flange - hub
2	Sprängskruv Forcing screw		-"-	4	935090	1	Axelfläns - Navkropp Shaft flange - Hub body
3	Avdragare för styrtapp Puller for guide bolt		-"-	1	503363D	01-3	Navkropp & prop.blad Hub body & prop.blade
4	Verktyg för momentdragning Tool for torque tightn.		-"-	1 2	577361	1,4 2-3	Skruvar i blad & axelfläns Screws in blade & shaft flange
5	Momentmätare Tension testing machine	 0-500 kp	-"-	1	935090	5	-"-
6	Lyftverktyg Lifting tool	Se ritn. See drw. 586583 	-"-	1 2	Single 586583	2,5 Ø6 1,3 4	Nav Hub

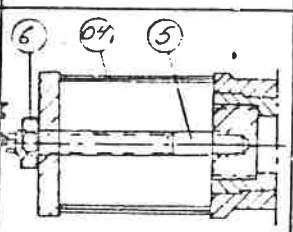
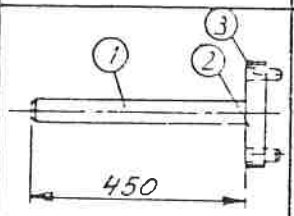
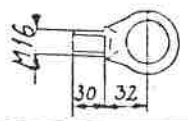
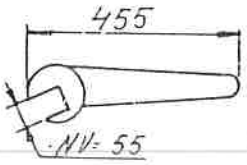
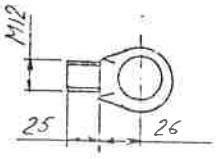
KMW
AB KARLSTADS MEKANISKA VERKSTAD

Kaplan-propeller
Verktygslista till nav 85 XF/4W
för instruktionsbok.
List of tools for hub 85 XF/4W
for instruction manual. 1 of 3

Konstr. Lnl
Datum 84.04.06
Blad 3/ 502
935096

Nr No	Benämning Description	Skiss Sketch	Material	Antal No off	Märkning Marking Ritn. nr. Dwg. nr.	Märkning Marking Det Item	Placering Located
7	Skruv Screw		Stål Steel	4	935090	8	Navspets Hub cone
8	Tapphylsa Key		Stål Steel	1	935090	9	Navspets Hub cone
9	Ledhandtag Pivoted handle		Stål Steel	1	586574	1,2	Navspets Hub cone
10	Monteringsverktyg Erection tools		Stål Steel	1 3	903549	1 2,3	Montage av fjädrar Erection of springs
11	Lyftverktyg Lifting tool	Se ritn. 935057 See drw. 	Stål Steel	1 3 4	935057	1-4, 6-8, 11 5 9,10	Propellerblad Propeller blade

KMW AB KARLSTADS MEKANISKA VERKSTAD	Kaplan-propeller Verktygslista till mod 86 XF/4W för instruktionsbok List of tools for hub 86 XF/4W for instruction manual 2 of 3	Konstr. Lnl	Skala
		Datum 84.04.06	Reg. S/ 502
		935096	

Nr No	Benämning Description	Skiss Sketch	Material	Antal No off	Märkning Marking Ritn.nr. Dwg. nr.	Märkning Marking Det Item	Placering Located
12	**Montageverktyg** **Erection tool**		**Stål** **Steel**	**1**	903549	04-6	**Demontage av foder i kolvstång** **Dismountain of liner in piston rod**
13	**Slaghakenyckel** **key**	 D= 195-250	**Stål** **Steel**	**1**	935090	12	**Kolvstång** **Piston rod**
14	**Hyckel** **Key**		**Stål** **Steel**	1 2	390570	1,2 3	**Kolvstång** **Piston rod**
15	**Lyftögla** **Lifting eye**		**Stål** **Steel**	**2**	935090	14	Kolvstång, Kolv Piston rod Piston
16	*U-nyckel* *U-spanner*		*Stål* *Steel*	2	935090	15	*Ventilstång* *Valve rod*
17	Lyftögla Lifting eye		Stål Steel	1	915429	17	Tätningsbricka Sealing washer

KMW
AB KARLSTADS MEKANISKA VERKSTAD

KMW-propeller
Verktygslista till nav 86 XF/4W
förbindelsehandbok
List of tools for hub 86 XF/4W
for instruction manual 3 of 3

Konstr: Lnl
Datum: 84.04.06
Reg.:
Skala:
S/302
935096

BI 452 a 12 80 2 000 ... 37500 ...

(B)

Nr No	Benämning Description	Skiss Sketch	Material	Antal No off	Ritning Drawing Nr No	Ritning Drawing Det Item	Placering Located
1	Högtrycks-pump High pressure pump	Se ritning 518200 See drawing 518 200	-	1	518200	1	SKF koppling SKF coupling
2	Oljein-jektor Nr 226400 Oil injec-tor No 226400	Se SKF ritning TSP 6028 See SKF drawing TSP 6028	Stål Steel	2	518200	02	-"-

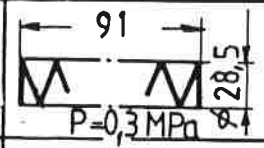
levereras AJCO Montreal

BI 452 • 12 86 2 000 ... 37500

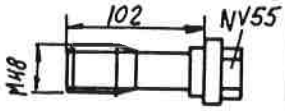
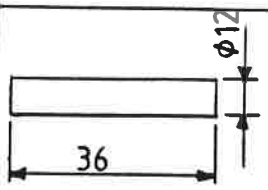
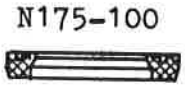
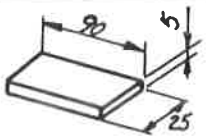
KMW
AB KARLSTADS MEKANISKA VERKSTAD

KaMeWa Propeller
Verktygslista - Axelledning
List of tools - Shafting

Konstr. Jom | Skala ----
Datum 84.04.25 | Reg. | S/ 502
927 888

Nr No	Benämning Description	Skiss Sketch	Material	Antal No off	Märkning Marking		Placering Located
					Ritn.nr Dwg.no.	Det Item	
1	Fjäder. Spring		Stål Steel	– 1	927761	55	Tryckupphålln.-ventil. Pressure main valve.
2	Testmanometer Gauge for testing.		—"—	1	—"—	54	Hydraulsystem Hydraulic system.

KAMEWA	KaMeWa-propeller Verktygslista för hydraulsystem List of tools for hydraulic system	Konstr. Jom	Skala
		Datum 840425	Reg S/502
		927889	

Nr No	Benämning Description	Skiss Sketch	Material	Antal No off	Märkning Marking: Ritn.nr. Dwg.no.	Märkning Marking: Det Item	Placering Located
1	Skruv Screw		Stål Steel	12	935060	13	Axelfläns Shaft flange
2	Låsplåt Locking plate		Stål Steel	18	- " -	18	Skruvar i blad och axelfläns Screws in blade and shaft flange
3	Tätn.ring Sealing ring		Gummi Rubber	1	- " -	19	Navkropp - Kolvstång Hub body - Piston rod
4	O-ring	475 x 14,7	Gummi Rubber	4	- " -	20	Bladtätnings-ring Blade sealing ring
5	O-ring	44,2 x 5,7 - 1	Gummi Rubber	72	- " -	21	Skruvar i blad och axelfläns Screws in blade and shaft flange
6	O-ring	715 x 8,4 - 1	Gummi Rubber	2	- " -	22	Axelfläns - Navkropp Shaft flange Hub body
7	O-ring	629,3 x 5,7 - 1	Gummi Rubber	1	- " -	23	Navcylinder - Navkropp Hub cylinder - Hub body
8	O-ring	22,2 x 3 - 1	Gummi Rubber	2	- " -	24	Propp i navkropp Plug in hub body
9	Låsplåt Locking plate		Stål Steel	20	- " -	33	Navcylinder-skruv Hub cylinder screw

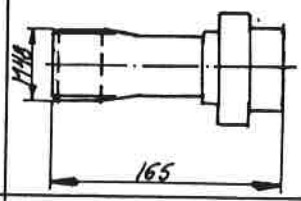
KMW
AB KARLSTADS MEKANISKA WERKSTAD

KaMeWa-propeller
Reservdelslista till nav 86XF/4W
för instruktionsbok
List of spare parts for hub 86XF/4W
for instruction manual. 1 of 2

Konstr. LnL | Skala

Datum 84.04.06. | Rev. | S/502

935095

Nr No	Benämning Description	Skiss Sketch	Material	Antal No off	Märkning Marking Ritn.nr. Dwg.no.	Det Item	Placering Located
10	Skruv Screw		Stål Steel	6	935060	38	Bladfläns Blade flange
11	O-ring	14,3 x 2,4 - 1	Gummi Rubber	4	-"-	49	Skruv i tätnings-bricka Screw in sealing washer
12	O-ring	171,4 x 4 - 1	Gummi Rubber	4	-"-	41	Tätn.bricka - vevt.ring Sealing washer - Crank pin ring
13	O-ring	246 x 4 - 1	Gummi Rubber	4	-"-	42	Tätn.bricka - vevt.ring Sealing washer - Crank pin ring
14	O-ring	378 x 4 - 1	Gummi Rubber	4	-"-	43	Tätn.bricka - vevt.ring Sealing washer - Crank pin ring
15	O-ring	478 x 6 - 1	Gummi Rubber	4	-"-	44	Tätn.bricka - vevt.ring Sealing washer - Crank pin ring
16	O-ring	50 x 5	Gummi-Rubber	4	-"-	50	Tätningsbricka-bricka Sealingwasher-washer

KMW
AB KARLSTADS MEKANISKA WERKSTAD

KaMeWa-propeller
Reservdelslista till nav 86XF/4W
för instruktionsbok
List of spare parts for hub 86XF/4W
for instruction manual. 2 of 2

Konstr LnL | Skala
Datum 84.04.06 | Reg | S/502
935095

Nr No	Benämning Description	Skiss Sketch	Material	Antal No off	Märkning Marking		Placering Located
					Ritn. nr. Draw. no.	Det. Item	
1	O-ring	499,3×5,7-704	Gummi Rubber	1	927791	4	Propelleraxel Propeller shaft
2	O-ring	13,3×2,4	Viton	16	927791	7	Propelleraxel Propeller shaft
3	O-ring	22,2×2,6	Gummi Rubber	4	927791	9	Propelleraxel Propeller shaft
4	O-ring	479,3×5,7-704	Gummi Rubber	1	927792	3	Mellanaxel Intermediate shaft

vereras AJCO Atreal

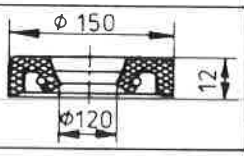
KAMEWA

KaMeWa-propeller
Reservdelar, axelledning
Spare parts, shafting

Konstr. Jom | Skala

Datum 84.04.24 | Reg. | Sl 502

927 886

Nr No	Benämning Description	Skiss Sketch	Material	Antal No off	Marking Ritn.nr Dwg.no.	Marking Det Item	Placering Located
1	O-ring	109,1 x 5,7 -1	Gummi Rubber	1	937 140	49	Axeltapp Stub shaft
2	-"-	229,3 x 5,7 - 1	-"-	1	-"-	50	Aktre gland Aft gland
3	-"-	159,3 x 5,7 - 1	-"-	1	-"-	51	Lågtrycks-tätningsring Low pressure sealing ring
4	-"-	209,3 x 5,7 - 1	-"-	2	-"-	52	Högtrycksdel och lock High pressure part and cover
5	-"-	249,3 x 5,7 - 1	-"-	1	-"-	53	Högtrycksdel/ växel High pressure part/gear hous
6	-"-	59,2 x 5,7 - 1	-"-	1	-"-	54	TO-box, ut-lopp OD-box, out-let
7					-"-	55	
8	Tätningsring Sealing ring		Gummi/ Stål Rubber/ Steel	1	-"-	56	Aktre gland Aft gland
9						57	
10						58	
11						59	
12						60	

KMW
AB KARLSTADS MEKANISKA WERKSTAD

KaMeWa Propeller
Reservdelslista för instr bok
Tryckoljebox ϕ 121 F3-spec
Spare parts for instruction manual
Oil distribution box ϕ 121 F3- spec

Konstr: Fmj | Skala: —
Datum: 77.05.16 | Reg | S/502
937 149