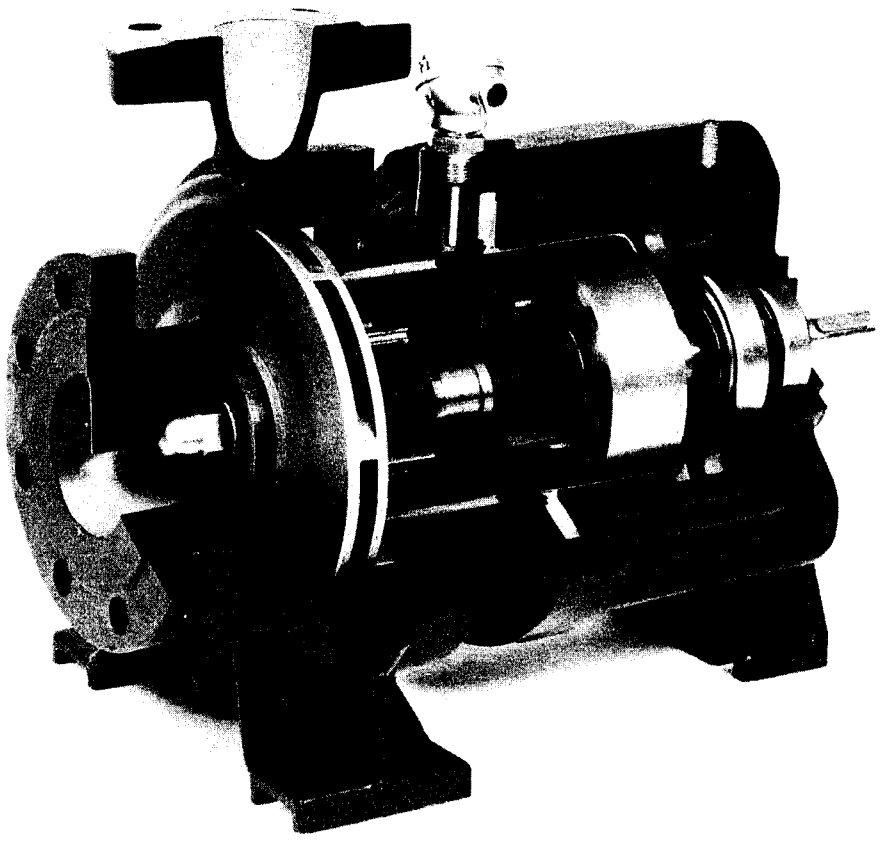
Installation, Operation and Maintenance Instructions

Type AMF



Sizes:					
	1 1/2"	x	1"	x	6 1/2"
	1 1/2"	x	1"	x	8"
	3"	x	1 1/2"	x	6 1/2"
	3"	x	2"	x	6 1/2"
	3"	x	1 1/2"	x	8"

Issue : 06/92

DICKOW PUMPEN KG

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1. GENERAL INFORMATIONS

1.1 INTRODUCTION

This manual provides instructions for the installation, operation and maintenance of the DICKOW-model AMF, magnetic driven process pumps.

IT IS ESSENTIAL THAT THIS MANUAL BE THROROUGHLY REVIEWED AND THAT COMPLETE COMPREHENSION OF THE MATTERS EXPLAINED HEREIN IS ATTAINED BEFORE ATTEMPTING INSTALLATION AND START-UP.

The design, materials and workmanship incorporated into the DICKOW Pump are based on years of experience. They assure trouble-free service throughout the life of the Pump. However, like any rotating equipment, satisfactory performance depends on correct initial sizing, proper installation, periodic inspection, monitoring of operating conditions (temperature, vibration, flow) and prescribed maintenance. This Manual has been prepared to assist the operator in understanding the workings of the DICKOW Pump, i.e. proper installation, operation and maintenance.

1.2 LIMITED WARRANTY

Dickow warrants that DICKOW Pumps and parts are free, upon installation and start-up per this Manual and under rated use and service, from defects in design, material, and workmanship for a period of one (1) year from date of installation, but not to exceed eighteen (18) months from date of shipment by Dickow. This warranty does not cover

(i) any loss or damage resulting from wear, corrosion, abrasion or deterioration due to normal use in rated service;
(ii) replacement of service items such as shaft packings and mechanical seals;
(iii) products or parts manufactured by others but furnished by Dickow which, if defective, shall be repaired or replaced only to the extent of the original manufacturer's warranty;
(iv) any loss or damages to, or defects in any such products or parts resulting from the misuse or improper storage, installation or operation thereof; or
(v) any loss or damages to, or defects in, any such products or parts resulting from any alteration or modification of the products or parts not expressly authorized and approved by Dickow in writing.

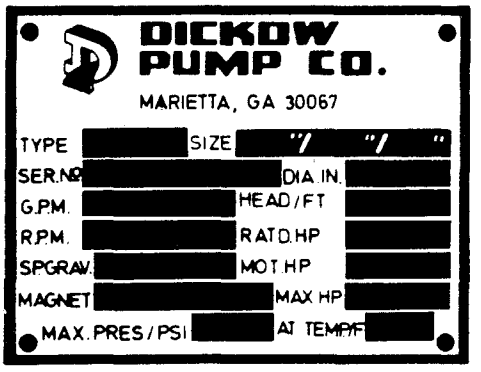
Dickow shall not be liable, directly or indirectly under any circumstances, in an amount greater than the purchase price nor for consequential or incidental damages, including, but not limited, to: any loss of business or profits, and labor, material or other charges, claims for losses or damages incurred or suffered from, in connection with, or in consequence of the working upon, alteration, or repair of any such defective products or parts by persons or firms other than Dickow. Dickow's liability for breach of warranty hereunder is limited solely to the repair or to the replacement, F.O.B. Dickow facility, as the case may be, of any products or parts which shall have been determined by Dickow, after written notice to Dickow, and inspection by Dickow within the warranty period, to be so defective when shipped by Dickow.

THIS WARRANTY AND THE LIABILITY SET FORTH HEREIN ARE EXCLUSIVE AND IN LIEU OF ALL OTHER LIABILITIES AND WARRANTIES, EXPRESS OR IMPLIED, INCLUDING IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR PARTICULAR PURPOSE.

1.3 FACTORY INSPECTION

Before delivery, all pumps are performance-tested in our factory test area at the specified speed. Test reports are available on request. Furthermore, a hydrostatic pressure test is performed before delivery. Unless otherwise stated in our order acknowledgement, the test pressure is at least 300 psi (20 bar). Pressure test certificates together with performance reports are available on request.

1.4 NAME PLATE INFORMATION



A name plate providing information on your pump is located on the bearing frame of each pump. Following information is given:

- Designation of pump size (discharge / suction / nominal impeller dia. e.g. 1 1/2 x 1 x 8)
- Pump serial number
- Installed impeller diameter
- Rated pump data acc. to your order
- Installed magnet at rated speed and ambient temperature
- Max. allowable pressure at temperature (^{o}F)

ATTENTION !

The rated motor power should not exceed the maximum transmissible power of the magnets, otherwise the magnets will slip during start-up.

1.4.1 Spare parts orders

When ordering spare parts, you will need to know the pump model, size, serial number, and the item number of the required parts. Information can be taken from the pump casing tag. Item number information can be found in this manual. In case the name plate is lost, the serial number is also stamped on the pump's discharge flange.

1.5 SAFETY

1.5.1 Medical precautions

ATTENTION !
All magnetic driven pumps contain extremely strong magnets which may pose health risks. Following Guidelines must always be observed:

1. Individuals with artificial cardiac pacemakers, implanted defibrillators, metallic prosthetic heart valves, internal wound clips (from surgery), prosthetic joints, metallic wiring, or other metallic prosthetic devices shall avoid working with, being in proximity of, or handling the magnets contained in the pumps.

2. Individuals with sickle cell anemia or those with significant blood pressure elevation shall also avoid work on this unit.

3. Individuals who have had previous surgeries (especially chest or head surgery) and who do not know if they have metallic clips internally should avoid work on this unit unless it can be firmly established by his or her physician that no metallic devices exist.

1.5.2 General Precautions

ATTENTION !
Personal injuries will result if procedures outlined in this manual are not followed.

1. Never operate pump without correct installed coupling guard.

2. Never start pump without making sure it is primed and the pump- and suction line is completely filled with liquid.

3. Never run pump at dead head or below minimum flow.

4. Never run pump dry.

5. Always switch off power to driver when performing pump maintenance.

6. Never operate pump without safety devices installed.

7. Never operate pump with suction valve closed or throttled or with clogged suction strainer.

8. Never disassemble pump before completely drained and cleaned from pumped liquid.

9. Never use heat for pump disassembly.

2. PUMP DESCRIPTION

The DICKOW-AMF-pumps are sealless frame-mounted centrifugal pumps with an enclosed impeller driven by a synchronous magnetic coupling. The flange to flange dimensions meet the standard of ANSI B73.1

2.1 CONSTRUCTION

Disassembly of the rotating hydraulic part - complete with magnetic drive and bearing - is possible without loosening suction- and discharge flanges. When spacer-type couplings are used, the driving motor can also remain bolted on the baseplate while dismantling the rotating unit.

Furthermore, the bearing bracket with the outer magnetic unit can be removed without releafing the stress of the pump. The advantage is that a safety inspection of the shroud (i.e. wall thickness, wearing test through ultrasonic) or the change of the outer ball bearings is possible at any time without emptying the pump.

2.1.1 Pump casing

The casing is of end suction and centerline top discharge type, self-venting. Flanges 150 lbs/ANSI raised face are standard. The pumped liquid is sealed from the atmosphere by a static chambered gasket. Complete drainage of the pump including magnet area is possible through the 1/2" casing drain connection.

2.2.2 Impeller

The closed impellers of the AMF-pumps are hydraulically balanced by certain balancing devices and keyed to the pump shaft. Frame size AB/A50/A60 is also provided with a rear impeller as a part of the balancing system.

2.2.3 Bearing housing, internal circulation

The bearing housing connects the pump casing with the shroud and the magnetic drive parts and accepts the sleeve bearings. The bearing housing is provided with holes for an internal circulation flow that dissipates the heat generated by the magnetic losses. The circulation flow leads from discharge to discharge and pressurizes the magnet end to prevent flashing of the pumped liquid in this area. No liquid with elevated temperature will lead to the impeller eye on the suction side. Therefore, handling of boiling liquids with low NPSH-requirement is possible, The magnet area is also self-venting. Gas or air in the shroud area escape through the internal circulation holes until the shroud is completely filled with liquid.

2.2.4 Outer ball bearings

The drive shaft that transfers the motor power to the drive rotor is carried in permanent lubricated antifriction bearings. These bearings are protected against dust and moisture from the atmosphere by a lip seal. In order to prevent possible skidding and to achieve smooth running and low noise, the bearings are preloaded by cup spring.

2.2.5 Sleeve bearings and thrust bearings

DICKOW-Standard bearing material is "Pure sintered alpha grade Silicon Carbide". SiC-bearings with diamond layer for an extended dry running capability are available as an option. The Silicon Carbide parts are not positively held by pins or keys, they are shrink-fitted or flexibly mounted to prevent mechanical damage. The bearing unit is thermo-shock resistant as no thermal stress occurs.

2.2.6 Magnet drive

DICKOW-Standard magnet material is Cobalt Samarium (CoSm) that allows temperatures in the magnet area up to 425 °F (220°C). The inner magnets are encapsulated by the rotor can and protected against the pumped liquid.

2.2.7 Shroud

The shroud separates the pumped liquid from the atmosphere. Standard material is Hastelloy C that provides excellent corrosion- and erosion resistance and low magnetic losses. Standard shroud thickness 0.039" (1 mm). The pressure containing shroud is made in one piece without welds. Sealing from atmosphere by fully confined O-ring; metal to metal fit between bearing housing and shroud.

3. INSTALLATION

3.1 RECEIVING THE PUMP

Inspect the pump as soon as it is received. Make notes of damaged or missing items on the receipt and freight bill. File any claims with the transportation company immediately.

Storage Requirements

Short Term - (less than 6 months):
DICKOW normal packaging procedure is designed to protect the pump during shipping. Upon receipt store in a covered and dry location.

Long Term - (more than 9 months):
Preservative treatment of bearings and machined surfaces will be required. Rotate shaft several times every 3 months. Refer to driver and coupling manuals for their long term storage procedures.

Handling

Use care when moving pumps. Lifting equipment must be able to adequately support the entire assembly. Hoist bare pumps, using a sling under the suction flange and bearing housing.

ATTENTION !
Failure to properly lift and support equipment may result into serious injury or damage of the pumps.

3.2 SITE, FOUNDATION

The pump should be located near the medium source and have adequate space for operation, maintenance, and inspection.

Baseplate mounted pumps are normally grouted to a concrete foundation, which has been poured on a solid footing. The foundation must be able to absorb any vibration and to form a permanent, rigid support for the pumping unit.

The location and size of the foundation bolts are shown on the outline assembly drawing, provided with the pump data package.

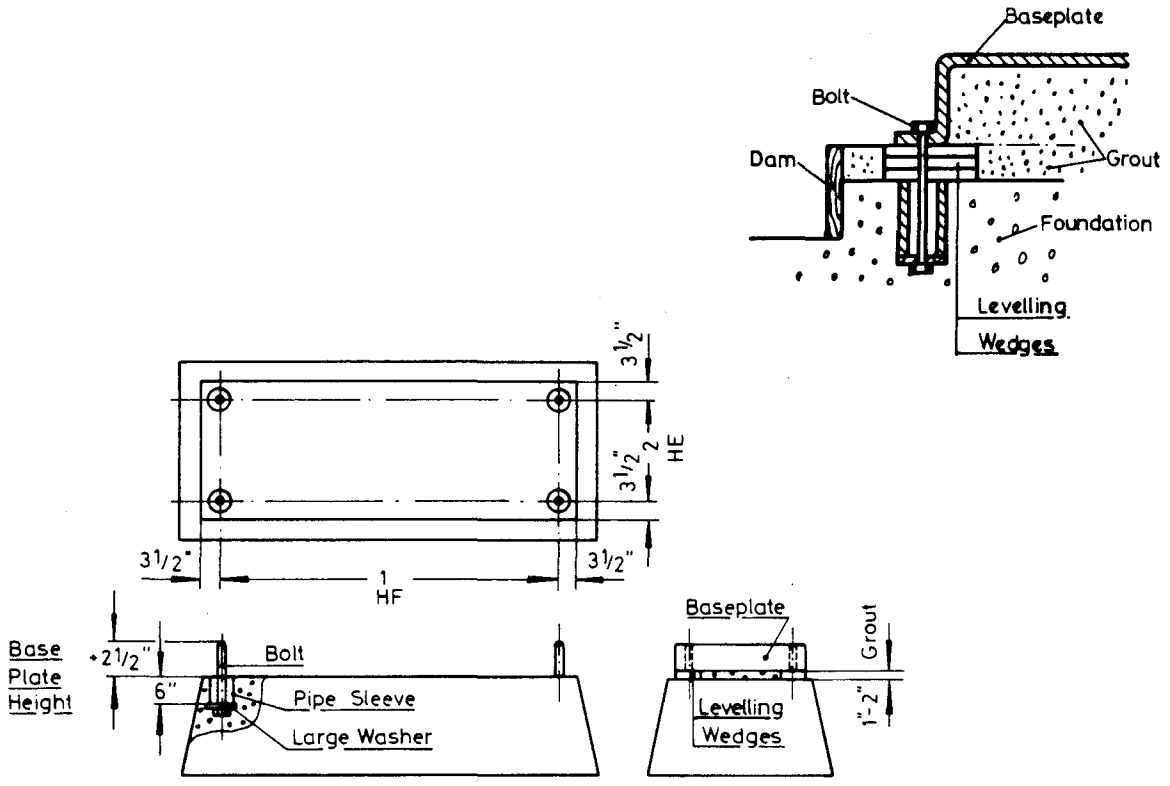
Foundation bolts commonly used are sleeve type and J-type. Both designs permit movement for final bolt adjustment.

3.3 BASEPLATE LEVELLING, PIPING CHECK

The sequence of mounting which must be observed for proper baseplate and pump mounting is as follows:

1) Place baseplate with pump and driver mounted on the pump foundation.

2) Use wedges under the baseplate edges to properly level the unit. Check this with a machinist's level. Pull down the baseplate mounting bolt nuts tightly and recheck that plate is level. Correct if necessary.



TYPICAL FOUNDATION LAYOUT

3) Check driver rotation by removing the coupling spacer and bumping the motor starting button. If driver rotation is correct, proceed with alignment. If not, reconnect the motor wiring properly and again check for rotation. When the driver rotation is correct, proceed with alignment.

4) Align the driver to the pump.

5) Grout the baseplates in accordance to par. 3.5.
Do not grout the baseplate to the foundation until pump and driver are correctly aligned.

6) Determine that piping to the pump is in exact alignment with the pump flanges and imposes no piping strain on the pumping unit. When the alignment is exact, the piping may be bolted in place. Consider also par. 3.6.

7) Recheck pump and driver alignment to ensure that no distortion of the pump unit has been caused by piping strain. Correct piping if misalignment has occured and again align pump and driver.

8) Pump and driver alignment must again be checked at the operating temperature.

9) After about two weeks of normal pump operation, the pump and driver alignment should again be checked under hot conditions. If alignment is still correct the driver feet may be doweled to the baseplate. If the alignment has changed, realign the unit and recheck after two weeks.

3.4 PUMP AND DRIVER ALIGNMENT

ATTENTION !
Before starting any alignment procedure, make sure that driver is shut off.

Proper running life of a pump and driver unit depends on the accuracy with which the axis of the driver shaft coincides with the axis of the pump shaft when the unit is running. Although pumps and drivers are check aligned at the factory, handling during shipment and installation may cause the alignment to change.
The pump and driver alignment must always be checked and corrected before the baseplate is grouted to the foundation and again before the pump is first started.

Note: Proper alignment of the complete unit is the responsibility of the owner of the unit!

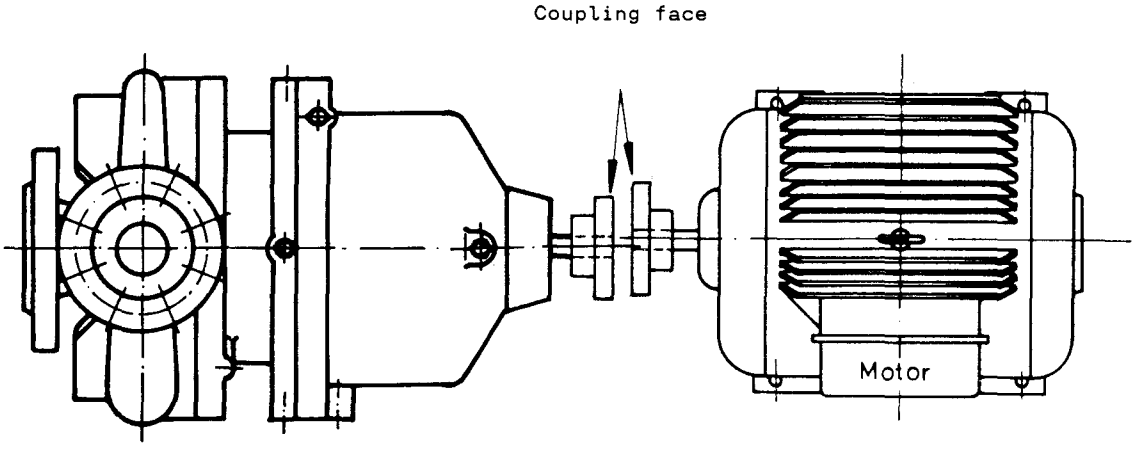
If the baseplate mounting instructions have been carefully followed, no difficulties in making the alignment should be experienced. Failure to properly align the unit will result in vibration and short bearing life.

Pumps are not constructed to be used as pipe anchors. Both suction- and discharge piping must be supported independently of the pumping unit and thermal expansion joints provided to guard against expansion loads on the pump. Pipes should be anchored between the expansion joint and the pump and as closely to the pump as possible. Failure to provide proper piping support and expansion joints may impose strains on the pumping unit which will result in serious misalignment.
No allowance for thermal expansion is made for motor driven units in mounting the driver. Final alignment must always be checked and corrected at the operating temperature of the pump and driver.

Misalignment of the two shafts is of two kinds:

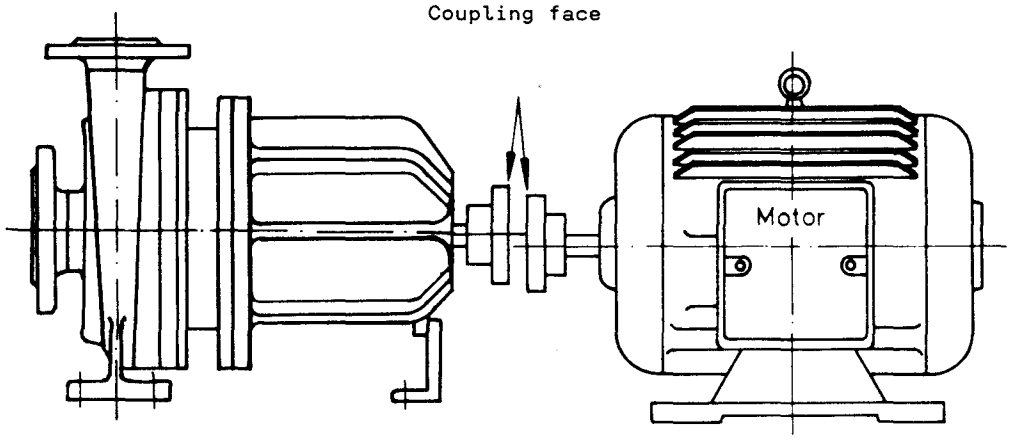
- The first of these is angular misalignment where the axis of one shaft is at an angle from the other.
- The other is offset alignment where the center of one shaft is offset from the center of the other shaft.

These effects usually occur together so that both angular and offset misalignment are present.



ANGULAR MISALIGNMENT

Coincident alignment of the driver and pump shaft is measured at the faces of the coupling hubs. Because of the variety of coupling types furnished at customer's request, the procedure here given is general in nature but may be applied by simple adaptation to most coupling types.



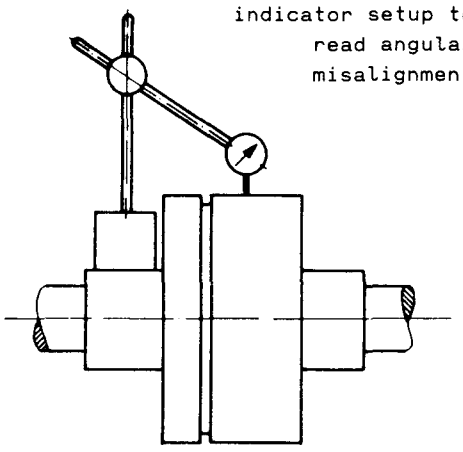
OFFSET MISALIGNMENT

The first step is to remove the spacer from the coupling. To one of the remaining coupling hubs, firmly seated on the shaft, attach a dial indicator. Let the indicator button ride on the face of the other coupling hub and near the outside diameter. Rotate the shaft on which the dial indicator is mounted, allowing the indicator button to move on the stationary coupling hub.

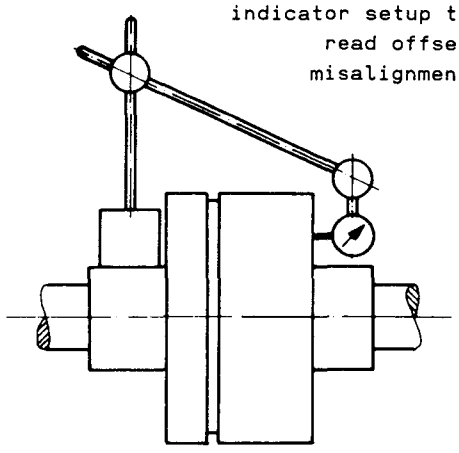
The indicator dial movement will show the difference in distance between the two hubs. This indicates the amount of angular misalignment between the hubs and therefore the shaft axes.

To check the offset alignment, mount the dial indicator as shown but with the indicator button on an outside diameter of the stationary coupling hub. Rotate the shaft on which the dial indicator is mounted, allowing the indicator button to ride on the outside diameter of the stationary hub. The indicator dial movement will show the difference in the center locations of the two shafts.

indicator setup to read angular misalignment



indicator setup to read offset misalignment



Angular and offset alignment is adjusted by placing thin metal shims under the driver mounting feet to bring the driver into exact alignment with the bolted down pump. If misalignment is of major proportions, the baseplate has been improperly installed on the foundation and must be relevelled before proceeding with alignment.

After each change by shims, it is necessary to recheck both angular and offset alignment of the coupling. After the pump and driver are aligned, tighten all lock nuts of hold-down bolts and then recheck alignment. Both parallel and angular alignment should be within 0.002 inches (0.05 mm).

<u>The closer the alignment, the better the running life will be</u> !

3.5 GROUTING OF BASEPLATE

1. Clean areas of baseplate that will contact grout. Do not use an oil-based cleaner because grout will not bond to it.

2. Build a dam around foundation (see typical foundation layout, page 6). Thoroughly wet foundation.

3. Pour grout slowly through grout holes in baseplate until level with the top of the dam. The use of non-shrink epoxy grout is recommended, follow manufacturer`s recommendations. If cementitious grout is used, remove air by tamping or with a vibrator.

4. Allow grout to set.

5. Fill remainder of baseplate with grout. Remove air as required.

6. Allow final grout to set for 48 hours.

7. Tighten foundation bolts.

Alignment check:
Recheck alignment before continuing. Use methods as previously described.

3.6 PIPING

ATTENTION !
Never draw piping into place by forcing of the flanges. This will impose uncontrolled strains on the unit and cause misalignment between pump and driver. Pipe strain will adversely effect the reliability of the pump.

General

Guidelines for piping are given in the "Hydraulic Institute Standards" (Edition 14, Centrifugal Pump Section) and should be reviewed prior to pump installation.

1. All piping must be supported independently and must line up naturally with the pump flanges.

2. Piping runs shall be designed to minimize friction losses.

3. DO NOT make final connection of piping to pump unit until grout has hardened and pump and driver hold-down bolts have been tightened.

4. Piping that handles hot liquids requires proper installation of expansion loops/joints so that linear expansion of piping will not cause misalignment.

5. Piping should be arranged to allow pump flushing and draining prior to the removal of pump for servicing.

6. System should be thoroughly cleaned prior to installation of the pumps in order to prevent penetration of solids into the magnet area.

7. Gasket installation and materials must be suitable for the service.

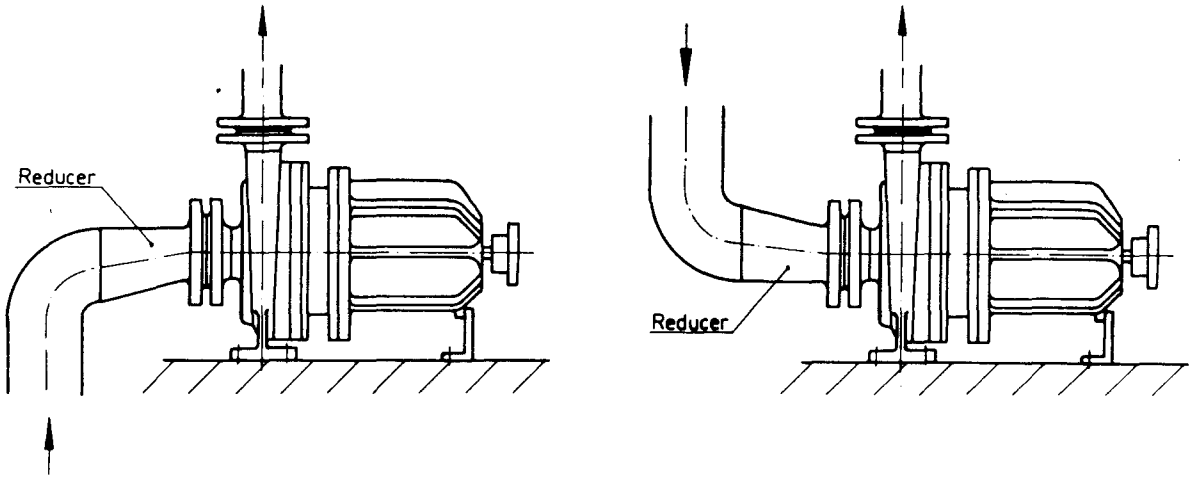
Suction piping

ATTENTION !
When using sealless pumps care must be taken for the NPSH-conditions. The suction piping requires careful design for these pumps. It is especially important that the NPSH for suction of the pump is exactly determined. Suction pipe should be flushed before connection to the pump and the following must be consdidered:

1. Use of elbows close to the pump suction flange should be avoided. There should be a minimum of 2 pipe diameters of straight pipe between the elbow and suction inlet. Any elbows used should be long radius.

2. Size suction pipe one or two sizes larger than pump suction, with a reducer at suction flange. Suction piping must never be of smaller diameter than the pump suction.

3. Reducers, if used, must be eccentric at pump suction flange as shown in the following drawing.



4. Suction strainer, when used, must have a net "free area" of at least three times the suction pipe area.

5. Separate suction lines are recommended when more than one pump is operating from the same medium source.

Suction lift conditions

1. Suction pipe must continuously slope upward towards pump suction to eliminate air pockets.

2. All joints must be air tight.

3. A means of priming the pump must be provided, such as a foot valve.

Flooded suction conditions

1. An isolation valve should be installed in suction line to permit closing of the line for pump inspection and maintenance.

2. Piping should be level or slope gradually downward from medium source.

3. No portion of piping should extend below pump suction flange.

4. The suction pipe shall be submerged sufficiently below the liquid surface to prevent eddies and air entrapment at the source.

Discharge piping

1. Isolation and check valves should be installed in discharge line. Locate check valve between isolation valve and pump which will have access for inspection of check valve. An isolation valve is required for isolating, priming, regulation of flow, inspection and maintenance of the pump.

2. Increasers, if used, should be placed between pump and check valves.

3. Cushioning devices should be used to protect pump from surges and water hammer, if quick-closing valves are installed in system.

4. An additional bypass line should be installed if minimum pump flow exceeds minimum process flow requirements. Lead the bypass line back to suction vessel, not to pump suction side !

Final piping check

After connecting piping to the pump:

1. Rotate shaft several times by hand to be sure that there is no binding and all parts are free.

2. Check alignment per the alignment procedure outlined previously to determine absence of pipe strain. If pipe strain exists, correct piping.

4. OPERATION OF THE PUMP

4.1 START-UP PROCEDURE

Checking of rotation at pumps with spacer coupling:

1. Shut off power to driver.

2. Make sure that coupling hubbs are fastened and secured to the shafts.

3. Remove spacer if installed during alignment.

4. Unlock driver.

5. Jog driver just long enough to determine direction of rotation which must correspond with the arrow on casing.

6. Shut off power to driver.

Couple pump and driver:

1. Lubricate coupling, if necessary, according to manufacturer`s instructions and install coupling spacer.

2. Install coupling guard.

ATTENTION !
Never check direction of rotation if the dry pump is coupled to the motor !

Connect condition monitoring devices:

Always connect thermocouple to control panel and/or temperature switching in driver starter. If unit is also equipped with leak detection and vibration monitoring systems, these must also be connected.

Priming the pump:

Never start pump until properly primed (Pump casing and suction piping are full of liquid). Components such as internal sleeve bearings depend on liquid for lubrication and will quickly fail if run dry.

Your particular system conditions will dictate method used to prime pump.

Starting the pump:

1. Make sure that suction valve and any recirculation line is open.

   ATTENTION !
   The magnet coupling is normally designed for direct-on-line starting of the motor. If star-delta starting is foreseen, contact our application engineers for checking start-up conditions.

2. Open or partially open discharge valve. Closed discharge valve needs open recirculation line to meet minimum flow requirements.

3. Start driver briefly for a few seconds, shut off and control the trouble free and smooth rundown of the machine. Restart after complete standstill.

   ATTENTION !
   Immediately observe the pressure gauges. If discharge pressure is not quickly attained, stop driver, reprime and attempt to restart.

4. Adjust discharge valve until rated flow is obtained.

   ATTENTION !
   Continued operation with dead headed pump will cause overheating within the pump. Flashing of the liquid will damage the pump.

4.2 OPERATING

General considerations:

1. Always adjust capacity with the valve in discharge line. Never throttle flow by suction valve.

2. Pump and motor should always operate steadily and free of vibrations. A sudden increase of running noise is always a sign of possible trouble.

3. The ampere load specified on the name plate of the driving motor must not be exceeded.

   ATTENTION !
   Never operate pump below minimum flow.

4. When operating with a capacity higher than rated and stamped on the name plate, make sure that NPSH-available > NPSH-required.

5. The thermal stable minimum flow bases on the magnetic losses of the magnet coupling. The following table can help you to determine this minimum flow for your pump. Magnet length is stamped on the name plate.

THERMAL STABLE MINIMUM FLOW Qmin.H20				
Magnet length	60 cycles GPM		50 cycles m3/h	
mm	3500	1750	2900	1450
18	4	2	0.7	0.3
36	8	3	1.3	0.6
54	12	5	1.7	0.8
20	16	7	2.2	1.0
30	23	10	3.1	1.5
40	30	13	4.4	2.0
50	37	16	5.1	2.5
60	44	20	6.1	3.0

The flow rates stated in this table are based on water with density $\varrho = 1$ and specific heat C = 1. When handling other liquids, the minimum flow rates can be calculated as follows:

$$\text{Min.flow,Liquid} = Q_{min,H20} \cdot \frac{1}{\varrho_{Liquid}} \cdot \frac{1}{C_{Liquid}}$$

4.3 SHUT DOWN

1. Close the discharge valve slowly.

2. Shut down immediately after closing the valve.

3. Shut off driver to prevent accidential rotation.

ATTENTION !
When handling hazardous toxic fluids, eye and skin protection are required. If pump is being drained, flushing is requiered to remove fluid completely. Precaution must be taken to prevent injury or environmental contamination.

4.4 FINAL ALIGNMENT

1. Run the pump for a certain time to bring the complete unit up to the operating temperature.

2. Check alignment as explained in alignment procedure.

BE SURE TO STRICTLY OBSERVE ALL APPLICABLE FEDERAL, STATE, AND LOCAL LAWS AND REGULATIONS.

4.5 PREVENTIVE MAINTENANCE

DICKOW Chemical Process pumps with magnet drive are working maintenance-free and do not require any manual control. But without doubt, a routine maintenance program can extend the life of your pump and can prevent serious damages. Well maintained equipment will last longer and requires less repair. You should keep maintenance records to help pinpoint potential causes of problems.

4.5.1 Maintenance Schedule

Routine maintenance:

1. Temperature monitoring:
   Nearly all possible operational troubles such as operating below minimum flow, operating with closed discharge valve, clogging of the internal circulation holes, immediately cause an increase in shroud temperature. Therefore, it is wise to install a temperature probe in the fluid or on the shroud surface to prevent flashing of the liquid and damage to the sleeve bearings. Connection for probes are standard on the AMF-pumps.

2. Vibration monitoring:
   All rotating pump parts are properly dynamically balanced. During performance test, we check pump vibration and ensure that a rate of velocity = 0.1"/s will not be exceeded. Measurement is made on the frame at ball bearing location. During operation a vibration rate of 0.18"/s is allowable. If this rate is exceeded change ball bearings immediately.
   If a vibration rate of more than 0.18"/s is noted at start-up of a new pump unit, the reason may be misalignment of coupling between pump and motor or instable foundation.

3. Discharge pressure control

4. Motor load control:
   In case of dry running or slipping magnets the power consumption of the motor is similar to the magnetic losses and far away from the rated output. An ampere or power factor control device can switch off the pump before magnet overheating or wrecked bearings will occure.

Routine inspections:

1. Check for unusual noise, vibration and bearing temperature.

2. Inspect pump and piping for leaks.

6 Months maintenance:

1. Check foundation hold down bolts of motor and pump for tightness.

2. Check alignment in accordance with section 3.4

Yearly inspections:

Check pump capacity, discharge pressure and power consumption. If pump performance does not meet the process requirements, the pumps should be disassembled and internal clearances must be checked. Worn parts should be replaced.

4.6 BEARING MAINTENANCE

The AMF-pumps have outer ball bearings, grease filled for life. The life of these bearings is determined by speed and ambient temperature as shown in the following table.

AMBIENT TEMPERATURE 78°F / 25°C speed n/rpm				AMBIENT TEMPERATURE 105°F / 40°C speed n/rpm			
1500	1750	2900	3500	1500	1750	2900	3500
35000 h	30000 h	18000 h	15000 h	18000 h	15000 h	9000 h	7500 h

It is recommended to change bearing preventively if above stated operating hours are exceeded.

4.7 TROUBLE SHOOTING

4.7.1 No liquid delivered

Problem: Suction line is not completely primed.
Remedy: Fill up again pump and suction line. Reprime pump completely and check foot valve in suction line.

Problem: Block valve in suction line is closed.
Remedy: Open valve.

Problem: Suction line contains air pockets.
Remedy: Layout of the pipes must be checked. Suction lines must continually slope down to the pump.

Problem: Pump does not come up to speed, magnets de-coupled.
Remedy: Shut off the motor, check motor output and transmissible coupling power as given on the name plate. If motor power exceeds coupling power, choose smaller motor or stronger magnets.
If star-delta starting is foreseen, it can help to start the pump against closed discharge valve. Open immediately after start-up.

ATTENTION !
Switch off motor immediately when magnet coupling slips in order to prevent over-heating of the magnets.
If above advices are not successful, contact our engineers.

Problem: Impeller clogged with foreign material.
Remedy: Disassemble and remove blockage.

4.7.2 Pump does not obtain rated flow or head after start-up

Problem: Block valve in suction line is not opened completely.
Remedy: Open valve.

Problem: Strainer basket filter on suction side is plugged.
Remedy: Clean the filter.

Problem: Pump rotates in wrong direction.
Remedy: Change poles of motor.

Problem: Differential head of the system is higher than specified in the order and stamped on the name plate.
Remedy: Check with the application engineer whether the pump can at this stage be equipped with larger impeller (check capacity of the motor and the magnets).

Problem: Viscosity of pumping liquid is higher than stated in the order.
Remedy: Check with the application engineer.

Problem: NPSH-available < NPSH-required, pump cavitates.
Remedy: Increase NPSH-available.

4.7.3 Pump does not obtain rated flow or head after longer running period

Problem: Wear rings are worn out.
Remedy: Replace worn out rings.

Problem: Worn or broken impeller.
Remedy: Inspect and replace.

Problem: Impeller partly clogged.
Remedy: Disassemble and remove blockage.

4.7.4 Pump starts but then stops pumping

Problem: Improperly primed pump.
Remedy: Reprime pump.

Problem: Air-leak in suction line.
Remedy: Check for leakage and correct.

Problem: Air or vapour pockets in suction line.
Remedy: Re-arrange piping layout to eliminate pockets.

4.7.5 Outer ball bearings run hot

Problem: Improper alignment.
Remedy: Check pump alignment.

4.7.6 Motor requires excessive power

Problem: Head lower than rated, pump delivers too much capacity.
Remedy: Install throttle valve or orifice in discharge line.

Problem: Density or viscosity higher than expected.
Remedy: Check density and viscosity.

4.7.7 Magnet slips after system power cut

Problem: After power cut (very short interruption of motor power, possible by lightning or electrical system failure), the power comes back to the motor before a complete standstill of the pump unit and decouples the magnets. Operating of the pump with slipping magnets causes overheating.
Remedy: Adjust fuse and relays so that restart is possible only when the pump has come to a complete stop. Install motor load control or additional temperature probes. Check magnet torque in acc. to 6.1 and replace, if necessary.

4.7.8 Pump does not restart after a longer operating time

Problem: Magnets decouple.
Remedy: Check magnets with breakaway torque test, replace magnets if necessary.

ATTENTION !
Permanent magnets keep their designed torque for life. Reduced torque capability is caused by overheating or by corroded protection cover. If overheating has occured, install additional protection devices or change operating conditions.

4.7.9 Pump is noisy and vibrates

Problem: Improper alignment of pump and driver.
Remedy: Repeat alignment procedure.

Problem: Base not rigid enough.
Remedy: Tighten hold down bolts of pump and motor or adjust stilts. Check grout.

Problem: Pump is cavitating.
Remedy: Increase NPSH-available or ask DICKOW's application engineer for possibilities to improve NPSH-required.

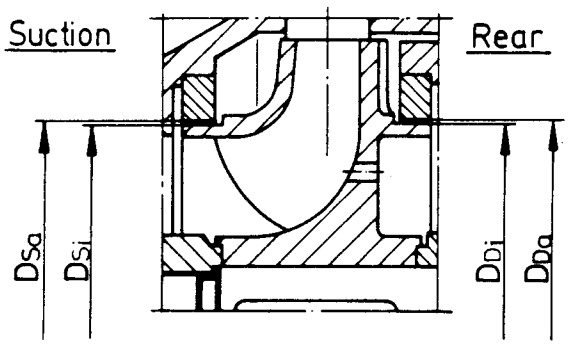
Problem: Outer ball bearings are worn out.
Remedy: Replace them.

Problem: Broken sleeve and/or thrust bearings.
Remedy: Replace and check the causes as described as follows.

4.7.10 Internal sleeve- and thrust bearings are destroyed

Problem: Thrust bearings on shroud side destroyed, abrasive solids are existing. The abrasives caused excessive wear and clearance between impeller and wear ring on suction side. Different clearences on suction- and rear impeller-wear ring disturb the balancing system and generate additional thrust forces.

Remedy: After disassembling check clearances on impeller. If the diametrical clearance on suction side extends the rear clearance by more than 0.016" (0.4 mm), replace wear ring or impeller. In order to extend pump's life-time it is wise to clean the complete piping system or to install a suction strainer, or to choose wear resistant materials.



Problem: Thrust bearing on impeller side destroyed, no solids exist. Thrust balancing system disturbed through cavitation.

Remedy: Replace destroyed bearings. After start-up check rated capacity and head. If pump operates with excessive capacity throttle discharge side by valve or orifice or trim impeller to reduce diameter. Improve NPSH-available or ask DICKOW's application engineer for possibilities to improve NPSH-required.

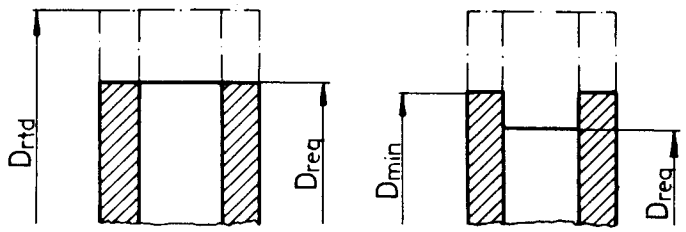
Problem: Thrust bearing and/or shaft sleeve in shroud area are destroyed by flashing liquid. Internal circulation holes are not plugged.

Remedy: Replace standard SiC-bearings by diamond-layer bearings ro reduce friction losses. Check minimum flow conditions. Install fluid probe in magnet area. Check shroud temperature, shroud pressure and vapour pressure of liquid.

Problem: Thrust bearings and/or shaft sleeve in shroud area are destroyed by flashing liquid. Internal circulation holes are clogged.

Remedy: If the holes are plugged by solids, install suction strainer or separate magnet end from liquid. If holes are clogged by polymerized product, reduce temperature rise in the magnet end. In both cases ask DICKOW's application engineer for possible solution.

4.8 IMPELLER TRIMMING



a) $D_{min} < D_{req}$ b) $D_{min} > D_{req}$

D_{rtd} = Rated impeller ø

D_{req} = Required impeller ø

D_{min} = Minimum allowable shroud ø

Select required impeller diameter in accordance with the pump performance curve and available process data. If required diameter > than minimum available shroud diameter, trim shrouds and impeller blades in accordance with figure a). If required diameter < than minimum allowable diameter, trim shroud and blades to different diameters according to figure B).

TYPE AMF						D_{min}
1 1/2"	×	1"	×	6 1/2"		5" / 130 mm
1 1/2"	×	1"	×	8"		6" / 160 mm
3"	×	1 1/2"	×	6 1/2"		5" / 130 mm
3"	×	2"	×	6 1/2"		---
3"	×	1 1/2"	×	8"		7" / 180 mm

Checking of dynamic balancing of impeller after trimming is required.

5. DISASSEMBLY / REASSEMBLY

5.1 REQUIRED TOOLS AND ACCESSORIES

- Ring screw	M8, DIN
- Wrench/adapter unit	03.60.807
- Adapter	04.60.670
- Sleeve	04.60.724
- Sleeve disassembling unit (puller)	04.60.721/804
- Sleeve assembling unit	04.60.723/668
- Key assembling unit	03.60.754/672

Besides the following disassembling and reassembling instructions, consider also the exploded pump views, page 39-44.

5.2 REPLACEMENT OF OUTER BALL BEARINGS

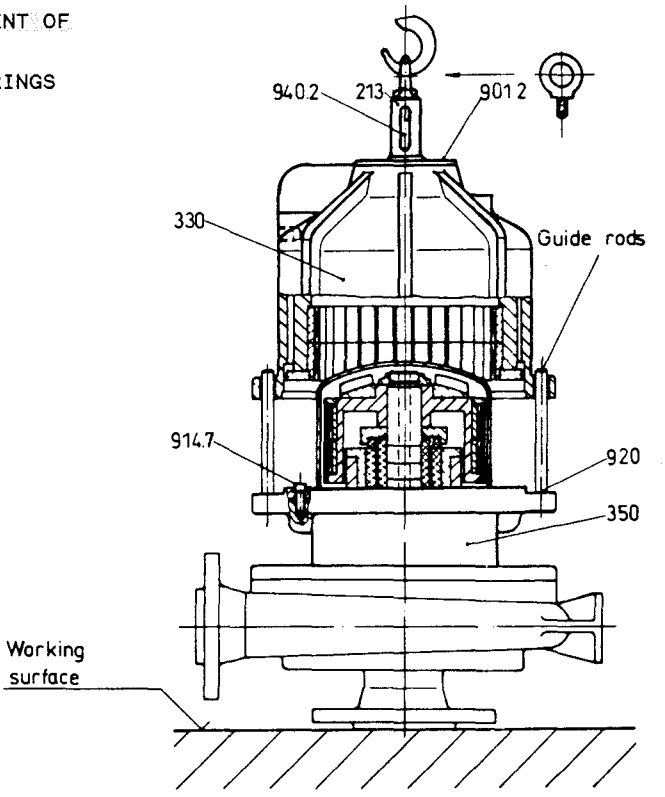


fig. A

1. After cleaning working surface to prevent damage to flange surface, place pump on it in upright position.

   ATTENTION !
   Pump unit may have a weight of more than 150 lbs/70 kg. Care should be taken when handling.

2. Remove frame adapter nuts 920.

3. Tighten the ring screw to the drive shaft 213. Metric thread M8 is used.

4. Remove bearing bracket by using a crane. Never remove bearing bracket without using the guide rods which come along with your pump. Personal injury and damage of the magnets may occur.

   ATTENTION !
   The magnets contained in this unit are extremely powerful. Keep magnetic drive components and magnetic tools apart from each other. Otherwise, fingers and hands may be seriously injured.

To continue disassembling, the use of the wrench/adapter unit 04.60.807 is highly recommended in order to remove the shaft nut 921.2.

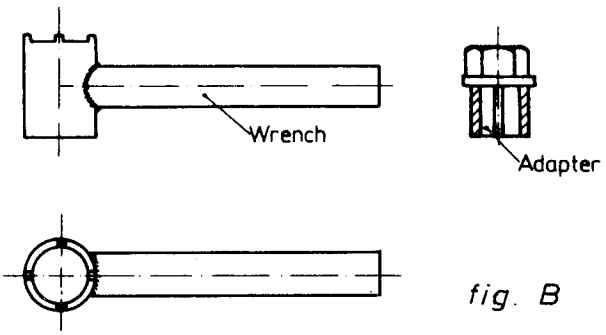


fig. B

5. Place bearing bracket unit to bench, remove ring screw and key 940.2

6. Bolt or clamp bearing bracket 330 to the bench.

7. Remove bolts 901.2 and bearing cover 360 with lip seal 421.

8. Assemble the wrench/adapter unit to the drive shaft 213 as shown in fig. C.

9. Use a second wrench to loosen shaft nut, consider direction. Remove shaft nut.

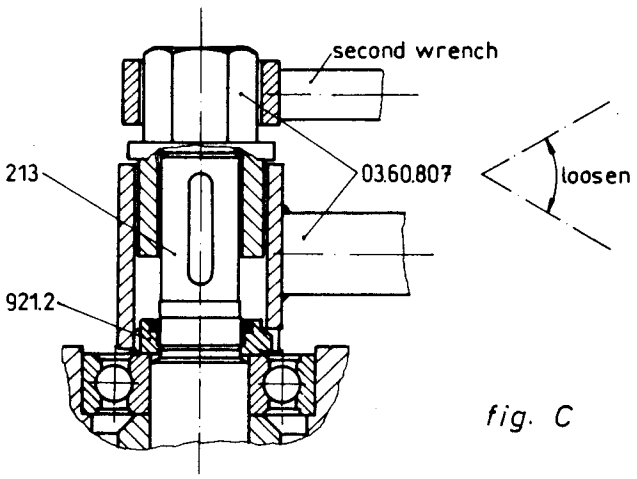


fig. C

10. Place unit in vertical position resting it on non-magnetic blocks as shown. Height of blocks approx. 2".

11. Press down the pump shaft together with outer magnet assembly. Remove bearing bracket 330.

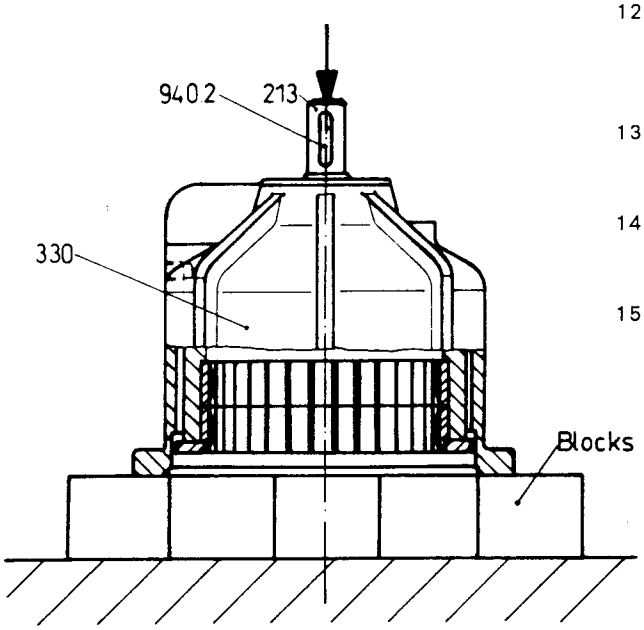


fig. D

12. Remove the remaining ball bearing 321.2 by puller from the bearing bracket.

13. Remove the ball bearing 321.1 from the drive rotor 818.1 by puller.

14. Exercise care with the cup springs 950.2

15. Heat up the new ball bearing 321.1 to 210 °F (100 °C). Push the warm ball bearing onto the drive rotor until it rests.

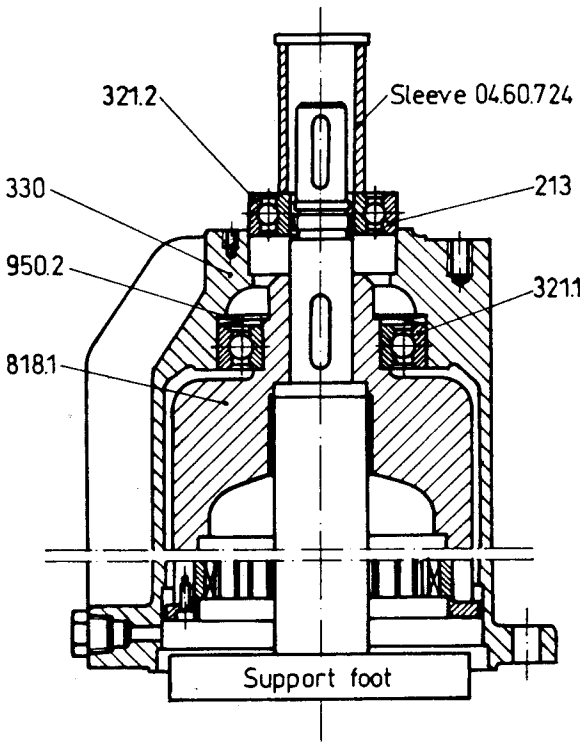


fig. E

16. Provide a non-magnetic support foot as shown in figure E, put pump shaft with outer coupling half and ball bearing on top of support foot.

17. Place cup spring on top of bearing 321.1

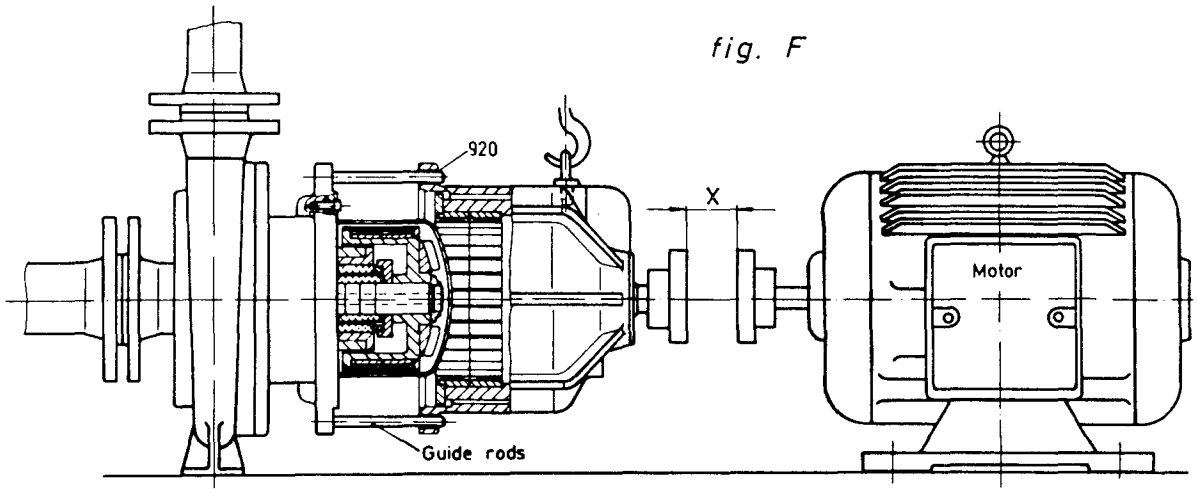
18. Push bearing bracket onto the bearing 321.1 until it rests.

19. Press in ball bearing 321.2 with a sleeve until it rests.

20. Reassemble the complete unit as explained before by reversing disassembly process.

An important design feature of your DICKOW-AMF-pump is the ability to remove the bearing bracket without disconnecting or draining the casing. The units can still remain in the piping system during ball bearing replacement.

fig. F



When using spacer type couplings, the motor can also remain bolted on the baseplate. In this case consider following spacer length requirements:

AMF 1 1/2" x 1" x 6" and 1 1/2" x 1" x 8"	:	X = 5"
Other pump sizes	:	X = 4"

After removing nuts 920, bearing unit can be removed by hand.

ATTENTION !
Never remove bearing unit without guide rods.

5.3 REPLACEMENT OF PUMP IMPELLER

Pump impeller can be replaced for trimming without disassembling the complete unit as follows:

1. Place pump in vertical position as per figure A.

2. Remove bearing housing adapter nuts 920.

3. Loosen the connection between bearing housing and volute casing by guide rods.

4. Replace complete rotating unit by crane and put it on the bench.

5. Clamp impeller, loosen and remove impeller nut with a wrench.

6. Remove impeller by hand. It may be necessary to use a puller. Puller must be placed under the vanes such as not to damage the impeller.

7. Before reassembling the unit, the casing gasket 400.5 must be replaced.

5.4 REPLACEMENT OF INTERNAL ROTOR AND SLEEVE BEARINGS

1. Place the pump in vertical position as per figure A.

2. Remove the bearing bracket unit with outer magnets in accordance with item 5.2 (par. 2., 3., and 4.). Place the unit, protected against magnet damage, away from magnetic parts.

3. Remove shroud adapter bolts 914.7, remove clamping flange 511, shroud 817 and O-ring 412.

4. Remove bearing housing adapter nuts 920.

5. Loosen connection between bearing housing and volute casing by guide rods.

6. Remove bearing housing unit and clamp it in vertical position into the work bench or in a chuck jaw as per figure G.

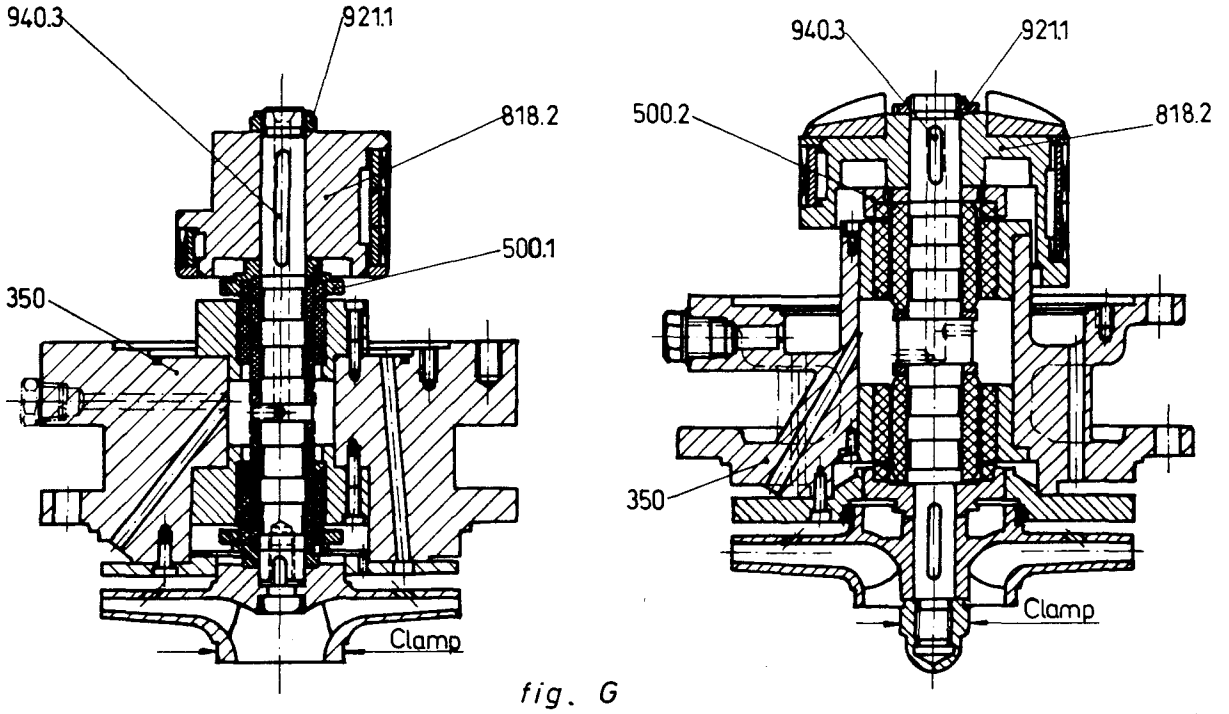


fig. G

Sizes: 1 1/2" x 1" x 6"
1 1/2" x 1" x 8"

Sizes: 3" x 1 1/2" x 6 1/2"
3" x 2" x 6 1/2"
3" x 1 1/2" x 8"

When clamping in the impeller, use protection cheeks to prevent damage to running surface.

7. Loosen shaft nut 921.1 by wrench. For shroud with rear impeller the adapter 04.60.724 should be used. Remove shaft nut.

8. Remove driven rotor 818.2, place it away from magnetic parts.

9. Remove key 940.3 and thrust bearing 500.1 or 500.2

10. Remove bearing housing with sleeves, put on bench.

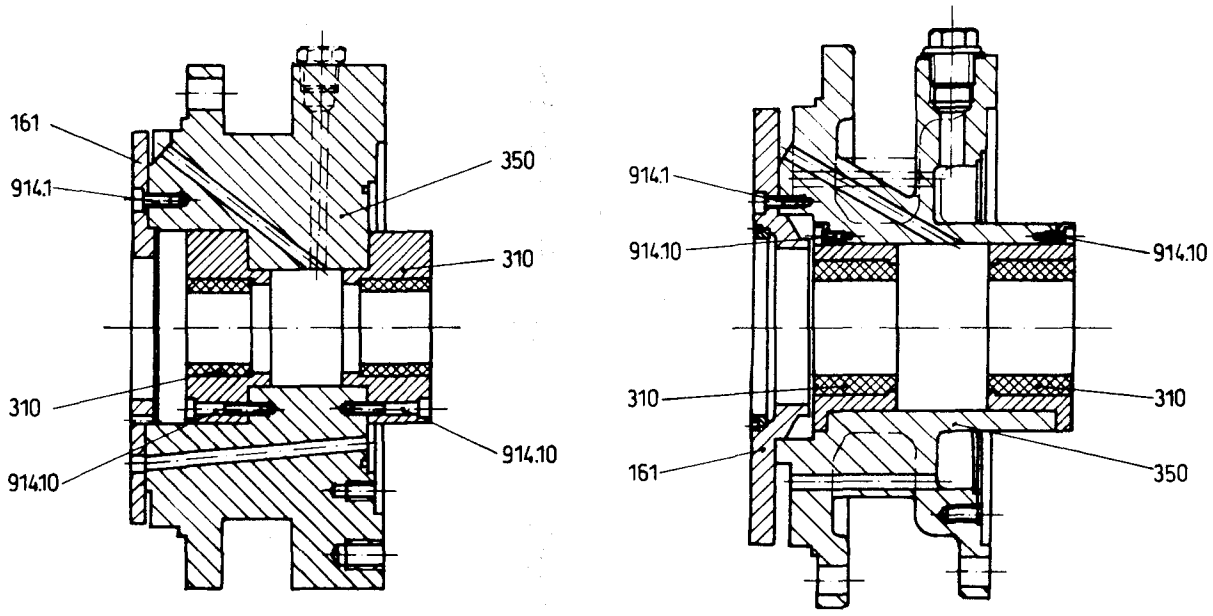


fig. H

11. Remove casing cover adapter bolts 914.1, remove cover 161.

12. Remove sleeve bearing adapter bolts 914.10, loosen connection between bearing housing and sleeve holder with guide rods, remove complete sleeve bearing.

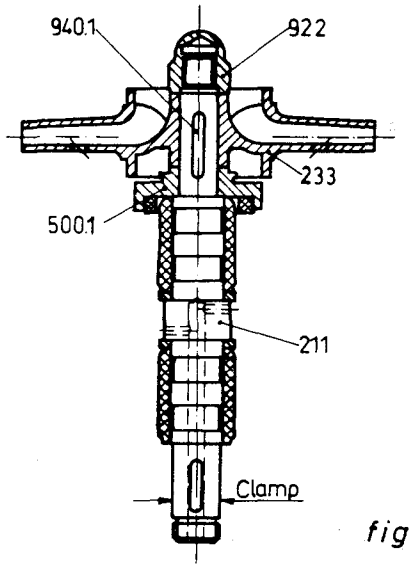


fig. I

13. Clamp in the pump shaft with impeller and shaft sleeves in vertical position as per figure I.

14. Remove impeller nut 922 or adapter bolt 914.12.

15. Remove impeller. If puller is required it must be placed under the vanes to avoid damage to the impeller.

16. Remove key 940.1 and thrust bearing 500.2

17. Check surfaces of sleeve bearings and available clearances (see "Inspection"). If sleeves are worn out, remove them by using the sleeve disassembling unit as follows:
Place the unit-insert on the center of the sleeve, clamp the unit by tightening bolt 1, turn bolt 2 until the sleeve is completely removed from pump shaft. (see figure J)

SLEEVE - disassembling unit (puller)

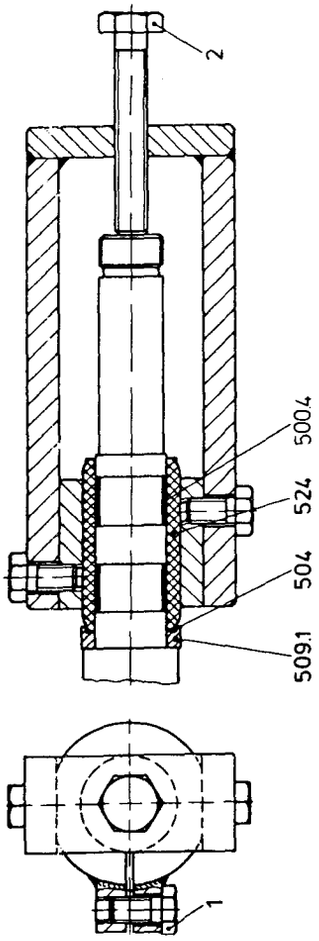


fig. J

SLEEVE - assembling unit

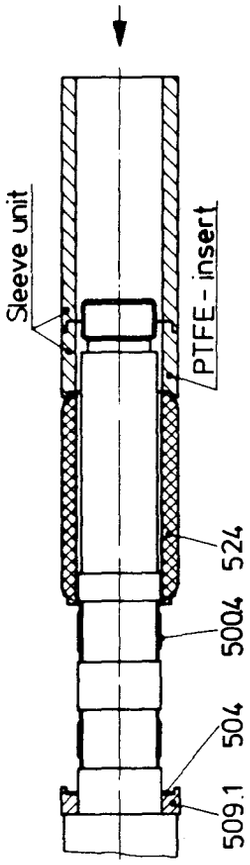


fig. K

KEY - assembling unit

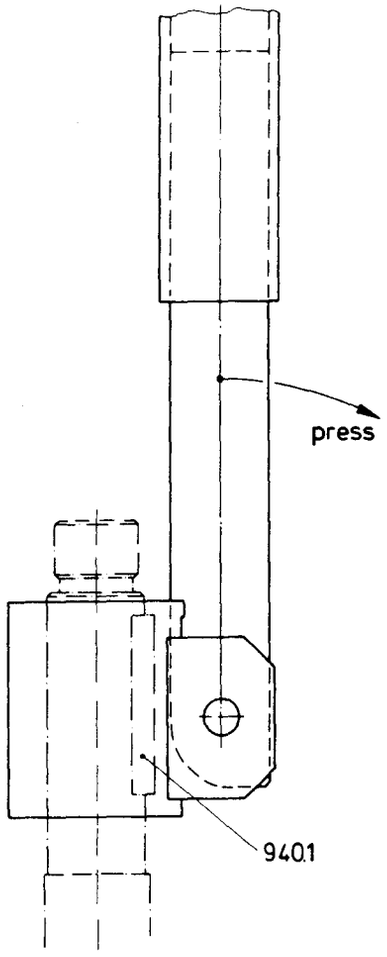


fig. L

PUMP SIZES	Unit Figure "J"	Unit Figure "K"	Unit Figure "L"
	Drawing / Order No.		
1 1/2" x 1" x 6 1/2" 1 1/2" x 1" x 8"	04.60.721	04.60.723	03.60.754
3" x 1 1/2" x 6 1/2" 3" x 2" x 6 1/2" 3" x 1 1/2" x 8"	04.60.804	04.60.668	03.60.672

18. Before installing the new sleeve, replace the tolerance rings 500.4 and the distance ring 504 as well. Then place the sleeve by hand over the shaft until it rests on the upper tolerance ring. Press the sleeve down with the assembling unit until it rests on the distance ring 509.1. Place the PTFE-insert in SiC-sleeve to prevent any damages. Push down with a press or with a drilling machine spindle. Never use a hammer (see figure K).

19. The impellers 233 and the thrust bearings 500.1/2 are keyed to the pump shaft 211. The adapter nut 922 and the adapter bolt 914.2 are secured by Heli-Coil-inserts. The Heli-Coil-inserts come along with the nut or with the pump shaft. Before starting the reassembly, check availability of the inserts for the above parts. (see figure M)

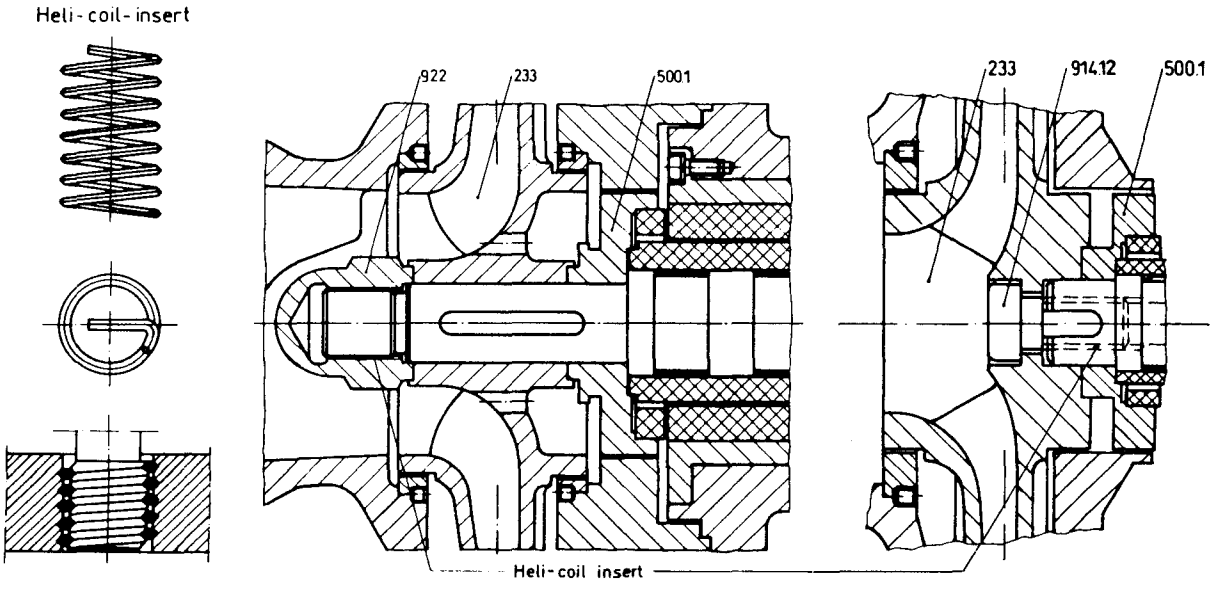


fig. M

20. For reassembling the unit, put shaft with properly mounted sleeve in vertical position as per figure I. Push thrust bearing down until it rests. Install thrust sleeve and impeller, lock impeller nut or adapter bolt.

21. Turn impeller/shaft unit upside down as per figure G. Place bearing housing unit on the shaft unit. Place thrust bearing in its position. Don't forget distance ring 504.

22. Place key 940.3 to the key way per hand. Use key assembling unit to press key to the bottom of the key way. (see figure L)

23. Continue further reassembly as previously described in reverse manner.

ATTENTION !
Before starting reassembling the new rotating parts, they must be inspected for the following criteria to insure proper running. Any parts that do not meet required criteria should be replaced.

5.5 TORQUE SETTINGS

TORQUE SETTINGS			
Part No.	Designation	Nm	Ft/lbs
920	Casing nut	40	30
914.7	Adapter screw	42	32
914.12	Impeller screw	45	34
922	Impeller nut	120	90
921.2	Shaft nut	180	125
AMF 1 1/2 x 1 x 6 1/2" and 1 1/2 x 1 x 8"			
921.1	Shaft nut	81	64
AMF 3"			
921.1	Shaft nut	160	110

6. INSPECTION

6.1 MAGNET ASSEMBLY

1. Driven rotor 818.2

Must be free of bulges and distorsions.
Check back vanes for cracks and corrosion.
Must be free of pits and scratches exceeding 0.005" depth.
Bulges are a sign of penetration of liquid into the internal magnets, check corrosion resistance of rotor material and replace.

2. Drive magnets

If drive magnets were exposed to product (in case of shroud leakage) and showing corrosion, they must be replaced.

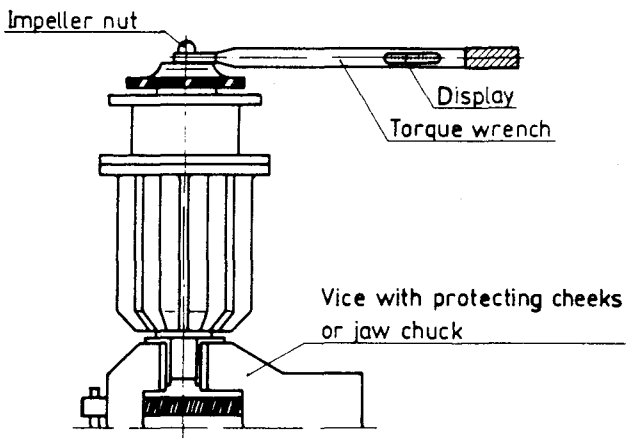
3. Torque capacity

New magnet assembling units have the following torques:

AXIAL MAGNET LENGTH mm / in	TORQUE Nm / lbs/ft
18 / 0.71	18 / 13
36 / 1.42	36 / 26
54 / 2.13	54 / 38
20 / 0.79	31 / 22
30 / 1.18	51 / 36
40 / 1.58	70.5 / 50
50 / 1.97	90.5 / 64
60 / 2.36	108.5 / 77

(see pump name plate)

Place the pump without the casing in vertical position.
Clamp the drive shaft as per figure M.
Check available torque. If the measured value is more than 10 % below the nominal value (caused by overheating or corrosion), it must be checked with DICKOW's application engineer whether the assembly is still usable.
Probably replace driven rotor.



6.2 DIAMETRICAL WEAR RING CLEARANCES

	LOCATION			
	Impeller to Wear ring mm/in		Impeller to cover mm/in	
Size	new	replace	new	replace
1 1/2" x 1" x 6 1/2"	0.5 / 0.02	0.8 / 0.032	0.6 / 0.024	0.9 / 0.036
1 1/2" x 1" x 8"	0.5 / 0.02	0.8 / 0.032	0.6 / 0.024	0.9 / 0.036
3" x 1 1/2" x 6 1/2"	0.6 / 0.024	0.9 / 0.036	---	---
3" x 2" x 6 1/2"	0.6 / 0.024	0.9 / 0.036	---	---
3" x 1 1/2" x 8"	0.6 / 0.024	0.9 / 0.036	---	---

6.3 DIAMETRICAL SILICON CARBIDE BEARING CLEARANCES

Size	LOCATION	NEW CLEARANCE mm (in)	REPLACE at mm (in)
1 1/2" x 1" x 6 1/2" 1 1/2" x 1" x 8"	Shaft-sleeve to Sleeve bearing	0.13 - 0.185 (0.0041 - 0.0073)	0.215 (0.0085)
3" x 1 1/2" x 6 1/2" 3" x 2" x 6 1/2" 3" x 1 1/2" x 8"			

6.4 SHROUD 817

Wall thickness 0.0395" (1.0 mm) is standard.
Must be free of cracks or pittings.
If any groove exceeds by more than 0.01" (0.25 mm) replace shroud.
Inspect O-ring 412 for cuts and cracks.

6.5 BEARING BRACKET 330

Inspect bracket and support foot 183 visually for cracks. If frame has been exposed to the liquid, inspect for pittings or corrosion. Inspect frame bearing bores, replace it if maximum diameter is exceeded.

Frame	Location	Maximum Location Bearing bore mm (in)	Maximum	Bearing bore mm (in)
AA	Inboard	100.025 (3.9380)	Outboard	72.021 (2.8355)
AB		100.025 (3.9380)		72.021 (2.8355)

Inspect ball bearings for contamination and damage. Replace if operating hours stated in par. 4.6 are exceeded.
Inspect lip seal 421 for cracks and cuts.

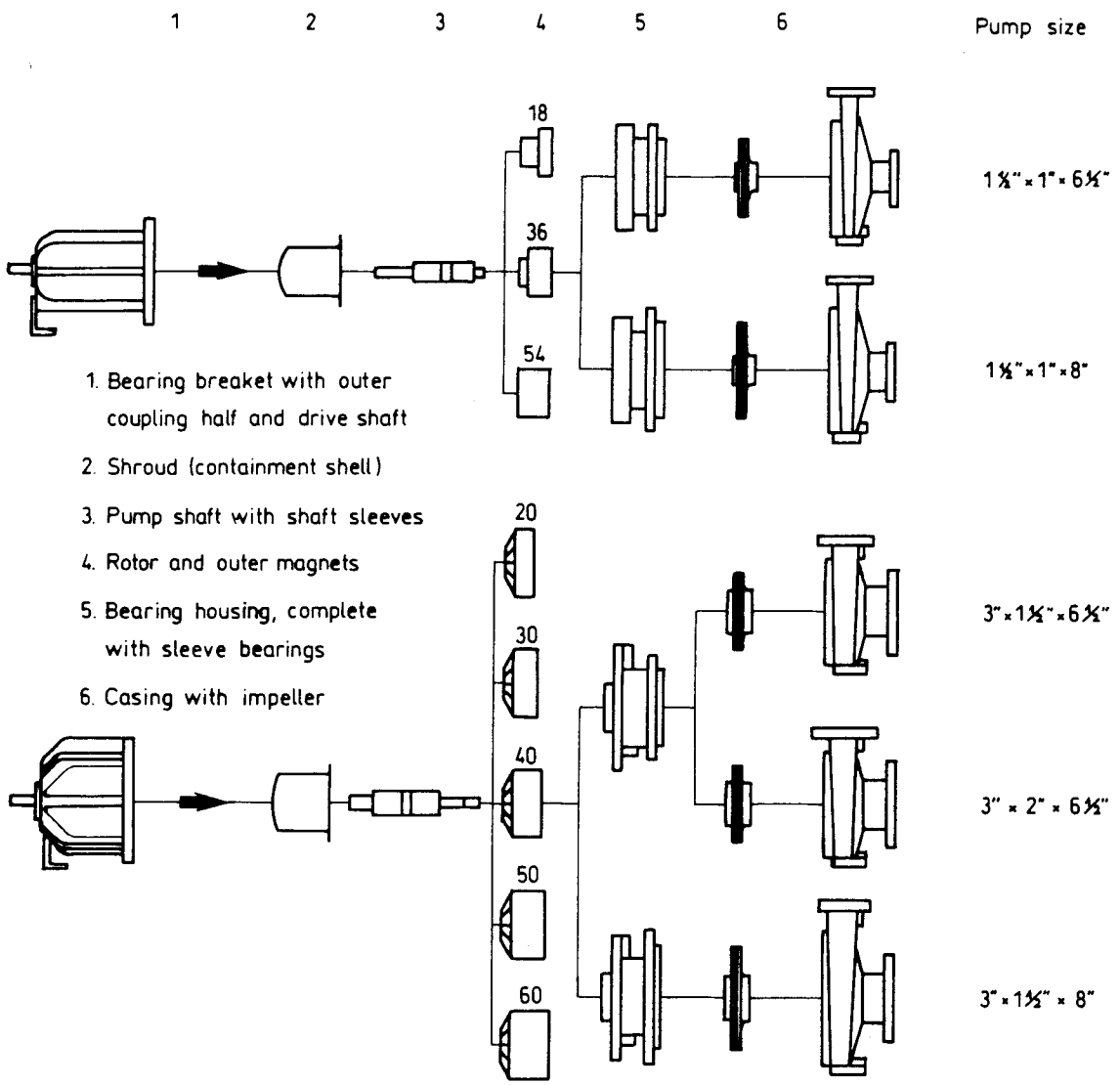
6.6 BEARING HOUSING 350

Check internal circulation holes, make sure that they are open.
Check for clean surfaces for gasket 400.5 and groove for O-ring 412.

6.7 SILICON CARBIDE BEARINGS

Inspect for scratches and chips, if worn out replace them in accordance with the table in par. 6.3.

7. INTERCHANGEABILITY CHART - AMF-PUMPS

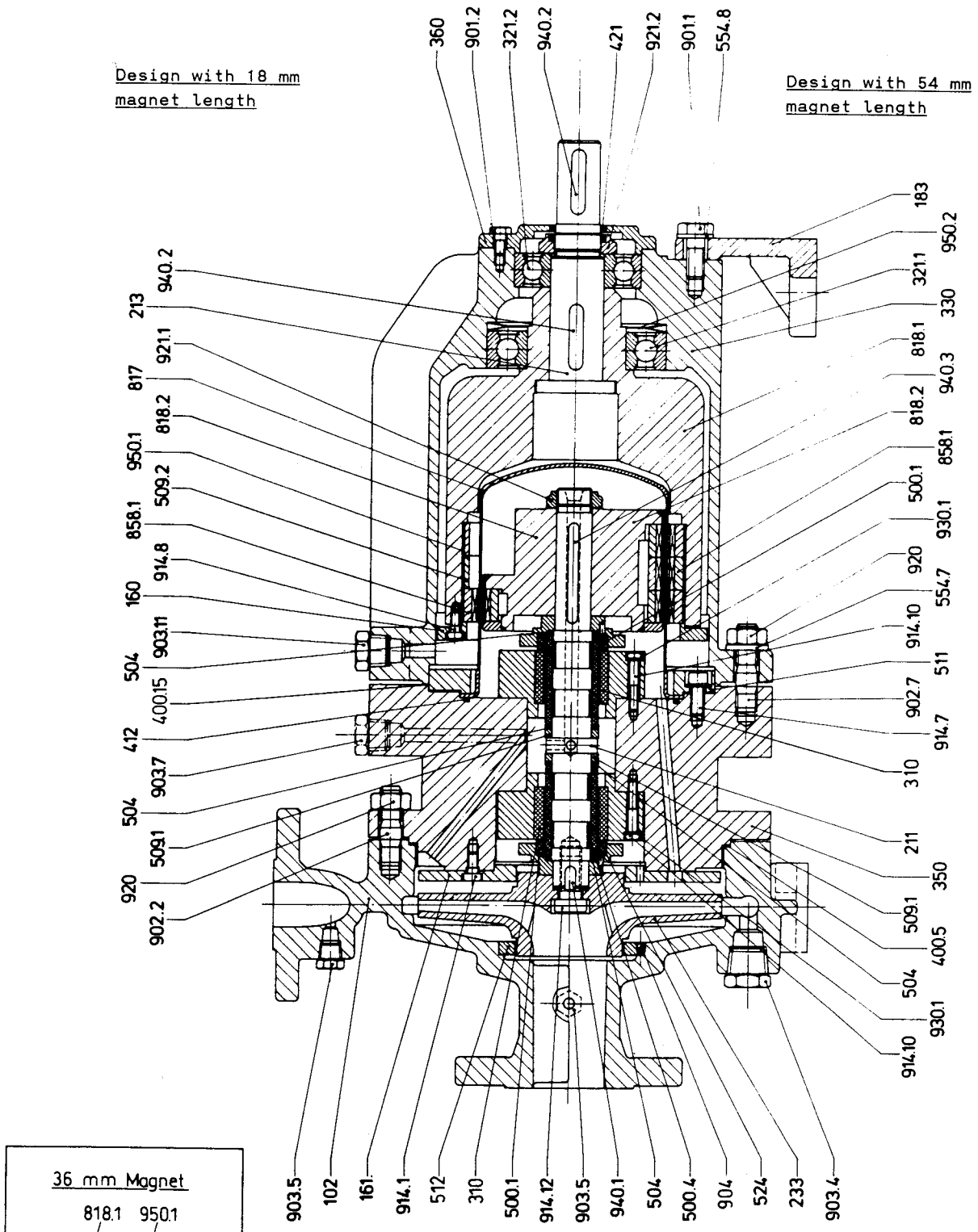


Magnet drive assembly	MAX. RATED MOTOR OUTPUT KW / HP *							
	60 cycles				50 cycles			
	3500 rpm		1750 rpm		2900 rpm		1450 rpm	
	kW	HP	kW	HP	kW	HP	kW	HP
18	5.5	7.5	2.2	3.0	5.5	7.5	2.5	3.5
36	11.0	15.0	5.5	7.5	11.0	15.0	5.5	7.5
54	18.5	25.0	7.5	10.0	15.0	20.0	7.5	10.0
20	11.0	15.0	5.5	7.5	7.5	10.0	4.0	5.5
30	18.5	25.0	7.5	10.0	15.0	20.0	7.5	10.0
40	22.0	30.0	11.0	15.0	20.0	27.0	10.0	13.5
50	30.0	40.0	15.0	20.0	24.0	33.0	13.5	18.0
60	37.0	50.0	18.5	25.0	30.0	41.0	15.0	20.0

*) Based on operating temperature max 100°C / 210°F

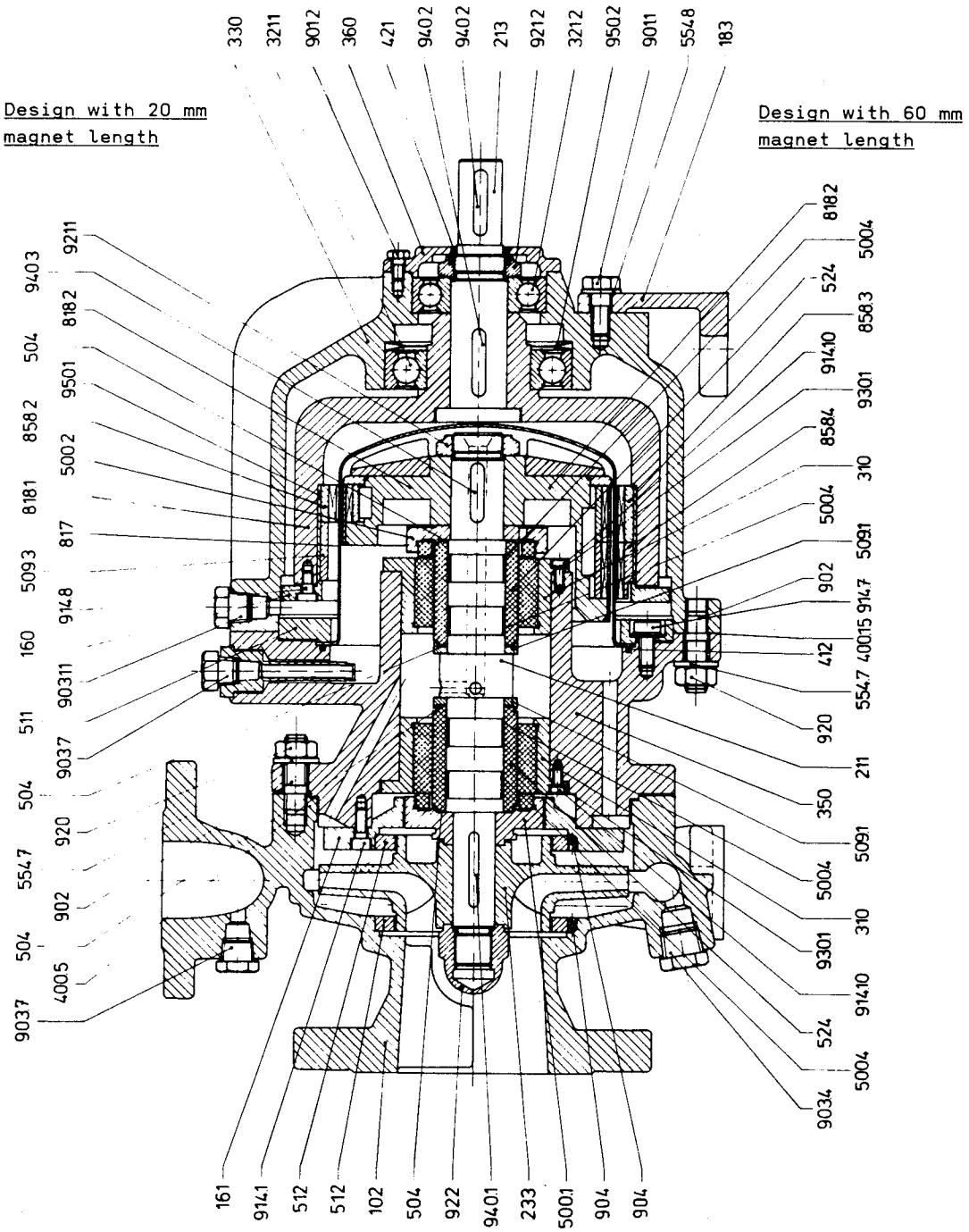
8. SPARE PARTS IDENTIFICATION

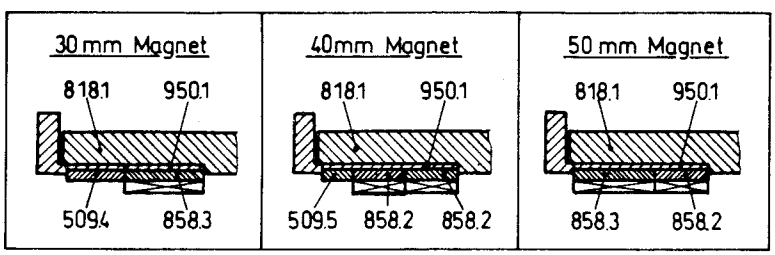
8.1 SECTIONAL DRAWING 54.AMF.1



Pump sizes: 1 1/2" x 1" x 6 1/2"
1 1/2" x 1" x 8"

8.2 SECTIONAL DRAWING 54.AMF.2





Pump sizes:
3" x 1 1/2" x 6 1/2"
3" x 2" x 6 1/2"
3" x 1 1/2" x 8"

8.3 SPARE PARTS IDENTIFICATION LIST

8.3.1 Sizes: 1 1/2" x 1" x 6 1/2")
1 1/2" x 1" x 8") Drawing No. 54.AMF.1

P/No.	Designation	Material	Drwg.No.	Ident No.
8.3.1.1	Bearing bracket with magnet coupling, shroud, sleeve bearings and shafts			
160	Magnet adapter flange	St37	04.35.526	00578642
211	Pump shaft	1.4571	03.26.1113	00256509
213	Drive shaft	1.4021	04.26.977	00253535
310	Sleeve bearing, shrinked	1.4462/SiC	04.27.1003	00367058
321.1	Ball bearing 6211 + 2ZR + C3 + L12	St	DIN 625	01003336
321.2	Ball bearing 6306 + 2ZR + C3	St	DIN 625	01003324
330	Bearing bracket	GGG40.3	02.18.369	00630530
360	Bearing cover	GG25	04.35.591	00579131
400.15	Gasket Ø 170x161x0.5	Graphite	04.39.39	00597230
412	O-ring Ø 115x3	PTFE		01903674
421	Lip seal DH 25x31x2.5	NBR		01907193
500.1	Thrust bearing	1.4462/SiC	03.32.1232	00485319
500.4	Tolerance ring	2.4610	04.60.680	00691475
504	Spacer ring Ø 22x28.1x1.5	Rotatherm	04.39.383	00599278
509.1	Intermediate ring	1.4571	04.32.1030	00483296
509.2	Intermediate ring	GG25	04.32.1012	00483112
511	Adapter flange	St37	03.32.1372	00486711
524	Shaft sleeve	SiC	04.27.863	00363560
554.7	Washer size 14	1.4571	DIN 126	01000945
554.8	Washer size 11	St	DIN 126	01000941
817	Shroud	2.4610	04.60.889	00692263
818.1	Drive rotor	GGG40.3	02.43.90	00617628
818.2	Driven rotor 18 mm	1.4571	03.60.875	00692194
	Driven rotor 36 mm	1.4571	03.60.877	00692203
	Driven rotor 54 mm	1.4571	03.60.758	00691651
858.1	Drive magnet 18 mm	St37/CoSm	04.32.1280	00485791
901.1	Hexagon cap screw M 10x25	4.6	DIN 558	01002105
901.2	Hexagon cap screw M 6x12	4.6	DIN 558	01002315
902.2	Stud M 12x30	1.4401	DIN 939	01011330
902.7	Stud M 12x35	1.4401	DIN 939	01011334
903.4	Plug NPT 1/2"	1.4571		01907492
903.5	Plug NPT 1/4"	1.4571		01907484
903.7	Plug NPT 3/8"	1.4571		01907488
903.11	Plug NPT 3/8"	St		01907487
914.1	Adapter screw M 6x12	1.4571	DIN 6912	01017309
914.7	Self-locking adapter screw M 8x16	100	W251.12	01906442
914.8	Adapter screw M 5x12	8.,8	DIN 6912	01017211
914.10	Adapter screw M 5x10	1.4571	DIN 6912	01017209
914.12	Impeller adapter screw M 12x25	1.4571	DIN 6912	01017609

P/No.	Designation		Material	Drwg.No.	Ident No.
920	Nut	M 12	1.4571	DIN 555	01001878
921.1	Shaft nut	M 20x1.5 left	1.4571	GT	01907090
921.2	Shaft nut	M 27x1.5 left	St	GUA	01906848
930.1	Washer	size 5	1.4305	DIN 7980	01018281
940.1	Key		1.4571	04.60.551	00691078
940.2	Key	8x7x36	1.4571	DIN 6885	01016861
940.3	Key	6x6x56	1.4571	DIN 6885	01016942
950.1	Locking key		St	04.60.740	00691614
950.2	Cup spring		FSt	K6211	01908121
8.3.1.2	Volute casing and impeller, Size 1 1/2" x 1" x 6 1/2"				
102	Volute casing	150 lbs RF	1.4408	01.15.678	00734694
161	Casing cover		1.4571	03.35.734	00580151
183	Support foot		GG25	04.60.230	00690333
233	Impeller		1.4408	03.12.370	00635071
350	Bearing housing		1.4571	01.18.367	00630516
400.5	Gasket	Ø 172x180x1	Graphite	04.39.379	00599255
512	Wear ring		1.4408	04.40.218	00611522
904	Grub screw	M 5x6	1.4571	DIN 915	01006646
	Volute casing and impeller, Size 1 1/2" x 1" x 8"				
102	Volute casing	150 lbs RF	1.4408	01.15.679	00734705
161	Casing cover		1.4571	03.35.735	00580161
183	Support foot		GG25	04.60.230	00690333
233	Impeller		1.4408	03.12.424	00635346
350	Bearing housing		1.4571	01.18.368	00630523
400.5	Gasket	Ø 213x220x1	Graphite	04.39.251	00598502
512	Wear ring		1.4408	04.40.218	00611522
904	Grub screw	M 5x6	1.4571	DIN 915	01006646

8.3.2 Sizes: 3" x 1 1/2" x 6 1/2")
3" x 2" x 6 1/2") Drawing No. 54.AMF.2
3" x 1 1/2" x 8")

P/No.	Designation	Material	Drwg.No.	Ident No.
8.3.2.1	Bearing bracket with shroud, sleeve bearings and shafts			
160	Magnet adapter flange	St37	04.35.539	00578751
211	Pump shaft	1.4571	03.26.879	00252113
213	Drive shaft	1.4021	04.26.977	00253535
310	Sleeve bearing, shrinked	1.4462/SiC	04.27.815	00362358
321.1	Ball bearing 6211 + 2ZR + C3 + L12	St	DIN 625	01003336
321.2	Ball bearing 6306 + 2ZR + C3	St	DIN 625	01003324
330	Bearing bracket	GGG40.3	01.18.377	00630582
360	Bearing cover	GG25	04.35.591	00579131
400.15	Gasket Ø 211x259x0.5	Graphite	04.39.398	00599369
412	O-ring Ø 160x3	PTFE		01903794
421	Lip seal DH 25x31x2.5	NBR		01907193
500.1	Thrust bearing	1.4462/SiC	03.32.1178	00484779
500.2	Thrust bearing	1.4462/SiC	03.32.1179	00484789
504	Spacer ring Ø 30x41.1x1.2	Rotatherm	04.39.355	00599113
509.1	Intermediate ring	1.4571	04.32.949	00482486
511	Shroud adapter flange	St	03.32.1404	00482486
500.4	Tolerance ring	2.4610	0825.118.51	01906121
524	Shaft sleeve	SiC	04.27.788	00361685
554.7	Washer size 14	1.4571	DIN 126	01000945
554.8	Washer size 11	St	DIN 126	01000941
818.1	Drive rotor	GGG40.3	02.43.91	00617635
901.1	Hexagon cap screw M 10x20	4.6	DIN 558	01002105
901.2	Hexagon cap screw M 6x10	4.6	DIN 558	01002315
902	Stud M 12x30	1.4401	DIN 939	01011330
903.4	Plug NPT 1/2"	1.4571		01907492
903.6	Plug NPT 1/4"	1.4571		01907484
903.7	Plug NPT 3/8"	1.4571		01907488
903.11	Plug NPT 3/8"	St		01907487
914.1	Adapter screw M 6x16	1.4571	DIN 912	01003808
914.7	Self-locking adapter screw M 8x16	100	W251.12	01906442
914.8	Adapter screw M 6x12	8.8	DIN 6912	01017306
914.10	Adapter screw M 5x10	1.4571	DIN 6912	01017209
920	Nut M 12	1.4571	DIN 555	01011878

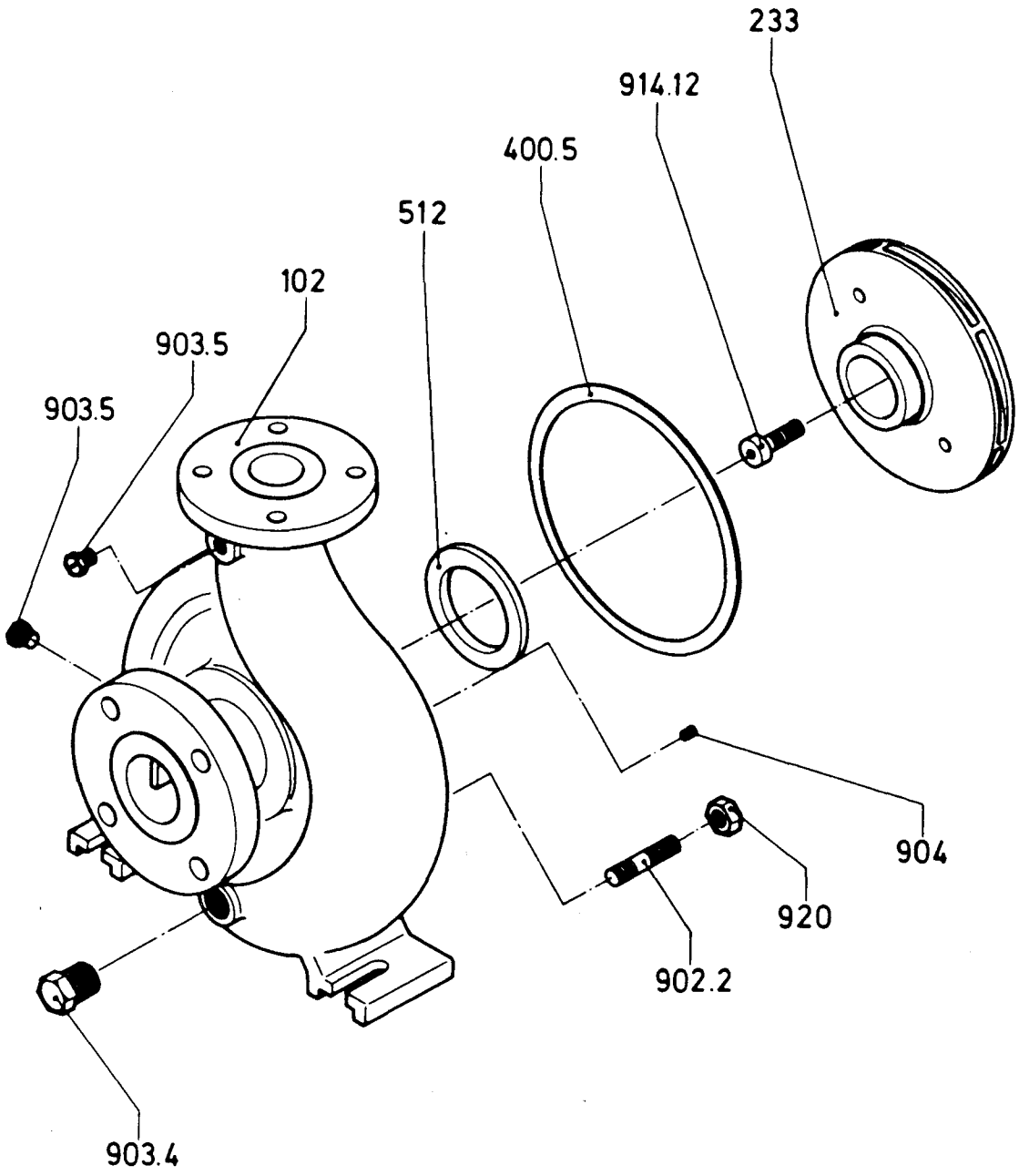
P/No.	Designation		Material	Drwg.No.	Ident No.
921.1	Shaft nut	M 27x1.5 left	1.4571	GT	01907084
921.2	Shaft nut	M 27x1.5 left	St	GUA	01906848
922	Impeller nut		1.4571	04.28.57	00442510
930.1	Spring washer	size 5	1.4305	DIN 7980	01018281
940.1	Key	6x6x40	1.4571	DIN 6885	01016834
940.2	Key	8x7x36	1.4571	DIN 6885	01016861
940.3	Key	8x7x32	1.4571	DIN 6885	01016858
950.1	Locking key		St	04.60.736	00691608
950.2	Cup spring		FSt	K6211	01908121
8.3.2.2	Shroud and magnet assembly				
	Axial magnet length: 20 mm				
509.3	Intermediate ring		St37	04.32.943	00482421
858.2	Drive magnet	20 mm	St37/CoSm	03.32.962	00482611
818.2	Driven rotor	20 mm	1.4571	03.60.815	00691903
	Axial magnet length: 30 mm				
509.4	Intermediate ring		St37	04.32.941	00482401
858.3	Drive magnet	30 mm	St37/CoSm	03.32.856	00481551
818.2	Driven rotor	30 mm	1.4571	03.60.816	00691908
	Axial magnet length: 40 mm				
509.5	Intermediate ring		St37	04.32.982	00482811
858.2	Drive magnet	2 x 20 mm	St37/CoSm	04.32.962	00482611
818.2	Driven rotor	40 mm	1.4571	03.60.817	00691913
	Axial magnet length: 50 mm				
858.2	Drive magnet	30 mm	St37/CoSm	03.32.856	00481551
858.3	Drive magnet	20 mm	St37/CoSm	03.32.962	00482611
818.2	Driven rotor	50 mm	1.4571	03.60.818	00691918
	Axial magnet length: 60 mm				
858.3	Drive magnet	30 mm	St37/CoSm	03.32.856	00481551
858.4	Drive magnet	30 mm	St37/CoSm	03.32.1035	00483341
818.2	Driven rotor	60 mm	1.4571	03.60.819	00691923
	Shroud (magnet length 20-60 mm)				
817	Shroud - wall thickness	1.0 mm	2.4610	04.60.894	00692304

P/No.	Designation	Material	Drwg.No.	Ident No.
8.3.2.3	Volute casing and impeller Size 3" x 1 1/2" x 6 1/2"			
102	Volute casing with foot 150 lbs RF	1.4408	01.15.680	00734716
161	Casing cover	1.4571	03.35.475	00578264
183	Support foot	GG25	04.60.230	00690333
233	Impeller Ø 165 mm	1.4408	02.12.447	00635478
350	Bearing housing	1.4408	01.18.378	00630586
400.5	Gasket Ø 167x175x1.5	Graphite	04.39.254	00598520
512	Wear ring	1.4408	04.40.56	00610388
904	Grub screw M 5x6	1.4571	DIN 915	01006646
	Volute casing and impeller Size 3" x 2" x 6 1/2"			
102	Volute casing with foot 150 lbs RF	1.4408	in progress	
161	Casing cover	1.4571	"	
183	Support foot	GG25	"	
233	Impeller Ø 165 mm	1.4408	"	
350	Bearing housing	1.4408	"	
400.5	Gasket Ø 213x219x1.5	Graphite	"	
512	Wear ring	1.4408	"	
904	Grub screw M 5x6	1.4571	DIN 915	01006646
	Volute casing and impeller Size 3" x 1 1/2" x 8"			
102	Volute casing with foot 150 lbs RF	1.4408	in progress	
161	Casing cover	1.4408	"	
183	Support foot	GG25	"	
233	Impeller Ø 210 mm	1.4408	"	
350	Bearing housing	1.4408	"	
400.5	Gasket Ø 167x175x1.5	Graphite	"	
512	Wear ring	1.4408	"	
904	Grub screw M 5x6	1.4571	DIN 915	01006646

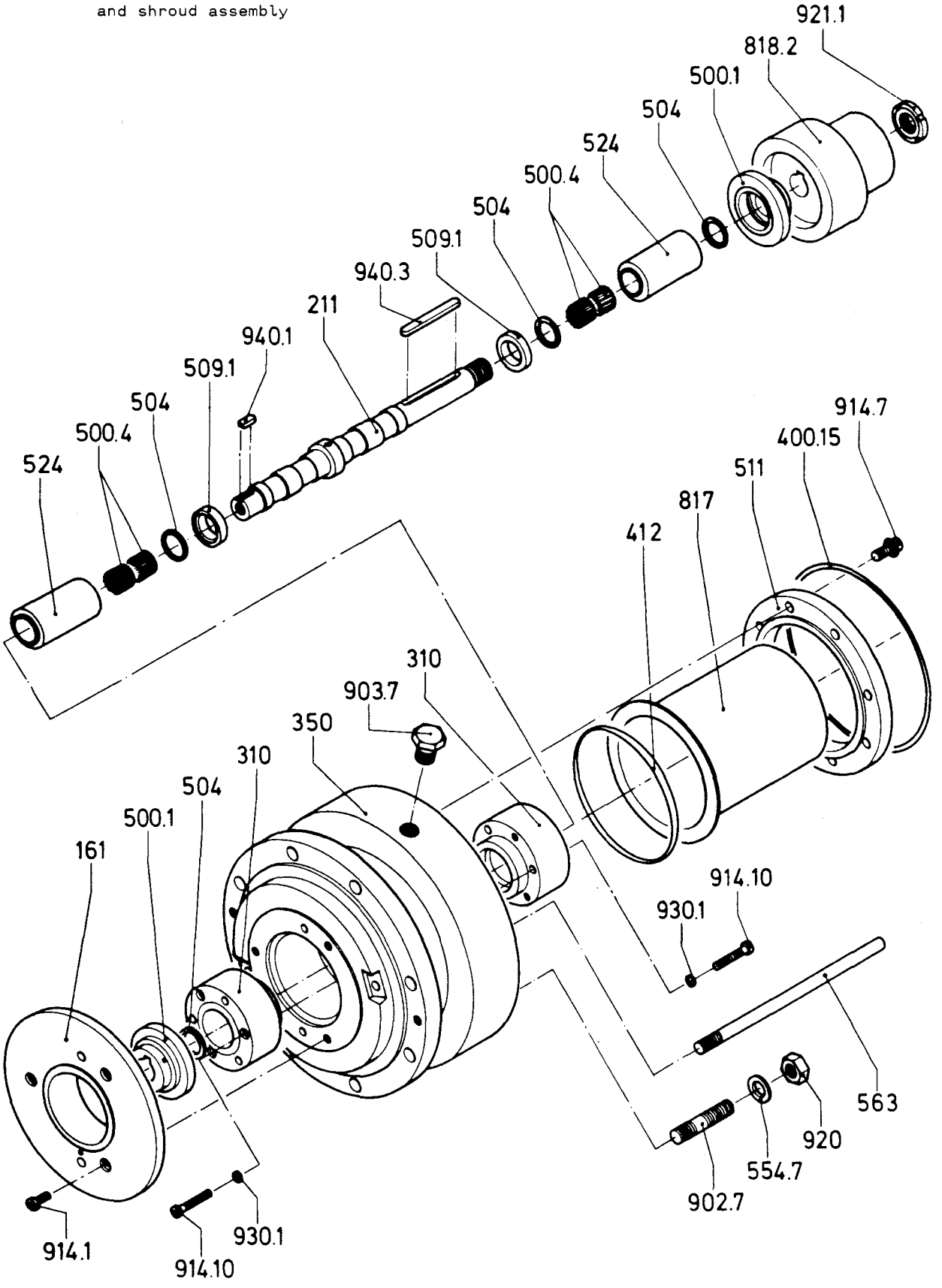
9. EXPLODED VIEWS

9.1 SIZES: 1 1/2 x 1 x 6 1/2" and 1 1/2 x 1 x 8"

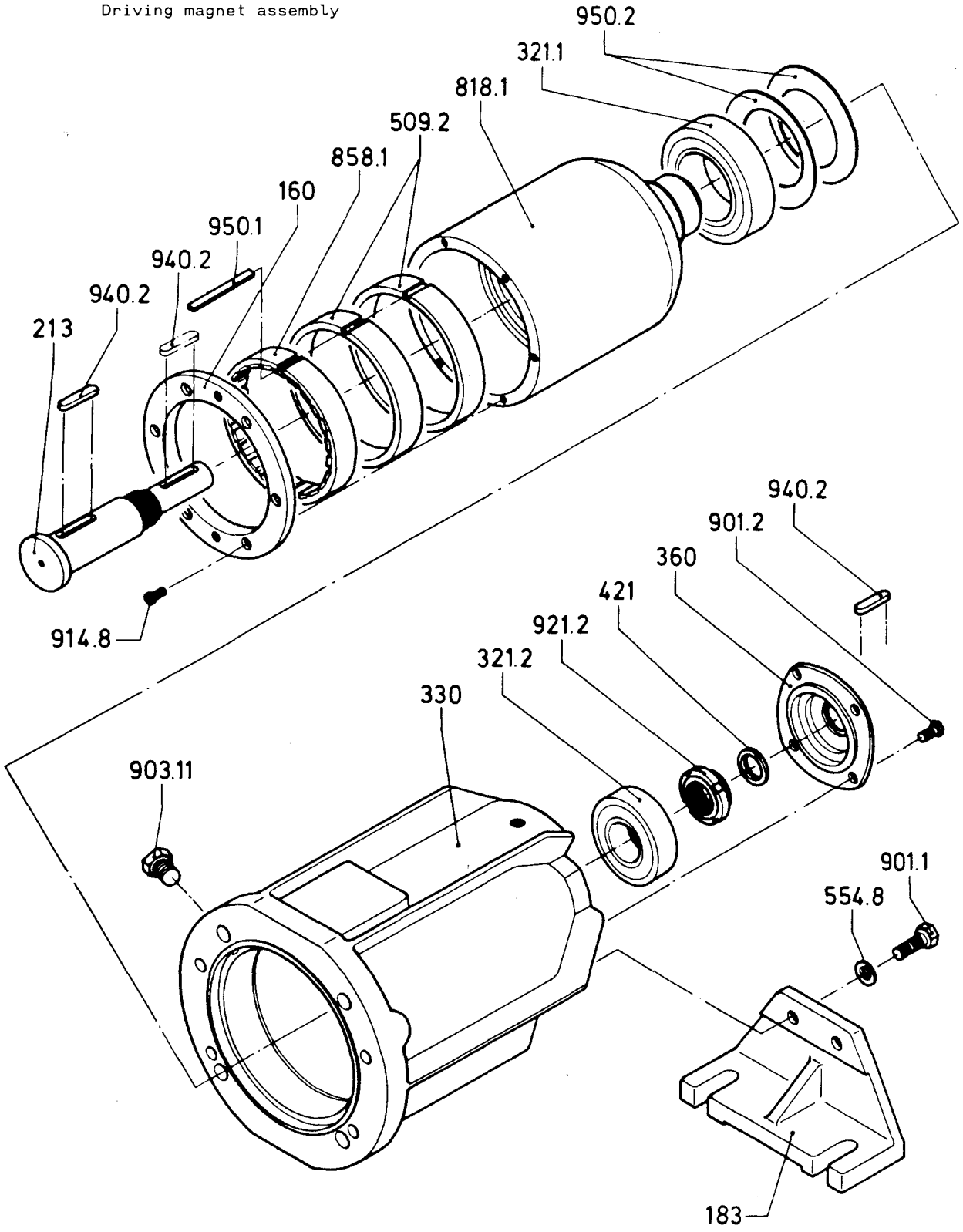
9.1.1 Volute casing, impeller



9.1.2 Bearing housing, driven magnet and shroud assembly

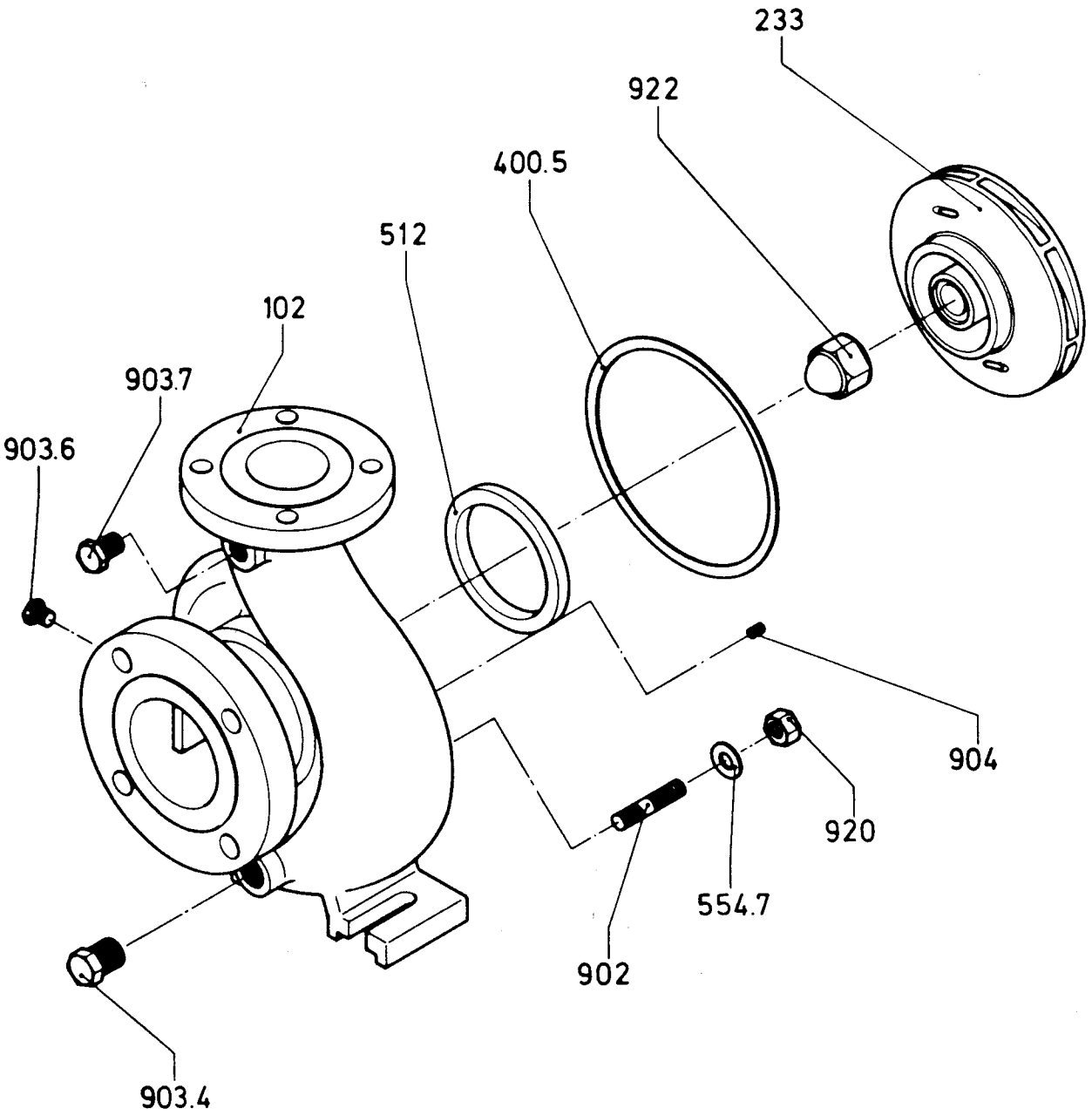


9.1.3 Bearing bracket,
Driving magnet assembly

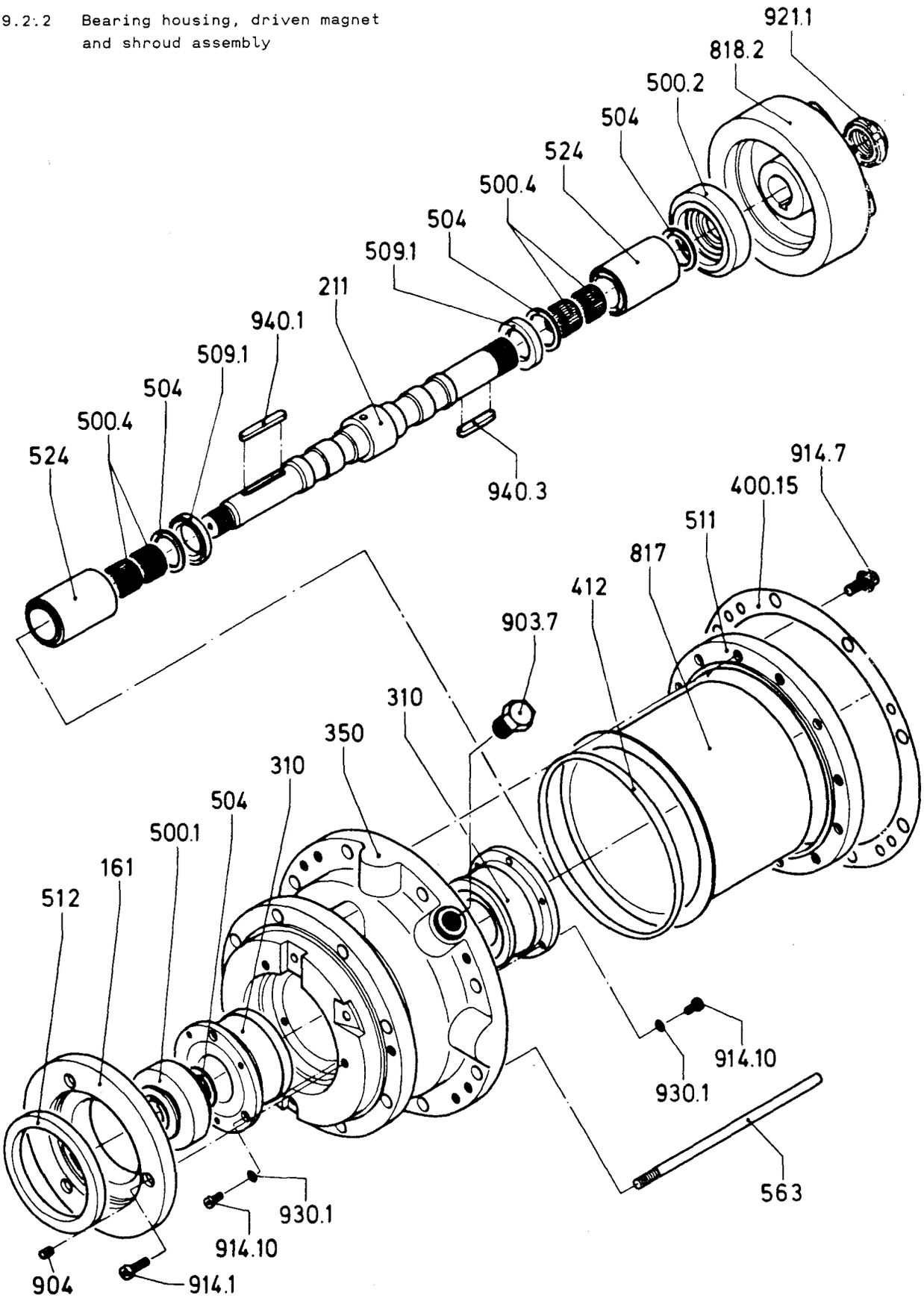


9.2 SIZE: 3 x 1 1/2 x 6 1/2"

9.2.1 Volute casing, impeller



9.2.2 Bearing housing, driven magnet and shroud assembly



9.2.3 Bearing bracket,
Driving magnet assembly