Purifier Unit 150

Service Manual

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Solutions beyond technology

Alfa Laval

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1 Separator Basics

1.1 Design and function

1.1.1 Application

The P150 is a high-speed centrifugal separator intended for marine and land applications. It is specifically designed for cleaning of mineral oils from water and solid particles (sludge). The cleaned oil is discharged continuously, while the sludge is discharged at intervals.

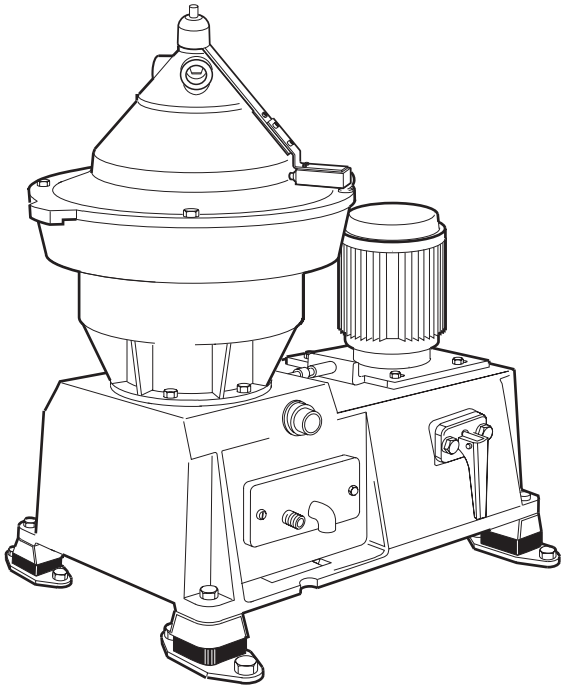
The separator handles the following types of lubricating oils and low viscosity fuel oils:

- Distillate, viscosity 1,5 - 5,5 cSt/40 °C
- Marine diesel oil, viscosity 13 cSt/40 °C
- Intermediate fuel oil and heavy fuel oil (viscosity 30-380 cSt/50 °C)
- Lubricating oil of R & O type, detergent or steam turbine.

The separator can be operated either as a purifier or as a clarifier. When operated as a purifier the separator discharges the separated water continuously.

When the oil contains only small amounts of water the separator is operated as a clarifier, discharging the water together with the solid particles.

The separator has to be installed together with devices for control of its operation.



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The P150 separator.

DANGER

Disintegration hazards

Use the separator only for the purpose and parameters (type of liquid, rotational speed, temperature, density etc.) specified in chapter *4 Technical Reference*, *page 92* and in the Purchase Order documents.

Consult your Alfa Laval representative before any changes outside these parameters are made.

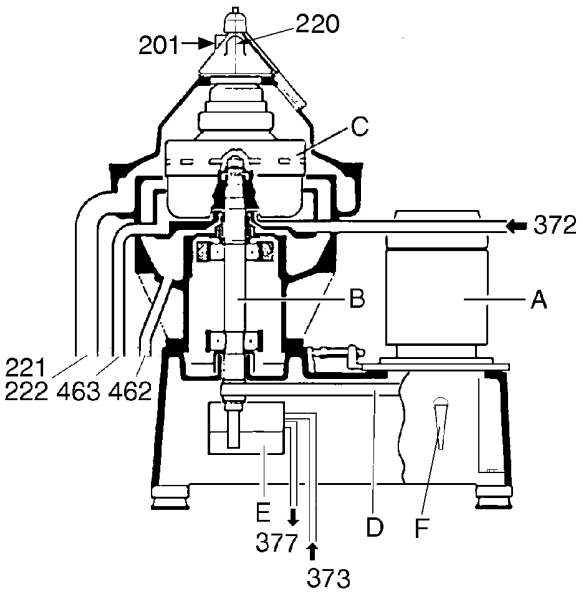
1.1.2 Design

The P150 separator comprises a frame consisting of the frame lower part, the intermediate part and the frame top part with a frame hood.

The separator bowl (C) is driven by an electric motor (A) via a flat-belt power transmission (D) and bowl spindle (B). The motor drive is equipped with a friction coupling to prevent overload.

The bowl is of disc type and hydraulically operated at sludge discharges. The hollow bowl spindle (B) features an impeller which pumps closing water from a built-in tank to the operating system for sludge discharge.

The main inlets and outlets are shown with their connection numbers in the illustration. The connections are listed in chapter *4 Technical Reference, page 92*, where also the basic size drawing can be found.



Sectional view
Main parts, inlets and outlets

A Electric motor
B Bowl spindle
C Bowl
D Flat belt
E Closing water tank

201 Oil inlet
220 Oil outlet
221, 222 Water/sludge outlet
372 Opening water inlet
373 Bowl closing water
377 Overflow
462 Drain
463 Drain

1.1.3 Outline of function

The separation process takes place in the rotating bowl. Unseparated oil is fed into the bowl through the inlet (201). The oil is cleaned in the bowl and leaves the separator through the outlet (220) via a paring chamber.

Impurities heavier than the oil are collected in the sludge space at the bowl periphery and removed automatically at regular intervals.

Permissible pressures and operating conditions are specified in chapter *4 Technical Reference, page 92*.

The processing parts of the separator are shown in the illustration on next page.

There are no contacting surfaces between process rotating parts (the bowl) and stationary parts (inlet, outlet, feed devices), and the interfacing surfaces are not sealed. As the separation process is carefully balanced regarding pressures and fluid levels, any leakages will not occur as long as the correct running conditions are maintained.

1.1.4 Separating function

Liquid flow

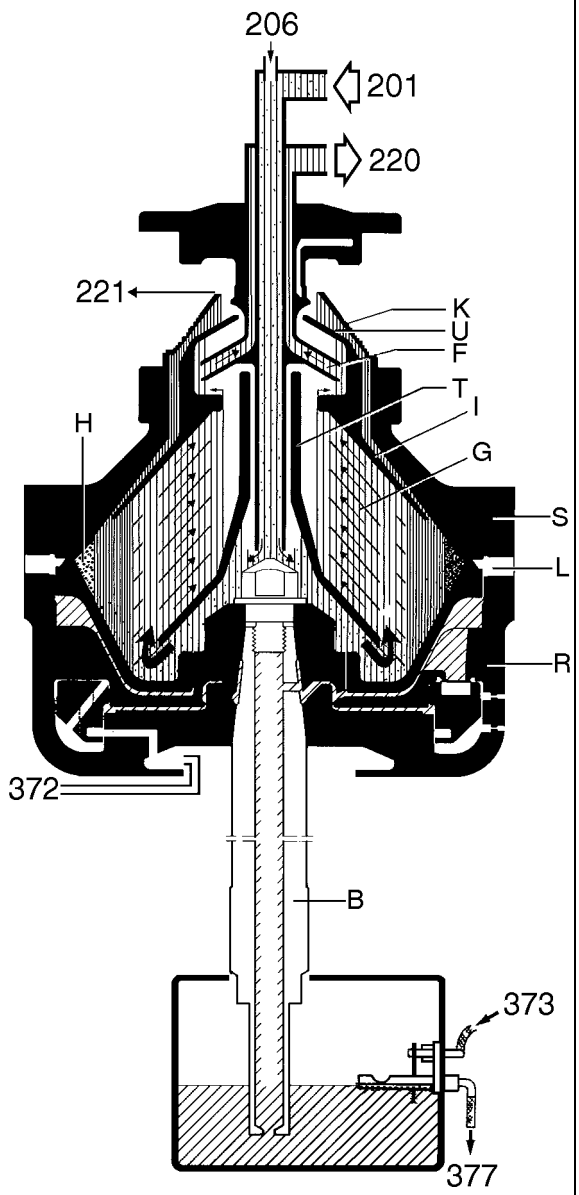
Separation takes place in the separator bowl to which unseparated oil is fed through the inlet pipe (201). The oil is led by the distributor (T) towards the periphery of the bowl.

When the unseparated oil reaches the slots of the distributor, it will rise through the channels formed by the disc stack (G) where it is evenly distributed into the disc stack.

The oil is continuously separated from water and sludge as it will flow towards the center of the bowl. When the cleaned oil leaves the disc stack it rises upwards and enters the paring chamber. From there it is pumped by the paring disc (F) and leaves the bowl through the outlet (220).

Separated sludge and water move towards the bowl periphery. In purification separated water rises along the outside of the disc stack, passes from the top disc channels over the edge of the gravity disc (K) and leaves the bowl into the common sludge and water outlet (221) of the separator.

Heavier impurities are collected in the sludge space (H) outside the disc stack and are discharged at intervals through the sludge ports (L).



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F	Paring disc	201	Oil inlet
G	Disc stack	206	Water seal and displacement water inlet
H	Sludge space		
I	Top disc		
K	Gravity disc		
L	Sludge ports	220	Oil outlet
R	Bowl body	221	Water outlet
S	Bowl hood	372	Opening water inlet
T	Distributor	373	Bowl closing water
U	Paring chamber cover	377	Overflow

Water seal in purification

To prevent the oil from passing the outer edge of the top disc (I) and escaping through the water outlet (221), a water seal must be provided in the bowl. This is done by filling the bowl with water through the water inlet (206), before unseparated oil is supplied. When oil feed is turned on the oil will force the water towards the bowl periphery and an interface (X) is formed between the water and the oil. The position of the interface is determined by the inner diameter of gravity disc (K).

Displacement of oil

To avoid oil losses at sludge discharge, displacement water is fed to the bowl.

Prior to a discharge the oil feed is stopped and displacement water added through the water inlet (206). This water changes the balance in the bowl and the interface (X) moves inwards to a new position (Y), increasing the water volume in the sludge space. When the sludge discharge takes place sludge and water alone are discharged.

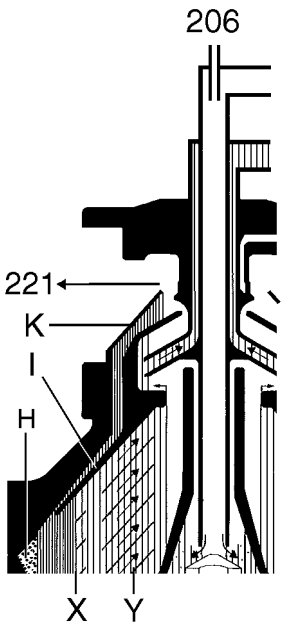
Sludge discharge occurs while the displacement water is still flowing. A new water seal will therefore establish immediately afterwards. The oil feed is then turned on again.

Gravity disc

In the purification mode, the position of the interface (X) can be adjusted by replacing the gravity disc (K) for one with larger or smaller diameter.

A gravity disc with a larger hole will move the interface towards the bowl periphery, whereas a disc with a smaller hole will place it closer to the bowl centre.

The correct gravity disc is selected from a nomogram, see *4.7.4 Gravity disc nomogram*, *page 116*.



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Principle of liquid seal and displacement water in purification

H Sludge space
I Top disc
K Gravity disc
X Normal interface position
Y Interface position just before discharge

206 Water inlet
221 Water outlet

Clarifier disc

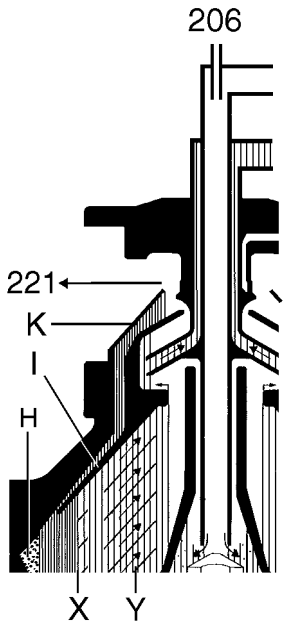
In the clarification mode, the gravity disc is replaced by a clarifier disc which seals off the water outlet. In this case no water seal is required and consequently there is no oil/water interface in the bowl. The clarifier disc is an optional disc with a hole diameter of 40 mm. This disc is not shown in the nomograms.

1.1.5 Sludge discharge function

Sludge is discharged through a number of ports (L) in the bowl wall. Between discharges these ports are covered by the sliding bowl bottom (M), which forms an internal bottom in the separating space of the bowl. The sliding bowl bottom is pressed upwards against a sealing ring (m) by force of the closing water underneath.

The sliding bowl bottom is operated hydraulically by means of operating water supplied to the discharge mechanism from an external freshwater line. Opening water is supplied directly to the operating system in the bowl while closing water is supplied to the built-in closing water tank, and pumped to the operating system through the bowl spindle.

The opening and closing only takes a fraction of a second, therefore the discharge volume is limited to a certain percentage of the bowl volume. This action is achieved by the closing water filling space above the upper distributor ring and pushing the sliding bowl bottom upwards. Simultaneously, the water in the chamber below the operating slide is drained off through the nozzles in the bowl body.



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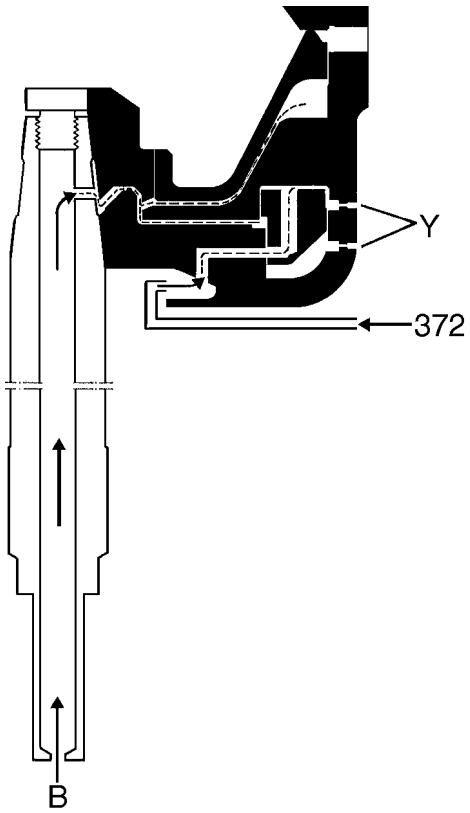
Sludge discharge mechanism
L Sludge ports
M Sliding bowl bottom
m Sealing ring
N Upper distributing ring
O Operating slide
P Lower distributing ring
R Bowl body

Bowl opening

The key event to start a sludge discharge is the downward movement of the operating slide. This is accomplished by supply of opening water (372) to the discharge mechanism. Water is drained off through nozzles (Y) in the bowl body. The sliding bowl bottom is rapidly pressed downwards by the force from the liquid in the bowl, opening the sludge ports.

Bowl closing

After the sludge is discharged the sliding bowl bottom is immediately pressed up and the sludge ports in the bowl wall are closed.



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Supply of opening water and closing water

372 Opening water

B Closing and make-up water through bowl spindle
Y Nozzles

1.1.6 Power transmission

Bowl spindle

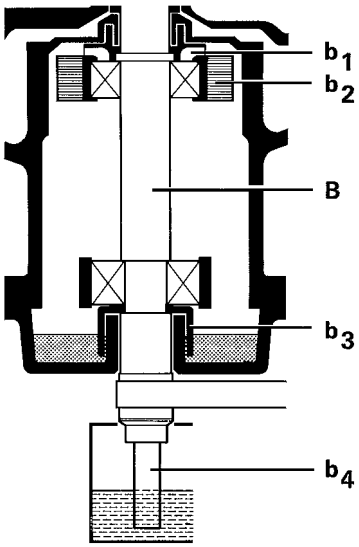
In addition to its primary role in the power transmission system, the bowl spindle also serves as:

- pump for the closing water
- supply pipe for the closing water
- lubricator for spindle ball bearings.

Closing water is pumped through the hollow spindle (B) to the discharge mechanism in the bowl. For this purpose a pump sleeve (b4) is fitted in the lower end.

The two spindle bearings are lubricated with oil mist. An oil pump (b3) creates the oil mist, which is sucked through the upper ball bearing by a fan (b1). Oil is supplied via an oil filling device, which also serves as a level indicator.

Two identical ring-shaped rubber buffers (b2) support the top bearing housing. The buffers are held in place by a buffer holder and form channels through which the recirculated oil passes.



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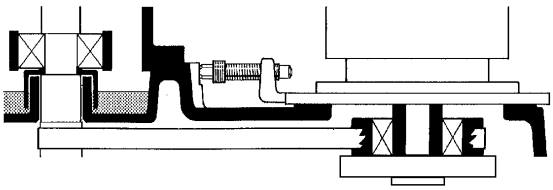
Bowl spindle assembly

B Bowl spindle
b1 Fan
b2 Rubber buffers
b3 Oil pump
b4 Sleeve

Belt drive

The bowl spindle is driven by a flat belt. Adaptation to 50 or 60 Hz power supply is made by selecting the motor belt pulley with the appropriate diameter. A longer belt is needed for the pulley for 50 Hz.

Correct tension is set by means of a spring-loaded belt tightener.



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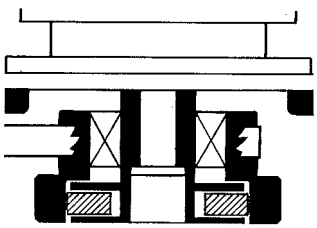
Belt drive

Friction coupling

The friction coupling on the motor pulley ensures gentle start-up and prevents overload of the electric motor. Centrifugal force creates a torque that acts on the pulley through the friction elements.



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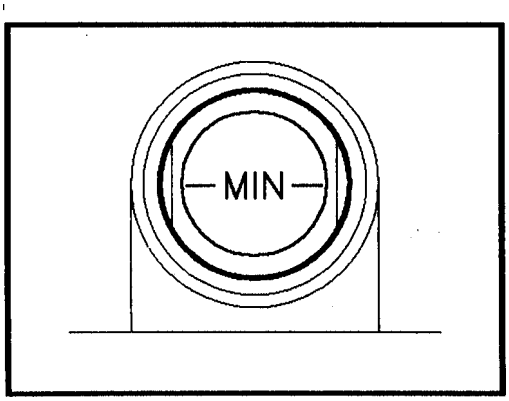
Friction coupling

1.1.7 Sensors and indicators

Sight glass

The sight glass shows the oil level in the oil sump.



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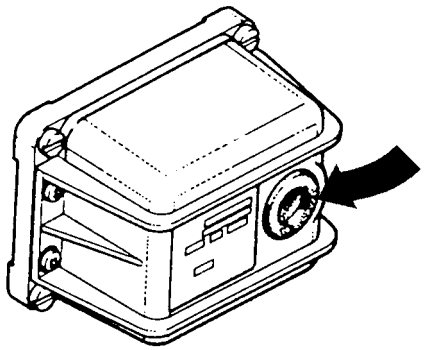
Vibration switch (option)

The vibration switch, properly adjusted, trips on a relative increase in vibration.

The vibration switch is sensitive to vibration in a direction perpendicular to its base. It contains a vibration detecting mechanism that actuates a snap-action switch when the selected level of vibration is exceeded. After the switch has tripped it must be reset manually by pressing the button on the switch.



Reset push button on vibration switch

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1.2 Definitions

Back pressure	Pressure in the separator outlet.
Clarification	Liquid/solids separation with the intention of separating particles, normally solids, from a liquid having a lower density than the particles.
Clarifier disc	An optional disc, which replaces the gravity disc in the separator bowl, in the case of clarifier operation. The disc seals off the heavy phase outlet in the bowl, thus no liquid seal exists.
Counter pressure	See Back pressure.
Density	Mass per volume unit. Expressed in kg/m^3 at a specified temperature, normally at 15 °C.
Gravity disc	Disc in the bowl hood for positioning the interface between the disc stack and the outer edge of the top disc. This disc is only used in purifier mode.
Interface	Boundary layer between the heavy phase (water) and the light phase (oil) in a separator bowl.
Intermediate Service (IS)	Overhaul of separator bowl and inlet/outlet. Renewal of seals in bowl and inlet/outlet.
Major Service (MS)	Overhaul of the complete separator, including bottom part (and activities included in an Intermediate Service). Renewal of seals and bearings in bottom part.
Phase	Light phase: the lighter liquid separated, e.g. oil. Heavy phase: the heavier liquid separated, e.g. water.
Purification	Liquid/liquid/solids separation with the intention of separating two intermixed and mutually insoluble liquid phases of different densities. Solids having a higher density than the liquids can be removed at the same time. The **lighter** liquid phase, which is the major part of the mixture, shall be purified as far as possible.
Sediment (sludge)	Solids separated from a liquid.
Sludge discharge	Ejection of sludge from the separator bowl.
Throughput	The feed of process liquid to the separator per time unit. Expressed in m^3/hour or litres/hour.
Viscosity	Fluid resistance against movement. Normally expressed in centistoke (cSt = mm^2/s), at a specified temperature.
Water seal	Water in the solids space of the separator bowl to prevent the light phase (oil) from leaving the bowl through the heavy phase (water) outlet, in purifier mode.

2 Service Instructions

2.1 Periodic maintenance

2.1.1 Introduction

Periodic, preventive maintenance reduces the risk of unexpected stoppages and breakdowns. Maintenance logs are shown on the following pages in order to facilitate periodic maintenance.

Disintegration hazards

Separator parts that are worn beyond their safe limits or incorrectly assembled may cause severe damage or fatal injury.

2.1.2 Maintenance intervals

The following directions for periodic maintenance give a brief description of which parts to clean, check and renew at different maintenance intervals.

The service logs for each maintenance interval later in this chapter give detailed enumeration of the checks that must be done.

Daily checks consist of simple check points to carry out for detecting abnormal operating conditions.

Oil change interval is 1500 hours. If the total number of operating hours is less than 1500 hours change oil at least once every year.

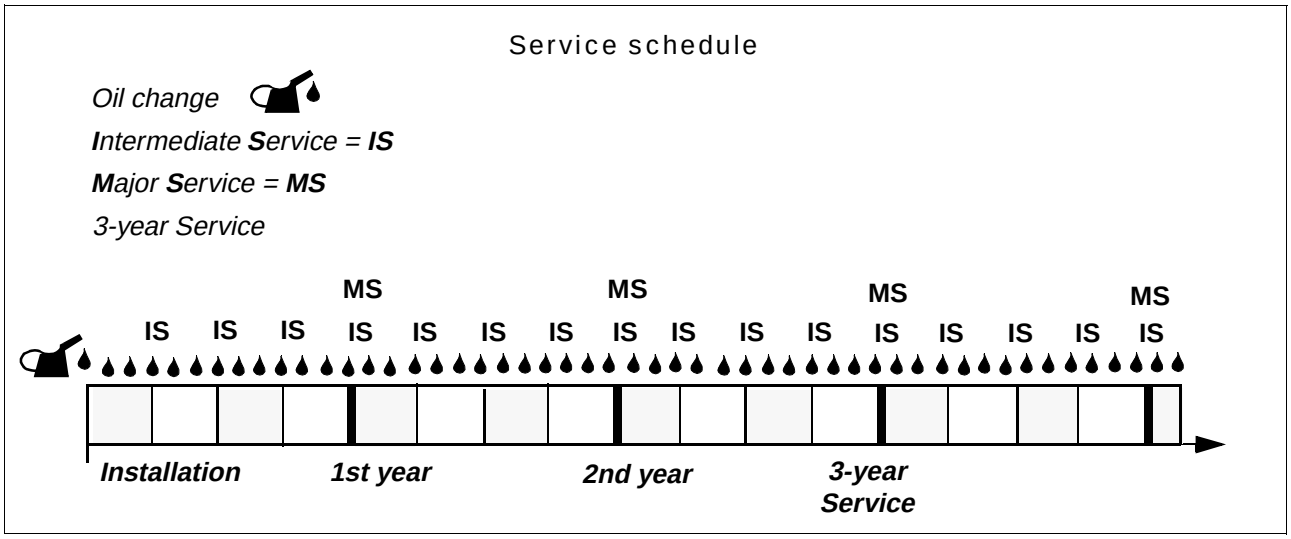
Time of operation between oil changes can be extended from the normal 1500 hours to 2000 hours if a synthetic oil of group D is used.

In seasonal operation change the oil before a new period.

IS - Intermediate Service consists of an overhaul of the separator bowl, inlet and outlet every 3 months or 2000 operating hours. Seals in bowl and gaskets in the inlet/outlet device and operating device are renewed.

MS - Major Service consists of an overhaul of the complete separator every 12 months or 8000 operating hours. An Intermediate Service is performed, and the flat belt, friction elements, seals and bearings in the bottom part are renewed.

3-year service consists of service of the coupling bearings, service of frame intermediate part and renewal of frame feet. The rubber feet get harder with increased use and age.



Other

Check and prelubricate spindle bearings of separators which have been out of service for 6 months or longer. See also *2.10.2 Before shut-downs, page 42*.

NOTE

Do not interchange bowl parts!

To prevent mixing of parts, e.g. in an installation comprising several machines of the same type, the major bowl parts carry the machine manufacturing number or its last three digits.

2.1.3 Maintenance procedure

At each intermediate and major service, take a copy of the service log and use it for notations during the service.

An intermediate and major service should be carried out in the following manner:

1 Dismantle the parts as mentioned in the service log and described in chapter *3 Dismantling/Assembly, page 43*.
Place the separator parts on clean, soft surfaces such as pallets.

2 Inspect and clean the dismantled separator parts according to the service log.

3 Fit all the parts delivered in the service kit while assembling the separator as described in chapter *3 Dismantling/Assembly, page 43*.
The assembly instructions have references to check points which should be carried out during the assembly.

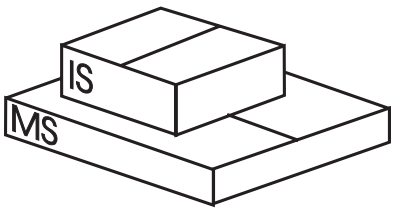
2.1.4 Service kits

Special service kits are available for Intermediate Service (IS) and Major Service (MS).

For other services the spare parts have to be ordered separately.

Note that the parts for IS are **not** included in the MS kit.

The contents of the service kits are described in the *Spare Parts Catalogue*.



Spare parts kits are available for Intermediate Service and Major Service

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NOTE

Always use Alfa Laval genuine parts as otherwise the warranty will become invalid.
Alfa Laval takes no responsibility for the safe operation of the equipment if non-genuine spare parts are used.

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2.2 Maintenance Logs

2.2.1 Daily checks

The following steps should be carried out daily.

Main component and activity	Part	Page	Notes
Inlet and outlet			
Check for leakage	Connecting housing	-	
Separator bowl			
Check for vibration and noise		-	
Belt transmission			
Check for vibration and noise		-	
Oil sump			
Check	Oil level	-	
Electrical motor			
Check for vibration, heat and noise See manufacturer's instructions			

2.2.2 Oil change - monthly

The oil change and check of belt transmission should be carried out every 1500 hours of operation.

When using a group D oil, time of operation between oil changes can be extended from the normal 1500 hours to 2000 hours.

When the separator is run for short periods, the lubricating oil must be changed every 12 months even if the total number of operating hours is less than 1500 hours (less than 2000 hours if a group D oil is used).

See chapter *4.6 Lubricants, page 103* for further information on oil brands etc.

Main component and activity	Part	Page	Notes
Bowl spindle and transmission			
Check	Belt tension	*83*	
Change	Oil in oil sump	*35*	

2.2.3 IS - Intermediate Service

Name of plant: Local identification:

Separator: P150 Manufacture No./Year:

Total running hours: Product No.: 881100-03-01

Date: Signature:

Renew all parts included in the Intermediate Service kit (IS) and do the following activities.

Main component and activity	Part	Page	Notes
Inlet and outlet, frame			
Clean and inspect	Threads of inlet pipe	*24*	
	Paring disc	*24*	
	Housings and frame hood	-	
Separator bowl			
Clean and inspect	Bowl hood	*25*	
	Top disc	*34*	
	Bowl discs	*34*	
	Distributor	-	
	Nozzles in bowl body	*21*	
	Sliding bowl bottom	*21*	
	Discharge mechanism	*21*	
	Threads on bowl hood and bowl body	*25*	
	Bowl spindle cone and bowl body nave	*24*	
Check	Disc stack pressure	*27*	
	Galling of guide surface	*25*	
	Corrosion, erosion, cracks	*17 - 19*	
Power transmission			
Check	Belt and belt tension	*83*	
Change	Oil in oil sump	*35*	
Electrical motor			
Lubrication (if nipples are fitted)	See sign on motor	-	
Signs and labels on separator			
Check attachment and legibility	Safety label on hood	*114*	
	Other plates and labels	*114*	

2.2.4 MS - Major Service

Name of plant: Local identification:

Separator: P150 Manufacture No./Year:

Total running hours: Product No.: 881100-03-01

Date: Signature:

Renew all parts included in the Intermediate and Major Service kits and do the following activities.

Main component and activity	Part	Page	Notes
Inlet and outlet, frame			
Clean and inspect	Threads of inlet pipe	*24*	
	Paring disc	*24*	
	Housings and frame hood	-	
Separator bowl			
Clean and inspect	Bowl hood	*25*	
	Top disc	*34*	
	Bowl discs	*34*	
	Distributor	–	
	Nozzles in bowl body	*21*	
	Sliding bowl bottom	*21*	
	Discharge mechanism	*21*	
	Threads on bowl hood and bowl body	*25*	
	Bowl spindle cone and bowl body nave	*24*	
Check	Height of paring disc	*28*	
	Disc stack pressure	*27*	
	Galling of guide surface	*25*	
	Corrosion, erosion, cracks	*17* - *19*	

Main component and activity	Part	Page	Notes
Vertical driving device			
Clean and inspect	Oil mist fan	*66*	
	Oil pump	*66*	
	Water tank	*89*	
	Pump sleeve		
	Bowl spindle	*63*	
	Ball bearing housing indentations	*63*	
Check	Radial wobble of bowl spindle	*29*	
Oil sump			
Clean	Oil sump	*35*	
Change	Oil	*35*	
Clean and inspect	Oil filling device	*88*	
Friction coupling			
Clean and inspect	Friction coupling	*77*	
Electrical motor			
Replace	Bearings[1)]		
Signs and labels on separator			
Check attachment and legibility	Safety label on hood	*114*	
	Other signs and labels	*114*	

1) See manufacturer's instructions.

2.3 Check points at Intermediate Service

2.3.1 Corrosion

Evidence of corrosion attacks should be looked for and rectified each time the separator is dismantled. Main bowl parts such as the bowl body and hood must be inspected with particular care for corrosion damage.

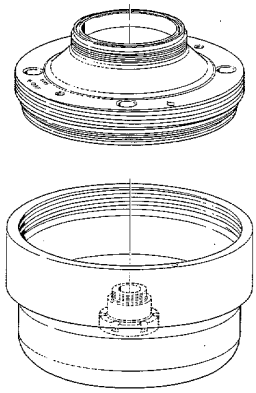
DANGER

Disintegration hazard

Inspect regularly for corrosion damage. Inspect frequently if the process liquid is corrosive.

Always contact your Alfa Laval representative if you suspect that the largest depth of a corrosion damage exceeds 1,0 mm or if cracks have been found. Do not continue to use the separator until it has been inspected and given clearance for operation by Alfa Laval.

Cracks or damage forming a line should be considered as being particularly hazardous.



Main bowl parts to check for corrosion

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Non-stainless steel and cast iron parts

Corrosion (rusting) can occur on unprotected surfaces of non-stainless steel and cast iron. Frame parts can corrode when exposed to an aggressive environment.

Stainless steel

Stainless steel parts corrode when in contact with either chlorides or acidic solutions. Acidic solutions cause a general corrosion. The chloride corrosion is characterised by local damage such as pitting, grooves or cracks. The risk of chloride corrosion is higher if the surface is

- exposed to a stationary solution,
- in a crevice,
- covered by deposits,
- exposed to a solution that has a low pH value.

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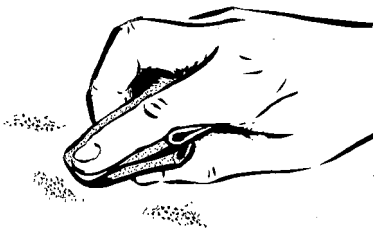
Example of chloride corrosion in stainless steel.

A corrosion damage caused by chlorides on stainless steel begins as small dark spots that can be difficult to detect.

- Inspect closely for all types of damage by corrosion and record these observations carefully.
- Polish dark-coloured spots and other corrosion marks with a fine grain emery cloth. This may prevent further damage.



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Polish corrosion marks to prevent further damage.

Disintegration hazard

Pits and spots forming a line may indicate cracks beneath the surface.

All forms of cracks are a potential danger and are totally unacceptable.

Replace the part if corrosion can be suspected of affecting its strength or function.

Other metal parts

Separator parts made of materials other than steel, such as brass or other copper alloys, can also be damaged by corrosion when exposed to an aggressive environment. Possible corrosion damage can be in the form of pits and/or cracks.

2.3.2 Erosion

Erosion can occur when particles suspended in the process liquid slide along or strike against a surface. Erosion can become intensified locally by flows of higher velocity.

DANGER

Disintegration hazard

Inspect regularly for erosion damage. Inspect frequently if the process liquid is erosive.

Always contact your Alfa Laval representative if the largest depth of any erosion damage exceeds 1,0 mm. Valuable information as to the nature of the damage can be recorded using photographs, plaster impressions or hammered-in lead.

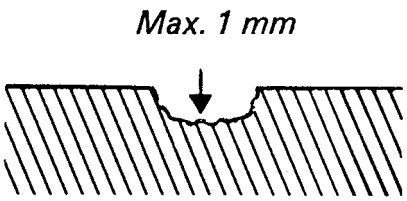
Erosion is characterised by:

- Burnished traces in the material.
- Dents and pits having a granular and shiny surface.

Parts of the bowl particularly subjected to erosion are:

- The paring disc.
- The top disc.
- The underside of the distributor in the vicinity of the distribution holes and wings.
- The sludge ports.

Look carefully for any signs of erosion damage. Erosion damage can deepen rapidly and consequently weaken parts by reducing the thickness of the metal.



Maximum permitted erosion.

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2.3.3 Cracks

Cracks can initiate on the machine after a period of operation and propagate with time.

- Cracks often initiate in areas exposed to high cyclic material stresses. These cracks are called fatigue cracks.
- Cracks can also initiate due to corrosion in an aggressive environment.
- Although very unlikely, cracks may also occur due to the low temperature embrittlement of certain materials.

The combination of an aggressive environment and cyclic stresses will speed-up the formation of cracks. Keeping the machine and its parts clean and free from deposits will help to prevent corrosion attacks.

Disintegration hazard

All forms of cracks are potentially dangerous as they reduce the strength and functional ability of components.

Always replace a part if cracks are present

It is particularly important to inspect for cracks in rotating parts.

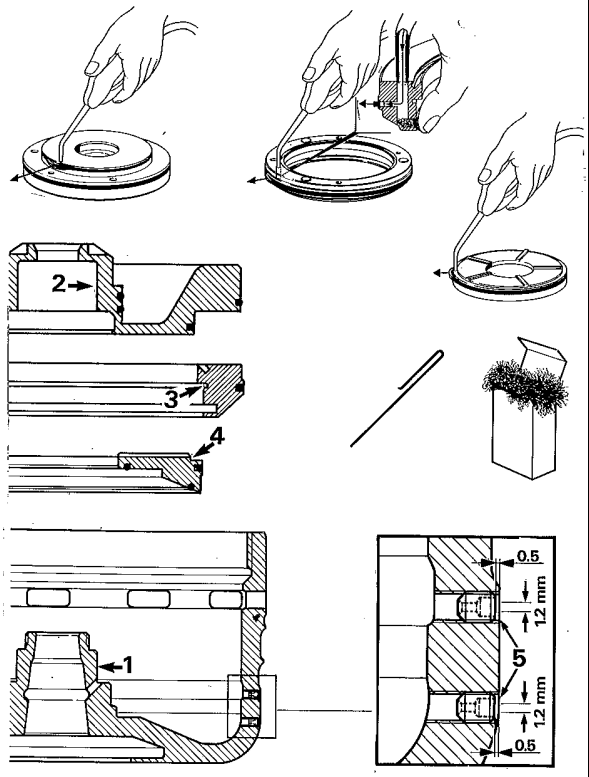
Always contact your Alfa Laval representative if you suspect that the largest depth of the damage exceeds 1,0 mm. Do not continue to use the separator until it has been inspected and cleared for operation by Alfa Laval.

2.3.4 Discharge mechanism

Dirt and lime deposits in the sludge discharge mechanism can cause discharge malfunction or no discharge.

- Thoroughly clean and inspect the parts. Pay special attention to important surfaces (1, 2, 3 and 4). If necessary, polish with steel wool.
- Clean nozzles (5) using soft iron wire or similar. Note that lime deposits can with advantage be dissolved in a 10% acetic acid solution.

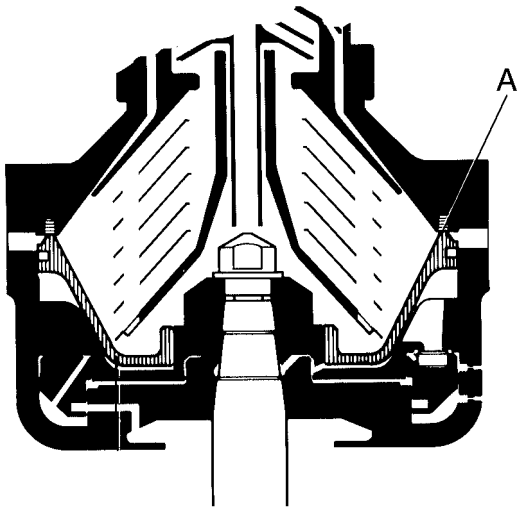
Use Loctite 242 on the threads if the nozzles have been removed or replaced.



G0121511

2.3.5 Bowl hood and sliding bowl bottom

Poor sealing between the bowl hood seal ring and the edge of the sliding bowl bottom will cause a leakage of process liquid from the bowl.



G0071031

A Sealing surface in the bowl between bowl hood and sliding bowl bottom.

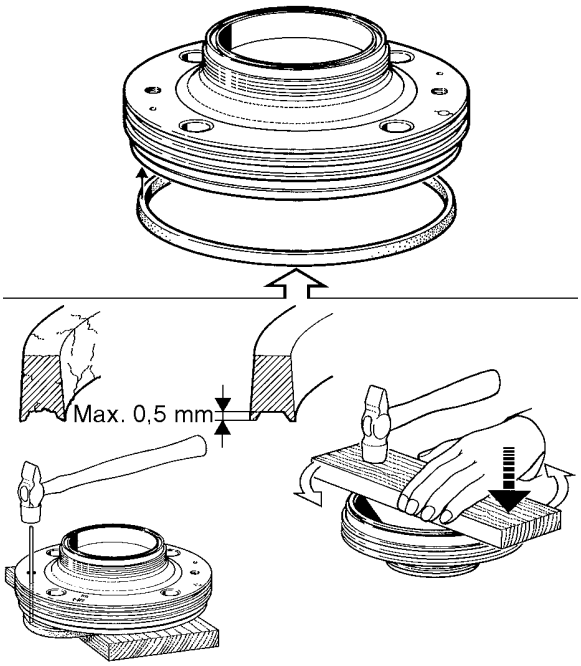
Fit a new bowl hood seal ring at each Intermediate Service (IS) if the old ring is damaged or indented more than 0,5 mm.

Fit a new ring as follows:
Press the ring into the groove with a straight board (1” x 4”), placed across the ring.

NOTE

If a new ring is too narrow, put it into hot water, 70 - 80 °C for about 5 minutes.

If it is too wide it will recover after drying at 80 - 90 °C for about 24 hours.

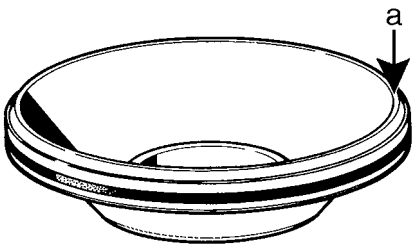


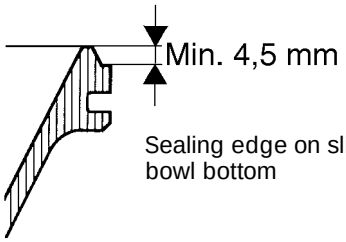
G0071121

Exchange of seal ring in bowl hood.

Check the sealing edge (a) of the sliding bowl bottom.

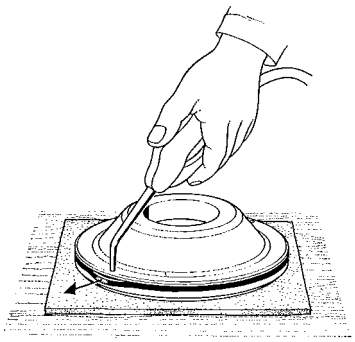
If damaged through corrosion or erosion or in other ways it can be rectified by turning in a lathe. Minimum permissible height of sealing edge: 4,5 mm.





Sealing edge on sliding bowl bottom

G0071221



Removal of seal ring on sliding bowl bottom.

G0071231

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2.3.6 Spindle top cone and bowl body nave

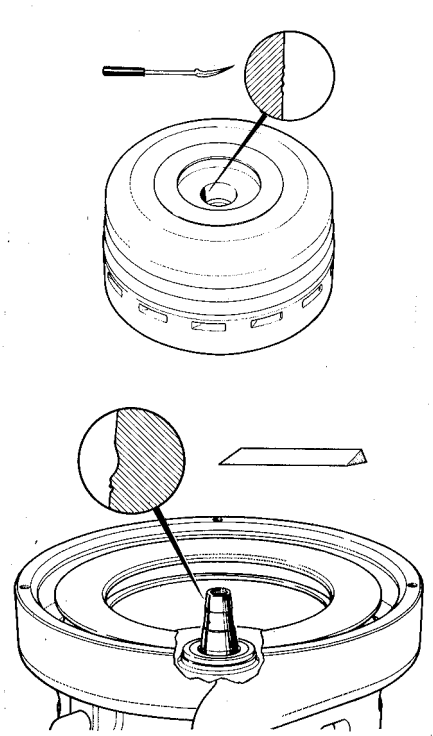
Impact marks on the spindle cone or in the bowl body nave may cause the separator to vibrate while running.

Corrosion may cause the bowl to stick firmly to the spindle cone and cause difficulties during the next dismantling.

- Remove any impact marks using a scraper and/or a whetstone.
  Rust can be removed by using a fine-grain emery cloth (e.g. No. 320).Finish with polishing paper (e.g. No. 600).

NOTE

Always use a scraper with great care. The conicity must not be marred.



Use whetstone or scraper with great care

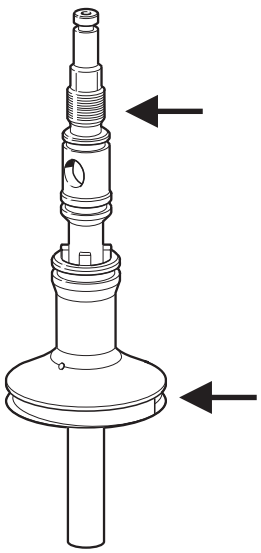
G0071611

2.3.7 Threads of inlet pipe, paring disc

Damage to threads or a broken paring disc can prevent correct tightening of the inlet pipe and cause the paring disc to scrape against the top disc, even though the height adjustment of the paring disc has been made correctly.

1 Examine the threads for damage and rectify if required.

2 Examine the paring disc for damage and to see if the disc walls have parted. If they have, the inlet pipe has to be replaced with a new one.



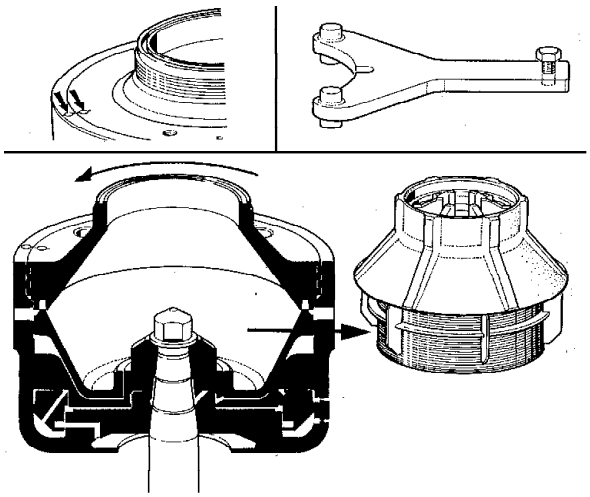
G0113031

2.3.8 Threads on bowl hood and bowl body

Excessive wear or impact marks on threads and guide surfaces of the bowl hood or bowl body can cause seizure damage.

Examine the thread condition by tightening the bowl hood after removing the disc stack and top disc from the bowl.

When the bowl is new the alignment marks on the bowl hood and the bowl body should be aligned. If not, contact an Alfa Laval representative.



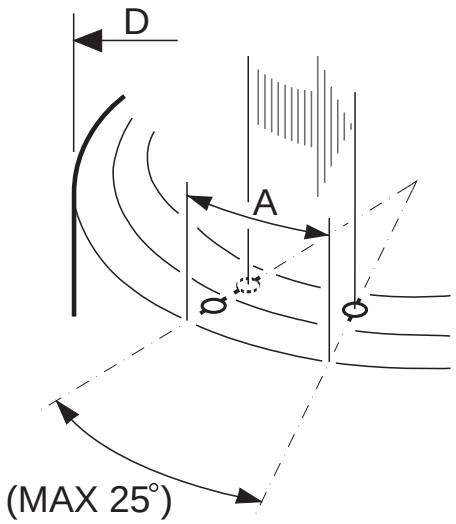
G0071311

Wear

If thread wear is observed, mark the bowl body at the new position by punching a new alignment mark. If the mark on the bowl hood passes the mark on the bowl body by more than 25°, (A in the illustration) an Alfa Laval representative should be contacted immediately.

The measure A in millimetres (mm) is obtained by calculating bowl outside diameter D times 0,2.

If the marks are illegible, an Alfa Laval representative should be contacted for determination and punching of new alignment marks.



G0578111

DANGER

Disintegration hazards

Wear on threads must not exceed safety limit. f mark on bowl hood must not pass f mark on bowl body by more than 25°.

Damage

The position of threads, contact and guide surfaces are indicated by arrows in the illustration.

Examine for burrs and protrusions caused by impact.

Clean the threads, contact and guide surfaces with a suitable degreasing agent.

CAUTION

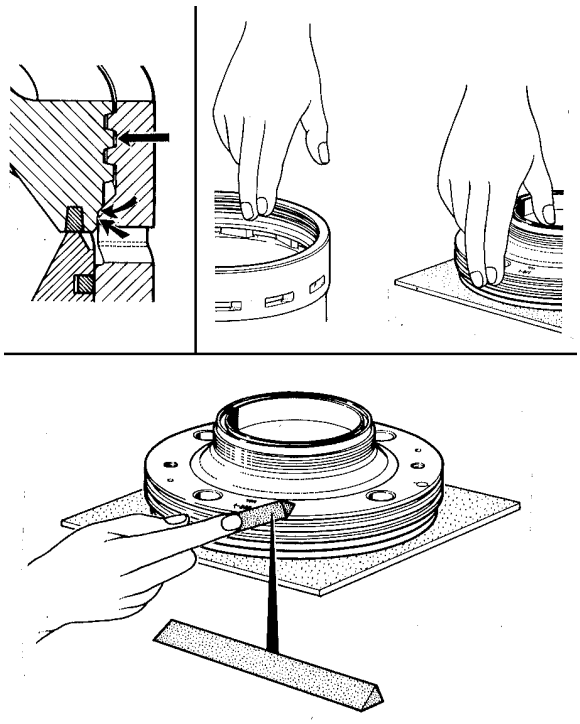
Cut hazard

The threads have sharp edges which can cause cuts.

If damage is found, rectify by using a whetstone or fine emery cloth. Recommended grain size: 240.

If the damage is bad, use a fine single-cut file, followed by a whetstone. After rectifying, the threads have to be primed with Molykote 1000.

Contact surfaces to inspect on the bowl



G0071511

2.3.9 Priming of bowl parts

The instruction refers to contact surfaces (dark shaded) of both matching parts.

Before assembly:

1 These surfaces should be sprayed with Molykote D321R after a careful cleaning.

2 Air cure for 15 minutes.

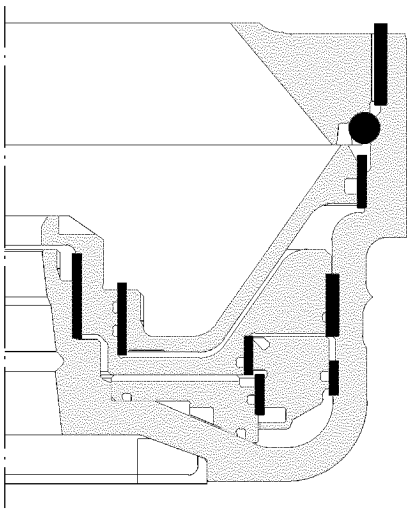
3 Polish to an even, homogenous surface.

4 Spray a second time.

5 Air cure for 15 minutes.

6 Polish to a shiny surface, the surface shoud look like well polished leather when properly done.

7 Finish the treatment by lubricating the surfaces with lubricating paste see *4.6.3 Recommended lubricants, page 106*.



G0887731

2.3.10 Disc stack pressure

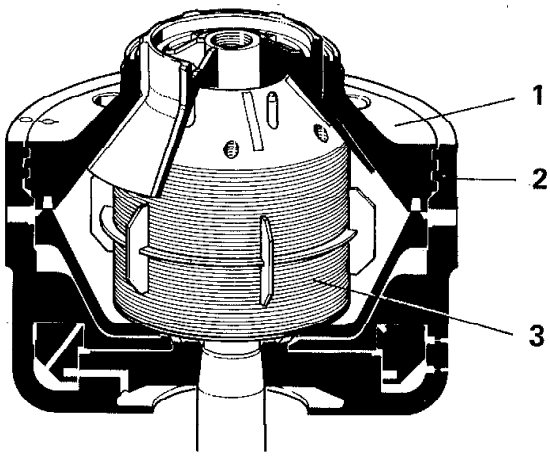
The bowl hood exerts a pressure on the disc stack clamping it in place.

NOTE

Insufficient pressure in the disc stack may affect the bowl balance, which in turn will cause abnormal vibration of the separator and shorten the life of ball bearings.

1 Place the bowl hood on the top of the disc stack and tighten it by hand.
The assembly mark on the bowl hood should now be positioned at the angle a (see illustration), 30° - 60° ahead of the corresponding mark on the bowl body.

2 If the bowl hood can be tightened by hand without resistance until the marks are in line with each other, an extra disc must be added to the top of the disc stack beneath the top disc.



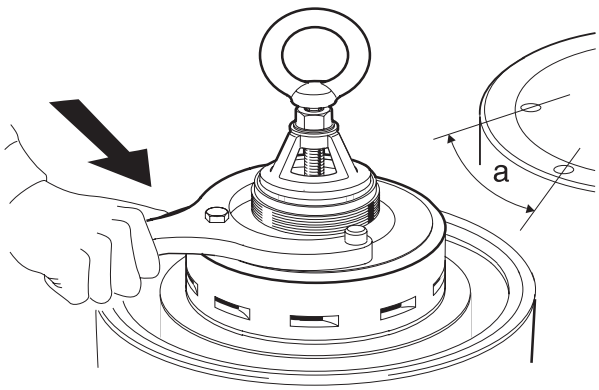
G0071911

1 Bowl hood
2 Bowl body
3 Disc stack. Number of discs
- below wing insert: 42
- above wing insert: at least 41

3 If one or more discs have been added re-check the disc stack pressure by repeating the procedure above.

NOTE

The top disc can stick inside the bowl hood and fall when the hood is lifted.



G0357651

a Angle 30° - 60° between assembly marks before final tightening

2.4 Check points at Major Service

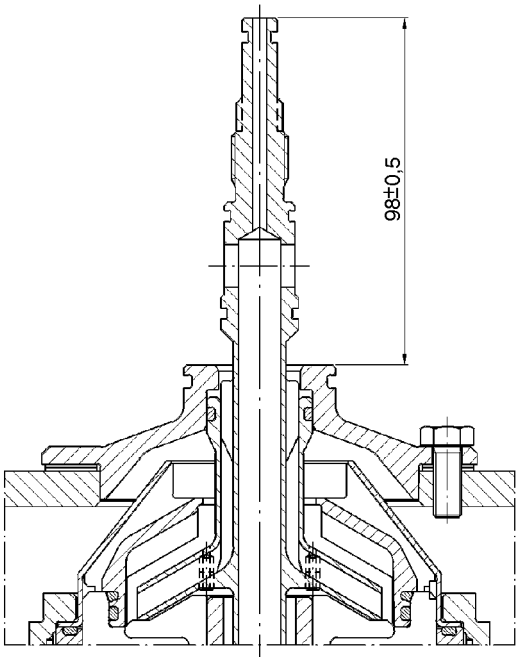
2.4.1 Paring disc height adjustment

The height of the paring disc above the frame hood must be measured if the bowl spindle has been dismantled or if the bowl has been replaced with a new one.

NOTE

Incorrect height position can cause the paring disc (14) to scrape against the paring chamber cover.

Pay attention to scraping noise at start-up after service.



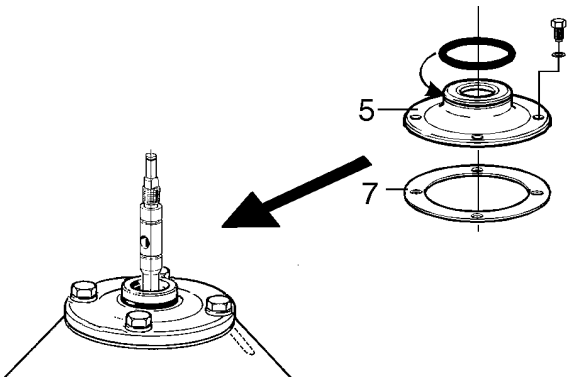
G0883911

1 Assemble the bowl and frame hood as described in chapter *3.1.2 Inlet/outlet and bowl - assembly, page 53*.

2 Measure the distance according to the illustration above. Adjust the distance by adding or removing height adjusting rings (7).

3 Fit the support ring (5) and the inlet/outlet housing. Tighten the nut with 30 Nm.

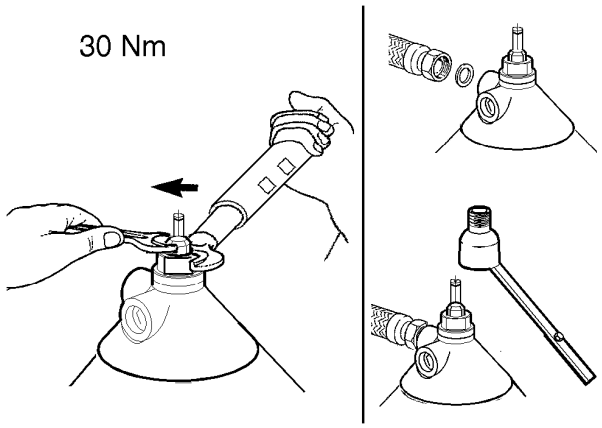
Left-hand thread!



G00729A1

4 Rotate the bowl spindle by hand by means of the flat belt. If it does not rotate freely or if a scraping noise is heard, incorrect height adjustment or incorrect fitting of the inlet pipe can be the cause. Remove the parts and readjust.

5 Finally, fit the safety device.



G0172951

2.4.2 Radial wobble of bowl spindle

The bowl spindle wobble must be measured if the bowl spindle has been dismantled or if rough bowl run (vibration) occurs.

NOTE

Spindle wobble will cause rough bowl run. This leads to vibration and reduces lifetime of ball bearings.

Check the wobble **before** removing the bowl spindle.

If the bowl spindle has been dismantled check the wobble before installing the bowl.

1 Fit a dial indicator in a support and fasten it in position as illustrated.

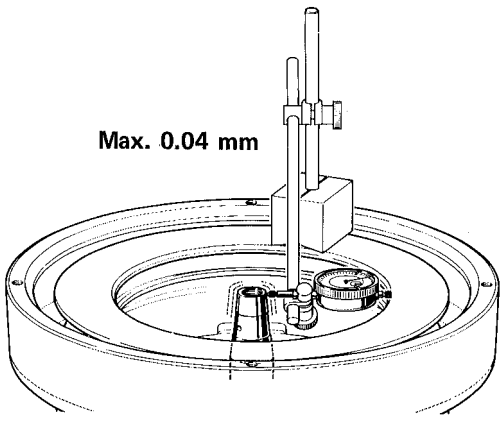
2 Remove the water tank from the frame bottom part for access to the flat belt. Use the flat belt to turn the spindle.

3 Permissible radial wobble: max. 0,04 mm.

If the spindle wobble is more than the maximum permitted value, contact Alfa Laval representatives.

4 Finally fit the water tank to the frame bottom part.

Incorrect belt tension causes displacement of the vertical line of the spindle centre, but does not affect the wobble of the spindle.



G0121211

2.5 3-year service

Exchange of frame feet

See *3.8.1 Mounting of new frame feet, page 91*.

Friction coupling

Exchange of ball bearings, see *3.3 Friction coupling, page 77*.

Frame intermediate part

Replace O-ring and gasket, see *3.2.2 Bowl spindle and frame - assembly, page 69*.

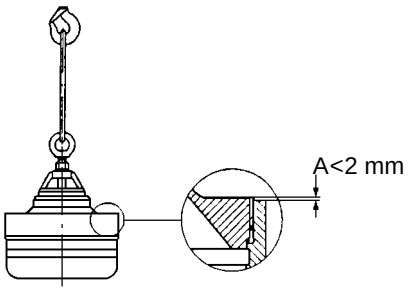
2.6 Lifting instructions

1 Remove the inlet/outlet housings, the frame hood and the bowl according to the instructions in chapter *3.1.1 Inlet/outlet and bowl - dismantling*, *page 48*.

NOTE

Make sure to remove the cap nut fixing the bowl to the bowl spindle.

Before lifting the bowl, check that the bowl hood has been screwed home into the bowl body. Less than 2 mm of bowl hood threading must remain above the bowl body edge. See illustration.



G0507121

When lifting the bowl, use the compression tool fastened on the distributor.

2 Disconnect the motor cables.

3 Tighten the frame hood.

4 Fit the lifting eyes. The two eyebolts must be fitted in the holes nearest to the electric motor.

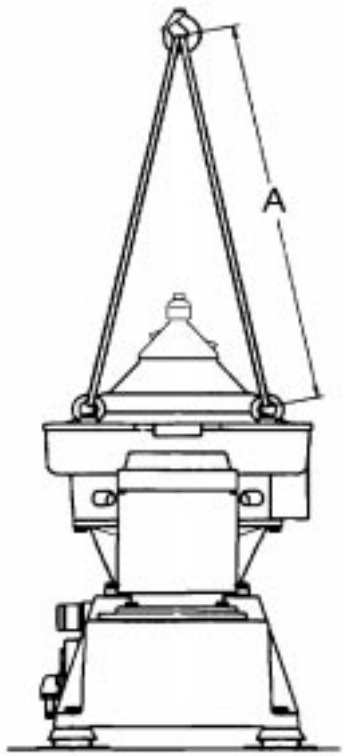
5 Use two endless slings to lift the separator. Length of each sling: minimum 1,5 metres. Thread the slings through the lifting eyes and fit them to the hook of the hoist.

6 Unscrew the foundation bolts.

7 When lifting and moving the separator, obey normal safety precautions for lifting large heavy objects.

Do not lift the separator unless the bowl has been removed.

8 Remove the lifting eyes afterwards.



G0820621

A Minimum 750 mm distance between lifting eye and hook.
Use a lifting hook with catch.

NOTE

Separator without bowl: Use lifting slings for WLL 300 kg.

Bowl: Use lifting slings for WLL 100 kg.

WARNING

Crush hazards

Use only the two special lifting eyes (M12) for lifting the machine. They are to be screwed into the special threaded holes.
Other holes are not dimensioned for lifting the machine.

A falling separator can cause accidents resulting in serious injury and damage.

2.7 Cleaning

External cleaning

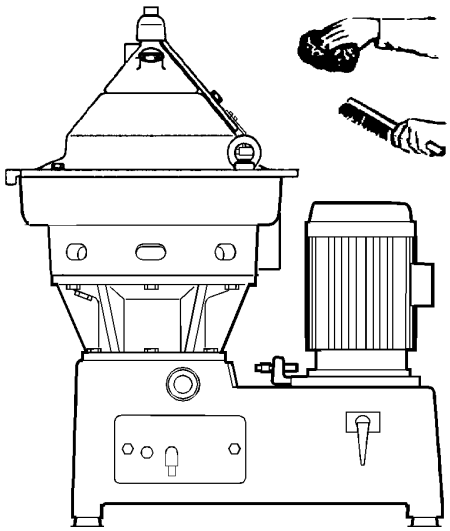
The external cleaning of frame and motor should be restricted to brushing, sponging or wiping while the motor is running or is still hot.

Never wash down a separator with a direct water stream. Totally enclosed motors can be damaged by direct hosing to the same extent as open motors and even more than those, because:

- Many operators believe that these motors are sealed, and normally they are not.
- A water jet played on these motors will produce an internal vacuum, which will suck the water between the metal-to-metal contact surfaces into the windings, and this water cannot escape.
- Water directed on a hot motor may cause condensation resulting in short-circuiting and internal corrosion.

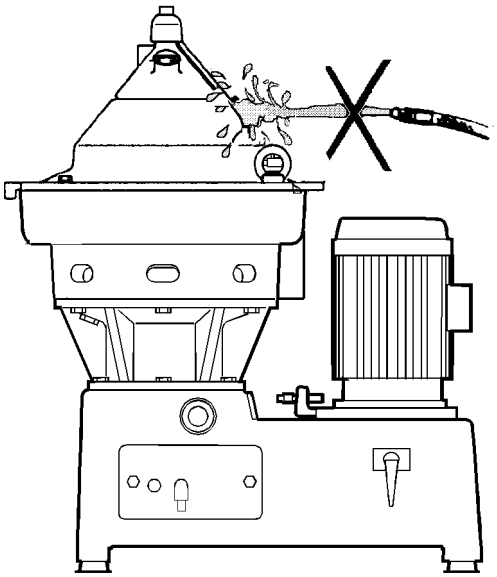
Be careful even when the motor is equipped with a protecting hood. Never play a water jet on the ventilation grill of the hood.

Use a brush and a sponge or cloth when cleaning.



G0615361

Never wash down a separator with a direct water stream or spray.



G0613661

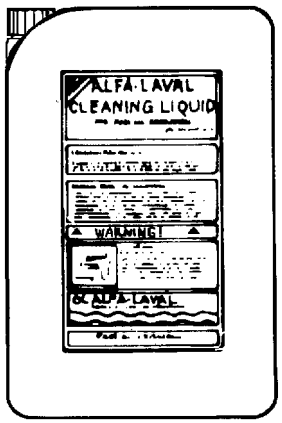
2.7.1 Cleaning agents

When using chemical cleaning agents, make sure you follow the general rules and suppliers' recommendations regarding ventilation, protection of personnel, etc.

For separator bowl, inlet and outlet

A chemical cleaning agent must dissolve the deposits quickly without attacking the material of the separator parts.

- For cleaning of lube oil separators the most important function of the cleaning agent is to be a good solvent for the gypsum in the sludge. It should also act as a dispersant and emulsifier for oil. It is recommended to use Alfa Laval cleaning liquid for lube oil separators which has the above mentioned qualities. Note that carbon steel parts can be damaged by the cleaning agent if submerged for a long time.
- Fuel oil sludge mainly consists of complex organic substances such as asphaltenes. The most important property of a cleaning liquid for the removal of fuel oil sludge is the ability to dissolve these asphaltenes.



Alfa Laval cleaning liquid for lube oil and fuel oil separators.

S0008511

CAUTION

Skin irritation hazard

Read the instructions on the label of the plastic container before using the cleaning liquid.

Always wear safety goggles, gloves and protective clothing as the liquid is alkaline and dangerous to skin and eyes.

For parts of the driving devices

Use white spirit, cleaning-grade kerosene or diesel oil.

Oiling (protect surfaces against corrosion)

Protect cleaned carbon steel parts against corrosion by oiling. Separator parts that are not assembled after cleaning must be wiped and coated with a thin layer of clean oil and protected from dust and dirt.

2.7.2 Cleaning of bowl discs

Bowl discs

Handle the bowl discs carefully so as to avoid damage to the surfaces during cleaning.

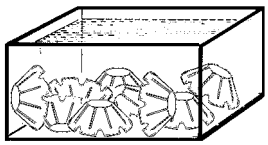
NOTE

Mechanical cleaning is likely to scratch the disc surfaces causing deposits to form quicker and adhere more firmly.

A mild chemical cleaning is therefore preferable to mechanical cleaning.

1 Remove the bowl discs from the distributor and lay them down, one by one, in the cleaning agent.

2 Let the discs remain in the cleaning agent until the deposits have been dissolved. This will normally take between two and four hours.



Put the discs one by one into the cleaning agent.

G0065831

3 Finally clean the discs with a soft brush.

WARNING

Cut hazards

The discs have sharp edges that can cause cuts.

Clean the discs with a soft brush.

G0065841

2.8 Oil change

2.8.1 Oil change procedure

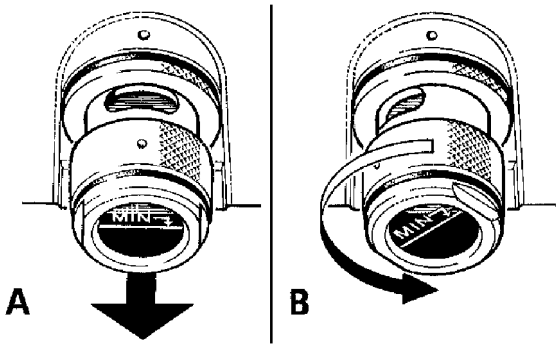
NOTE

Before adding or renewing lubricating oil in the oil sump, the information concerning different oil groups, handling of oils, oil change intervals etc. given in chapter *4.6 Lubricants*, *page 103* must be well known.

The separator should be level and at standstill when oil is filled or the oil level is checked. The MIN-line on the sight glass refers to the oil level at standstill.

1 Place a collecting vessel under the drain hole.

2 Pull out (A) the oil filling device and turn it half a turn (B).



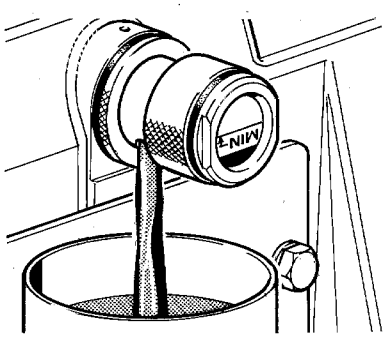
G0068911

3 Collect the oil in the vessel.

CAUTION

Burn hazards

The lubricating oil and various machine surfaces can be sufficiently hot to cause burns.

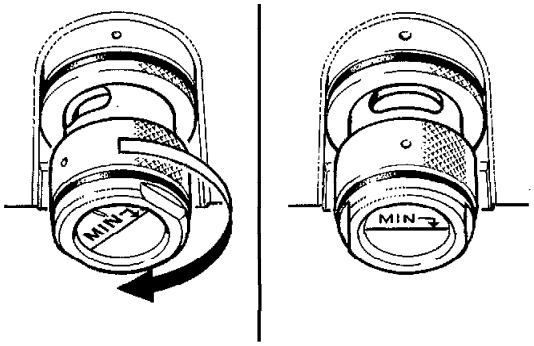


G0173811

4 Turn the oil filling device back to its normal position (A), the drain hole pointing upwards.

NOTE

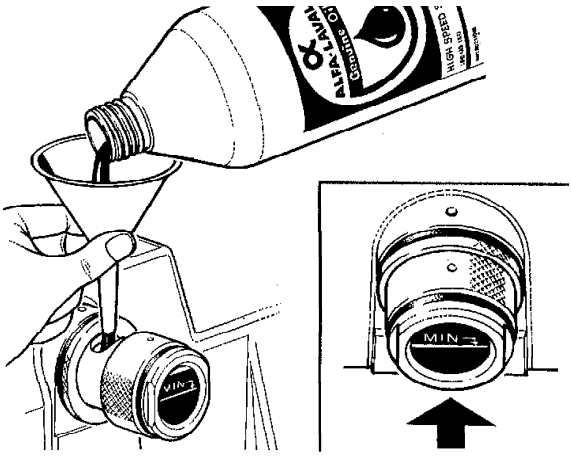
When changing from one group of oil to another, the frame housing and the spindle parts must be thorougly cleaned before the new oil is filled.



G0069111

5 Fill the oil sump in the frame housing with new oil. The oil level should be slightly above middle of the sight glass. Information on volume see *4.1 Technical data*, *page 92*.

6 Push in the oil filling device.



G0069211

2.9 Vibration

2.9.1 Vibration analysis

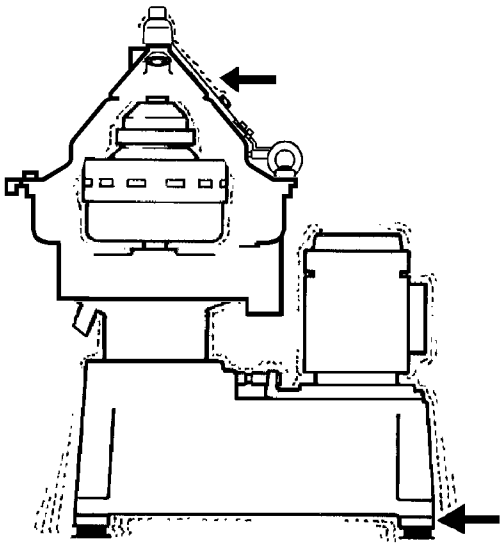
A separator normally vibrates and produces a different sound when passing through its critical speeds during run-up and run-down.

It also vibrates and sounds to some extent when running. It is good practice to be acquainted with these normal conditions.

Excessive vibrations and noise indicate that something is wrong. Stop the separator and identify the cause.

Use vibration analysis equipment to periodically check and record the level of vibration.

The level of vibration of the separator should not exceed 9 mm/s.



G0075251

DANGER

Disintegration hazards

When excessive vibration occurs, keep bowl filled and stop separator.

The cause of the vibration must be identified and corrected before the separator is restarted.

Excessive vibration can be due to incorrect assembly or poor cleaning of the bowl.

2.9.2 Vibration switch (optional)

Adjustment of setpoint

The vibration switch is adjusted with the separator in operation. The cover must be removed to gain access to the setpoint adjusting screw (1).

1 Back-off the setpoint adjusting screw counter-clockwise (A) two or three turns. Press the reset button. If the armature does not remain in the reset position, turn the adjusting screw another turn or two until the armature stays in position when the reset button is pressed.

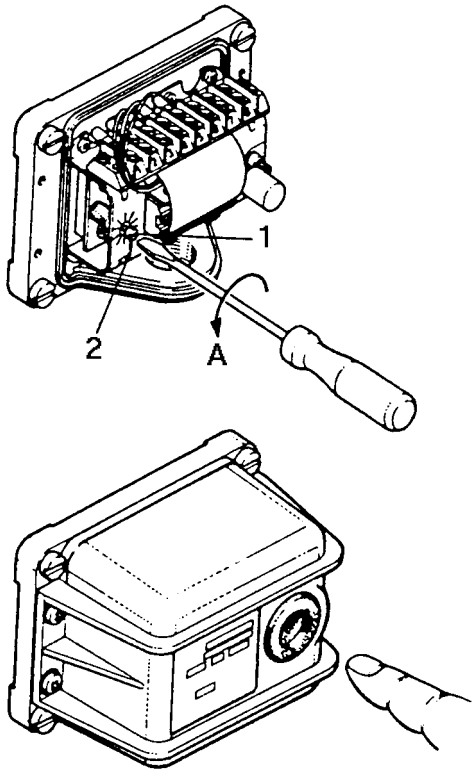
2 Now turn the adjusting screw slowly clockwise until the armature rocks. Mark this position with a line immediately in front-of the adjusting screw pointer (2).

3 Back-off the adjusting screw counter-clockwise a three-quarter turn. Press the reset button. If the armature now rocks, turn the adjusting screw counter-clockwise another quarter turn and so on until the armature remains in the reset position.

Refit the cap and fasten with the screws.

NOTE

Further adjustment may become necessary if alarm occurs due to vibration from surrounding equipment.



G0546521

Setpoint adjustment

1. Adjusting screw
2. Pointer
A. Direction of increased checkpoint (admit higher vibration)

2.10 General directions

2.10.1 Ball and roller bearings

Specially designed bearings for the bowl spindle

The bearings used for the bowl spindle are special to withstand the speed, vibration, temperature and load characteristics of high-speed separators.

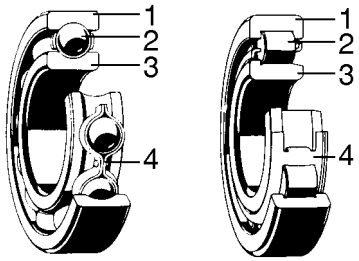
Only Alfa Laval genuine spare parts should be used.

A bearing that in appearance looks equivalent to the correct may be considerably different in various respects: inside clearances, design and tolerances of the cage and races as well as material and heat treatment.

NOTE

Using an incorrect bearing can cause a serious breakdown with injury to personnel and damage to equipment as a result.

Do not re-fit a used bearing.
Always replace it with a new one.



G0587321

1. Outer race
2. Ball/roller
3. Inner race
4. Cage

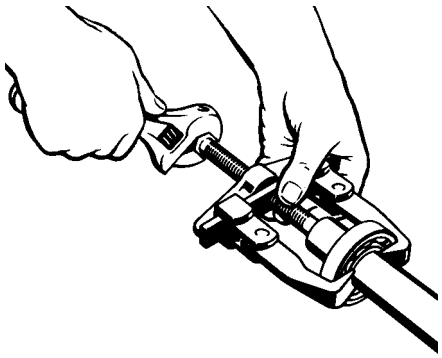
Dismantling

Remove the bearing from its seat by using a puller. If possible, let the puller engage the inner ring, then remove the bearing with a steady force until the bearing bore completely clears the entire length of the cylindrical seat.

The puller should be accurately centered during dismantling; otherwise it is easy to damage the seating.

NOTE

Do not hit with a hammer directly on the bearing.



G0587411

For bearings where no driving-off sleeve is included in the tool kit, use a puller when removing bearings.

Cleaning and inspection

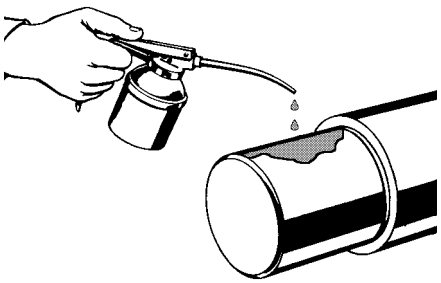
Check shaft (spindle) end and/or bearing seat in the housing for damage indicating that the bearing has rotated on the shaft (spindle) and/or in the housing respectively. Replace the damaged part, if the faults cannot be remedied by polishing or in some other way.

Assembly

- Leave new bearings in original wrapping until ready to fit. The anti-rust agent protecting a new bearing should not be removed before use.
- Use the greatest cleanliness when handling the bearings.

To facilitate assembly and also reduce the risk of damage, first clean and then lightly smear the bearing seating on shaft (spindle) or alternatively in housing, with a thin oil.

Clean and smear the bearing seating before assembly.



G0587511

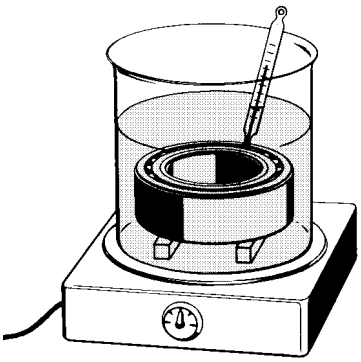
- When assembling ball bearings, the bearings must be heated in oil to maximum 125 °C.

NOTE

Heat the bearing in a clean container with a cover.

Use only clean oil with a flash point above 250 °C.

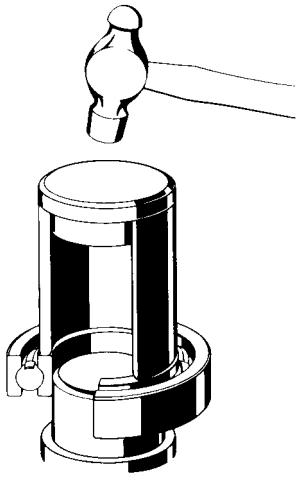
The bearing must be well covered by the oil and not be in direct contact with the sides or the bottom of the container. Place the bearing on some kind of support or suspended in the oil bath.



G0587611

The bearing must not be in direct contact with the container.

- There are several basic rules for assembling cylindrical bore bearings:
  - Never directly strike a bearing's rings, cage or rolling elements while assembling. A ring may crack or metal fragments break off.
  - Never apply pressure to one ring in order to assemble the other.
  - Use an ordinary hammer. Hammers with soft metal heads are unsuitable as fragments of the metal may break off and enter the bearing.
  - Make sure the bearing is assembled at a right angle to the shaft (spindle).
- If necessary use a driving-on sleeve that abuts the ring which is to be assembled with an interference fit, otherwise there is a risk that the rolling elements and raceways may be damaged and premature failure may follow.

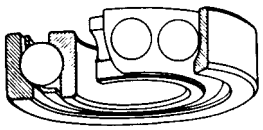


G0587711

Use a driving-on sleeve for bearings that are not heated.

Angular contact ball bearings

Always fit single-row angular contact ball bearings with the wide shoulder of the inner race facing the axial load (upwards on a bowl spindle).



G0587211

The wide shoulder of the inner race must face the axial load.

2.10.2 Before shut-downs

Before the separator is shut-down for a period of time, the following must be carried out:

- Remove the bowl, according to instructions in chapter *3 Dismantling/Assembly, page 43*.
- Protect parts in contact with process liquid from corrosion by applying a thin layer of oil.
- Remove the O-rings.

Protect cleaned carbon steel parts against corrosion by oiling. Separator parts that are not assembled after cleaning must be wiped and protected against dust and dirt.

NOTE

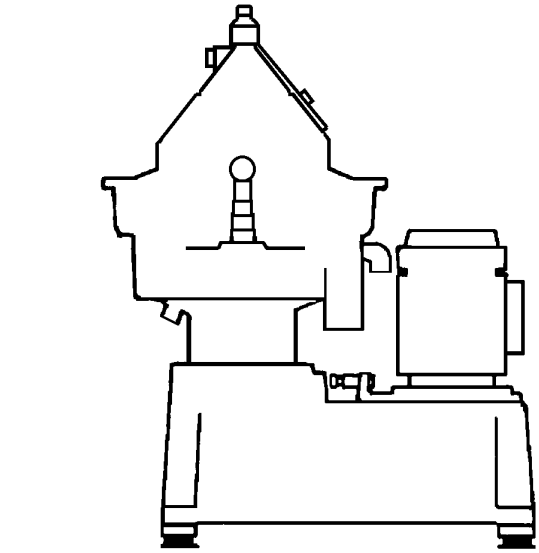
The bowl must not be left on the spindle during standstill for more than one week.

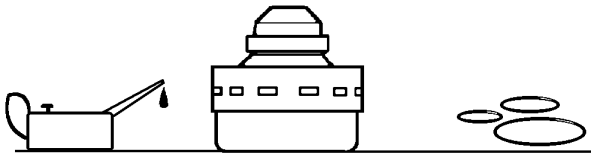
Vibration in foundations can be transmitted to the bowl and produce one-sided loading of the bearings.

The resultant indentations in the ball bearing races can cause premature bearing failure.

If the separator has been shut-down for more than 3 months but less than 12 months, an Intermediate Service (IS) has to be made before the separator is put into operation again.

If the shut-down period has been longer than 12 months, a Major Service (MS) should be carried out.





Remove the bowl if the separator is left at standstill for more than one week.

G0466851

3 Dismantling/Assembly

References to check points

In the text you will find references to the check point instructions in chapter 5. The references appear in the text as in the following example:

✔ **Check point**
2.3.10 Disc stack pressure, page 27.
In this example, look up check point **Disc stack pressure** for further instructions.

S0051011

Switch off and lock power supply before starting *any* dismantling work.

Tools

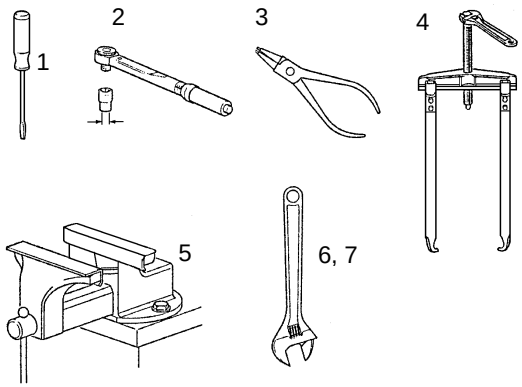
Special tools from the tool kit must be used for dismantling and assembly. The special tools are specified in the *Spare Parts Catalogue*.

Additional tools needed for dismantling but not included in the tool kit are shown here.

For bowl and bowl spindle

1 *Screw driver*
2 *Torque wrench (50 Nm) with socket 16 mm*
3 *Pliers for internal snap ring*
4 *Ball bearing puller*
5 *Screw vice with copper liners*
6 *Adjustable wrench, length approx. 400 mm*
7 *Adjustable wrench or spanner, width of jaws 24 mm*

Two lifting slings, working load limit (WLL): >300 kg are also needed.



G0278821

For friction coupling and flat belt

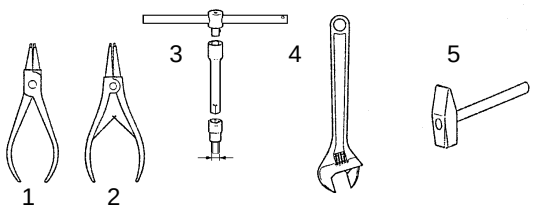
1 *Pliers for internal snap ring*

2 *Pliers for external snap ring*

3 *T-handle, extension rod and socket 16 mm*

4 *Adjustable wrench or spanner, width of jaws 36 mm*

5 *Hammer*



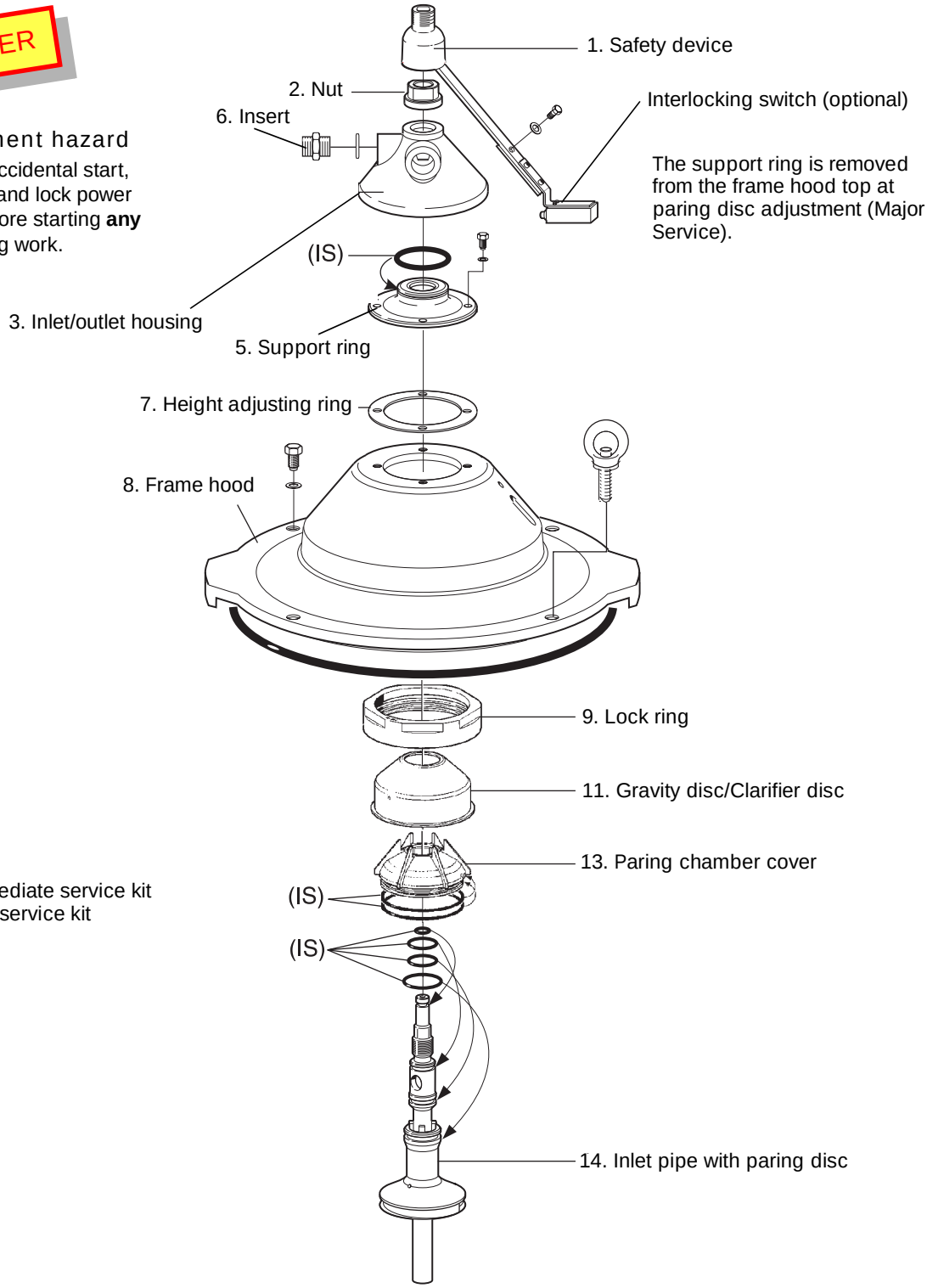
G0278921

3.1 Inlet/outlet and bowl

DANGER

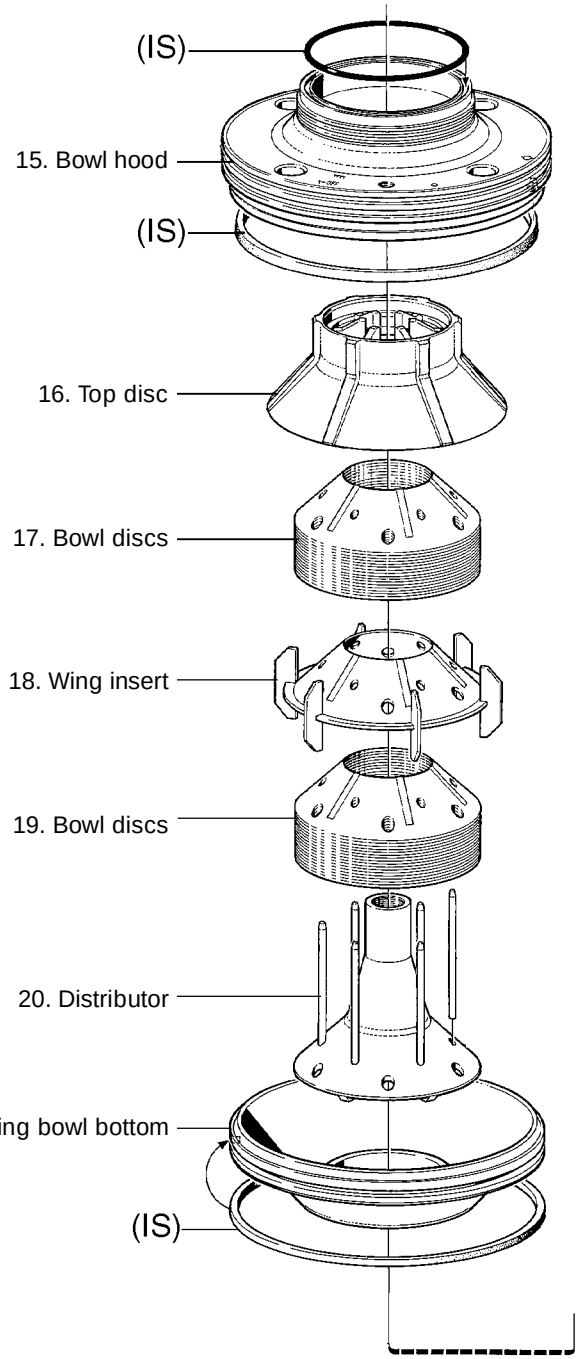
Entrapment hazard

To avoid accidental start, switch off and lock power supply before starting **any** dismantling work.



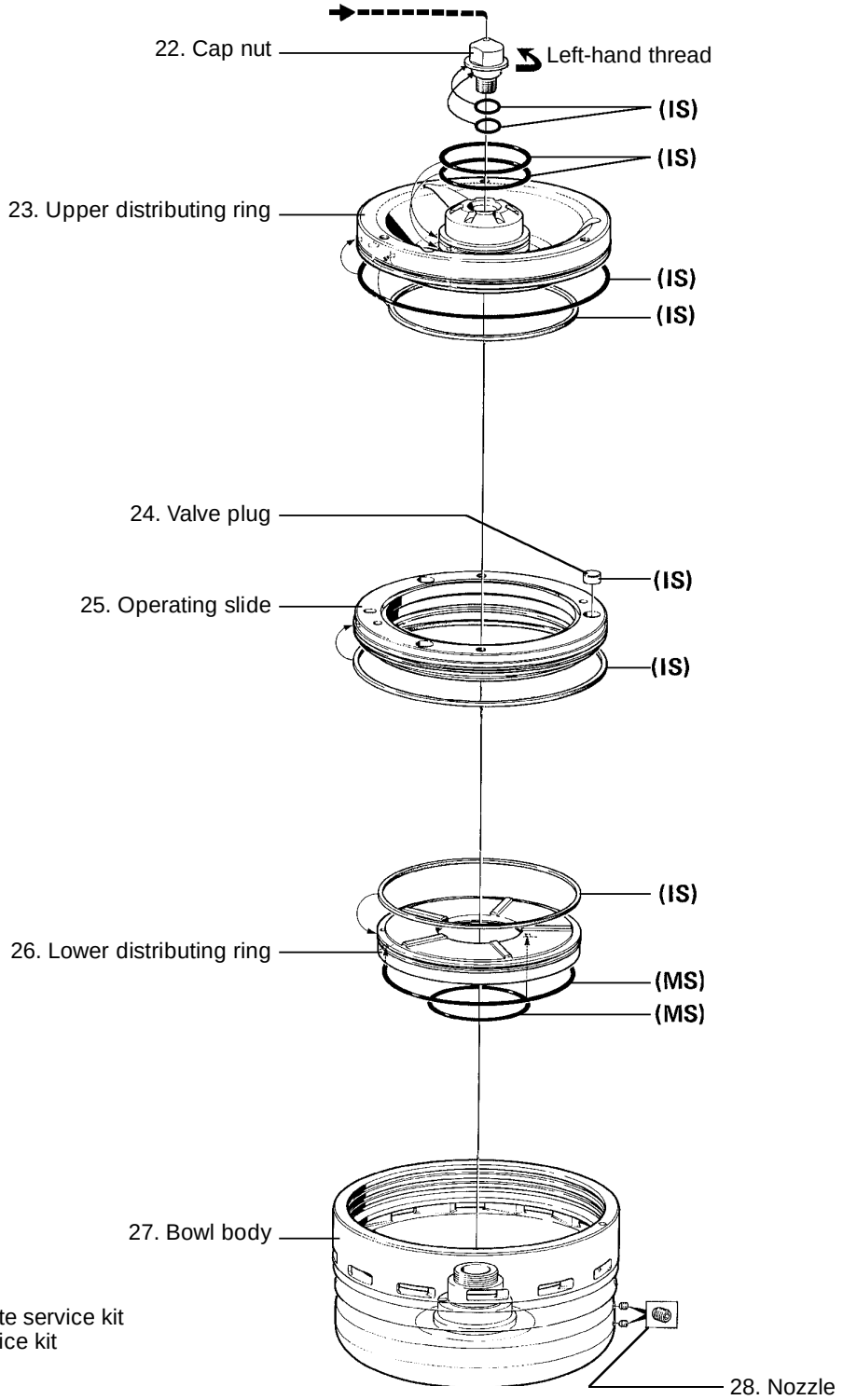
IS Intermediate service kit
MS Major service kit

G00073751



IS Intermediate service kit
MS Major service kit

G0887711



IS Intermediate service kit
MS Major service kit

G00744221

3.1.1 Inlet/outlet and bowl – dismantling

The frame hood and the heavy bowl parts must be lifted by means of a hoist. Position the hoist exactly above the bowl centre. Use an endless sling and a lifting hook with catch.

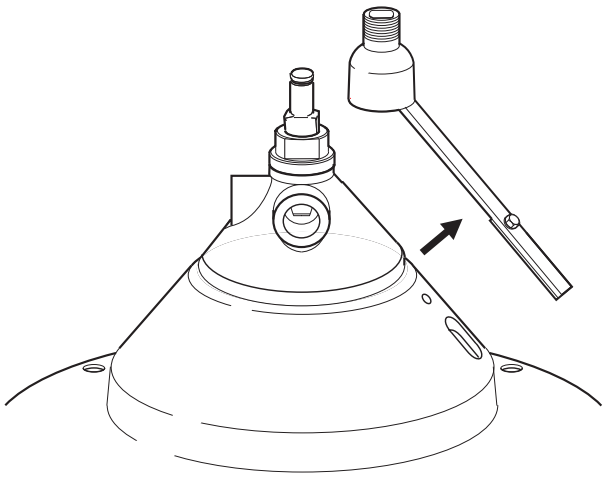
The parts must be handled carefully. Don't place parts directly on the floor, but on a clean rubber mat, fibreboard or a suitable pallet.

1 Remove safety device and look through the slot in the frame hood to see if the bowl still rotates.

DANGER

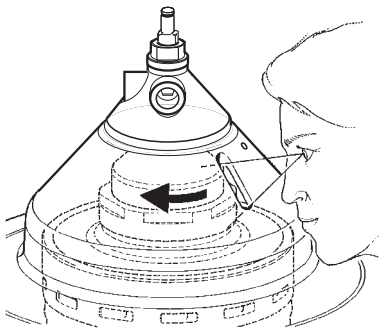
Entrapment hazard

Make sure that rotating parts have come to a complete standstill before starting any dismantling work.



G0819751

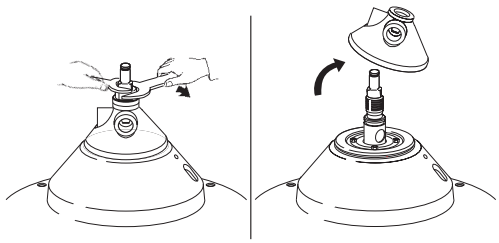
The bowl parts can remain very hot for a considerable time after the bowl has come to a standstill.



G0467361

2 Unscrew nut clockwise and lift off inlet- outlet housing together with the connecting hoses. When removing the connecting hoses, do not drop the washer.

Left-hand thread!

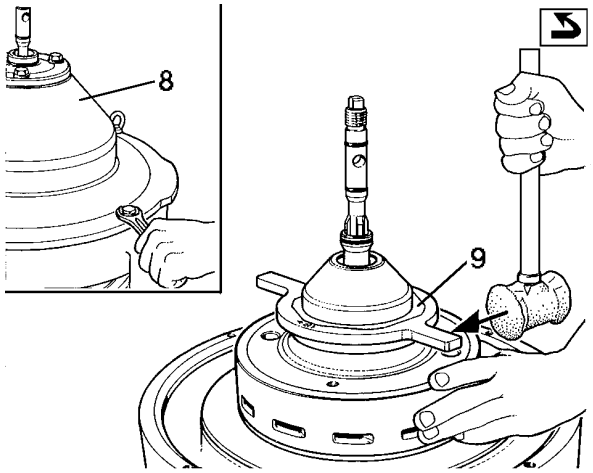


G0821531

3 Remove the bolts and lift off frame hood (8).

4 Unscrew lock ring (9) clockwise by using the special tool; spanner for lock ring.

Left-hand thread!



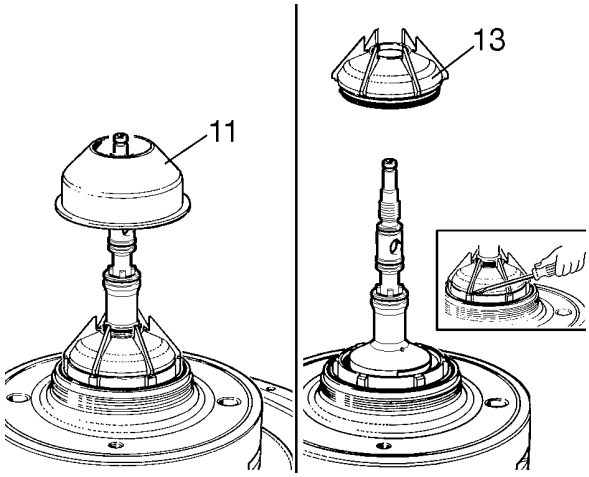
G0070021

5 Lift off gravity disc (clarifier disc) (11).

6 Carefully prise loose paring chamber cover (13) by using a screwdriver. Lift off the paring chamber cover.

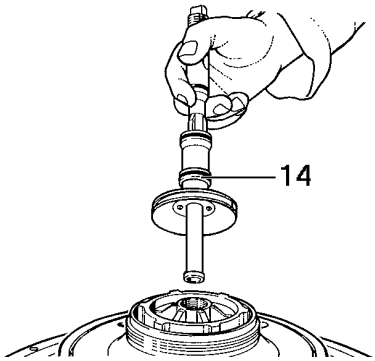
NOTE

If the gravity disc has to be replaced owing to changed operating conditions, see *4.7.4 Gravity disc nomogram*, *page 116*.



G0070131

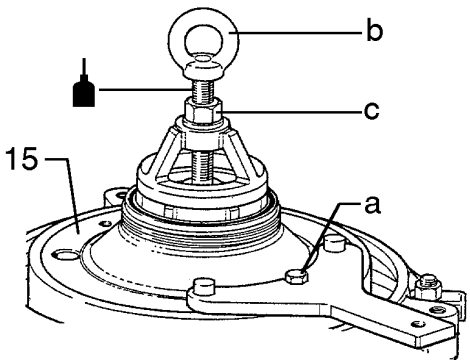
7 Lift out inlet pipe (14) with the paring disc.



G0070221

8 Preparations for unscrewing of bowl hood (15):

- Fit the spanner to the bowl hood and secure it with the bolt (a).
- Fit the compression tool and screw down the central screw (b) until it stops
- Compress the disc stack by tightening the nut (c) firmly.



G0167121

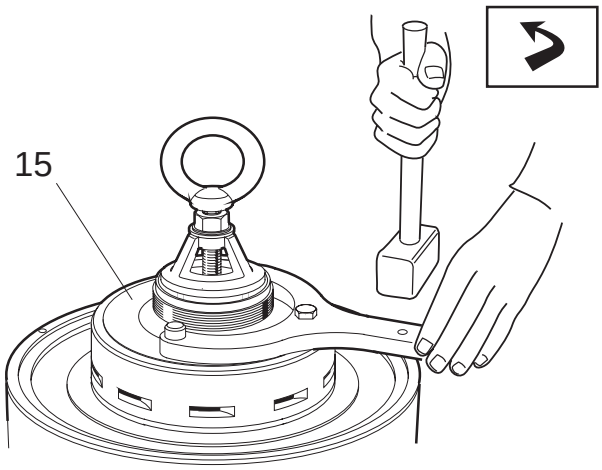
NOTE

Use the compression tool as instructed.
Use of substitute tools can damage the equipment.

9 Unscrew bowl hood (15) clockwise by using a tin hammer.

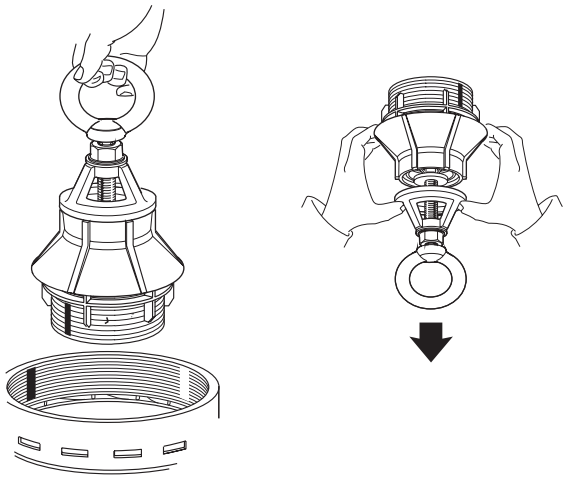
Left-hand thread!

10 Lift off the bowl hood with the spanner still attached.



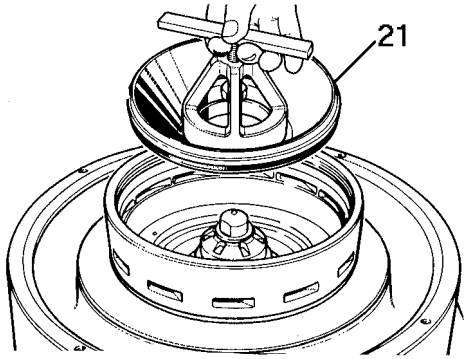
G0357411

11 Lift out the top disc, the bowl discs with wing insert and the distributor.
Screw the nut of the compression tool up against the eye bolt, turn the unit with the tool still attached upside down and hit it against a firm base. This will facilitate loosening of the top disc.



G0357521

12 Lift out sliding bowl bottom (21) using the special tool.
Ease the sliding bowl bottom off with the central screw of the tool. If necessary, knock on the handle.



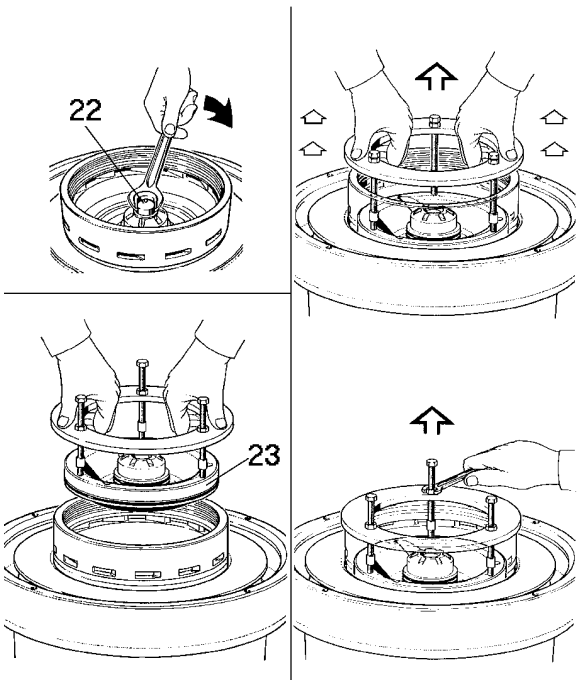
G0072031

13 Unscrew cap nut (22).

Left-hand thread!

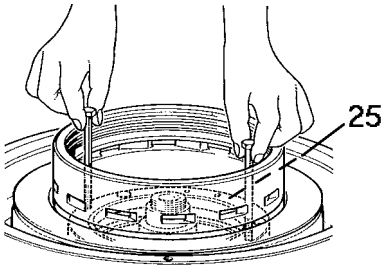
14 Remove upper distributing ring (23) using the special tool.
Detach the distributing ring either:

- by jerking, or
- by tightening the nuts equally



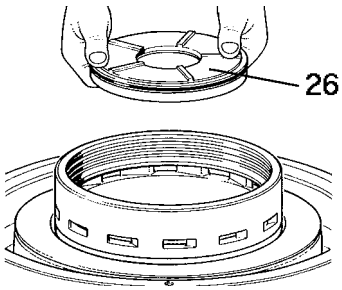
G0070631

15 Lift out operating slide (25) using the special tool: lifting bolts for operating slide.



G0070721

16 Lift out lower distributing ring (26).



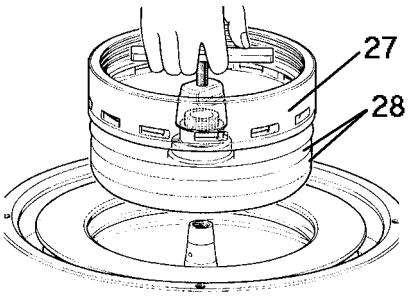
G0070821

17 Lift out bowl body (27) using the special tool.

18 Ease the bowl body off with the central screw of the tool. If necessary, knock on the handle.

19 Soak and clean all parts thoroughly in suitable cleaning agent, see *2.7.1 Cleaning agents, page 33*.

20 Clean nozzles (28) in bowl body (27) using soft iron wire of maximum 1,2 mm diameter, see *2.3.4 Discharge mechanism, page 21*.



G0070922

NOTE

Dirt and lime deposits in the sludge discharge mechanism can cause discharge malfunction or failing discharge.

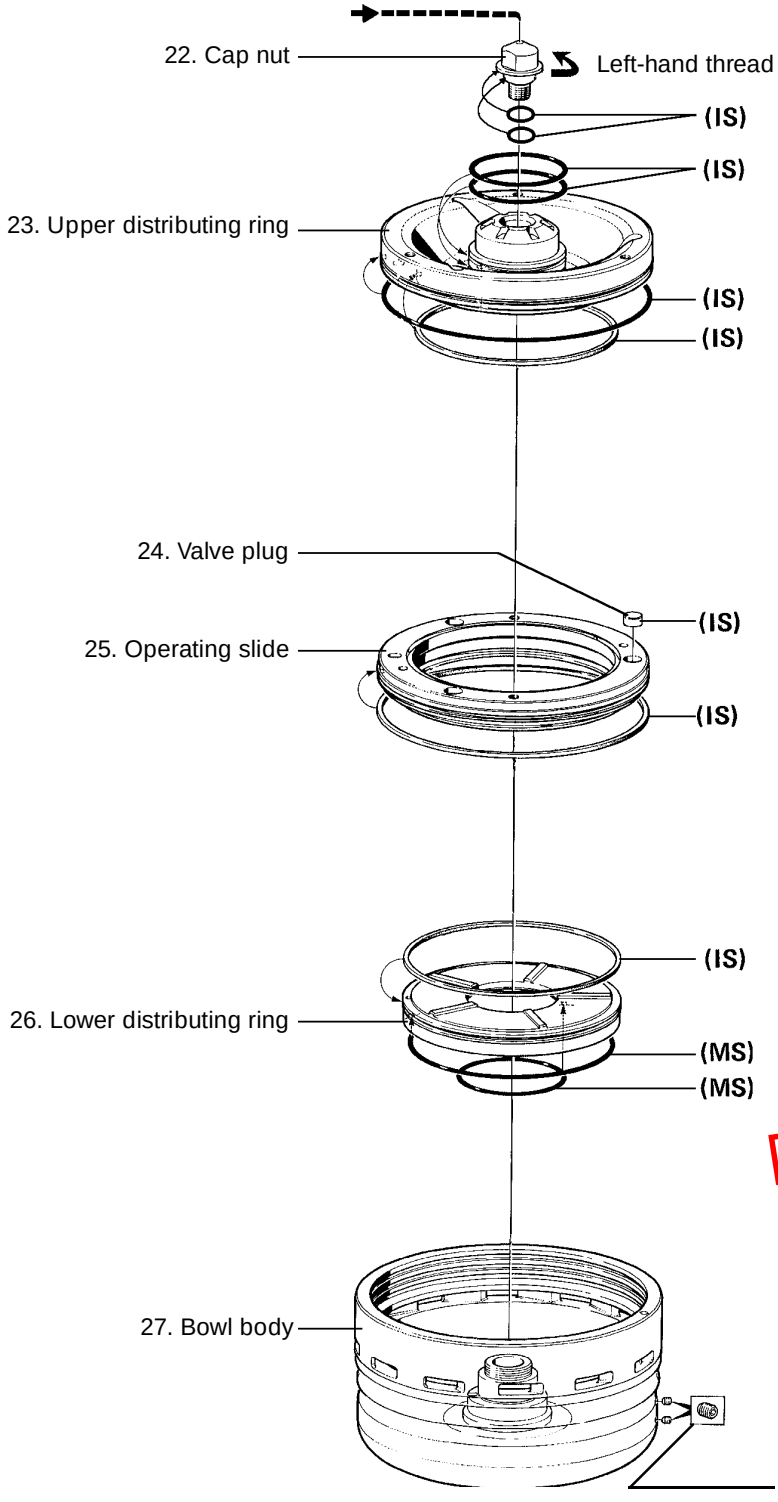
21 Remove O-rings and replace them with spares from the intermediate service kit (IS).

3.1.2 Inlet/outlet and bowl – assembly

Make sure that the following check points are carried out before and during assembly of the separator bowl.

Check point

2.3.1 Corrosion, page 17,
2.3.2 Erosion, page 19,
2.3.3 Cracks, page 20,
2.3.4 Discharge mechanism, page 21,
2.3.6 Spindle top cone and bowl body nave, page 24,
2.3.7 Threads of inlet pipe, paring disc, page 24,
2.3.8 Threads on bowl hood and bowl body, page 25,
2.3.10 Disc stack pressure, page 27,
2.4.1 Paring disc height adjustment, page 28.



IS Intermediate service kit
MS Major service kit

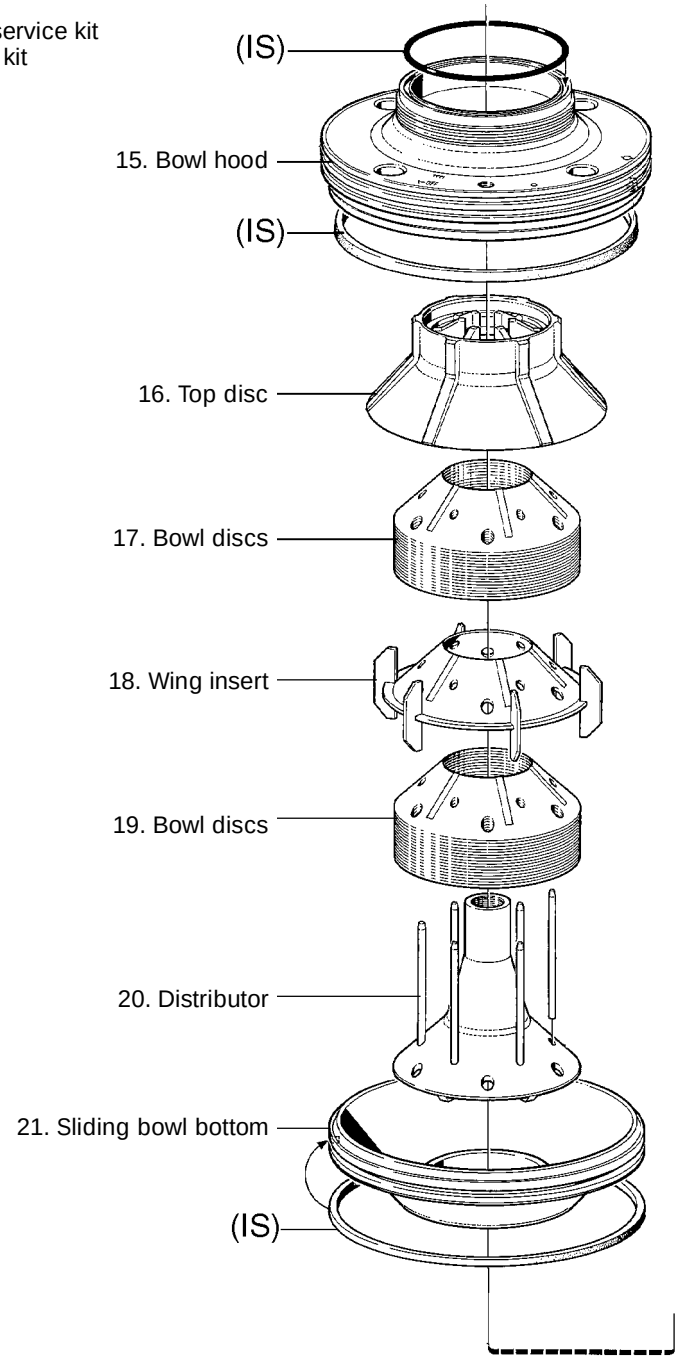
NOTE

Be sure bowl parts are not interchanged.

Out of balance vibration will reduce ball bearing life.

G00744221

IS Intermediate service kit
MS Major service kit

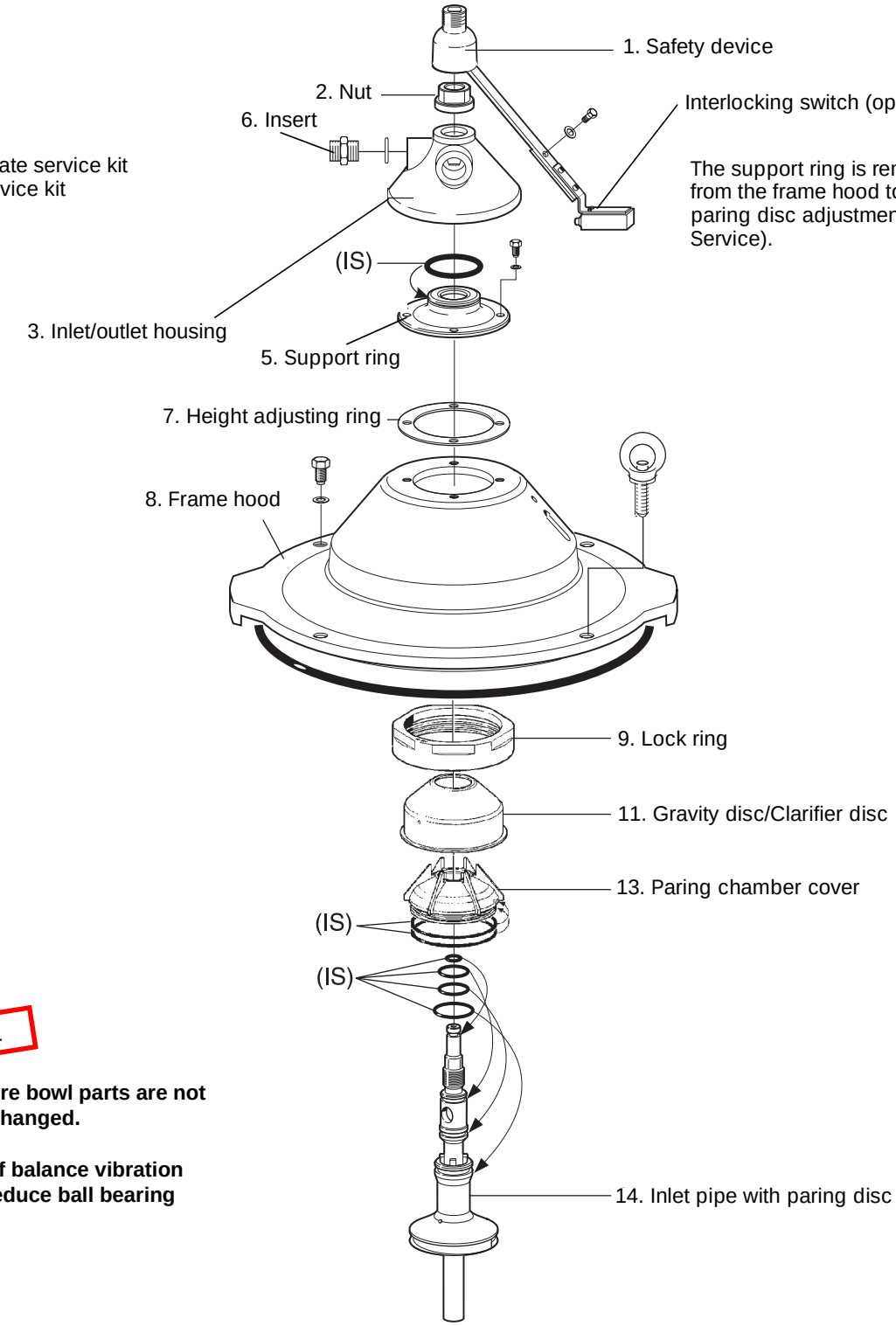


NOTE

Be sure bowl parts are not interchanged.

Out of balance vibration will reduce ball bearing life.

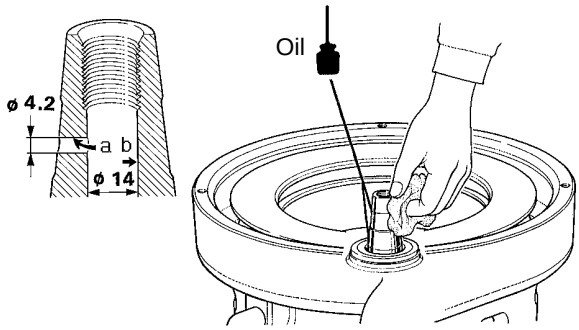
G0887711


1. Safety device
2. Nut
6. Insert
Interlocking switch (optional)
IS Intermediate service kit
MS Major service kit
The support ring is removed from the frame hood top, at paring disc adjustment (Major Service).
(IS)
3. Inlet/outlet housing
5. Support ring
7. Height adjusting ring
8. Frame hood
9. Lock ring
11. Gravity disc/Clarifier disc
13. Paring chamber cover
(IS)
(IS)
14. Inlet pipe with paring disc
NOTE
Be sure bowl parts are not interchanged.
Out of balance vibration will reduce ball bearing life.
G0073751

1 Clean the hollow part (b) of the spindle top and the radial hole (a). Wipe clean the spindle top and nave bore in the bowl body. Apply oil to the tapered end of the spindle, smear the oil over the surface and wipe off surplus with a clean cloth.

2 Clean the nozzles in the bowl body, see *2.3.4 Discharge mechanism, page 21*.

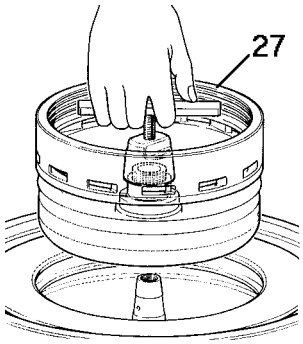
Check point
2.3.6 Spindle top cone and bowl body nave, page 24 and *2.3.9 Priming of bowl parts, page 26*.



G0071721

3 Fit the bowl body (27) on the spindle.
Avoid damaging the spindle cone.

– Attach the special lifting tool to the bowl body nave.
– Screw down the central screw of the tool, then lower the bowl body until the screw rests on the spindle top.
– Screw up the central screw and the bowl body will sink down on the spindle cone.



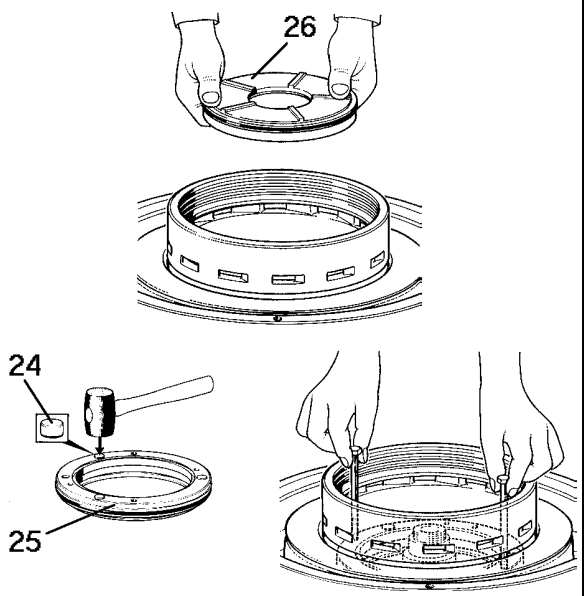
G0071831

4 Place the lower distributing ring (26) in the bowl body.

Using the lifting bolts fit the operating slide (25).

Make sure that the seal rings lie concentrically in their grooves.

If replacing valve plugs (24), use a rubber mallet.



G0071841

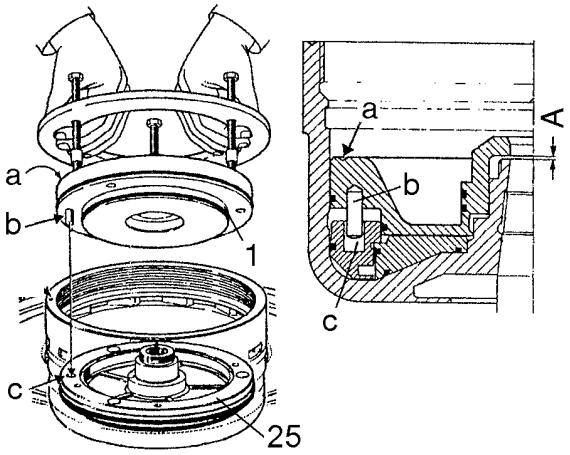
5 Fit the upper distributing ring so that drill mark (a) is in line with hole (c) on the distributing ring.

When the distributing ring is in correct position the guide pin (b) will enter hole (c).

NOTE

The guide pin (b) in the distributing ring has to be fitted properly in the hole (c).

Check the distance "A". If the play is larger than 2 mm the guide pin has not entered the hole properly.

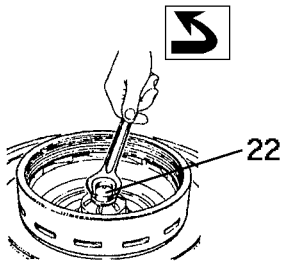


G0378031

a. Drill mark
b. Guide pin
c. Guide pin

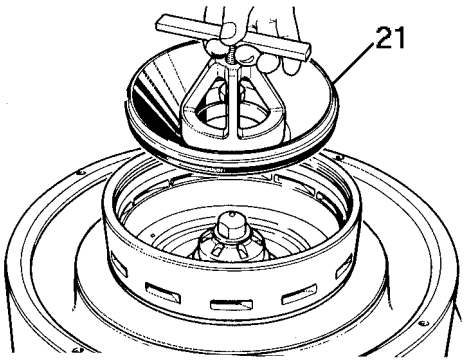
6 Screw cap nut (22) counter-clockwise onto the spindle.
Tighten firmly.

Left-hand thread!



G0378111

7 Fit sliding bowl bottom (21).
Make sure that the square seal ring lies concentrically in its groove.
Press the sliding bowl bottom down on the upper distributing ring.



G0072031

Check point

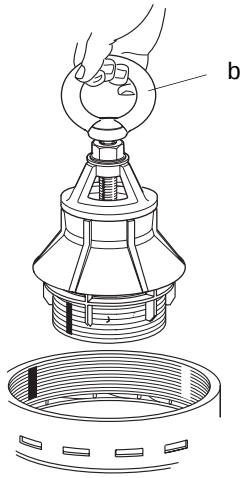
Before assembling the bowl discs, check the threads of the bowl hood and bowl body, see 2.3.8 Threads on bowl hood and bowl body, page 25.

8 Assemble the bowl discs with wing insert and top disc on the distributor. Note the angular positioning (six options).
Ensure that the pins in the distributor fit properly into the holes of the top disc.

9 Preparations for lifting in the disc stack

- Fit the compression tool and screw down the central screw (b) until it stops
- Tighten the compression nut by hand

10 Fit the disc stack assembly in the bowl body. Make sure that the cuts in the wings on the underside of the distributor fit properly in the corresponding lugs of the bowl.

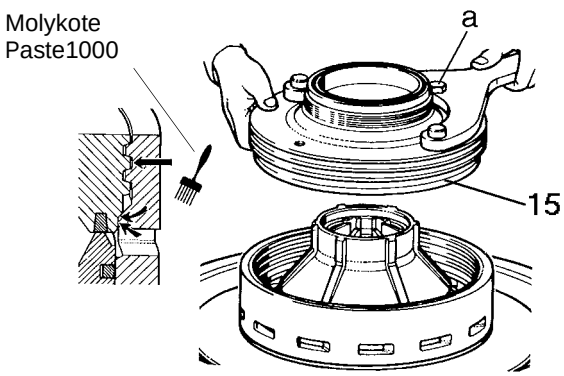


G0357561

11 Fit bowl hood (15):

- Apply a thin layer of Molykote Paste 1000 to threads and on contact and locating surfaces.
- Fit the spanner for the bowl hood and secure it with the bolt (a).
- Screw on the bowl hood by hand.

Left-hand thread!



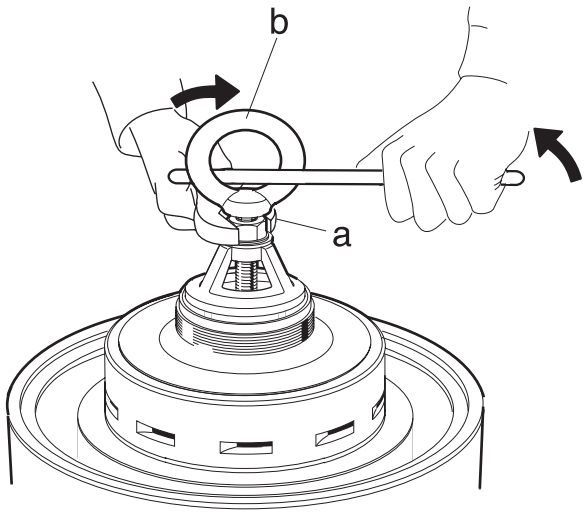
G0072231

12 Fit the compressing tool and screw down the central screw (b) until it stops.
Compress the disc stack by tightening the nut (a) firmly.

NOTE

Use the compression tool as instructed.
Use of substitute tools can damage the equipment.

Check point
2.3.10 Disc stack pressure, page 27.



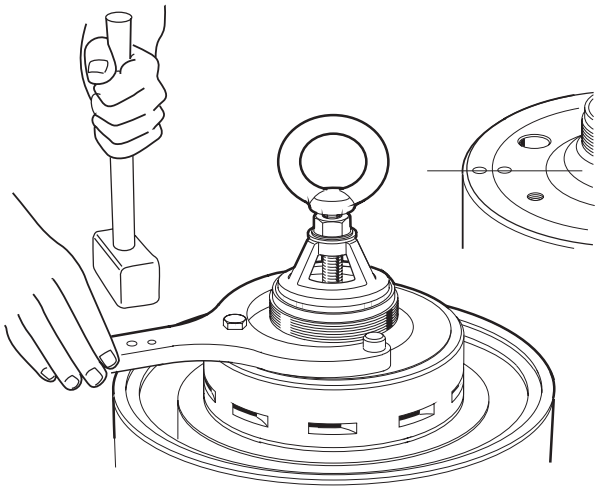
G0072361

13 Attach the spanner and tighten the bowl hood by using a tin hammer.
Strike the spanner handle until the bowl hood lies tightly against the bowl body. In a new bowl, the assembly marks now will be in line with each other.

DANGER

Disintegration hazard
The assembly mark on the bowl hood must never pass the mark on the bowl body by more than 25°.

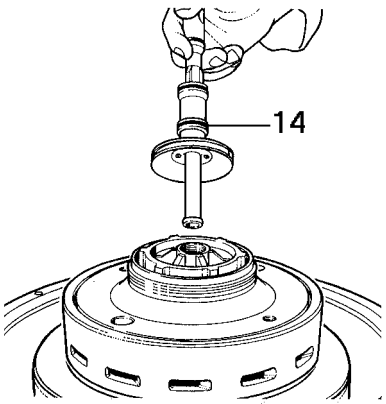
See also *2.3.8 Threads on bowl hood and bowl body, page 25.*



G0357711

14 Place inlet pipe (14) in the bowl.

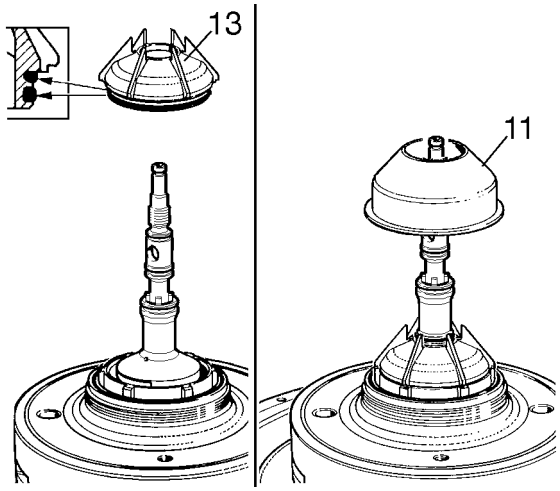
Check point
2.3.7 Threads of inlet pipe, paring disc, page 24.



G0072721

15 Fit paring chamber cover (13) by pressing it down gently.

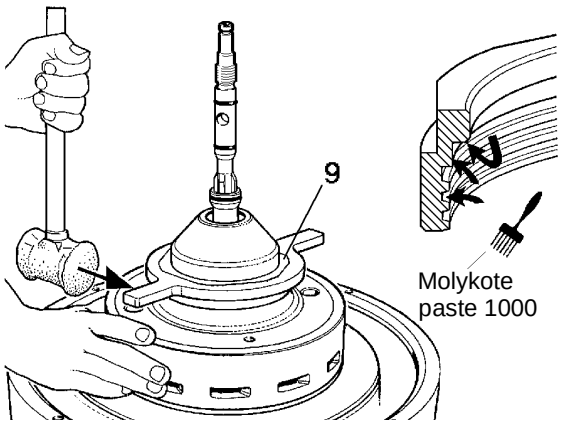
16 Assemble gravity disc/ clarifier disc (11).



G0073341

17 Fit lock ring (9).
Apply a thin layer of Molykote Paste 1000 to the threads and on contact and locating surfaces.

Left-hand thread!

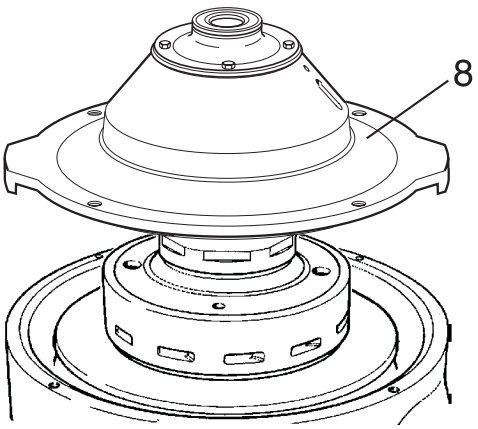


G0074331

18 Fit frame hood (8).
The two eye-bolts must be fitted in the holes nearest to the electric motor.

In case of Major Service remove the connecting housing and fit a new O-ring on the insert (2).

Check point
2.4.1 Paring disc height adjustment, page 28.
To be performed at Major Service and if the bowl spindle has been dismantled.

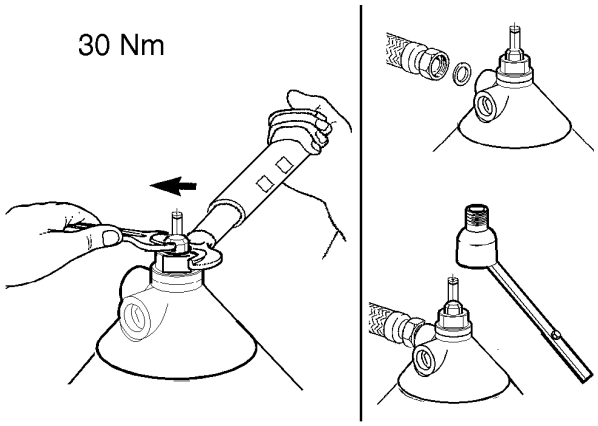


G0073581

19 Fit inlet/outlet housing.
Tighten nut.

Left-hand thread!

20 Then rotate the bowl by means of the flat belt. If the bowl does not rotate freely or a scraping noise is heard, incorrect bowl assembly or incorrect height adjustment of the paring disc can be the cause.



G0172951

NOTE

To avoid damage on the inlet pipe the tightening torque must not exceed 30 Nm.

21 Make sure that the gasket on the safety device is in position. If not, glue with Loctite 407.
Fit and secure safety device.

22 Fit the connecting hoses if they have been removed. Make sure to fit their gasket rings.

23 Fit the water tank on the frame bottom part if it has been removed.

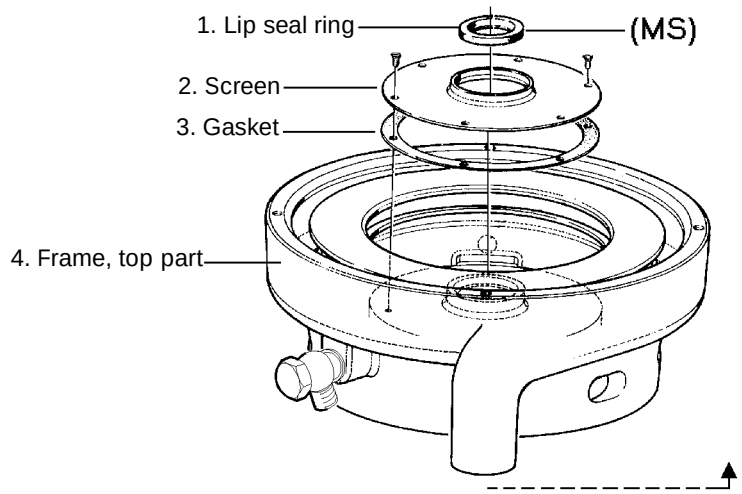
3.2 Bowl spindle and frame

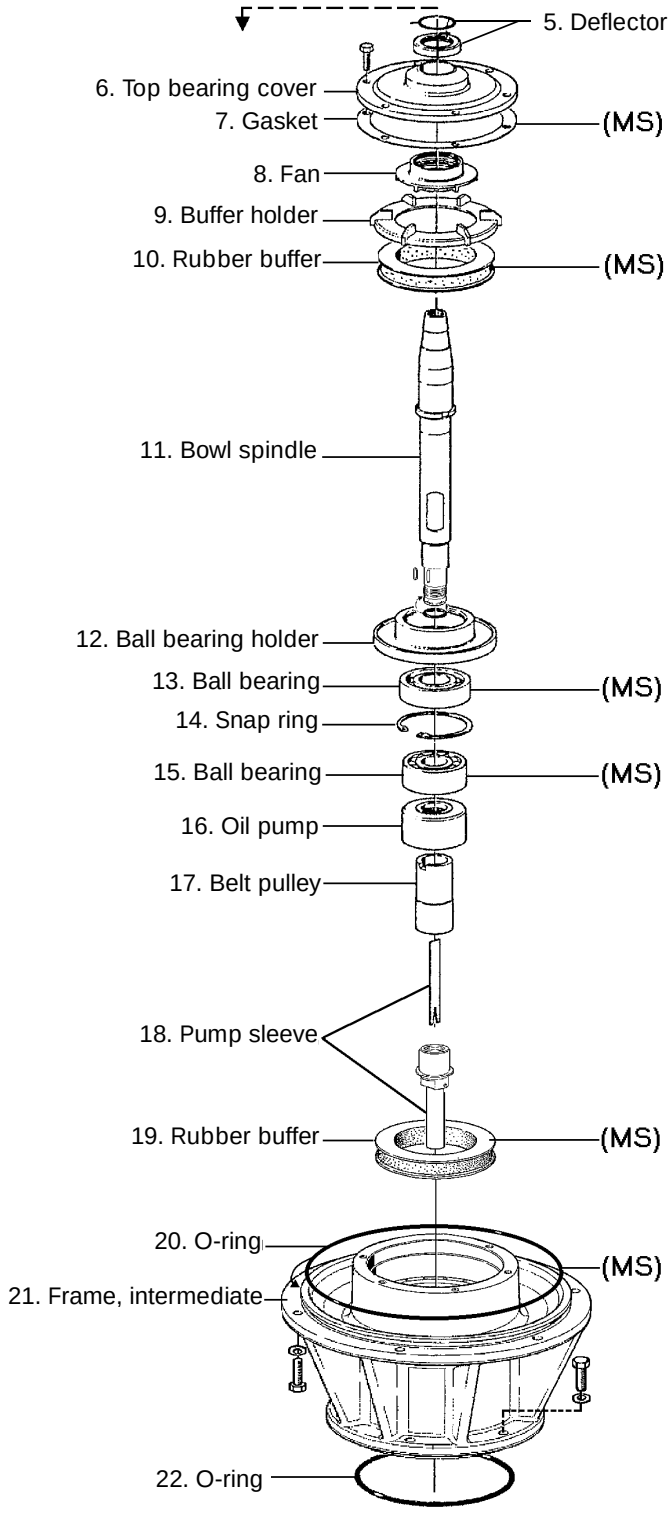
3.2.1 Bowl spindle and frame – dismantling

Before dismantling the bowl spindle, the inlet and outlet housing, frame hood and bowl as well as the flat belt must be removed.

Before dismantling, in the case of Major Service, or if the separator vibrates while running, see

Check point
2.4.2 Radial wobble of bowl spindle, page 29.





MS Parts to be renewed at Major Service

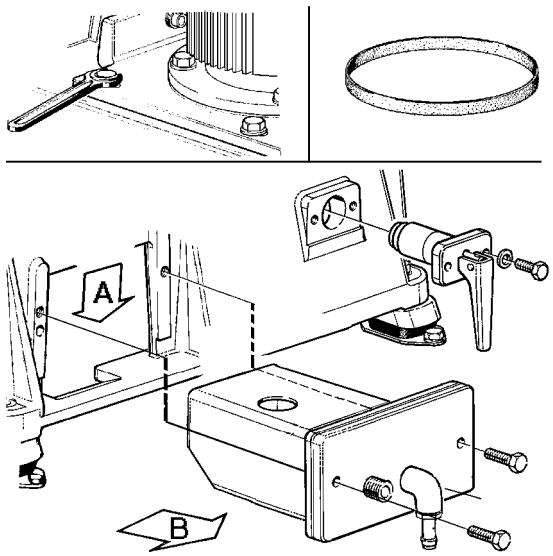
G01131A1

1 Loosen but do not remove the motor adapter screws.

2 Remove the water tank.

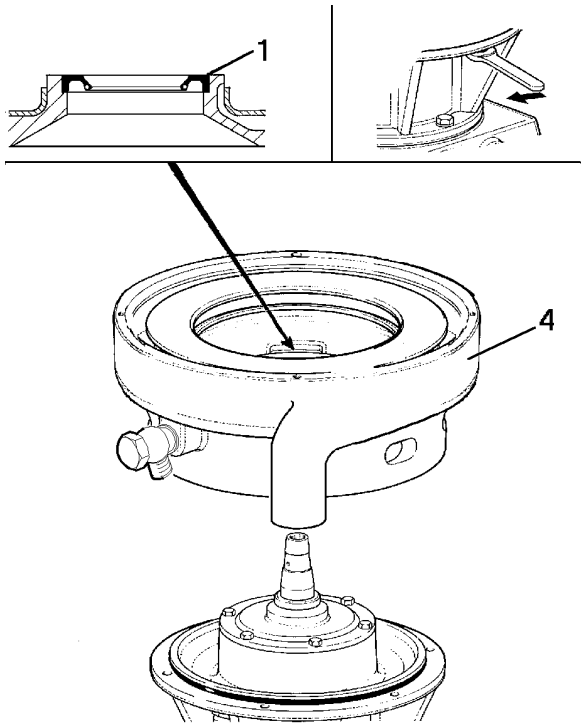
3 Remove the brake.

4 Remove the flat belt.



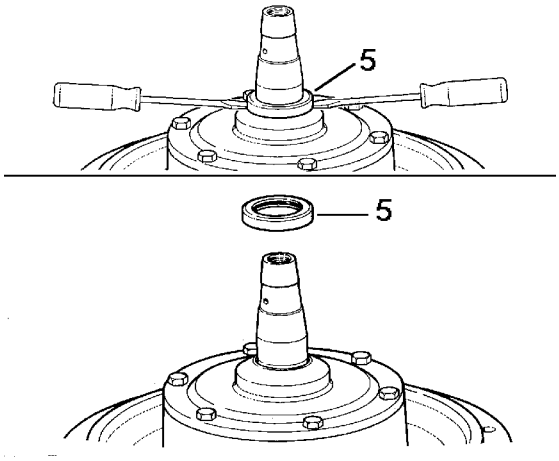
G01133E1

5 Remove the screws and lift off frame top part (4). Lip seal ring (1) must be removed in the case of Major Service, or if found damaged.



G0113461

6 Clean the bowl spindle cone in place and remove deflector ring (5).



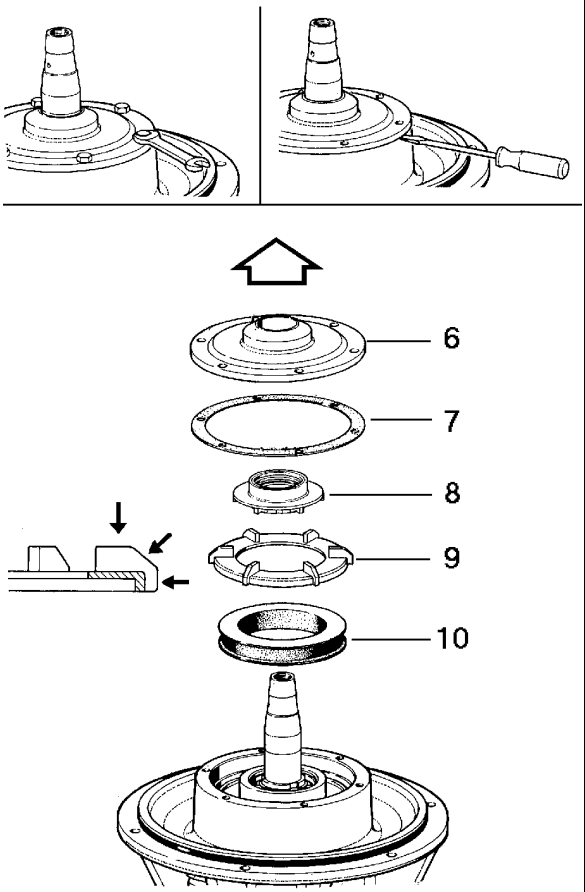
G0113521

7 Remove, in the following sequence:

- Top bearing cover (6)
- Gasket (7)
- Fan (8)
- Buffer holder (9)
- Rubber buffer (10).

NOTE

Be very careful not to damage the wings of the buffer holder.

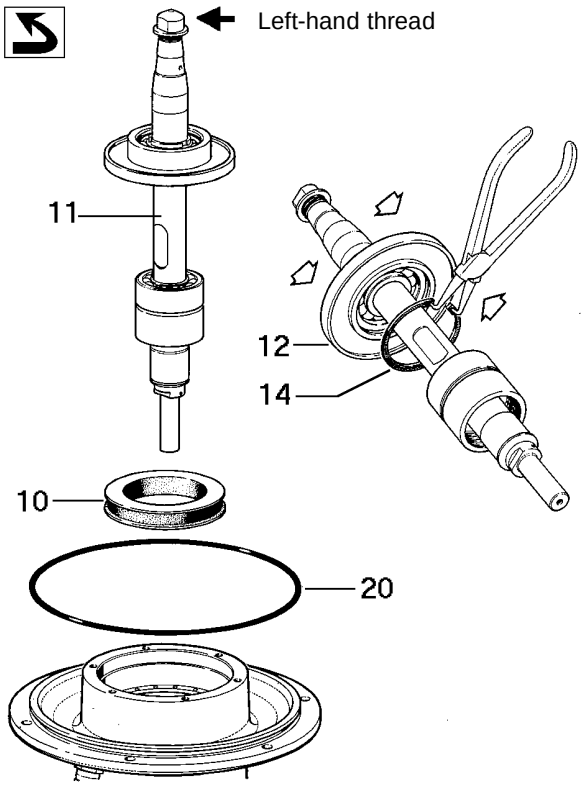


G0113621

8 Screw the cap nut counter-clockwise (left-hand thread) onto the spindle top to protect the top and bore.

Lift out spindle assembly (11), rubber buffer (10) and O-ring (20).

Remove snap ring (14) by using a pair of pliers and pull off ball bearing holder (12).



G0076132

9 Clamp the bowl spindle (11) in a screw vice. Remove the pump sleeve (18). When turning the spindle upside down there is a risk that the vane in the pump sleeve can slide down partly or entirely into the spindle. Therefore, after unscrewing the sleeve, check that the vane has not been damaged.

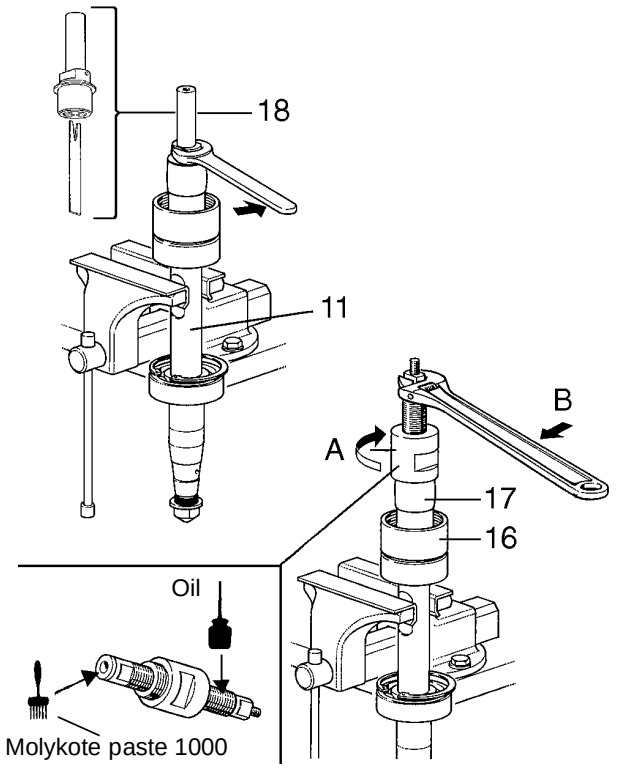
10 Remove the belt pulley (17). If the pulley has stuck proceed with point 10.

11 Lubricate the mounting/dismantling tool.

Fit the mounting/dismantling tool and screw it down as far as it will go (A).

Use a long spanner (450 - 650 mm) to press the belt pulley off the spindle (B).

Remove the oil pump (16) by hand, do not loos the flat key.



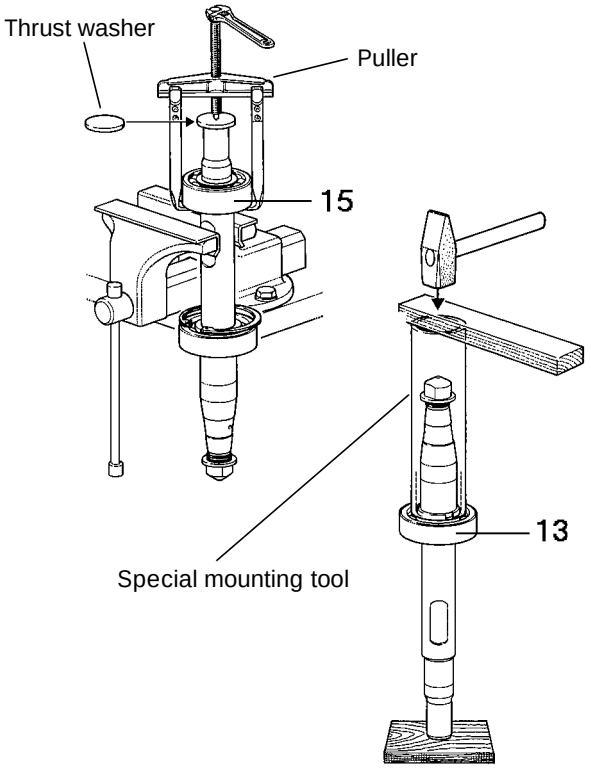
G0076251

12 Pull off ball bearing (15) using a puller and thrust washer.

Pull off bearing (13) using the special mounting tool and a hammer.

NOTE

Always discard a used bearing.

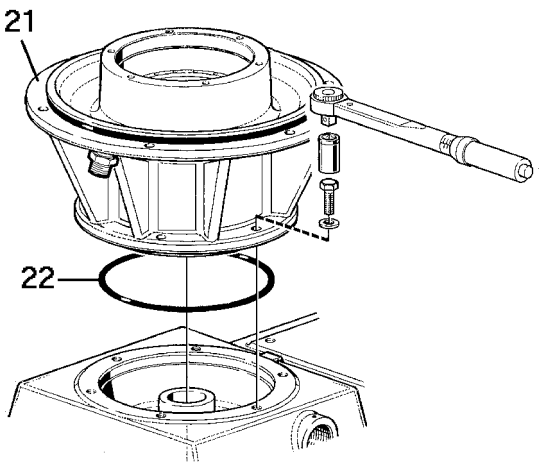


G0076321

In case of 3-year-service

13 Loosen the screws and lift off the frame intermediate part (21).

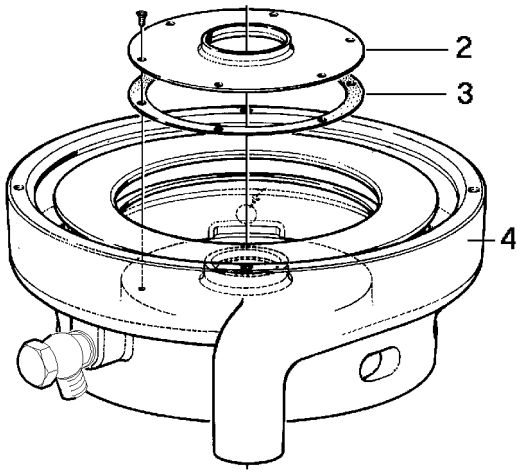
14 Discard the O-ring (22).This O-ring is not included in any service kit, but must be ordered separately.



G0093791

15 Remove the screen (2) from the frame top part (4).

Discard the gasket (3). This gasket is not included in any service kit, but must be ordered separately.



G0113771

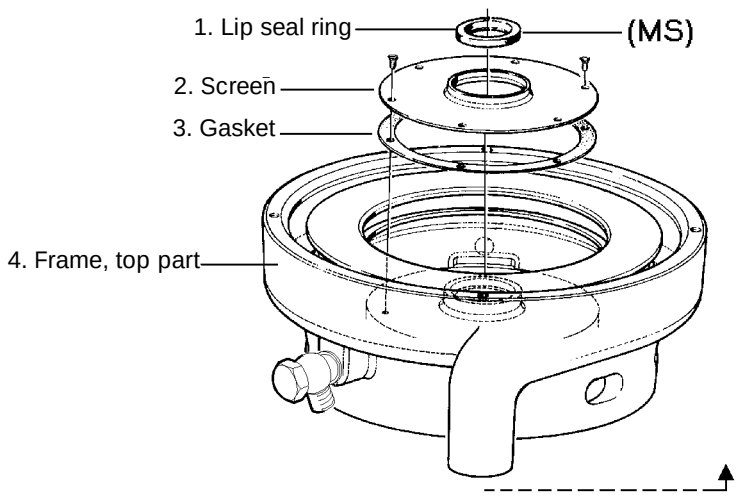
16 Clean the oil sump.

17 Clean all dismantled parts thoroughly in a degreasing agent and check for damage and corrosion.

Replace all parts supplied in the spare parts kits.

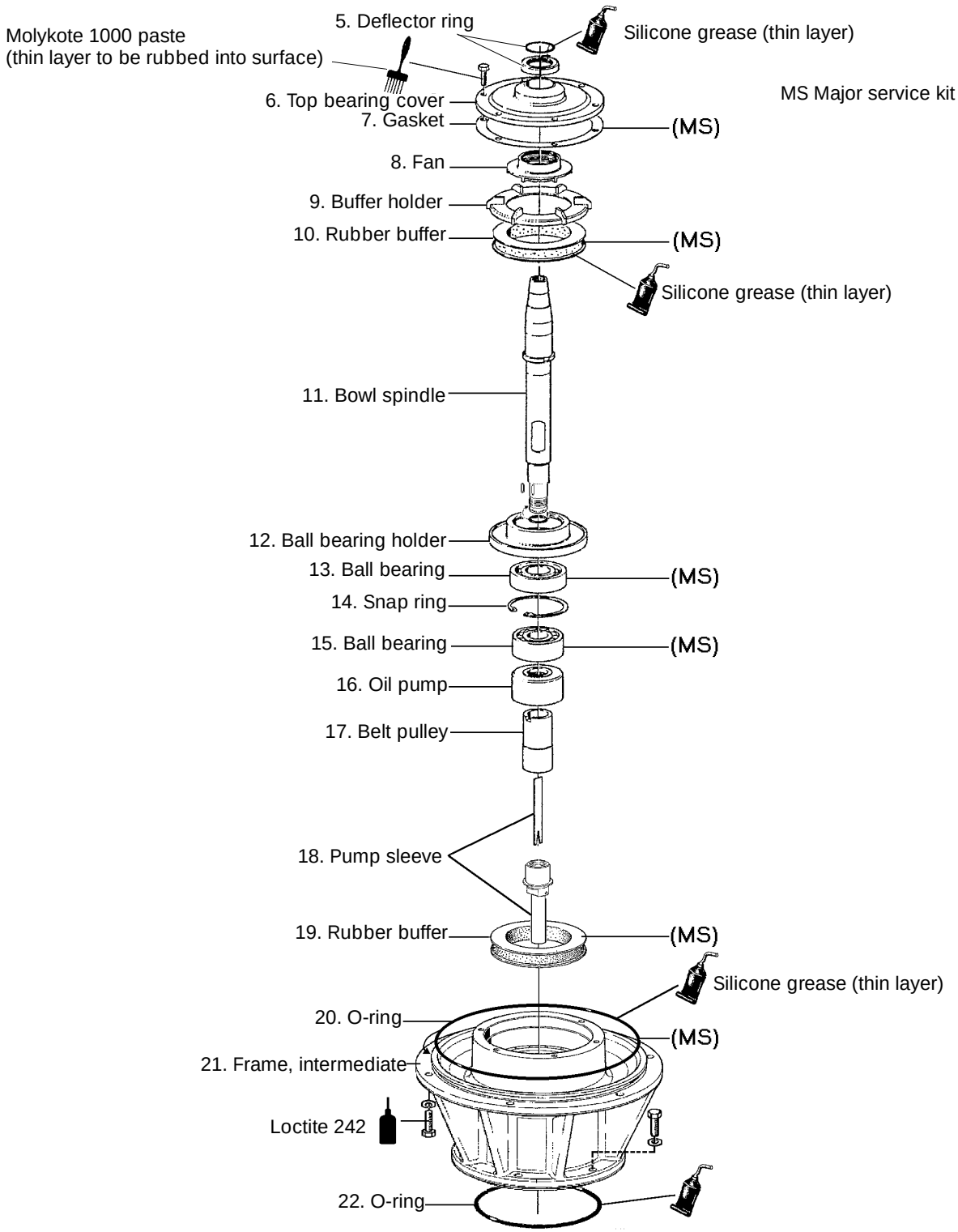
3.2.2 Bowl spindle and frame – assembly

The bowl spindle and frame is assembled in reverse sequence to dismantling.



MS Parts to be renewed at Major Service

G0113271

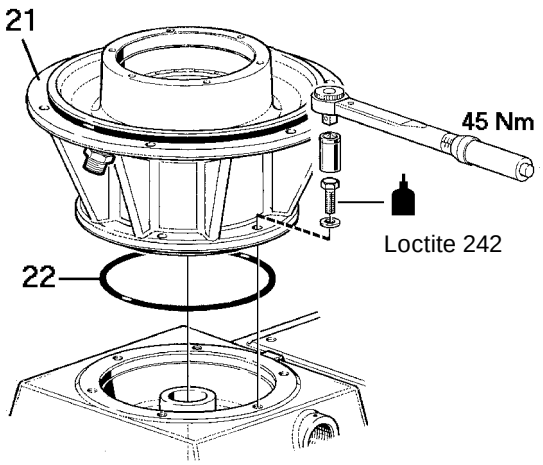

Molykote 1000 paste
(thin layer to be rubbed into surface)
5. Deflector ring
Silicone grease (thin layer)
MS Major service kit
6. Top bearing cover
7. Gasket
(MS)
8. Fan
9. Buffer holder
10. Rubber buffer
(MS)
Silicone grease (thin layer)
11. Bowl spindle
12. Ball bearing holder
13. Ball bearing
(MS)
14. Snap ring
15. Ball bearing
(MS)
16. Oil pump
17. Belt pulley
18. Pump sleeve
19. Rubber buffer
(MS)
Silicone grease (thin layer)
20. O-ring
(MS)
21. Frame, intermediate
Loctite 242
22. O-ring
G01131B1

In case of 3-year-service

1 Fit a new O-ring (22) and assemble the frame intermediate part (21).

Use a torque wrench and tighten the screws lightly crosswise at first. Then tighten all around to 45 Nm.

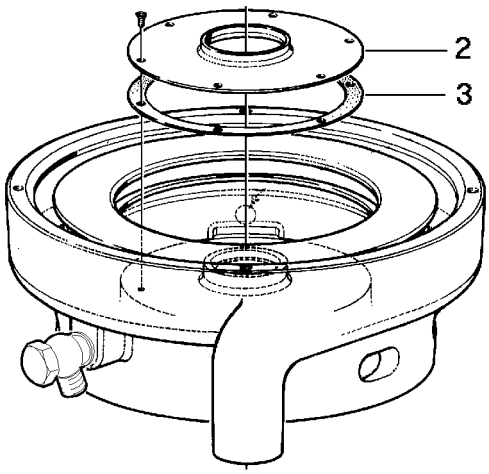
Secure the screws with Loctite 242.



G0093781

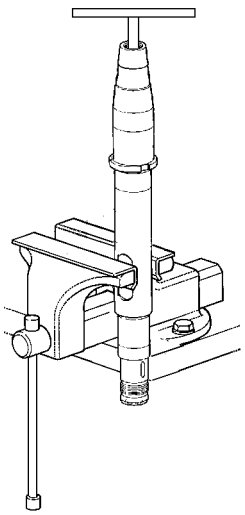
2 Fit a new gasket (3).

Fit the screen (2).



G0113761

3 Clear the spindle bore from dirt and lime deposits with the special reamer



G0076341

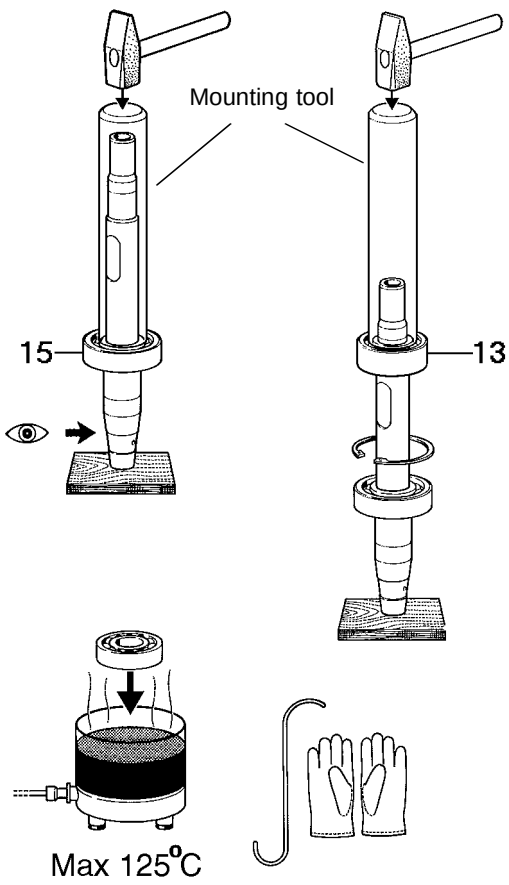
4 Inspect the tapered end and the hollow part of the bowl spindle for wear and clean if necessary. Assemble ball bearings (13 and 15).

Heat the new ball bearings in oil to maximum 125 °C. Use the special mounting tool from the tool kit.

NOTE

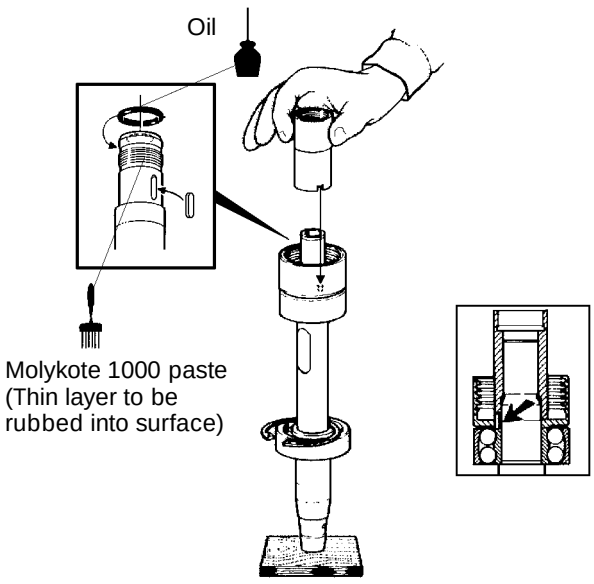
Always fit new bearings.

If in doubt how to install roller bearings in a correct way, please see the detailed description in *2.10.1 Ball and roller bearings*, *page 39*.



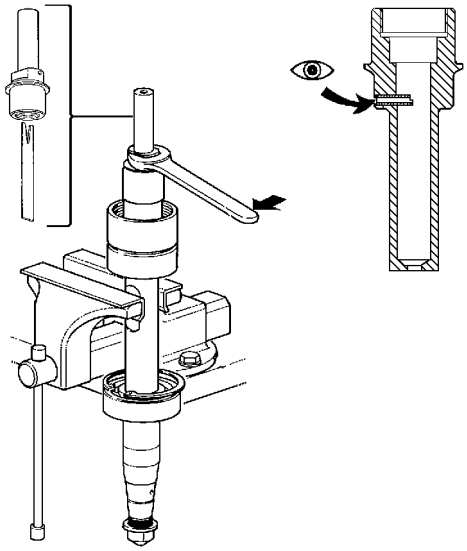
G0113831

5 Fit oil pump, flat key and belt pulley. Make sure that the recess in the belt pulley fits over the guide pin in the oil pump.



G0113941

6 Check that the radial hole (Ø 1 mm) in the pump sleeve is clean, and fit the pump.

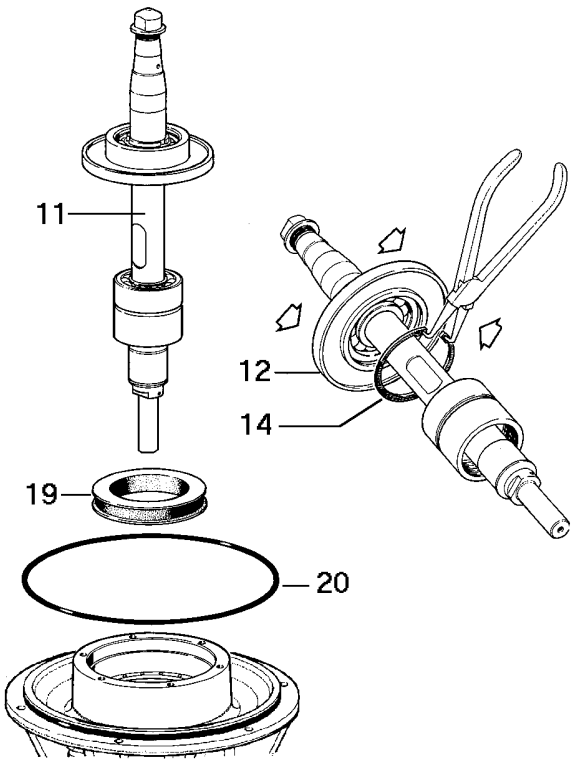


G0114341

7 Fit ball bearing holder (12) and secure it with snap ring (14).

Fit O-ring (20) and rubber buffer (19).

Lower spindle assembly (11) carefully into the separator intermediate frame.



G0076122

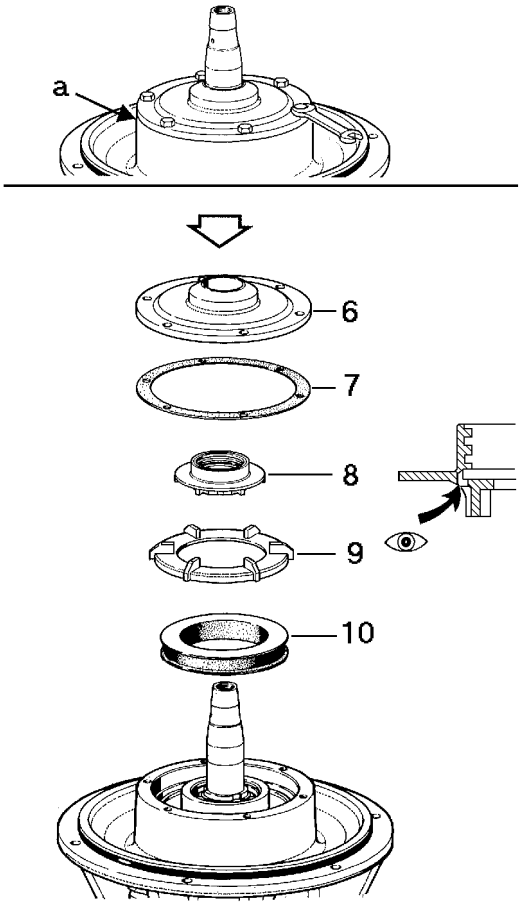
8 Assemble, in the following sequence:

- Rubber buffer (10)
- Buffer holder (9)
- Fan (8)
- Gasket (7)
- Top bearing cover (6)

Make sure that the Ø 3 mm hole in fan (8) is clean and the lugs in the fan enter the recesses in the bowl spindle.

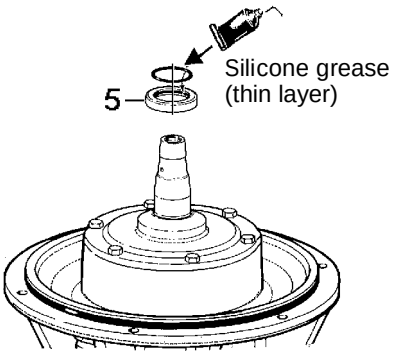
Before tightening, make sure that there is some play (a) between top bearing cover (6) and the frame. The play will disappear when the screws are tightened.

Tighten the screws sequentially (not crosswise) in order to successively compress the rubber buffers.



G0114421

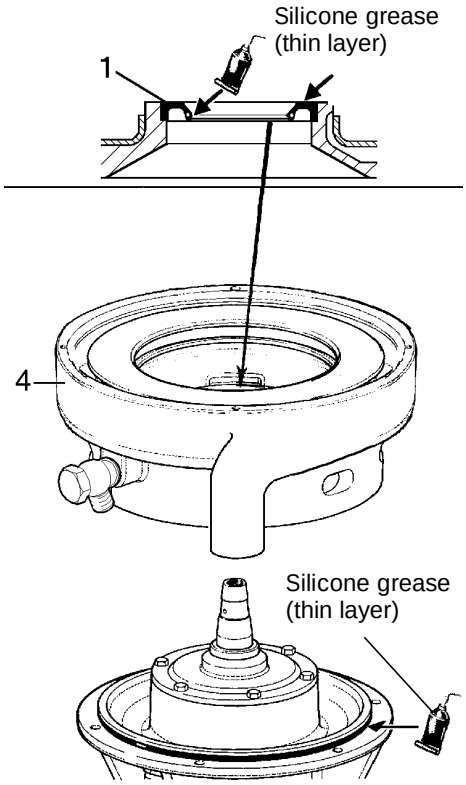
9 Push down deflector ring (5) till it stops.



G0114521

10 Assemble frame top part (4). If lip seal ring (1) has been removed, fit a new one before the frame top part is put in place.

Make sure the lip seal is turned the correct way. See illustration.

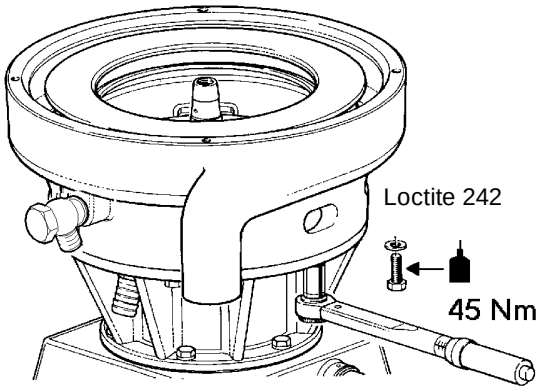


G0114661

11 Tighten the screws of the top frame using a torque wrench (width across flats 16 mm).

Tighten the screws slightly crosswise at first. Then tighten all around to 45 Nm.

Secure the screws with Loctite 242.

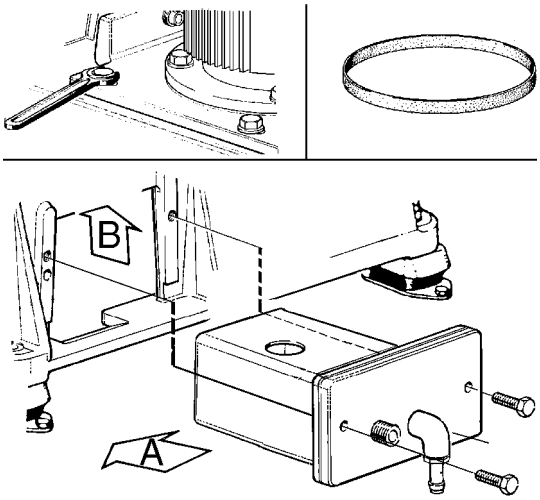


G0114741

12 Fit and adjust the flat belt, see *3.4.1 Belt replacement and tightening*, page 83.

Check point
2.4.2 Radial wobble of bowl spindle, page 29.

13 Fit the water tank and tighten the screws.



G01133A1

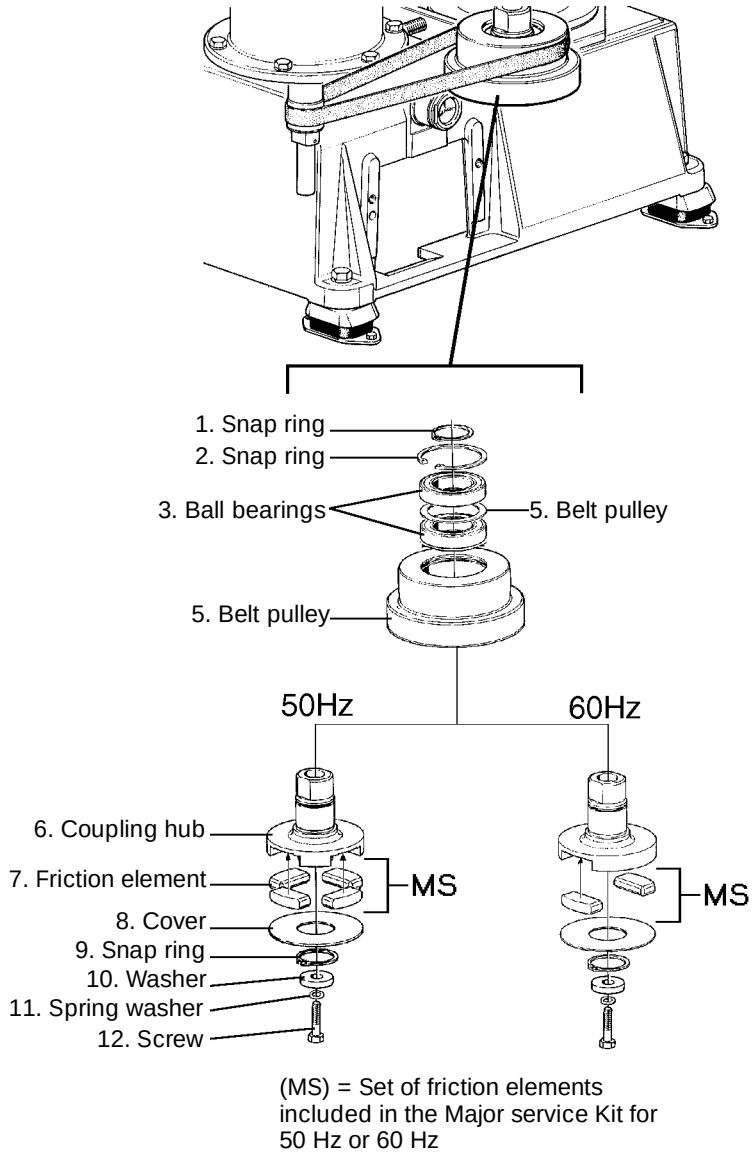
3.3 Friction coupling

If the separator does not attain full speed within about 2 minutes, the friction elements or the coupling may be worn or greasy. The friction elements must then be replaced with new ones or be thoroughly cleaned from grease.

DANGER

Entrapment hazards

Make sure that rotating parts have come to a complete standstill before starting any dismantling work.



(MS) = Set of friction elements included in the Major service Kit for 50 Hz or 60 Hz

G0372121

3.3.1 Friction coupling – dismantling

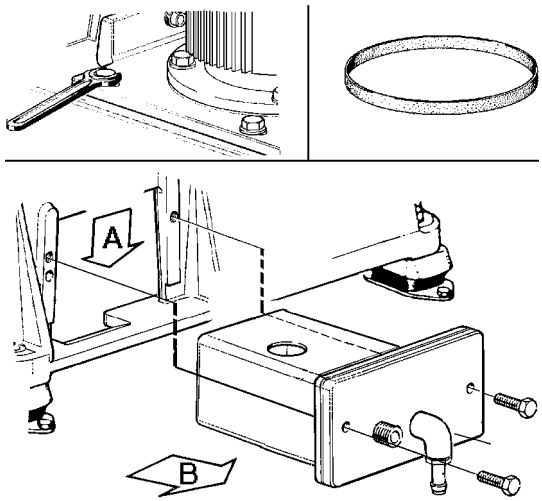
1 Check that the belt tightener is in backward position.

2 Remove the motor adapter screws.

3 Remove the water tank and the flat belt.

Note that the tank must be lowered past spindle end (A) before it can be withdrawn (B).

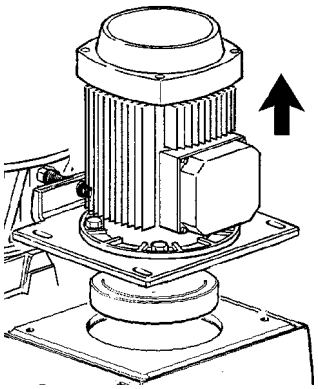
4 Remove the flat belt.



G0113391

5 Remove the electric motor complete with the friction coupling and motor adapter.

Weight of motor including adapter and friction coupling is not more than 35 kg.

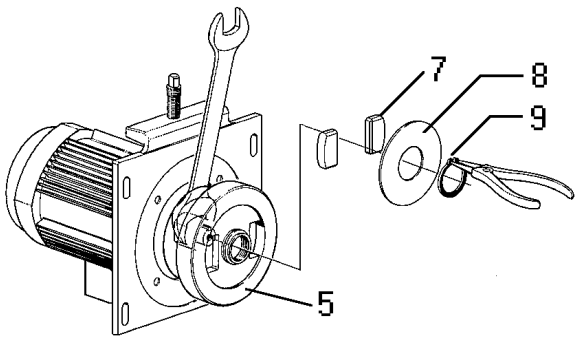


G0077331

6 Remove snap ring (9), cover (8) and friction elements (7).

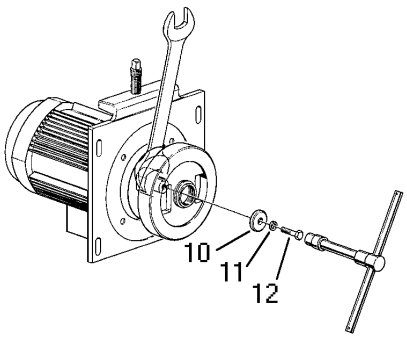
If the friction elements are worn, fit new ones. Replace all friction elements even if only one is worn.

If the friction elements are only greasy: Clean the friction elements and the inside of belt pulley (5) with a degreasing agent.



G0170841

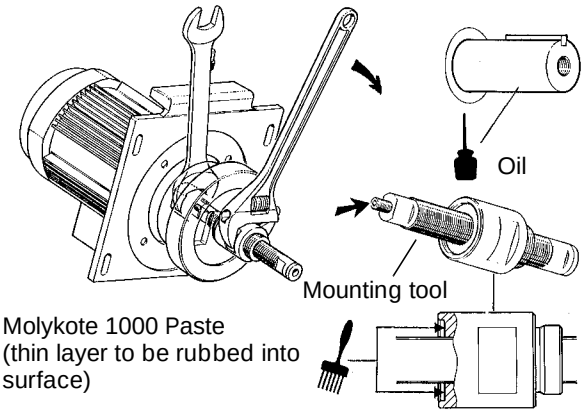
7 Remove the screw (12), spring washer (11) and washer (10) from the friction coupling.



Complete dismantling of the friction coupling

8 Lubricate and fit the special mounting and dismantling tool.

Ease off the coupling.



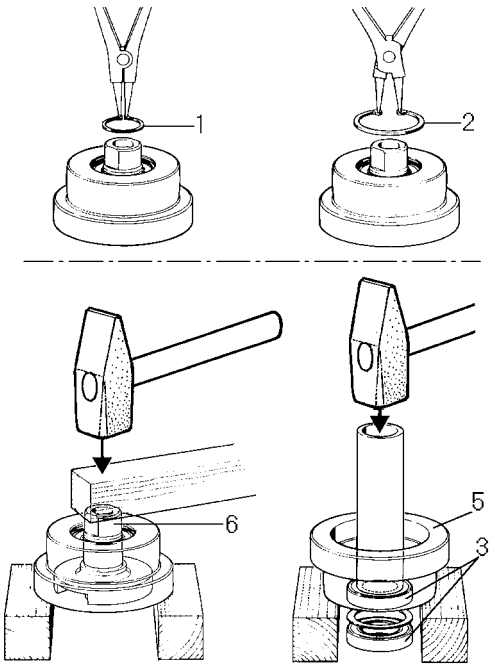
G0171021

9 Remove snap rings (1 and 2) and drive off coupling hub (6). Turn the coupling, i.e. belt pulley (5) with bearings (3), the other way round and drive off the ball bearings and washer by using a tube.

10 Clean all parts in a degreasing agent and replace parts supplied in the spare parts kits.

NOTE

Always discard a used bearing.



G0171131

3.3.2 Friction coupling – assembly

Before the friction coupling is assembled, examine all parts thoroughly for wear and corrosion.

1 Assemble the new ball bearings in belt pulley (5) by using a tube and a hammer.

Apply Loctite 641 on the outer surfaces of ball bearings (3).

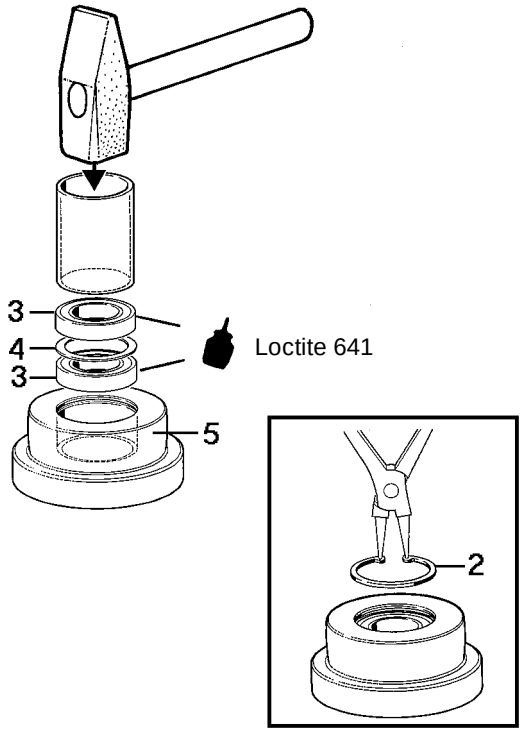
Knock down the bearings carefully (do not forget washer 4) by using the tube which must rest on the outer race of the bearing.

The new bearings must not be heated as they are packed with grease and sealed with plastic membranes.

After the assembly of the bearings, fit snap ring (2).

NOTE

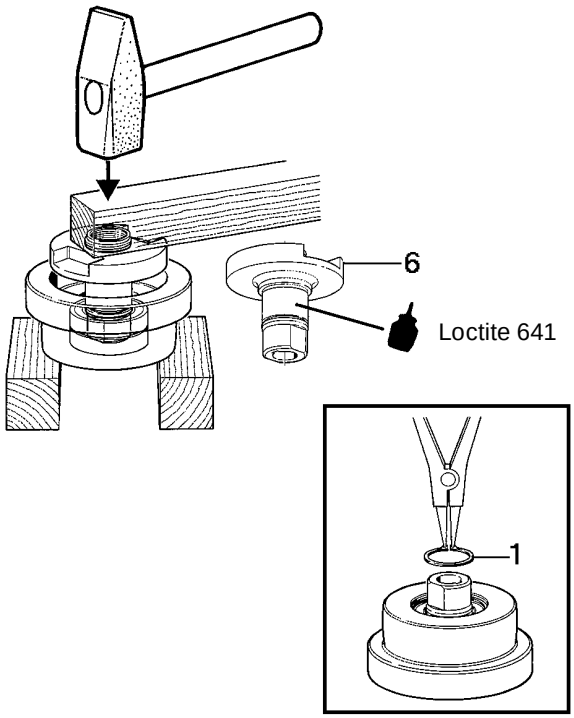
Do not refit used bearings.



G0171231

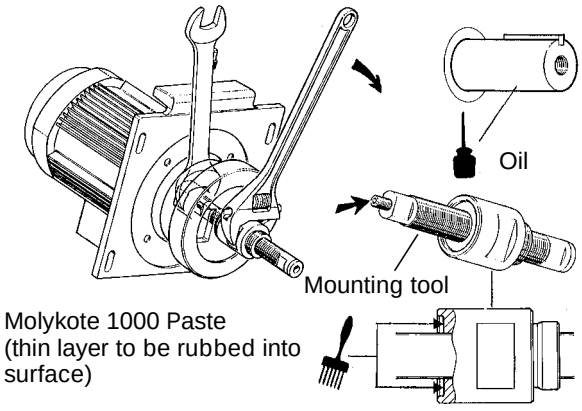
2 Apply Loctite 641 on the coupling hub (6) and knock it down into the belt pulley by using a hammer.

3 Fit snap ring (1).



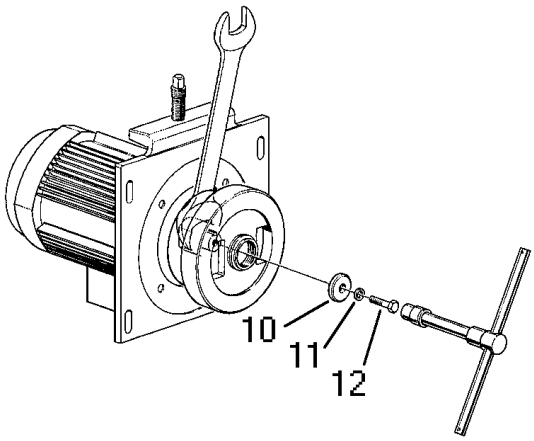
G0171321

4 Wipe clean the motor shaft and apply a thin oil film on it. Fit the special mounting and dismantling tool to the motor shaft (by means of the small screw on one end of the tool) and press the friction coupling onto the shaft.



G0171021

5 Fit the screw (12) with the washer (11) and spring washer (10) to secure the friction coupling.

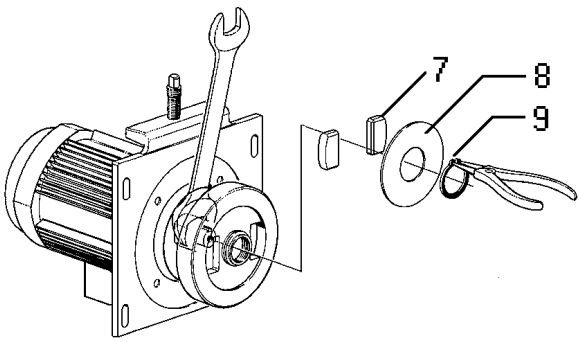


G0170921

Assembly of friction elements

6 Fit new friction elements (7), cover (8) and snap ring (9).

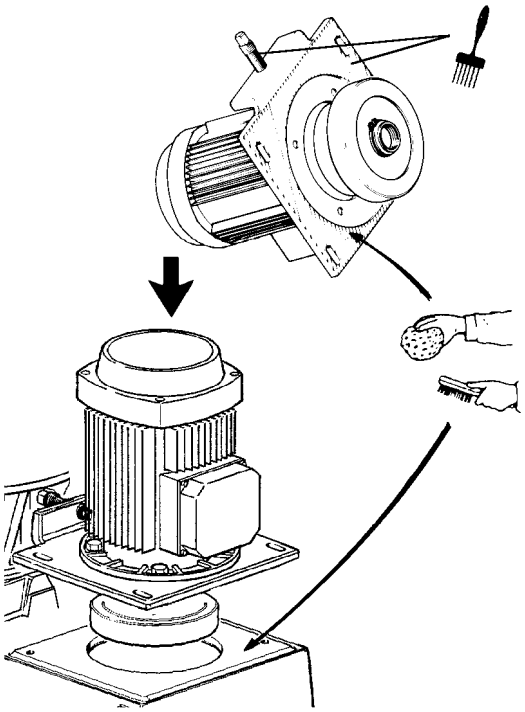
- A coupling with two friction elements is used for 60 Hz installations.
- A coupling with four friction elements is used for 50 Hz installations.



G0170831

7 Degrease and clean the contact surfaces of frame and motor adapter. Lubricate the contact surfaces with Molykote 1000 paste. Then fit the electric motor with adapter and friction coupling in position.

Also lubricate the threads of the belt tightener with Molykote 1000 paste or similar.



G0077341

8 Fit and tighten the flat belt, see *3.4.1 Belt replacement and tightening*, *page 83*.

9 Install the water tank and the cover.

NOTE

The belt must be re-tightened before starting the separator, see next page.

3.4 Flat belt and tightener

The flat belt must be removed before dismantling of the bowl spindle or the friction coupling. The procedure is the same when replacing the belt at a Major Service.

A new belt must be re-tightened **twice**:

- 30 minutes after the belt has been installed. The separator must not be started until the re-tightening has been done.
- after approximately 24 hours of operation.

NOTE

Do not start the separator unless the flat belt has been re-tightened after 30 minutes. If started, the belt may slip and be damaged.

3.4.1 Belt replacement and tightening

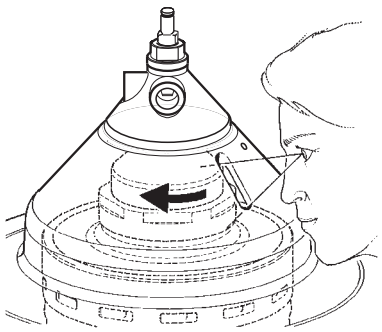
If only tightening of flat belt should be done, only steps *3* and *7*-*11* have to be performed.

DANGER

Entrapment hazards

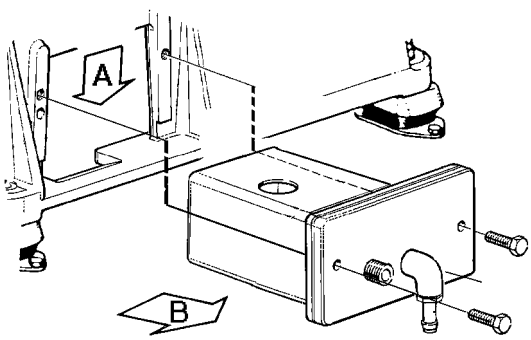
Make sure that rotating parts have come to a complete standstill before starting any dismantling work.

Look into the slot in the frame hood to see if separator parts are rotating or not.



G0467361

1 Remove the water tank.
Note that the tank must be lowered past spindle end (A) before it can be withdrawn (B).

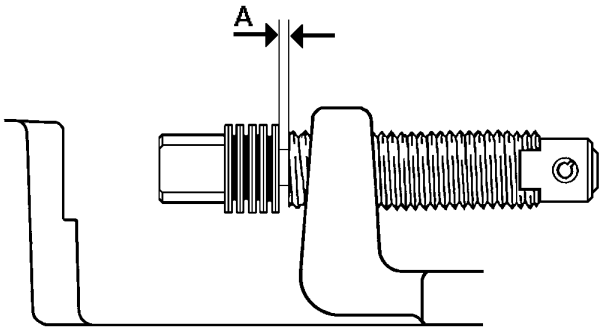


G0884721

2 Check that the belt tightener is in backward position.

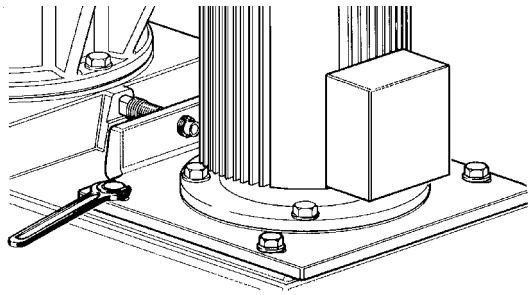
NOTE

Pay attention to the air gap “A” between the cup springs and the threaded sleeve.
The distance “A” must not exceed 0,5 mm.
Otherwise a correct belt tightening will be impossible.



G0473911

3 Loosen but do not remove the motor adapter screws.

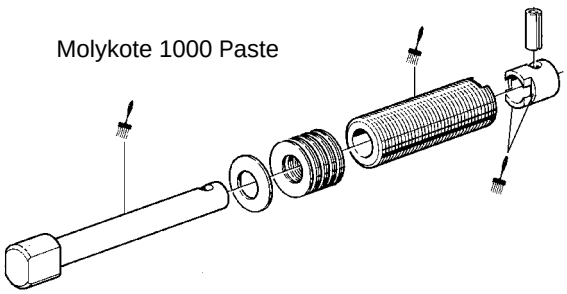


G0076622

NOTE

To guarantee a proper function of the belt tightener it is advisable to protect the surfaces

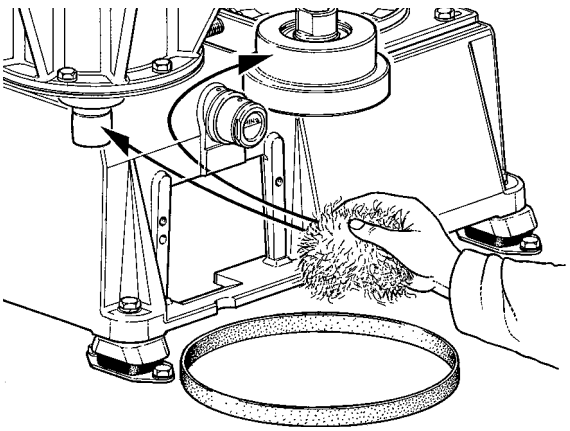
Knock out the tubular spring pin and separate the parts, lubricate and assemble the parts.



G0885711

4 Remove the existing belt and clean the raceways of the bowl spindle and the friction coupling by using a degreasing agent. Wipe the raceways with a clean rag after cleaning.

Exercise the greatest possible cleanliness. There must be no dirt, oil or grease on the raceways.

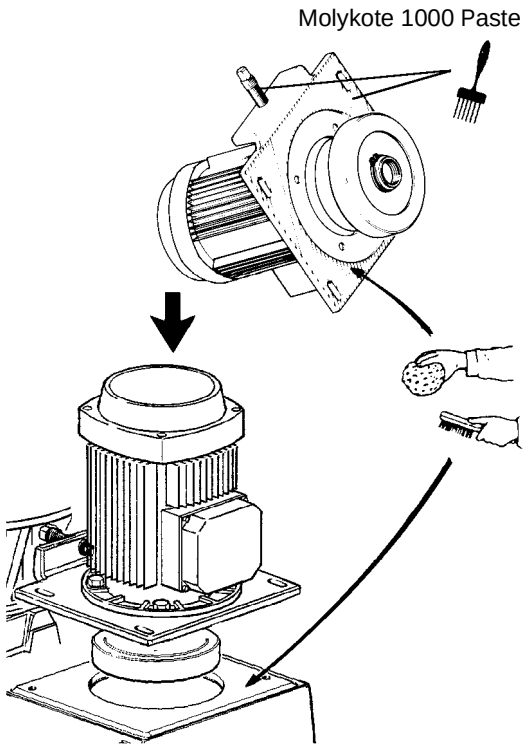


G0171531

5 Remove the motor adapter screws. Lift the motor together with adapter and friction coupling and check that there is a sufficient film of Molykote 1000 Paste, or an equivalent lubricating paste, between the adapter and the frame surface. Lower the motor after checking. Fit the motor adapter screws but do not tighten them.

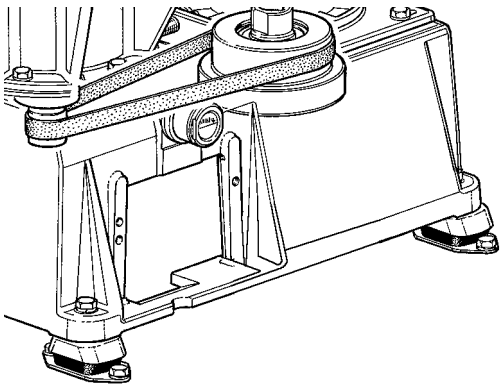
The weight of motor including adapter and friction coupling is not more than 35 kg.

The threads of the belt tightener should be lubricated with a thin layer of Molykote 1000 Paste.
(to be rubbed into surface)



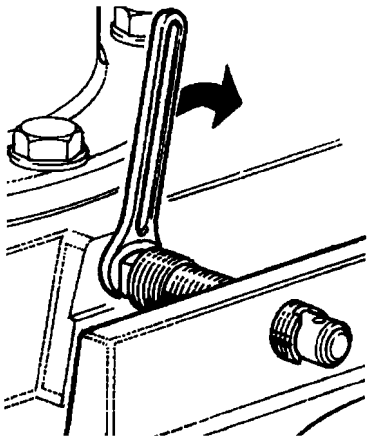
G0077341

6 Fit a new belt. Start on the motor side. Tighten the belt by moving the motor backwards by hand.
Pull the belt around a few turns by hand.



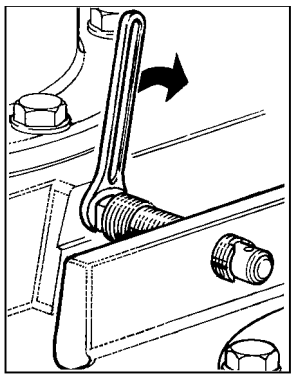
G0171661

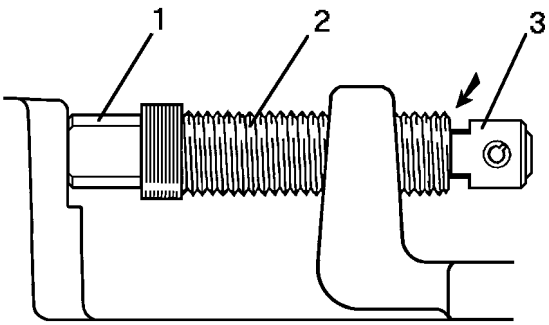
7 Rotate the belt tightener by rotating the shaft until it makes contact with the frame pad.



G0489821

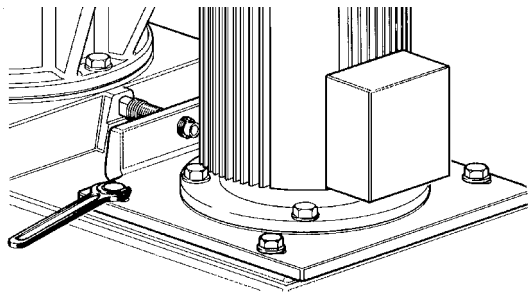
8 Tighten the shaft (1) further until the threaded sleeve (2) and dog (3) are disengaged. “Shake” the motor by hand several times during this operation in order to overcome the friction between the motor adapter and the frame.





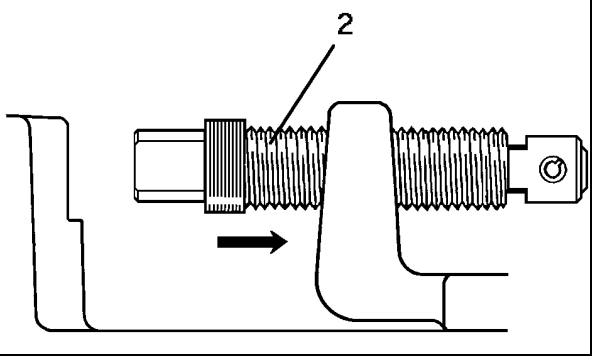
G0477111

9 Tighten the motor adapter screws.



G0076622

10 Loosen the belt tightener by rotating the threaded sleeve (2) backwards.

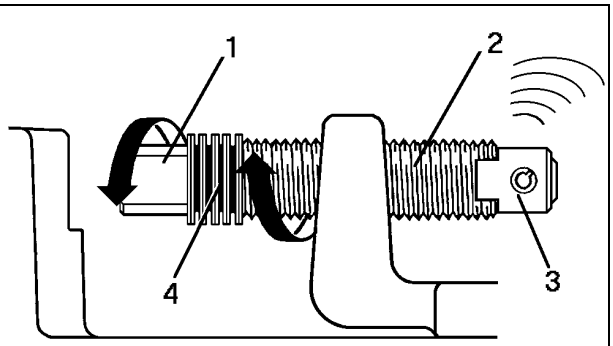


G0477211

11 Rotate the shaft (1) relative to the threaded sleeve (2) until the sleeve (2) and dog (3) are engaged again with a clicking sound.

NOTE

If the springs (4) are not decompressed they will loose their tension and correct tightening of belt will be impossible.



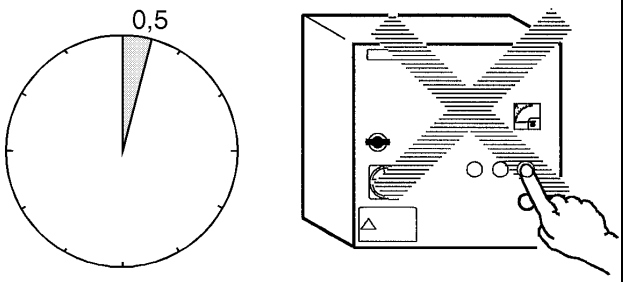
G0477311

12 Let the belt stay in this position for at least 30 minutes without starting the separator.

Then repeat steps *3* and *7-11* above. After this proceed to step *13*.

NOTE

Do not start the separator unless the flat belt has been re-tightened after 30 minutes.
If started, the belt may slip and be damaged.



G0474021

13 Fit the water tank and cover.

14 The separator may now be started.

NOTE

The belt must be re-tightened when the separator has been in operation approximately 24 hours after the belt change: Repeat steps *3* and *7-11*.

3.5 Oil filling device

3.5.1 Dismantling/assembly

Drain off the oil, see *2.8 Oil change, page 35*.

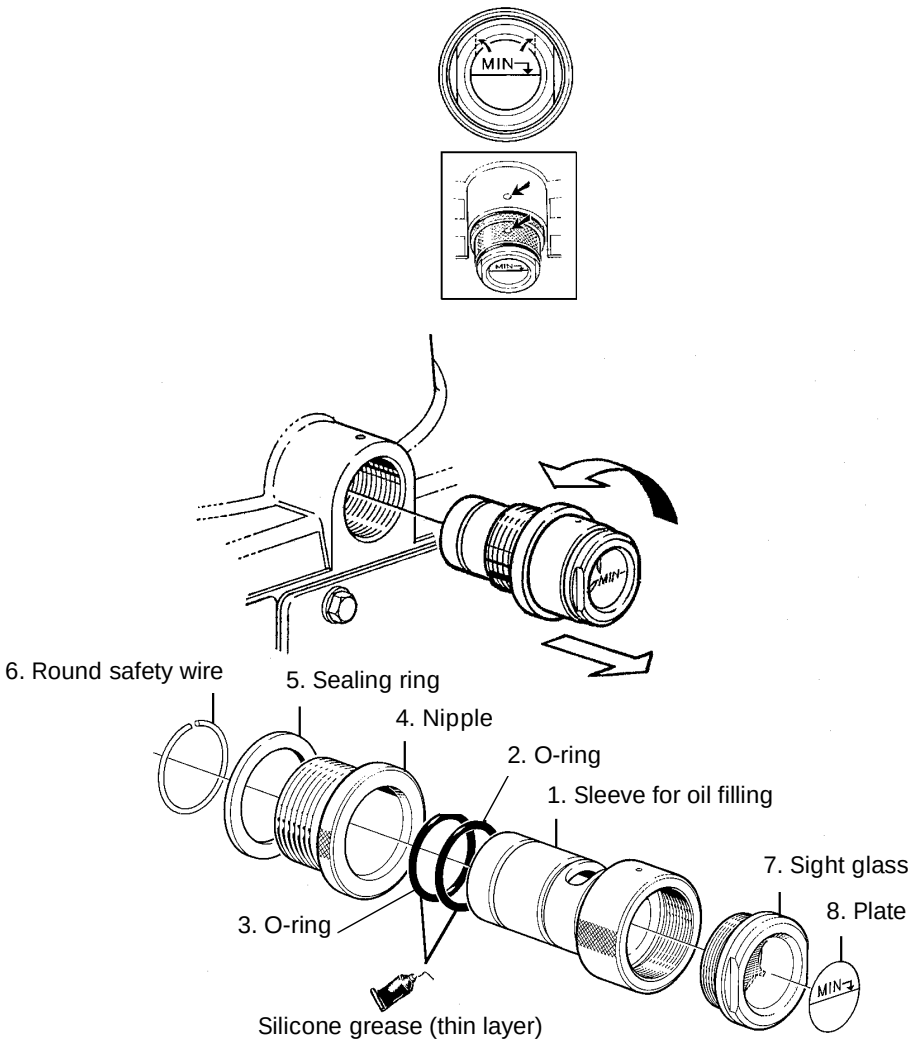
Unscrew nipple (4) and pull off the oil filling device. Then unbend the round safety wire (6) and pull off nipple (4).

1 If plate (8) is to be replaced, wipe the sight glass (7) with a degreasing agent.

2 Fit the new plate on the outside of the sight glass. The plate is self-adhesive.

3 Mark the position of the plate relative to the recess in sleeve (1).

Assemble the oil filling device and fit it into the frame. Note that the mark on sleeve (1) must be positioned opposite the mark on the frame. Fill the sump with new oil.



G0155811

G0155911

3.6 Water tank

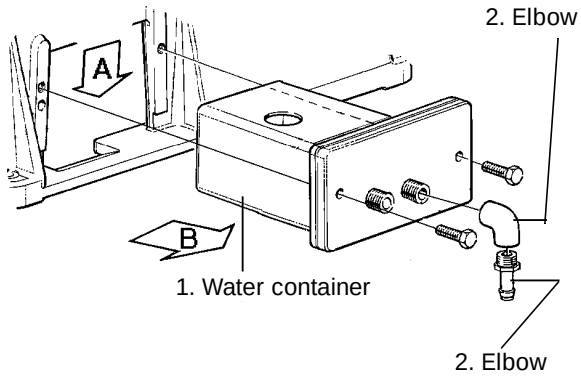
Remove the water tank (1).

Note that the tank must be lowered past the spindle end (A) before it can be withdrawn (B).

- Check the tank interior and clean out if necessary.
- Check that the pipes are not defective. Replace if necessary.

If the parts fitted on the tank have been removed, it is necessary to fit the parts properly together at assembly.

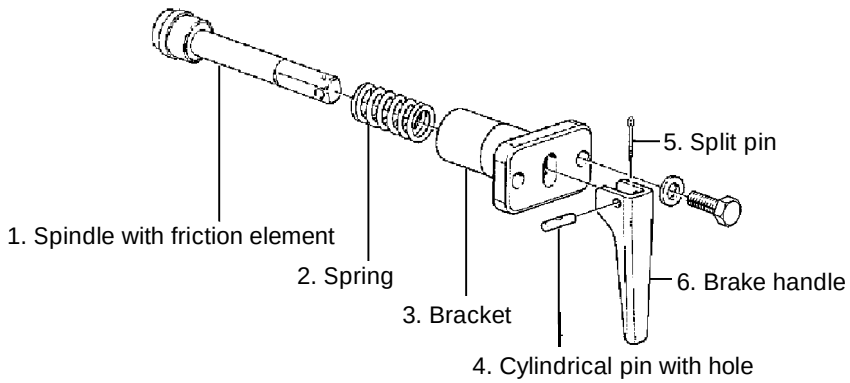
- Seal the water inlet pipe with Loctite 573.



G0884711

3.7 Brake

3.7.1 Exploded view

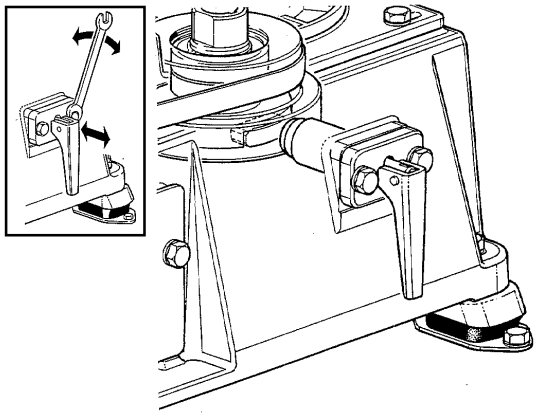


G0171731

3.7.2 Checking of friction element

A worn or oily friction element will lengthen the stopping time. Remove bracket with the brake. Examine the friction element.

- If the friction element is worn; Fit a new complete spindle (includes friction element).
- If the friction element is oily; Clean the element and its surface in contact with the belt pulley with a suitable degreasing agent.

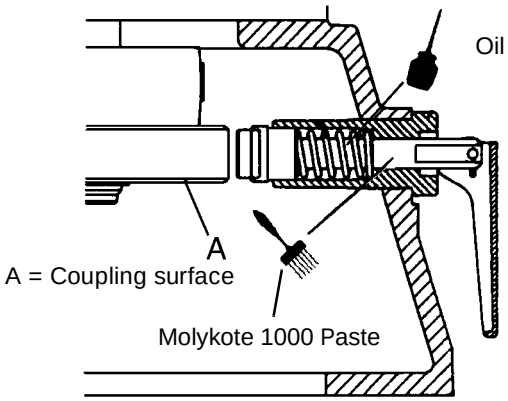


G0171821

Checking of bracket, spindle and spring

Rust can form on the brake parts and cause the brake to jam.

Remove rust from the spindle and the corresponding guide surface on the bracket. Rub the surface of the spindle with a thin layer of lubricating paste. Replace the spring with a new one if it has lost its stiffness. Oil the spring when assembling.



G0171931

Checking the brake

After the brake assembly has been fitted, release the brake and rotate the bowl slowly by hand. If a scraping noise is heard, the friction element is probably touching the coupling pulley surface (A). If so, it is necessary to adjust the position of the motor adapter and re-tighten the flat belt, see *3.4 Flat belt and tightener, page 83*.

3.8 Frame feet

3.8.1 Mounting of new frame feet

When replacing the frame feet, the separator must be lifted.

Remove the bowl before lifting the separator.

Follow*2.6 Lifting instructions, page 31* .

1 Loosen the foundation bolts and lift the separator.

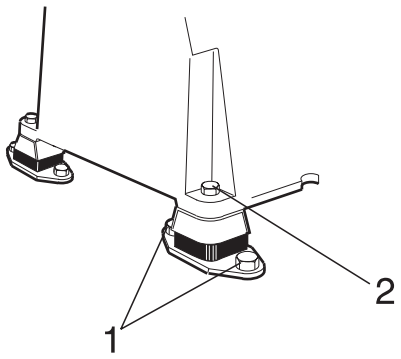
2 Remove the existing frame feet.

3 Mount the new feet.

4 Place the separator in its original position and fasten the foundation bolts.

5 Remove the two lifting eye bolts.

6 Assemble the separator bowl, see *3.1.2 Inlet/ outlet and bowl - assembly, page 53*.



G0358351

4 Technical Reference

4.1 Technical data

Alfa Laval ref. 561688, rev. 0

Units according to ISO Standard.

The manufacturer reserves the right to change specifications without notice.

Product number. 881100-03-01

Separator type. P150

Purpose.

– Continuous purification of fuel oil or lubricating oil from solid particles and water.

– Continuous clarification (as option) of fuel oil or lubricating oil from solid particles.

The flash point of the oil to be separated must be >60 °C.

Hydraulic capacity	Maximum 2,9 m^3/h	
Maximum density	feed sediment	1100 kg/m^3 2332 kg/m^3
Operating liquid	Max. density 1000 kg/m^3 Min. pressure 150 kPa	See also *4.5 Water quality, page 101*.
Feed temperature	Minimum 0 °C Maximum +100 °C	
Ambient temperature	Minimum +5 °C Maximum +55 °C	
Motor	2-pole 3 kW standard motor for 3-phase 50 or 60 Hz. Direct on-line start. Y/D-start: maximum 5 seconds in Y position.	
Power consumption	idling running (at max. capacity) max. power consumption	0,9 kW 2 kW 2,8 kW (at starting-up)
Speed	The prescribed speed of the bowl spindle is stamped on the name plate of the machine. The speed must not be exceeded.	
Gear ratio (pulleys)	130:41 (50 Hz) 106:41 (60 Hz)	
Starting time	1,8 - 2,3 minutes	

Stopping time	Running down	min. 15, max. 18 minutes
	With brake	min. 3, max. 4 minutes
Maximum running time without flow	Empty bowl	180 minutes
	Filled bowl	180 minutes
Sludge and water space volume	1,0 litre net	
Discharge volume	1,1 litre (nominal), fixed	
Discharge interval	Minimum 2 minutes,	
Required water quality	See *4.5 Water quality, page 101*	
Lubrication	See *4.6 Lubricants, page 103*	
Lubricating oil volume	0,5 litre	
Sound pressure level	76 dB(A)	
Vibration level	Separator in use	9 mm/s (RMS)
Weight	Separator without motor	Net weight approx. 213 kg
	Motor	See *4.7.2 Electric motor, page 112*
	Complete bowl	Approx. 38 kg
	Overhead hoist for 300 kp is required	
Shipping data	According to “Basic equipment”	
	Weight	Net 235 kg, gross 285 kg
	Volume	1,06 m^3
Materials	Bowl spindle	stainless steel
	Frame, lower and upper parts	cast iron (“Centriblue” finish[1)])
	Frame hood	Silumin (grey finish, An epoxy enamel)
	Bowl body and hood, disc stack, gravity discs	stainless steel
	Other bowl parts	brass
	Oil paring disc	brass
	Other inlet and outlet parts	stainless steel, brass, cast iron

NOTE

The separator is a component operating in an integrated system including a monitoring system. If the technical data in the system description does not agree with the technical data in this instruction manual, the data in the system description is the valid one.

4.2 Connection list

Alfa Laval ref. 561658, rev. 0

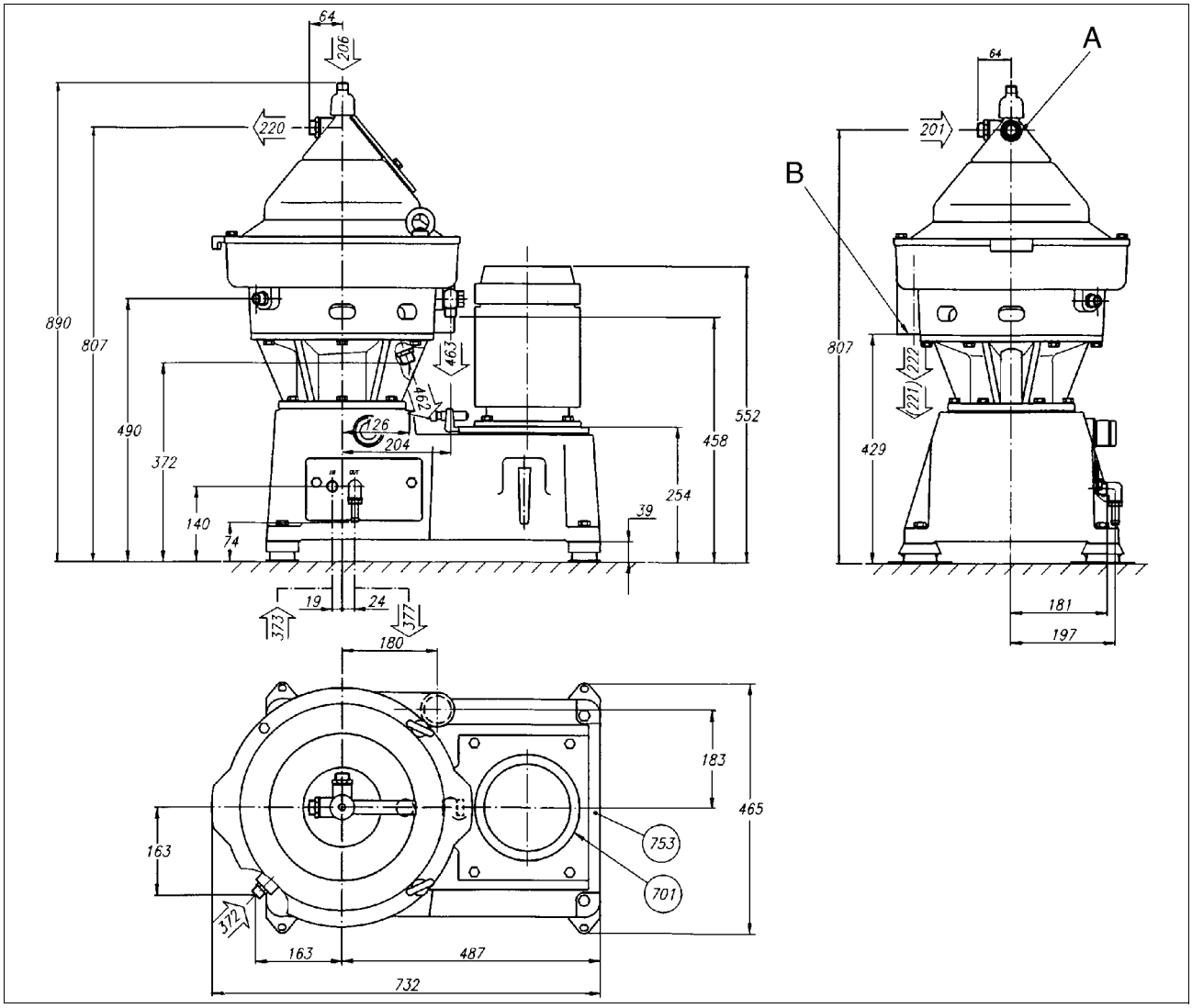
Connection No.	Description	Requirements/limit
201	Inlet for process liquid • Permitted temperature	 Maximum +100 °C minimum 0 °C
206	Inlet for liquid seal and displacement liquid • Quality requirements • Instantaneous flow • Pressure	 Fresh water 5,5 litres/minute 150-600 kPa
220	Outlet for light phase (oil) • Counter pressure	 Maximum 360 kPa
221	Outlet for heavy phase (water)	No counter pressure
222	Outlet for solid phase	The outlet after the separator should be installed in such a way that you can not fill the frame top part with sludge. (Guidance of sludge pump or open outlet)
372	Inlet for discharge liquid • Instantaneous flow • Quality requirements • Pressure • Time	 18 litres/minute See *4.5 Water quality, page 101* 150-600 kPa 1 second per discharge

Connection No.	Description	Requirements/limit
373	Inlet for closing liquid	
	• Instantaneous flow	0,9 litre per minute
	• Quality requirements	See *4.5 Water quality, page 101*
	• Pressure	150-600 kPa
	• Consumption	0,9 litre per discharge
377	Outlet for operating liquid	
462	Drain of frame top part, lower	
463	Drain of frame top part, upper	
701	Motor for separator	
	Allowed deviation from nominal frequency (momentarily during maximum 5 seconds)	±5% (±10%)
753	Unbalance sensors, vibration	See interface description
	• Type	Mechanical switch
	• Vibration measurement range	0 to 4,5 g from 0 to 300 Hz
	• Switch rating, resistive load max	5 A 12 V DC 2 A 24 V DC 1 A 48 V DC 0,5 A 120 V DC 7 A 460 V AC 50/60 Hz
	• Reset coil power supply max 14 W	48 V DC

Location of connections on the separator, see *4.3 Basic size drawing, page 96*, and *4.3.1 Dimensions of connections, page 97*.

4.3 Basic size drawing

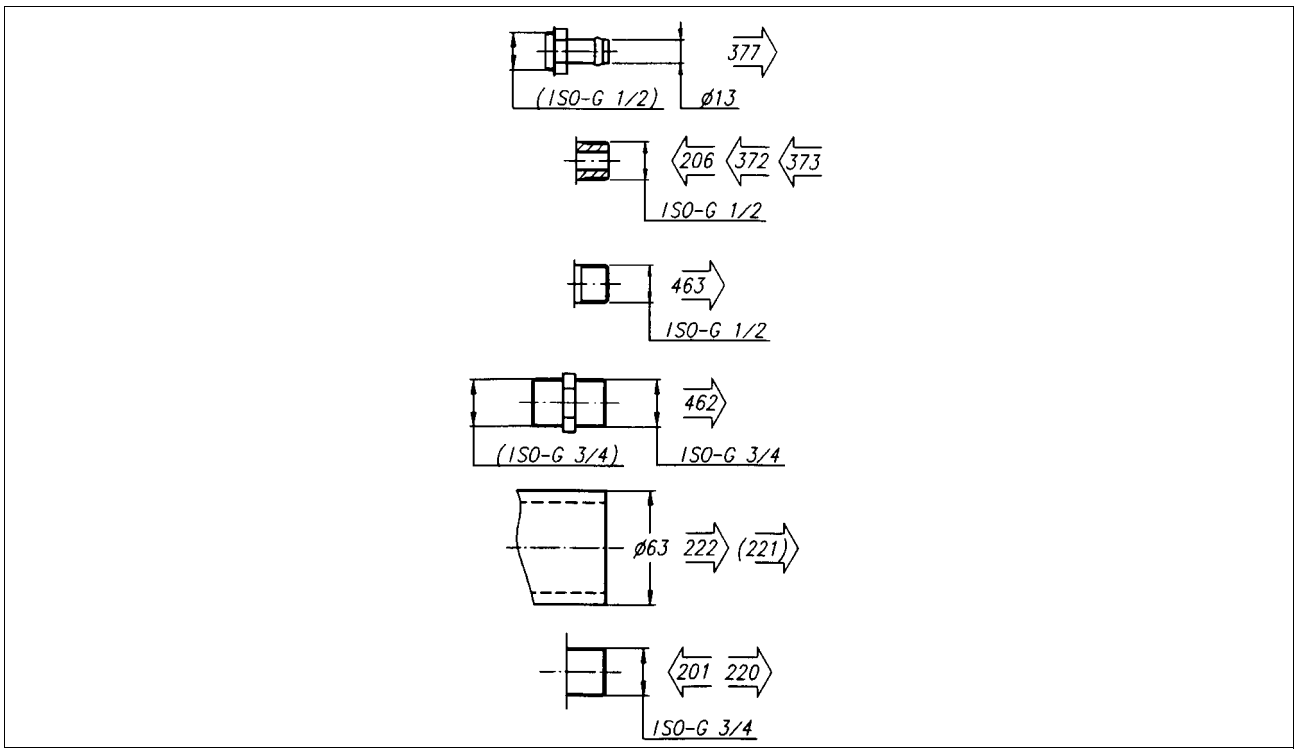
Alfa Laval ref. 565298, rev. 1



Connections 201 and 220 are turnable 90°.
A Maximum horizontal displacement during operation ±20 mm
B Maximum vertical displacement during operation ±10 mm

4.3.1 Dimensions of connections

Alfa Laval ref. 565298 rev. 1



All dimensions are nominal.
Reservation for individuall deviations due to tolerance.
All connections to be installed non-loaded and flexible.
Data for connections see *4.2 Connection list*, *page 94*

4.4 Interface description

Alfa Laval ref. 561707, rev. 0

4.4.1 General

In addition to the *4.2 Connection list*, *page 94* this document describes limitations and conditions for safe control, monitoring and reliable operation.

At the end of the document a function graph and running limitations are found.

4.4.2 Definitions

Stand still (Ready for start) means:

- The machine is assembled correctly.
- All connections are installed according to the preceding Connection List, Interconnection Diagram and Interface Description.

Start means:

- The power to the separator is on.
- The acceleration is supervised to ensure that a certain speed has been reached within a certain time. See *4.1 Technical data*, *page 92*.

Normal stop means:

- Stopping of the machine at any time with brake applied.
- The bowl must be kept filled.

Safety stop means:

The machine must be stopped in the quickest and safest way due to vibrations or process reasons.

Comply to the following conditions:

- The bowl must be kept filled.
- Sludge ejection (sludge discharge) must not be made.
- The machine must not be restarted before the reason for the safety stop has been investigated and action has been taken.

In case of emergency condition in the plant, the machine must be stopped in a way that is described in EN 418.

4.4.3 Component description and signal processing

Separator motor 701

The separator is equipped with a 3-phase DOL- (direct-on-line) started motor. The separator can also be started by a Y/D starter, but then the time in Y-position must be maximized to 5 seconds.

Vibration Sensor 753

The vibration sensor is an acceleration sensitive instrument with a mechanical switch.

It gives an open contact when the unbalance exceeds the pre-set value.

Signal processing
If to high vibration occur the machine must be stopped with automatic Safety Stop.

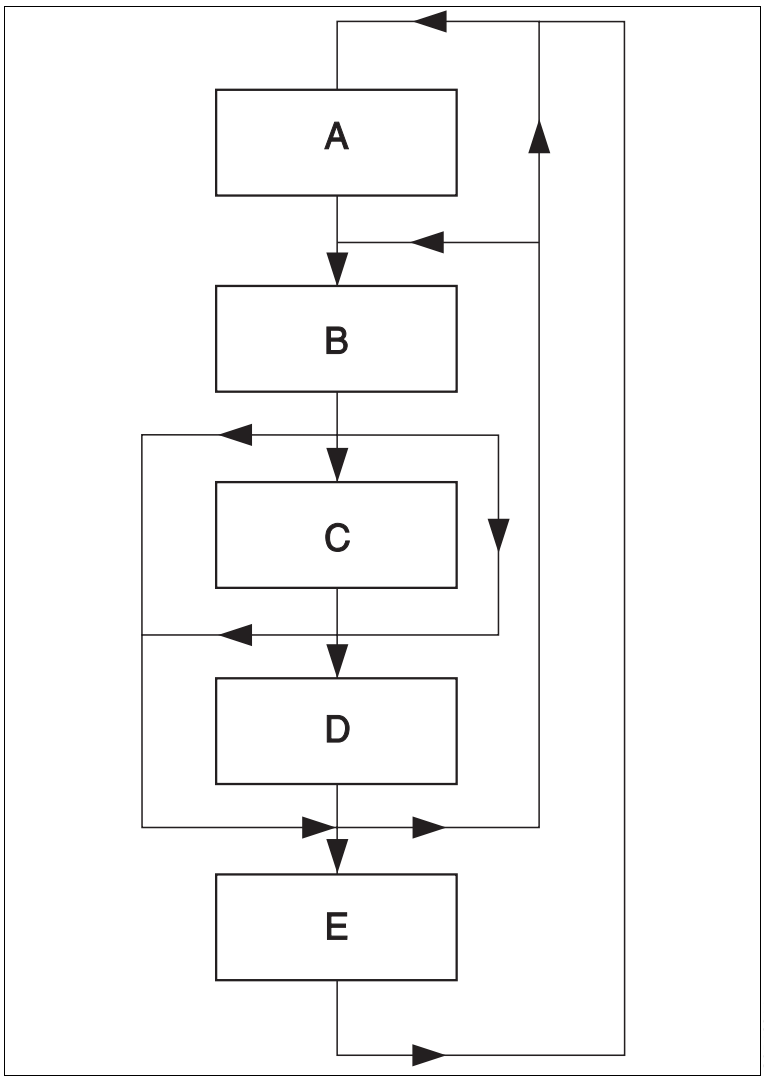
Discharge signal processing

The control system shall contain a memory function for registration of the number of initiated discharges.

At indication of the absence of a discharge the operator or the control system must initiate a new discharge.

At indication of the absence of two consecutive sludge discharges an alarm must be given and action must be taken.

Function graph and running limitations



A Stand still
B Starting mode
C Running mode
D Stop mode
E Safety stop mode

4.5 Water quality

Alfa Laval ref. 553406, rev. 5

Quality requirements for operating water

Operating water is used in the separator for several different functions: e.g. to operate the discharge mechanism, to lubricate and cool mechanical seals, etc. Poor quality of the operating water may with time cause erosion, corrosion and/or operating problem in the separator and must therefore be treated to meet certain demands.

The following requirements are of fundamental importance

1 Turbidity-free water, solids content <0,001% by volume. Deposits must not be allowed to form in certain areas in the separator.

2 Max particle size 50 µm.

3 Total hardness less than 180 mg $CaCO_3$ per litre, which corresponds to 10 °dH or 12,5 °E.Hard water may with time form deposits in the operating mechanism. The precipitation rate is accelerated with increased operating temperature and low discharge frequency. These effects become more severe the harder the water is.

4 Chloride content max 100 ppm NaCl (equivalent to 60 mg Cl/l).
Chloride ions contribute to corrosion on the separator surfaces in contact with the operating water, including the spindle. Corrosion is a process that is accelerated by increased separating temperature, low pH, and high chloride ion concentration. A chloride concentration above 60 mg/l is not recommended.

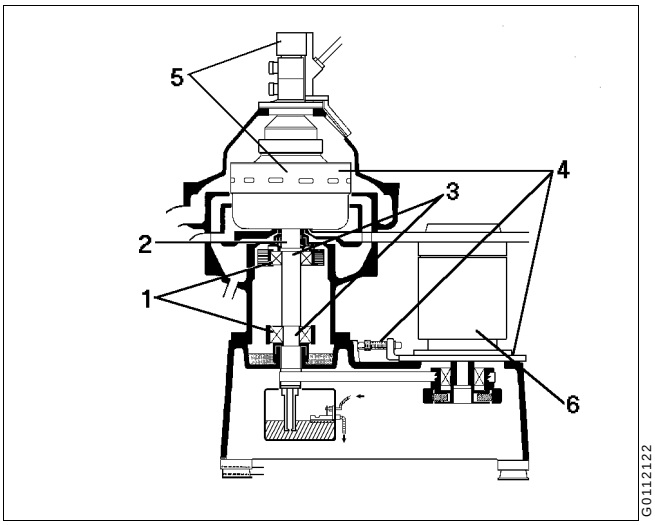
5 pH>6
Increased acidity (lower pH) increases the risk for corrosion; this is accelerated by increased temperature and high chloride ion content.

NOTE

Alfa Laval accepts no liability for consequences arising from unsatisfactorily purified operating water supplied by the customer

4.6 Lubricants

Alfa Laval ref. 553216-01 rev. 6



4.6.1 Lubrication chart.

	Lubricating points	Lubricants
1	Bowl spindle ball bearings and buffers are lubricated by oil mist.	Lubricating oil as specified in *4.6.5 Recommended oil brands, page 109*.
2	Bowl spindle taper.	Lubricating oil, only a few drops for rust protection.
3	Metal buffers of bowl spindle.	Lubricating oil.
4	Bowl: Sliding contact surfaces and pressure-loaded surfaces such as lock rings, threads of lock rings, bowl hood and cap nut.	Pastes as specified in *4.6.3 Recommended lubricants, page 106*.
5	Rubber seal rings.	Grease as specified in *4.6.3 Recommended lubricants, page 106*.
6	Friction coupling ball bearings.	The bearings are packed with grease and sealed, they need no extra lubrication.
7	Electric motor.	Follow the manufacturer's instructions.

NOTE

The Lubrication chart, general can be complemented with more detailed charts, showing the lubrication points in detail and what type of lubricant to use. Instructions related to a specific design of the machine, refer to the general assembly drawings. Some application processes demand special lubrication.
If not specified otherwise, follow the supplier's recommendation about method of application.

4.6.2 Alfa Laval lubricating oil groups

Alfa Laval ref. 553216-01 rev. 6

- **Group A oil:** a high quality gear oil on paraffin base with stable AW (anti wear) additives.
- **Group B oil:** a high quality gear oil on paraffin base with stable EP (extreme pressure) additives.
- **Group D oil:** a synthetic base oil with additives stable at high operating temperatures.
- **Group E oil:** Characteristics as a group D-oil but suitable at a higher operation power (≤55 kW)

Do not mix different oil brands or oils from different oil groups.

Always use clean vessels when handling lubricating oil.

Great attention must be paid not to contaminate the lubricating oil. Of particular importance is to avoid mixing of different types of oil. Even a few drops of motor oil mixed into a synthetic oil may result in severe foaming.

Any presence of black deposits in a mineral type oil is an indication that the oil base has deteriorated seriously or that some of the oil additives have precipitated. Always investigate why black deposits occurs.

If it is necessary to change from one group of oil brand to another it is recommended to do this in connection with an overhaul of the separator. Clean the gear housing and the spindle parts thoroughly and remove all deposits before filling the new oil.

Always clean and dry parts (also tools) before lubricants are applied.

Check the oil level before start. Top up when necessary.
Oil volume = see “Technical Data”.

It is of utmost importance to use the lubricants recommended in our documentation.

This does not exclude, however, the use of other brands, provided they have equivalently high quality properties as the brands recommended. The use of oilbrands and other lubricants than recommended, is done on the exclusive responsibility of the user or oil supplier.

Applying, handling and storing of lubricants

Always be sure to follow lubricants manufacturer's instructions.

4.6.3 Recommended lubricants

Alfa Laval ref. 553217-01 rev. 7

Pastes for non-food applications:

NOTE

The data in below tables is based on supplier information in regards to lubrication properties. Trade names and designations might vary from country to country, contact your local supplier for more information.

Brands with Alfa Laval article numbers are approved and recommended for use.

Manufacturer	Designation	Alfa Laval No.
Fuchs Lubritech	Gleitmo 805 K Gleitmo 705 K	
Dow Corning	Molykote 1000 (Paste) Molykote 1000 (Paste) Molykote G-rapid plus (Paste)	537086-02 (1000 g) 535586-01 (100 g) 535586-02 (50 g)
Rocol	Antiscuffing (ASP) (Paste)	
Kluber	Wolfracoat C (Paste)	

Bonded coatings

Manufacturer	Designation	Alfa Laval No.
Fuchs Lubritech	Gleitmo 900 (Varnish or spray)	
Dow Corning	Molykote D321R (Spray) Molykote D321R (Varnish)	535586-01 (300 ml) 535586-02 (60 ml)

Silicone grease for rubber rings

Manufacturer	Designation	Alfa Laval No.
Dow Corning	Molykote 111 (Compound) Molykote 111 (Compound)	539474-02 (100 g) 539474-03 (25 g)
Fuchs Lubritech	Gleitmo 750	
Kluber	Unisilkon L 250 L	
Wacker	Silicone P (Paste)	

Greases for ball and roller bearings:

NOTE

Always follow the specific recommendation for lubrication as advised by the manufacturer.

Manufacturer	Designation
BP	Energrease MM-EP2 Energrease LS2
Castrol	APS 2 Grease EPL 2
Chevron	Duralith grease EP2
Elf	Epexa 2
Esso/Exxon	Beacon EP2 Unirex N2
Mobil	Mobilith SHC 460 Mobilux EP2
Gulf	Gulflex MP2
Q8/Kuwait Petroleum	Rembrandt EP2
Shell	Albida Grease EP2 Alvania EP Grease 2
SKF	LGEP2 or LGMT2
Texaco	Multifak AFB 2

4.6.4 Recommended lubricating oils

Alfa Laval ref. 553219-09 rev. 0

Two different groups of lubricating oils are approved. They are designated as Alfa Laval lubricating oil groups A and D which are described in *4.6.2 Alfa Laval lubricating oil groups, page 104*.

The numerical value after the letter in the table states the viscosity grade..

Ambient temperature	Alfa Laval lubricating oil group	Time in operation Oil change interval
between +15 and +45 °C	A/150	1500 h
between +2 and +65 °C	D/220	2000 h

The corresponding commercial oil brands are listed on next page.

NOTE

- When the separator is operated for short periods, lubricating oil must be changed every 12 months even if the total number of operating hours is less than stated in the recommendations above.
- Check and prelubricate spindle bearings on separators which have been out of service for 6 months or longer.
- In seasonal operation: change oil before every operating period.

Alfa Laval do not accept responsibility for any damage caused by the use of lubricants which deviate from the recommended lubricants listed in this manual.

4.6.5 Recommended oil brands

Alfa Laval lubricating oil group A/150

Alfa Laval ref. 553218-04 rev. 2

NOTE

The data in below tables is based on supplier information in regards to lubrication properties. Trade names and designations might vary from country to country, contact your local supplier for more information.
Brands with Alfa Laval article number are approved and recommended for use.

Alfa Laval lubrication oil group A	
Viscosity grade VG (ISO 3448/3104) Viscosity index VI (ISO 2909)	150 >95
Manufacturer	**Designation**
Alfa Laval	546098-80(20 litres) 546098-81(4 litres) 546098-82(208 litres) 546098-83(1 litre)
BP	Bartran 150
Castrol	Alpha ZN 150
Esso/Exxon	Nuto 10 Teresso 150 Terrestic 150
Mobil	DTE oil Extra Heavy
Q8/Kuwait Petroleum	Haydn 150
Shell	Morlina 150 Tellus 150
Texaco/Caltex	Regal Oil 150 Paper Machine Oil Premium 150

Alfa Laval lubricating oil group D/220

Alfa Laval ref. 553218-08 rev. 2

NOTE

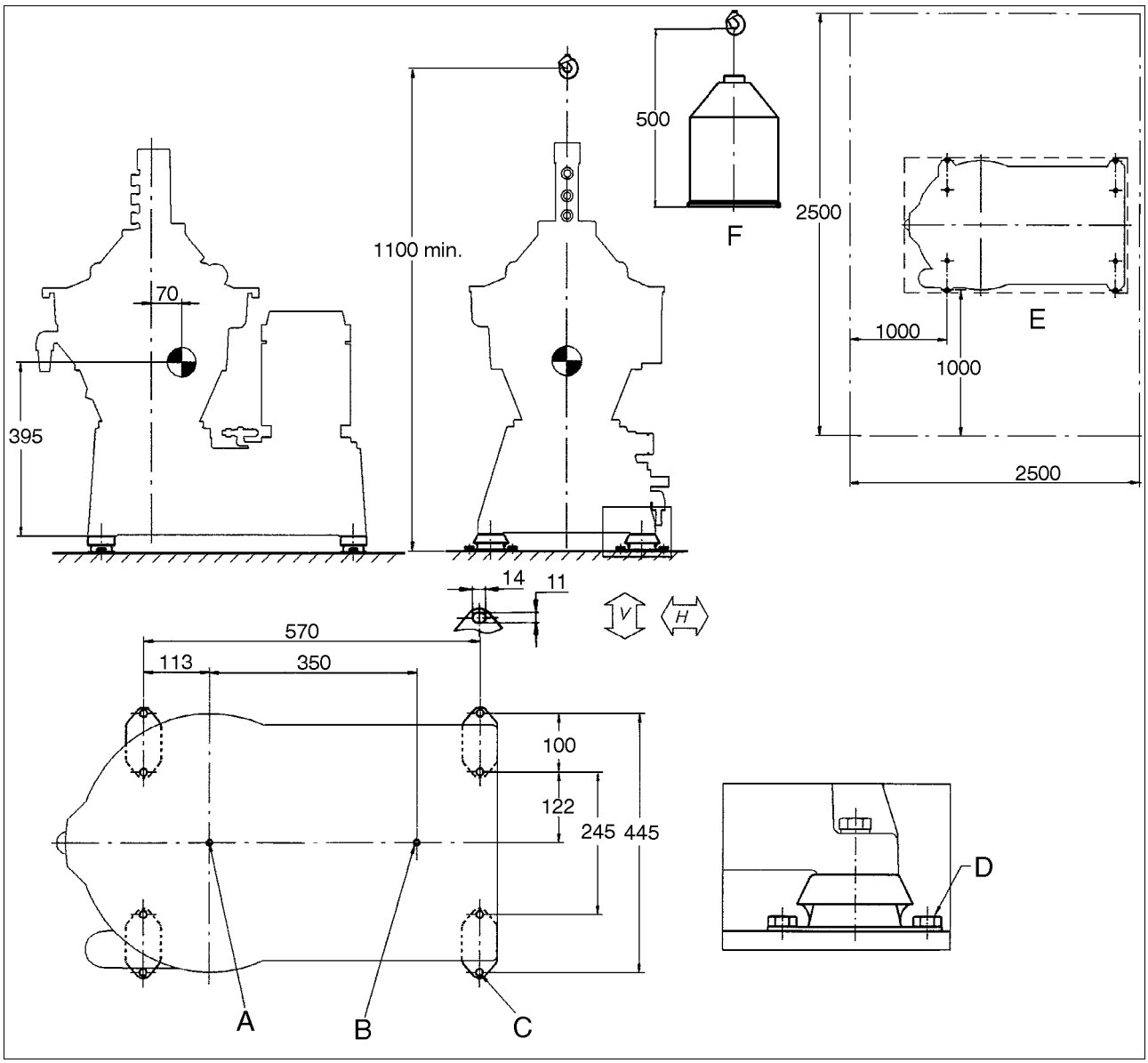
The data in below tables is based on supplier information in regards to lubrication properties. Trade names and designations might vary from country to country, contact your local supplier for more information.
Brands with Alfa Laval article number are approved and recommended for use.

Alfa Laval lubrication oil group D	
Viscosity grade VG (ISO 3448/3104) Viscosity index VI (ISO 2909)	220 >135
Manufacturer	**Designation**
Alfa Laval	542690-80(20 litres) 542690-81(4 litres) 542690-82(208 litres) 542690-83(1 litre)
BP	Enersyn HTX 220
Castrol	Alphasyn EP 220
Chevron	Tegra 220
ELF	Epona SA 220
Esso/Exxon	Terrestic SHP 220 Teresso SHP 220
Mobil	SHC 630
Q8/Kuwait Petroleum	Schumann 220
Shell	Paolina 220

4.7 Drawings

4.7.1 Foundation plan

Alfa Laval ref. 548711, rev. 2



A Center of separator bowl
B Center of motor
C 8 holes for foundation bolt
D Foundation bolt
E Service side
F Max. height of largest component incl. lifting tool

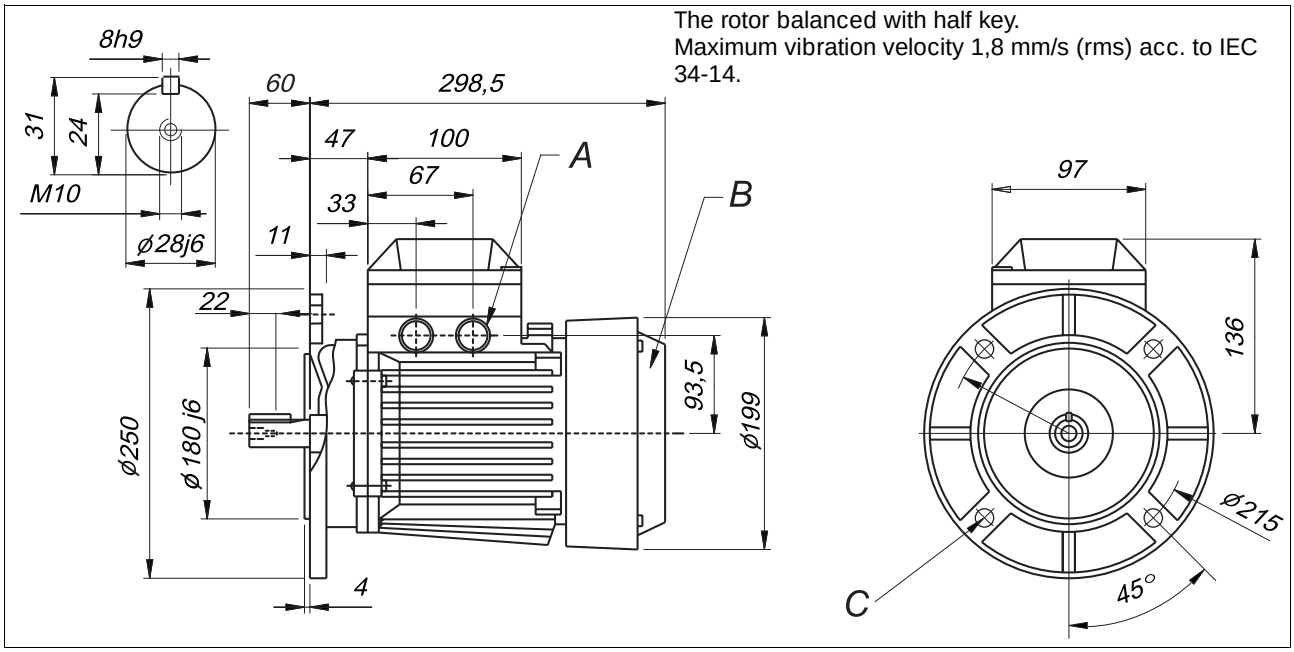
V Vertical force not exceeding 5 kN/foot

H Horizontal force not exceeding 7 kN/foot

Service area

4.7.2 Electric motor

Alfa Laval ref. 551821, rev. 5



A Knock out openings for cable glands on both sides 2 x ø23
B Sheet-steel fan hood
C 4 holes ø15

NOTE

The motor bearings are permanent lubricated.

Manufacturer	ABB Motors
Manufacturers drawing	CAT. BA/Marine motors GB 98-05
Standards	IEC 34-series, 72, 79 and 85
Size	100L
Type	M2AA 100L
Weight	21 kg
Poles	2
Insulation class	F
Bearings	D-end 6306-2Z/C3, N-end 6205-2Z/C3
Method of cooling	IC 411 (IEC 34-6)
Specification	Totaly enclosed three-phase motor for marine service[3)]

Type of mounting IEC 34-7		Degree of protection IEC 34-5
	IM 1001	IP 55
	IM 3001	
	IM 3011	
	IM3031	

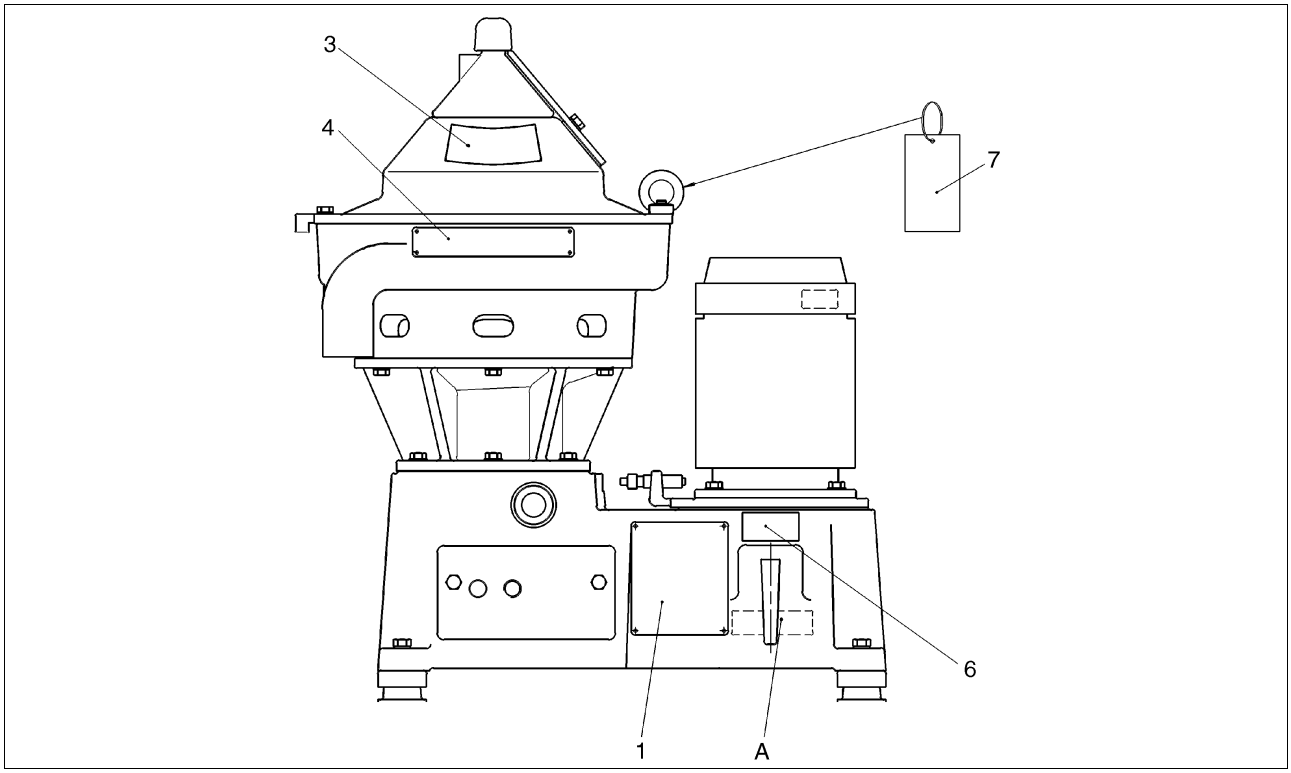
Article No.	Output kW	Speed RPM	Freq. Hz	Voltage V	Current A	Power factor Cos. j	I_{st} / I (1	Termist. °C (2	Note
551821-01	3	2890	50	220D 380Y	10,9 6,3	0,90	7,5		
551821-01	3,7	3480	60	255D 440Y	11,2 6,5	0,91	6,9		
551821-01	3,7	3480	60	220D	10,5	0,91	6,4		
551821-01	3	3470	60	220D	10,5	0,91	6,4		
551821-01	3	3470	60	255D 440Y	11,2 6,5	0,91	6,4		
551821-02	3	2890	50	415Y	5,8	0,90	7,5		
551821-03	3	2890	50	440 Y	5,4	0,90	7,5		
551821-04	3	2890	50	200Y	12	0,90	7,5		
551821-05	3,7	3480	60	220 Y	13,0	0,91	6,9		Y-par.
551821-05	3,7	3480	60	440 Y	6,5	0,91	6,9		Y-ser.
551821-06	3,7	3480	60	230Y	12,4	0,91	6,9		Y-par.
551821-06	3,7	3480	60	460Y	6,2	0,91	6,9		Y-ser.
551821-07	3,7	3480	60	575Y	5,0	0,91	6,9		CSA-plated
551821-08	3	2890	50	400Y	6,0	0,90	7,5		
551821-09	3	2890	50	230D	10,4	0,90	7,5		
551821-10	3	2890	50	500Y	4,8	0,90	7,5		
551821-11	3	2890	50	660Y	3,6	0,90	7,5		
551821-12	3	2890	50	690Y	3,5	0,90	7,5		
551821-13	3,7	3480	60	440Y	6,5	0,91	6,9		
551821-14	3,7	3480	60	460Y	6,2	0,91	6,9		
551821-15	3,7	3480	60	480Y	6,0	0,91	6,9		
551821-16	3,7	3480	60	690Y	4,1	0,91	6,9		
551821-17	3,7	3480	60	380Y	7,5	0,91	6,9		
551821-18	3,7	3480	60	220D	13,0	0,91	6,9		
551821-19	3,7	3480	60	230D	12,4	0,91	6,9		
551821-20	3,7	3480	60	200D	14,3	0,91	6,9		

1)	Ist /I=starting current /rated current at direction line starting.	
2)	Thermistors tripping temperature if applicable.	
3)	The motors can be designed to fulfil requirements of following Classification Societies (Essential Service, if required).	
	Lloyds Register of Shipping (LRS)	Nippon Kaiyi Kyokai (NK)
	Det Norske Veritas (DnV)	Korean Register of Shipping (KR)
	Germanischer Lloyd (GL)	Polski Rejester Statkow (PRS)
	Bureau Veritas (BV)	China Classification Societies (CCS)
	American Bureau of Shipping (ABS)	Indian Register of Shipping (IRS)
	Registro Italiano Navale (RINA)	Maritime Register of shipping (RMS)

Required classification society must always be specified when ordering. Factory test certificate to be enclosed at the delivery.
Rated output (kW) valid for temp-rise max. 90 °C.
The motors can be provided with space heaters for 110 V or 220 V, 25 W as option.
State supply voltage when ordering.
Connection to separate terminal board in the main terminal box acc. to attached connection diagram.

4.7.3 Machine plates and safety labels

Alfa Laval ref. 556430, rev. 3



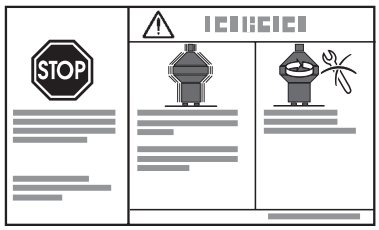
Location of machine plates and safety lables

S0061411

1. Machine plate

Separator	P150
Manufacturing serial No / Year	XXXX
Product No	881100-03-01
Inlet and outlet	561313-01
Bowl	561137-01
Machine bottom part	565390-01
Max. speed (bowl)	9510 r/min (50 Hz), 9305 r/min (60 Hz)
Direction of rotation (bowl)	←
Speed motor shaft	3000 r/min (50 Hz), 3600 r/min (60 Hz)
El. current frequency	50/60 Hz
Recommended motor power	2,2 kW (50 Hz), 2,2 kW (60 Hz)
Max. density of feed	1100 kg/m^3
Max. density of sediment	2332 kg/m^3
Process temperature min./max.	0/+100 °C

3. Safety label



S0061521

Text on label:

DANGER

Read the instruction manuals **before** installation, operation and maintenance. Consider inspection intervals.

Failure to strictly follow instructions can lead to fatal injury.

If excessive vibration occurs, **stop** separator and **keep bowl filled** with liquid during rundown.

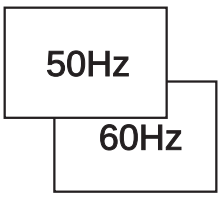
Out of balance vibration will become worse if bowl is not full.

Separator must **stop rotating** before **any** dismantling work is started.

4. Name plate

S0063211

6. Power supply frequency



S0063111

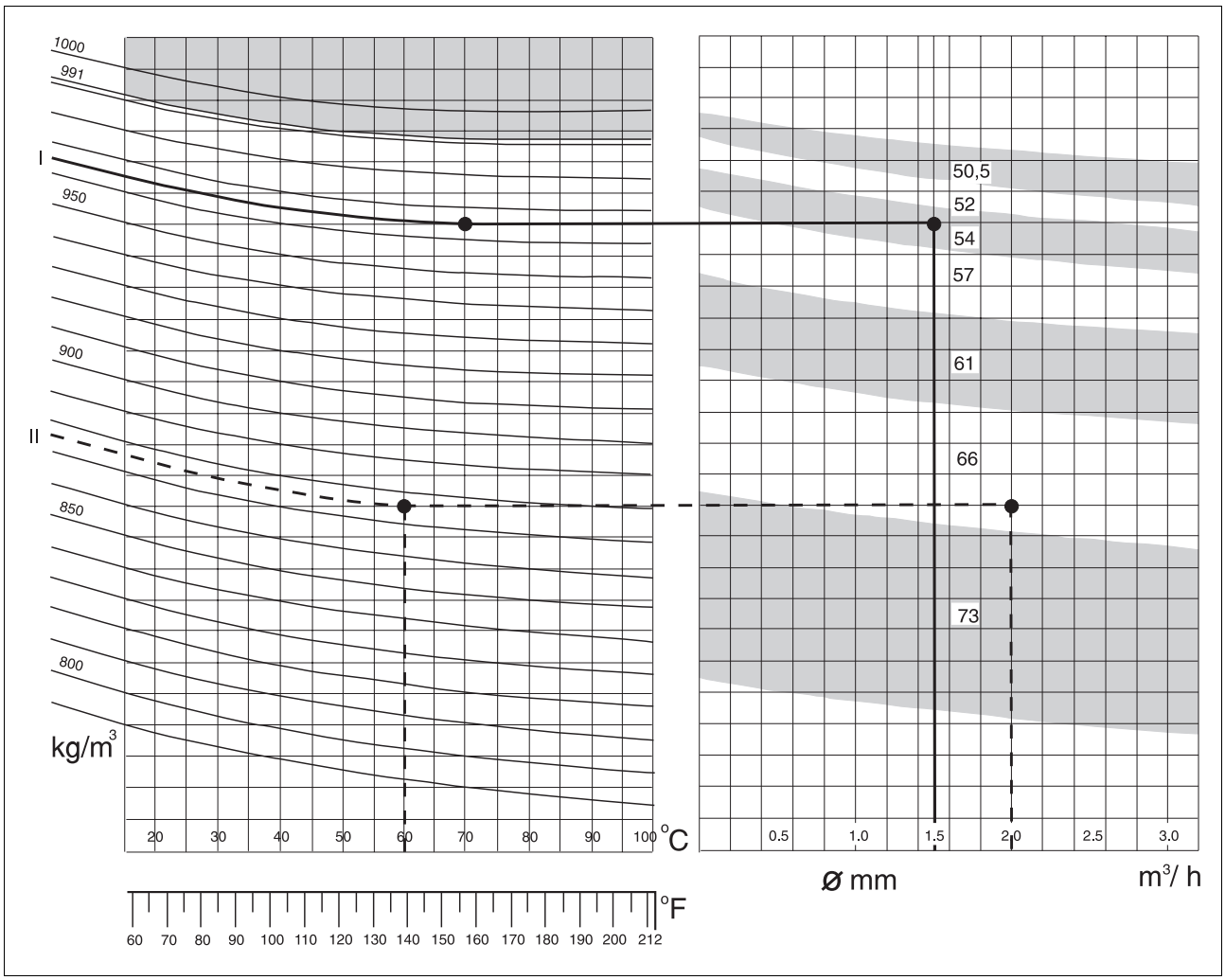
7. Label

Text on label:

Read the instruction manual before lifting.

A. Space for label indicating representative

4.7.4 Gravity disc nomogram



Oil density, kg/m³ at 15 °C

Oil temperature, °C, °F

Gravity disc hole diameter, ϕ mm

Throughput, m³/h

The nomogram is based on the properties of fresh water.

Example I in nomogram

Reference in graph: _____

Oil density	965 kg/m^3 at 15 °C (60 °F)
Separation temperature	70 °C (158 °F)
Throughput	1,5 m^3/h

From the graphs (heavy line), the correct gravity disc has a hole diameter of 54 mm.

Example II in nomogram

Reference in graph: _ _ _ _ _ _ _

Oil density	875 kg/m^3 at 15 °C (60 °F)
Separation temperature	60 °C (140 °F)
Throughput	2 m^3/h

From the graphs (broken line), the correct gravity disc has a hole diameter of 66 mm.

4.8 Storage and installation

4.8.1 Storage and transport of goods

Storage

Specification

Upon arrival to the store, **check all components and keep them:**

1 Well stored and protected from mechanical damage and theft.

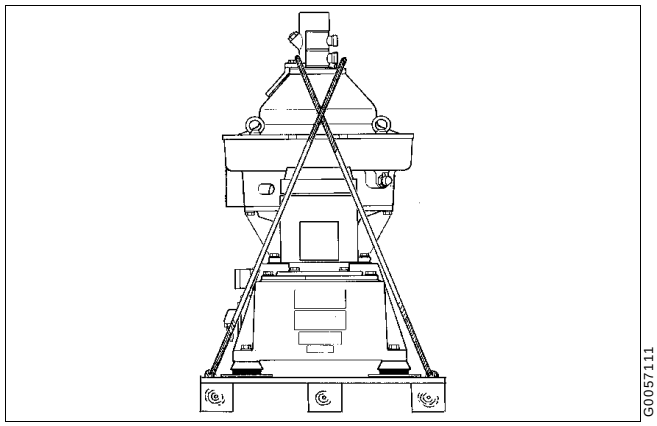
2 Dry an protected from rain and humidity

3 Organized in the store in such a way that the goods will be easily accessible when installation is about to take place.

A separator can be delivered with different types of protection:

- Fixed on a pallet.

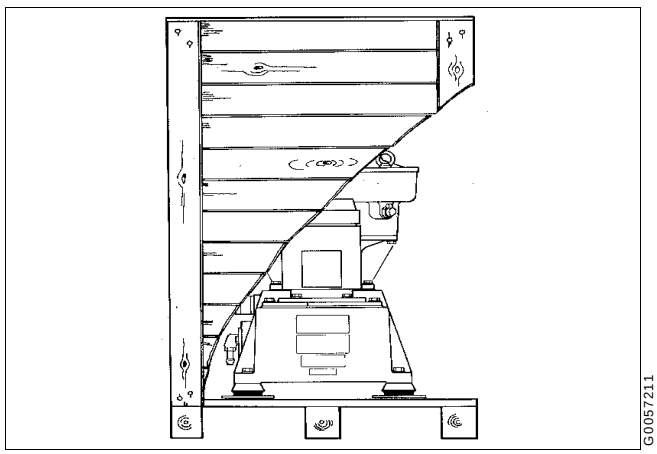
  The separator must be stored in a dry storage room, protected from rain and humidity. It must be well protected from mechanical damage and theft.



Fixed on a pallet

- In a wooden box which is not water tight.

  The separator must be stored in a dry storage room, protected from rain and humidity.

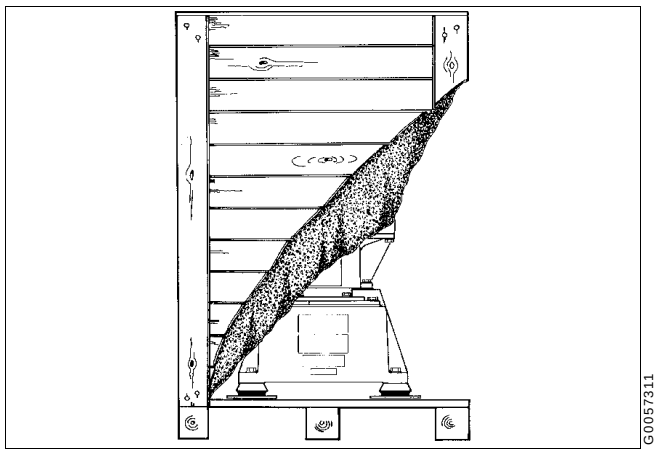


In a wooden box which is not water tight

- In a special water-resistant box for outdoor storage.

  The separator and its parts have been treated with an anti-corrosion agent. Once the box has been opened, store dry and protected from rain and humidity.

  The packaging for outdoor storage is only to special order.



In a special water-resistant box for outdoor storage

Transport

Specification

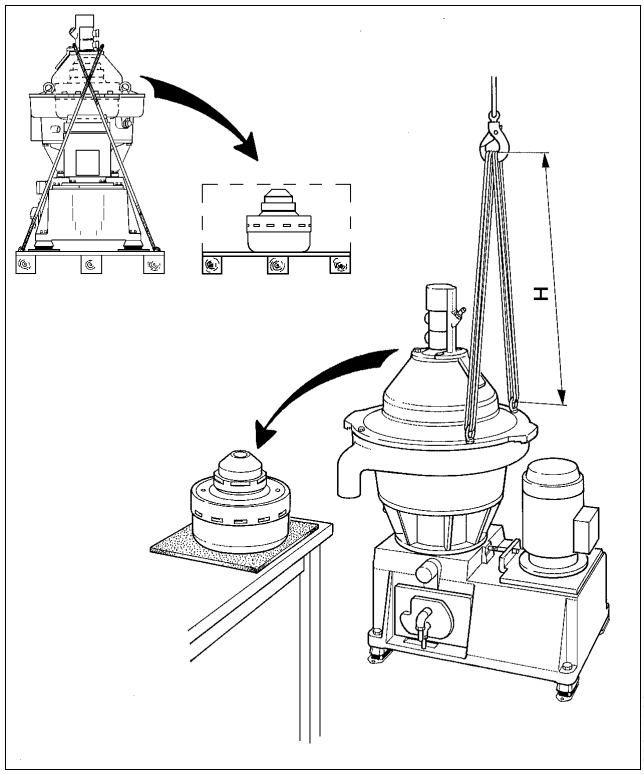
- During transport of the separator, the bowl must always be removed from the machine and transported separately.
- When lifting a separator it must always be hung securely. See details in chapter *2.6 Lifting instructions, page 31*.

WARNING

Crush hazard

Use correct lifting tools and follow lifting instructions.

- All inlets and outlets to separators and accessories must be covered to be protected from dust and dirt.

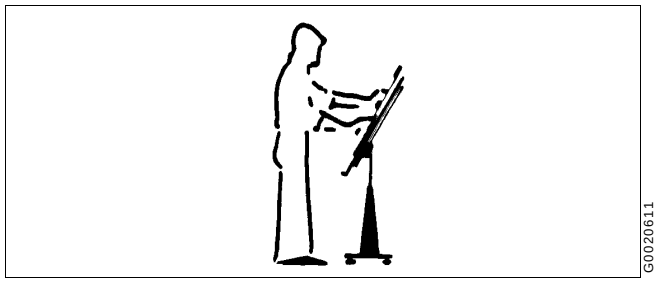


H = minimum 750 mm

4.8.2 Planning of installation

Introduction

The space required for one or more separators can be calculated by consulting *4.3 Basic size drawing, page 96*, and instructions for ancillary equipment, electrical and electronic equipment and cables.

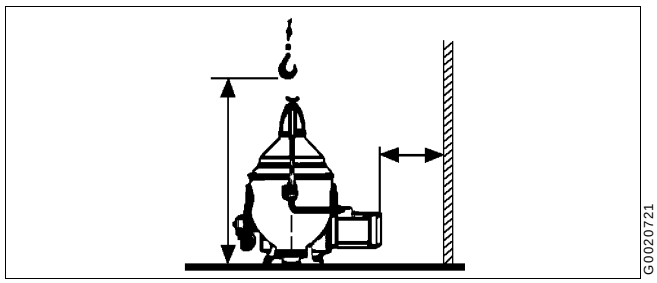


Check the drawings when planning the installation

Important measurements

Important measurements are the minimum lifting height for lifting tackle, shortest distance between driving motor and wall, free passage for dismantling and assembly, maintenance and operation.

Plan your installation with sufficient room for the controls and operation so that instruments are easily visible. Valves and controls must be within convenient reach. Pay attention to space requirements for maintenance work, work benches, dismantled machine parts or for a service trolley.



Suitable space must be obtained for the maintenance work

Space for separator

The separator shall be placed in such a way that suitable space for maintenance and repair is obtained.

Specification

See the *4.7.1 Foundation plan, page 111* for the service space required with the separator installed.

Recommendation

The spanner for the bowl hood should have sufficient space to make a complete turn without touching any of the ancillary equipment surrounding the separator.

Lifting height for transport of bowl

Specification

A minimum height is required to lift the bowl, bowl parts and the bowl spindle, see the drawing *4.7.1 Foundation plan, page 111*.

Recommendation

When two or more separators are installed, the lifting height may have to be increased to enable parts from one separator to be lifted and moved over an adjoining assembled separator.

Space for oil changing

Specification

The oil filling device must not be blocked by floor plate arrangement, etc.

Recommendation

It should be possible to place a portable collecting tray under the oil filling device drain hole.

4.8.3 Foundations

NOTE

When lifting a separator it must always be hung securely. see separate lifting instructions in this book.

- See *4.7.1 Foundation plan, page 111*.
- The separator must be installed on a strong and rigid foundation to reduce the influence of vibrations from adjacent machinery.
- The foundation should be provided with a cofferdam.
- Fit the separator frame on the foundation as follows:
  - Check that the bolts do not press against the edges of the holes, otherwise the elasticity of the mounting of the separator frame will be impeded.
  - Fit height adjusting washers required.
  - Check that the separator frame is horizontal and that all feet rest on the foundation.
  - Tighten the screws.

5 Change of Circuit Board

If a circuit board has to be changed, proceed as follows:

Note down the run time (days only) as shown in the function list of the EPC 50.

Change the board according to the instructions below.

Go to parameter Fa 90, and insert the run time.

OP-Board

- Switch power off.
- Remove the snap-in transparent cover.
- Disconnect the two cable plugs (do not remove the cables from the plugs).
- Disconnect the flatcable connector at the top.
- Unscrew the five hexagon nuts.
- Mount the new board, and connect in reverse order.

I/O-Board

- Switch power off.

If there is no optional board installed:

- Disconnect all the cable plugs on the large board (do not remove the cables from the plugs).
- Unscrew the hexagon nuts. Take care to note where the special nuts for optional board(s) are located.
- Mount the new board, and connect in reverse order.

If one or more optional board is installed:

- Switch power off.
- Disconnect the cable plug(s) on the optional board (do not remove the cables from the plug(s)).
- Disconnect the flatcable connector at the top.
- Unscrew the three hexagon nuts.
- Note the position of the board and remove the board.
- Disconnect all the cable plugs on the large board (do not remove the cables from the plugs).
- Unscrew the hexagon nuts. Take care to note where the special nuts for optional board(s) are located.
- Mount the new board in the same position as the old, and connect in reverse order.

MT-Board

- Switch power off.
- Disconnect the cable plug (do not remove the cables from the plug).
- Disconnect the centrally connected cable.
- Unscrew the four screws holding the board and lift out the board.
- Mount the new board, and connect in reverse order.
- Check that the central hexagon nut is properly tightened.

5.1 Circuit Board Temperatures

Circuit board temperature information can be read as follows:

- Set Pr 7 = 2.
- Push '+' and '–' at the same time ('Standst.' now shows on the display).
- Push '–'

The actual temperature, max. temperature, and the number of times the temperature has been above 70 °C for the transducer scrolls across the display.

- For further circuit board temperatures, push the '–' button.
- To leave the list push the '+' and the '–' buttons at the same time.
- Reset Pr 7 = 0.

6 Cleaning in Place

The use of Cleaning In Place (CIP) equipment is recommended for best separation results. For further information concerning the CIP equipment, see the CIP booklet, bookno. 1817261.

6.1 Cleaning in Place, Heatpac® CBM Heater

For systems including a Heatpac® CBM heater, cleaning in place of the heater should be carried out circa every 6 months, or according to experience. Cleaning in place of the heater should also be carried out in the event of a pressure drop increase greater than approximately 0.5 bar (which indicates that the heater is beginning to clog). If the heating medium is steam or hot water, the heating circuit must also be cleaned.

Recommended cleaning agents:

For fuel oil heater:

Alfa Laval fuel oil liquid.

For lube oil heater:

Alfa Laval lube oil liquid.

The Alfa Laval cleaning liquids are specially suitable for the materials used in the Heatpac® CBM heater. Liquids that are corrosive to copper or stainless steel, for example hydrochloric acid and nitric acid, must not be used.

Burn hazard

Shut off the oil flow and the heating medium flow before starting maintenance work.

WARNING

Corrosion hazard

Pay strict attention to the safety instructions for the cleaning liquid used.

NOTE

Use only specified cleaning liquids. Other cleaning agents may corrode the metal surfaces.

Proceed as follows:

1 Close the valves before and after the heater.

2 Open the heater drain valve until oil remaining in the heater has drained.

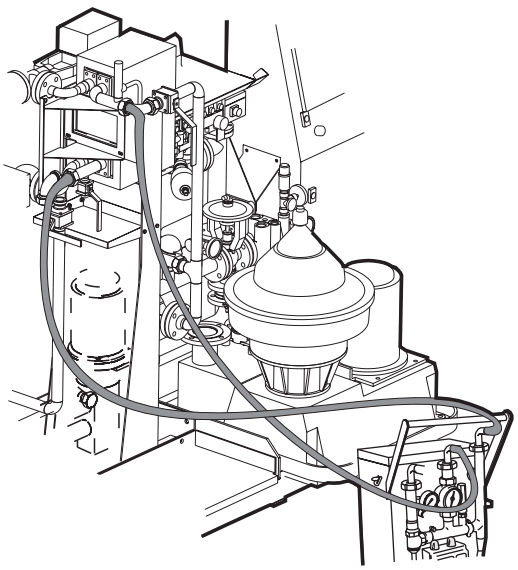
3 Close the drain valve.

4 Loosen the turnable connections before and after the heater. Turn the connections 90 ° so that the CIP equipment can be connected.

5 Connect the CIP equipment.

6 Clean with CIP fluid (50 – 70 °C).

7 Flush with water.



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After cleaning:

1 Open the heater drain valve until the flushing water has drained.

2 Close the drain valve.

3 Remove the CIP connections.

4 Return the turnable connections to their former positions and re-tighten.

5 Re-open the valves before and after the heater.

7 Heatpac® CBM Heater (Optional)

7.1 Technical Data

Operating pressure, maximum	1.6 MPa (16 bar)
Test pressure	2.4 MPa (24 bar)
Operating temperature, maximum	225 °C
Medium	Mineral oil
Heating media	Steam, hot water, thermal oil
The following shall apply to the heating media:	
Steam:condensate pH	8.8 - 9.2
sodium in condensate	< 0.01 mg/l
Water:pH value	Shall be neutral to minimize corrosion risk
Thermal oil	The thermal oil must be highly resistant to oxidation and thermal desintegration. It must also have good corrosion protection properties.

7.1.1 Manual Cleaning

Manual cleaning is carried out as follows:

1 Disconnect the heater.

2 Drain the heater.

3 Flush the heater through with fresh water.

4 Drain the heater from water.

5 Fill the heater with hot cleaning liquid (50-70 °C). Use the type and concentration required for the deposits present.

6 Let the liquid stay in the heater for at least 60 minutes. If possible, let the cleaning liquid circulate in the heater.

7 Drain the cleaning liquid.

8 Flush through with clean water.

9 Reconnect the heater using new gaskets.

NOTE

Take care to reinstall the heater the right way up.

8 Heatpac® EHM Electric Heater (Optional)

8.1 Technical Data

Media	Mineral oil
Max. testing pressure	2.4 MPa (24 bar)
Operating pressure and media temp	According to PN 16:
	Max. 1.6 MPa (16 bar) up to 150 °C
	Max. 1.5 MPa (15 bar) up to 160 °C
Material:	
Heating element	Aluminium
Pressure vessel	Pressure vessel steel
Cover	Aluminium
Insulation	20 mm mineral wool
Mounting style	Vertically or horizontally
Voltage supply	230, 400, 440, 480, 690 V AC, 50/60 Hz
Connections	Acc. to DIN standard 2633 or JIS standard B2213
Terminal box	IP 65
Elements; resistance, surface load, output	400 V: 63 Ω, 1.3 W/cm^2, 2.5 kW
	440 V: 70 Ω, 1.4 W/cm^2, 2.8 kW
	460 V: 83 Ω, 1.3 W/cm^2, 2.5 kW
	480 V: 83 Ω, 1.4 W/cm^2, 2.8 kW
	500 V: 83 Ω, 1.5 W/cm^2, 3.0 kW
	690 V see 400 V (= Y-connected 400 V elements)

Tightening Torques

Flange bolts	M16	240 Nm
Ground screw	M8	21 Nm
Connections on elements	M4	3 Nm
Element nut h = 9	M14	70 Nm
Element nut h = 5	M14	30-50 Nm
Relief valve	G1/2	80 Nm
Spring pocket for Pt 100 and safety guard	G1/2	30 Nm
Temperature sensors		80 Nm

8.2 Dismantling and Cleaning

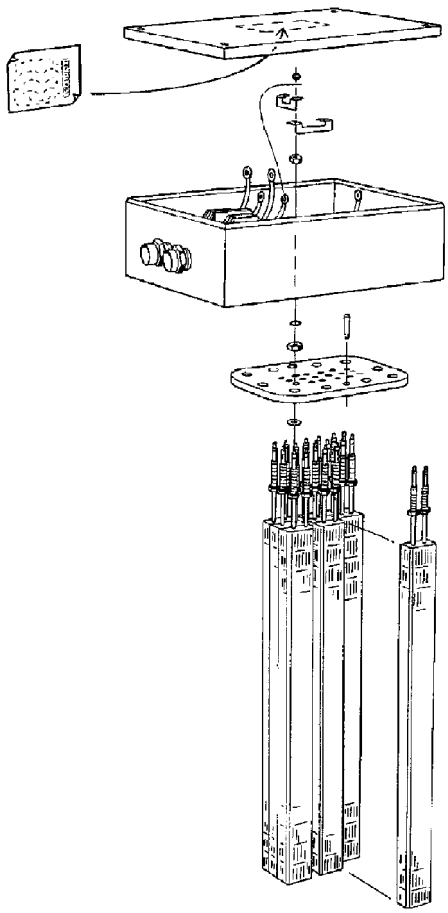
The electric heater requires regular opening for cleaning. The heater block resistance, and the insulation resistance of the heating elements should be checked and an inspection of the general condition carried out.

Any malfunctions of the heater are indicated in the control unit. For further information see the *Alarms and Fault Finding* booklet.

As a general guideline, the heater should be opened up for cleaning whenever an excessive pressure drop occurs, or if capacity falls and oil temperature is low.

Where heavy fuel is used, dismantle the heater when warm as described below:

1. Lift off the junction box cover.
2. Loosen the cable nipples.
3. Mark the signal wires, disconnect them and pull out the cables.
4. Remove the flange bolts.
5. Remove the earth connections between the flanges and the junction box.
6. Lift off the heater insert. If cold heavy fuel has stiffened the heater insert, a couple of screwdrivers may be used to ease off the insert. Avoid using a sling.
7. Clean the insert in a bath using Alfa-Laval cleaning liquid part no. 1762852-01 for lube oil heater; part no. 1763500-02 alternatively diesel oil, white spirit, or equivalent for fuel oil heater. Blow all parts dry with compressed air.
8. Assemble the heater in reverse order.
9. Measure the heater block resistance and the insulation resistance to ground before reconnecting the wires.



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8.2.1 Replacing Heater Element

1 Place the heater insert on a work bench.

2 Use a box spanner to disconnect the wires and the connecting plates. A wiring diagram is placed on the inside of the junction box cover.

3 Disconnect the junction box by removing the nuts on the heater element connecting rods inside the the junction box, using a box spanner. Be careful not to damage the insulation sleeves.

4 Remove the junction box.

5 Remove the O-rings above the tightening nuts of the heater element connecting rods.

6 Remove the nuts using a box spanner.

7 Pull out the heater element.

8 When reassembling:

9 Use a new copper packing.

10 Screw fast the elements in the top counter flange.

11 Before refitting the junction box, change the O-rings.

For tightening torques, see page 130.

It is very important that the appropriate heater element is installed.

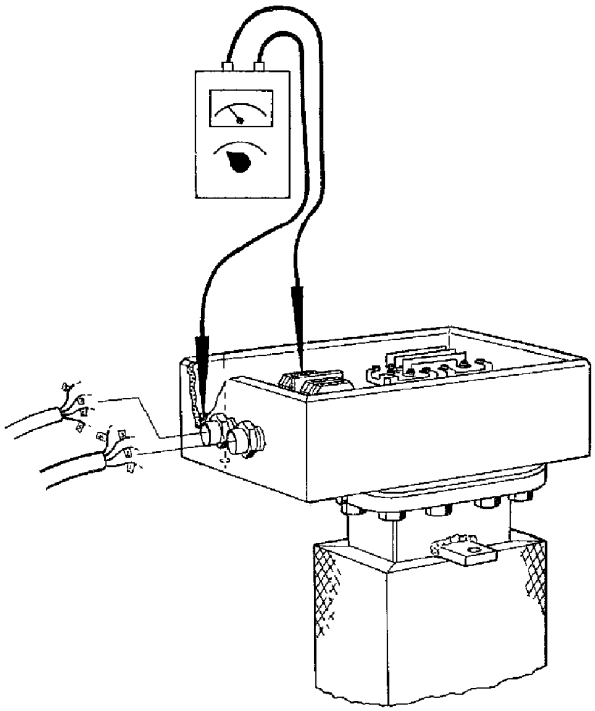
8.2.2 Insulation Resistance Megger Test

The heating elements are electrically insulated by means of compact magnesium oxide. Under certain conditions, e.g. during storage, transport, etc., magnesium oxide can attract damp which lowers the insulation resistance. The insulation resistance between terminal and ground for each heater block must therefore be measured before the heater is taken into use. This is done by means of a megger test.

Megger Test Procedure

- Disconnect the wires from the terminal in the heater junction box before starting measurement.
- Test the insulation resistance for the heater blocks by means of a megger connected between the heater terminals and ground in the heater junction box. The test voltage to use is 500 V DC.

The total insulation resistance for the heater should be ≥1 MΩ.



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Action to Increase Insulation Resistance

If the insulation resistance is between 100 kΩ and 1 MΩ, the heater can be reconditioned in place simply by taking it into use.

Please note that during the first period of operation the insulation resistance can be somewhat reduced before it starts to increase. This is due to the accumulation of moisture in the element top during heating.

In the event the insulation resistance is below 100 kΩ in any group of elements, the elements in the group must be measured separately. The insulation resistance in a single element is measured between the connecting pin on the element, with the closing links disconnected, and the ground.

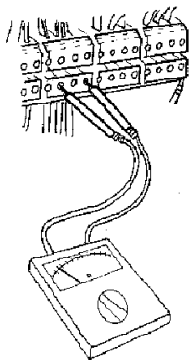
A single element with resistance below 100 kΩ can be reconditioned in place by indirect warming. Do not connect the connecting pins via the closing link to the terminal. Connect the remaining elements in the block to the terminal and allow the heater to be taken into operation.

New Megger Test

If the insulation resistance at start-up was under 1 MΩ, a new megger test should be carried out after 14 days operation. The elements should now have a resistance of over 1 MΩ. If this is not the case, any element still below 1 MΩ should be replaced.

8.2.3 Measuring of Heater Block Resistance

The heater block resistances are measured from the power unit. This ensures that the heater elements and the heater blocks are correctly connected.



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Resistances of available heater sizes and applicable voltage supply are given in the following table:

Heater Block Resistance (Ω)					
Size	Voltage (V)	Part load 1	Part load 2	Part load 3	Part load 4
7 kW	400	42	----	----	----
8 kW	440	47	----	----	----
8 kW	480	55	----	----	----
7 kW	690 V	126	----	----	----
14 kW	400	21	----	----	----
16 kW	440	23	----	----	----
16 kW	480	28	----	----	----
14	690	63	----	----	----
22 kW	400	21	42	21	----
24 kW	440	23	47	23	----
24kW	480	28	55	28	----
22	690	63	126	63	----
36 kW	400	21	42	21	----
40 kW	440	23	47	23	----
40 kW	480	23	47	23	----
36	690	63	126	63	----
50 kW	400	21	42	21	21
56 kW	440	23	47	23	23
56	480	28	55	28	28
50	690	63	126	63	63
65 kW	400	21	42	21	11
72 kW	440	23	47	23	12
72kW	480	28	55	28	14
65	690	63	126	63	32

Terminals for Block Resistance Measuring				
Power unit	Part load 1	Part load 2	Part load 3	Part load 4
	X11:4-5	X11:7-8	X11:10-11	X11:13-14
	X11:4-6	X11:8-9	X11:10-12	X11:14-15
	X11:5-6	X11:7-9	X11:11-12	X11:13-15
Control unit	X11:4-5	X11:7-8	----	----
	X11:4-6	X11:8-9	----	----
	X11:5-6	X11:7-9	----	----
Contactor box	----	----	K21:2-4	K22:2-4
	----	----	K21:4-6	K22:4-6
	----	----	K21:2-6	K22:2-6

9 Heatpac® Power Unit (Optional)

9.1 Technical Data

Power circuits. Up to 24 kW (smaller cabinet)	
31830-6356-1	
Mains supply (3 phase)	400, 440, 460/480/500, 690, V AC +10% /-15% , 50/60 Hz ±5%
External fuse	Max. 35 A
Overcurrent protection	Thermal relays, 16-23 A/8.5-12.5 A
Triac circuit current	Max. 23 A
Power circuits. 36 kW to 72 kW (larger cabinet)	
31830-6407-1	
Mains supply (3 phase)	400, 440, 460/480/500, 690, V AC +10% /-15% , 50/60 Hz ±5%
External fuse	Max. 100 A
Overcurrent protection	Fuses, 25 A, 16 A, 25 A, 63 A
Triac circuit current	Max. 23 A

Control circuits	
Control voltage	48 V AC +10% /-15% , 50/60 Hz ±5% (from external control unit)
Power consumption (inrush/hold)	31830-6356-1 Max. 120 VA/30 VA 31830-6407-1 Max. 200 VA/55 VA
General	
High voltage tested at 2000 V	
Max. ambient temperature	55 °C
Protection class	IP 65
Material	Steel
Weight	
Smaller cabinet	40 kg
Larger cabinet	54 kg
External inputs and outputs	
Inputs	Mains supply Control signals (48 V AC) Aux. contact on contactor for pump Pt 100 temp. sensor (to internal high temp. switch).
Outputs	Power to heater Safety alarm feedback to control unit

9.2 Working principle

Power for the electric heater is supplied from an external power source via the main switch and the different contactors.

The contactor K11 supplies power to a variable heater load of 0-7/8 kW or 0-14/16 kW, which is controlled from the triac modules A1 and A2. This contactor is activated at all times once the heater is started and as long as the control unit signals no function fault. The remaining contactors (12 and K16-K17, if applicable) supply power to fixed heater load as on/off functions in accordance with the size of the heater. By combining the variable load and the fixed loads, an overall stepless heater is achieved.

9.3 Electric Heater Function

By using the proportional and integral (PI) functions in the EPC or VCU control unit (whichever applicable), it is possible to activate the power unit load functions to feed the electric heater with variable and fixed power.

The power unit is equipped with the necessary contactors, fuses and terminals.

The power unit also holds two triac modules (A1 and A2) for regulating the variable load.

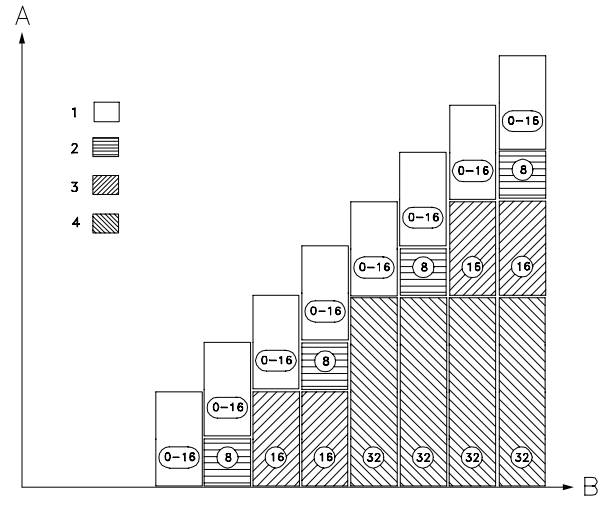
The electric heater requires an extra temperature sensor (on the heater) connected to a temperature switch (in the power unit) to prevent overheating.

9.4 Heating Performance Principle

The oil temperature is regulated from the control unit which gives the appropriate signals to the power unit. The power unit feeds the electric heater with both variable and fixed power.

The fixed power is fed in steps as a constant part load. The variable load operates on top of the fixed part load for fine tuning of temperature.

Sequential switching of the fixed part load and regulation of the variable part load are automatically controlled by the control unit, and results in an overall smooth operation.



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A Load (kW)
B Size (kW)
1. Part load #1 (variable 0 –16 kW)
2. Part load #2 (fixed 8 kW)
3. Part load #3 (fixed 16kW)
4. Part load #4 (fixed 32kW)

Heating Performance Principle for 440 V

9.5 Load Control and Functions

9.5.1 Variable Part Load

Power for the variable part load (#1) is fed via contactor K11 in the power unit and regulated by means of the two triac modules A1 and A2.

Contactor K11 is activated provided that there is a closed circuit through the safety switch (TS) and that there are no function faults in the control unit (see electrical diagram in *System Reference/Installation Instructions*). The triac modules are controlled from the control unit.

The required electric power is then supplied to the heater in accordance with the present load. Contactor K11 is furnished with a variable overload protection relay (F11).

9.5.2 Fixed Part Load

Power to the fixed part loads (#2 – #4) is fed via contactors K12, K16, and K17, and controlled from the control unit as on/off functions in accordance with the present load.

The contactors are switched off by the heater safety switch function (TS, K14) in the case of excessive temperature or low oil flow (pump interlocking).

9.5.3 External Safety Stop

The contactor circuits for switching power on/off to the different part loads are interlocked by means of the external safety stop switches, to prevent the electric heater from overheating.

The contactors K11, K12, K16, and K17 in the power unit are connected in series to the temperature switch TS. Excessive temperature or no oil flow (pump stopped) will deactivate the contactors, thus switching off the heater.

Overload relays F11, F12, F16, and F17 in the power unit are used for overload protection.

9.5.4 Start and Reset Functions

During normal operation, the contactors in the power unit are activated from the Control Unit and interlocked by the pump starter and contactor K14. Contactor K14 is interlocked by the temperature switch.

- If the temperature switch has been released, the heater must be restarted using the Alarm Reset on the Control Unit after the cause has been remedied.