Separator manual

High speed separator

MIB 503S-13/33

Product No. 881176-12-01/4
Book No. 9034764-02 Rev. 6

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The original instructions are in English

Contents

Read and understand instruction manuals and observe the warnings before installation, operation, service and maintenance.

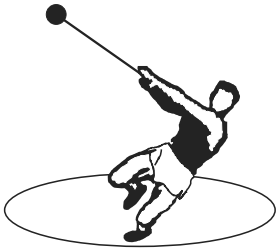
Not following the instructions can result in serious accidents.

In order to make the information clear only foreseeable conditions have been considered. No warnings are given, therefore, for situations arising from the unintended usage of the machine and its tools.

1 Safety Instructions

The centrifuge includes parts that rotate at high speed. This means that:

- Kinetic energy is high
- Great forces are generated
- Stopping time is long



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Manufacturing tolerances are extremely fine. Rotating parts are carefully balanced to reduce undesired vibrations that can cause a breakdown. Material properties have been considered carefully during design to withstand stress and fatigue.

The separator is designed and supplied for a specific separation duty (type of liquid, rotational speed, temperature, density etc.) and must not be used for any other purpose.

Incorrect operation and maintenance can result in unbalance due to build-up of sediment, reduction of material strength, etc., that subsequently could lead to serious damage and/or injury.

The following basic safety instructions therefore apply:

- **Use the separator only for the purpose and parameter range specified by Alfa Laval. Applies not only to the process but also to cleaning and service liquids.**
- **Strictly follow the instructions for installation, operation and maintenance.**
- **Ensure that personnel are competent and have sufficient knowledge of maintenance and operation, especially concerning emergency stopping procedures.**
- **Use only Alfa Laval genuine spare parts and the special tools supplied.**

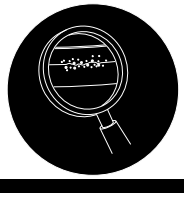
S0151211

Disintegration hazards

- If excessive vibration occurs, **stop** separator.
- Use the separator only for the purpose and parameter range specified by Alfa Laval.
- Welding or heating of parts that rotate can seriously affect material strength.

S0151241

- Inspect regularly for **corrosion** and **erosion** damage. Inspect frequently if process or cleaning liquid is corrosive or erosive.



S01512H1

Entrapment hazards

- Make sure that rotating parts have come to a **complete standstill** before accessing parts inside the machine or starting **any** dismantling work.

  If there is no braking function the run down time can exceed two hours.

S01512O1

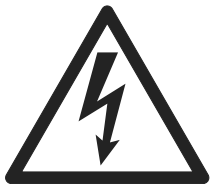
- To avoid accidental start, switch off and lock power supply before starting **any** dismantling work.

  Assemble the machine **completely** before start. **All** covers, connections and guards must be in place.
  Never run the separator without bowl.

S0151261

Electrical hazard

- Follow local regulations for electrical installation and earthing (grounding).
- Only qualified electricians are allowed to install and maintain the drive.
- Make sure the intermediate circuit capacitors discharge before you start working on the drive, motor or motor cable. After disconnecting the input power, always wait in accordance with the documentation for the frequency converter.



S0151271

Burn hazards

Hot surface can cause grave burn if touched.

- Lubrication oil, machine parts and various machine surfaces can be hot and cause burns. Wear protective gloves.
- Be careful when working near pipes, valves with hot process or utility liquid and heating equipment such as electric or thermal heaters (if applicable).
- In case of emergency stop, the module can contain hot liquid. Always handle with utmost care to avoid exposure of hot surface.
- After shutting down the system, allow sufficient time for the parts to cool down and adjust to atmospheric pressure before starting any work on the system.

S015124A1

Skin irritation hazards

- When using chemical cleaning agents, make sure you follow the general rules and suppliers recommendation regarding ventilation, personnel protection etc.
- Use of lubricants in various situations.

S01512D1

Flying objects

- Risk for accidental release of snap rings and springs when dismantling and assembly. Wear safety goggles.

S01512C1

1.1 Warning signs in text

Pay attention to the safety instructions in this manual. Below are definitions of the three grades of warning signs used in the text where there is a risk for injury to personnel.

DANGER

Type of hazard

DANGER indicates an imminently hazardous situation which, if not avoided, will result in death or serious injury.

WARNING

Type of hazard

WARNING indicates a potentially hazardous situation which, if not avoided, could result in death or serious injury.

CAUTION

Type of hazard

CAUTION indicates a potentially hazardous situation which, if not avoided, may result in minor or moderate injury.

NOTE

NOTE indicates a potentially hazardous situation which, if not avoided, may result in property damage.

1.2 Recycling Information

Unpacking

Packing material consists of wood, plastics, cardboard boxes and in some cases metal straps.

- Wood and cardboard boxes can be reused, recycled or used for energy recovery.
- Plastics should be recycled or burnt at a licensed waste incineration plant.
- Metal straps should be sent for material recycling.

Maintenance

During maintenance oil and wear parts in the machine are replaced.

- Oil must be taken care of in agreement with local regulations.
- Rubber and plastics should be burnt at a licensed waste incineration plant. If not available they should be disposed to a suitable licensed land fill site.
- Bearings and other metal parts should be sent to a licensed handler for material recycling.
- Seal rings and friction linings should be disposed to a licensed land fill site. Check your local regulations.
- Worn out or defected electronic parts should be sent to a licensed handler for material recycling.

Scrapping

At the end of use, the equipment must be recycled according to relevant local regulations.

Besides the equipment itself, any hazardous residues from the process liquid must be taken into consideration and dealt with in a proper manner. When in doubt, or in the absence of local regulations, please contact your local Alfa Laval sales company.

1.3 Requirements of personnel

Only **skilled** or **instructed** persons are allowed to operate the machine, e.g. operating and maintenance staff.

- **Skilled person**: A person with technical knowledge or sufficient experience to enable him or her to perceive risks and to avoid hazards which electricity/mechanics can create.
- **Instructed person**: A person adequately advised or supervised by a skilled person to enable him or her to perceive risks and to avoid hazards which electricity/mechanics can create.

In some cases special skilled personnel may need to be hired, like electricians and others. In some of these cases the personnel has to be certified according to local regulations with experience of similar types of work.

1.4 Remote start

If the separator is operated from a remote position where the separator cannot be seen or heard the power isolation device shall be equipped with an interlock device to prevent that a remote start command could result in liquid being fed to the separator when it is shut down for service.

The first start after the separator has been taken apart or been standing still for a long time shall always be manually supervised locally.

2 Separator basics

2.1 Application

The use of the separator is restricted to removal of water and solids from gas oil, marine diesel oil and lube oil.

The table below shows examples of oils to be treated:

Oil type	Density at +15 °C	Viscosity at +40 °C	Recommended separation temperature (°C)
HVO	770 - 790 kg/m^3	1,5 - 6 cSt	20-40
Gas oil	810 - 860 kg/m^3	1,5 - 6 cSt	20-40
Marine diesel oil	850 - 920 kg/m^3	Up to 14 cSt	40
Lube oil	Max. 920 kg/m^3	Up to 150 cSt	95

NOTE

Maximum permissible separation temperature is +95 °C.

WARNING

Disintegration hazard

Do not use the separator for separating any oils or liquids other than those specified above.

2.2 Conversion kit

If the liquid to clean only contains smaller amounts of water and solids, the purifier bowl can be converted to a clarifier, using the optional conversion kit to replace the purifier parts in bowl, see ‘‘2.5 Changing operation mode” on page 20.

A brief explanation of the different modes is given in ‘‘2.4 Working principle” on page 19.

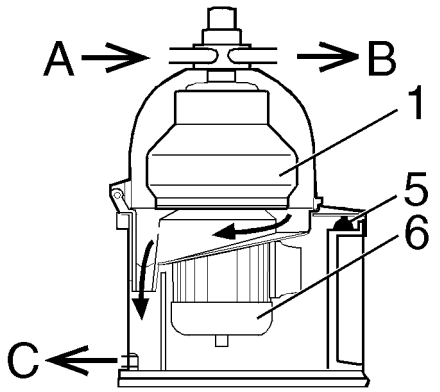
2.3 Description of main parts

2.3.1 Overview

A general view of the separator is shown in the illustration beside.

The oil is fed to the oil inlet (A) and down to the rotating bowl (1) where separation takes place. The cleaned oil leaves the separator at (B). If the separator is working as purifier, the separated water runs down the water collecting channel to the water outlet (C).

The bowl (1) and motor (6) are suspended on three vibration dampers (5).



Separator

A. Dirty oil inlet
B. Clean oil outlet
C. Water outlet.
When the separator is stopped the bowl is drained via this outlet.

1. Bowl
5. Vibration dampers
6. Electric motor

More details are shown in the illustration on next page.

2.3.2 Detailed description

Separation takes place in the bowl (6) which is mounted directly on the motor shaft. The bowl contains a set of conical discs (7) between which the separation process takes place.

The bowl wall (6) and the paring chamber cover (2) are held in place by the lock nut (5).

NOTE

The lock nut has a conventional right-hand thread contrary to most Alfa Laval separators that have left-hand threaded lock rings.

The paring disc (3) is stationary, held by the paring disc knob (1). Below the paring disc a level ring (4) is fitted.

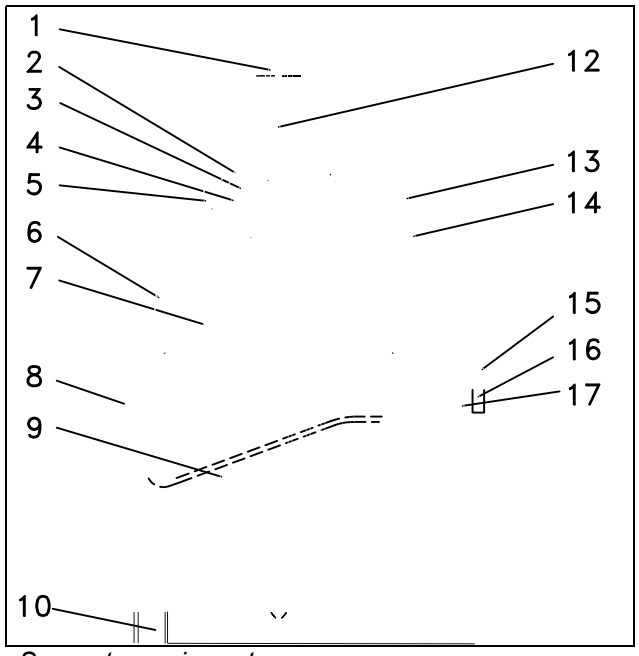
The motor flange rests on three rubber cushions (17) in the frame (8). When operating the separator as purifier, an inclined channel in the motor flange directs water that has been separated from the oil down to the water outlet (10).

The motor (9) is powered via an electronic frequency converter in the control cabinet, which converts the incoming mains to an output frequency of 125 Hz. This gives the motor and bowl a max. operating speed of 7500 r/min. When the current is switched off the converter acts as a brake quickly reducing the speed to below 1000 r/min. within 25 seconds.

The separator is equipped with the following safety devices:

A safety yoke (13) over the hood (14) and the oil connection housing (12) has a magnet (15) which operates a magnetic safety switch (16), so that power can only be supplied to the motor when the yoke is in its upright position. The yoke can be raised to this position only when both the mounting screws of the hood and the paring disc knob (1) have been tightened.

The separator also has built-in overload protection.

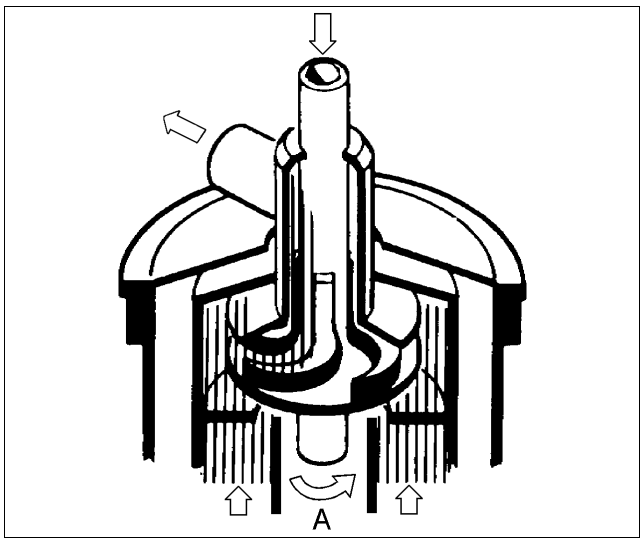


Separator main parts

1. *Paring disc knob*
2. *Paring chamber cover*
3. *Paring disc (see separate description on page 18)*
4. *Level ring*
5. *Lock nut*
6. *Bowl*
7. *Disc stack*
8. *Frame*
9. *Motor*
10. *Water outlet*
12. *Oil connection housing*
13. *Safety yoke*
14. *Hood*
15. *Magnet*
16. *Magnetic safety switch*
17. *Rubber cushions*

2.3.3 Paring disc

The paring disc serves as a stationary pump wheel mounted in a chamber in the rotating bowl neck. The paring disc dips radial into the rotating liquid ring and pares out the liquid (oil). The paring disc is used as a discharge pump.



The liquid and all bowl parts (except the stationary paring disc) rotate in direction illustrated by arrow (A)

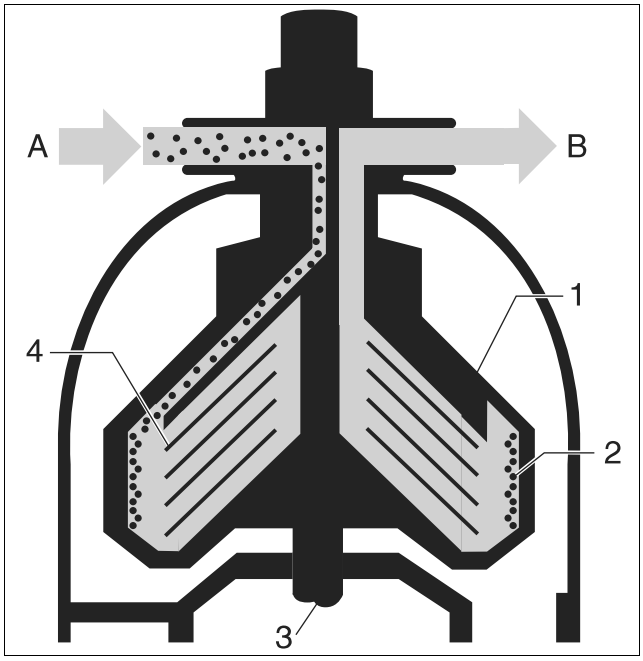
2.4 Working principle

2.4.1 Clarifier mode

The unseparated oil continuously enters at (A) and flows into the bowl (1). The particles (2) are separated and deposited on the bowl wall.

The cleaned oil is forced inwards to the centre of the bowl and up to a paring disc (not illustrated). Since the oil is rotating, the stationary paring disc acts as a pump which forces the oil out through outlet (B) under a constant pressure.

The particles accumulated on the bowl wall are removed periodically by hand.

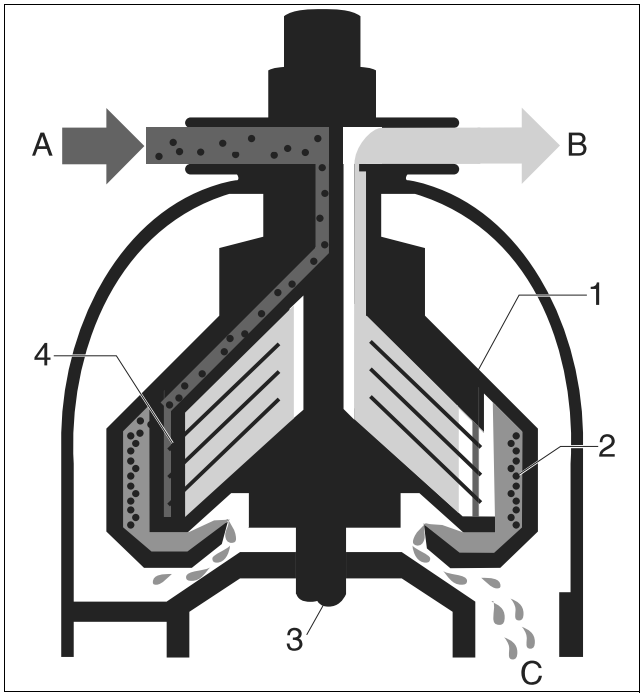


Clarifier bowl

2.4.2 Purifier mode

When operating the separator as a purifier a water seal must be established before the oil feed is started. If not, oil will flow out through the water outlet (C). How to proceed is described in “3.3.3 Start” on page 26.

Otherwise the separation principle is similar to clarification except that the separated water, which is heavier than the oil, leaves through the underside of the bowl at (C).



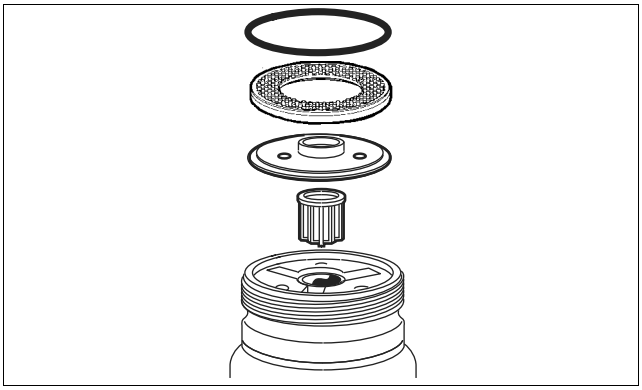
Purifier bowl

2.5 Changing operation mode

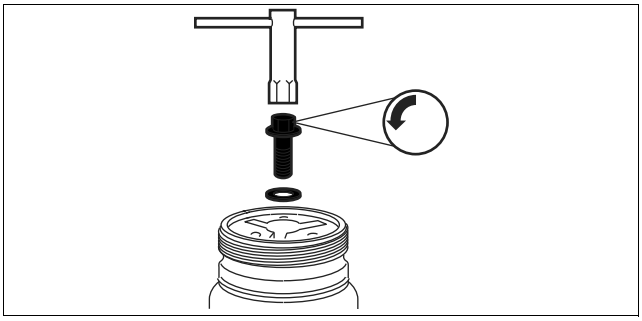
When changing operating mode from clarifier to purifier, or vice versa, proceed as follows:

1. Dismantle the separator in the same way as when cleaning the bowl, see “5.4.2 Cleaning of bowl” on page 38.

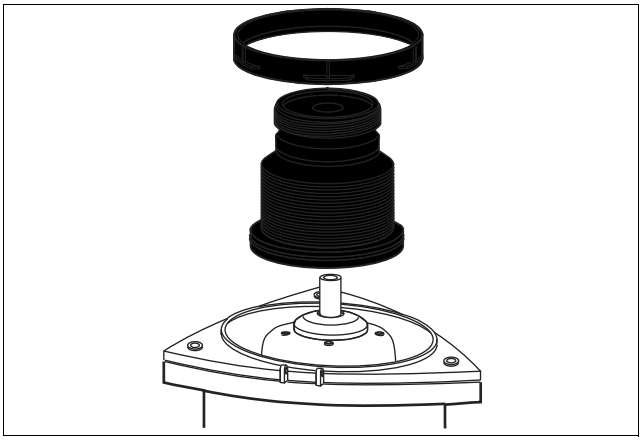
2. Remove the level ring, O-ring, lower part of paring chamber and the sleeve with wings.



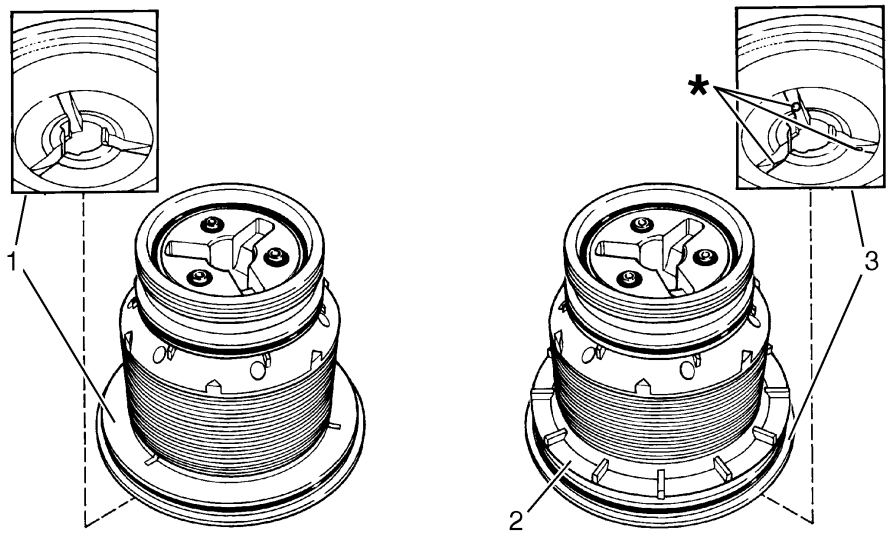
3. Unscrew the centre screw.



4. Lift out the bowl insert. If it is difficult to get the insert loose from the bowl spindle, then first remove the splash guard (the white plastic ring) to get a better grip on the bowl bottom.



A number of parts have to be replaced in the bowl when changing operation mode. The illustration below shows the differences between a clarifier and purifier bowl insert. The number of bowl discs is also different between the modes. The conversion kit contain all the parts that need to be replaced.



Clarifier bowl insert (fitted as delivered)

1. Bowl bottom (clarifier), no holes
2. Bottom disc (purifier)

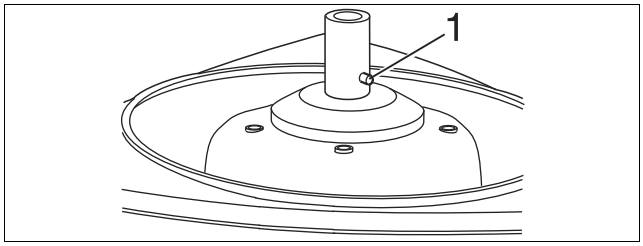
Purifier bowl insert

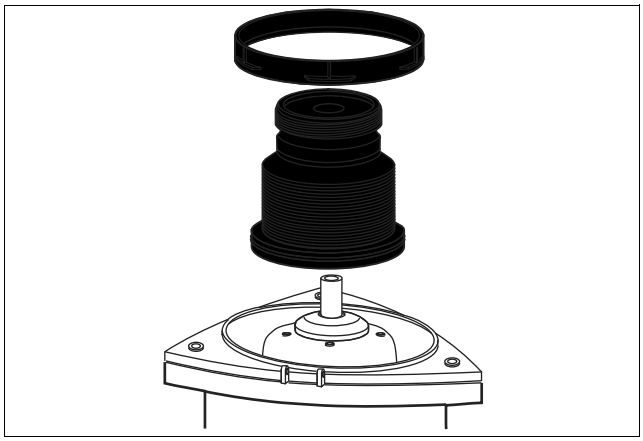
3. Bowl bottom (purifier) with three holes (*)

5. Install the conversion kit (clarifier to purifier) to replace the original bowl insert, or install the conversion kit (purifier to clarifier) to change operating mode from purifier to clarifier.

6. When fitting the insert, check that the cylindrical pin (1) is not missing in the shaft.

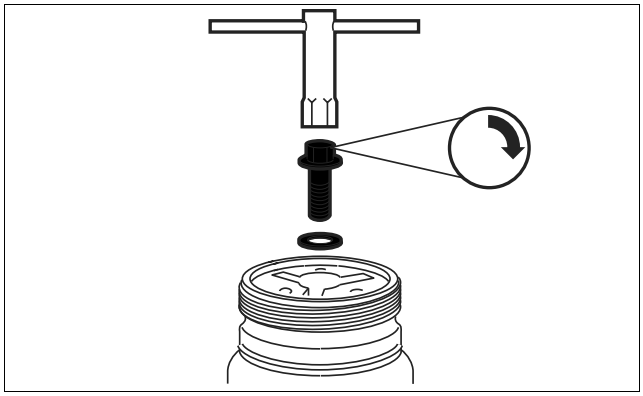
   Check that the pin enters the guide in the bottom of the insert.



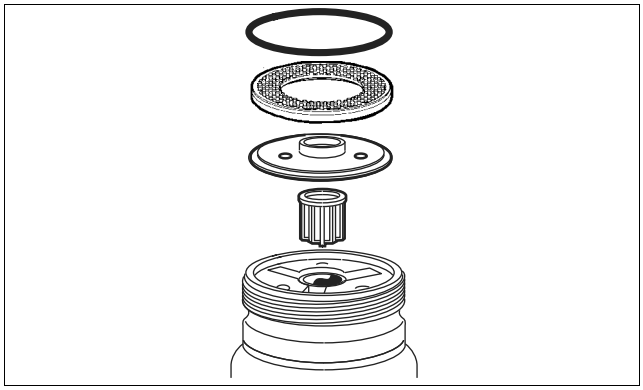


7. Tighten the centre screw.

   Check that **one** washer is fitted under the screw.



8. Fit the sleeve with wings, lower part of paring chamber, level ring and O-ring.



NOTE

See the instructions in ‘‘5.4.2 Cleaning of bowl” on page 38 how to fit the level ring and O-ring correctly.

These pages also describe the rest of the assembly of the separator.

3 Operating instructions

3.1 Separation mode

To learn the correct running strategy, first read the information below carefully before starting the separation process.

1. Decide if the separator will be operated as clarifier or purifier. The difference between them is described in "2.4 Working principle" on page 19.

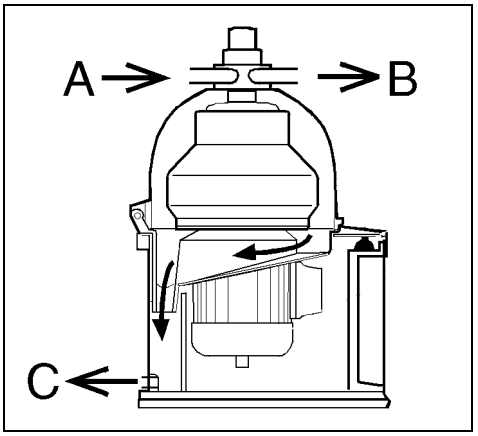
   At delivery the separator is assembled as a clarifier.

2. If the amount of water and sludge in the oil is unknown, start the separation in clarifier mode (how to change operation mode is described in chapter "2.5 Changing operation mode" on page 20).

3. Run the separator for 1 - 2 hours.

   Then stop the separator and drain content (about 1 litre) from the outlet (C) into a glass bottle or similar to check the water content. If water is found, operate the separator as a purifier.

A. Inlet of uncleaned oil
B. Outlet of cleaned oil
C. Water outlet. When the separator is stopped the bowl is drained via this outlet.

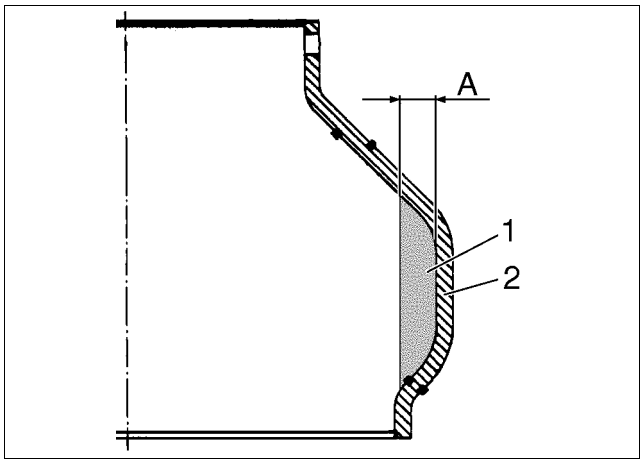


3.2 Separation time

Dismantle the separator and measure the thickness (A) of the sludge collected on the bowl shell, see “5.1 Cleaning” on page 35. The thickness should never exceed 10 mm.

Max. recommended cleaning interval is 3 days. A longer interval can result in a sludge cake that is hard and difficult to remove. Too long interval can also result in that sludge enters the disc stack and hinders separation. Oil overflow and vibration can also occur.

When cleaning very contaminated oil, bowl cleaning every 20 - 30 minutes could be necessary.



A. Max. thickness = 10 mm (corresponds to 0,6 litre)

1. Sludge
2. Bowl shell

NOTE

The separator can be operated either as a clarifier or as a purifier. Choose **clarifier operation** when **no** or only traces of **water** in the oil. At delivery the separator is assembled for clarifier operation.

Choose **purifier operation** when the oil contains **much water**.

The differences between the two modes are further described on page 19.

3.3 Operating routine

3.3.1 Introduction

These operating instructions describe routine procedures to follow before and during the start, running and stopping sequences of the separator.

NOTE

If there is a System Manual, always follow the operating instructions given therein. If there is no System Manual the instructions below are to be followed.

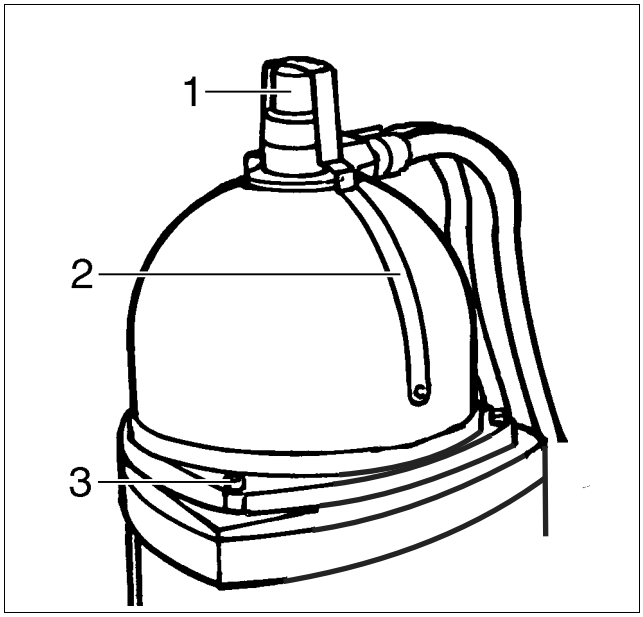
3.3.2 Before start

- The separator is set up as clarifier when delivered. In case that purifier mode is needed, please convert the bowl as described in chapter ‘‘2.5 Changing operation mode” on page 20.
- Make sure that the separator is correctly assembled according to the instructions given in chapter ‘‘5 Maintenance” on page 35.
- Make sure that correct complete bowl bottom is used. Diameter (51, 56 or 60) for ∅5 holes to be chosen according to Nomogram.
- Make sure that the three hood screws (3) and the paring disc knob (1) are firmly tightened and that the safety yoke (2) is in its closed (vertical) position.
- Make sure the bowl is free from sludge before restarting.

WARNING

Disintegration hazard

Unevenly spaced sludge cake will result in heavy vibration and damage can be caused.



1. Paring disc knob
2. Safety yoke
3. Hood screw (3 pcs)

3.3.3 Start

1. Make sure that the outlet valve for cleaned oil is open.
2. Start the separator (keep the button pressed 3 - 4 seconds).

WARNING

Disintegration hazard

Some vibrations can occur for short periods during the start phase when the separator passes through the critical speed. This is normal and passes over without danger. If the vibrations become very severe or continue at full speed, **stop the separator immediately**. See chapter ‘‘4.3 The separator vibrates” on page 30 for possible causes.

3. **When operating in purifier mode only!**

   After 20 seconds, when the separator has gained full speed, feed at least one litre of water into the oil inlet line. This will create the water seal.

4. Turn on the oil feed to the separator.

   Max. recommended flow is 1 250 litres/hour.

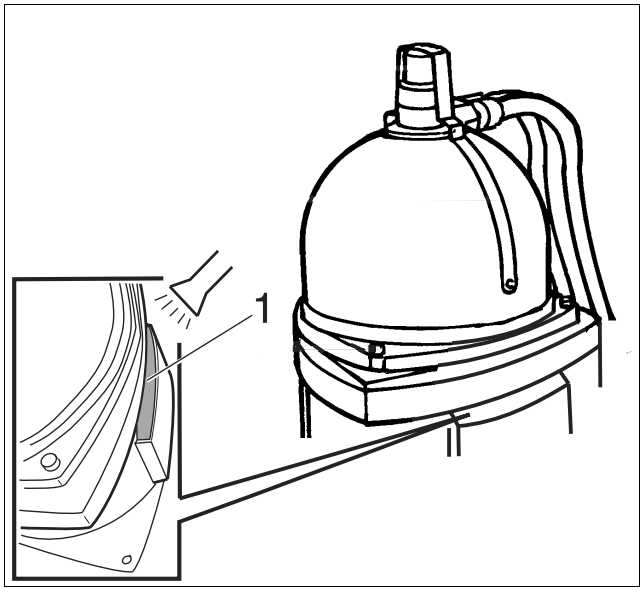
   Check that the oil has reached correct separating temperature, see ‘‘2.1 Application” on page 15.

5. Regulate the counter pressure in the oil outlet line to minimum 40 kPa. For recommended counter pressure, see ‘‘6.2 Performance data inlet/outlet device” on page 63.

6. **When operating in purifier mode only!**

   After 1 minute, check that oil is not discharging from the separator. Check as illustrated (1) using a torch or check through the water outlet at the bottom of the separator.

   If oil escapes through the water outlet, stop the oil feed and follow the instructions given in ‘‘4.7 Some oil is escaping through water outlet” on page 32 or ‘‘4.8 Oil flows through water outlet only” on page 32.



Check if oil escapes through the water outlet (1)

3.3.4 Operation

NOTE

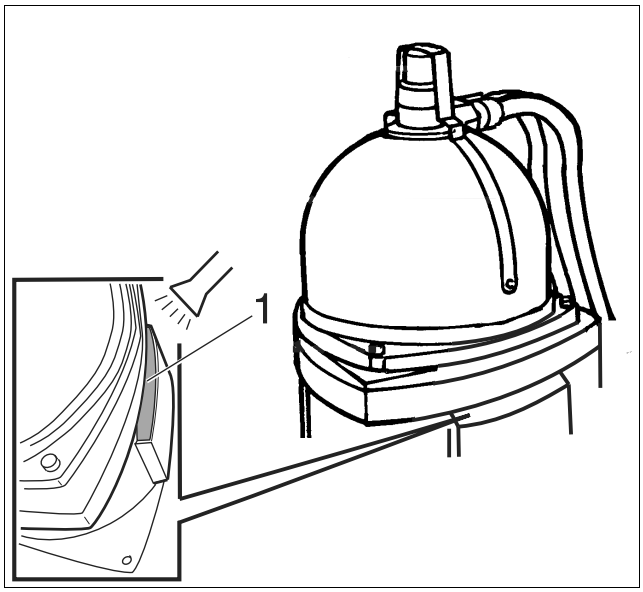
Never run the unit longer than 3 days between bowl cleaning. It is important to follow the instructions in ‘‘3.2 Separation time” on page 24.

Check the separator for correct operation (temperature, counter pressure and vibration). This is especially important the first few times the separator is run after installation or after any dismantling and assembly has been carried out.

When operating in purifier mode only!

Check that oil is **not** discharging from the separator. Check as illustrated (1) using a torch or check through the water outlet at the bottom of the separator.

If oil escapes through the water outlet, stop the oil feed and follow the instructions given in ‘‘4.7 Some oil is escaping through water outlet” on page 32 or ‘‘4.8 Oil flows through water outlet only” on page 32.



Check if oil escapes through the water outlet (1)

3.3.5 Manual stop

NOTE

After each stop the separator bowl must be well cleaned. Otherwise an unevenly spaced sludge cake will at next start result in heavy vibration and damage can be caused.

1. Turn off the oil feed.

2. Stop the separator.

   When the separator has nearly stopped rotating, the contents of the bowl (approx. 1 litre) will be drained out by gravity at the bottom of the separator. This is the normal draining of the bowl as it stops, both in purifier and clarifier mode.
   Make sure the separator has come to a standstill by opening the hatch at the front and using a torch.

3. Make sure that the valves are closed on both the feed and outlet sides of the separator. If this is not done and the position of the tank level is higher than the inlet/outlet of the separator, there is a risk that oil may be siphoned through the separator.

3.3.6 Automatic stop

The separator is automatically stopped by the built-in electronic safety devices if one of the following situations should occur:

- too high current due to overload of the separator motor
- too high temperature in the frequency converter
- wrong frequency from the converter.

Auxiliary safety devices that also stop the separator: See “6.5 Connection list” on page 68.

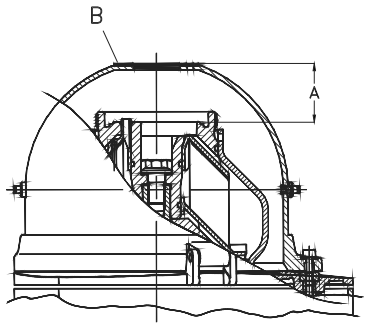
NOTE

If the separator stops, the oil feed must be stopped immediately or there will be serious oil overflow.

If the separator does not start or if it stops during operation, follow the instructions given in “4.1 The separator does not start” on page 29 and “4.2 The separator stops” on page 30.

4 Trouble shooting

4.1 The separator does not start

Possible cause	Action
Safety yoke is not in the correct position.	Position the yoke correctly.
No power supplied to the separator.	Check the mains switch, fuses and supply line.
Defective magnetic safety switch indicating the position of the safety yoke.	Make sure that the switch opens and closes when the safety yoke is moved up and down. Measure across terminal points Nos 5 and 6 on the frequency converter board. Replace the switch if faulty.
Incorrect assembly after cleaning. The bowl and motor shaft can not rotate freely.	Make sure that the bowl and motor shaft can rotate freely by turning the bottom end of the motor shaft with a suitable tool.
Incorrect height adjustment of paring disc after major overhaul.	The height adjustment of the paring disc is measured as shown in figure. The height A should be 48,5 ±0,5 mm and can be adjusted by the number of washers B (1-3 pcs) under the oil connection housing.  G0417831
Voltage protection on frequency card trips because of too low/high voltage or voltage spikes.	Check the voltage by current using multimeter or other measuring instrument. If unstable voltage, connect a transformer.

4.2 The separator stops

Possible cause	Action
The safety yoke has been moved out of its position.	Reposition the yoke. Running position = vertical.
Overload due to incorrect assembly.	Check the bowl assembly.
Too high counter pressure.	Reduce the counter pressure. minimum 40 kPa. For recommended counter pressure, see “6.2 Performance data inlet/outlet device” on page 63.
Tripped frequency converter due to too low or too high supplied voltage (>±10% of nominal voltage).	Check the voltage. If unstable voltage, connect a transformer.

4.3 The separator vibrates

WARNING

Disintegration hazard

If excessive vibrations occur, **stop** the separator.

Possible cause	Action
Bowl out of balance due to: • Insufficient or incorrect cleaning (sediment in disc stack). • Unevenly spaced sediment cake (bowl not cleaned prior to start). • Incorrect assembly.	Dismantle and clean the separator bowl. Be sure that the separator is assembled correctly.
Vibration dampers are worn.	Fit three new dampers.
Motor bearings are damaged.	Fit new bearings.

4.4 Noise

Possible cause	Action
Incorrect assembly.	Dismantle and assemble correctly.
Motor bearings are damaged.	Fit new bearings.
Vibration dampers are worn.	Fit new dampers.

4.5 Low outlet flow

Possible cause	Action
Too low flow rate of feed.	Check the feed line - increase the flow rate.
Too high counter pressure at outlet.	Reduce the counter pressure. minimum 40 kPa. For recommended counter pressure, see “6.2 Performance data inlet/outlet device” on page 63.
Leakage caused by incorrect assembly.	• The three screws fastening the frame hood or the paring disc knob (the upper part of the separator) are not completely tightened. • Dismantle and check the separator bowl parts. Especially check that no O-rings are missing, are defective or incorrectly fitted. Ensure that the separator is assembled correctly.
Separator rotates in wrong direction.	Connect the electrical connections properly.

4.6 Insufficient separation result

Possible cause	Action
Diameter (51, 56 or 60) for ∅5 holes on bowl bottom is too small.	Check nomogram and re-do bowl bottom selection.
The oil feed rate is too high.	Reduction of the feed rate improves the separation result.
The separation temperature is too low.	Adjust the setting of the heating.
The counter pressure is too low.	Increase the counter pressure until water is observed to be discharged from the water outlet. Minimum 40 kPa. For recommended counter pressure, see “6.2 Performance data inlet/outlet device” on page 63.

Possible cause	Action
The separator disc stack is clogged.	Clean the separator bowl and disc stack. Shorten the cleaning interval.

4.7 Some oil is escaping through water outlet

Possible cause	Action
Too high counter pressure at outlet.	Reduce the counter pressure. Minimum 40 kPa. For recommended counter pressure, see “6.2 Performance data inlet/outlet device” on page 63.
The separator disc stack is clogged.	Clean the separator bowl and disc stack. Shorten the cleaning interval.
The three screws fastening the bowl hood or the paring disc knob (the upper part of the separator) are not completely tightened, causing leakage.	Tighten the screws and /or the knob.
If operating in purifier mode: Insufficient sealing between bottom disc and bowl bottom in separator (O-rings may be missing).	Dismantle and check the separator bowl. Be sure that the separator will be assembled correctly.

4.8 Oil flows through water outlet only

Possible cause	Action
Obstruction in cleaned oil feed line.	Check the feed line.
If operating in purifier mode: Insufficient water seal in the bowl.	Either no water was added at start-up or the water seal has broken during operation. Add 1 litre of water to create a new water seal. If this fault repeats itself so that oil again discharges through the water outlet the density of the oil is too high. Stop the separator and check that bowl bottom selection corresponds with the Nomogram.

4.9 No outlet flow either through clean oil outlet or water drain

Possible cause	Action
No feed.	Check the feed line (valves, feed pump, filter etc.).
The separator has stopped.	See ‘‘4.2 The separator stops” on page 30.

4.10 Oil leakage through water outlet when separator is not running

Possible cause	Action
Oil is siphoned from oil tank due to siphon effect.	Close valves on both feed and outlet sides of the separator.

5 Maintenance

WARNING

Entrapment hazard

To avoid accidental start, switch off and lock the power supply before starting **any** dismantling work. Make sure that rotating parts have come to a **complete standstill** before starting any dismantling work.

5.1 Cleaning

The separated sludge collected inside the separator bowl must be removed manually. The length of the cleaning interval depends on the oil flow rate and on the amount of sludge, but the interval must never exceed 72 operating hours (3 days). For further information on max. permitted amount of sludge and other limitations, see ‘‘3.1 Separation mode” on page 23.

‘‘5.4.2 Cleaning of bowl” on page 38 explains how to proceed.

NOTE

Never use cleaning agents with a pH below 6 or above 9 as they can damage the metal surfaces.

5.2 Once per year

Replace the O-rings with new ones included in the O-ring service kit. Their positions are shown in the *Spare Parts Catalogue.* Before fitting, lubricate the O-rings with the Silicone grease supplied in the service kit.

See ‘‘5.4.3 Replacement of O-rings in purifier bowl” on page 44 and ‘‘5.4.4 Replacement of O-rings in clarifier bowl” on page 48 how to proceed.

Check the condition of discs in the bowl, replace if necessary. See comments in ‘‘5.3.1 Disc stack replacement” on page 36.

5.3 Every second year

5.3.1 Disc stack replacement

Check/replace the disc stack to maintain the separation efficiency. At separation temperature 60 °C and below, it is recommended to fit a new stack every two years to ensure that the separation efficiency is maintained.

At separation temperature above 60 °C, it is recommended that the disc stack is replaced every year or at any sign of brittleness.

See ‘‘5.4.3 Replacement of O-rings in purifier bowl” on page 44 and ‘‘5.4.4 Replacement of O-rings in clarifier bowl” on page 48 how to proceed.

The disc stack is available as a set.

5.3.2 Vibration damper replacement

Fit new vibration dampers every two years. Inspect the stop flanges of the dampers for possible damage and replace the stop flanges with new ones if necessary.

The position of the vibration dampers is shown in illustration No. 11 at page 52.

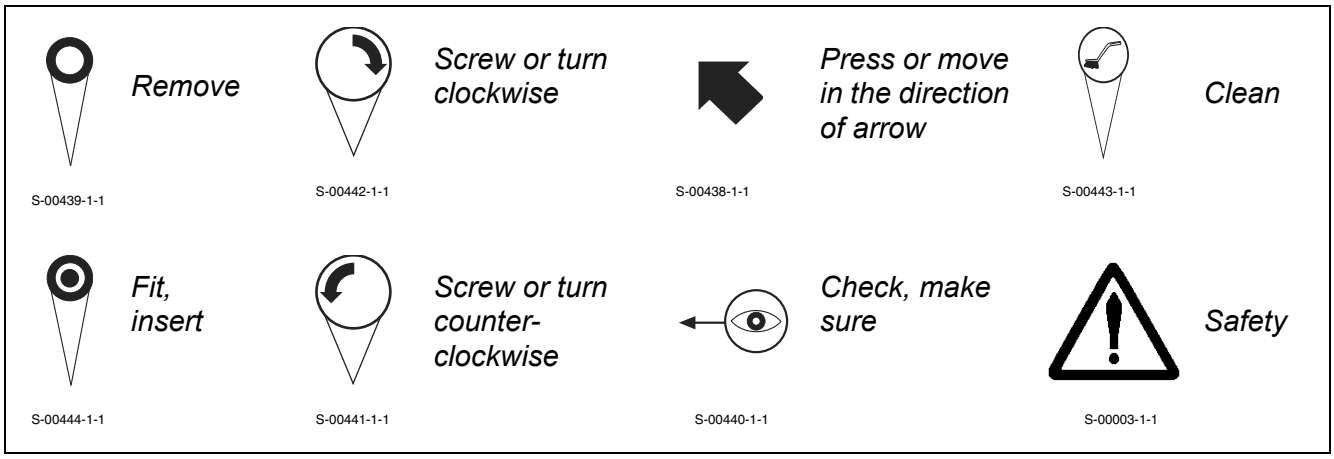
The vibration dampers are available as a set (see *Spare Parts Catalogue*).

5.4 Dismantling - assembly instructions

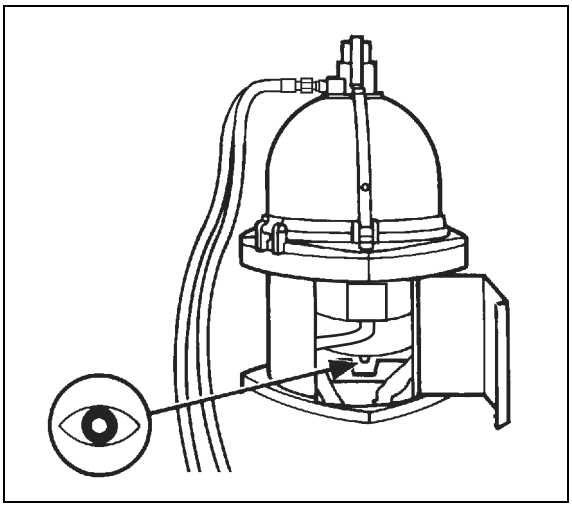
5.4.1 Introduction

The illustrations on the following pages describe step by step how to dismantle, clean, replace and assemble the various parts of the separator.

The illustrations have symbols only to indicate the actions required. The key to the symbols is given below.



5.4.2 Cleaning of bowl



Comments to illustrations on opposite page.

Illustration 4:

Before dismantling the separator, wait until the rotating parts have come to a complete standstill, which will take up to three minutes.

To be sure, open the front cover and use a flashlight to check that the electric motor shaft has stopped rotating.

NOTE

If the separator is opened too soon, the following could happen:

- The pin on the inside of the connecting housing breaks.
- The pin inside the top of the paring disc breaks.
- Excessive wear of top of level ring.

Illustration 8:

A few drops of oil will normally leak from the connecting housing when the bowl hood is opened.

If oil continues to leak, the cause could be a non-sealing check valve (if any) while the separator is connected to an oil tank with an oil level higher than the separator (siphon effect).

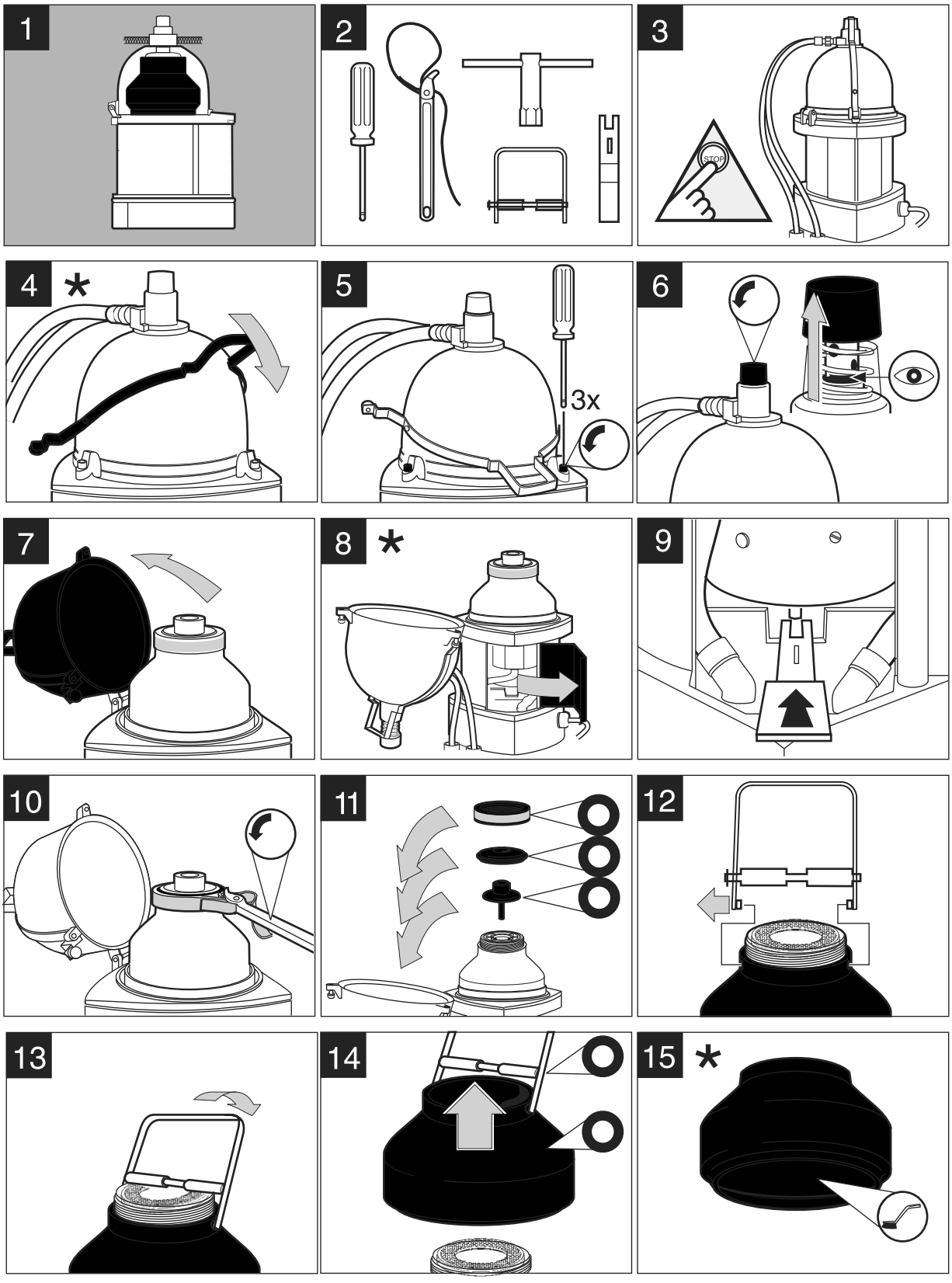
Illustration 15:

NOTE

Never use sharp or metallic tools when cleaning the bowl wall. This can damage the coating. Always use soft rags.

Cleaning of the disc stack in not normally necessary unless sludge has accumulated and entered the stack (cleaning interval too long).

Dismantling



* See comments on opposite page

Comments to illustrations on opposite page.

Illustration 16:

When fitting the bowl wall, press firmly downwards with both hands to overcome the resistance from the O-ring fitted on the bowl bottom. A “clicking” sound will be heard.

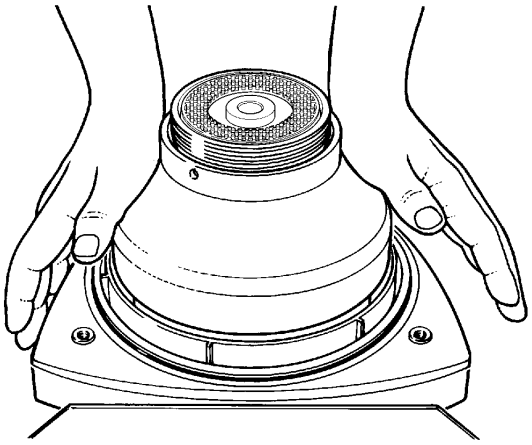


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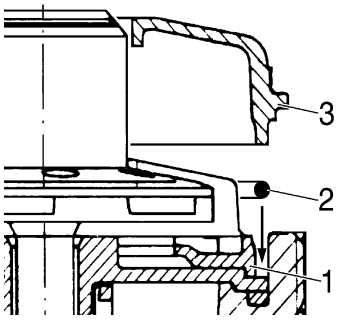
Illustration 17:

If the level ring (1) and O-ring (2) have been removed, first fit the level ring and then the O-ring outside the level ring. Finally press down the O-ring by pressing the cover (3) firmly with both hands.



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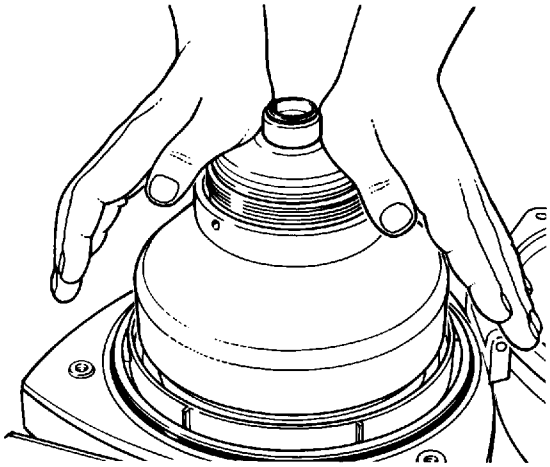


G0912121

Illustration 18:

Check that the distance illustrated is max. 0,5 mm. If not, the reason could be:

1. The O-ring outside the level ring is not in the downwards position or the O-ring is located under the level ring.
2. Two washers are fitted under the centre screw fixing the bowl to spindle.

Illustration 20:

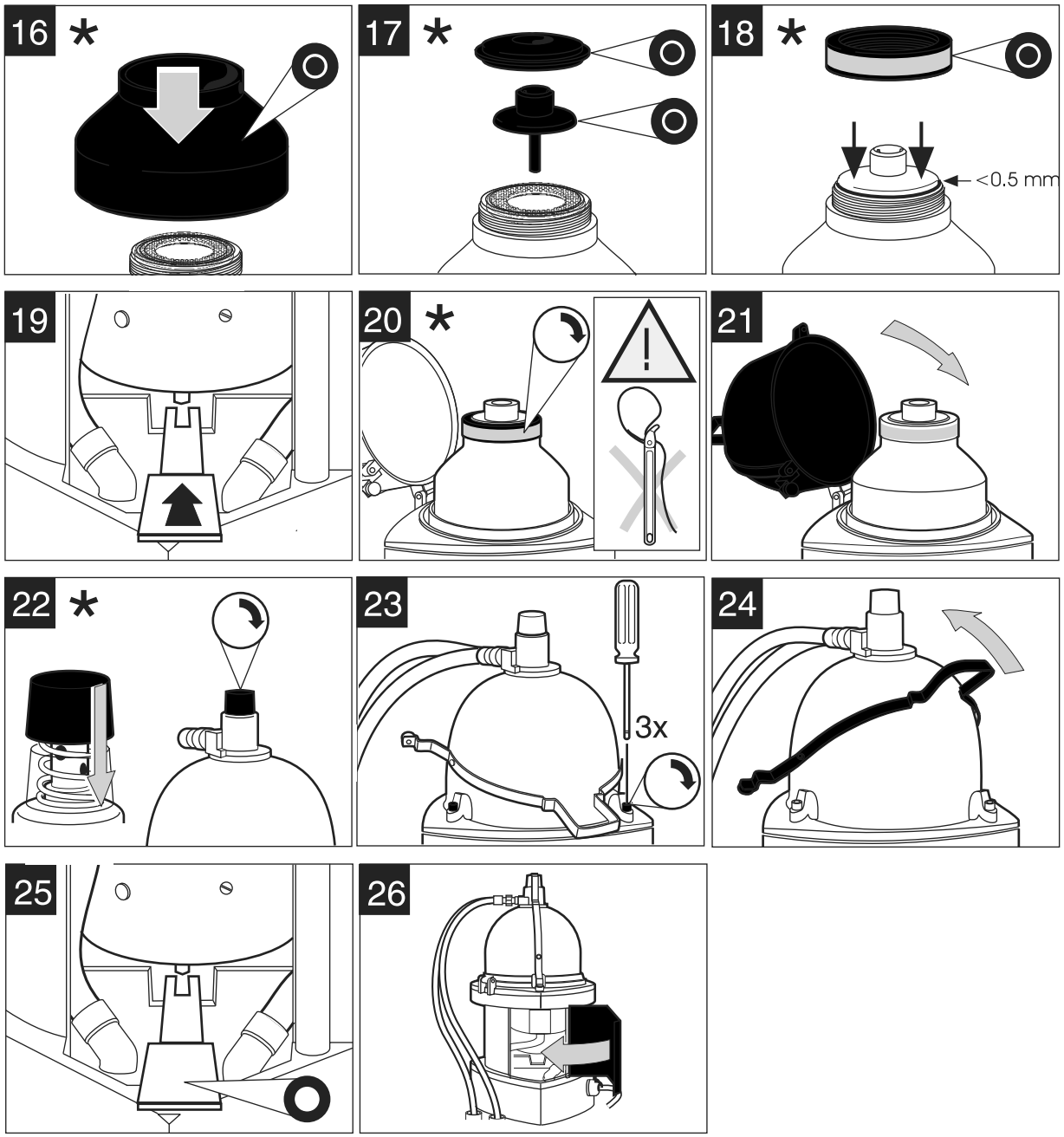
Only tighten by hand. Never over tighten when assembling parts.

Illustration 22:

NOTE

Always screw home the knob fitted on the connecting housing **before** tightening the screws shown in illustration 23. Otherwise there is a risk that the pin inside the connecting housing could break.

Assembly



* See comments on opposite page and at top of this page

5.4.3 Replacement of O-rings in purifier bowl

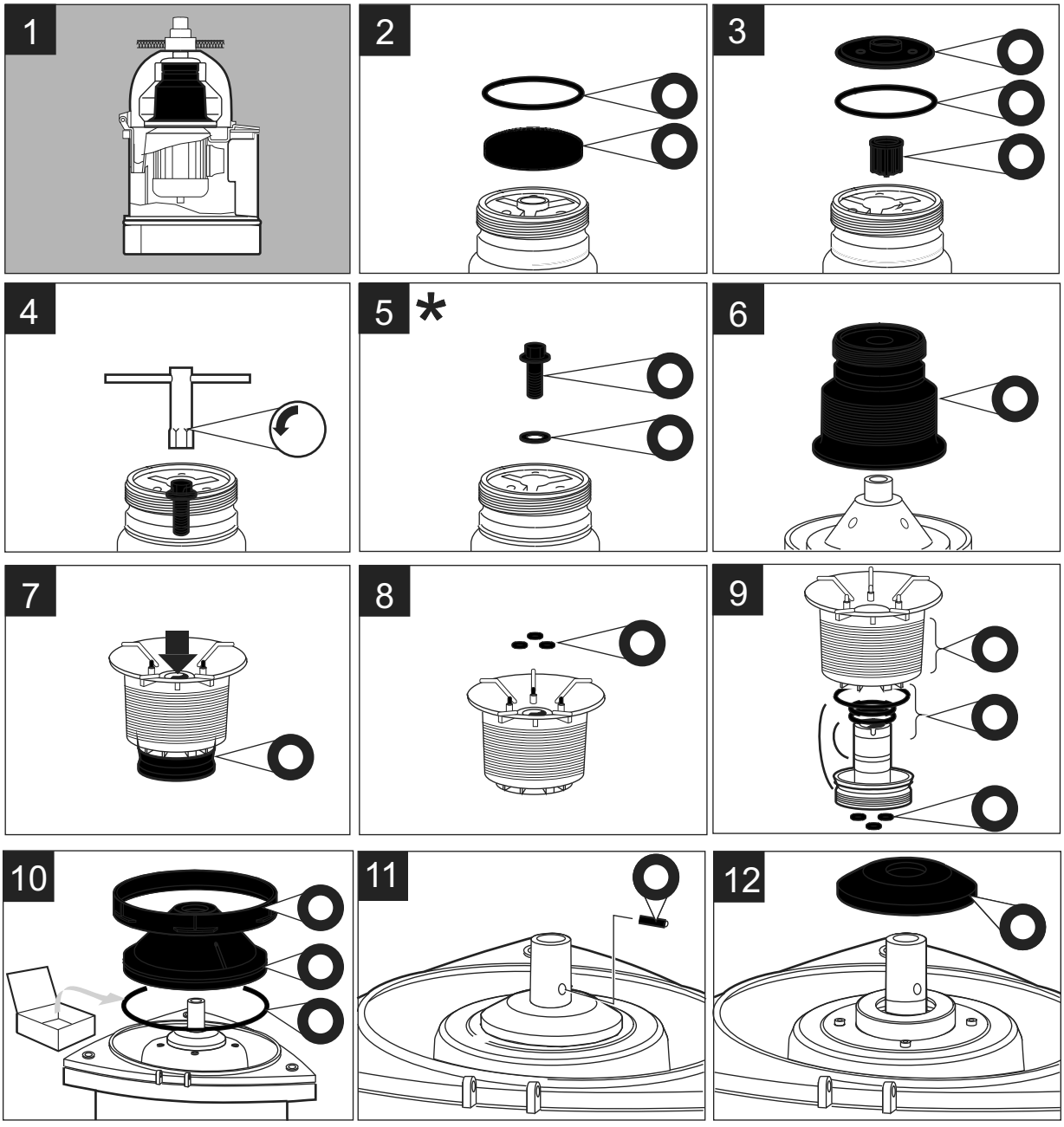
How to convert from purifier to clarifier bowl or vice versa is described in point ‘‘2.5 Changing operation mode” on page 20.

Comments to illustrations on opposite page.

Illustration 5:

Take care of the washer.

First dismantle the separator bowl as described in
“5.4.2 Cleaning of bowl” on page 38.



G05191R1

* See comments on opposite page.

Illustration 19:

Check that the washer is fitted. Otherwise there is a risk that the bowl will not make firm contact with the spindle.

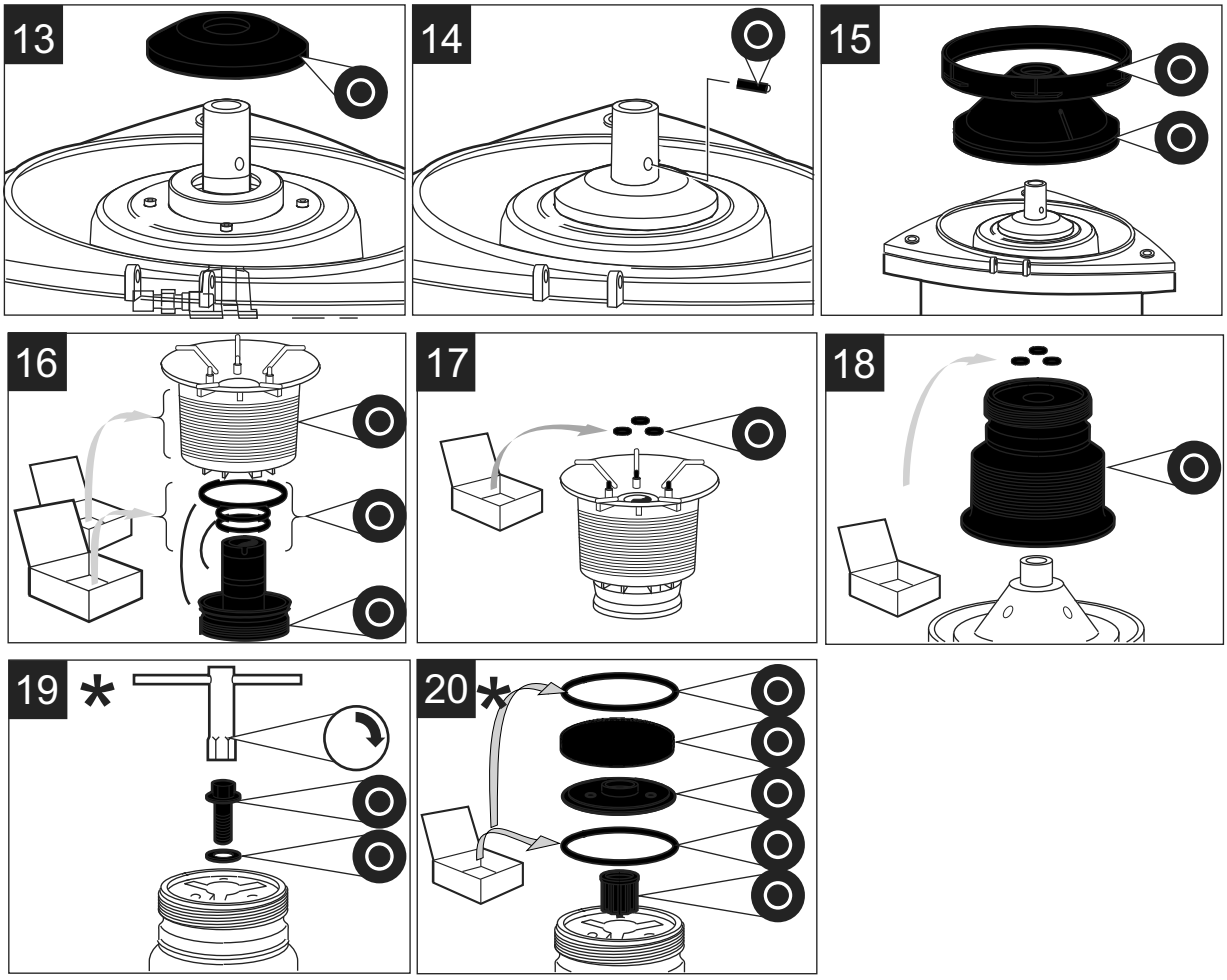
If two or more washers are fitted accidentally this will prevent the top parts of the bowl from being positioned correctly.

Illustration 20:

NOTE

Fit the upper O-ring outside the level ring, see comments to illustration 17 on page 41.

First dismantle the separator bowl as described in
“5.4.2 Cleaning of bowl” on page 38.



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* See comments on opposite page.

5.4.4 Replacement of O-rings in clarifier bowl

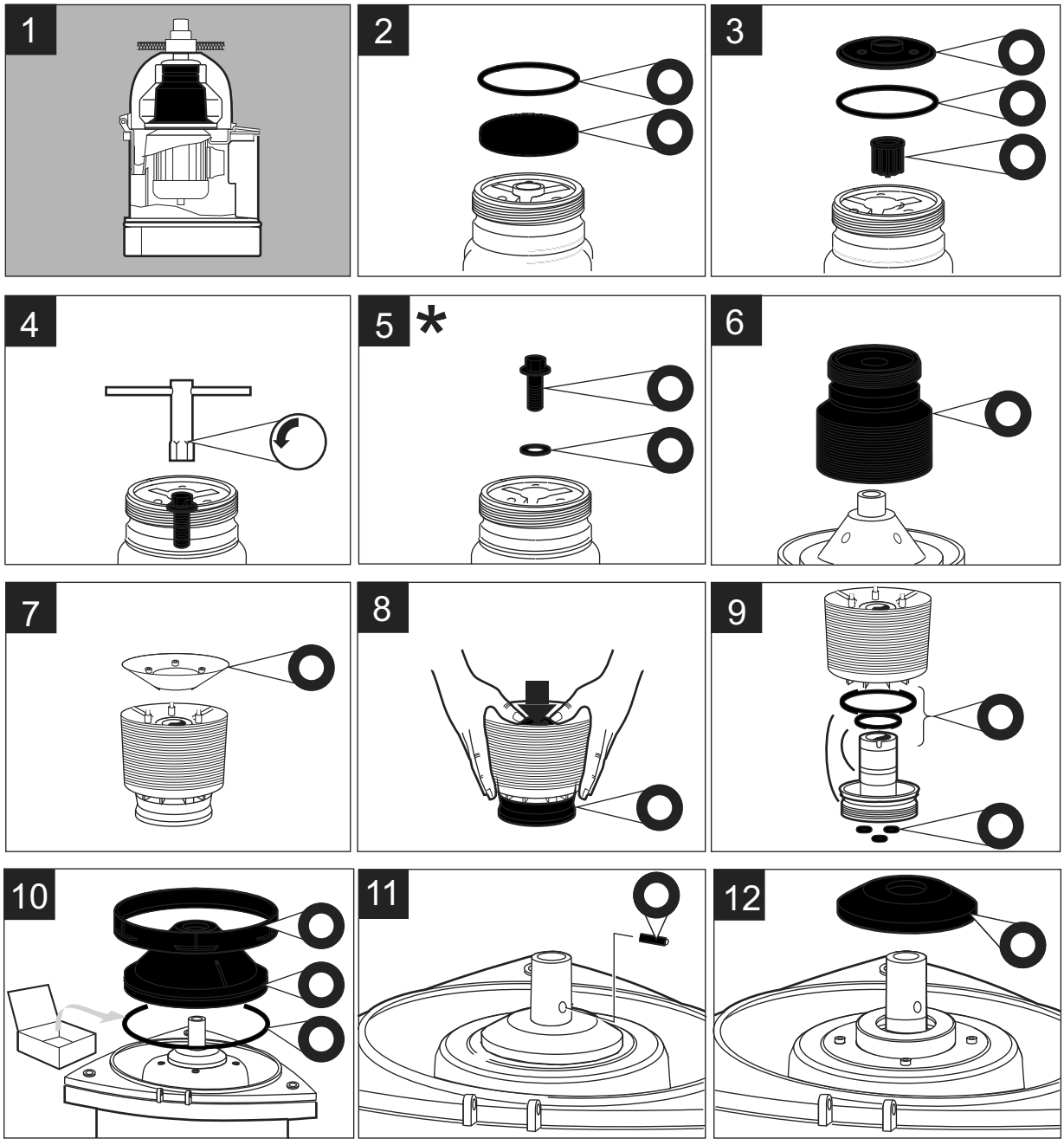
How to convert from purifier to clarifier bowl or vice versa is described in point ‘‘2.5 Changing operation mode” on page 20.

Comments to illustrations on opposite page.

Illustration 5:

Take care of the washer.

First dismantle the separator bowl as described in
“5.4.2 Cleaning of bowl” on page 38.



G05191P1

* See comments on opposite page.

Illustration 19:

Check that the washer is fitted. Otherwise there is a risk that the bowl will not make firm contact with the spindle.

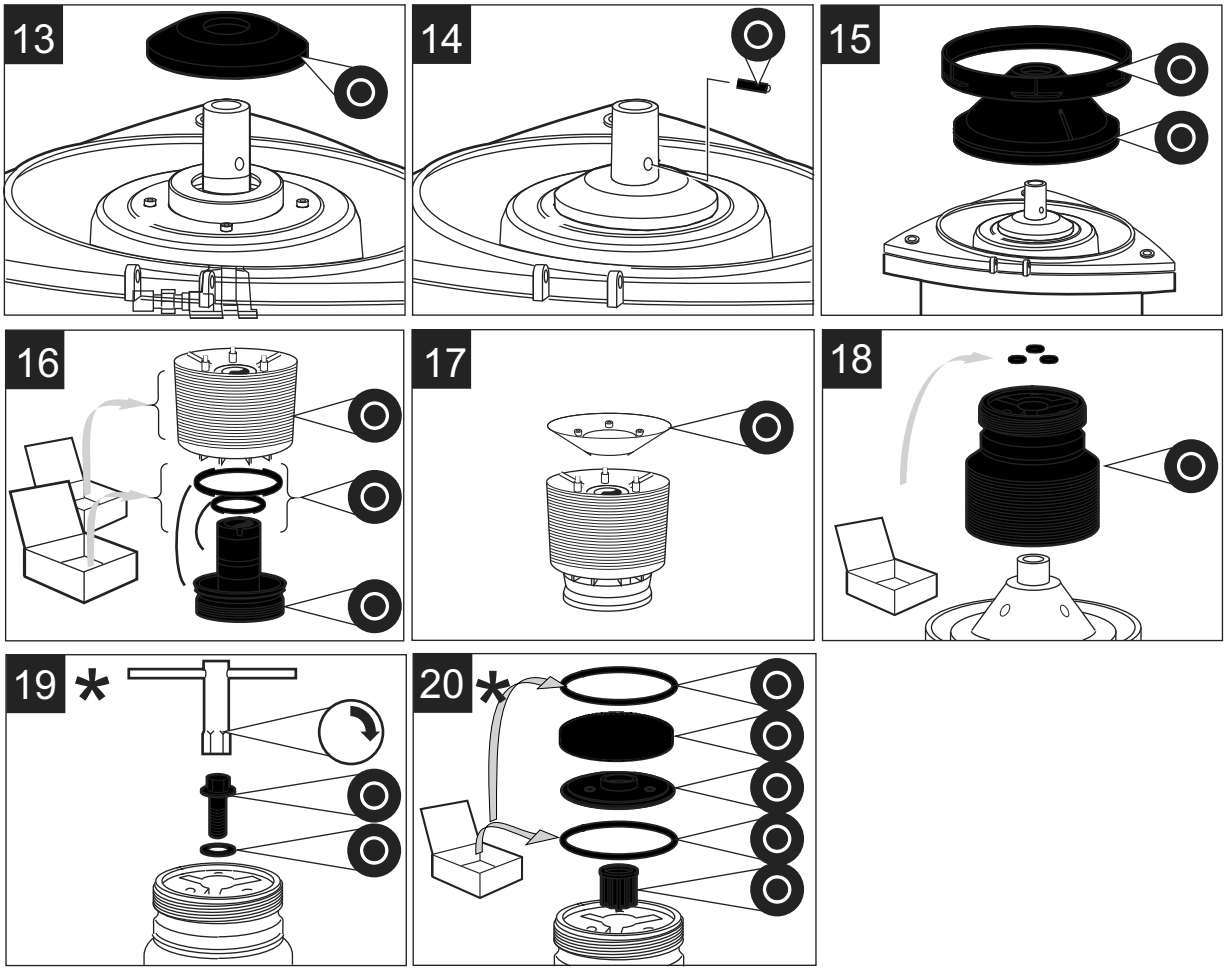
If two or more washers are fitted accidentally this will prevent the top parts of the bowl from being positioned correctly.

Illustration 20:

NOTE

Fit the upper O-ring outside the level ring, see comments to illustration 17 on page 41.

First dismantle the separator bowl as described in
“5.4.2 Cleaning of bowl” on page 38.



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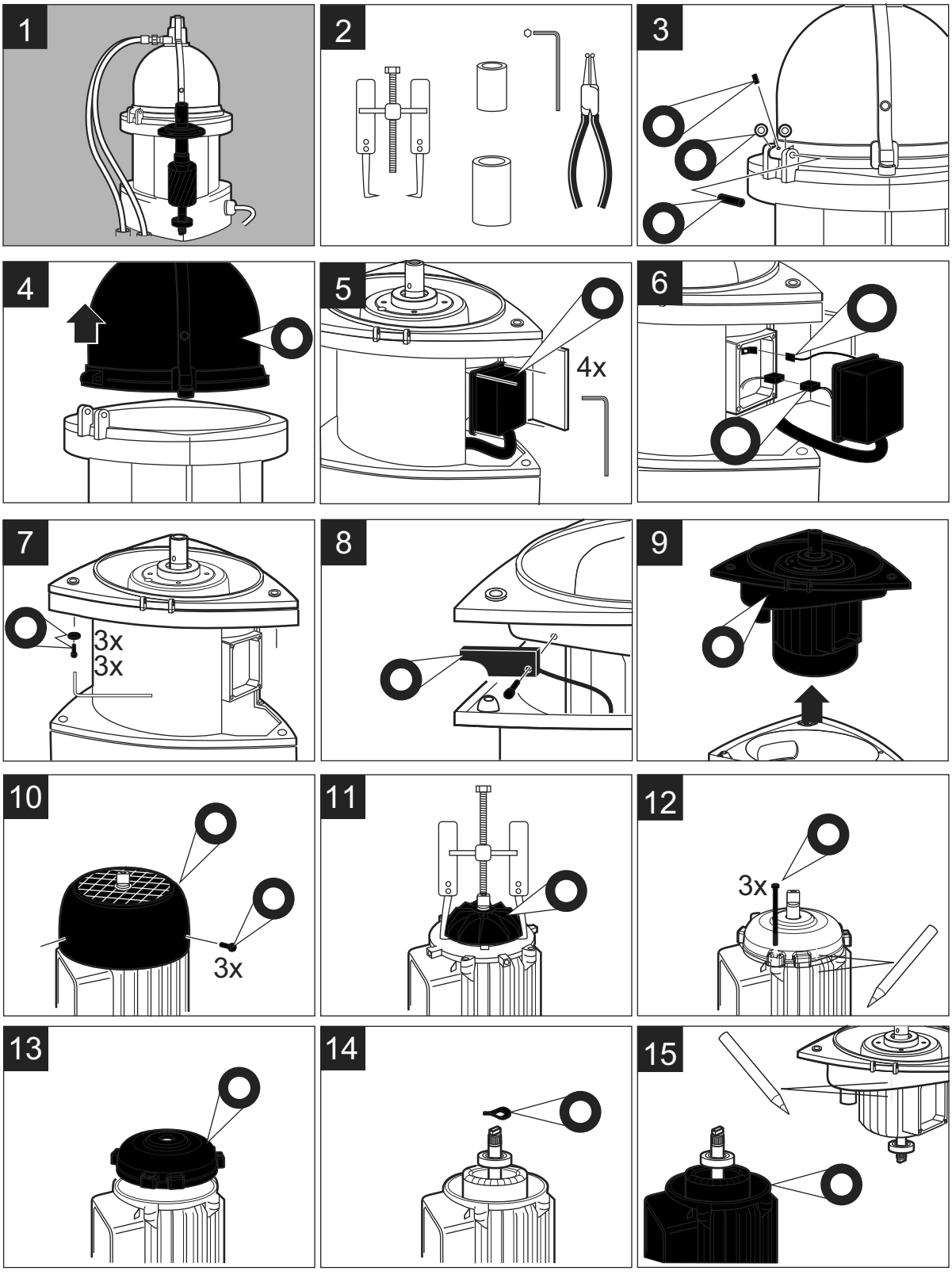
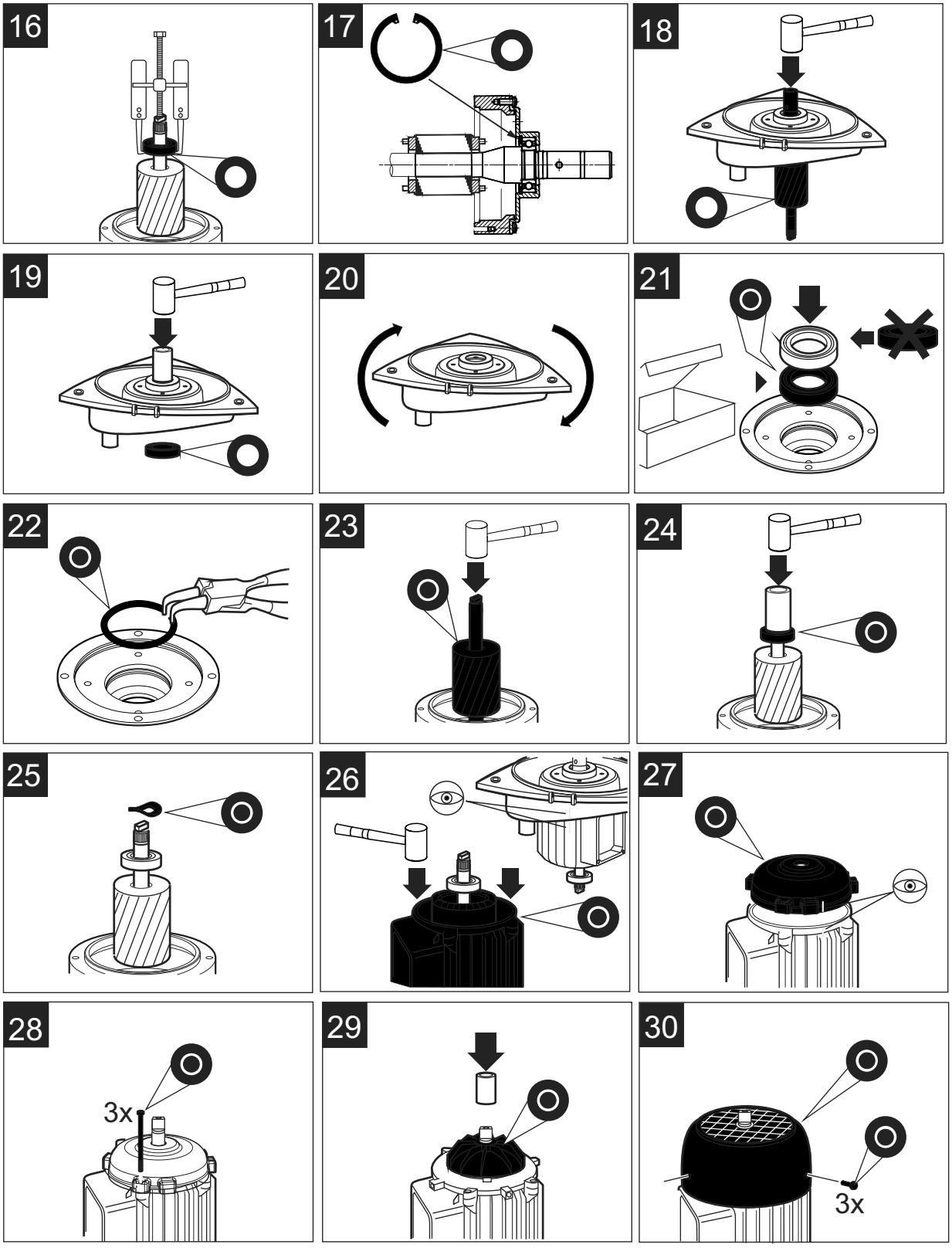
* See comments on opposite page.

5.4.5 Replacement of motor bearings

First dismantle the separator bowl as described in “5.4.2 Cleaning of bowl” on page 38.

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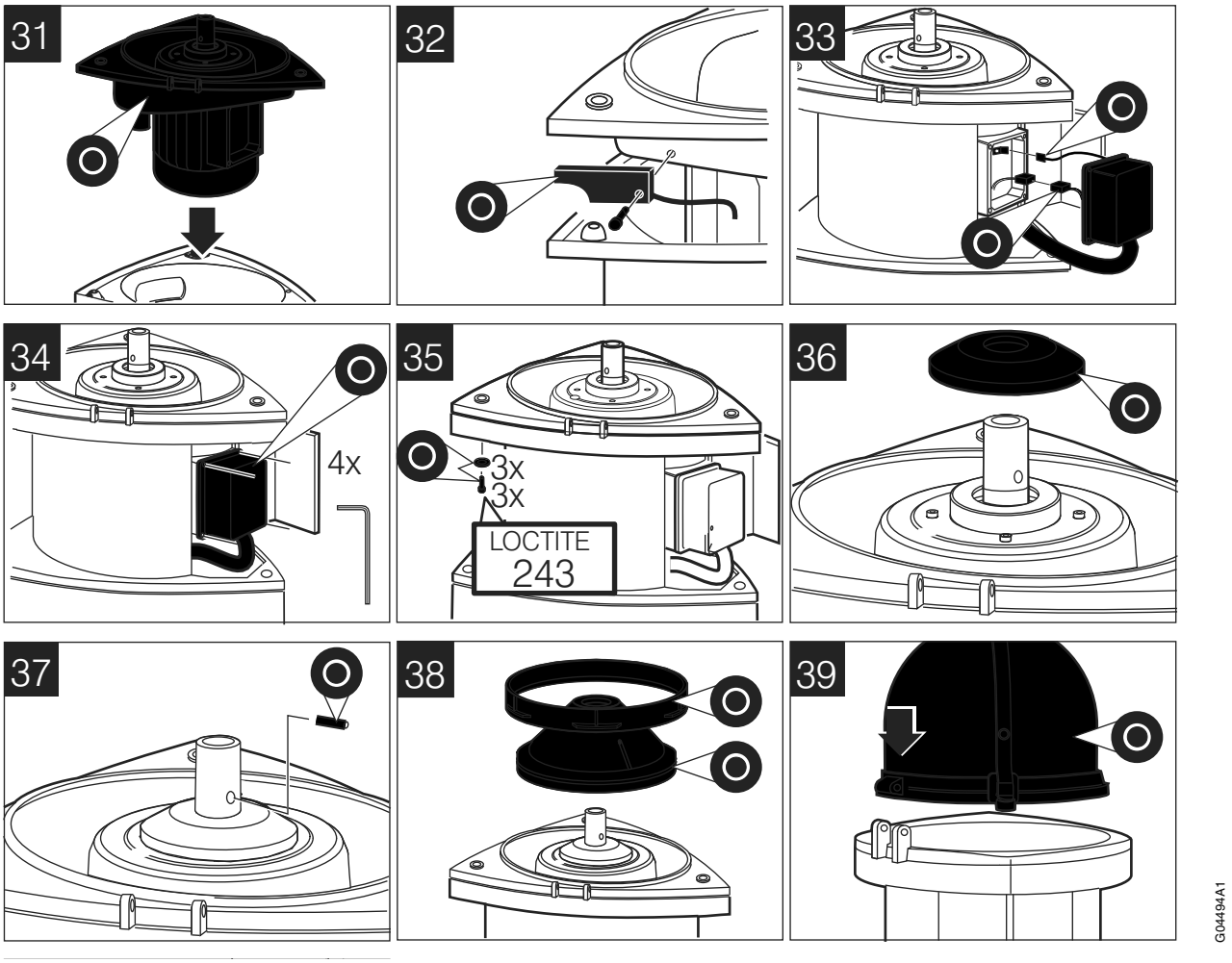
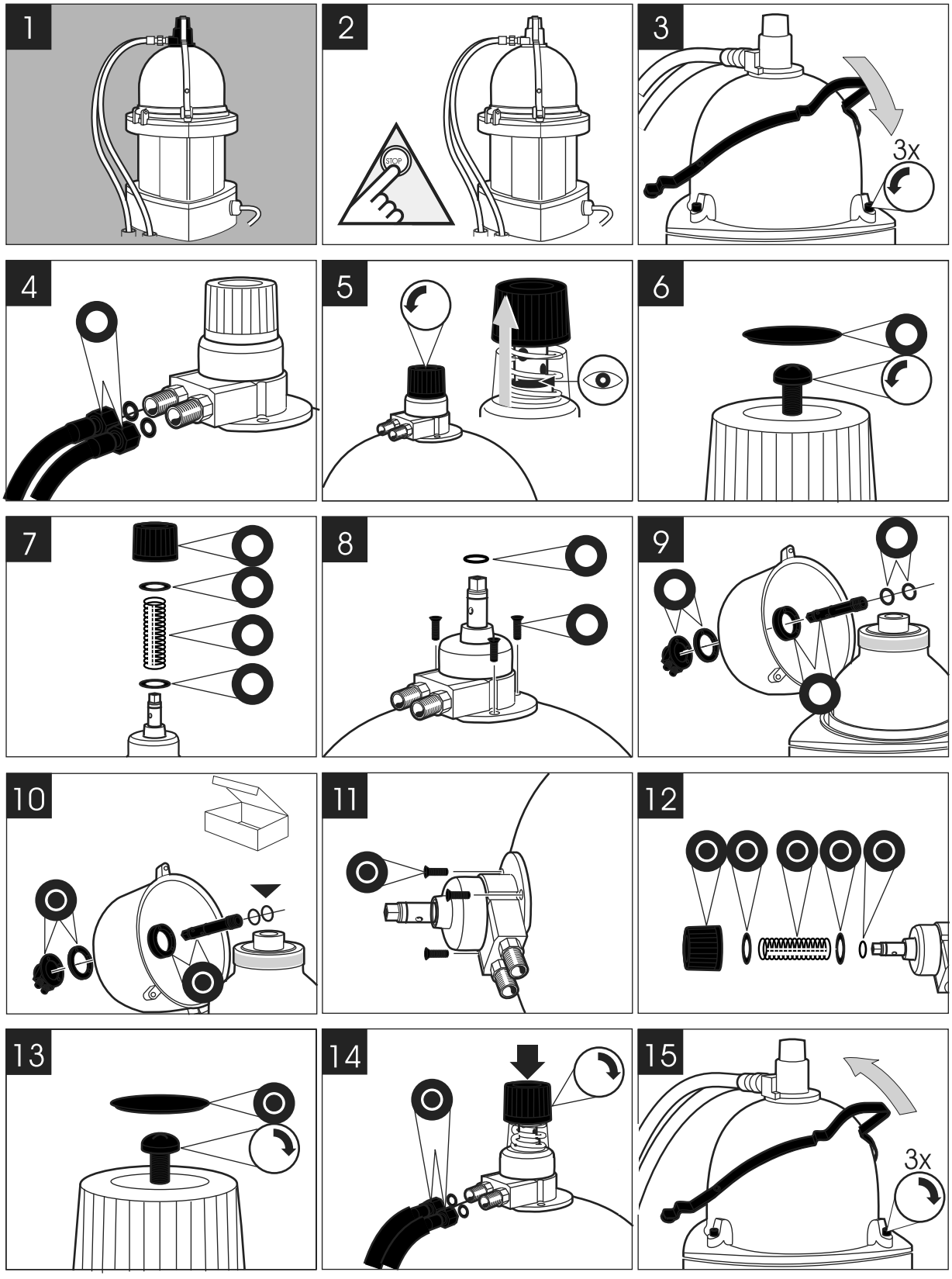


See “ **Assembly**” on page 43 for how to assemble the rest of the separator.

5.4.6 Replacement of connection housing



6 Technical references

6.1 Product description

Alfa Laval ref. 9034852, rev. 6

Product number	881176-12-01		
Separator type	MIB 503S-13/33		
Application	Removal of water and solids from HVO, gas oil, mineral oil (such as lube oil) and marine diesel oil.		
Technical design	Solid-wall bowl made of aluminium and plastic.		
	AC motor rotor mounted on the bowl spindle.		
	Rigidly mounted top bearing. Exterior rubber buffers.		
	Purifier/Clarifier function.		
Operational limits	Max. recommended flow: 1250 l/hour		
	Feed temperature: +15 °C to +95 °C		
Oil Type	**Density at +15 °C**	**Viscosity at +40 °C**	**Recommended separation temperature (°C)**
HVO	770 - 790 kg/m^3	1,5 - 6 cSt	20-40
Gas oil	810 - 860 kg/m^3	1,5 - 6 cSt	20-40
Marine diesel oil	850 - 920 kg/m^3	Up to 14 cSt	40
Lube oil	Max. 920 kg/m^3	Up to 150 cSt	95
	Ambient temperature: 0 °C to +55 °C		
	Use is restricted to above mentioned diesel fuels and mineral oils.		
	The separator cannot be installed in Hazardous Area.		
	The separator cannot be used on Flammable Liquids, heating of fuels can make them flammable.		
	Risk for corrosion and erosion has to be investigated in each case.		

6.1.1 Declaration - EU

Alfa Laval ref. 591985, rev. 12

This declaration is issued under the sole responsibility of the manufacturer.

Manufacturer: Alfa Laval Technologies AB

Manufacturer address: Alfa Laval Technologies AB, Box 74. SE-221 00 Lund- Sweden.

Type:.....

Product specification:.....

Configuration number:.....

Serial number:.....

Declaration of Incorporation of Partly Completed Machinery

The machinery complies with the relevant, essential health and safety requirements of:

Designation	Description
2006/42/EC	Machinery Directive

The following essential requirements of 2006/42/EC are applied and fulfilled:
1.1, 1.1.2, 1.1.3, 1.1.4, 1.1.5, 1.1.6, 1.1.7, 1.2.3, 1.2.4, 1.3.1, 1.3.2, 1.3.3, 1.3.4, 1.3.7, 1.3.8, 1.3.9, 1.5.1, 1.5.2, 1.5.4, 1.5.5, 1.5.6, 1.5.8, 1.5.9, 1.5.11, 1.5.15, 1.6.1, 1.6.3, 1.6.4, 1.6.5, 1.7

To meet the requirements the following standards have been applied:

Designation	Description
EN 60204-1:2018	Electrical equipment of machines, part 1: General requirements
EN ISO 12100:2010	Safety of machinery - General principles for design - Risk assessment and risk reduction
ISO 3744:2010	Acoustics - Determination of sound power levels of noise sources using sound pressure

EU Declaration of Conformity

The machinery complies with the following Directives:

Designation	Description
2014/30/EU	Electromagnetic Compatibility
2011/65/EU	Restriction of the use of certain hazardous substances in electrical and electronic equipment

To meet the requirements the following standards have been applied:

Designation	Description
EN IEC 63000:2018	Technical documentation for the assessment of electrical and electronic products with respect to the restriction of hazardous substances

The technical construction file for the machinery is compiled and retained by the authorized person Fredrik Nytomt within the Business Unit High Speed Separators,
Alfa Laval Technologies AB, Box 74. SE-221 00 Lund, Sweden. By reasoned request all relevant technical documentation will be sent by post to national authorities.

This machinery is to be incorporated into other equipment and must not be put into service until it has been completed with starting/stopping equipment, control equipment, auxiliary equipment. e.g. valves, according to the instructions in the technical documentation, and after the completed machinery has been declared in conformity with the directives mentioned above, in order to fulfill the EU-requirements.

Signed for and on behalf of: Alfa Laval Technologies AB

Place: .....

Date of issue: .....

Signature: .....

Name: .....

Function: .....

Entity .....

6.1.2 Declaration - UK

Alfa Laval ref. 591985, rev. 12

This declaration is issued under the sole responsibility of the manufacturer.

Manufacturer: Alfa Laval Technologies AB

Manufacturer address: Alfa Laval Technologies AB, Box 74. SE-221 00 Lund- Sweden.

Type:.....

Product specification:.....

Configuration number:.....

Serial number:.....

Declaration of Incorporation of Partly Completed Machinery

The machinery complies with the relevant, essential health and safety requirements of:

Supply of Machinery (Safety) Regulations 2008

The following essential requirements are applied and fulfilled:
1.1, 1.1.2, 1.1.3, 1.1.4, 1.1.5, 1.1.6, 1.1.7, 1.2.3, 1.2.4, 1.3.1, 1.3.2, 1.3.3, 1.3.4, 1.3.7, 1.3.8, 1.3.9, 1.5.1, 1.5.2, 1.5.4, 1.5.5, 1.5.6, 1.5.8, 1.5.9, 1.5.11, 1.5.15, 1.6.1, 1.6.3, 1.6.4, 1.6.5, 1.7

To meet the requirements the following standards have been applied:

Designation	**Description**
EN 60204-1:2018	Electrical equipment of machines, part 1: General requirements
EN ISO 12100:2010	Safety of machinery - General principles for design - Risk assessment and risk reduction
ISO 3744:2010	Acoustics - Determination of sound power levels of noise sources using sound pressure

UK Declaration of Conformity

The machinery complies with the following Regulations:

Designation	**Description**
Electromagnetic Compatibility Regulations 2016	
The Restriction of the Use of Certain Hazardous Substances in Electrical and Electronic Equipment Regulations 2012	

To meet the requirements the following standards have been applied:

Designation	Description
EN IEC 63000:2018	Technical documentation for the assessment of electrical and electronic products with respect to the restriction of hazardous substances

The technical construction file for the machinery is compiled and retained by the authorized person Fredrik Nytomt within the Business Unit High Speed Separators,
Alfa Laval Technologies AB, Box 74. SE-221 00 Lund, Sweden. By reasoned request all relevant technical documentation will be sent by post to national authorities.

This machinery is to be incorporated into other equipment and must not be put into service until it has been completed with starting/stopping equipment, control equipment, auxiliary equipment. e.g. valves, according to the instructions in the technical documentation, and after the completed machinery has been declared in conformity with the regulations mentioned above, in order to fulfill the UK-requirements.

Signed for and on behalf of: Alfa Laval Technologies AB

Place: .....

Date of issue: .....

Signature: .....

Name: .....

Function: .....

Entity .....

6.1.3 Technical data

Alfa Laval ref. 9034806 rev. 0

General technical data:

Motor power:	0.45 kW
Rated motor current:	2.4 A
Power consumption, idling/max. capacity:	0.2 / 0.4 kW
Gear ratio:	direct drive
Bowl inner diameter, max.:	176 mm
Jp reduced to motor shaft:	0.03 kgm²
Start time max.:	0.5 minutes
Density feed/sediment, max.:	1100 / 1600 kg/m³
Feed temperature, min./max.:	15 / 95 °C
Bowl material:	AL 111 4212-06

Operating data:

Allowed speed, max.:	7500 r/min
Speed motor shaft max:	7500 r/min
Stop time, normal stop, max.:	3 minutes
Sound power:	7.9 dBel(A)
Sound pressure:	62 dB(A)
Vibrations, separator in use:	30 mm/s (r.m.s)

Volume and capacity data:

Hydraulic capacity, bowl, max.:	1. 25 m³/h
Bowl liquid volume:	1.1 litres

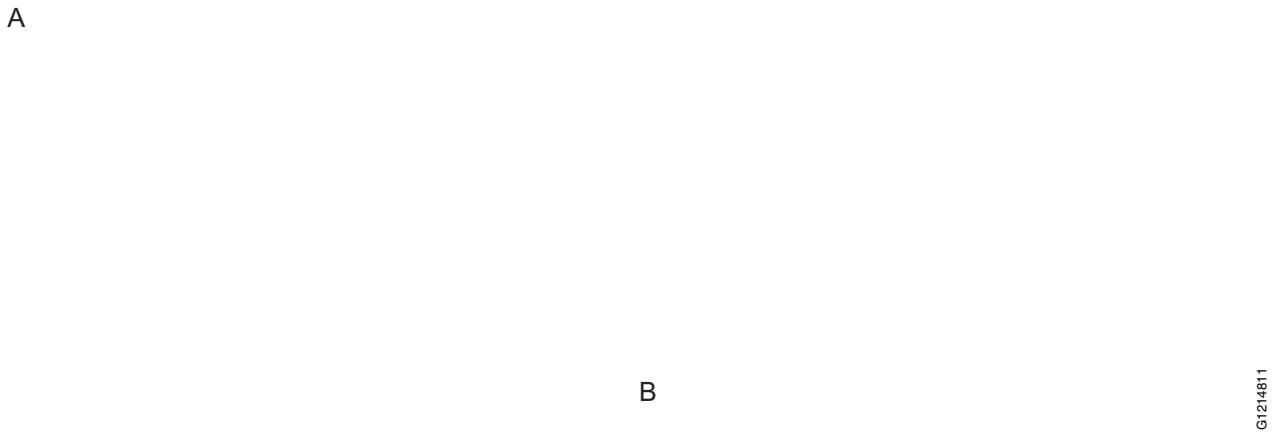
Weight information:

Bowl weight:	4 kg
Weight of separator:	18 kg

6.2 Performance data inlet/outlet device

Alfa Laval ref. 9035652 rev. 0

Maximal light phase counter pressure

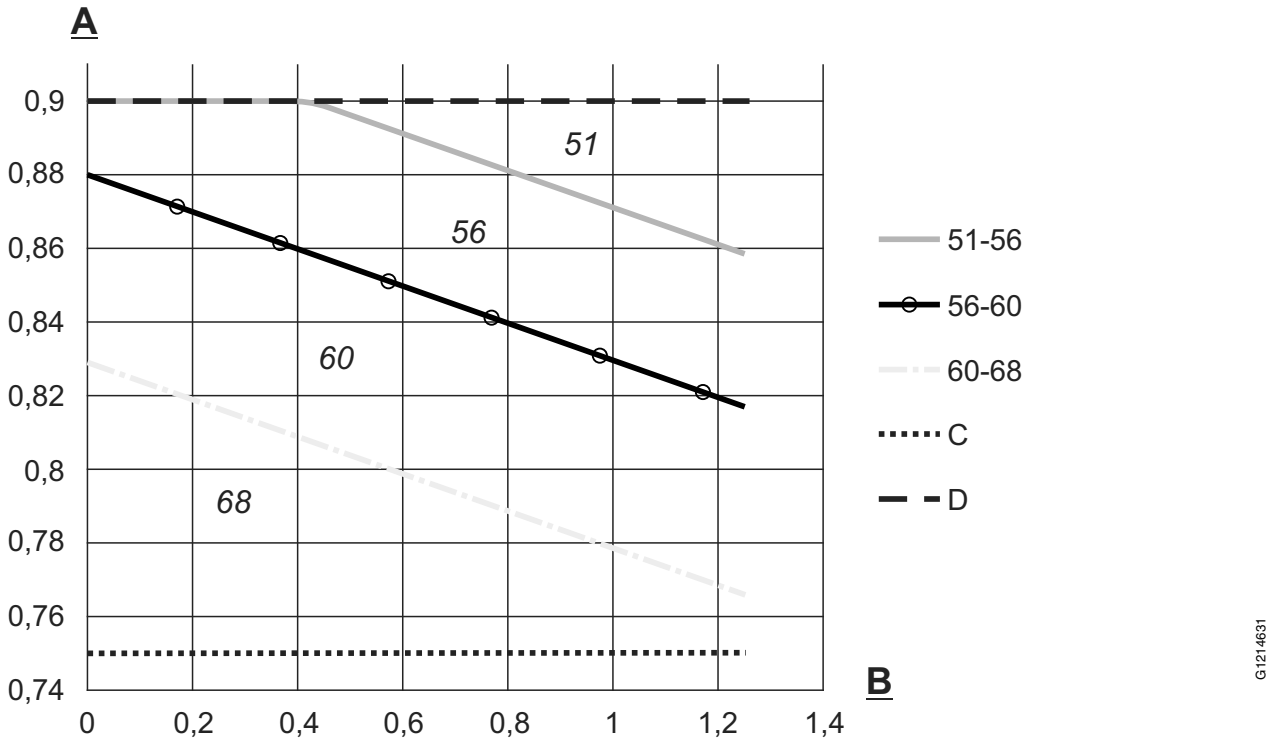


A. Counter pressure (kPa)
B. Flow rate m^3/h

6.3 Nomogram

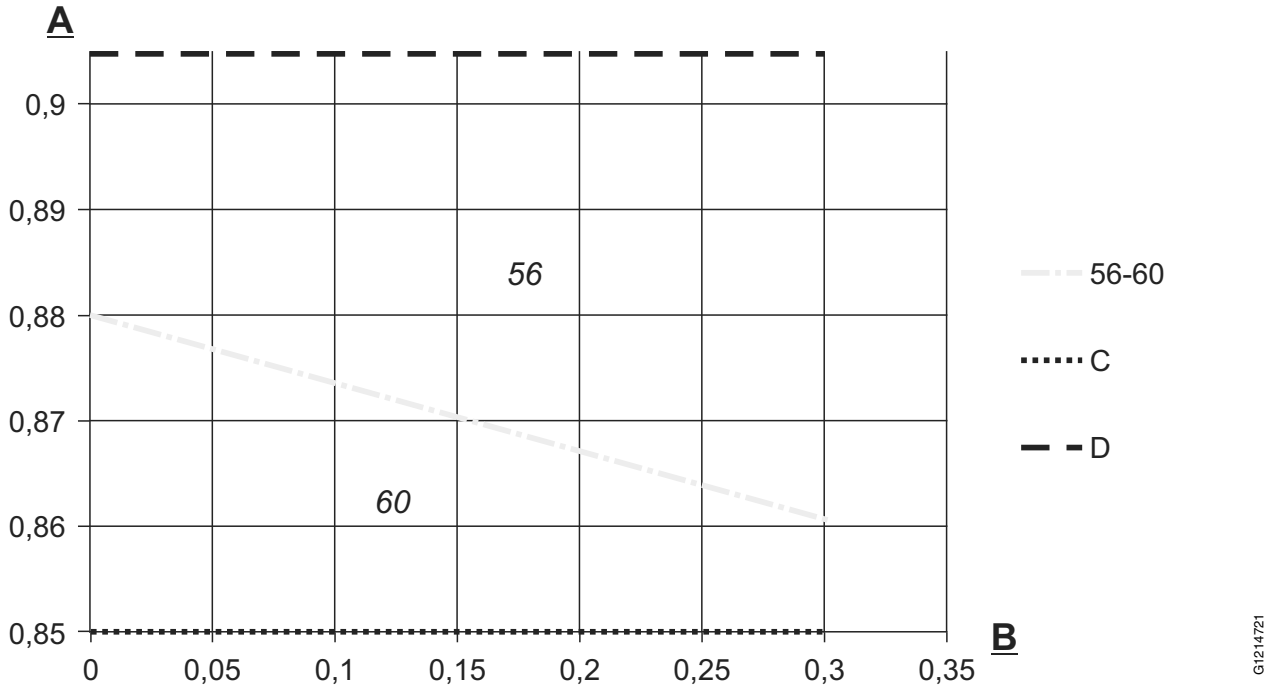
Alfa Laval ref. 9035653 rev. 3

MIB 503, GO/MDO, selection of bowl bottoms



A. Density ratio at separation temperature
B. Flow rate m^3/h
C. Min density
D. Max density

MIB 503, LO, selection of bowl bottoms

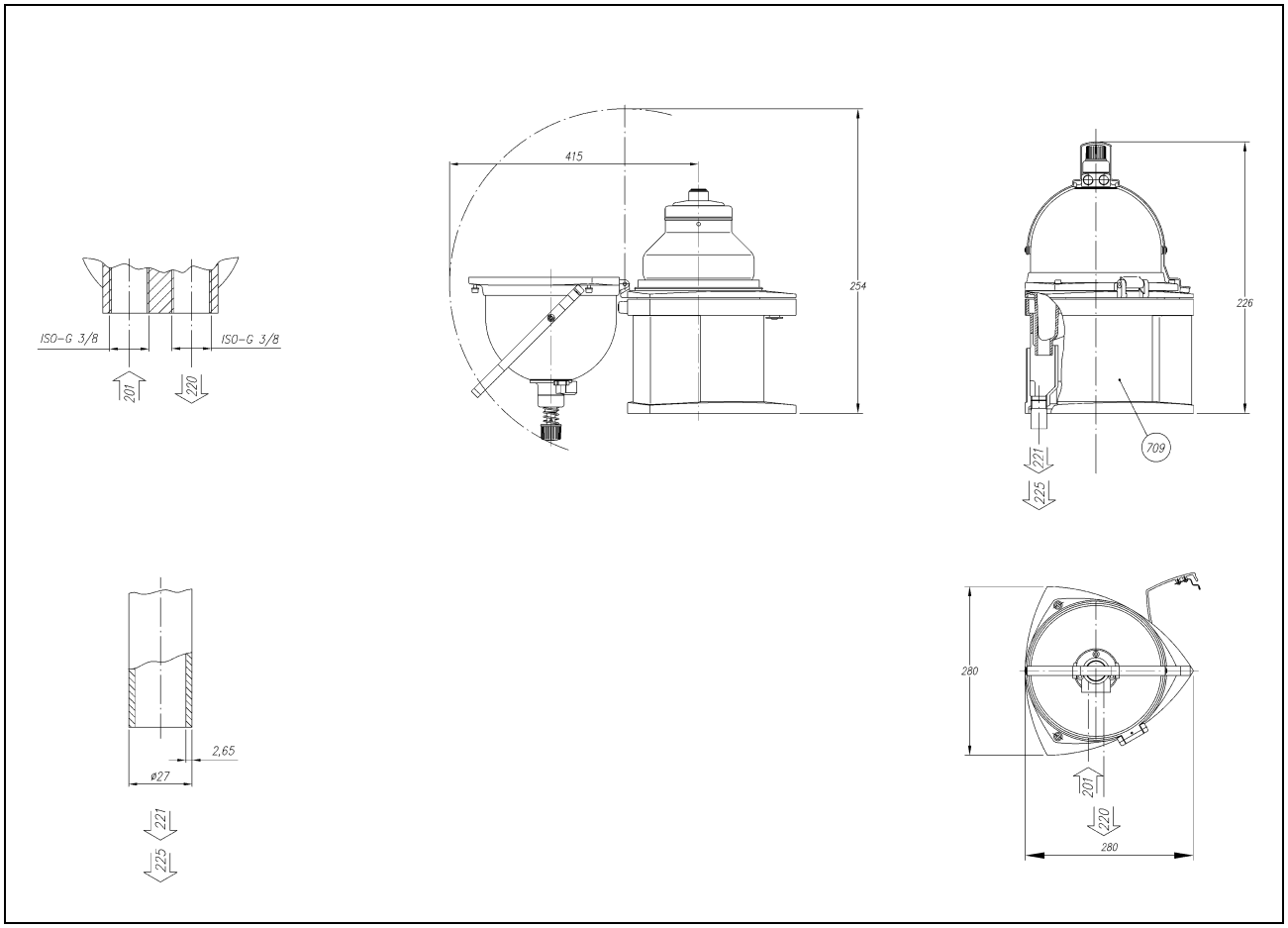


A. Density ratio at separation temperature
B. Flow rate m^3/h
C. Min density
D. Max density

6.4 Basic size drawing

6.4.1 Purifier

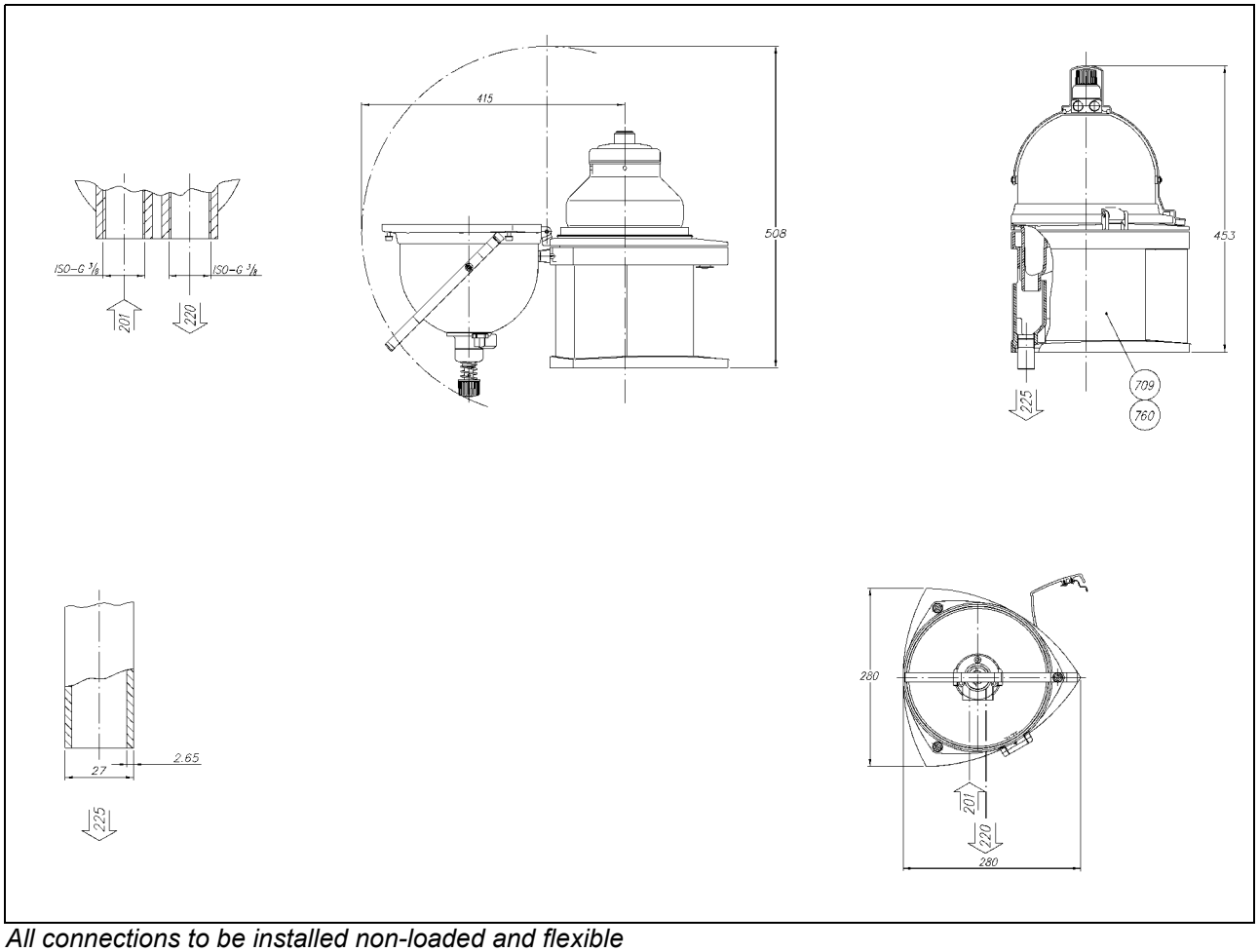
Alfa Laval ref. 598944, rev. 0



All connections to be installed non-loaded and flexible
See connection list for data on connections.

6.4.2 Clarifier

Alfa Laval ref. 598945, rev. 0



All connections to be installed non-loaded and flexible
See connection list for data on connections.

6.5 Connection list

Alfa Laval ref. 9034848 rev. 0, 9034849 rev. 0

No.	Description	Requirements/limits	
		MIB 503S-	
		-13 230 VAC	-33 230 VAC
201	Inlet for process liquid		
	– Allowed temperature	Min. 15 °C, Max. +95 °C	
	– Viscosity	Max. 14 cSt	Max. 50 cSt
	– Flowrate	Max. 1250 litres/h	
	– Pressure	0 - 75 kPa	
220	Outlet for light phase, clarified liquid		
	– Counter pressure	50-250 kPa	
221	Outlet for heavy phase		
	– Counter pressure	0 kPa	
225	Bowl drain outlet	No counter pressure	
709	Electrical connection	See “6.6 Interface description”.	
	– Power supply from VFD	125 Hz, 230 V	
760	Cover interlocking switch	See “6.6 Interface description”	
	– Type	Magnetic proximity switch	
	– Switch rating, Voltage Load	230 V AC 20 VA	

6.6 Interface description

Alfa Laval ref. 576923 rev. 1

6.6.1 Scope

This document gives information, requirements and recommendations about operational procedures and signal processing for safe and reliable operation of the separator. It is intended to be used for designing auxiliary equipment and control system for the separator.

6.6.2 References

This *Interface Description* is one complementary document to the separator. Other such documents that contain necessary information and are referred to here are:

Interconnection Diagram.

‘‘6.5 Connection list” on page 68.

“6.1.3 Technical data” on page 62.

Standards referred to are:

- EN ISO 13850 Safety of machinery - Emergency stop equipment, functional aspects - Principles of design
- EN ISO 14118 Safety of machinery - Prevention of unexpected start-up
- EN ISO 13849-1 Safety of machinery – Safety related parts of control systems – Part 1 General principles for design

6.6.3 Definitions

For the purpose of this document, the following definitions apply:

- **Maximum allowed speed**: The speed the separator bowl and other, to the bowl spindle attached parts, never shall exceed.
- **Change of separator mode**: It is assumed that the control system has done a reasonable amount of trials to correct the fault condition before further steps are initiated.

6.6.4 Goal

To eliminate situations that can cause harm, i.e. injury, damage to health or property and unsatisfactory process result are e.g.:

Situation	Effect
Failure in control system	Too high stress on bowl which might cause harm.
Unbalance caused by uneven sediment accumulation in the bowl.	Too high stress on bowl and bearing system which might cause harm.
Bowl speed exceeding maximum allowable rotor speed.	Too high stress on bowl which might cause harm.
Insufficient cleaning of separator.	Unsatisfactory product quality.
Bowl leakage.	Product losses.

Information and instructions given in this document aim at preventing these situations.

For this reasons functions that are indispensable or needed for safety reasons to protect the machine and/or personnel are denoted with shall while other functions are denoted with *should.*

6.6.5 Description of separator modes

For control purposes the operation of the separator should be divided into different modes.

The normally used modes are described below but other modes might exist.

It is assumed that:

- The separator is correctly assembled.
- All connections are made according to Connection List, Interconnection Diagram, and Interface Description.
- The separator control system is activated.

If above conditions are not fulfilled the separator will be in *SERVICE* mode.

STAND STILL means:

- The power to the separator motor is off
- The bowl is not rotating.

STARTING means:

- The power to the separator motor is on.
- The bowl is rotating and accelerating

RUNNING means:

- The power to the separator motor is on.
- The bowl is rotating at operating speed.
- *RUNNING* is a collective denomination for a number of sub modes which e.g. can be:
  - *STAND BY*: Separator is in a waiting mode and not producing.
  - *PRODUCTION*: Separator is fed with product and producing.

STOPPING means:

- The power to the separator motor is off.
- The bowl is rotating and decelerating.
- *STOPPING* is a collective denomination for a number of sub modes which e.g. can be:
  - *NORMAL STOP*: A manually or automatically initiated stop.
  - *SAFETY STOP*: An automatically initiated stop.
  - *EMERGENCY STOP*: A manually initiated stop at emergency situations. This stop will be in effect until it is manually reset.

6.6.6 Handling of connection interfaces

Electrical connections

701 Separator motor.

The separator is equipped with a 3-phase special motor. The motor is intended to be fed from a electric power drive. The design of the electric power drive shall include an overspeed protection which prevents the separator to reach a speed that exceeds the ”Maximum allowed speed” stated in the*“6.1.3 Technical data” on page 62*.

The electric power drive shall be protected against intentionally and unintentionally overspeed settings.

The acceleration period is to be chosen with regard to the separator’s moment of inertia, the braking torque during start, the motor’s rated torque.

The design, installation and handling of the electric power device shall follow local laws, standards and directives in force as well as international.

There shall be an emergency stop circuit designed according to EN ISO 13850 and a power isolation device according to EN ISO 14118.

There shall be a start button close to the separator that shall be used for first start after assembly of the separator.

Signal processing in *STARTING*:

- The separator should be stopped automatically according to *NORMAL STOP* procedure and an alarm should be given when the accumulated time for acceleration is longer than the maximum time specified in ”Technical Data”. An abnormal start time indicates some malfunction of the separator equipment and should be investigated.

Signal processing in *RUNNING*:

- If low speed is indicated, the separator should be stopped automatically according to *NORMAL STOP* procedure and an alarm should be given. Low speed indicates some malfunction of the separator equipment and shall be investigated.

760 Cover interlocking switch

The separator is equipped with a safety yoke and an interlocking switch. When the cover is closed and the yoke is in the upright position the interlocking circuit is closed and the separator could be started.

Signal processing

The cover interlocking switch should be connected so that starting and running

of the motor is prevented when the interlocking circuit is not closed.

6.6.7 Fluid connections

Complementary information is given in the document *"6.1.3 Technical data" on page 62*.

201 Inlet

Processing in *STAND STILL*:

- Shall be closed.

Processing in *STARTING*:

- Shall be closed. Bowl will be empty or filled depending on if start is done from *STAND STILL* or *STOPPING*.

Processing in *RUNNING*:

- Could be closed or open.

Processing in *NORMAL STOP* or *EMERGENCY STOP*:

- Could be closed or open but the bowl should be filled unless the stop is initiated in *STARTING*.

Processing in *SAFETY STOP*:

- Could be closed or open but the bowl should be filled unless the stop is initiated in *STARTING*.

220, 221 and 225 Outlets

Processing in *STAND STILL*:

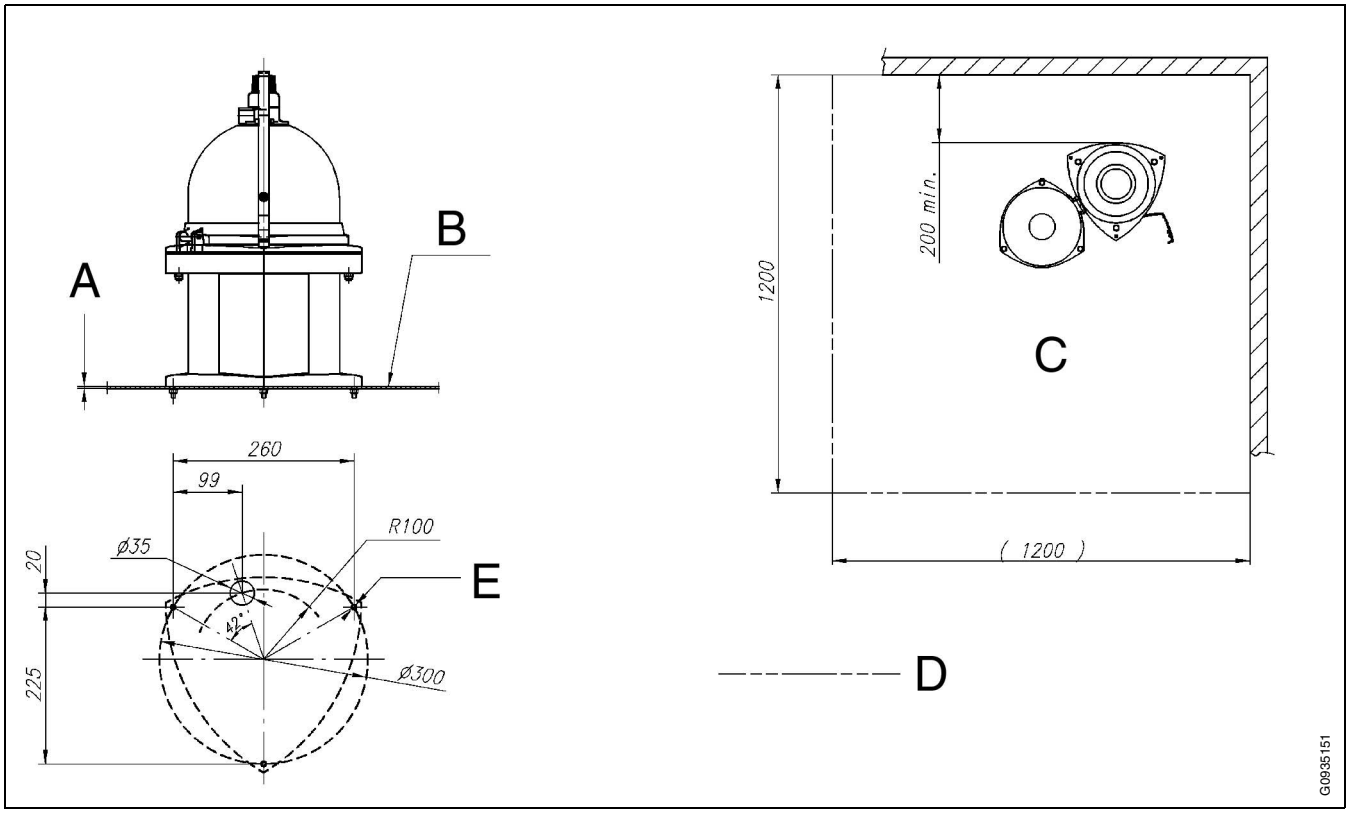
- Could be closed or open.

Processing in other modes:

- Shall be open.

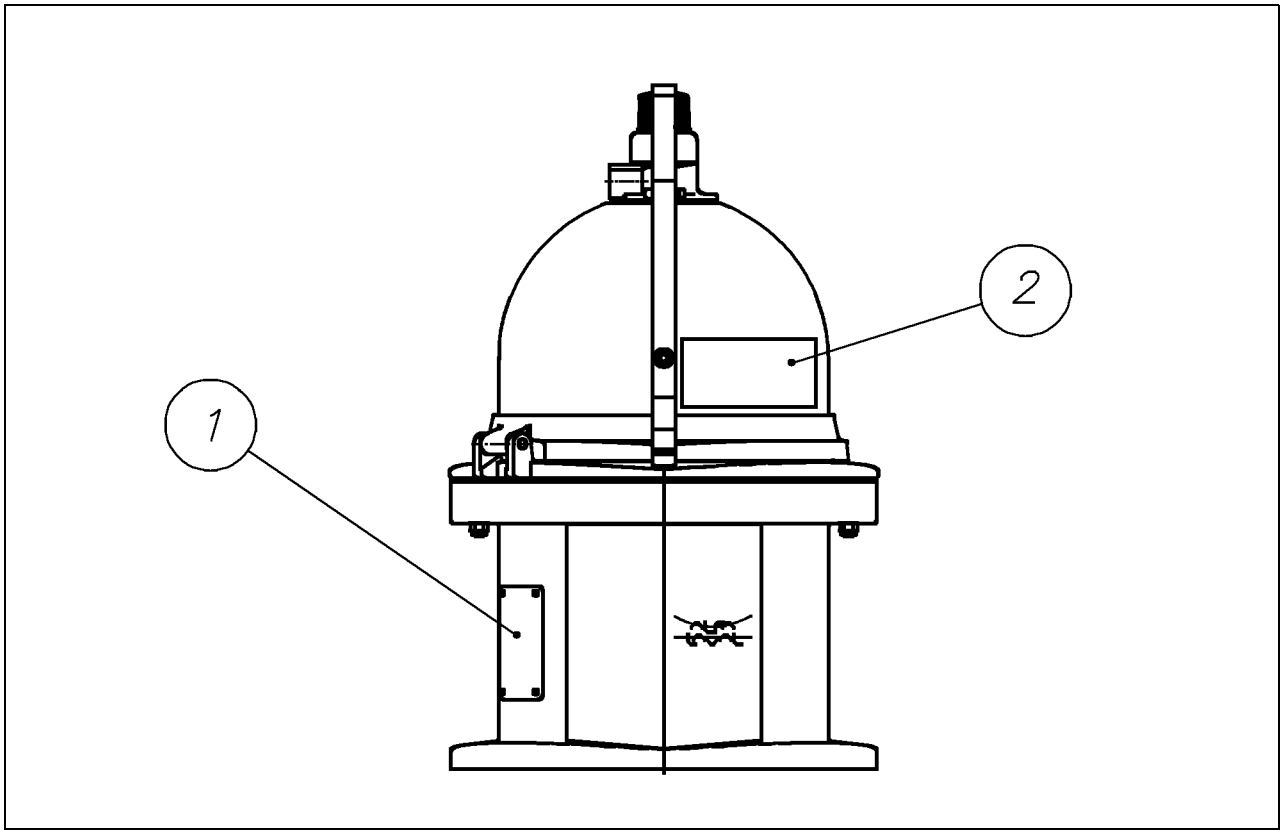
6.7 Foundation drawing

Alfa Laval ref. 576170, rev. 0



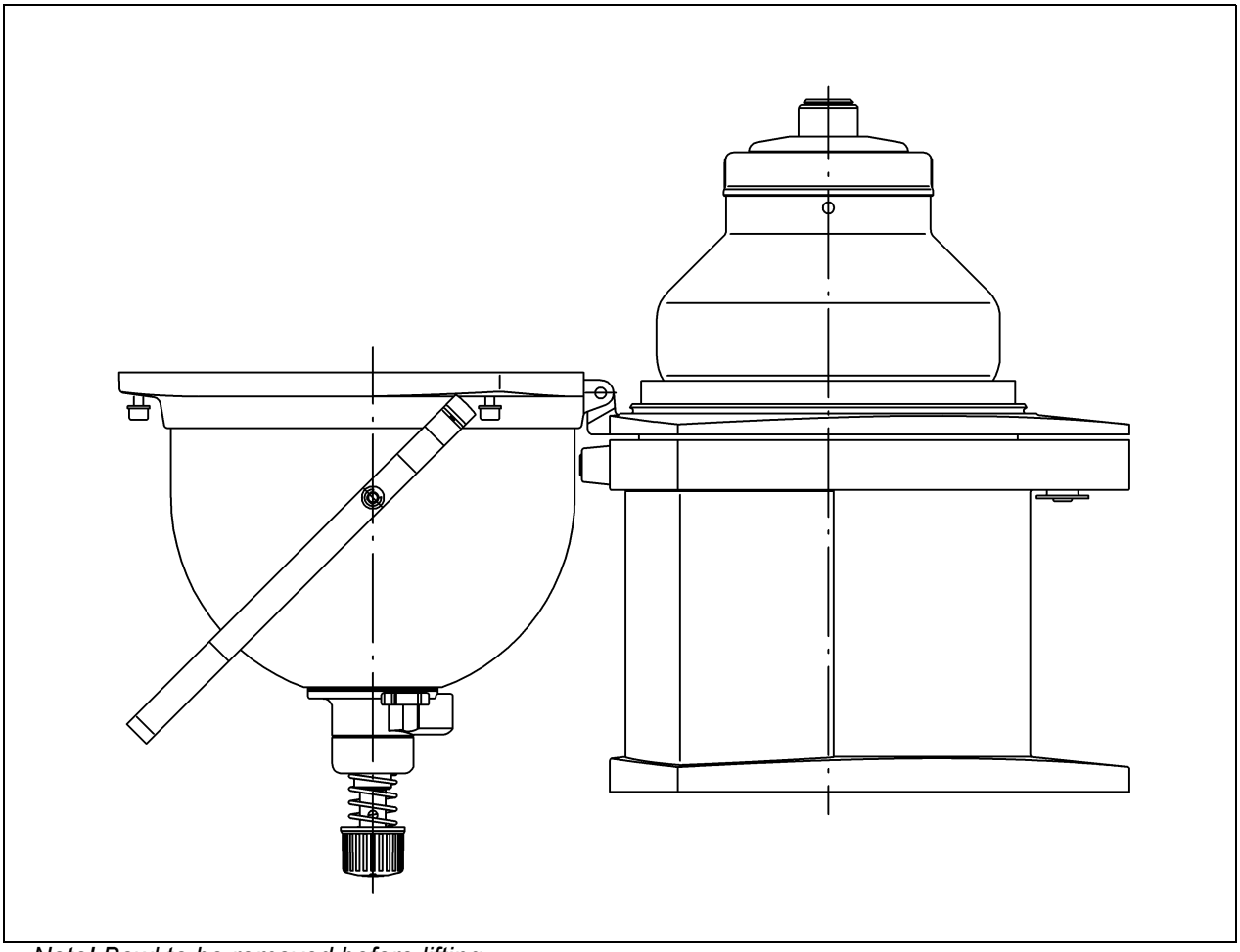
A. Recommended thickness 3 mm
B. Horizontal deviation, max. 3°
C. Service side
D. Recommended free floor space
E. 3 holes, Ø7 mm, spaced 120° for foundation bolts.

6.8 Machine plates



1. *Machine plate*
2. *Safety label*

6.9 Lifting instructions



Note! Bowl to be removed before lifting.

Weight: Bowl = 4 kg
Separator (without bowl) = 14 kg