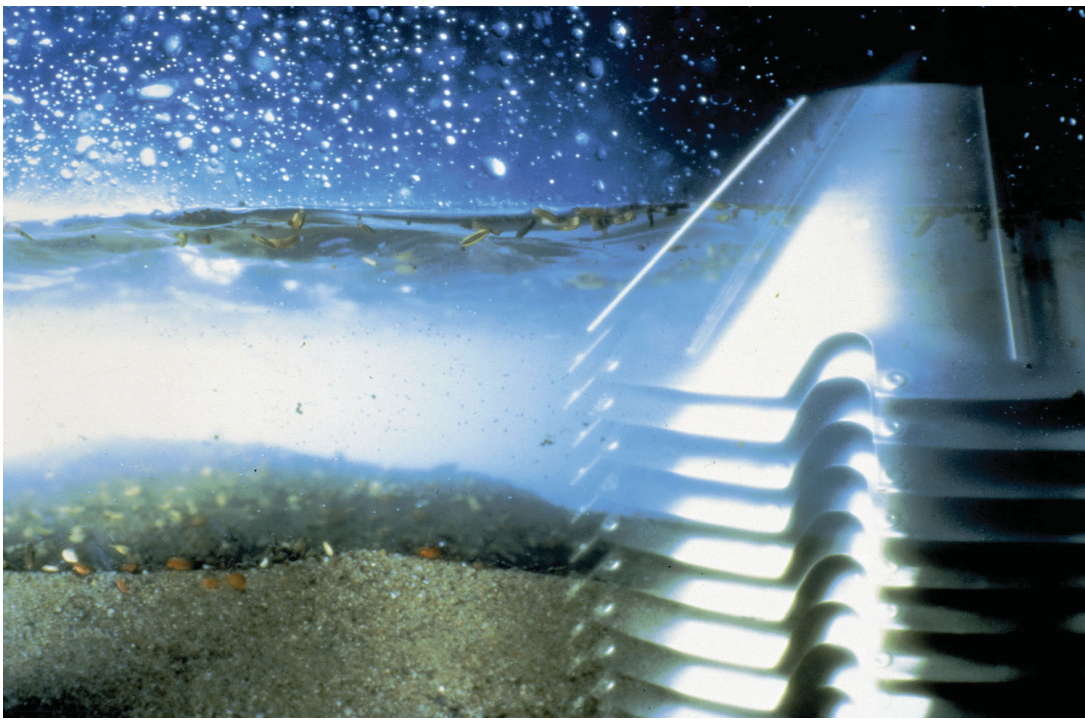
# Operators Manual



## Tetra Centri®

High Speed Separator

H60

Specification No. 881277-01-01/23
Book No. 9002486-02, Rev. 1
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Tetra Pak

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**Study 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 Read this first

This manual is designed for operators and service engineers working with Alfa Laval separators.

If the separator has been delivered and installed by Alfa Laval as part of a processing system, this manual is a part of the System Manual. In this case carefully study all the instructions in the System Manual.

The documentation for the separator consist of:

- *Installation Manual (ISM)*
- *Operator´s Manual (OPM)*
- *Service & Maintenance Manual (SEM)*
- *Spare Parts Catalogue (SPC)*

Complementary information for additional system components may be supplied depending on order configuration.

# 2 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.**



**Disintegration hazards**

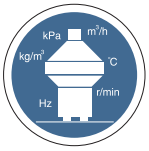
- When power cables are connected, always check direction of motor rotation. If incorrect, vital rotating parts could unscrew.



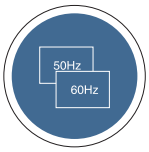
- If excessive vibration occurs, **stop** separator and **keep bowl filled** with liquid during rundown.



- Use the separator only for the purpose and parameter range specified by Alfa Laval.




- Check that the gear/pulley ratio is correct for power frequency used. If incorrect, subsequent overspeed may result in a serious break down.




- If the separator is run by a variable frequency drive, it is extremely important that the frequency does not exceed the allowed maximum, to avoid serious break down by too high speed.
- Wear on the large lock ring thread must not exceed safety limit.Φ-mark on lock ring must not pass opposite Φ-mark by more than specified distance.




- Welding or heating of parts that rotate can seriously affect material strength.



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





**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.



- 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.



**Electrical hazard**

- Follow local regulations for electrical installation and earthing (grounding).
- To avoid accidental start, switch off and lock power supply before starting **any** dismantling work.



**Crush hazards**

- Use correct lifting tools and follow lifting instructions.



- Do **not** work under a hanging load.



**Noise hazards**

- Use ear protection in noisy environments.



**Burn hazards**

- Lubrication oil, machine parts and various machine surfaces can be hot and cause burns. Wear protective gloves.





**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.



**Cut hazards**

- Sharp edges, especially on bowl discs and threads, can cause cuts. Wear protective gloves.



**Flying objects**

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



**Health hazards**

- Risk for unhealthy dust when handling friction blocks/pads. Use a dust mask to make sure not to inhale any dust





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




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




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




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



## 2.2 Environmental issues

**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.



## 2.3 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.

## 2.4 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.



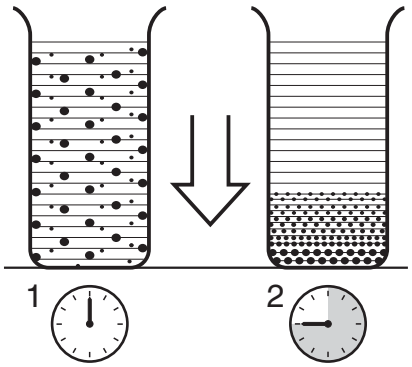
# 3 Separator basics

## 3.1 Basic principles of separation

### 3.1.1 Introduction

The purpose of separation can be:

- to free a liquid of solid particles,
- to separate two mutually insoluble liquids with different densities while removing any solids presents at the same time,
- to separate and concentrate solid particles from a liquid.




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*Sedimentation by gravity*

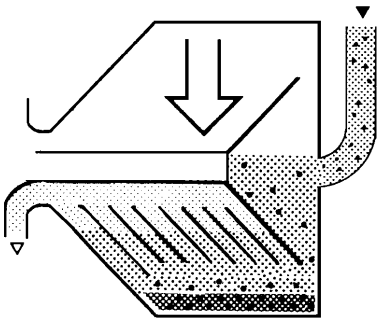
### 3.1.2 Separation by gravity

A liquid mixture in a stationary bowl will clear slowly as the heavy particles in the liquid mixture sink to the bottom under the influence of gravity.

A lighter liquid rises while a heavier liquid and solids sink.

Continuous separation and sedimentation can be achieved in a settling tank having inlet and outlet arranged according to the illustration.

Heavier particles in the liquid mixture will settle and form a sediment layer on the tank bottom.



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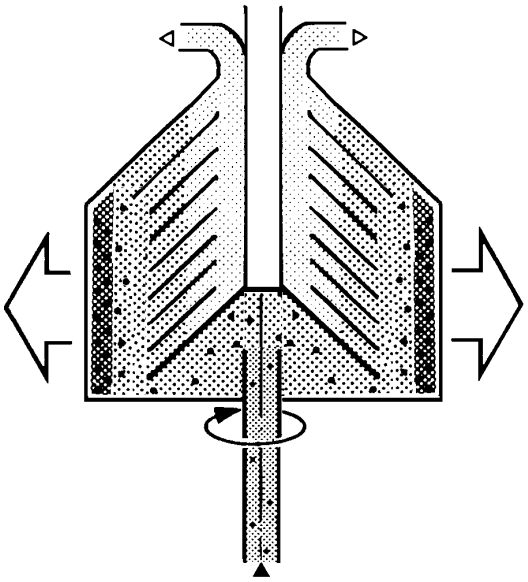
*Sedimentation in a settling tank with the outlet making it possible to separate the liquid from the sediment*

## 3.1.3 Centrifugal separation

In a rapidly rotating bowl, the force of gravity is replaced by centrifugal force, which can be thousands of times greater.

Separation and sedimentation is continuous and happens very quickly.

The centrifugal force in the separator bowl can achieve in a few seconds what takes many hours in a tank under influence of gravity.

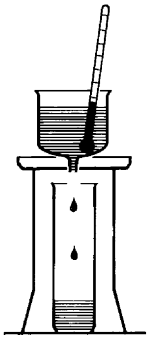


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*The centrifugal solution*

## 3.1.4 Separating temperatures

For some types of process liquids a high separating temperature will normally increase the separation capacity. The temperature influences viscosity and density and should be kept constant throughout the separation.

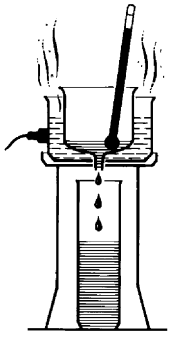


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*High viscosity (with low temperature)*

**Viscosity**

Low viscosity facilitates separation. Viscosity can be reduced by heating.

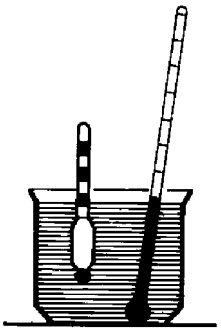


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*Low viscosity (with high temperature)*

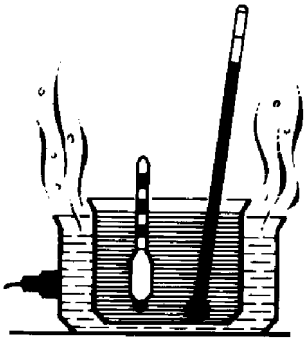
### Density difference

The greater the density difference between the two liquids, the easier the separation. The density difference can be increased by heating.



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*High density (with low temperature)*



G0011321

*Low density (with high temperature)*

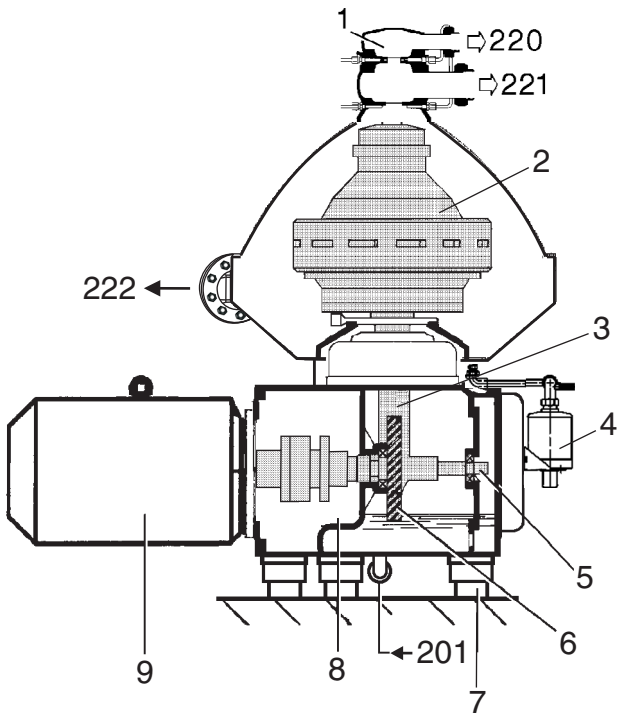
# 3.2 Design and function

## 3.2.1 Overview

The separator comprises a processing part and a driving part. It is driven by an electric motor (9). The motor is fanged to the frame as shown in the illustration.

The bottom part of the separator contains the horizontal driving device (5), driving shaft with a flexible coupling (8), a worm gear (6) and a vertical driving device (3). The bowl spindle is hollow and its lower end is connected to the liquid inlet (201). The bottom part also contains an oil bath for the worm gear.

The upper part of the separator contains the processing parts, the bowl (2) and the outlet device (1).




G1018611

*1. Outlet device*
*2. Bowl*
*3. Vertical driving device with bowl spindle*
*4. Operating water module (OWMC)*
*5. Horizontal driving device*
*6. Worm gear*
*7. Foundation feet*
*8. Flexible coupling*
*9. Electric motor*
*201. Unseparated liquid inlet*
*220. Separated light liquid phase outlet*
*221. Separated heavy liquid phase outlet*
*222. Sediment outlet*

**Twin phase outlet**

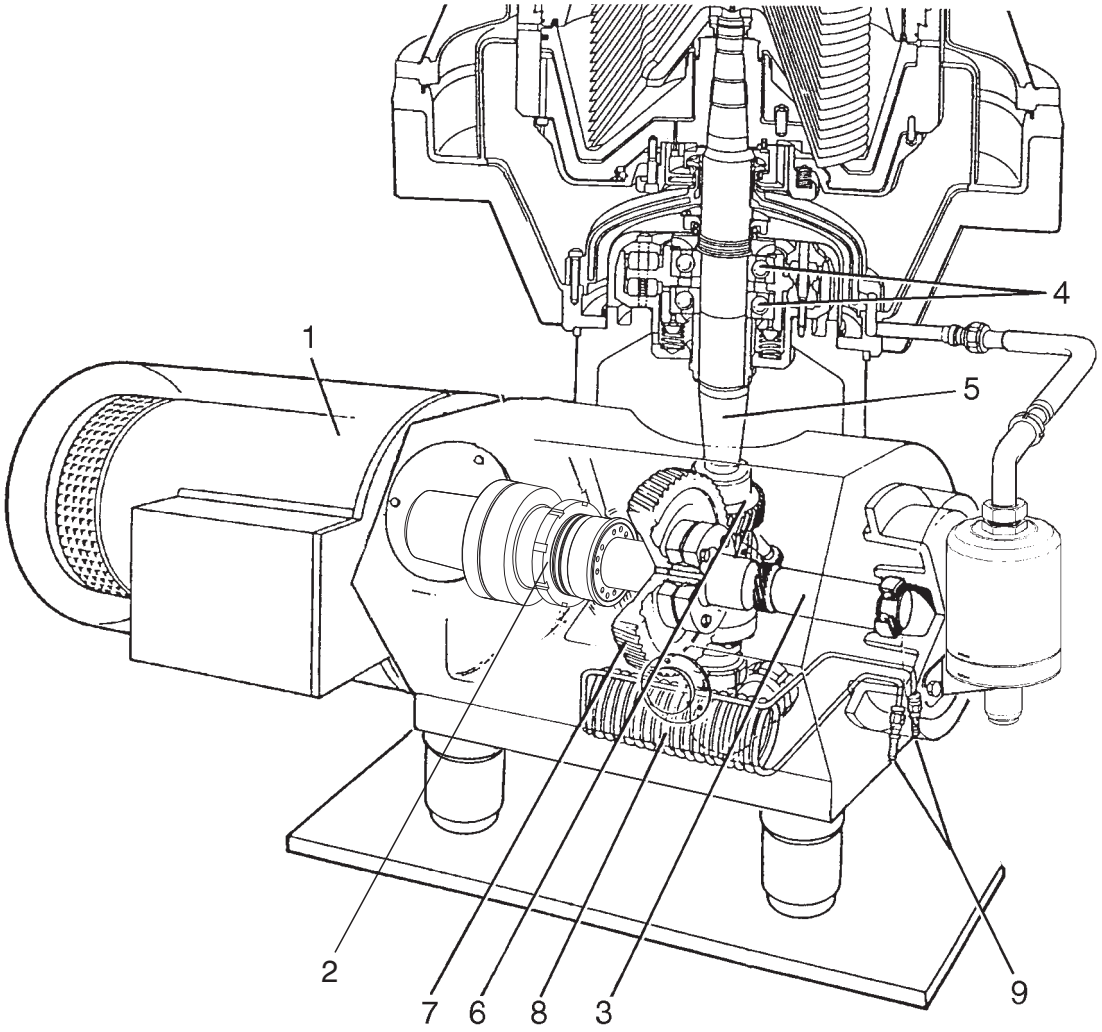
The liquid is separated into two phases in the separator bowl, one light liquid phase and one heavy liquid phase. Heavier sediment is also separated out of the liquid.

The bowl is fitted on the upper part of the vertical spindle and rotates at high speed. The bowl also contains the discharge mechanism which empties sediment from the bowl.

An operating water module, abbreviated OWMC (4), initiates the sludge discharges for the separator. With the supplied air pressure to the OWMC the discharge volumes can be regulated.

The inlet for the liquid to separate, the separated liquid outlet and the outlet for the concentrate are shown with connection numbers in the illustration (201, 220, 221 & 222). The separator is also provided with connections for supply of operating liquid, sealing liquid, flushing liquid and cooling/heating liquid. The connections are further described in chapter *Connection list* in the *Installation Manual*.

## 3.2.2 Mechanical power transmission




G06774O1

*1. Electric motor*
*2. Coupling*
*3. Worm wheel shaft*
*4. Top bearing*
*5. Bowl spindle*
*6. Worm*
*7. Worm wheel*

} *Crossed- helical gear drive*

*8. Cooling coil for oil bath*
*9. Cooling water inlet and outlet*

The motor (1) rotates the bowl via the flexible coupling (2) and the worm gear (6,7).

The worm gear has a ratio which increases the bowl speed several times compared with the motor speed. For correct ratio see chapter *Technical data* in the *Installation Manual*.

To reduce bearing wear and the transmission of bowl vibrations to the frame and foundation, the top bearing (4) of the bowl spindle (5) is mounted in a bearing support with rubber buffers.

The worm wheel runs in a lubricating oil bath. The bearings on the spindle and the worm wheel shaft (3) are lubricated by the oil splash produced by the rotating worm wheel.

To keep the oil temperature low, a cooling coil (8) is installed in the worm gear housing.

**Frequency drive motor**

The separator is direct driven by the motor, and for this reason the motor must be able to endure long run-up times. For this purpose this separator is equipped with a frequency drive motor.

This motor is similar to a standard three phase motor. The long running up time is, however, controlled by a frequency converter.

Refer to Installation Manual.

## 3.2.3 Sensors and indicators

**Cover interlocking switch (3), option**

The cover of the separator can be equipped with an interlocking switch. When cover is closed the interlocking circuit in the control system is closed which makes it possible to start the separator.

**Speed sensor (2)**

The proximity speed sensor is of inductive type, giving a number of pulses per revolution of the spindle shaft. The number of pulses is stated in chapter Connection list in the Installation Manual. The bowl speed may also be calculated from the gear ratio and the r/minute of the motor shaft.

During normal operation the speed is allowed to vary within speed limits described in chapter *Interface Description* in the *Installation Manual*.

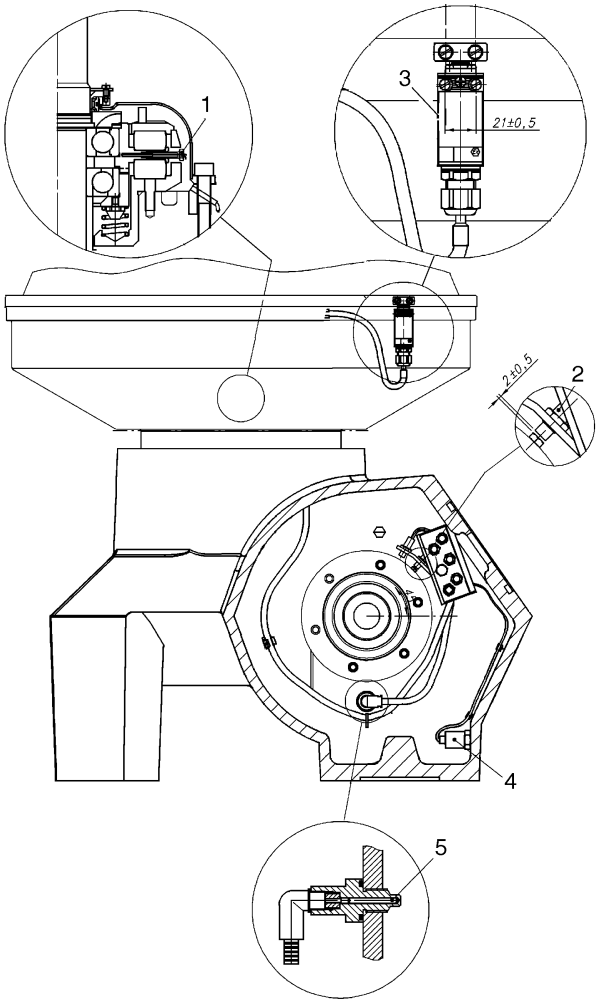
**Vibration sensor (4)**

The vibration sensor is of accelerometer type. The signal must be converted to a signal usable in the control system.

When any of the two limit values is exceeded appropriate countermeasures should be undertaken. The two levels are warning for unacceptable vibrations and safety stop respectively in case of extreme unbalance. The vibration levels are further described in chapter *Interface description* in the *Installation Manual*.

**Temperature sensor (1 / 5)**

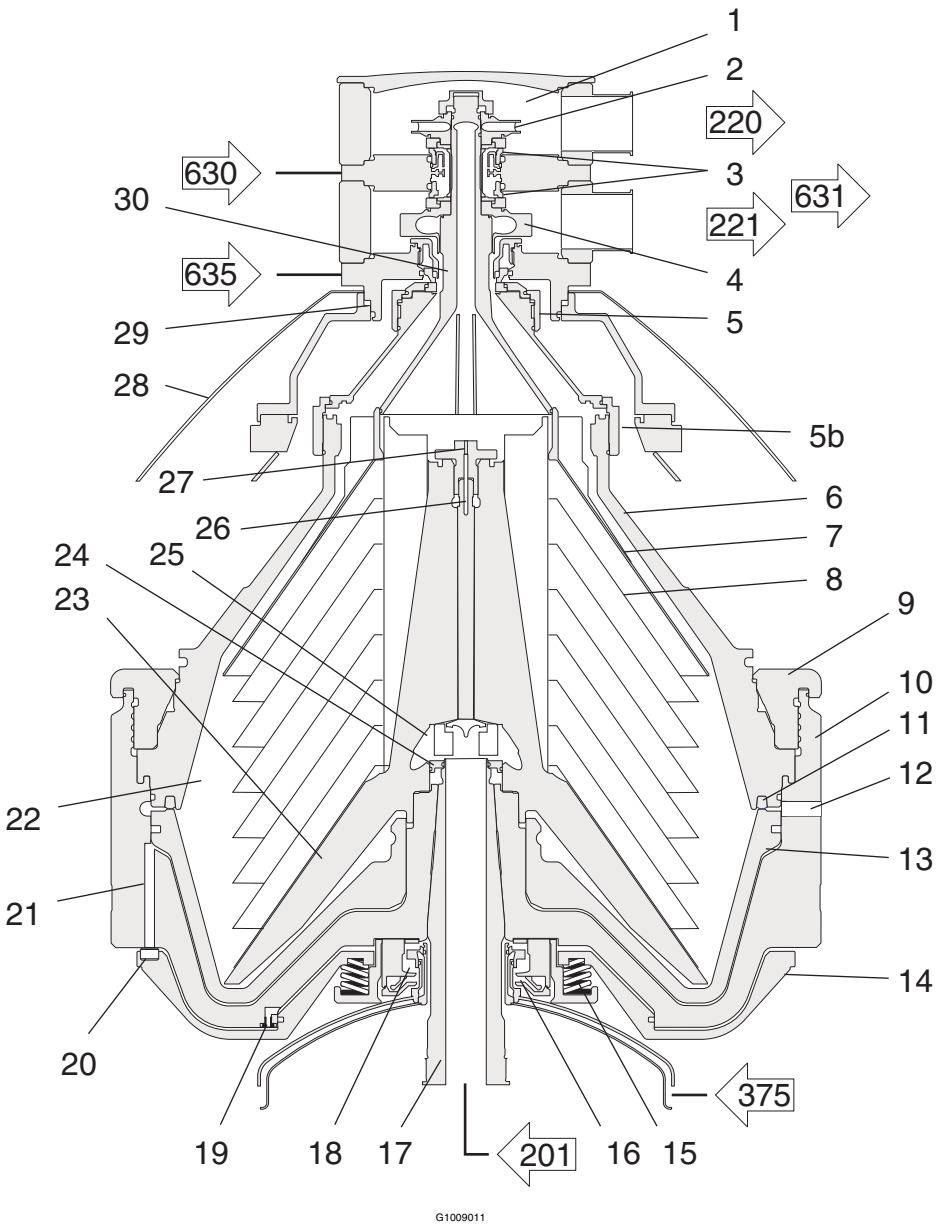
Temperature sensors is mounted to check the temperature in the neck bearing housing and the driving device.




G09377r1

1. *Temperature sensor*
2. *Speed sensor*
3. *Cover interlocking switch (option)*
4. *Vibration sensor*
5. *Temperature sensor*

### 3.2.4 Process main parts



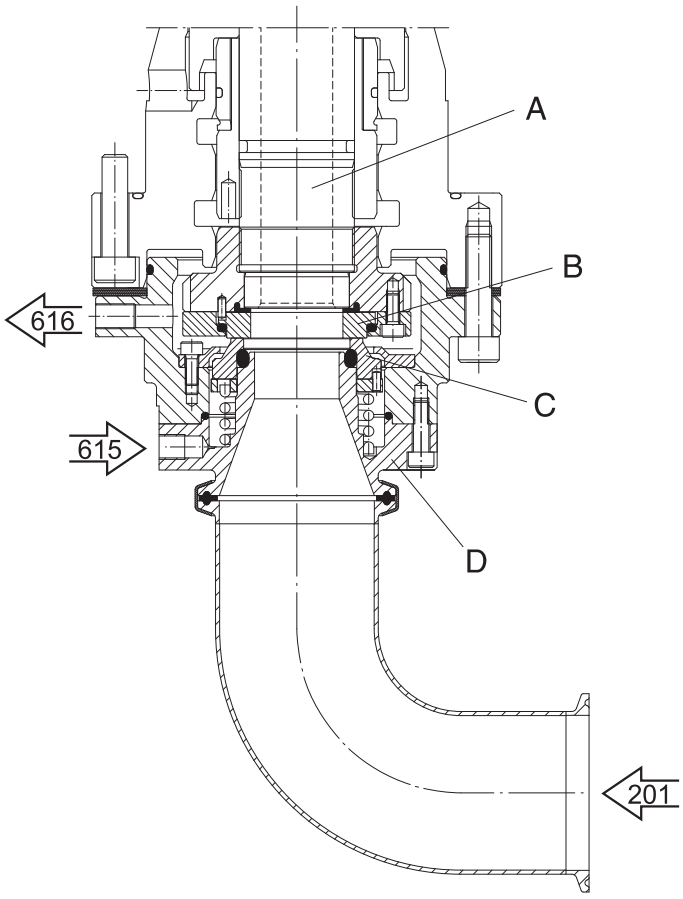
*1. Discharge housing*
*2. Impeller for light liquid phase*
*3. Mechanical axial seal*
*4. Impeller for heavy liquid phase*
*5. Small lock ring*
*5b. Lock ring*
*6. Bowl hood*
*7. Top disc*
*8. Disc stack*
*9. Large lock ring*
*10. Bowl body*
*11. Bowl hood seal ring*
*12. Sediment port*
*13. Sliding bowl bottom*
*14. Operating slide*
*15. Spring*
*16. Spring support*
*17. Bowl spindle (hollow)*
*18. Control paring disc device*
*19. Nozzle*
*20. Valve plug (3 pcs)*
*21. Drain channel*
*22. Sediment space*
*23. Distributor*
*24. Cap nut*
*25. Crowned wing*
*26. Air evacuating channel in distributor*
*27. Nozzle*
*28. Frame hood*
*29. Height adjusting ring*
*30. Outlet pipe*

### Inlet device (single sealing)

The inlet for product (201) is located in bottom of the separator. The product is led via the hollow bowl spindle (A) up into the bowl.

The rotating bowl spindle and the non-rotating inlet housing (D) are sealed by a mechanical axial seal. The main parts of the seal are the rotating wear ring (B) and the non-rotating seal ring (C).

To reduce the friction between the rings, these must always be in contact with liquid when the bowl rotates. The seal is therefore supplied with sealing liquid (connections 615 & 616).




*Inlet device consisting of an axial seal with single seal ring and wear ring*

*A. Bowl spindle (hollow)*
*B. Wear ring (rotating)*
*C. Seal ring (non-rotating)*
*D. Inlet housing*
*201. Inlet for product*
*615. Sealing liquid inlet*
*616. Sealing liquid outlet*

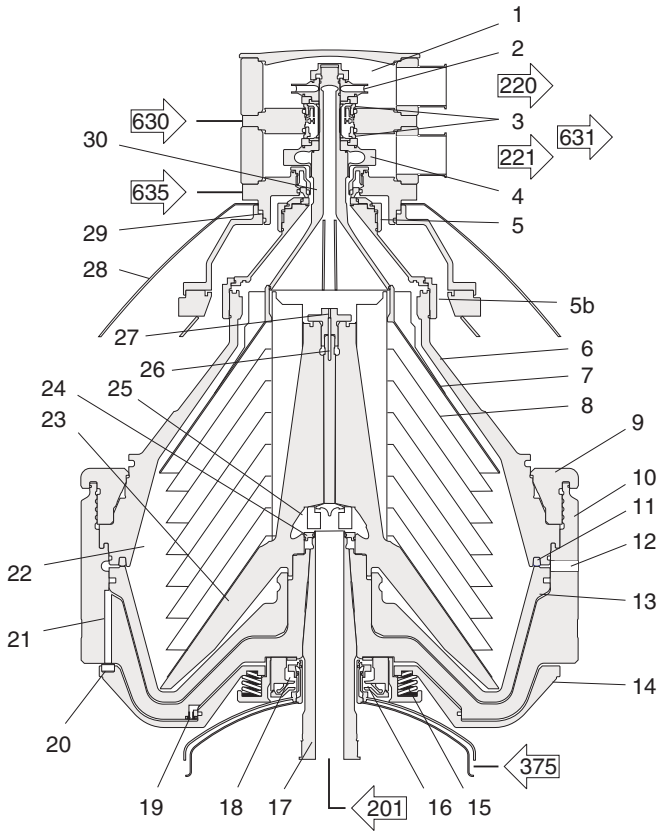
### Separator bowl

The separator bowl with its sediment discharge mechanism is built-up as follows:

The bowl body (10) and bowl hood (6) are held together by the large lock ring (9). Inside the bowl are the distributor (23) and the disc stack (8). The disc stack is kept compressed by the bowl hood. The sliding bowl bottom (13) forms an internal separate bottom in the bowl.

The bowl top is covered by an outlet pipe (28) which is tightened to the bowl hood by the small lock ring (5b).

The sediment space (22) is the space between the sliding bowl bottom and the bowl hood in the bowl periphery. It is kept closed by the sliding bowl bottom which seals against a seal ring (11) in the bowl hood.



**Outlet device twin phase concentrator**

The outlet device consists mainly of the two impellers, one (4) for the heavy liquid phase (221) and one (2) for the light liquid phase (220).

The impellers follow the rotation of the bowl and provide the necessary pressures for the heavy and light phases. It is assumed that the separator is supplied with adequate inlet pressure.

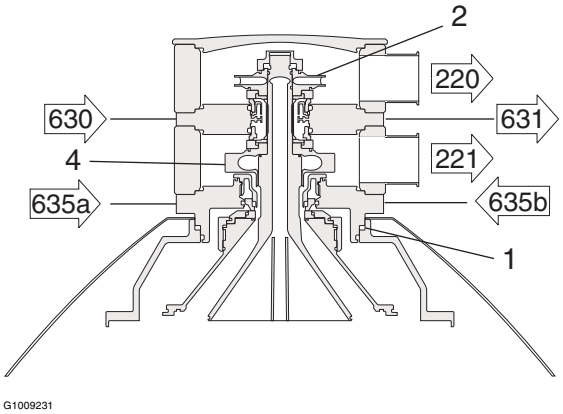
The connections in the outlet device are made airtight (hermetic sealed) from each other by O-rings and mechanical seals. There are three seals for the outlets.

An axial seal consists of a rotating wear ring and a non-rotating seal ring.

The seals must always be flushed with liquid when the bowl rotates. The seals are therefore supplied, through special channels (630, 635a & 635b) with flushing water, and during the CIP-period with CIP-liquid.

Alternatively, the 635a can be used for both CIP and cooling, then 635b plugged

A height adjusting ring (1) determines the height position of the discharge housing in relation to the impellers.




G1009231

*1. Height adjustment ring*
*220. Outlet light phase*
*221. Outlet heavy phase*
*630. Inlet sealing liquid*
*631. Outlet sealing liquid*
*635a. Inlet sealing liquid*
*635b. Additional Inlet sealing liquid (CIP)*

### Sediment discharge mechanism

At intervals decided by the operator, the sliding bowl bottom drops to empty the sediment from the bowl.

The sediment discharge mechanism, which controls the sliding bowl bottom, comprises the operating slide (14) and an operating liquid device. Passive parts are the nozzle (19) and the drain valve plugs (20). The operating liquid device on the underside of the bowl supplies discharge and make-up liquid (375) to the discharge mechanism via the control paring disc device (18).

The discharge liquid is injected by the operating water module (OWMC), which is further described next.

A closer description of the sediment discharge mechanism can be found in 3.3.2 Sediment discharge cycle on page 45

### 3.2.5 Operating water module compact (OWMC)

**Purpose**

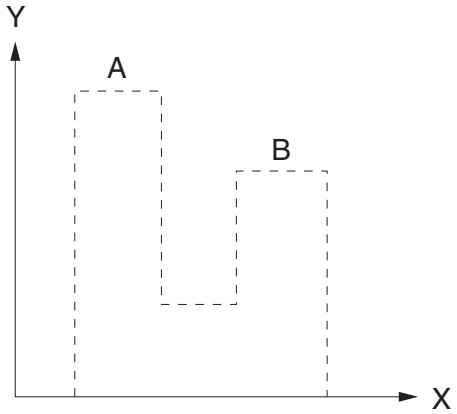
The separator bowl can be emptied from solids by two different sediment discharge volumes determined by the duration of the increased operating liquid flow from the Operating Water Module Compact (OWMC), i.e. the time the bowl is being open. The two discharge volumes may be regarded as small and large respectively. See 3.3.2 Sediment discharge cycle on page 45 for a further description.

## Design

The OWMC is designed as a stainless steel construction consisting of an air reservoir (6), a water cylinder (3) with piston (4) and a servo valve (5). The module is equipped with connections for air supply (506a) and signal air (506b and c).

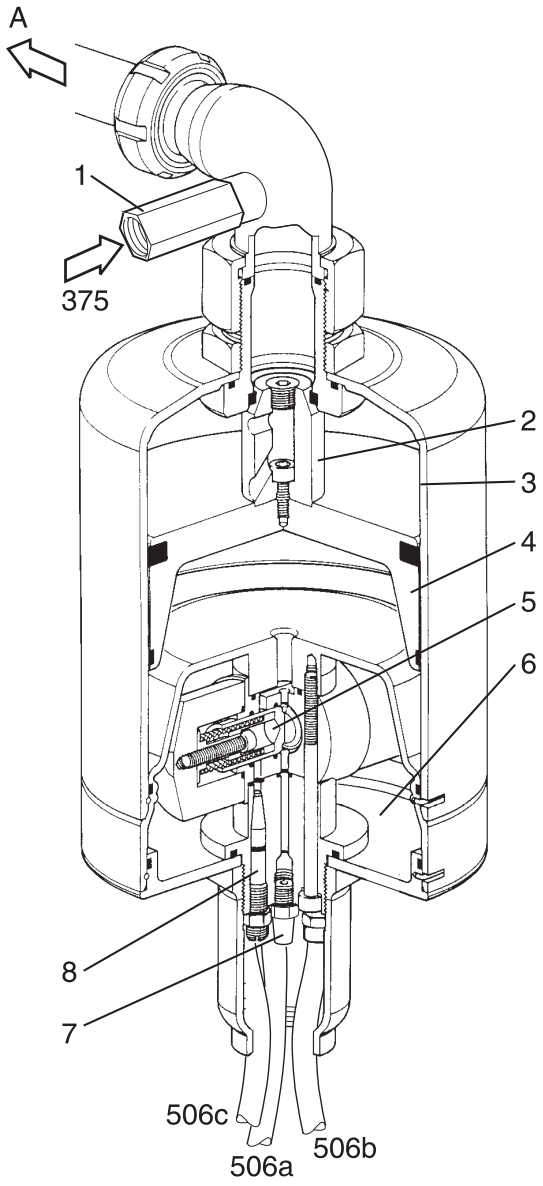
The OWMC is also equipped with a needle valve (8) for regulating of air flow for the small discharge and a silencer (7).

The OWMC gives a two-step flow which implies that the liquid flows into a one channel system in two steps, see the illustration below. The first step creates a high liquid flow which triggers a sediment discharge and the second step (with a lower flow) will admit the bowl to close while closing (make-up) liquid is added to the bowl. The flow between the two steps is very low.




G1009111

*A. Discharge water*
*B. Closing water*
*X. Time*
*Y. Flow*




G0877921

*1. Check valve*
*2. Two-step adapter*
*3. Water cylinder*
*4. Piston*
*5. Servo valve*
*6. Air reservoir*
*7. Silencer*
*8. Needle valve*
*375. Inlet of discharge and make-up liquid to OWMC*
*506a. Air supply into air reservoir*
*506b. Signal air, small discharge*
*506c. Signal air, large discharge*
*A. Outlet of discharge and make-up liquid from OWMC to bowl*

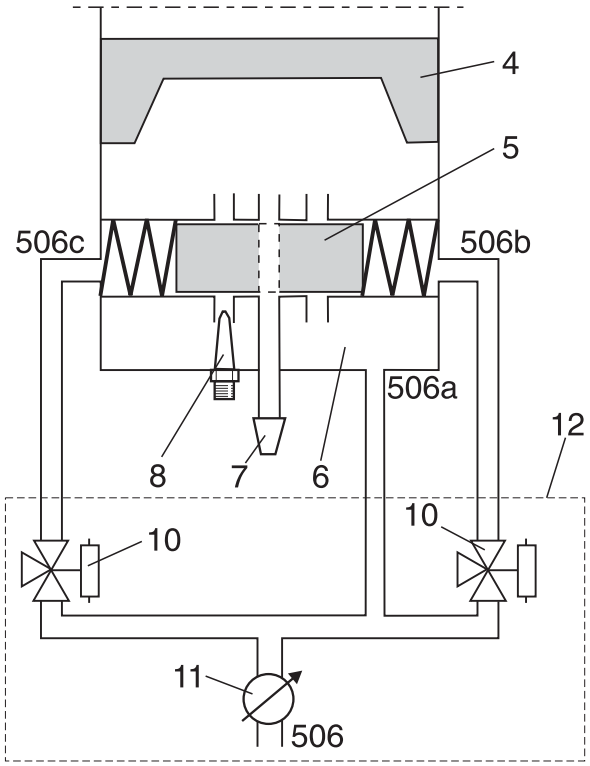
### Working principle

#### Introduction

The OWMC is working as an integrated part of the operating water system in this separator. It creates an instant increase in the liquid flow to the separator discharge mechanism which will initiate the sediment discharge. A complete sediment discharge cycle is described in section 3.3.2 on page 45.

Compressed air from the control air system (506) is reduced in an air pressure regulator (11). From the regulator the air is supplied directly into the air reservoir (6) via connection (506a).

The signal air (connections 506b and c) is guided by solenoid valves (10), see the illustration. When signal air is supplied to the servo valve (5), the piston inside the valve is moved to one side and air is supplied into the reservoir under the piston (4). The piston (4) moves upwards and presses the liquid inside the water cylinder into the operating liquid system in the bowl bottom.

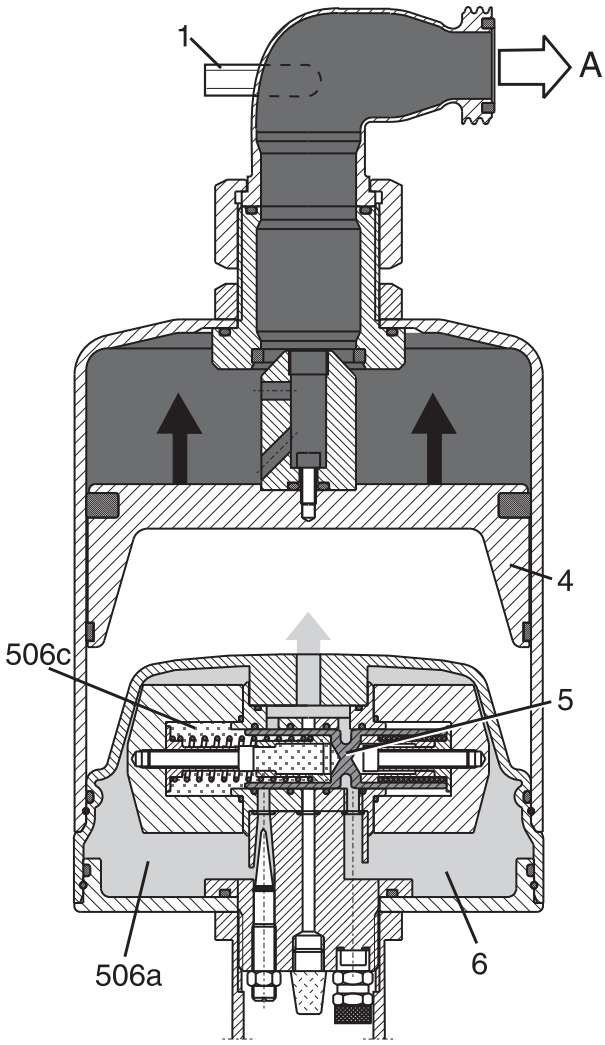



*4. Piston*
*5. Servo valve*
*6. Air reservoir*
*7. Silencer*
*8. Needle valve*
*10. Solenoid valve (3-way with drain)*
*11. Air pressure regulator with indicator*
*12. Control cabinet in safe area*
*506. Pressurized air inlet (~7 bar)*
*506a. Air supply into air reservoir*
*506b. Signal air, small discharge*
*506c. Signal air, large discharge*

### Initiating a large sediment discharge

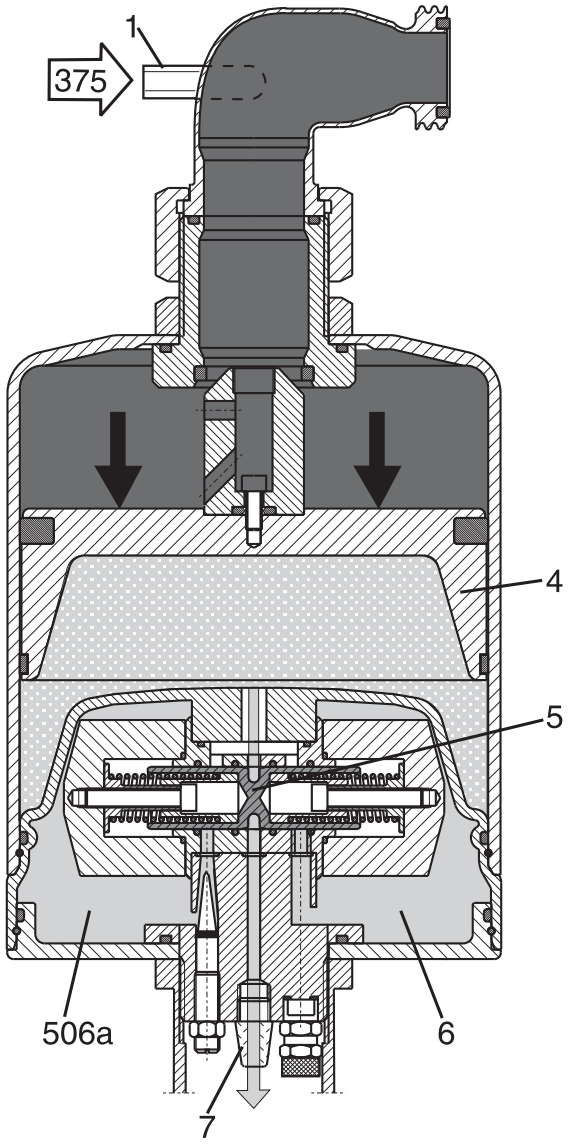
When the solenoid valve for a large discharge activates inlet (506c), air is fed into the left side of the servo valve (5) during a period of about 5 seconds. The piston inside the valve moves to the right and the supply air (506a) in the air reservoir (6) flows up into the space under the piston (4) which then moves the piston upwards. The movement of the piston increases the flow of liquid (A) to the bowl discharge mechanism in order to open the bowl. The check valve (1) ensures that no water flows back to the liquid supply system.

The air reservoir (6) acts as a buffer in order to supply sufficient of air to the cylinder under the piston during the sediment discharge cycle.




*Operating liquid is supplied into the separator bowl*

When the solenoid valve for the signal air (506c) is deactivated, the piston in the servo valve (5) moves to its neutral position and air in the cylinder under the piston (4) is drained by the servo valve out through the silencer (7). The operating liquid supply from the liquid supply system (375) presses the piston (4) back to its original bottom position.

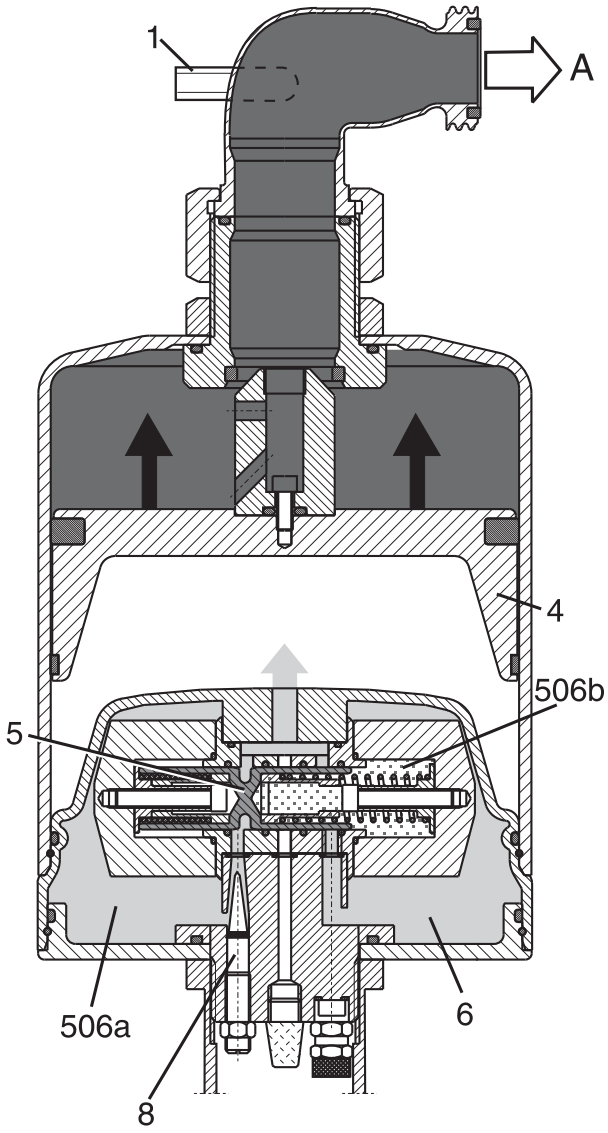



*Operating liquid is supplied into the OWMC from the liquid supply system (375)*

### Initiating a small discharge

When the solenoid valve for a small discharge activates inlet (506b), air is fed into the right side of the servo valve (5) during a period of about 5 seconds. The piston inside the valve moves to the left and air is supplied into the cylinder below the piston (4) via the valve. The air flow is reduced when it passes the needle valve (8).

A reduced air flow will result in a lower flow of operating liquid into the bowl. This liquid is continuously drained from the bowl. Because of the lower flow, a larger amount of operating liquid will be drained out from the bowl before sufficient volume of the liquid has been built up to create a sediment discharge. This implies that the time the bowl is open for a sediment discharge is shorter which will give a smaller amount of discharged sediment i.e. small discharge.




*Operating liquid is supplied into the centrifuge bowl with a lower flow*

### Settings

Start to set the large discharge volume.

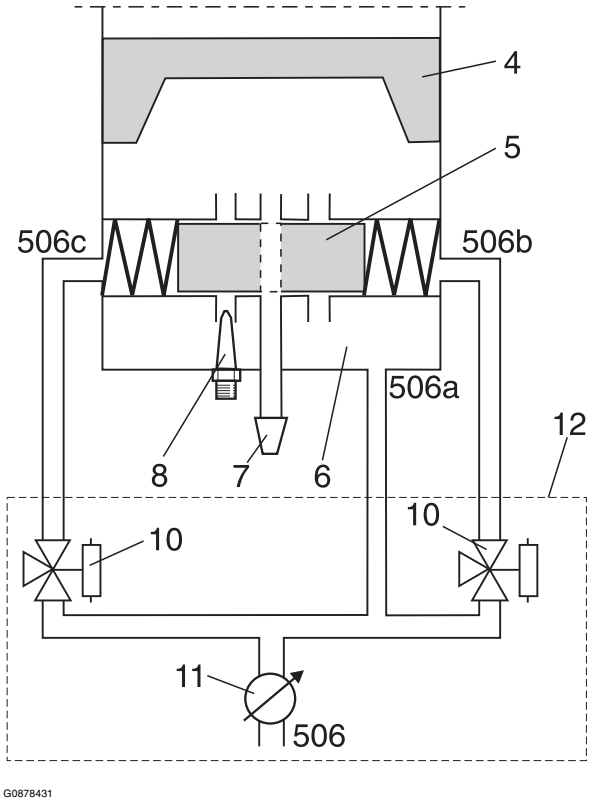
Proceed in following way:

1. Set the air pressure regulator (11) to 400 kPa (4 bar).
2. Initiate a discharge by opening solenoid valve for air supply inlet (506c).
3. Measure the discharged volume.
4. Adjust the discharged volume by altering the pressure of the compressed air. A higher pressure gives a larger volume. The air pressure can be regulated between 4 - 6 bar.

   Continue with the small discharge in following way:

5. Open the needle valve (8) 3 turns.
6. Initiate a discharge by opening solenoid valve for air supply inlet (506b).
7. Measure the discharged volume. The recommended volume for a small discharge is the sediment space volume of the bowl given in chapter Technical data in the Installation Manual.
8. Adjust the discharged volume by regulating the needle valve. A more open valve (anti-clockwise) gives a larger volume.

Continue with the small discharge in following way:




**NOTE**

**Do not adjust the air pressure to change the volume for the small discharge. If doing so, the volumes for both large and small discharges will be changed.**

**The needle valve only sets the ratio between the large and small discharges.**

**NOTE**

**The separator bowl must not be discharged with a too small volume as this leads to build-up of sediment in the sediment space as well as in the disc stack resulting in an impaired separation efficiency.**

## 3.2.6 Flushing

To avoid sediment deposits inside the bowl enclosure, the separator is equipped with several flushing possibilities.

A flushing inlet at the top of the separator, connection 302 (only for open outlet separators), to give a spray that hits the outside of the bowl. By the bowl rotation the liquid is thrown to the inside of the frame hood which then will be cleaned.

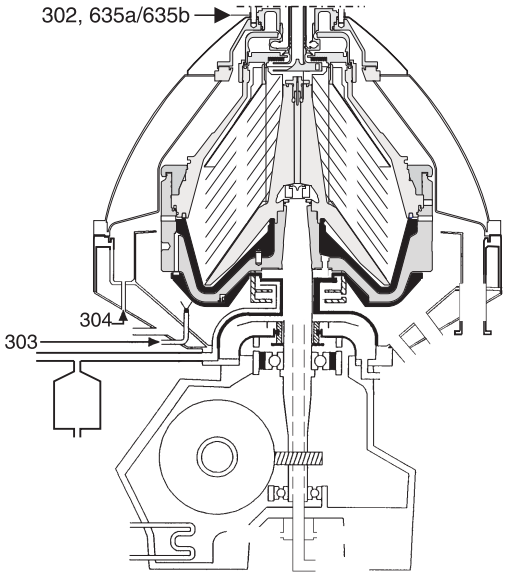
Another flushing inlet is placed in the sediment channel (connection 304) to clean this channel and one nozzle is placed below the bowl (connection 303) to clean the inside of the frame top part.

How to use the flushing possibilities depends on the process and the properties of the product. In many cases no flushing at all is needed. In other cases it is only done at CIP (cleaning in place) and in some cases both at production and CIP.

Normally flushing is done in connection with discharges. A typical sequence is that a few seconds flush is given to wet the surfaces just before the discharge. When the main part of the discharged sediment is drained a new flush is done to remove the final part of the sediment. Possibly another flush can be done after a new draining period. If the separator is supervised by a control system which controls the flushing the timers ought to be adjustable so the flushing can be adapted to suit the actual requirements.

When making a flush it could be possible to feed flushing liquid to all flushing connections at the same time. To minimize the flushing liquid consumption and dilution of the discharged sediment it is however of advantage if the different flushing points could be controlled individually.

See the *Installation Manual* for details of the connections.




*The flushing connections have numbers 302, 303 and 304*

## 3.2.7 Jackets in separator frame

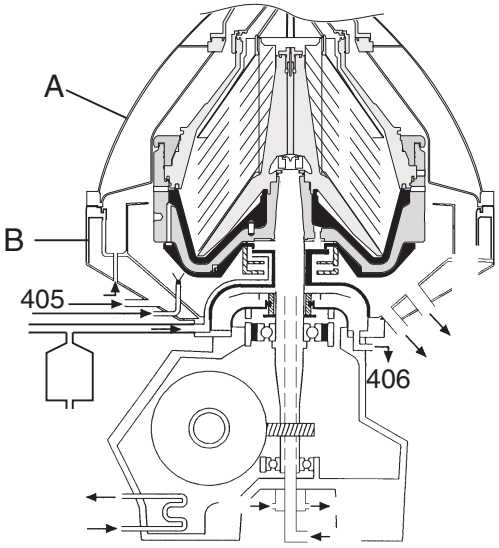
The frame top part (B) and the frame hood (A) are equipped with jackets connected in series with the inlet at connection 405 and the outlet at connection 406. There are several purposes with these jackets. One purpose is noise suppression as a filled jacket will work as a sound barrier. Another purpose is to cool the bowl. When the bowl is rotating it is heated up by air friction. If the bowl is operating without feed and with no flow in the jackets then the temperature might increase to a higher level than the design temperature for the bowl which means that it can be damaged. For this reason there is a time limitation given in chapter Technical data in the Installation Manual for running with no flow in the bowl. This limitation is valid if the bowl is at ambient temperature when the time calculation starts. If cooling liquid is supplied to the jacket then the risk of getting too high bowl temperature is reduced. If the flow of cooling liquid is supervised then the time can be prolonged.

The purpose of cooling with the jackets can also be to prevent sediment on the inside surfaces of the bowl enclosure to dry and build up deposits on these surfaces. Still another purpose of cooling is to cool or avoid unnecessary heating up of the discharged sediment if this is temperature sensitive.

The jackets can also be used to heat the discharged sediment if this is needed to keep the viscosity low or avoid solidifying. In such cases the time for running in standby without flow in the bowl must be reduced and if jacket temperature is close to bowl design temperature no such running is allowed.

The jackets are not designed for high pressure which means that only low back pressure or no back pressure at all can be applied on the jacket outlet. If too high back pressure is used it can deform and damage the separator. See requirements/limits in chapter Connection list in the Installation Manual for further information.

Jacket to be drained through both connection 405 and 461.




*A. Frame hood*
*B. Frame top part*

## 3.2.8 Cyclone

When accumulated sediment in the bowl is discharged, it leaves the bowl at high speed.

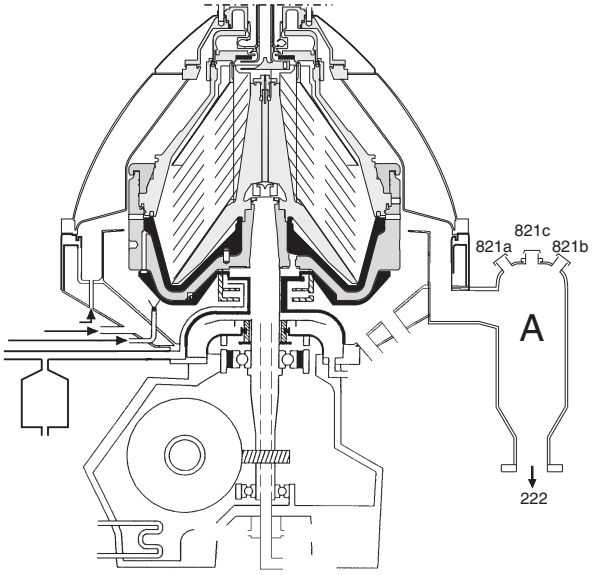
To prevent reaction forces on the separator this speed must be reduced before the sediment leaves the separator. This is done in the outlet cyclone (A) where the sediment will rotate while its speed is gradually reduced by the wall friction until its speed is low enough to be discharged by gravity by outlet 222.

When the sediment is suddenly discharged into the cyclone there will be a positive gas pressure shock in the cyclone and a corresponding negative pressure shock in bowl enclosure because a certain volume of material is suddenly moved from one region to another.

After the discharge the pressure will be equalized by back flow of gas from the cyclone to the bowl enclosure. This back flow will contain some sediment that might cause build up of sediment deposits on the surfaces in the bowl cover. A part of the pressure shock will also go out by the connection 222 into the external sediment receiving system where it can damage the system or spread aerosols to the surroundings.

The cyclone is equipped with two blocked connections at the top. One of 821a & 821b could be used for mounting a spray ball or turbine in such applications where the properties of the sediment is such that it will stick to the walls of the cyclone and needs to be flushed out. The other connection of the two mentioned could be used for mounting a level probe in the cyclone to give an alarm if the sediment accumulates in the cyclone because the cyclone outlet or the receiving system outside the separator is blocked or full. If the cyclone is full and the discharged sediment can not leave the bowl enclosure then the rotating bowl can hit the discharged sediment which will cause the separator to stop by overload and/or vibration that might damage the equipment.

The blocked connection (821c) at top of the cyclone can be used for ventilation of the cyclone which will reduce the pressure shock at a sediment discharge.

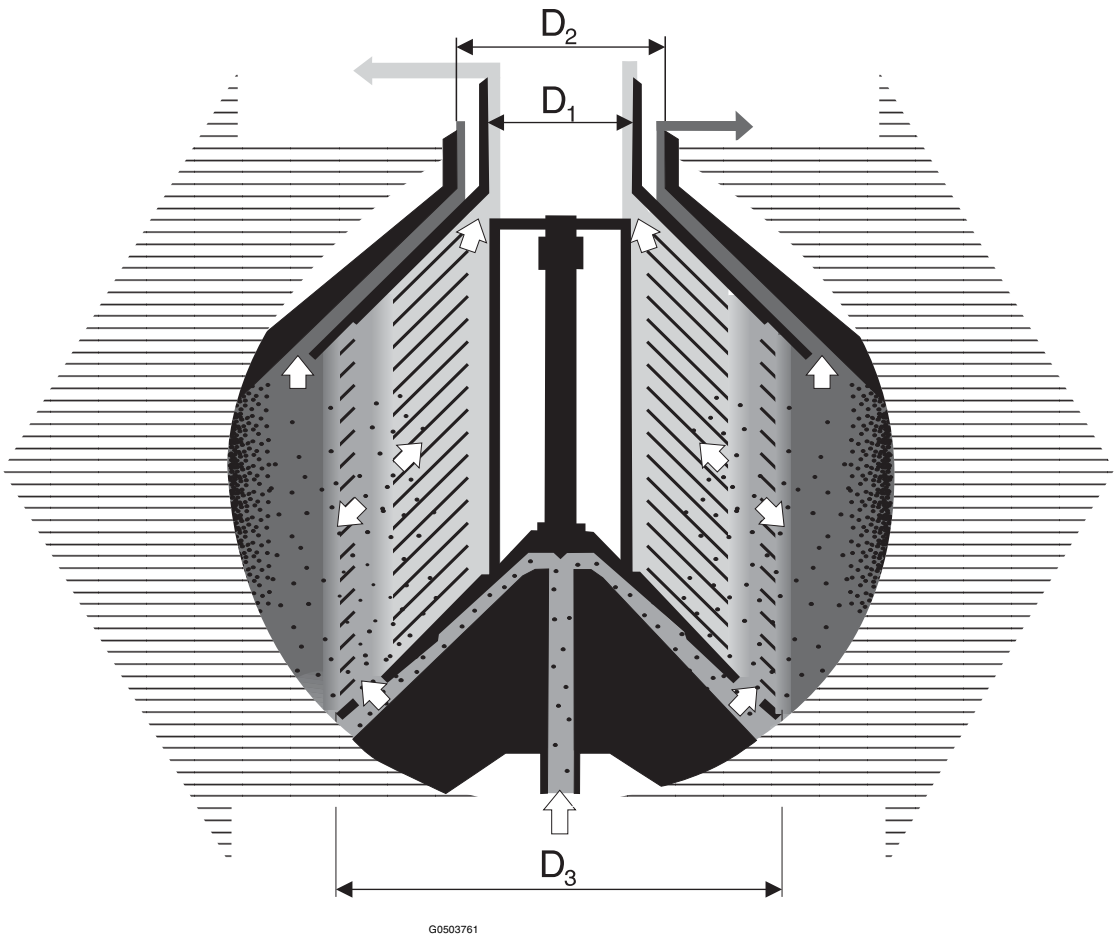



G10067h1

*A. Cyclone*

# 3.3 Separating function

## 3.3.1 Normal separation twin phase




Centrifugal force

Bowl parts

Process liquid

$D_1$ Diameter of inner outlet (same as the hole diameter in the neck of the top disc)

Heavy liquid phase

$D_2$ Diameter of outer outlet (same as twice the radius of the paring tubes)

Light liquid phase

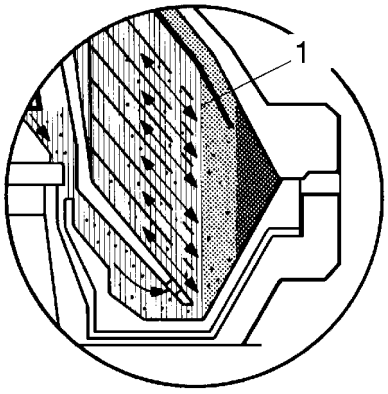
$D_3$ Diameter of interface

Sediment (solids)

### Position of interface

An interface (1) must be formed between the light and heavy phases in the bowl. In order to achieve optimum separation, the interface must be maintained in the correct position, which is between the disc stack and the outer edge of the top disc. If the interface moves outside the outer edge of the top disc the liquid seal will break and light phase will be discharged with the heavy phase. An interface positioned inside the disc stack will cause bad separation results.

Where the interface is formed is dependent on the difference of specific gravities between the heavy and light phases and the viscosity of the heavy phase.




G0047061

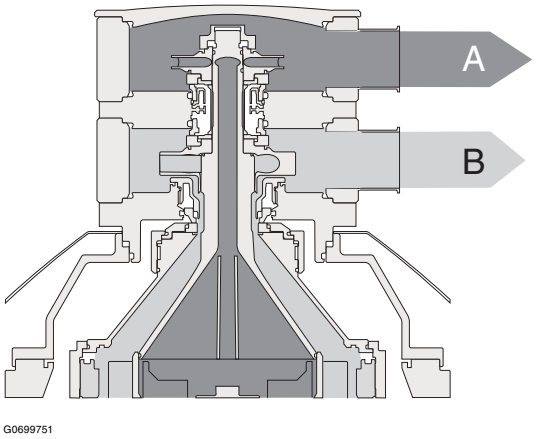
*Interface position (1)*

### Concentration of light phase

The relationship in the light phase outlet between the back pressure and the concentration is:

The light phase flow and thus the concentration of the light phase are determined by the pressure difference between the two outlets. With one and the same throughput a certain pressure difference will always give the same light phase flow. The light phase concentration will be higher with a higher back pressure in the light phase outlet.

A impeller fitted in the light phase outlet gives a high outlet pressure (and thus a high back pressure).



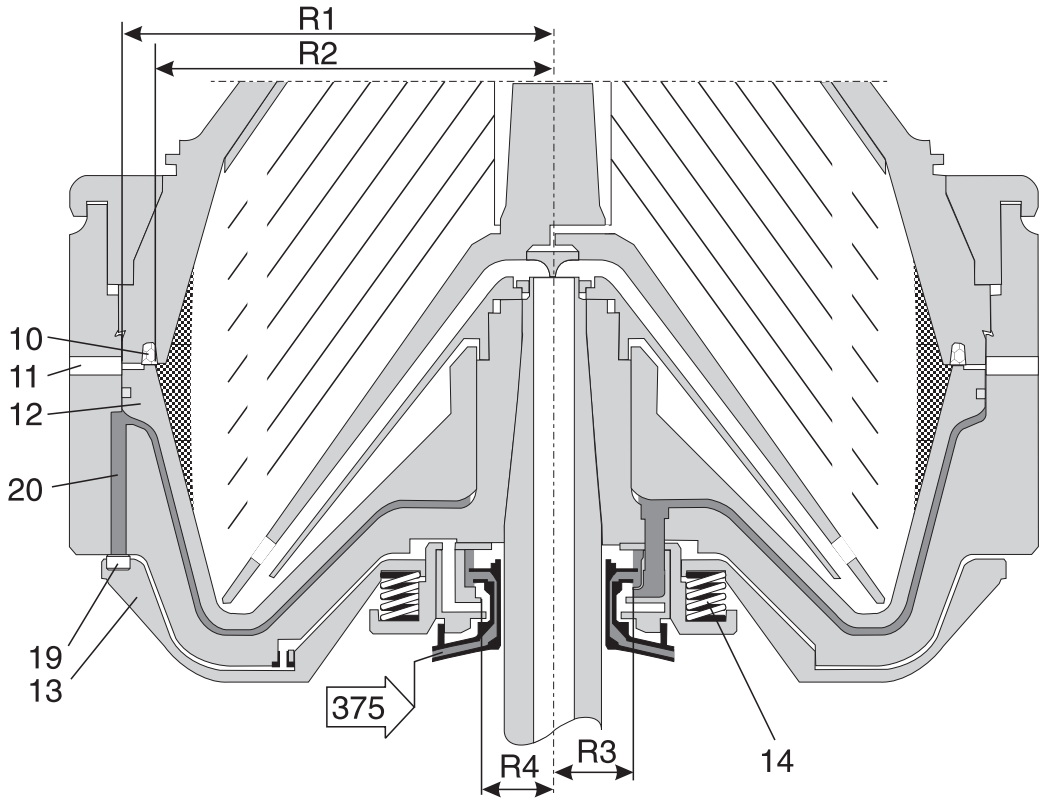

G0699751

*Light phase Heavy phase*

| | | |
|---|---|---|
| Lower back pressure | • | Lower concentration |
| Higher back pressure | • | Higher concentration |

## 3.3.2 Sediment discharge cycle

The illustrations in this description of a sediment discharge cycle are of a general nature and do not necessarily correspond exactly to the actual bowl.




G08316M1

Operating liquid (375)

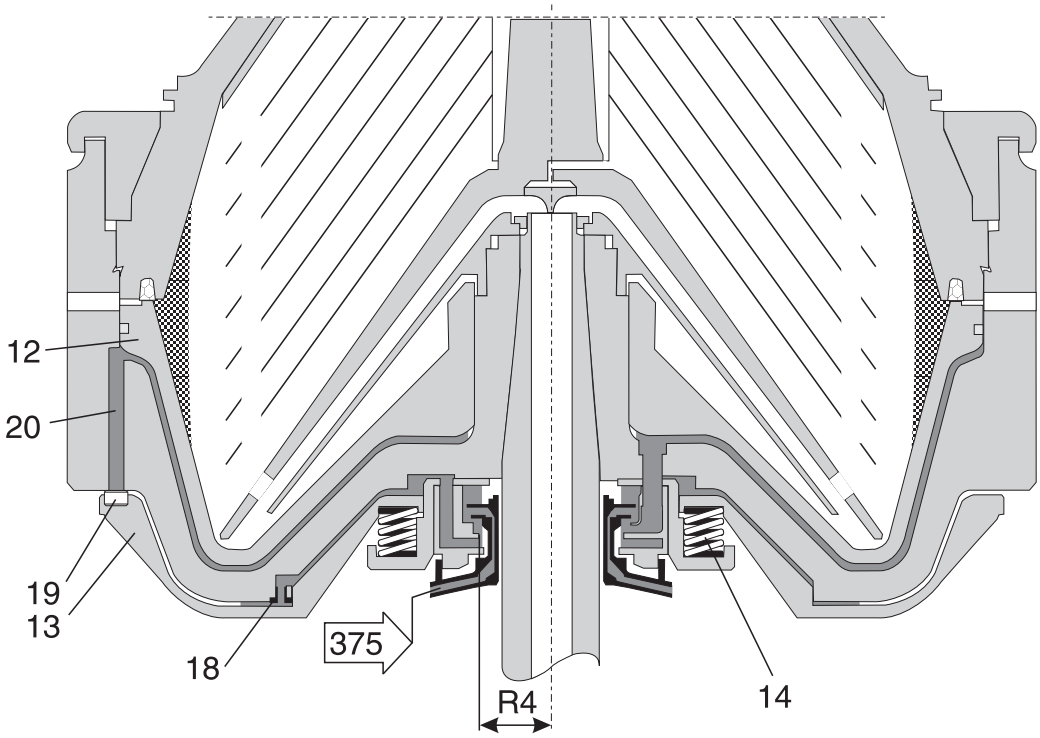
G1005611

Sediment

G1005621

**Closed bowl (normal operation)**
Discharge of the solids takes place through a number of slots or ports (11) in the bowl wall. Between discharges, these ports are closed by a large valve slide, the so-called sliding bowl bottom (12), which constitutes an inner bottom in the separating space. The sliding bowl bottom is forced upwards against a seal ring (10) by the liquid force acting on its underside. The operating slide (13) is pressed upwards by the springs (14) and the valve plugs (19) then cover the drain channels (20). During rotation, the pressure of the liquid increases with the distance from the axis of rotation because of the centrifugal force.

The operating liquid exerts an upward pressure on the sliding bowl bottom (12) exceeding the counter-acting downward pressure from the process liquid, because the underside of the sliding bowl bottom has a larger pressure surface (radius R1) than its upper side (radius R2). Operating liquid (375) is supplied at the underside of the bowl through a paring disc device. Leakage or evaporation of operating liquid is made up for automatically by the paring disc, which maintains a constant operating liquid level (radius R3), as its pumping effect counter-balances the static pressure from the supply. During a sediment ejection, this feed of operating liquid continues even during the ejection cycle described in the following illustrations.

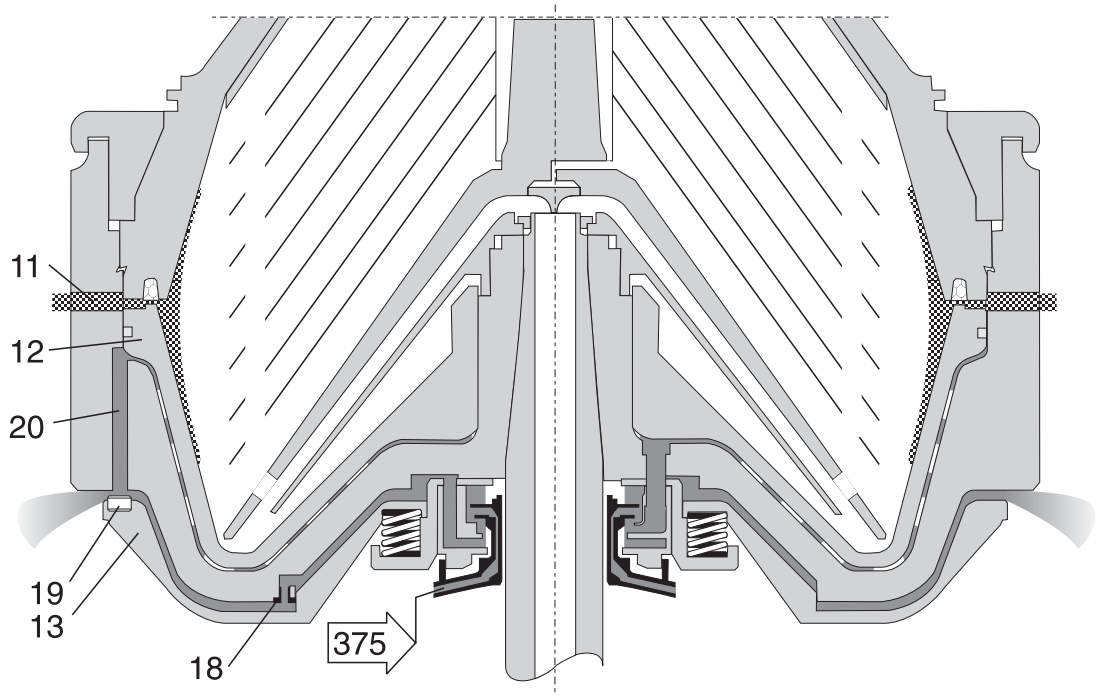



G08316N1

**Bowl opens for discharge**

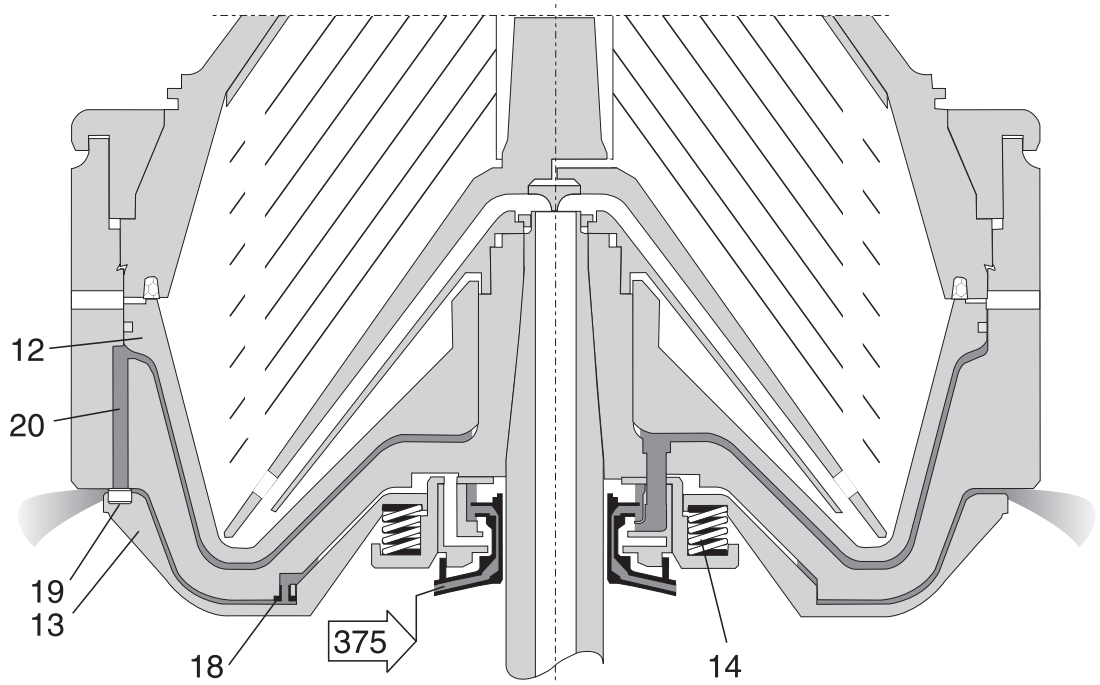
Pressurized operating liquid injected by the OWMC is now supplied at a higher rate of flow for a number of seconds (see 3.2.5 Operating water module compact (OWMC) on page 32 for a further description). The liquid flows above the paring chamber (radius R4) through a channel up to the upper side of the operating slide (13). When the liquid flows out towards the operating slide periphery it is throttled by a nozzle (18).

The operating liquid pressure on the upper side of the operating slide (before the nozzle) overcomes the force from the springs (14) and the operating slide is pressed downwards. The valve plugs (19) open and the closing liquid drains out via the drain channels (20) as illustrated on next page.




G08316o1

When the valve plugs (19) are opened, the operating liquid pressure on the underside of the sliding bowl bottom (12) is reduced. The sliding bowl bottom is pressed downwards, thereby uncovering the sediment ports (11) in the bowl wall through which the sediment discharges.




G08316p1

**Bowl closes after discharge**

After that the injection of operating liquid by the OWMC has ended and most of the liquid has been drained from the upper side of the operating slide (13) via the nozzle (18), the forces directed upwards on the operating slide from the springs (14) move the operating slide upwards.

The drain channels (20) are closed by the drain valve plugs (19) and the increasing force from the operating liquid presses the sliding bowl bottom (12) upwards. The bowl closes and the sediment discharge has been accomplished.

The remaining opening water above the operating slide leaves the separator.

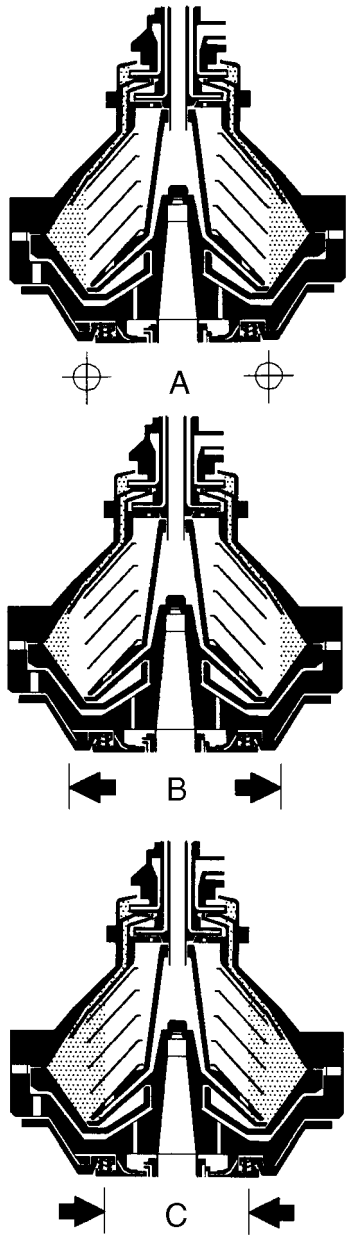
# 3.4 Factors influencing the separation result

## 3.4.1 Interface position

A. Correct interface position

B. Wrong interface position - broken liquid seal

C. Wrong interface position - bad separation

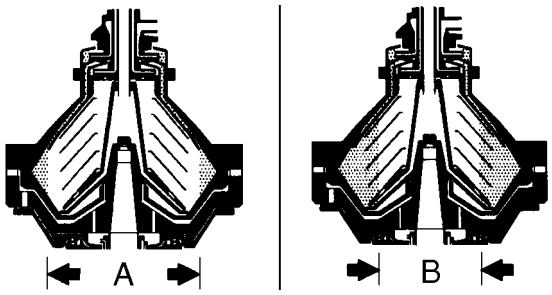



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### Factors influencing the interface position

Density differences and throughput

Phases with small density differences, as well as high throughput, will position the liquid interface closer to the bowl periphery than if the phases have great density differences.

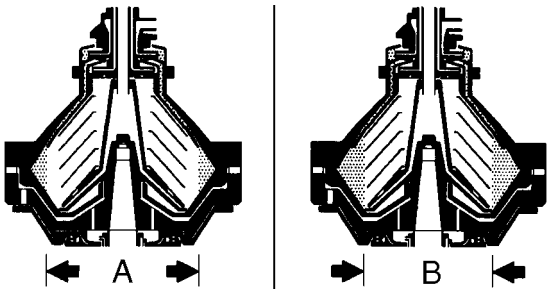



G0011831

*A. Small density differences/high throughput*
*B. Great density differences/low throughput*

Excessive back pressure

Excessively high back pressure in the light phase outlet prevents the light phase from being pumped out. The interface position will move outwards towards the bowl periphery. The effect is a wrong interface position, which may cause broken liquid seal.




G0012021

*A. Excessive back pressure*
*B. Normal back pressure*

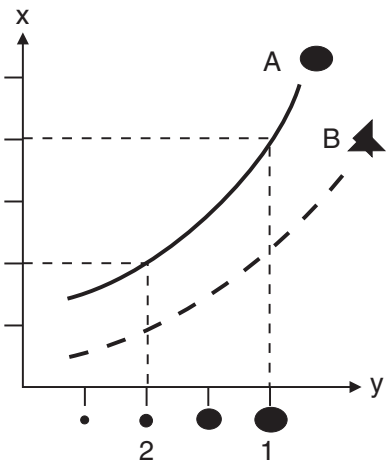
## 3.4.2 Viscosity and density

See 3.1.4 Separating temperatures on page 18.

### 3.4.3 Size and shape of sediment particles

The round and smooth sediment particle (A) is more easily separated out than the irregular one (B).

Rough treatment, for instance in pumps, may cause a splitting of the particles resulting in slower separation. Larger particles (1) are more easily separated out than smaller ones (2) even if they have the same density.




*1. Large particle*
*2. Small particle*
*A. Smooth particle*
*B. Irregular particle*
*x. Throughput*
*y. Particle size*

### 3.4.4 Phase proportions

An increased quantity of heavier phase (sediment) in a process liquid will influence the separating result through the optimum transporting capacity of the disc set. An increased concentration in the process liquid can be compensated by reducing the throughput in order to restore the optimum separating efficiency.

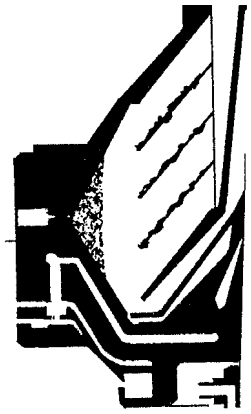
### 3.4.5 Throughput

The throughput depends on the separating ability and the sediment space volume of the bowl relative to the concentration, particle size, density and viscosity of the process liquid.

A better separation result can often be achieved by reducing the throughput, i.e. by increasing the settling time.

### 3.4.6 Properties of the sediment

Some types of sediment can through adhesion form deposits in the bowl, thereby reducing the separating efficiency. In such cases the cleaning procedure after separation must be adjusted.



G0677541

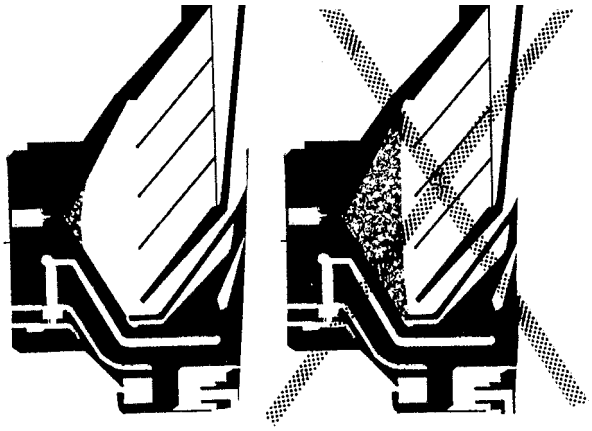
*The sediment space in separator bowl*

### 3.4.7 Disc stack

A neglected disc stack – containing deformed discs or discs coated with deposits – will impair the separating result.

### 3.4.8 Sediment discharge

With a high content of solids in the process liquid discharges are required at shorter intervals. An overfilled sediment space impairs the quality of the separated liquid. However, keep the discharge within the min. and max. time stated in chapter Technical data in the Installation Manual. How to calculate the discharge interval is described in 3.5 Sediment discharge interval on page 53.



G0677731

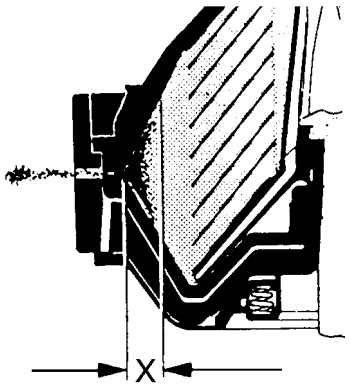
*Never overfill the sediment space*

# 3.5 Sediment discharge interval

## 3.5.1 Different sediment discharge volumes

The separator is of a controlled partial-discharge type. The bowl of the separator can be emptied from solids by two different sediment discharge volumes determined by the duration of the increased operating liquid flow from the operating water module (OWMC), i.e. the time the bowl is being open.

The volume of the sediment discharge has to be choosen in accordance with the process condition and the prevailing process flow. The following exemplifies the difference between two different sediment discharge volumes.

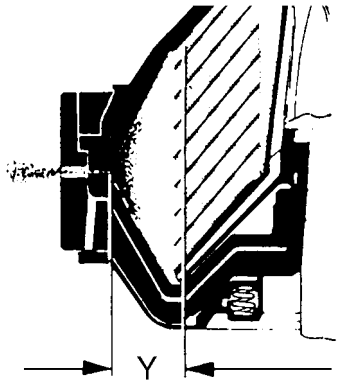



G0830811

*Small discharge volume*

- A normal sediment discharge is represented by the volume (X). This discharge may be regarded as “small” and should as a rule be used in order to avoid loss of process liquid.
- A sediment discharge used during e.g. a stand by program is represented by the volume (Y). This discharge may be regarded as “large” and is used for obtaining a large discharge volume from the separator bowl.

The operating water module (OWMC) is described in 3.2.5 Operating water module compact (OWMC) on page 32.




G0830821

*Large discharge volume*

### 3.5.2 Time interval

The appropriate time to be chosen between sediment discharges depends on local conditions because many factors influence accumulation and hardening of sediment between discharges. However, keep the discharge interval within the min. and max. time stated in chapter Technical data in the Installation Manual.

Long intervals between sediment discharges can cause accumulation and compaction of sediment. The sediment may then break-up unevenly on discharge and cause the bowl to become unbalanced. If such unbalance is too large, there is risk of serious separator damage and injury to personnel.




**Disintegration hazards**

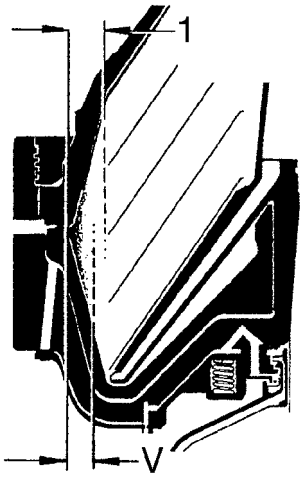
**Ensure that correct discharge intervals and cleaning procedures are used.**

**Unbalance due to improper discharge of solids may lead to solids accumulation and unbalance which may lead to contact between rotating and non-rotating parts.**

If the solids content of the process liquid expressed in per cent by volume of wet sediment is known or can be established (for instance in a test-tube centrifuge), the formula below can serve as a guidance for the selection of sediment ejection intervals.

$$t = V \cdot \frac{100 \cdot 60}{p \cdot Q}$$

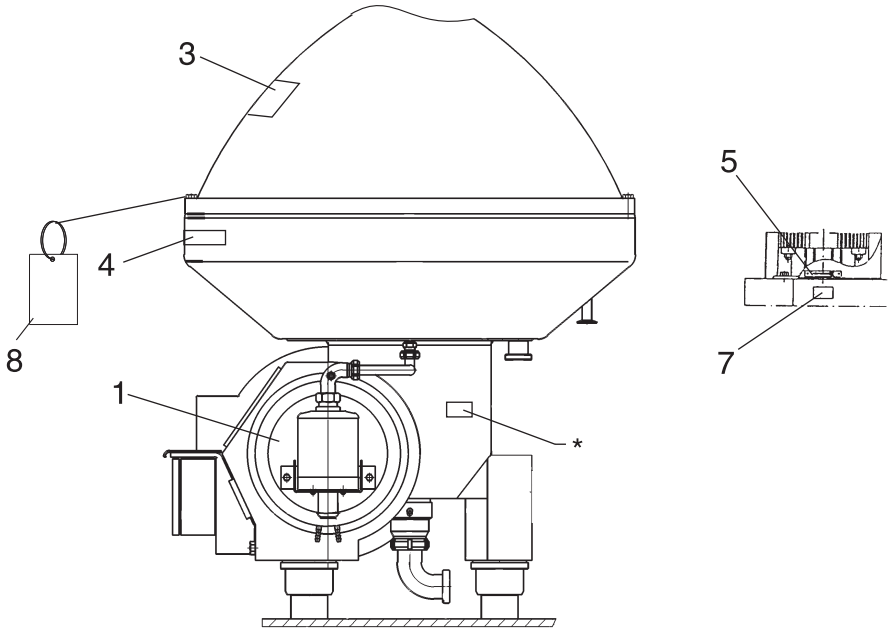
| | |
|---|---|
| t = | Theoretic maximum time in minutes between two ejections. |
| p = | Percent by volume of wet sediment in the process liquid. |
| Q = | Throughput in litres/hour. |
| V = | The sediment volume (in litres or $dm^3$) **which may be allowed to accumulate in the bowl without impairing the separating result or without packing too firmly.** As a rule, “V” should be maximum three quarters of the sediment space volume, calculated from the outer edge of the upper bowl disc. The sediment space volume can be found in chapter Technical data in the Installation Manual. |



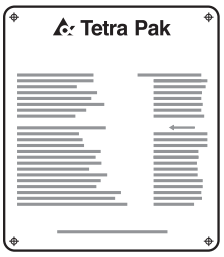

*1. Total sediment space volume*
*V. Allowed sediment volume*

# 3.6 Machine plates and safety labels

*Alfa Laval ref. 567710 Rev. 1*




**1. Machine plate**




Separator type
Serial No / Year
Product No
Main group no
Configuration no
Designation
Max allowed speed (bowl)
Direction of rotation (bowl)
Speed motor shaft
El. current frequency
Recommended motor power
Max. density of feed
Max. density of sediment
Max. density of operating liquid
Process temperature min./max.
Inside diameter of bowl body
Manufacturer
Service enquiries
www.alfalaval.com

**3. Safety label**




Text on label:

**Warning**

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.

**4. Name plate**

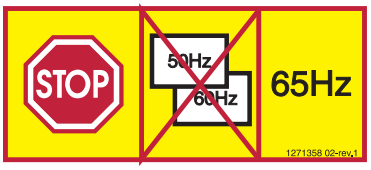



**5. Arrow**

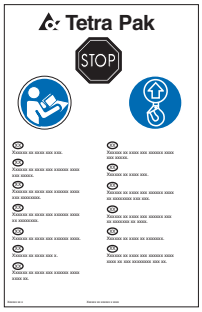


Indicating direction of rotation.

**7. Power supply frequency**




**8. Lifting instructions**




Text on label:

Read instruction manual before lifting.

**9. Cable tie**

*** Space reserved for plate indicating representative**

# 3.7 Definitions

| | |
|---|---|
| **Back pressure** | Pressure in the separator outlet. |
| **Concentration** | 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 **heavier** liquid phase, which is the major part of the mixture, shall be concentrated as far as possible. |
| **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 concentrated as far as possible. |
| **Counter pressure** | See *Back pressure*. |
| **Density** | Mass per volume unit. |
| **Interface** | Boundary layer between the heavy phase (outer) and the light phase (inner) in a separator bowl. |
| **Intermediate Service (IS)** | Overhaul of separator bowl, inlet/outlet and operating liquid device. Renewal of seals in bowl inlet/outlet and operating liquid device. |
| **Liquid seal** | Liquid in the solids space of the separator bowl to prevent the light phase from leaving the bowl through the heavy phase outlet, in purifier mode. |
| **Major Service (MS)** | Overhaul of the complete separator, including bottom part (and activities included in an Intermediate Service, if any). Renewal of seals and bearings in bottom part. |
| **Sediment** | Solids separated from a liquid. |
| **Sediment discharge** | Ejection of sediment from the separator bowl. |
| **Throughput** | The feed of process liquid to the separator per time unit. |
| **Viscosity** | Fluid resistance against movement. |

# 4 Operating instructions

## 4.1 Operating routine

These instructions are related only to the separator itself. If the separator is a part of a system or module follow also the instructions for the system.

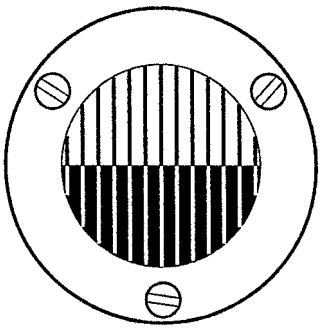
### 4.1.1 Before first start

Technical demands for connections and logical limitations for the separator is described in the following documents in the Installation Manual:

- *Technical data*
- *Basic size drawing*
- *Connection list*
- *Interface description*
- *Foundation drawing*

Before first start the following check points shall be checked:

- Ensure the separator is installed correctly and that feed-lines and drains have been flushed clean.
- Fill oil in the gear housing. Fill up to slightly above the middle of the sightglass. Use the correct grade of oil. The separator is delivered without oil in the worm gear housing. Oil volume: approx. **12 litres** Suitable oil brands can be found in chapter *Recommended oil brands* in the *Service & Maintenance Manual*.
- After the separator has been started, the discharge volumes at sediment ejections has to be set. This is described Settings on page 38.
- Motors equipped with regreasing nipples: When starting the motor for the first time, or after long storage of the motor, apply the specified quantity of grease until new grease is forced out of the grease outlet. The information can be found in *Lubrication of electric motor* in the *Service & Maintenance Manual*.


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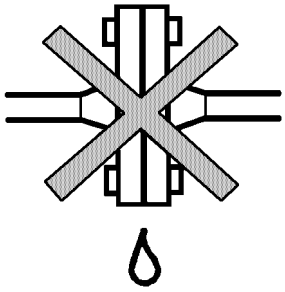
*Fill oil in the gear housing*

## 4.1.2 Ready for start

To achieve the best separation results the bowl should be in a clean condition.

1. Check that the bolts of the frame hood are fully tightened.

2. Check that all inlet and outlet connections have been correctly made and properly tightened.



*Check for leakages (not admitted)*

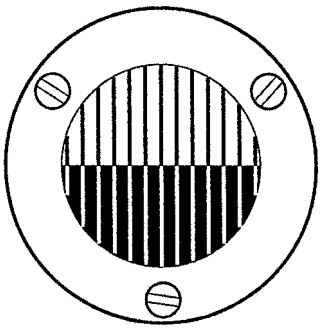
CAUTION

**Burn and corrosive hazards**

**Make sure that hose connections and flange couplings are properly assembled and tightened.**

**Escaping hot and/or corrosive liquid can cause skin injuries.**

3. Check that the oil level is slightly above middle of the sight glass. Be aware of that a very small quantity of oil may remain at the bottom edge of the sight glass even when the gear housing is emptied for oil. Fill if necessary. See chapter *Recommended oil brands* in the *Service & Maintenance Manual* for a list of recommended oils.



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*Check the oil level*

NOTE

**During running the oil level should be slightly below the middle of the sight glass.**

**Too much or too little oil can damage the separating bearings.**

4. Check that the frequency converter is set to parameters corresponding to the *Set bowl speed* in the *Installation manual*.

WARNING

**Disintegration Hazard**

**This machine must not be operated with higher bowl speed than 4600 r/minute.**

**Correct value is stated on the machine plate.**

### 4.1.3 Start

1. Before starting the separator, open following cooling / sealing liquid supplies:

   - Cooling liquid for frame part (405)
   - Cooling liquid for oil cooler (409)
   - Sealing liquid for outlet device (630)
   - Sealing liquid for outlet device (635a)
   - Sealing liquid for inlet device (615)

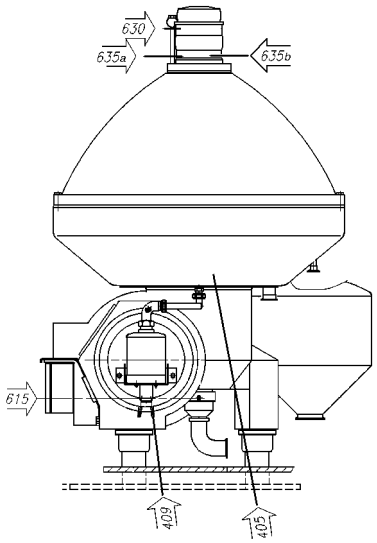
   Be sure that liquid flows also through the outlets.

   **NOTE**

   **To reduce the friction between sealing elements and wear rings in the mechanical seals, these must always be in contact with liquid when the bowl spindle / outlet pipe rotates. Otherwise the seals will get destroyed.**

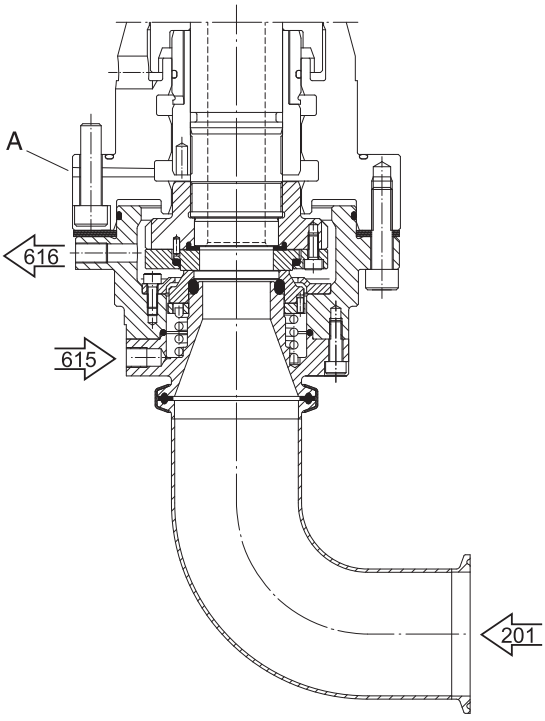
   For single sealing: If liquid comes out from the drain holes (A) above the inlet housing the liquid flow is too high or the outlet is obstructed or discharged on a too high level. The requirements for the flow can be found in chapter *Connection list* in the *Installation Manual*.

2. Start the separator.




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*Locations of cooling / sealing liquid inlets. Connection 630 only for 2-phase, 635b used during CIP.*




G08300h1

*single sealing*

*A. Drain hole for mechanical seal in inlet device.*
*615. Sealing liquid inlet*
*616. Sealing liquid outlet*

3. Check the direction of rotation of the bowl by checking that the direction of the motor fan corresponds to the arrow on the plate fixed on the motor.



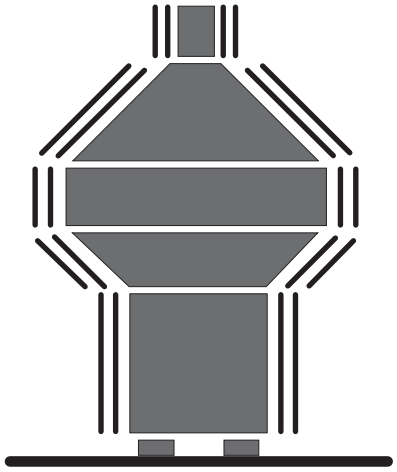
*The direction of rotation can be checked by comparing the direction of motor fan and the arrow on the fixed plate on the motor*




**Disintegration hazards**

**When power cables have been connected, always check direction of rotation. If incorrect, vital rotating parts could unscrew.**

4. Check the separator for vibration. Some vibration can occur for short periods during the starting cycle, when the separator passes through its critical speeds. This is normal and passes without danger. Try to learn the vibration characteristics of the critical speed pattern.



*Check for vibration*




**Disintegration hazards**

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

**The cause of the vibration must be identified and rectified before the separator is restarted. Excessive vibration may be due to incorrect assembly or insufficient cleaning of the bowl.**

In the trouble-tracing chapter 5.2.3 Separator vibrates on page 72, a number of causes are described that can create vibration.

5. When the bowl speed exceeds 3000 r/min close the bowl by supplying make-up liquid (375).

6. Check, if possible, the current drawn by the motor starter to ensure that the separator has reached full speed. The time to reach full speed may not exceed the limit given in chapter *Technical data* in the *Installation Manual*.




**Disintegration hazards**

**When the separator is equipped with a frequency controlled motor, it is extremely important to ensure that the motor speed does not exceed the allowed maximum speed. A serious break down may be the consequence.**

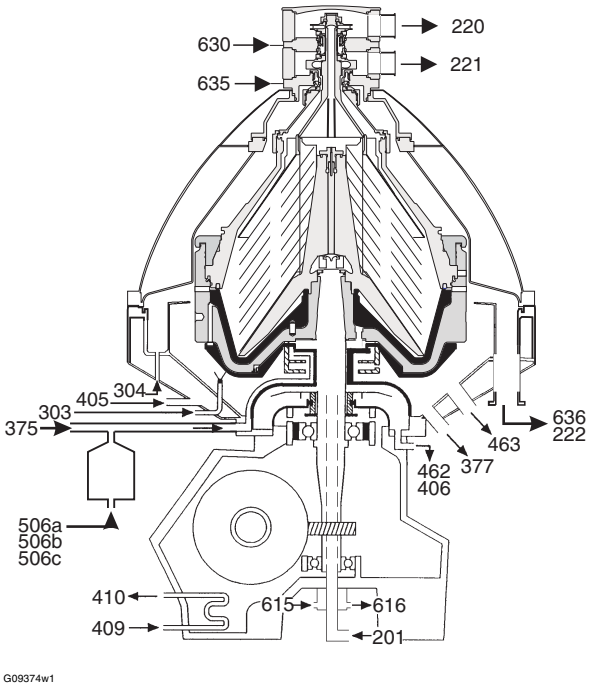
### Frequency drive motor

During start the ammeter will increase to about the rated motor current. At full speed the ammeter decrease to an idling value.

## 4.1.4 Running

1. Make sure that the outlets for the separated liquids (220) and (221) is fully open.

2. When the process liquid conditions are correct, open the process liquid feed (201) and adjust to a suitable throughput. This must not exceed the flow permissible and must be suited to the separability of the process liquid, see chapter *Connection list* in the *Installation Manual*.




*Purifier/Concentrator*

3. Discharge the sediment from the separator when the interval time for the sediment discharge has elapsed. The discharge is initiated by supplying discharge liquid (375) until the discharge has occurred. The discharge interval must be adjusted according to the solid contents in the feed. See 3.5 Sediment discharge interval on page 53 how to calculate the discharge interval. Keep the discharge interval within the values given in chapter *Technical data* in the *Installation Manual*.




**Disintegration hazards**

**Ensure that correct discharge intervals and cleaning procedures are used.**

**Unbalance due to improper discharge of solids may lead to solids accumulation and unbalance which may lead to contact between rotating and non-rotating parts.**

4. Adjust the back pressure according to the permitted values given in the *Connection List* in the *Installation Manual*.




**Risk of explosion**

**If the process liquid flow is interrupted or sharp decreased for some reason, the temperature of liquid remaining in the separator bowl will increase to a temperature in excess of 100 °C.**

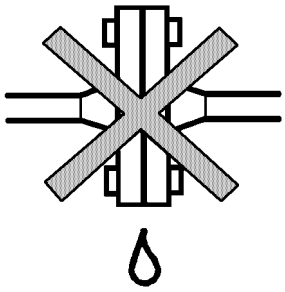
### Daily condition checks

Carry out following steps daily:

1. Check all pipe and hose connections for leakage.




**Burn and corrosive hazards Make sure that hose connections and flange couplings are not leaking. Escaping hot and/or corrosive liquid can cause skin injuries.**



*Check for leakages (not admitted)*

2. Check the mechanical seals for possible leakages from the in and outlet devices in following way:

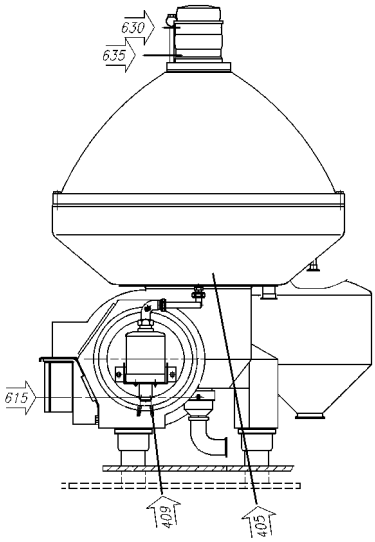
   a. Shut off the sealing liquid supply (615, 630 & 635) to the axial seals for a short while.




**It must be liquid flow through the bowl.**

   b. Check at the outlets for possible leakage. Major leaks must not occur. Minor leaks may temporarily be left uncorrected.

   c. Open the sealing liquid supply again.




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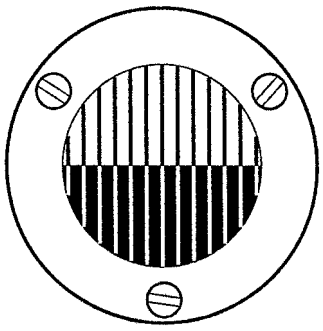
*Locations of cooling / sealing liquid inlets.*

3. Check that the cooling / sealing liquid flows are sufficient (connections 405, 409, 615, 630 & 635).

4. Check the oil level in gear housing. Fill if necessary. See chapter *Lubricants* in the *Service & Maintenance Manual* for a list of recommended oils.




**During running the oil level should be slightly below the middle of the sight glass. Too much or too little oil can damage the separator bearings.**



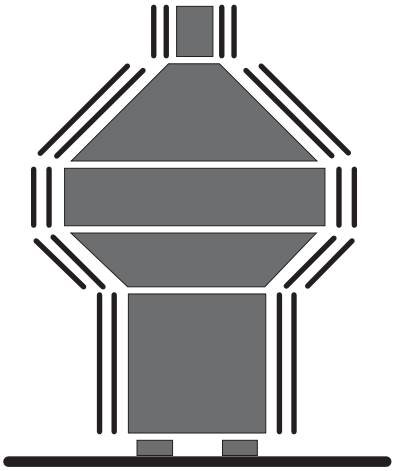
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*Check the oil level*

5. Check the separator for noise and vibration.




**Disintegration hazards When excessive vibration occurs, keep bowl filled and stop separator. The cause of the vibration must be identified and rectified before the separator is restarted.**



*Check for vibration*

6. Check the electric motor for overheating.

### 4.1.5 Normal stop

1. Empty the separator bowl totally from solids before stopping it. If not, a manual cleaning has to be done before next startup. Discharge repeatedly until solids no longer is remained in the bowl. The bowl must be filled with liquid during the discharges.

2. After the discharges and flushing, supply liquid to the bowl and stop the separator with the bowl filled.




**Disintegration hazards**

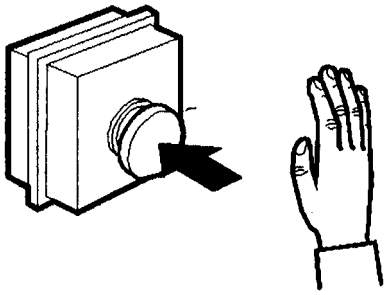
**The bowl must always be filled with liquid during the run-down period to prevent excessive vibration if there is uneven sludge accumulation in the bowl.**

3. When the bowl speed passes 3000 r/min shut off the make-up liquid (connection 375).

4. After the bowl has come to a complete standstill, turn off the sealing liquid supply (615) for the axial seal in the product inlet housing. Turn off the liquid supply to outlets 630 and 635a.

### 4.1.6 Emergency stop

1. If the separator begins to vibrate excessively during operation, stop it immediately by switching off the separator motor, e.g. by pushing the emergency stop button. Keep the bowl filled during the run-down to minimize the excessive vibration.



*Push the emergency stop if excessive vibration*

2. Check that the protective gas supply (if any) is not interrupted.




**Risk of explosion**

**If the protective gas is interrupted this will give rise to an immediate danger of explosion which may cause severe damage or fatal injury.**

3. Shut off the make-up liquid (connection 375) at max. bowl speed 3000 r/min.

4. Evacuate the room. The separator may be hazardous when passing its critical speeds during the run-down.




**Disintegration hazards**

**Do not discharge an excessive vibrating separator. Out-of-balance vibration can become worse if only part of the sediment is discharged.**




**Disintegration hazards**

**After an emergency stop the cause of the fault must be identified. If all parts have been checked and the cause remains unclear, contact Alfa Laval for advice.**

## 4.1.7 CIP (Cleaning In Place)

**Main principles of a CIP program**

CIP is used to keep the separator clean and thereby preventing heavy displacement, clogging of disc stack and to avoid micro-biological infection. The use of CIP together with repeated sediment discharges prolongs the intervals between manual cleaning of the separator.

No general rules can be given for frequency and type of CIP to be used as this depends on the properties of the product to be separated. The CIP frequency also depends on the requirements of the cleaning result regarding micro-organisms.

The CIP liquids to be used is also dependent on product properties and cleaning requirements.

**Example of a CIP program:**

| Media | Temperature | Reason | Time period (min-utes) | No. of discharges per period | Notes |
|---|---|---|---|---|---|
| 1. Water | Hot or cold* | Primary flushing | 5 | 5 | Used water usually passes to drain |
| 2. Lye (NaOH) 1 - 2% | 70 - 80 °C | Dissolving protein deposits | 30 - 60 | 6 - 12 | The lye is normally recirculated |
| 3. Water | Hot or cold* | Flushing | 5-10 | 3 - 5 | Used water normally either passes to drain (before or after heat recovery) or is recirculated. |
| 4. Nitric acid [a] 1% | 70 °C | Dissolving inorganic deposits (primarily calcium salts) | 5-10 | 3 - 5 | If soft water is used, acid washing is only required a few times a year. In this case the return can pass to drain. If hard water is used, acid washing will perhaps be required at every CIP. In this case a recirculating system should be used. |
| 5. Water | Hot / 90 - 95 °C | Flushing and sterilizing | 10 | 5 | Return as for 3 above |

* Temperature depending on application

# 5 Trouble-tracing

## 5.1 Introduction

First check if there are any alarms in the system and study the alarm list.

If the separator has been installed as a part of a processing system always study the trouble-tracing part (if any) in the system documentation first.

If the problem is not solved, continue with this chapter.

## 5.2 Mechanical functions

### 5.2.1 Smell

| Cause | Corrective actions |
|---|---|
| Bearing is damaged | Renew |
| Oil level in gear housing is too low | Check oil level and add oil if necessary |

### 5.2.2 Noise

| Cause | Corrective actions |
|---|---|
| Oil level in gear housing is too low | Check oil level and add oil if necessary |
| Height adjustment of the outlet device for processed liquid is incorrect | Stop the separator, measure and adjust the height |
| Worm wheel and worm are worn | Renew worm wheel and worm |
| Bearing is damaged or worn | Renew |
| Incorrect play between elastic plates in coupling | Adjust the play |

## 5.2.3 Separator vibrates




**Some vibration is normal during the starting and stopping sequences when the separator passes through its critical speed.**




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

**The cause of the vibration must be identified and corrected before the separator is restarted. Excessive vibration may be due to incorrect assembly or poor cleaning of the bowl.**

| Cause | Corrective actions |
|---|---|
| Bowl out of balance due to:<br>- poor cleaning<br>- incorrect assembly<br>- incorrect disc stack compression<br>- bowl assembled with parts from other separators | Dismantle the separator and check the assembly and cleaning. Check the number of bowl discs, compare with the number in *Spare Parts Catalogue*. If necessary, rebalance the bowl. |
| Uneven sediment deposits in sediment space | Dismantle and clean the separator bowl |
| Bowl spindle bent (max 0,05 mm) | Renew the bowl spindle |
| Bearing is damaged or worn | Renew |
| Vibration damping rubber cushions are worn out | Renew all rubber cushion |

## 5.2.4 Starting power too high

| Cause | Corrective actions |
|---|---|
| Wrong direction of rotation | Change electrical phase connections to the motor |
| Wrong settings of the frequency converter | Check the parameter settings in *Technical data* and *Motor drive data* in the *Installation Manual* |

## 5.2.5 Starting power too low

| Cause | Corrective actions |
|---|---|
| Motor failure | Repair/renew the motor |

### 5.2.6 Speed too low

| Cause | Corrective actions |
|---|---|
| Bowl is leaking or not closed | Dismantle the bowl and check |
| Motor failure | Repair/renew the motor |
| Bearing is damaged | Renew |
| Wrong settings of the frequency converter | Check the parameter settings in *Technical data* and *Motor drive data* in the *Installation Manual* |

### 5.2.7 Starting time too long

| Cause | Corrective actions |
|---|---|
| Height position of outlet device for processed liquid or the operating liquid device is incorrect | Stop, check and adjust the height(s) |
| Bearing is damaged or worn | Renew |
| Wrong settings of the frequency converter | Check the parameter settings in *Technical data* and *Motor drive data* in the *Installation Manual* |

### 5.2.8 Water in worm gear housing

| Cause | Corrective actions |
|---|---|
| Bowl casing drain is obstructed | Clean the casing and the drains properly. The drains have connection Nos. 462 & 463 on the *Basic size drawing* in the *Installation Manual*. Solve the reason for obstruction. Clean worm gear housing and change oil. |
| Leakage at top bearing | Renew seal ring and change oil |
| Condensation | Clean worm gear housing and change oil |

# 5.3 Separating functions

## 5.3.1 Unsatisfactory separation result

| Cause | Corrective actions |
|---|---|
| Incorrect separation temperature | Adjust |
| Throughput is too high | Adjust |
| Wrong back pressure in clean liquid outlet | Adjust the back pressure or inlet pressure |
| Bowl disc stack is clogged | Clean the disc stack |
| Sediment space in bowl is filled | See 5.3.7 Bowl clogged with sediment on page 75 |
| Bowl speed is too low | Examine the motor and power transmission including the gear ratio, see 5.2.6 Speed too low on page 73 |
| Cleaned liquid contains sediment | Shorten the discharge interval |
| | |

## 5.3.2 Outgoing heavy phase contains light phase

| Cause | Corrective actions |
|---|---|
| The make-up liquid line is obstructed or the pressure/flow is too low | Check make-up liquid pressure/flow. Compare with the recommended values in *Connection List* in the *Installation Manual*. |
| O-ring sealing between upper and lower paring chambers is defective | Renew the O-rings |
| | |

## 5.3.3 Light phase discharges through heavy phase outlet (broken liquid seal)

| Cause | Corrective actions |
|---|---|
| Incorrect separation temperature | Adjust |
| Throughput too high | Adjust |
| The make-up liquid line is obstructed or the pressure/flow is too low | Check make-up water pressure/flow. Compare with the recommended values in the *Connection List* in the *Installation Manual*. |
| Valve(s) in light phase outlet line is closed | Open the valve(s) |
| Disc stack is clogged | Clean the disc stack |
| Bowl hood seal ring defective or the sealing surface of sliding bowl bottom is damaged | Renew the seal ring. Polish the surface on sliding bowl bottom or renew it |
| Rectangular seal ring in sliding bowl bottom is defective | Renew the seal ring |
| Bowl speed too low | See 5.2.6 Speed too low on page 73 |
| Bowl is incorrectly assembled | Check the assembly |
| | |

### 5.3.4 Bowl fails to open for sediment discharge

| Cause | Corrective actions |
|---|---|
| Operating liquid supply is obstructed | Check the liquid supply |
| Seal rings in operating liquid device are defective | Renew the seal rings |
| Discharge liquid pressure/flow is too low | Check the discharge liquid pressure/flow. Compare with the recommended values in chapter *Connection list* in the *Installation Manual.* |
| Seal ring in the operating slide is defective | Renew the seal ring. Carry out an Intermediate Service (IS) |
| Faulty OWMC unit | See 5.3.12 OWMC related faults on page 78 |

### 5.3.5 Bowl opens accidentally during operation

| Cause | Corrective actions |
|---|---|
| Strainer in the operating liquid supply is clogged | Clean the strainer |
| No liquid in the operating liquid system | Check the operating liquid system and make sure the valve(s) are open |
| Liquid connections to the separator are incorrectly fitted | Correct |
| Square-sectioned ring in sliding bowl bottom is defective | Renew the square-sectioned ring. Carry out an Intermediate Service (IS) |
| Valve plugs are defective Renew all plugs. | Carry out an Intermediate Service (IS) |
| Sediment deposits on the operating slide | Clean the operating slide |
| Seal ring in operating slide is defective | Renew the seal ring |

### 5.3.6 Unsatisfactory sediment discharge

| Cause | Corrective actions |
|---|---|
| Sediment hard packed due to long discharge interval | Shorten the discharge interval |
| Valve plugs in the operating slide are worn or too high | Renew with correct valve plugs |
| Sediment deposits in the operating system | Check and clean the operating system |
| Faulty OWMC unit | See 5.3.12 OWMC related faults on page 78 |

### 5.3.7 Bowl clogged with sediment

| Cause | Corrective actions |
|---|---|
| Sediment is too viscous | Discharge more frequently |
| Sediment tank is overfilled | Empty the sediment tank and clean the bowl casing in frame |

### 5.3.8 Too much process liquid in sediment

| Cause | Corrective actions |
|---|---|
| Discharge interval is too short | Prolong the discharge interval |
| Bowl is leaky | See 5.3.11 Liquid flows through the bowl casing drain and/or sediment outlet on page 77 |
| Axial seal in outlet device is leaky | See 5.3.11 Liquid flows through the bowl casing drain and/or sediment outlet on page 77 |

### 5.3.9 High pressure in clean liquid outlet

| Cause | Corrective actions |
|---|---|
| Throughput is too high | Adjust |
| Valve(s) in clean liquid outlet line is throttled too much | Open the valve(s) and adjust according to values in chapter Connection list in the Installation Manual |

### 5.3.10 Air intermingled with the cleaned liquid

| Cause | Corrective actions |
|---|---|
| Back pressure in the clean liquid outlet is too low | Increase the back pressure.<br>See 4.1.4 Running on page 64 |
| Pump wheel in outlet device is defective | Renew the pump wheel |
| Too low inlet pressure in the feed line (201) | Increase the pressure |
| Air is already intermingled in the process liquid before entering the separator | Modify the treatment of the feed |
| | |

### 5.3.11 Liquid flows through the bowl casing drain and/or sediment outlet

| Cause | Corrective actions |
|---|---|
| Sediment discharge or liquid draining in progress | None (normal) |
| The make-up liquid line is obstructed or the liquid pressure/flow is too low or too high | Check make-up liquid pressure/flow. Compare with recommended values in chapter Connection list in the Installation Manual. |
| Channels in operating liquid device are clogged | Clean the operating liquid device |
| Seal rings in the operating liquid device are defective | Renew the seal rings |
| O-ring under the paring chamber cover is defective | Renew the O-ring |
| Paring chamber cover is defective | Renew the paring chamber cover |
| Seal ring in the bowl hood is defective | Renew the seal ring |
| Sealing edge of the sliding bowl bottom is defective | Smoothen sealing edge of the sliding bowl bottom or renew it |
| Operating slide of bowl jams due to poor lubrication, defective seal ring, burrs or deformation | Dismantle and check |
| Operating slide springs are defective | Renew the springs |
| Valve plugs are defective | Renew all valve plugs |
| Sliding bowl bottom jams - seal ring is defective | Renew the seal ring |
| Bowl speed is too low | See 5.2.6 Speed too low on page 73 |
| Axial seal in outlet device is leaky because of:<br>- Insufficient flow of sealing liquids (630)<br>- Deposits on sealing surfaces because of insufficient cleaning program<br>- Bowl out of balance<br>- Frame hood not centred in relation to the outlet pipe<br>- Wobbling outlet pipe<br>- Too high back pressure in liquid outlet | Renew the seal and remedy the cause |

### 5.3.12 OWMC related faults

| Indication | Cause | Corrective actions | Page |
|---|---|---|---|
| The bowl does not discharge or the volume is too small | Needle valve for setting of small discharge is throttled too much | Adjust the throttling | 38 |
| | Air pressure for setting of large discharge is too low | Adjust the air pressure | 38 |
| | No supply or signal air to the OWMC | Check the air supply | – |
| | Faulty check valve in operating water feed line before the OWMC inlet | Check function of the valve | – |
| OWMC piston does not return to its initial position or returns too slowly | Impurities in water or air which increase friction between piston and cylinder | Follow the instructions carefully for air and water quality. | 1) |
| | | Clean and lubricate piston and cylinder with GLEITMO 1821V | 2) |
| | Too low operating water pressure in the feed line before the OWMC | Check the operating water pressure | 3) |
| | Silencer for air outlet in the OWMC is clogged | Renew the silencer | – |
| | Faulty check valve in operating water feed line before the OWMC inlet | Check function of the valve | – |
| The discharged volume too large | Faulty sealing for the two-pulse adapter, see OWMC starting on page 32 | Renew the sealing | 2) |
| | Too high pressure of the air supply (506a). | Reduce the air pressure | 38 |
| Bowl fails to close after sediment discharge | Clogged nozzle fitted in the two-pulse adapter | Clean the nozzle | 2) |

1. See *Installation Manual*
2. See *“Operating water module (OWMC)”* in *Service & Maintenance Manual*
3. See *Installation Manual*, *“Connection list”*, connection 375