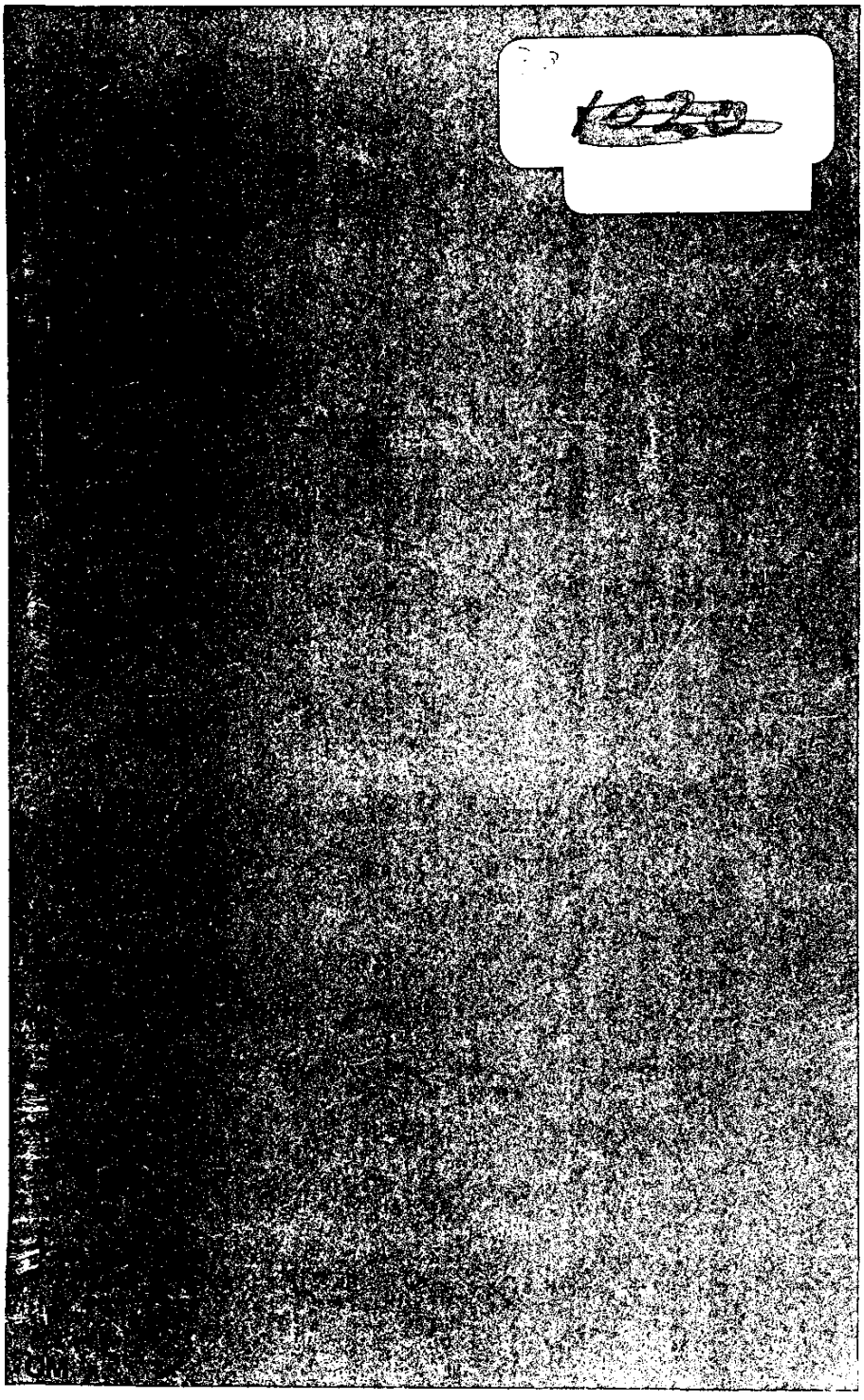
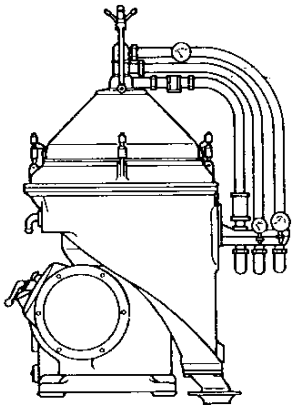
104

ALFA-LAVAL

Operator's Manual





WHPX 405
WHPX 407
WHPX 409
WHPX 410

Mineral Oil Separators

WHPX 405 TGD-20
WHPX 407 TGD-20
WHPX 409 TGD-20
WHPX 410 TGD-20

With machine trimming accomplished and trimming values entered in the manual, insert the manufacturing number in the space below.

Manufact. No.:

Book No. OM SO 4562E 3/8405

ALFA-LAVAL SEPARATION AB – S-147 00 TUMBA – SWEDEN

FOREWORD

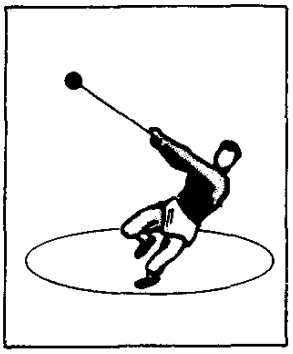
This instruction book is intended primarily for the machine operating personnel. It is essential that these persons should be familiar with the contents of the book, which deal with the mechanical and separating functions of the machine as well as operation and daily maintenance.

The purpose of the manual is to enable the reader to operate the machine complying with safety stipulations, and to achieve satisfactory separating results.

ALFA-LAVAL SEPARATION AB
Department SDI

CONTENTS

⚠ SAFETY PRECAUTIONS ⚠
FOR HIGH SPEED SEPARATORS



The bowl of a centrifugal separator rotates at a very high speed and great forces are generated.

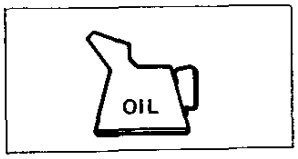
To ensure the safety of personnel and equipment:

- Always carefully follow the safety instructions and precautions.
- Always carefully follow the instructions in the instruction manuals concerning installation, assembly of the components, operation and regular maintenance.
- Always use genuine Alfa-Laval spare parts and tools.
- Ensure that all operators who run and service a separator are well trained and knowledgeable about the machine and its mode of operation.

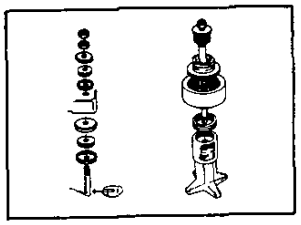
NONCOMPLIANCE MAY CAUSE A SERIOUS ACCIDENT

BEFORE INITIAL START-UP OF NEW/OVERHAULED MACHINES

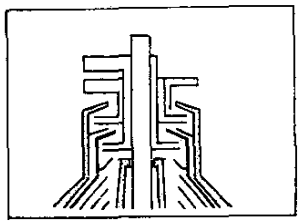
- Never transport or lift a separator with its bowl installed. This may cause bearing and bowl spindle damage.



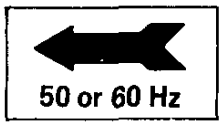
- Make sure that the gear housing has been filled with the correct quantity of specified oil.



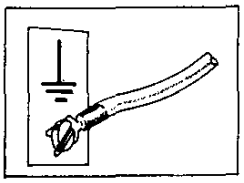
- Check that installation and tightness of rubber vibration dampers between frame and foundation is according to instructions.



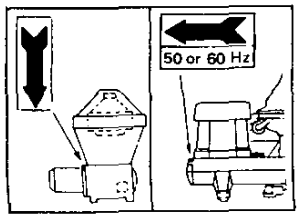
- Many separators are equipped with paring disc liquid discharge. It is important that the paring device/feed tube assembly has correct height adjustment and is securely tightened before machine is operated. See instruction manual for detailed instructions.



- Be sure to check that the frequency and voltage of the current to be connected agrees with machine specifications, see figure on the arrow sign on the frame.



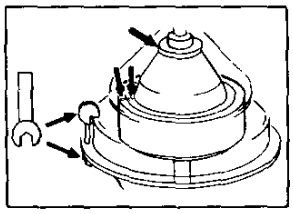
- Make sure that the separator frame, control boxes and cabinets are connected to earth (ground) in accordance with local regulations.
- Note that a separator must never be started without its bowl. This may damage its bearings.



- Be sure that the motor rotates in the same direction as arrow on separator frame. The lock ring(s) of the bowl may unscrew if it rotates in the wrong direction.

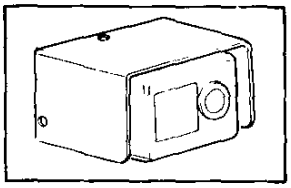
  Check the operating rpm. with an empty bowl against the value specified in the instruction book. Self-cleaning separators are to be checked before the operating water is introduced (open bowl).

OPERATION

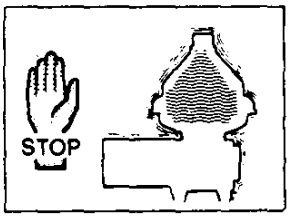


- NEVER start the machine before the lock rings of the bowl, inlet and outlet devices, frame hood, clamps, pipe couplings and other fastenings have been securely tightened. Note that the assembly mark Q on the main lock ring must be aligned or pass the Q mark on bowl body or bowl hood when lock ring is fully tightened. In this position there must be proper compression of disc stack. See the MR manual.

- The brake should always be released before start.



- If machine is equipped with vibration alarm unit check the setting and adjust it if necessary to individual process conditions.



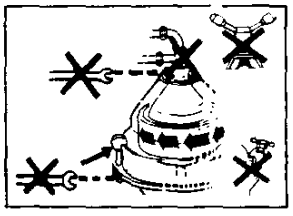
- If unusual vibration occurs:

  INSTANT ACTIONS
  - o switch off separator motor
  - o apply brake
  - o ascertain that liquid is fed to the bowl, see chapter OPERATION in Operator's Manual (OM)

  Switch off preheater. Wait until the separator has come to a complete standstill, then switch off:
  - o separate feed pump (if any)
  - o programme equipment (if any)

  Arrange manually for recirculation of unseparated oil. Dismantle, clean and check all parts carefully. Do not operate until the cause of the vibration has been located and eliminated.

- Check that there is no leakage from piping connections on the separator and to/from the separator.

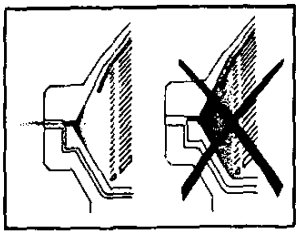


- NEVER loosen any part of the machine until the bowl has come to a COMPLETE STANDSTILL.

- NEVER use the machine for separating liquid which is more corrosive or has higher density, higher temperature, different characteristics of the solids, etc. than originally specified. Consult your ALFA-LAVAL representative.

- Follow local safety regulations concerning inflammable, toxic, or corrosive process media. Affix information and warning notices in prominent places.

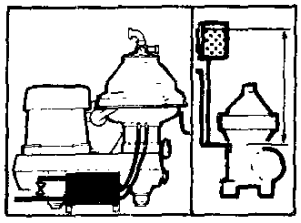
TO BE OBSERVED FOR SAFE OPERATION OF SOLIDS–EJECTING SEPARATORS OF PX–TYPE



- The bowl has to be discharged from solids at intervals which depend on the feed rate, feed solids content of the entering product and the characteristics of the solids. To avoid excessive vibration and risk of damage the solids must be discharged before the solids space is overfilled or hard packed.

  Always consult your ALFA-LAVAL representative, if possible before increasing feed rate or the solids content of feed.

- NEVER program a machine with a variable discharge program for total discharge before consulting your ALFA-LAVAL representative.



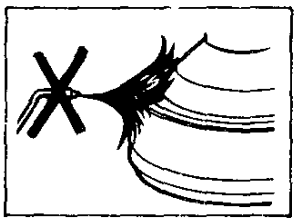
- The function of the bowl's discharge mechanism is vital for safe operation of the separator. It is therefore absolutely necessary to have an uninterrupted flow of clean, soft (dehardened) water/ /liquid at prescribed **constant** pressure. Ensure that the **entering pressure cannot fall** below the minimum level required and does not exceed the maximum level allowed.

- At manual operation always stop the machine with a liquid filled bowl and run it down filled until the bowl opens by itself.
  If your separator has been equipped with an automatic safety liquid system to ensure that the bowl is filled at feed power failure, run-down or heavy unbalance – make sure that the liquid supply is always available whenever machine is operated. This is very important to avoid heavy vibrations/damages.

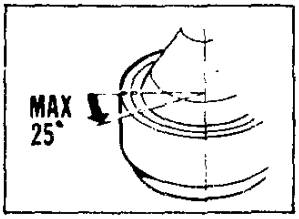
MAINTENANCE

- Switch off and, if possible, lock out the power to the machine and allow it to stop completely before starting any dismantling work. Hang up sign warning against turning on power.

- A separator bowl is balanced as a complete unit. Do not interchange the components of a bowl with those of any other bowl. Make sure that no parts are left out during assembly. All major parts are marked with the full serial number or the last three digits for identification purposes.

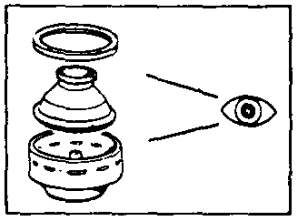


- NEVER heat rotating bowl parts, such as bowl body, bowl hood, lock rings, etc. with a naked flame or attempt repairs by welding. This could destroy the mechanical and structural strength of the material.



- NEVER operate the machine when the ¢ assembly mark on the main lock ring can pass the corresponding mark on bowl body/ bowl hood by more than 25 degrees.
  Consult your ALFA-LAVAL representative.

- The disc stack gradually settles and looses compression force. At each maintenance occasion check whether more disks are to be added in order to assure correct compression. NEVER remove a disc without replacing it with a new one. When reassembling, be sure to assemble slotted discs in the same order that they previously had.

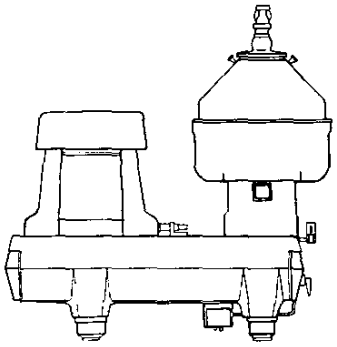


- At each service occasion, yet at least every third month the most important parts should be checked for damage. Special attention should be given to bowl pillars at sludge discharge ports, threads of bowl body/main lock ring as well as the frame and the upper frame part which is permanently hit by the ejected solids and/or the operating water. If the process conditions are corrosive or erosive the frequency must be increased.

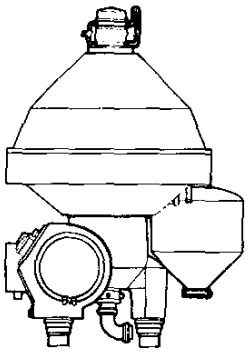
- Make sure that the brake is in good condition on machines equipped with a brake.

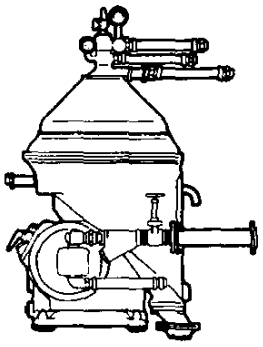
IF YOU ARE UNCERTAIN OF ANY POINTS, CONTACT YOUR ALFA-LAVAL REPRESENTATIVE.

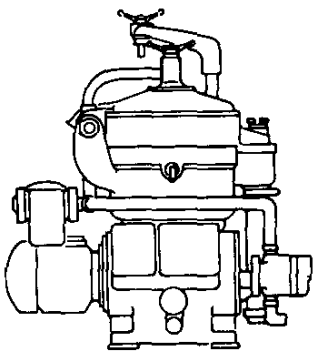
ALFA-LAVAL SERVICE



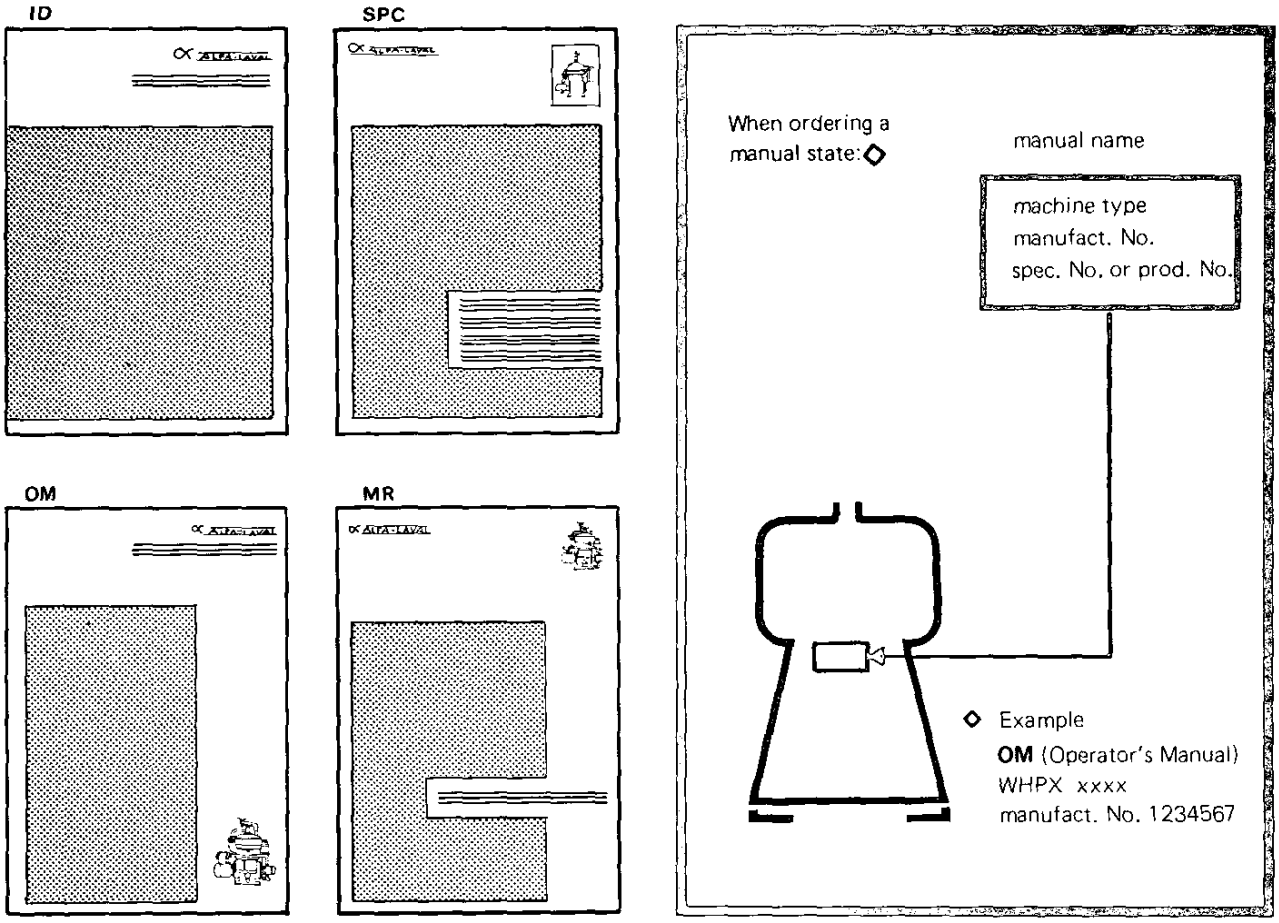
For reliability and safe operation we recommend that your separator is inspected at regular intervals by ALFA-LAVAL service engineers. These inspections will also ensure that your separator is working efficiently and economically.







MANUALS



Manual	Contents	Intended for
ID *Installation Data*	Installation instructions, measurements, technical data	Project engineers Design engineers Fitters Production engineers
OM *Operator's Manual*	Instructions on operation and daily maintenance of machine	Machine operator
SPC Spare Parts Catalogue	Spare parts lists	Maintenance personnel *Purchasing department*
MR Maintenance and Repair	Maintenance schedule, disassembly and assembly *instructions, adjusting meas*urements, repair instructions	Maintenance *personnel*

GENERAL INFORMATION

GENERAL DEFINITIONS

Density (specific gravity) — Mass per volume unit.

Sediment — Solids separated from a liquid.

Sludge — Sediment and some liquid.

Throughput — The feed of process liquid to the separator per unit time. Expressed in m^3/h or lit/h (UKGPH) (USGPH).

Clarification — Liquid/solids separation with the intention of separating particles, normally solids, from a liquid having a lower density than the particles.

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 is the major part of the mixture.

Abbreviations

h = hour
r.p.m. = revolutions per minute
Hz (Herz) = c/s = cycles per second
Ø = diameter
SAE-grade = indication of oil viscosity according to Society of Automotive Engineers, USA
SSU = Saybolt Seconds Universal, indication of oil viscosity
^{O}E = degree Engler, indication of oil viscosity
cSt = centistoke, indication of oil viscosity
Sec. R1/100 ^{O}F = Redwood seconds, indication of oil viscosity at 100 ^{O}F (38 ^{O}C)
EP = Extreme Pressure, lubricants made capable of resisting high contact pressures through a mixture of additives
ASTM = American Society for Testing Materials
NLGI-classes = classification of lubricating grease by means of penetration after processing according to National Lubricating Grease Institute, USA
ISO = standards of machining according to International Organization for Standardizing
1 bar = 0.1 MPa = 100 kPa ≈ 1 kp/cm^2

Basic principles

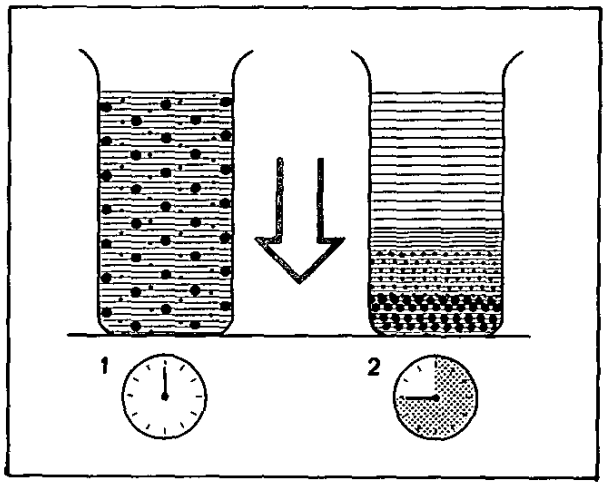
The purpose of separation is

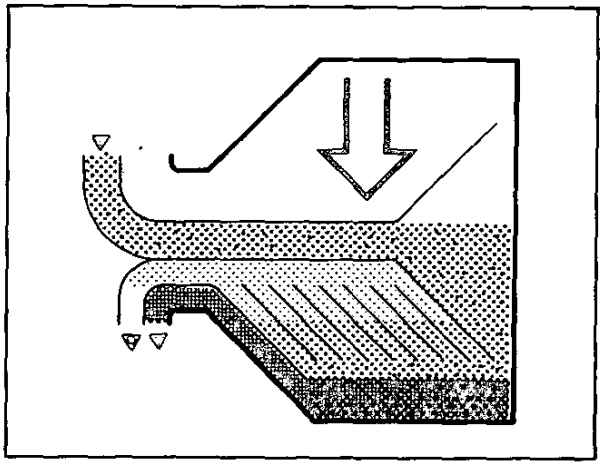
to free a liquid of solid particles

to separate two mutually insoluble liquids with different densities, removing any solids at the same time.

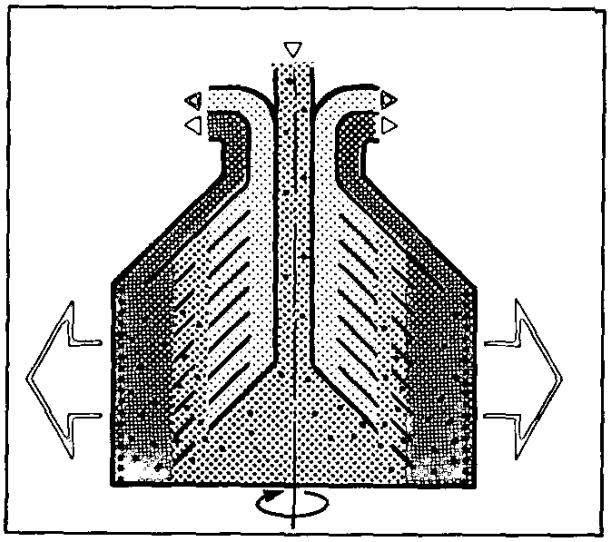
Separation by gravity

A turbid liquid in a stationary vessel will clear slowly as the heavy particles in the liquid mixture are sinking to the bottom under the influence of gravity. The lighter liquid phase will rise while the heavier sinks.





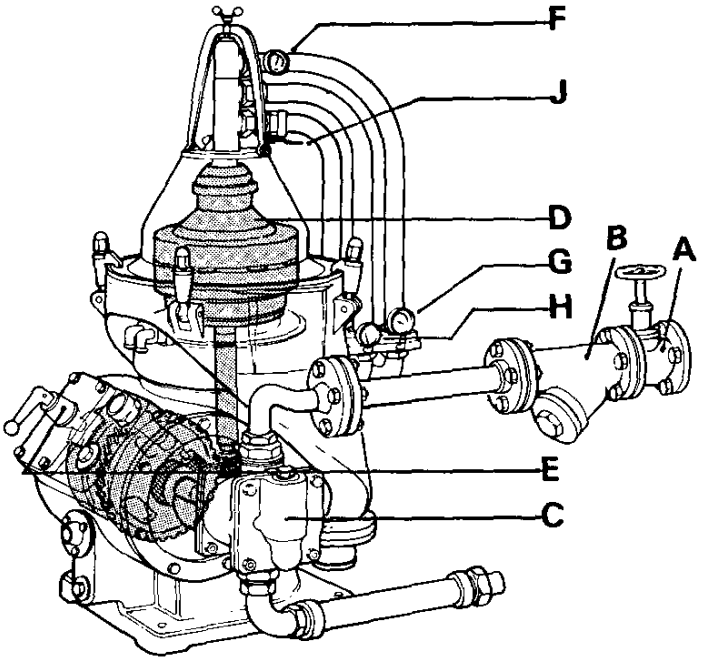
Continuous separation and sedimentation can be achieved in a settling tank having the outlets arranged at levels suited to the density ratio of the two liquid phases. Any solid and heavier particles in the liquid mixture will settle and form a sediment layer on the tank bottom.



Centrifugal separation

In a rapidly rotating vessel the gravity is replaced by the centrifugal force, which can be thousands of times greater. Separation and sedimentation are continuous and very fast. When liquid and solid particles in a liquid mixture are subjected to the centrifugal force in a separator bowl, it takes only a few seconds to achieve what takes many hours in a tank under the influence of gravity.

MECHANICAL FUNCTION

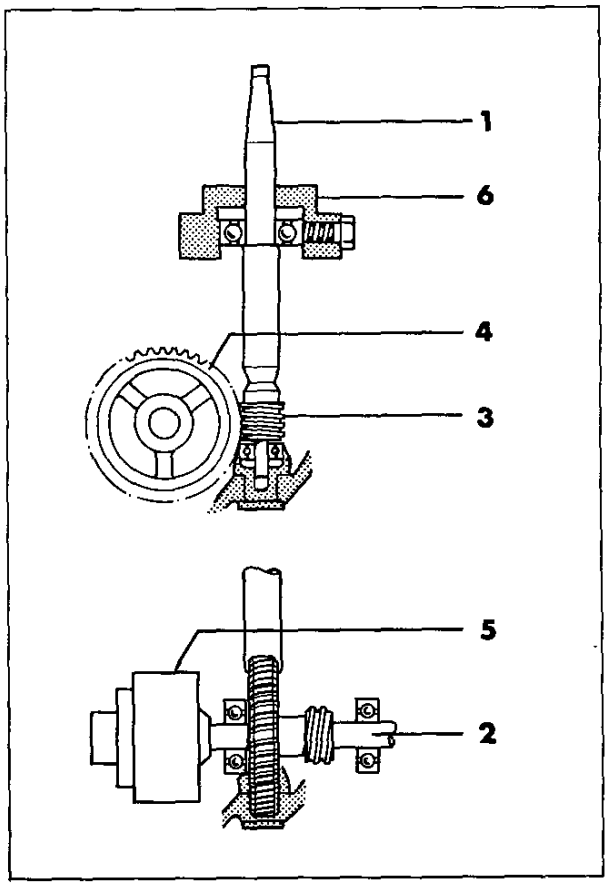


WHPX SEPARATORS

These are centrifugal separators intended for the removal of impurities from fuel and lubricating oils.
With this type of machine the sludge can be ejected without interruption of the oil flow through the separator and virtually no oil loss.

Machine components

A.	Shut-off valve	E.	Brake
B.	Strainer	F.	Thermometer
C.	Feed pump	G.	Flow meter
D.	Bowl	H.	Pressure gauge
		J.	Shut-off valve

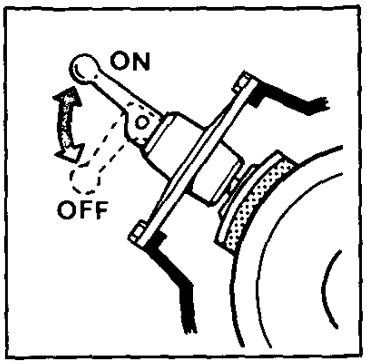


POWER TRANSMISSION

1. Bowl spindle
2. Worm wheel shaft
3. Worm] Worm gear
4. Worm wheel]
5. Friction coupling
6. Top bearing

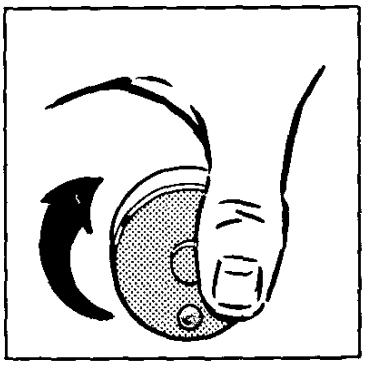
The motor rotates the bowl through the friction coupling and worm gear.
The friction coupling ensures a gentle start and acceleration and prevents overloading of worm gear and motor.
The worm gear serves to adapt the bowl speed to the motor speed.
To decrease bearing wear and prevent transmission of bowl vibrations to frame and foundation the top bearing of the bowl spindle is mounted in a spring casing.

BRAKE

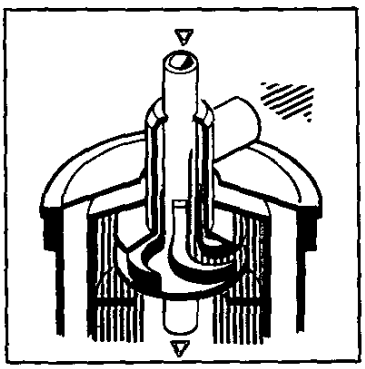


When stopping the machine always apply the brake in order to reduce the retardation time of the bowl, thus quickly passing the critical speed.

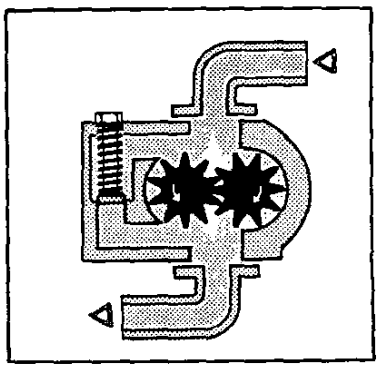
REVOLUTION COUNTER



It is essential to operate the machine at the correct speed both in order to achieve the best separating results and for reasons of safety. Count the number of revolutions per minute. Refer to name plate for speed particulars.



Paring disc



Gear pump

PARING DISC

A paring disc is a stationary pump wheel, which dips into a liquid ring confined in a rotary part and pares out liquid. Shown above by way of example is a paring disc mounted in a chamber in the top disc neck and serving as a discharge pump for clean oil.

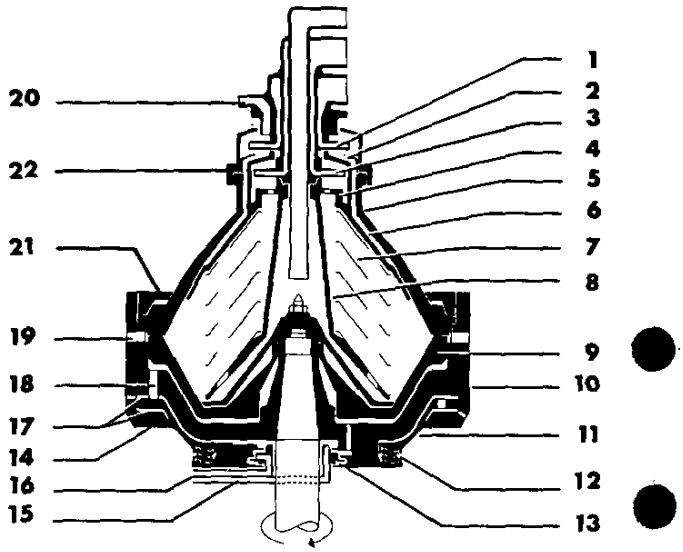
GEAR PUMP

The built-on feed pump of all WHPX separators *is of the gear* type and is direct-driven by the worm wheel shaft.

MECHANICAL FUNCTION

BOWL

The bowl body 10 and bowl hood 5 are held together by the large lock ring 21. Housed in the bowl are the distributor 8 and the disc set 7 through which the dirty oil flows and where the separation takes place. Uppermost in the disc set is the top disc 6. The top disc neck and the level ring form a paring chamber where the paring disc 3 pumps the clean oil from the bowl. The separated water flows to the upper paring chamber of the bowl through the gravity disc 2, which is clamped to the bowl hood 5 by the small lock ring 22 that also forms the top part of the upper paring chamber. The parts by which sludge and/or water discharge is effected are marked by an asterisk (*) in the list below, and their functions are described on page 14.



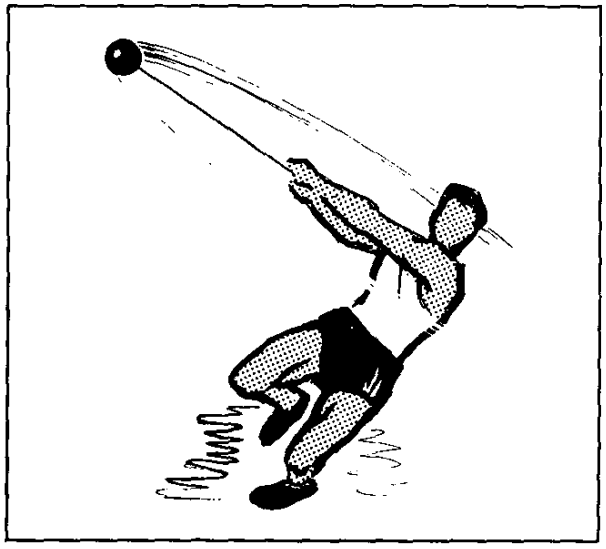
Bowl parts

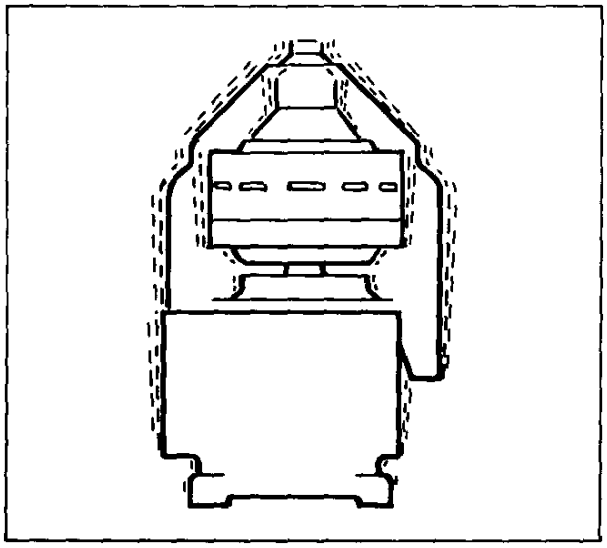
1	Paring disc, water	13*	Control paring disc
2	Gravity disc	14*	Dosing ring
3	Paring disc, oil	15*	Opening water inlet
4	Level ring	16*	Closing and make-up water inlet
5	Bowl hood	17*	Dosing chamber
6	Top disc	18*	Drain valve
7	Disc set	19*	Sludge port
8	Distributor	20	Liquid seal and displacement water inlet
9*	Sliding bowl bottom	21	Large lock ring
10	Bowl body	22	Small lock ring
11*	Operating slide		
12*	Spring		

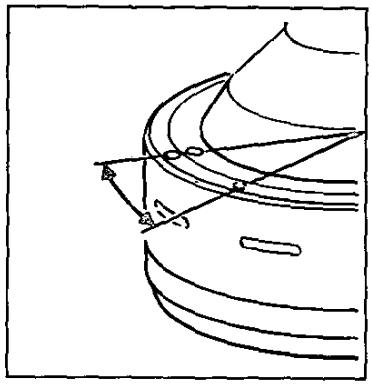
CENTRIFUGAL FORCE

In all centrifugal separators the bowl is running at a very high speed, normally between 4000 and 9000 r.p.m.

Great forces are at work, subjecting the machine to heavy stress. It is essential to follow exactly the directions given in the instruction book concerning assembly of bowl, operation, and overhaul, and the safety precautions as well. Remember particularly that the bowl is a balanced unit, which will get out of balance when incorrectly assembled or insufficiently cleaned.

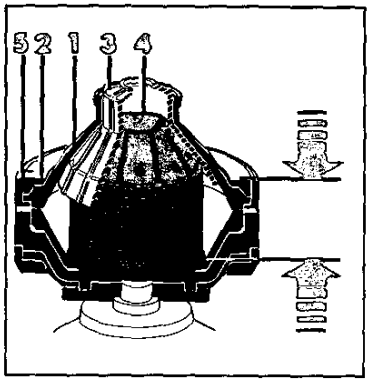






Checking thread condition

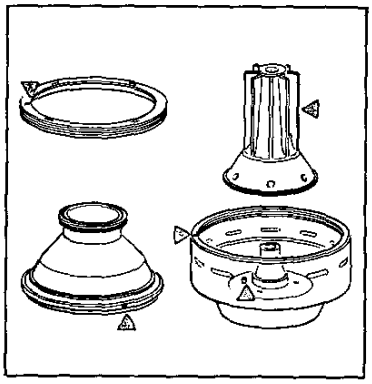
The threads of the large bowl lock ring and bowl body should be checked for wear at least once a year.
If the mark ϕ on the lock ring goes past the stationary mark ϕ by more than 25 °, consult an ALFA-LAVAL representative immediately, as this indicates an excessive thread wear.



Disc set pressure

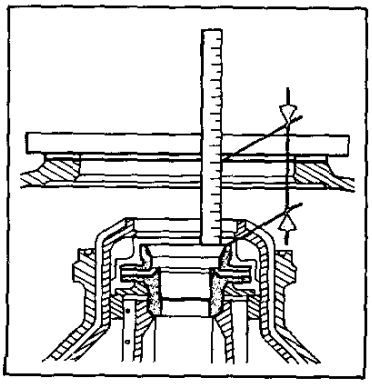
1. Bowl hood
2. Large lock ring
3. Top disc
4. Bowl disc set
5. Bowl body

If the lock ring can be screwed down without using the lead hammer until tight contact between bowl hood and bowl body is obtained, increase the pressure by adding one or more spare bowl discs to the top of the bowl disc set (beneath top disc).



Guide means

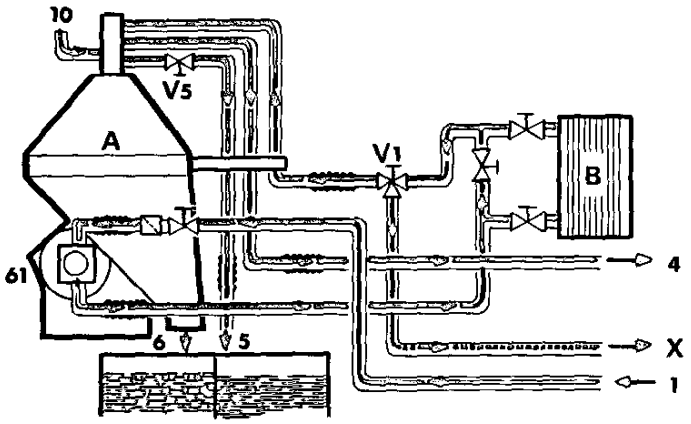
When assembling, make certain that the bowl parts are in the proper position. Take care not to damage the guides when assembling.



Height adjustment of paring discs

The Maintenance and Repair Manual (MR) contains information on height adjustment measures as well as checking and adjusting procedure.
It is essential that the paring discs should be correctly positioned relative to the rotary parts of the bowl.

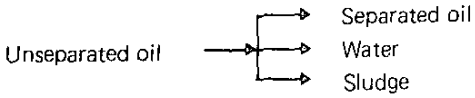
SEPARATING FUNCTION



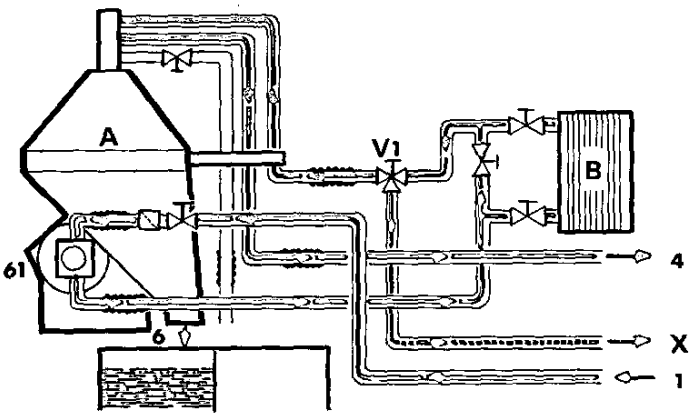
1. Unseparated oil inlet
4. Separated oil outlet
5. Water outlet
6. Sludge outlet
10. Sealing liquid inlet
61. Feed pump
V1. Three-way valve
V5. Ball valve in water outlet
A. Separator
B. Heater
X. Recirculation

Purification

The flow chart shows a separator A arranged for purification – liquid/liquid/solids separation.



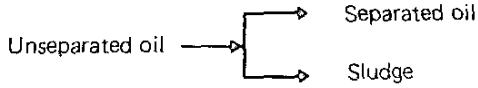
The unseparated oil (1) is pumped by the feed pump (61) through a heater B to the separator. By means of the valve (V1) the liquid can be brought to circulate through the heater until it has obtained the correct separating temperature. The separated oil leaves the separator through the outlet (4) , the water through outlet (5), and the sludge through outlet (6).



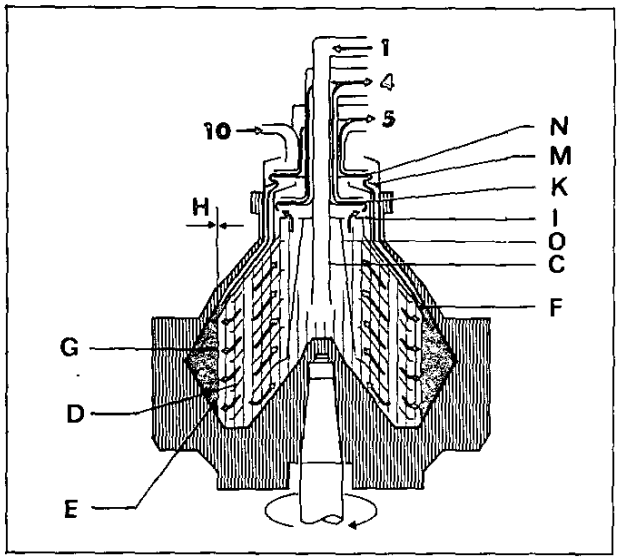
1. Unseparated oil inlet
4. Separated oil outlet
6. Sludge outlet
61. Feed pump
V1. Three-way valve
A. Separator
B. Heater
X. Recirculation

Clarification

The flow chart shows a separator A arranged for clarification – liquid/solids separation.



The unseparated oil (1) is pumped by the feed pump (61) through a heater B to the separator. By means of the valve (V1) the liquid can be brought to circulate through the heater until it has obtained the correct separating temperature. The separated oil leaves the separator through the outlet (4) and the sludge through outlet (6).



1. Unseparated oil inlet
4. Separated oil outlet
5. Water outlet
10. Liquid seal water inlet
C. Inlet pipe
D. Bowl discs
E. Bowl wall
F. Top disc
G. Liquid seal
H. Interface
I. Level ring
K. Paring disc, oil
M. Gravity disc
N. Paring disc, water
O. Distributor

Gravity disc and level ring

The gravity disc (M) determines the free water level (Ø D_M) in the bowl and the position (H) of the interface.
The level ring (I) determines the free oil level (Ø D_I - outer hole diameter) in the bowl.

Purification: Use the standard level ring (I) and a gravity disc (M) according to nomogram.

Clarification: Use the standard level ring (I) and the gravity disc (M) with the smallest hole diameter (D_M).
The clarifier disc is the smallest »gravity disc» delivered with the separator.

Displacement of oil in purification (see next two pages)

To prevent discharge of oil through the bowl sludge ports together with sludge (and water), displacement water is fed to the sludge space of the bowl.
Prior to sludge discharge the valve (V5) in the water outlet is closed and water added by the inlet (10) through valve (V10). This water will force the oil-water interface (H) towards the bowl centre, so that sludge and water alone are discharged.

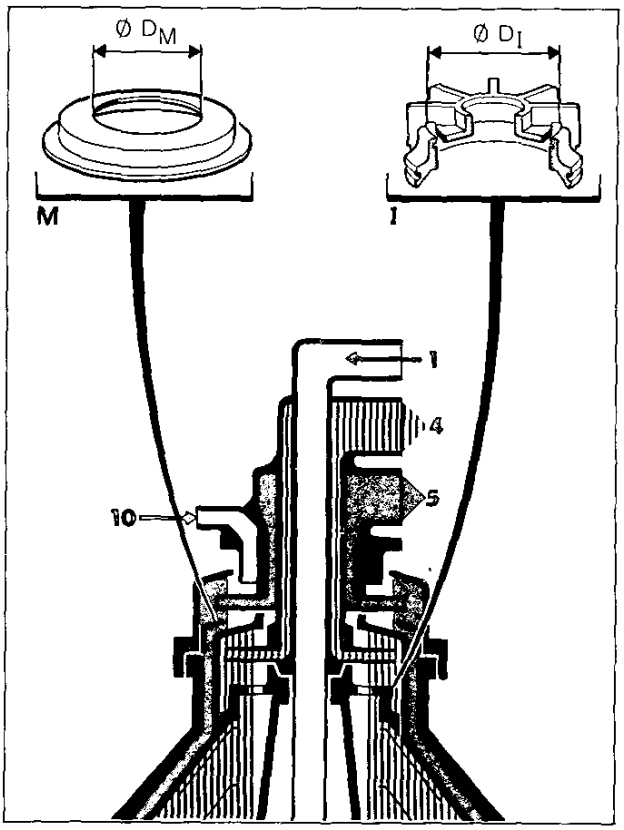
Liquid flow in bowl

From the inlet (1) the dirty oil flows through the distributor (O) into the spaces between the bowl discs (D) where separation takes place. Water and solids (or sludge alone, respectively) will move towards the bowl periphery. In purification the water leaves the bowl by the outlet (5) through the gravity disc (M) and the paring disc (N).

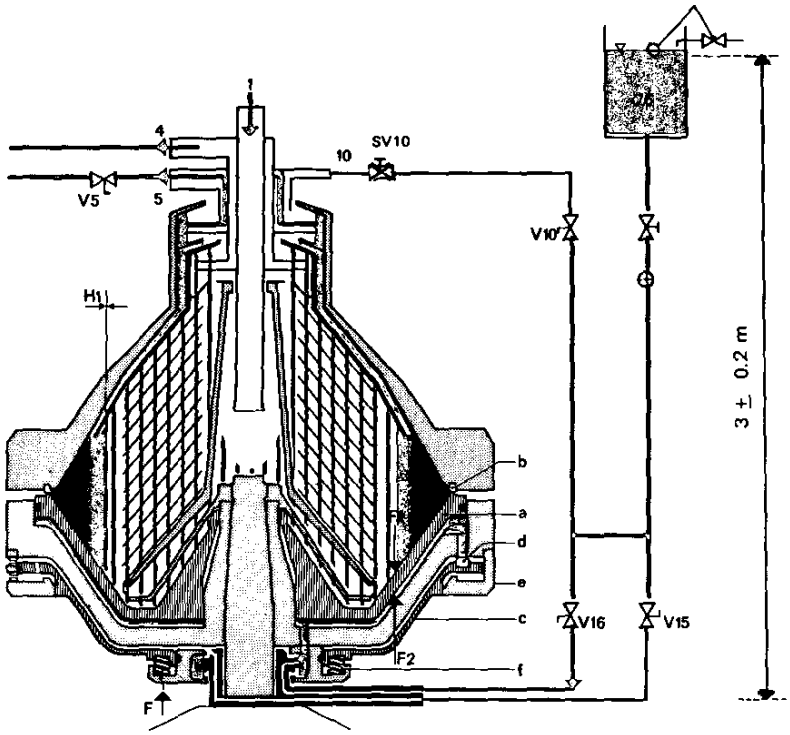
The clean oil is moved towards the bowl centre and proceeds to the outlet (4) through the level ring (I) and the paring disc (K).

Liquid seal – in purification

To prevent the oil from passing the outer edge of the top disc (F) and escaping the outer way with the water by 5, a liquid seal (G) must be provided in the bowl. To this end the bowl must be filled with water through 10 before the contaminated oil is supplied. The latter will then force the water towards the bowl periphery. An interface (H) will form between the water and the oil. Its position can be adjusted by altering the diameter of the gravity disc (M). The water leaves through outlet (5).



DISCHARGE FUNCTION



DISCHARGE CYCLE

Process liquid is supplied during the whole of the discharge cycle.

Regulating valve SV10 should be set according to directions under TRIMMING on page 25.

Before discharge

Valve V16 is open.

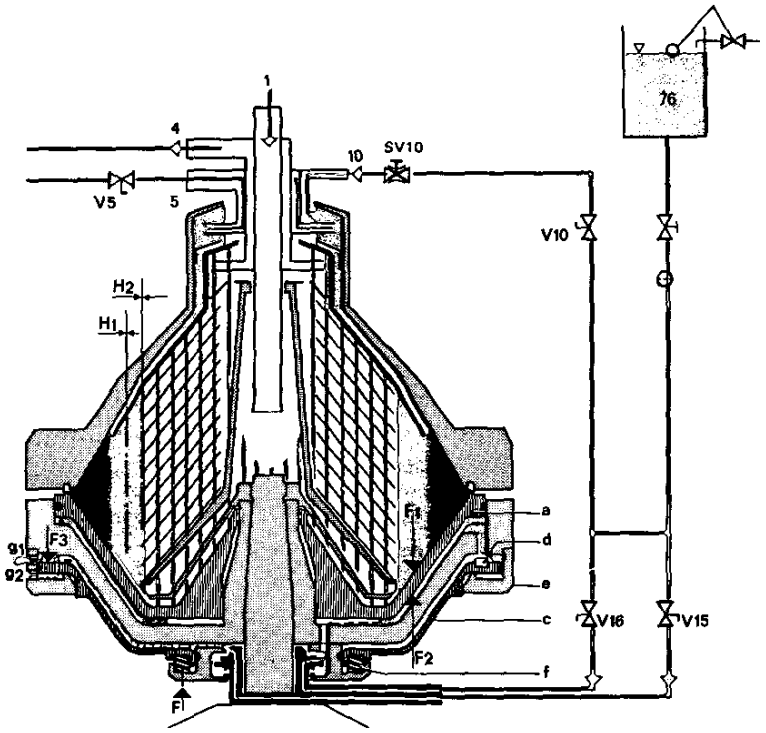
Compartment under sliding bowl bottom (a) filled.

Sliding bowl bottom (a) is pressed against seal ring (b), as force F_2 is greater than F_1.

Operating slide (c) keeps drain valves (d) closed by means of the force F produced by coil springs (f).

Valve V5 is open.

Separation is going on and solids are moving towards the bowl wall.



Initiation of discharge

Valve V16 is open.

Valve V5 to be closed.

Valve V10 to be opened for displacement of oil-water interface H1 towards bowl centre – position H2.

Valve V15 to be opened.

Chamber at dosing ring (e) above operating slide (c) is filled.

Liquid force F3 exceeds spring force F.

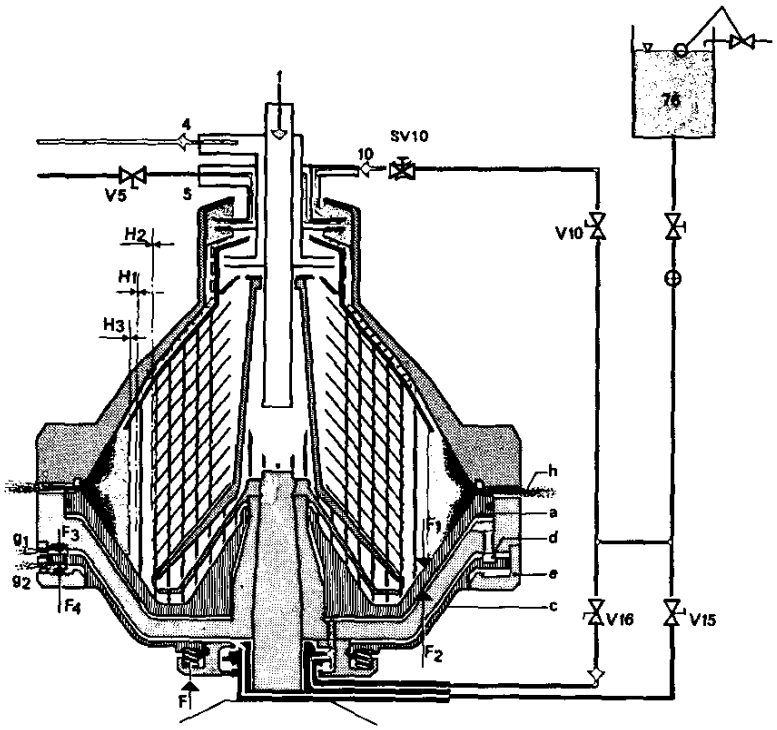
Operating slide (c) moves downwards, thereby uncovering drain valves (d).

Compartment below sliding bowl bottom (a) is drained and force F_2 decreases.

Low-rate outflow through nozzle g1.

Overflow begins to the chamber at dosing ring (e) below operating slide (c).

DISCHARGE FUNCTION



Discharge

Compartment below sliding bowl bottom (a) is drained and force F_2 becomes smaller than F_1.

Sliding bowl bottom (a) moves downwards and discharge of sludge and water takes place through ports (h) in the bowl wall. The interface (H2) moves towards the bowl wall to position (H3).

Valve V15 to be closed.

The chamber in dosing ring (e) below operating slide (c) has become filled and force F4 together with spring force F is greater than F3.

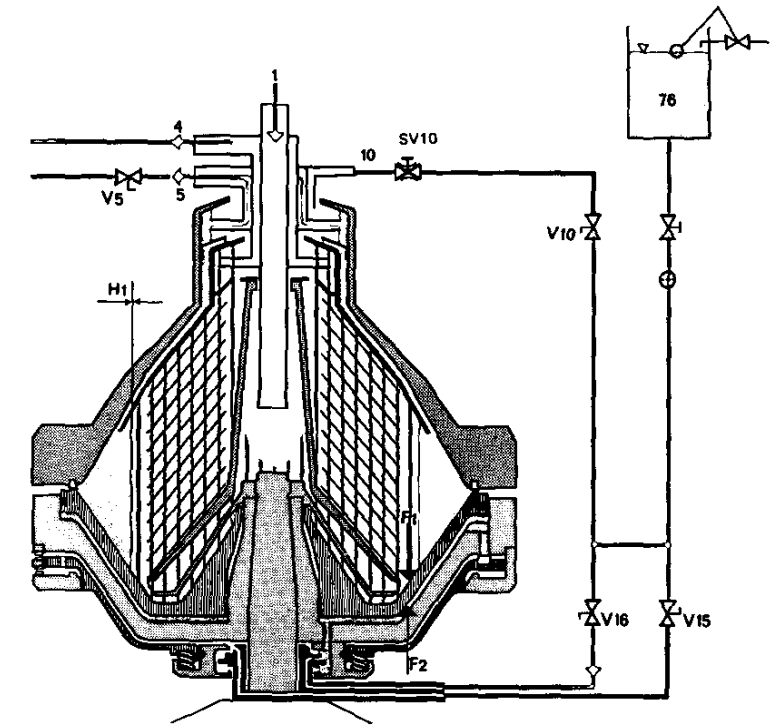
The operating slide is moved upwards and closes drain valves (d).

The chambers in dosing ring (e) are drained through nozzles g_1 and g_2.

The compartment below the sliding bowl bottom (a) is filled from operating water tank (76) via the open valve V16. Force F_2 increases.

The separating space above the sliding bowl bottom (a) is filled. Force F_1 increases.

Liquid seal is continuously supplied through the open valve V10.



After discharge

Force F_2 now exceeds F_1.
Sliding bowl bottom (a) is forced into closing position.

The compartment below and the separating space above the sliding bowl bottom are full.

The interface moves back from position (H3) to (H1).

Valve V10 to be closed.

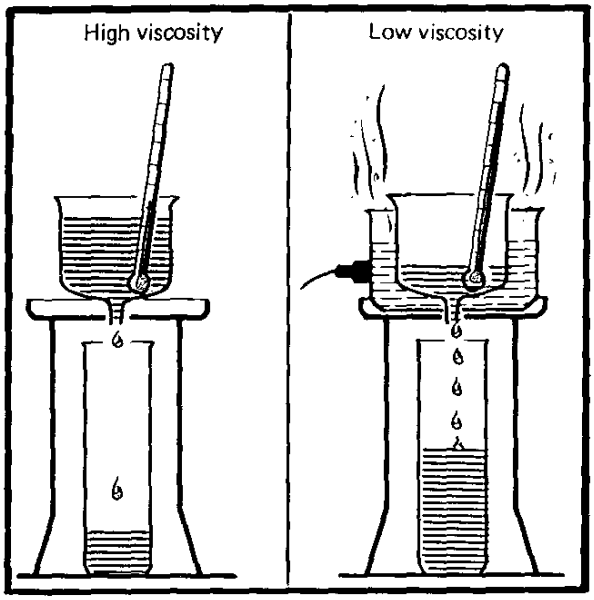
Valve V5 to be opened.

Any excess water leaves the bowl by outlet 5.

Discharge has been completed.

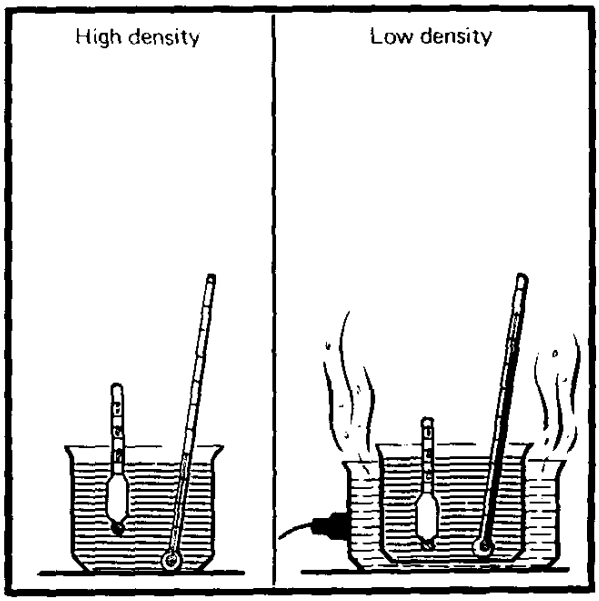
SEPARATING RESULTS

FACTORS INFLUENCING SEPARATION



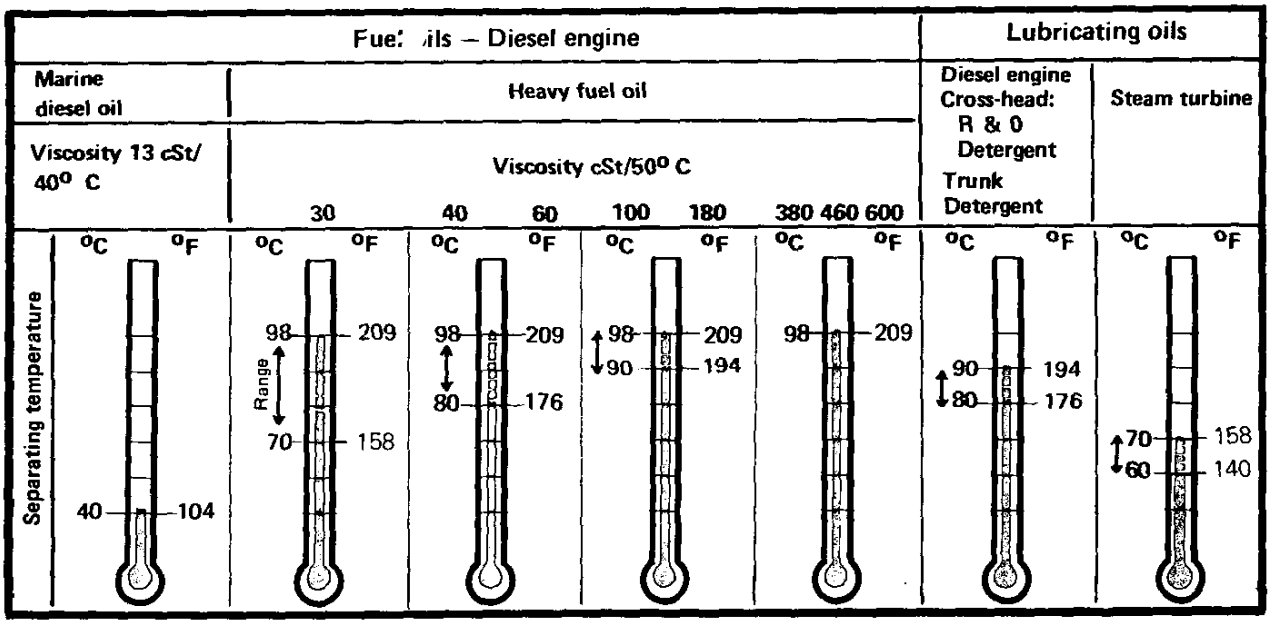
1 Viscosity

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



2 Density difference (specific gravity ratio)

The greater the density difference between the phases of the process liquid, the easier the separation. The difference can be increased by heating.



3 Separating temperature

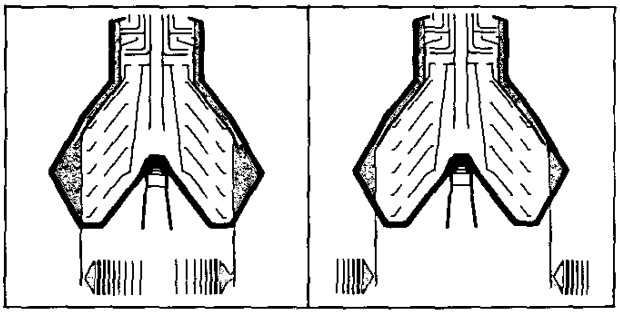
A high separating temperature is normally favourable in mineral oil separation. The temperature should be constant throughout separation.

4 Rate of throughput

see recommendations on page 18.

5 Optimum

utilization of machine – see trimming instructions

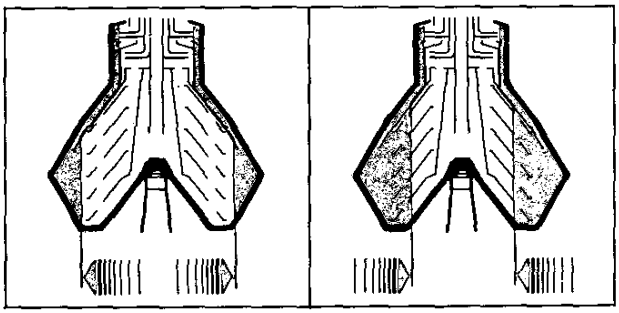


Correct position

Wrong position –
liquid seal broken

6 Position of interface

The interface between the liquid seal (water) and the oil should be positioned slightly outside the disc stack. It must not be located so far from the bowl centre that the oil will pass the outer edge of the top disc, breaking the liquid seal and discharging with the water.



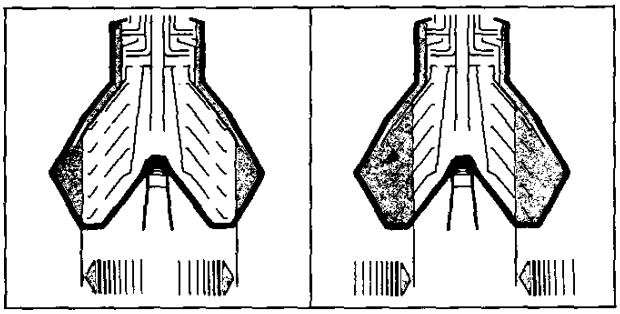
High viscosity/density

Low viscosity/density

Factors influencing the interface position are:

6a oil viscosity and density

A high oil density will position the interface closer to the bowl periphery than will a low density.

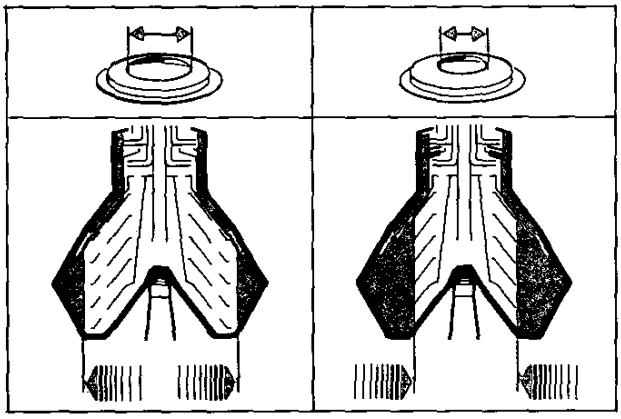


High throughput/
high back pressure

Low throughput

6b throughput and back pressure

As a rule, the interface will be located closer to the bowl periphery at a high throughput than at a low one. The same effect is produced by a very high back pressure in the clean oil outlet.



Large-hole disc

Small-hole disc

6c gravity disc

The location of the interface is adjusted by altering the outlet for the water, i.e. exchanging the gravity disc. Changing to a gravity disc with larger hole diameter will move the interface towards the bowl periphery, whereas a disc with smaller hole diameter will position the interface closer to the bowl centre.

SEPARATING RESULTS

THROUGHPUT – TIME IN CENTRIFUGAL FIELD

Bad separating results may be due to excessive throughput.

Recommended maximum throughput capacities, WHPX series. Throughput capacities in litres per hour.

FUEL OILS – DIESEL ENGINE												
Type of oil		Distillate	Marine diesel oil	Heavy fuel oil								
Viscosity		1.5 - 5.5 cSt/40°C	13 cSt/40°C	30	40	60	100	180	380	460	600	
				cSt/50°C								
Separation temp.		20 - 40°C	40°C	70-98	80-98	80-98	90-98	90-98	98	98	98°C	
Separator model	Rated capacity											
WHPX 405	4,700	3,700	3,100	2,900	2,900	2,200	2,100	1,500	1,200	-	-	
WHPX 407	9,000	7,000	6,000	5,600	5,600	4,200	4,100	2,800	2,300	2,000	1,600	
WHPX 409	12,500	9,800	8,400	7,800	7,800	5,900	5,600	3,900	3,300	2,800	2,300	
WHPX 410	16,000	12,500	10,700	9,900	9,900	7,500	7,200	5,000	4,200	3,500	2,900	

For heavy fuel oil (HFO) cleaning plants, dimensioned specifically for operation in series, the recommended maximum throughput capacities are to be increased by 35% (purifier - clarifier plus stand-by).

LUBRICATING OILS					
Lube oil for		Diesel engine			Steam turbine
		R & O[1] cross-head	Detergent		
			cross-head	trunk	
Separation temp.			80 - 90°C		60 - 70°C
Separator model	Rated capacity				
WHPX 405	4,700	1,400 - 1,600	1,200 - 1,400	800 - 1,000	3,100
WHPX 407	9,000	2,700 - 3,200	2,300 - 2,700	1,600 - 2,000	5,900
WHPX 409	12,500	3,800 - 4,400	3,100 - 3,800	2,300 - 2,800	8,100
WHPX 410	16,000	4,800 - 5,600	4,000 - 4,800	2,900 - 3,500	10,400

1) »Rust and Oxidation» type.

Note! Maximum density of oil 991 kg/cm^3 at 15°C. Density preferably measured at 50°C and according to ASTM method D 1298-80, corrected to 15°C according to ASTM tables D 1250-80.

NOMOGRAM FOR SELECTION OF GRAVITY DISC, WHPX 405

OPERATION AS A PURIFIER

SELECTION OF LEVEL RING

Select standard level ring with a diameter of 62 mm.

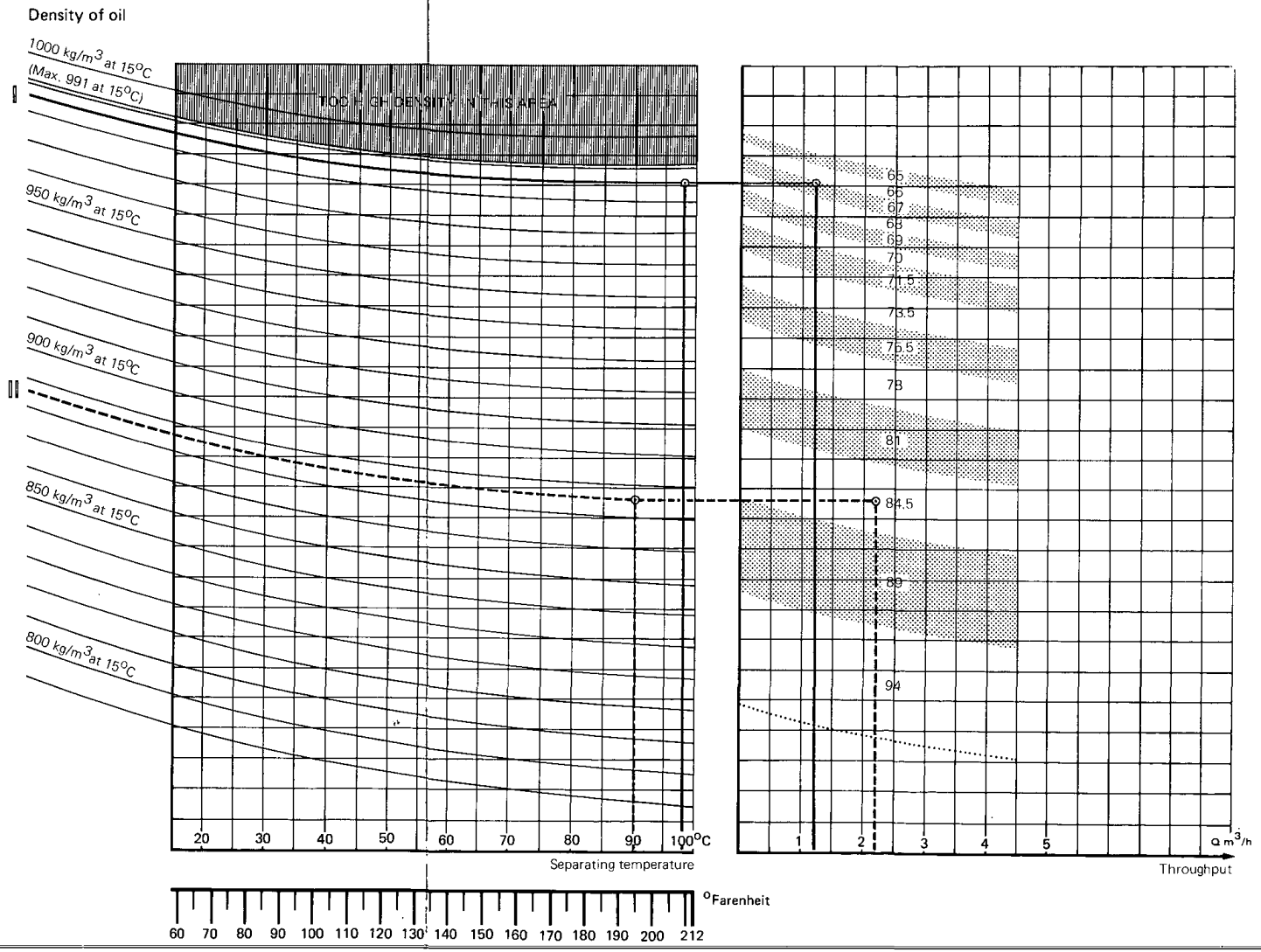
SELECTION OF GRAVITY DISC

The nomogram is an aid to select a tentative gravity disc in purification, when the density of the oil at a temperature of 15° C is known.

The hole diameter of the first gravity disc to be tried appears directly from the nomogram.

However, in practical operation the best result is obtained by using the gravity disc with the largest hole diameter that will not cause a break of the liquid seal in the bowl or an emulsification in the water outlet.

The presence of salt water may demand the use of a gravity disc with larger hole than indicated in the nomogram. (The nomogram is based on the properties of fresh water).



Example I in nomogram

Reference in graph ————————

Density of oil	985 kg/m^3 at 15° C (60° F)
Separating temperature	98°C (208°F)
Throughput	1.2 m^3/h
→ *Hole diameter*	*Ø 67 mm*

Example II in nomogram

Reference in graph – – – – – – – – – –

Density of oil	885 kg/m^3 at 15° C (60° F)
Separating temperature	90°C (194°F)
Throughput	2.2 m^3/h
→ Hole diameter	Ø 84.5 mm

NOMOGRAM FOR SELECTION OF GRAVITY DISC, WHPX 407

OPERATION AS A PURIFIER

SELECTION OF LEVEL RING

Select standard level ring with a diameter of 93 mm.

SELECTION OF GRAVITY DISC

The nomogram is an aid to select a tentative gravity disc in purification, when the density of the oil at a temperature of 15° C is known.

The hole diameter of the first gravity disc to be tried appears directly from the nomogram.

However, in practical operation the best result is obtained by using the gravity disc with the largest hole diameter that will not cause a break of the liquid seal in the bowl or an emulsification in the water outlet.

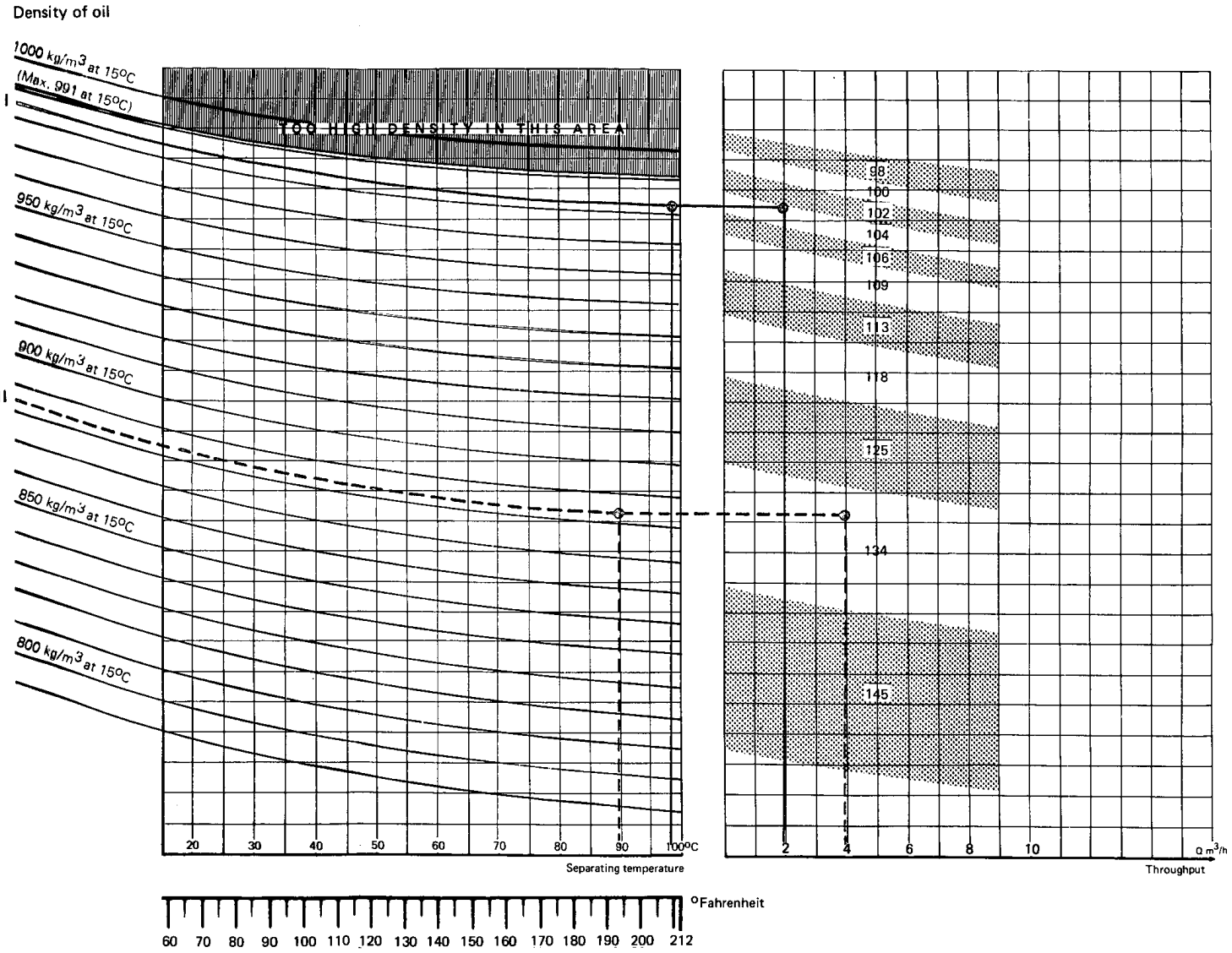
The presence of salt water may demand the use of a gravity disc with larger hole than indicated in the nomogram. (The nomogram is based on the properties of fresh water).

Example I in nomogram

Reference in graph	———
Density of oil	985 kg/m^3 at 15° C (60° F)
Separating temperature	98°C (208°F)
Throughput	2 m^3/h
Hole diameter	Ø 104 mm

Example II in nomogram

Reference in graph	– – – – – – – – – –
Density of oil	885 kg/m^3 at 15° C (60° F)
Separating temperature	90°C (194°F)
Throughput	4 m^3/h
Hole diameter	Ø 134 mm



OPERATION AS A PURIFIER

SELECTION OF LEVEL RING

Select standard level ring with a diameter of 93 mm.

SELECTION OF GRAVITY DISC

The nomogram is an aid to select a tentative gravity disc in purification, when the density of the oil at a temperature of 15° C is known.

The hole diameter of the first gravity disc to be tried appears directly from the nomogram.

However, in practical operation the best result is obtained by using the gravity disc with the largest hole diameter that will not cause a break of the liquid seal in the bowl or an emulsification in the water outlet.

The presence of salt water may demand the use of a gravity disc with larger hole than indicated in the nomogram. (The nomogram is based on the properties of fresh water).

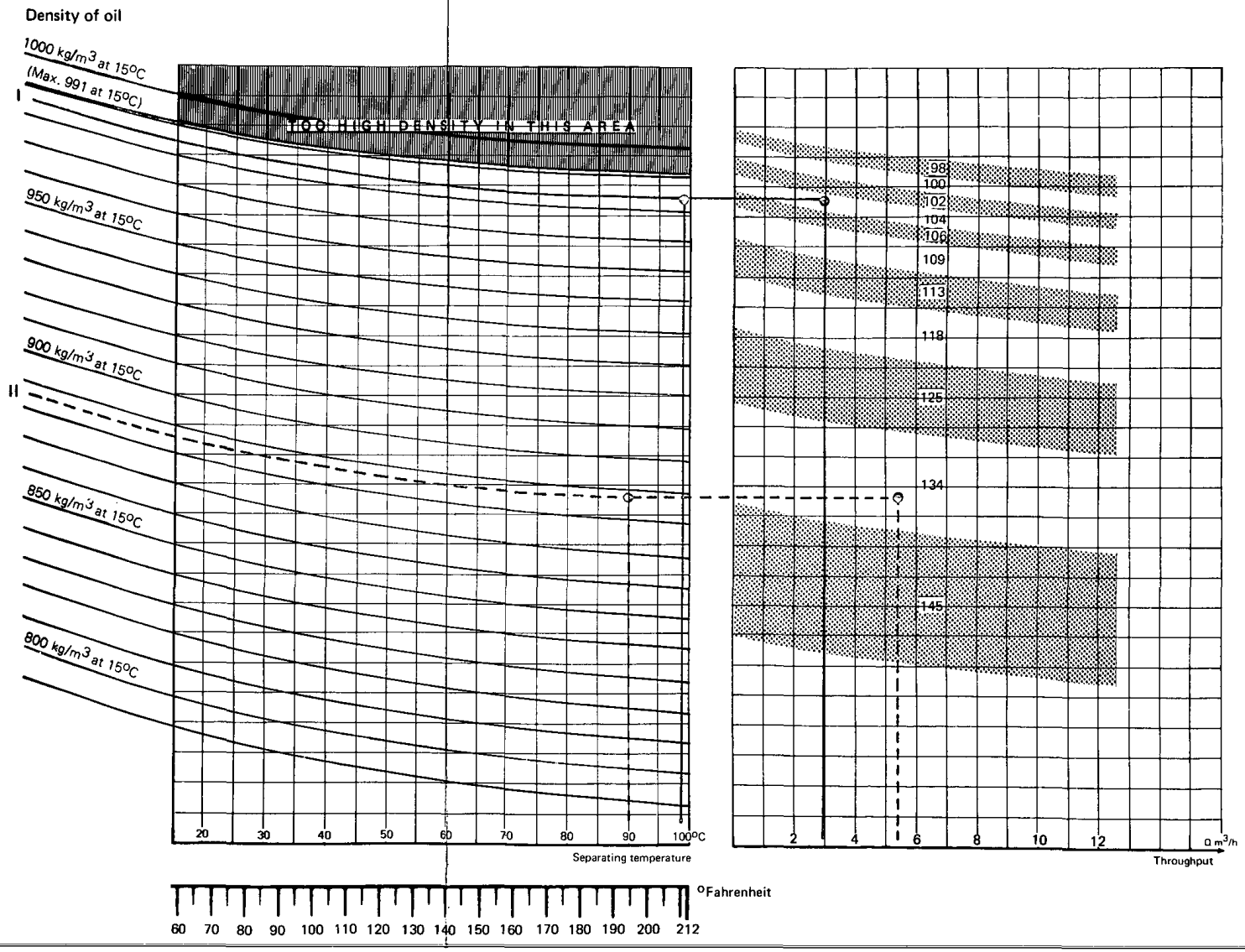
Example I in nomogram

Reference in graph	———————
Density of oil	985 kg/m³ at 15° C (60°F)
Separating temperature	98°C (208°F)
Throughput	3 m³/h
Hole diameter	Ø 104 mm

Example II in nomogram

Reference in graph	– – – – – – – – – –
Density of oil	885 kg/m³ at 15° C (60°F)
Separating temperature	90°C (194°F)
Throughput	5.5 m³/h
Hole diameter	Ø 134 mm

NOMOGRAM FOR SELECTION OF GRAVITY DISC, WHPX 409



NOMOGRAM FOR SELECTION OF GRAVITY DISC, WHPX 410

OPERATION AS A PURIFIER

SELECTION OF LEVEL RING

Select standard level ring with a diameter of 93 mm.

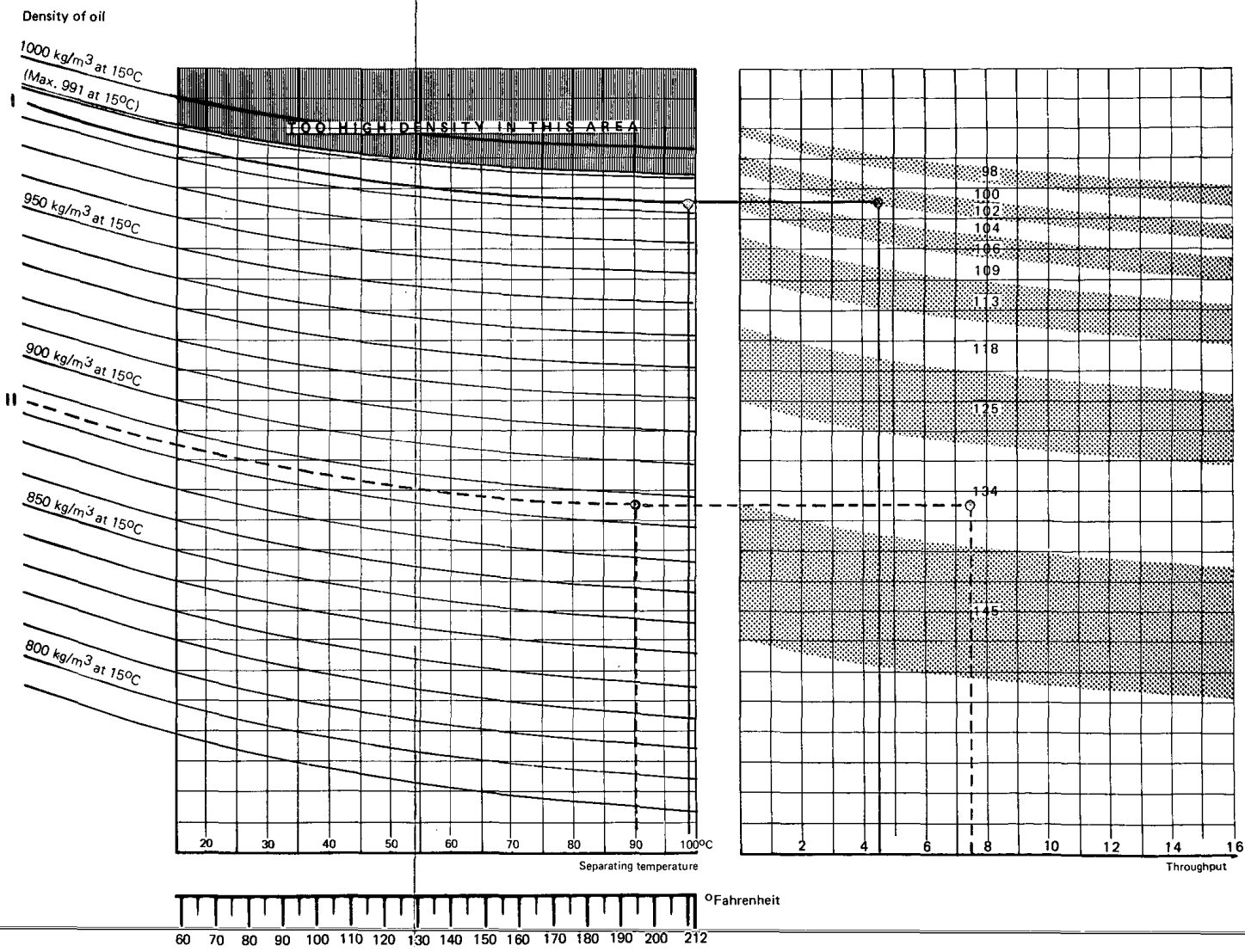
SELECTION OF GRAVITY DISC

The nomogram is an aid to select a tentative gravity disc in purification, when the density of the oil at a temperature of 15° C is known.

The hole diameter of the first gravity disc to be tried appears directly from the nomogram.

However, in practical operation the best result is obtained by using the gravity disc with the largest hole diameter that will not cause a break of the liquid seal in the bowl or an emulsification in the water outlet.

The presence of salt water may demand the use of a gravity disc with larger hole than indicated in the nomogram. (The nomogram is based on the properties of fresh water.)



Example I in nomogram

Reference in graph	———————
Density of oil	985 kg/m^3 at 15° C (60°F)
Separating temperature	98°C (208°F)
Throughput	4.5 m^3/h
Hole diameter	Ø 102 mm

Example II in nomogram

Reference in graph	- - - - - - - - - -
Density of oil	885 kg/m^3 at 15° C (60° F)
Separating temperature	90°C (194°F)
Throughput	7.5 m^3/h
Hole diameter	Ø 134 mm

SEPARATING RESULTS

OPERATION AS A CLARIFIER

SELECTION OF LEVEL RING

Select standard level ring according to the table.

WHPX 405 -- 62 mm
WHPX 407 -- 93 mm
WHPX 409 -- 93 mm
WHPX 410 -- 93 mm

SELECTION OF CLARIFIER DISC

The clarifier disc is the smallest »gravity disc» delivered with the separator.
Select clarifier disc according to the table.

WHPX 405 -- 45 mm
WHPX 407 -- 64 mm
WHPX 409 -- 64 mm
WHPX 410 -- 64 mm

Observe the following when the separator is operating as a clarifier:

No liquid seal is needed when clarifying and therefore no water should be supplied before feeding the unseparated oil. Neither should displacement water be supplied before sludge discharge. See further instructions in chapter Operation, page 30.

TRIMMING OF MACHINE

See figure on page 30

General: Correct trimming of the separator, related to the system and the oil actually in use is very important in order to have a troublefree operation and optimum separation result.

Part A = Trimmings made at commissioning or after plant modifications
- A0 – Preparations before start of trimming.
- A1 – Trimming the feed rate of sealing and displacement water.
- A2 – Establishing the actual delivery head $P_{min.}$
- A3 – Establishing the overload pressure $P_{max.}$

Part B = Trimming made when selecting the correct gravity disc for the actual oil.
- B1 – Trimming the normal back pressure.
- B2 – Selecting the gravity disc.

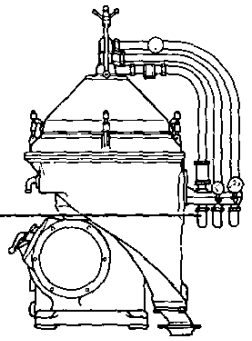
Note: To facilitate trimming, mark all valves with the references appearing in the flow chart.

A0 Preparations before start of trimming
For separator provided with programme equipment, follow the corresponding directions in the instruction book for that equipment.

Actions		Key points
A0.1	Fit the smallest gravity disc shown in the diagram for selection of gravity disc	See – Selection of gravity disc
A0.2	Assemble the separator	Make sure that frame hood and inlet parts are clamped by hinged bolts and clamp bolt
A0.3	Release the brake	Brake handle should point downwards
A0.4	Check for correct oil level in worm gear housing*	Oil level should be at the middle of the gauge glass
A0.5	Check that operating water tank is kept filled and that shut-off valves are open	
A0.6	Flush out the piping for operating water	Disconnect the hoses from the connections at the separator. Open valves V10, V15, and V16. After flushing close the valves and connect the hoses
A0.7	Make sure provisions are made for oil recirculation to tank	Reset 3-way valve V1 for recirculation
A0.8	For separator with built-on pump: Open slightly the shut-off valve V60 before the pump	If V60 is closed, the pump might run dry
A0.8	For separator with separate pump: Start the pump motor	
A0.9	Start the separator motor	In case of heavy vibration or noise switch off the motor and apply the brake. Check the height position of paring disc and the assembly and cleaning of the bowl
A0.10	Check the number of revolutions	Refer to name plate on separator
A0.11	Open valve V60	
A0.12	Switch on the preheater when oil begins to flow through the preheater	
A0.13	Open valve V16 for closing and make-up water	The bowl closes

* The bowl must always be at a standstill when oil is supplied and when oil level is checked

A1 **Trimming the feed rate of sealing and displacement water.**
For separator provided with programme equipment, follow the corresponding directions in the instruction book for that equipment.

Actions		Key points
A1.1	Open valve V5	
A1.2	Loosen the flexible hose in water outlet 5	 Water outlet
A1.3	Open valve SV10 entirely	
A1.4	Open valve V10 for sealing and displacement water feed	The water runs out through water outlet 5
A1.5	Measure the flow through water outlet 5	Use a measuring vessel of known volume and note the filling time of this volume
A1.6	Close valve V10	
A1.7	Repeat the procedure and adjust valve SV10 so that the volume indicated in the table is supplied in 40 secs.	WHPX 405 ≈ 2 l WHPX 407 ≈ 7 l WHPX 409 ≈ 7 l WHPX 410 ≈ 7 l
A1.8	Reconnect the flexible hose	

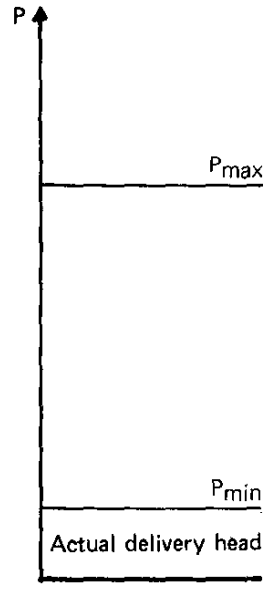
A2 **Establishing the actual delivery head P_{min}**
For separator provided with programme equipment, follow the corresponding directions in the instruction book for that equipment.

Actions		Key points
A2.1	Part A1 is performed	
A2.2	Close valve V5	
A2.3	Keep valve V10 open for 60 secs.	Liquid seal is supplied
A2.4	Open valve V5	A small quantity of water leaves the bowl by outlet 5. Check at sight glass
A2.5	Check that back pressure valve V4 in oil outlet (4) is completely open	
A2.6	Check that valves to appropriate tank are fully opened	
A2.7	Check the oil temperature	Oil outlet of preheater
A2.8	Set three-way valve V1 to feed of unseparated oil to the separator	If the valve is of the spring-return type lock it with the catch
A2.9	For separator with built-on pump: Adjust to suitable throughput	To be done according to the delivered type of flow regulating equipment
A2.9	For separator with separate pump: Adjust throughput in a suitable way	

A2.10	Check oil temperature. Adjust if necessary	
A2.11	Observe the water outlet a) If oil leaves through water outlet	Too high system back pressure - check piping to tank for obstructions or too high delivery head to tank. Stop the separator and REMEDY FAULT IN SYSTEM. Then restart at point A2.1
	b) If no oil is seen in the water outlet: Read the backpressure on pressure gauge 96 in oil outlet. Note this pressure and make a diagram as shown in adjoining figure	This is the actual delivery head = P_{min}.

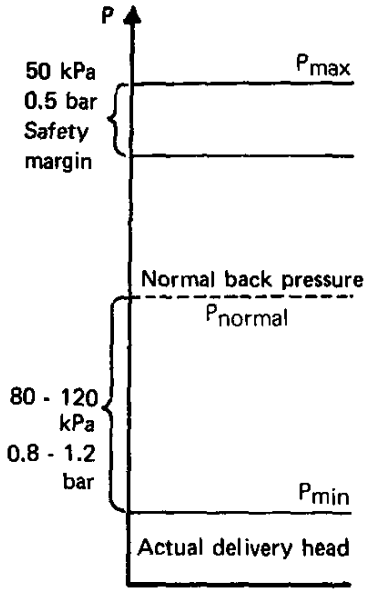
A3 **Establishing overload pressure P_{max}**

This is the pressure when oil flows from oil paring disc chamber into water paring disc chamber. For separator provided with programme equipment, follow the corresponding directions in the instruction book for that equipment.



Actions		Key points
A3.1	Part A2 is performed	
A3.2	Increase the backpressure in oil outlet by closing valve V4 slowly and stepwise	
A3.3	Note the pressure in oil outlet when oil starts to continuously flow through water outlet	See pressure gauge 96 in oil outlet
A3.4	Reduce the packpressure by opening valve V4 completely	
A3.5	Check if oil still flows through water outlet a) No oil is seen in water outlet. Continue to point A3.6 b) If oil continues to flow this indicates a broken water seal. Probably the smallest gravity disc is not fitted, see part A1	This is P_{max}.
A3.6	Open valve V10 and close V5 for 20 seconds	Water seal filled

TRIMMING



B1 Setting the normal backpressure

Actions		Key points
B1.1	Parts A2 - A3 are performed	
B1.2	Close valve V4 slowly and stepwise until pressure gauge in oil outlet reads about 80 - 120 kPa higher than P_{min}. Note this pressure	This is NORMAL BACKPRESSURE P_{normal} at which the separator should be operated. See diagram Please observe that this P_{normal} must NOT be the same or close to the P_{max} pressure. See »safety» margin in diagram
B1.3	Set valve V1 for oil recirculation	
B1.4	Stop the separator, pump and pre-heater	See chapter Operating routine, page 30

B2 Selecting the gravity disc

Actions		Key points
B2.1	The separator is at a stand-still	
B2.2	Fit a gravity disc one size larger than that for the actual oil to be cleaned	See Selection of gravity disc
B2.3	Assemble the separator	
B2.4	Check that three-way valve V1 is set for recirculation	
B2.5	Start the separator, pump and pre-heater When the bowl is at full operation speed	See Operating routine, page 30
B2.6	Open valve V16 and leave it opened	The bowl closes
B2.7	Open valve V10 and close V5 for 60 seconds	Filling the water seal
B2.8	Check the oil temperature	Oil outlet on preheater
B2.9	Set the three-way valve V1 in »feed»-position	
B2.10	Check oil flow rate. Adjust if necessary	
B2.11	Check oil temperature. Adjust if necessary	
B2.12	Observe if oil flows through water outlet a) if **yes**, see point B2.13 b) if **no**, see point B2.15	

B2.13 Stop the separator, set valve V1 in recirculation position

B2.14 Fit next smaller gravity disc. Restart from point B2.3

B2.15 No oil flows through water outlet
a) If this is the first choice of gravity disc, see point B2.16
b) If this is the case after fitting a smaller gravity disc, according to B2.12a, see point B2.18

B2.16 Stop the separator, set valve V1 in recirculation position

B2.17 Fit next LARGER gravity disc and restart from B2.3

B2.18 Now the correct gravity disc is fitted provided that the normal back pressure is applied

---

RECOMMENDED INTERVALS BETWEEN DISCHARGES

Many factors influence length of the intervals between discharges and therefore the appropriate interval for a specific case must be found by experience.

Recommended intervals:

	Initial	Maximum
o Distillate (4-8 cSt/40°C)	6	12 hours
o Marine Diesel Oil (13 cSt/40°C)	2	4 hours
o Heavy Fuel Oil	1	2 hours
o Lubricating oils for:		
– Trunk engines	0,5	2 hours
– Crosshead engines	1	4 hours

To check whether these intervals are appropriate, the bowl should be inspected after one week's operation.

If sludge space is clean – interval may be prolonged, however, not exceeding max. recommended time.

If sludge space is dirty – interval has to be shortened.

The phrase »If sludge space is dirty» and »clean» refer to whether accumulated sludge remains in sludge space or not.

The only way of achieving a clean sludge space is by appropriate adjustment of the interval based on regular inspection.

When the bowl is opened for routine cleaning, the sludge space should also be inspected and, if necessary, the interval between discharges changed in accordance with the above.

Note the following for lubricating oils:
Initially the oil is clean but as it gets dirtier the interval between discharges will have to be shortened until a »steady state» is reached.

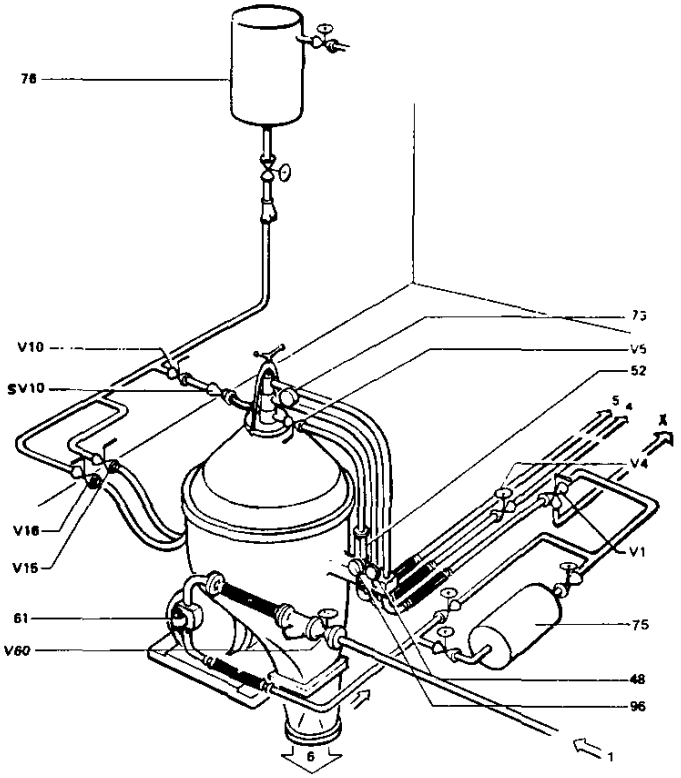
The interval between discharges must be shortened if the separator has been out of service for 24 hours or longer while the main engine has been running.

WARNING
Too long an interval between discharges causes accumulation and compaction of sludge, which may break up enevenly on discharge and cause bowl unbalance. If gross unbalance occurs there is a risk of serious machine damage and injury to personnel.

OPERATION

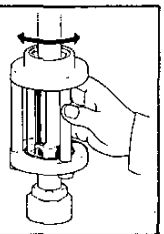
OPERATING ROUTINE for PURIFICATION
-- without programme equipment

For separators with programme equipment and/or devices for interface control – see also separate instructions.



1	**Unseparated oil**
4	**Separated oil**
5	**Water outlet**
6	**Sludge outlet**
48	**Flow meter**
52	**Sight glass**
61	**Pump (for machine with built-on feed pump)**
73	**Thermometer**
75	**Preheater**
76	**Operating water tank**
96	**Pressure gauge**
V1	**Three-way valve for unseparated oil**
V4	**Regulating valve for back pressure**
V5	**Ball valve in water outlet**
V10	***Ball valve for sealing and displacement water***
SV10	**Throttling valve**
V15	**Valve for opening water**
V16	**Valve for closing and make-up water**
V60	**Shut-off valve ahead of pump**
X	**Recirculation to tank**

Inside sight glass 52 for type WHPX 405 there is a scraper. Clean the sight glass by turning it around the scraper in either direction.



BEFORE STARTING

Check that

- o The bowl has been properly cleaned and is correctly assembled as a purifier
- o Inlet and outlet parts and frame hood are securely fastened
- o Brake has been released
- o Oil level in worm gear housing is correct
- o Operating water tank is kept full and shut-off valves are open
- o Valves on the suction side of the pump are open from the tank to be used. Shut-off valve V60 should be slightly opened to prevent the pump from running dry
- o Valves between pump and preheater and between preheater and separator are open
- o Three-way valve V1 is in position for recirculation to tank
- o Valves between separator and appropriate tank are open.

STARTING

- o Start the motor. For separator with separate feed pump: *start the pump. If abnormal vibration or* noice occurs during the running-up period, stop the separator and check for improper assembly and cleaning
- o Check the speed after running-up time
- o Close the bowl by opening valve V16 for closing and make up water. Leave the valve open
- o Open valve V60
- o Switch on the preheater when oil begins to flow through the preheater

OPERATION – purification

- o Check that the correct oil temperature after the preheater is attained
- o Close V5
- o Open V10 and keep it open for 60 secs.
- o *Close V10*

o Open V5

o Open V4 if this valve has been shut

o Set valve V1 in »feed»-position. Check throughput on flow meter 48

o Adjust to suitable throughput by means of the control equipment installed for this purpose. (If such an equipment is not installed, adjust the throughput by means of V60.)

o Check and adjust the oil temperature

o If necessary, adjust back pressure by means of V4 (back pressure P =. . . . . bar)

SLUDGE DISCHARGE DURING OPERATION

o Close V5

o Open V10
- when 20 secs. have lapsed: open V15 for discharge
- after discharge: close V15
- keep V10 open for another 20 secs.

o Close V10

o Open V5. A small quantity of water should now leave by outlet 5 -- observe sight glass 52

o Observe operation and separating result and repeat sludge discharge at suitable intervals.
See TRIMMING, page 29.

STOPPING

o Shut off the preheater

o Change over V1 for recirculation

o Carry out 3 discharges as follows:
- Close V5
- Open V10 and keep it open for 40 secs.
- Close V10
- Close V16
- Open V15 until the discharge sound is heard
- Close V15
- Open V5 and wait 15 secs.
- Open V15 for 4 secs.
- Close V15 and wait 15 secs.
- Open V15 for 4 secs.
- Close V15

o Open V16
- Close V5
- Open V10 and keep it open for 60 secs.
- Close V10
- Open V5
- Close V16

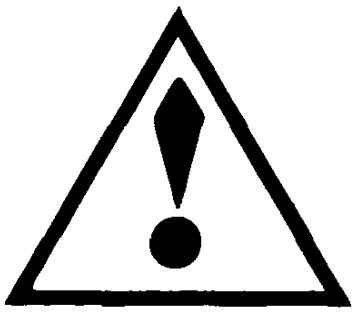
o Stop the motor

o Apply the brake

o When the bowl has stopped completely: stop the separate feed pump, if any installed

o Never loosen hinged bolts etc. until the bowl has stopped completely. Then release the brake.

EMERGENCY STOP/EXCESSIVE VIBRATIONS



Procedure

1. **Switch off separator motor instantly**
2. **Apply brake instantly**
3. **Manually set three-way valve V1 in FEED position instantly**
4. **Switch off preheater**
5. **Wait until the bowl has come to a complete standstill**
   - **Switch off separate feed pump (if any)**
   - ***Switch off programme equipment***
   - **Manually reset the three-way valve V1 to RECIRCULATION position.**

INDICATION

TROUBLE TRACING

Mechanical function

Machine vibrates	Run-up time too long	Smell	Noise	Speed too high	Speed too low	Starting power too low	Starting power too high	Retardation time too long	Water in worm gear housing	CAUSE	REMEDY
										Bowl out of balance due to. bad cleaning – incorrect assembling – bad tightening of lock ring – bowl assembled with parts from several machines. Bowl spindle bent. Vibration-damping rubber washers worn out. Top bearing spring broken.	Fill the bowl with liquid, stop immediately and establish cause. Badly tightened lock ring involves fatal danger. Replace bowl spindle. Renew washers every second year. Exchange all these springs.
										Uneven sludge deposits in sludge space.	See *Unsatisfactory sludge discharge*, page 34.
										Height position of paring disc or bowl spindle is wrong.	Stop, check and adjust.
										Normal occurrence during start as friction blocks are sliding.	None.
										Bearing overheated.	Replace.
										Oil quantity wrong.	Check quantity and quality.
										Worm wheel and worm are worn.	Replace.
										Bearing damaged or worn.	Replace.
										Wrong play between coupling pulley and elastic plate	Adjust.
										Brake applied.	Release.
										Friction pads worn.	Replace.
										Friction pads oily.	Clean.
										Motor failure.	Repair.
										Bowl not closed or leaking.	Dismantle and check.
										Brake lining worn or oily.	*Replace.*
										Condensation.	Change oil.
										Bowl casing drain obstructed.	Clean and change oil.
										Leakage at top bearing.	*Replace seal ring and change oil*
										Wrong gear transmission (50 Hz gears for 60 Hz current or vice versa).	Stop immediately and rectify faults. In case of overspeed check bowl for possible deformation.

☐ – To be checked in the first place

INDICATION							
in clarification and purification				in purification			
Liquid flows out through bowl casing drain and/ or sludge outlet	Bowl opens un-intentionally during operation	Bowl fails to open for discharge	Unsatisfactory sludge discharge	Unsatisfactory separation of oil	Outgoing water contains oil	Oil discharges through water out-let.(Broken liquid seal).	Discharged sludge and water contains oil

in clarification		CAUSE	REMEDY
Unsatisfactory separation	Oil discharges through water outlet		
		Gravity disc hole too large	Use disc with smaller hole
		Gravity disc hole too small	Use disc with larger hole
		Throughput too high	Adjust
		Back pressure too high	Adjust
		Wrong separating temperature	Adjust
		Bowl hood seal ring defective or sealing surface of sliding bowl bottom damaged	Replace seal ring. Polish surface on sliding bowl bottom or replace the latter
		Seal rings on top of heavy phase paring disc defective	Replace
		Wrong level ring	Check hole diameter according to instructions
		Bowl speed too low	Make sure brake is off, examine motor and power transmission
		Sludge space in bowl filled	Clean and shorten time between discharges
		Bowl disc set clogged	Clean
		Nozzles in dosing ring clogged	Clean
		Feed oil contains water	1. Check preceeding purifier when operating in series 2. Reduce time between discharges 3. Assemble and operate the separator as a purifier
		Bowl incorrectly assembled	Check and rectify
		Discharge in progress	None (normal)
		Operating water tank placed too high Control paring disc dirty	Max. height: 3.2 m above operating water inlets to water level in tank
		Operating water tank placed too low	Min. height: 2.8 m above operating water inlets to water level in tank
		Seal rings in control paring disc device defective	Exchange
		Water outlet valve V1 not closed, leaking during discharge cycle	Check and remedy
		Displacement water volume too large	Adjust throttling valve SV10 and/or filling time
		Displacement water volume too small	Adjust throttling valve SV10 and/or filling time
		Valve plugs defective	Replace
		Seal ring in operating slide defective	Replace
		Dosing ring tightened too much	Check tightening torque (see MR)
		Seal ring in sliding bowl bottom defective	Replace
		Seal ring at gravity disc or small lock ring (paring chamber cover) defective	Replace
		Operating water strainer or piping clogged or valves closed	Remedy
		Sludge deposits in operating system	Clean
		Sludge deposits on operating slide	Clean

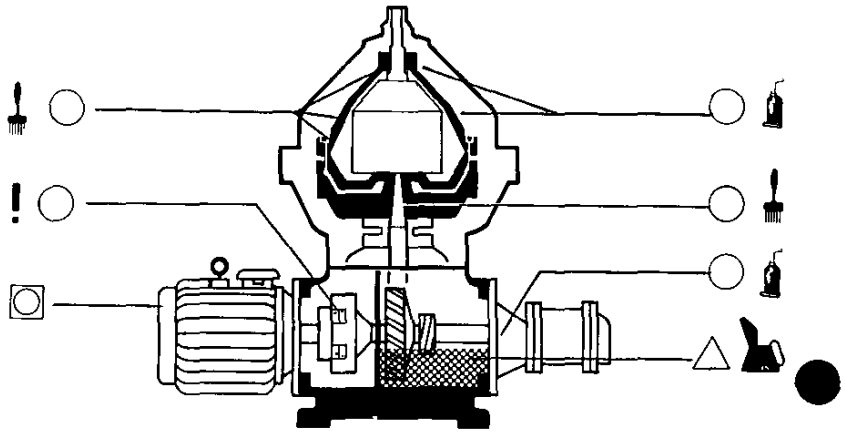
OPERATION

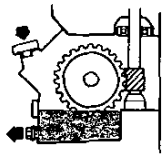
LUBRICATION SCHEDULE

○ **BEFORE EVERY ASSEMBLY**

△ **CHANGE EVERY 1000 HOURS – FIRST CHANGE AFTER 300 HOURS**

▣ **FOLLOWS SUPPLIER'S DIRECTIONS**



Lubricating oil for worm gear housing	Separator type	Oil quality / Oil quantity lit. (UK.gals)	SAE 40	SAE 50
	WHPX 405	4.1 (0.9)		
	WHPX 407 WHPX 409	12.0 (2.6)		
	WHPX 410	12.0 (2.6)		
	Separating temperature	15 - 70°C 60 - 160°F		15 - 98°C 60 - 208°F
	Ambient temperature	5 - 40°C 40 - 105°F		10 - 55°C 50 - 131°F

Within those ranges of temperature where both oils may be used it is of no importance which one of them that is to be chosen.

With an ambient temperature higher than 55°C (131°F) a special oil with higher viscosity and heat resistance must be used. In the first place a synthetic oil of poly-alpha-olefinetype with a viscosity of 26 - 34 cSt at 100°C is recommended. Example: Mobil SHC 630.

!	Lubricate ball bearings sparsely with ball bearing grease.	Specified lubricating instructions – see Maintenance and Repair Manual, MR
	Use a special lubricant for: o Lock ring joints of the bowl. o Sliding, contact surfaces and threads in the bowl as well as in the feed and discharge assembly. o Cap nut of the bowl and the bowl spindle tapered end (on the latter the lubricant is to be applied very sparsely).	
	o Lubricate O-rings and lip seal rings stated in the Maintenance and Repair manual (MR) with silicone grease.	

Examples of recommended lubricants from various suppliers – see next page.

LUBRICANTS

Lubricating oil

Always use a high grade mineral lubricating oil with prescribed viscosity and suitable for worm gears of steel – tin bronze.

Examples of recommended oils from various suppliers			
	SAE 30	**SAE 40**	**SAE 50 *** (EP-1)
BP	Energol GR-XP100 Energol HLP100 Energol DL-MP 30 Energol IC-MB 30	Energol GR-XP150 Energol DL-MP 40 Energol IC-HF 40	Energol GR-XP220 Energol CLO 50 M
CASTROL	Hyspin AWS/AWH 100 215 M, MX, MXD Marine MPX 30 Marine Heavy DR/MO	Alpha ZN/SP 150 Marine MPX 40 220 M, MX, MXD Marine RM/DZ	Alpha ZN/SP 220 Alpha ZN/SP 320 Marine S/DZ-65
ESSO	TRO-MAR 30 or HD 30 TRO-MAR SD 30 Teresso 100	TRO-MAR HD 40 TRO-MAR SD 40 SPARTAN EP 150	TRO-MAR SV SPARTAN EP 220 SPARTAN EP 320
GULF	Veritas V9, AC 30 Veritas DPO 30 Harmony 100	EP Lubricant HD 150 Veritas DPO 40 Veritas SD 40	EP Lubricant HD 220 EP Lubricant HD 320 Cyloil 700
MOBIL	Mobilgard 312, 324 Mobilgard 300 Mobil DTE Oil No. 3 Mobil DTE Extra Heavy	Mobilgard 412, 424 Mobilgear 629	Mobilgard 512, 570 Mobilgard 593 Mobilgear 632
SHELL	Melina Oil 30 Gadinia Oil 30 Tellus Oil 100	Melina Oil 40 Gadinia Oil 40 Omala Oil 150	Omala oil 220
TEXACO	Ursa Oil ED 30 Taro XD 30, DP 30 Regal Oil R&O 150	Ursa Oil ED 40 Taro XD 40, DP 40 Regal Oil R&O 220	Ursa Oil ED 50 Meropa 220

* The oils according to this viscosity class are suitable also for separators where the instruction book prescribes EP 1-oils.

Underlined oils are commonly available for industrial applications of marine separators.

Lubricating grease

Lithium-soap type ball bearing grease.
NLGI class 2 or 3 usable up to 110 °C.

Examples:			
BP	Energrease LS 2 or 3	Mobil	Mobilux 2 or EP 2
Castrol	Spheerol AP 2 or AP 3	Shell	Alvania R 2 or R 3
Esso	Beacon 2 or 3	Texaco	Multifak EP 2
Gulf	Gulfcrown EP 2		

Special lubricant for lock ring joints of *bowl hood etc.*

Molykote universal paste 1000
Molykote paste G rapid

TEST YOURSELF

These questions will allow you to test your knowledge after reading the manual.
The correct answers are given overleaf together with a reference to the page (or section) which should be studied again if your answer was wrong.

QUESTIONS **ANSWERS**

1. Is purification a liquid/solids separation for separating particles, normally solids, from a liquid having a lower density than the particles
   Yes ☐ No ☐

2. If large bowl lock ring can be tightened without resistance till bowl hood is in tight contact with bowl body, what should be checked?
   Lock ring threads ☐ Disc set pressure ☐ Height position ☐

3. How many outlets has a WHPX purifier bowl?
   One outlet (oil) ☐ Two outlets (water and oil) ☐ Three outlets (sludge water, oil) ☐

4. Can the separating result in purification be influenced by exchanging the gravity disc?
   Yes ☐ No ☐

5. Is it correct to feed sealing water to the bowl in clarification?
   Yes ☐ No ☐

6. Can the density of a liquid be decreased by heating?
   Yes ☐ No ☐

7. Where should the interface between oil and water be located in purification to ensure best possible separating results?
   As close as possible to bowl centre ☐ As close as possible to bowl peripherry ☐

8. Will the interface be moved towards bowl centre by changing from small to large gravity disc?
   Yes ☐ No ☐

9. Is a low density of the dirty oil favourable?
   Yes ☐ No ☐

TEST YOURSELF

QUESTIONS	ANSWERS		
10. Can the previous throughput and separating temperature be maintained when shifting to process a different type of oil?	Yes ☐	No ☐	
11. In the manual are nomograms for selection of gravity disc. Which factor or factors must you know to find out the proper disc?	Separating temperature ☐	Density ☐	Viscosity ☐
12. If machine begins to vibrate heavily, which action must be taken immediately?	Adjust vibration dampers of frame ☐	Empty the bowl ☐	Fill the bowl and stop machine ☐
13. When checking the threads bowl body/lock ring the angle between marks ⌖ is an indication of thread wear. Which angle value is **absolutely not** to be exceeded?	10 ° ☐	25 ° ☐	35 ° ☐

CORRECT ANSWERS

1. No (pages 6, 12)
2. Disc set pressure (page 11)
3. Three outlets (page 12)
4. Yes (pages 13,19-23)
5. No (pages 12, 24)
6. Yes (page 16)
7. As close as possible to bowl periphery (page 17)
8. No (page 17)
9. Yes (page 16)
10. No, usually not (page 18)
11. Separating temperature and density (pages 19-23)
12. Fill bowl and stop machine (page 31)
13. 25 ° (page 11)

ALFA-LAVAL