Mineral Oil Separators

MOPX 205 TGT
MOPX 207 SGT
MOPX 209 TGT
MOPX 210 TGT
MOPX 213 TGT

Book No. OM SO 2686E/7808

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

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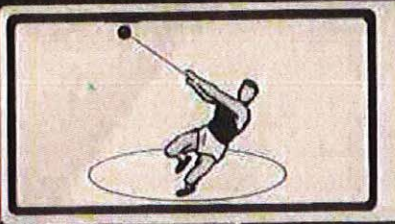
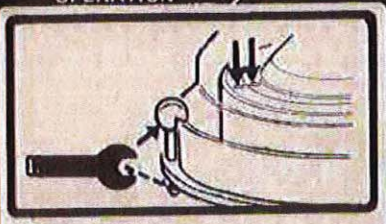
SO 2687E

△ SAFETY PRECAUTIONS FOR CENTRIFUGAL SEPARATORS △

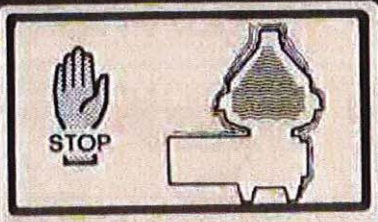


The bowl of a centrifugal separator rotates at a very high speed and great forces are generated.
To ensure your own safety, always carefully follow the instruction book(s) concerning installation, assembly of the components, operation and regular maintenance.
Always use Alfa-Laval spare parts and tools supplied with the machine.

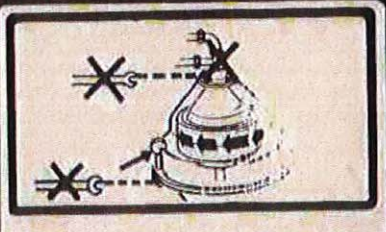
OPERATION



Never start the machine before the lock rings of the bowl inlet, outlet and other fastenings have been securely tightened. Note that the assembly marks Ø (arrowed) must be aligned or pass each other (due to thread wear) when the lock ring is fully tightened.

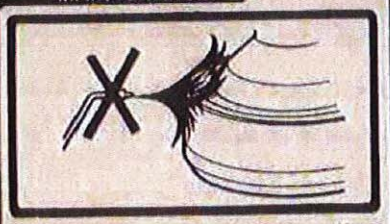


If excessive vibration occurs, IMMEDIATELY fill and keep the bowl full of liquid whilst stopping. Switch off and apply brakes, if fitted. After the bowl has stopped, dismantle, clean and check all parts carefully.



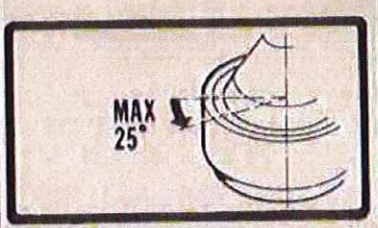
Never loosen any part of the machine until the bowl has completely stopped.

MAINTENANCE

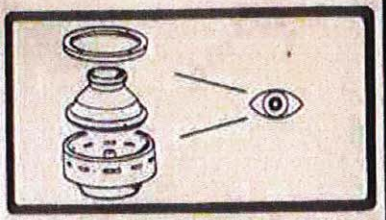


Never heat the bowl body, bowl hood or lock ring with a naked flame.

Never carry out any welding work on the components that rotate.



Never operate the machine when the Ø assembly mark on the lock ring can pass the corresponding mark on bowl body/bowl hood by more than 25 degrees. Consult your AL representative.

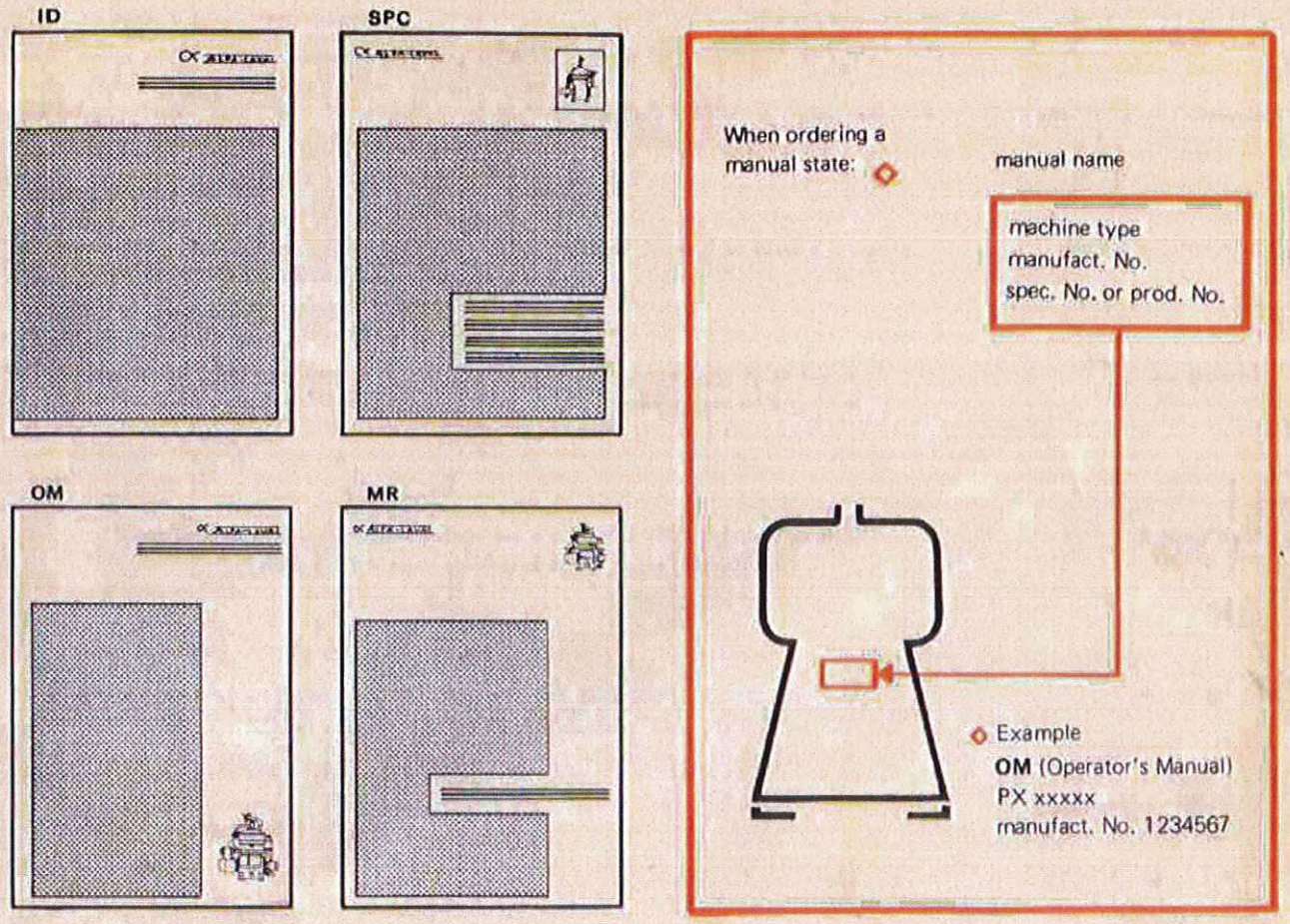


Check at regular intervals for damage due to corrosion and/or erosion. If in doubt, consult your AL representative.

- Switch off and disconnect the power supply to the machine before starting any dismantling work.
- Never use the machine for separating a liquid that is more corrosive or has a higher density, temperature, different characteristics of the solids, etc. than that for which the machine has been purchased.
  In case of doubt, consult your AL representative.
- A separator bowl is balanced as a complete unit. Do not interchange the components of a bowl with those of any other machine, even if it is the same type. Make sure that no parts are left out at assembly.
- Follow the safety instructions concerning inflammable, toxic or corrosive process media and cleaning agents. Affix information and warning notices in prominent places.

SO 2614E

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 measurements, repair instructions	Maintenance personnel

GENERAL INFORMATION

GENERAL DEFINITIONS

Density (specific gravity) — The mass per unit of volume.

Sediment (Sludge) — Solids separated from a 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 Automative Engineers, USA
SSU = Saybolt Seconds Universal, indication of oil viscosity
^{o}E = degree Engler, indication of oil viscosity
cS_t = 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 kg/cm^2

Basic principles

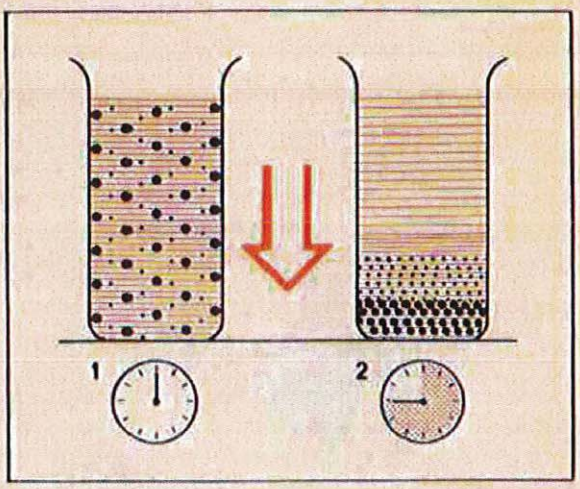
The purpose of separation is

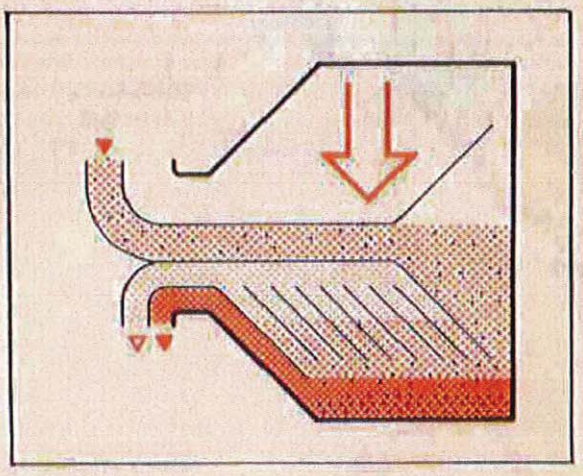
to free a liquid of solid particles

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

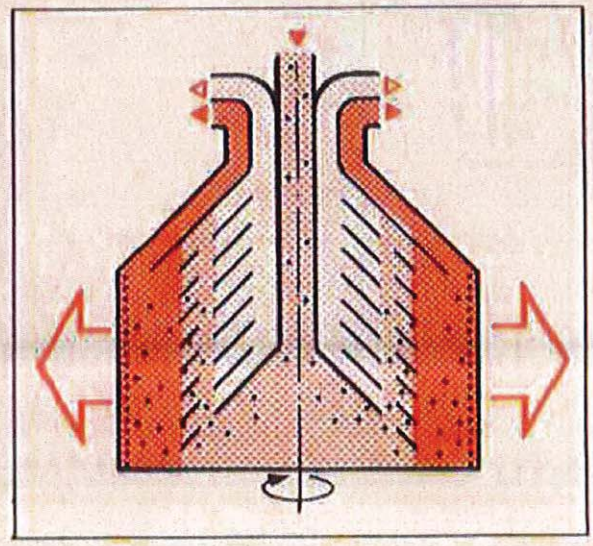
Separation by gravity

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.





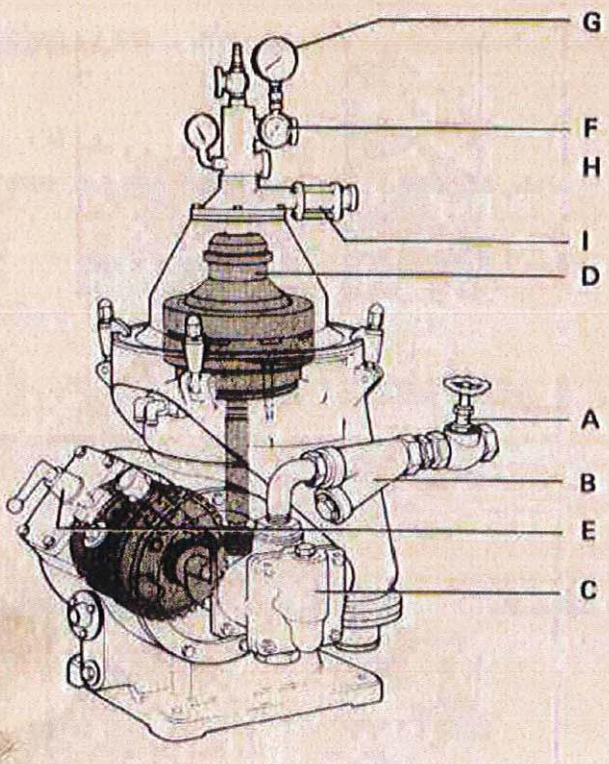
Continuous separation and sedimentation can be achieved in a settling tank having the outlets arranged at levels suited to the density ratio of the two liquid phases. Any solid and heavier particles in the liquid mixture will settle and form a sediment layer on the tank bottom.



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

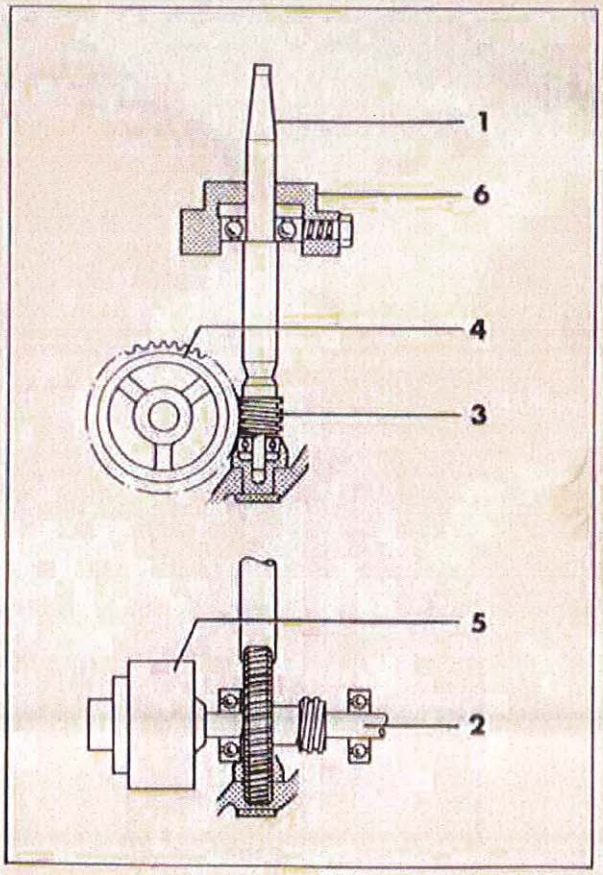


MOPX SEPARATORS

These are centrifugal separators intended for the removal of impurities from mineral oils – fuel and lubricating oils, for instance.

Machine components

A.	Shut-off and regulating valve	E.	Brake
B.	Strainer	F.	Thermometer
C.	Feed pump	G.	Flow meter
D.	Bowl	H.	Pressure gauge
		I.	Sight glass

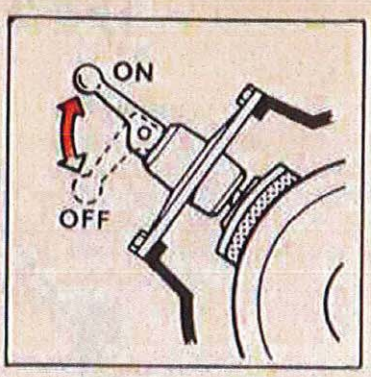


POWER TRANSMISSION

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

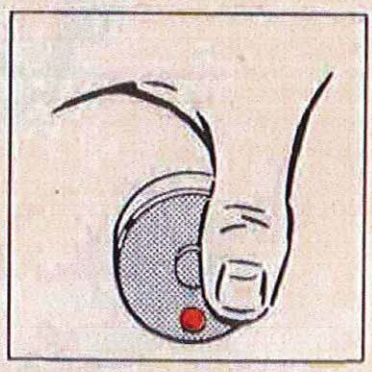
The motor rotates the bowl through the friction coupling and worm gear.
The friction coupling ensures a gentle start and acceleration and prevents overloading of worm gear and motor.
The worm gear serves to adapt the bowl speed to the motor speed.
To decrease bearing wear and prevent transmission of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

BRAKE

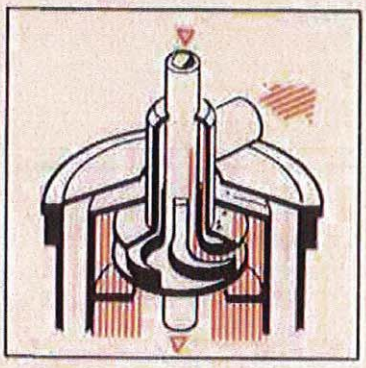


When stopping the machine always apply the brake in order to reduce the retardation time of the bowl, thus quickly passing the critical speed.

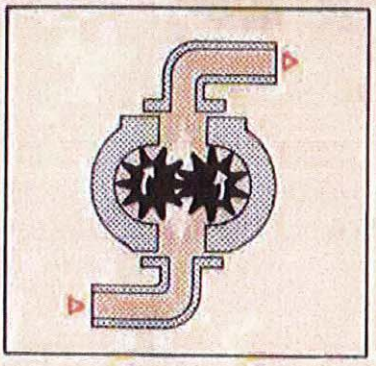
REVOLUTION COUNTER



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 contined 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.

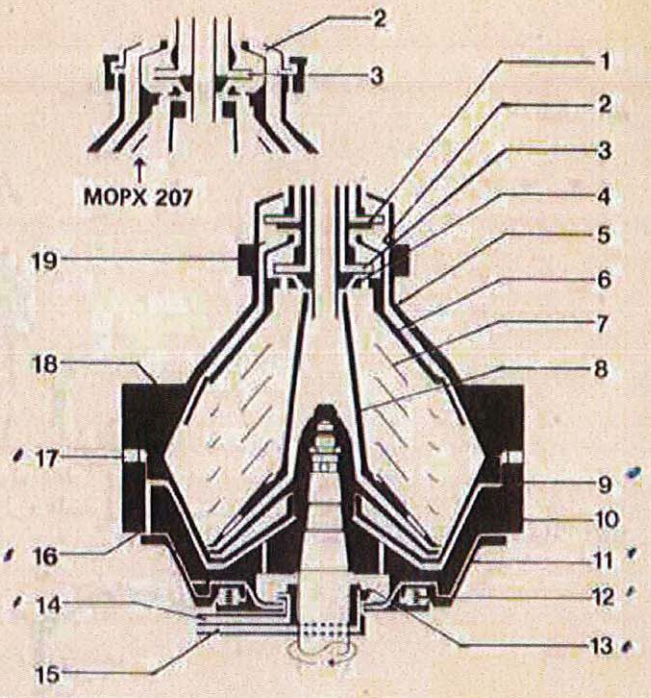
GEAR PUMP

The feed pump of all MOPX separators is of the gear type and 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 18. 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, wich is clamped to the bowl hood 5 by the small lock ring 19 that also forms the top part of the upper paring chamber. With MOPX 207, which is not equipped with the paring disc 1 the heavy liquid (water) leaves the bowl through the gravity disc 2. The parts by which sludge and/or water ejection is effected are marked by an asterisk (*) in the list below, and their functions are described on page 4:1.



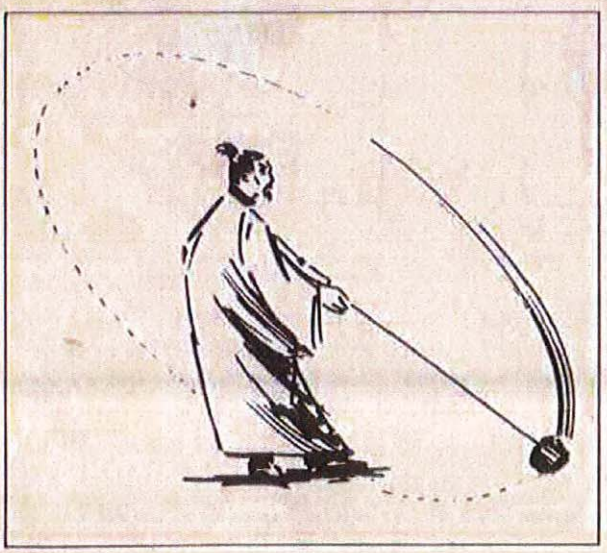
Bowl parts

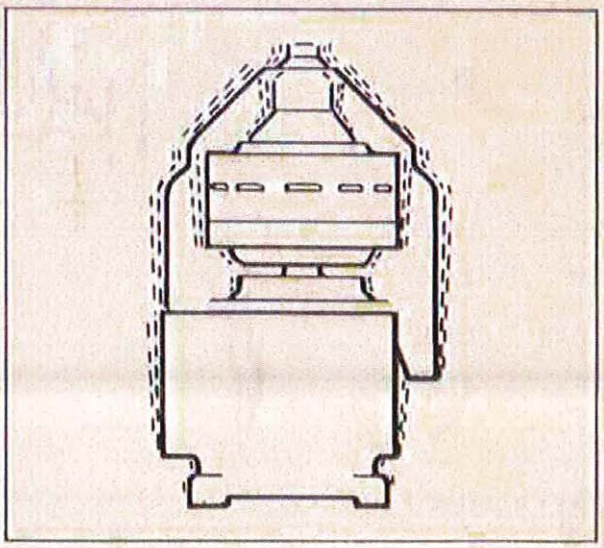
1	Paring disc, water – (not with MOPX 207)	10	Bowl body
2	Gravity disc	11*	Operating slide
3	Paring disc, oil	12*	Spring
4	Level ring	13*	Control paring disc
5	Bowl hood	14*	Closing and make-up water inlet
6	Top disc	15*	Opening water inlet
7	Disc set	16*	Drain valve
8	Distributor	17*	Sludge port
9*	Sliding bowl bottom	18	Large lock ring
		19	Small lock ring

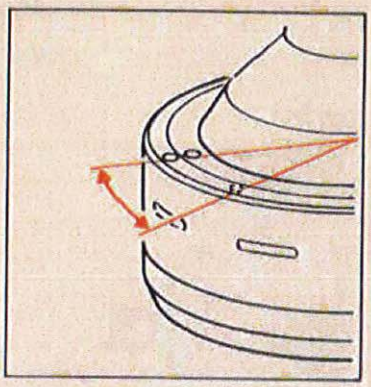
CENTRIFUGAL FORCE

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.

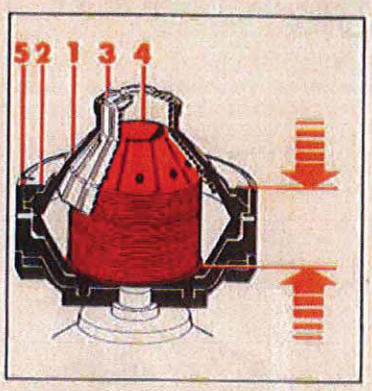






Checking thread condition

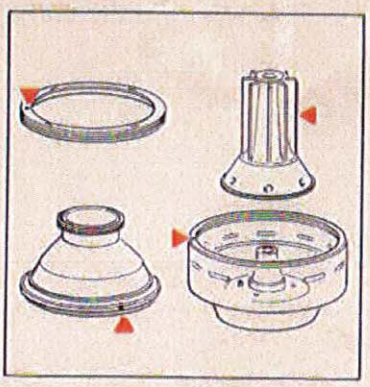
The threads of the large bowl lock ring and bowl body should be checked for wear at least once a year.
If the mark ϕ on the lock ring goes past the stationary mark ϕ by more than 25 °, consult an ALFA-LAVAL representative immediately, as this indicates an excessive thread wear.



Disc pressure

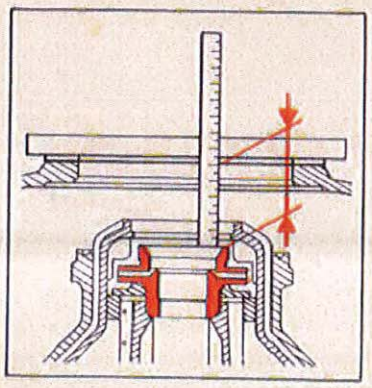
1. Bowl hood
2. Large lock ring
3. Top disc
4. Bowl disc set
5. Bowl body

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



Guide means

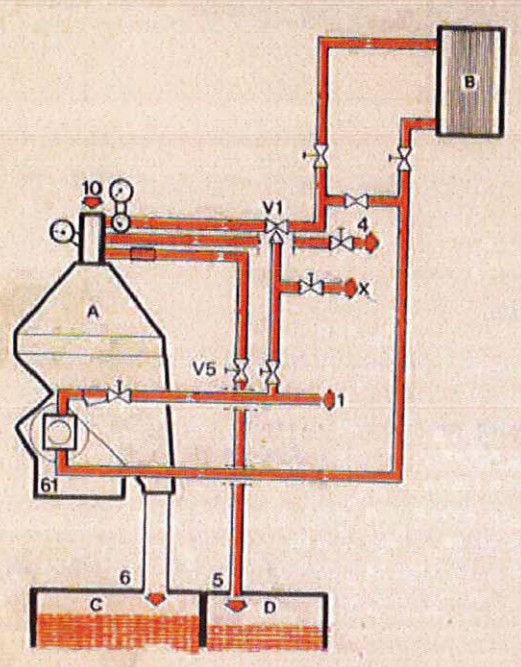
When assembling, make certain that the bowl parts are in the proper position. Take care not to damage the guides when assembling.



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.

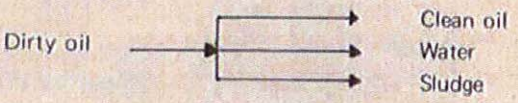
SEPARATING FUNCTION



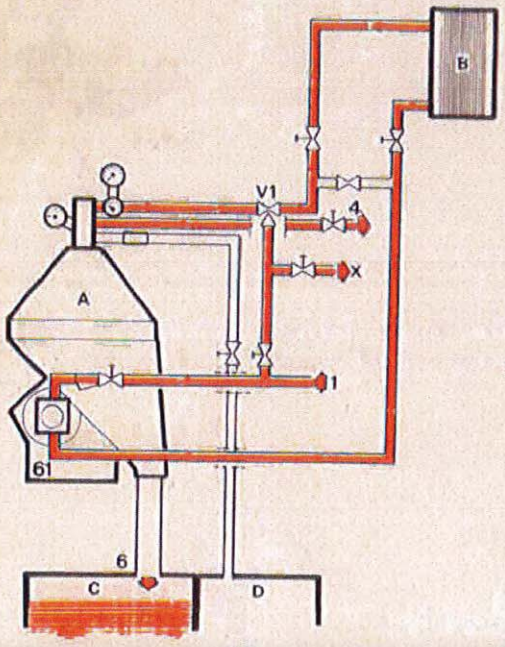
1	Dirty oil inlet	V5	Ball valve in water outlet
4	Clean oil outlet	A	Separator
5	Water outlet	B	Heater
6	Sludge outlet	C	Sludge tank
10	Sealing liquid inlet	D	Drain tank
61	Feed pump	X	Recirculation to tank (alternative)
V1	Three-way valve		

Purification

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



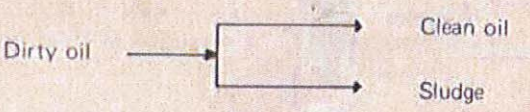
The dirty oil (1) is pumped by the feed pump (61) through a heater B to the separator. By means of the valve (V1) the liquid can be brought to recirculate through the heater until it has obtained the correct separating temperature. The clean oil leaves the separator through the outlet (4), the water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



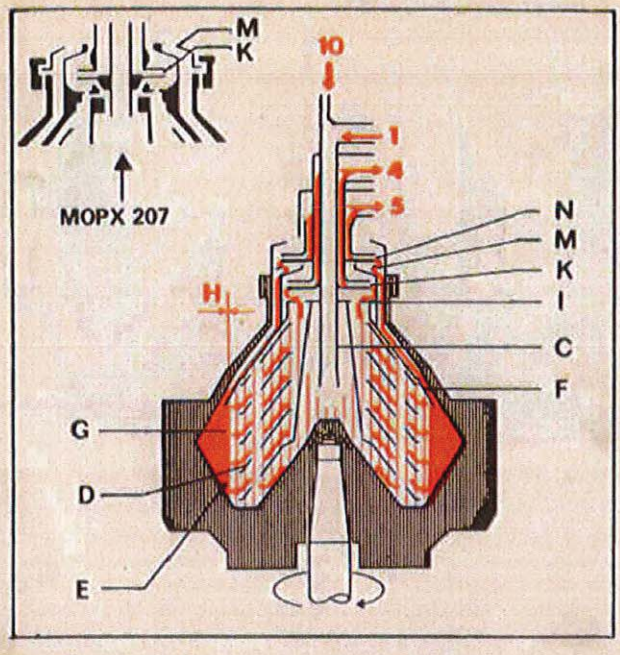
1	Dirty oil inlet	A	Separator
4	Clean oil outlet	B	Heater
6	Sludge outlet	C	Sludge tank
61	Feed pump	D	Drain tank
V1	Three-way valve	X	Recirculation to tank (alternative

Clarification

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



The dirty 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 recirculate through the heater until it has obtained the correct separating temperature. The clarified oil leaves the separator through the outlet (4) and the sludge through outlet (6).



1. Dirty oil inlet
4. Clean oil outlet
5. Water outlet
10. Liquid seal inlet
C. Distributor
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 (not with MOPX 207)

Liquid flow in bowl

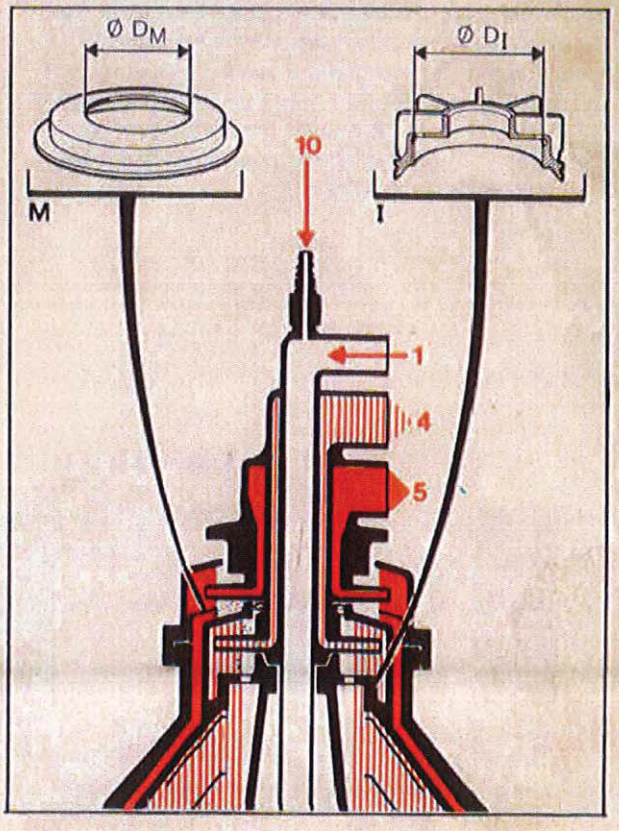
From the inlet (1) the dirty oil flows through the distributor C into the spaces between the bowl discs D where separation takes place. Water and solids (or sludge alone, respectively) will move towards the bowl periphery. In purification the water leaves the bowl by the outlet (5) through the gravity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

With MOPX 207, which is not equipped with the paring disc (N), the heavy liquid (water) leaves the bowl through the gravity disc (M).

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 F of the top disc 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 water outlet (5), i.e. by exchanging the gravity disc (M).



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) in the bowl.

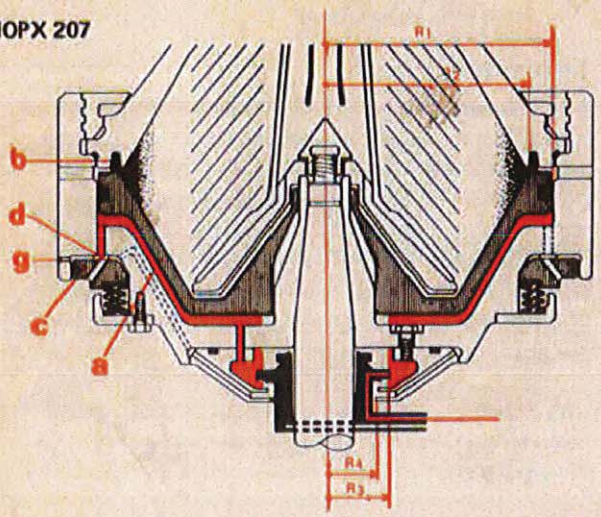
Purification: Use the level ring (I) with the smaller hole pitch diameter (D_I), and a gravity disc (M) according to nomogram.
If the separator is furnished with device for interfase adjustment, use the level ring with the larger hole diameter (ØD_I).

Clarification: Use the level ring (I) with the larger hole pitch diameter (D_I), and the gravity disc (M) with the smallest hole diameter (D_M).

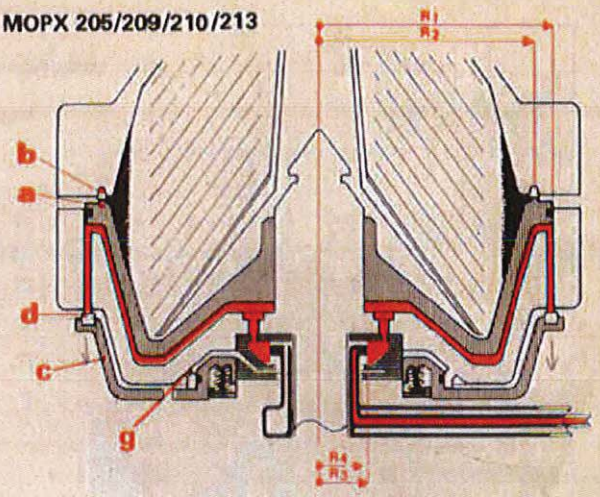
EJECTING FUNCTION

EJECTION CYCLE

MOPX 207



MOPX 205/209/210/213

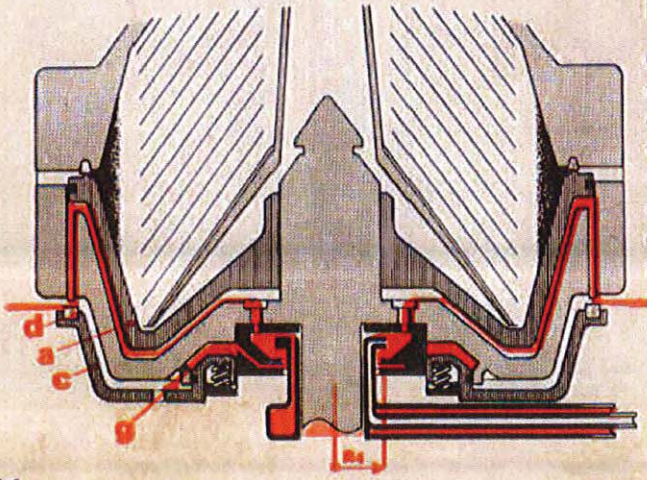


a sliding bowl bottom
b seal ring
c operating slide
d discharge valve
g nozzle

The sludge discharge takes place through a number of sludge ports in the bowl wall. Between discharges these ports are closed by a large valve slide (a), the sliding bowl bottom, which constitutes an inner, sliding bottom in the separating space. The sliding bowl bottom is forced upwards against a seal ring (b) by the liquid pressure acting on its underside. During rotation, this pressure increases with the distance from the axis of rotation because of the centrifugal force. The operating liquid exerts an upward pressure exceeding the counter-acting downward pressure from the process liquid, because the underside of the sliding bowl bottom has a larger pressure surface (radius R_1) than it upper side (radius R_2).

Operating liquid is supplied on 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 horizontal operating liquid level (radius R_3), as its pumping effect neutralizes the static pressure from the supply.

This feed of operating liquid through the inner, narrower tube is going on also during the discharge cycle shown in the following illustrations but has not been indicated in the latter, as it is of minor effect in this connection.

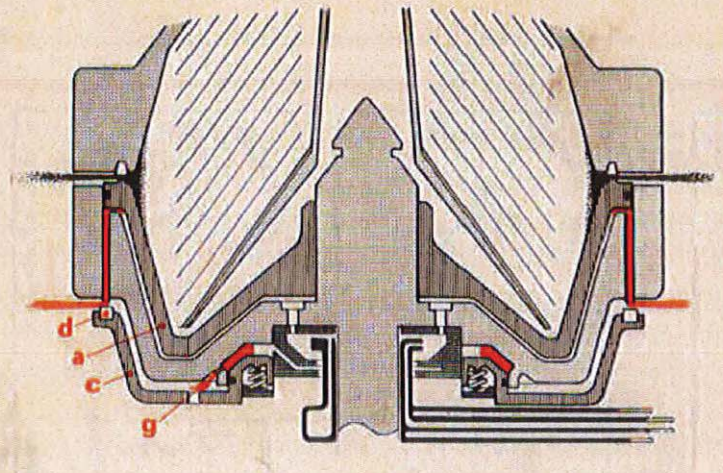


Initiation of ejection

Operating liquid is now supplied through the outer, wider tube so that it flows over the lower edge of the paring chamber (radius R_4) and continues through a channel out to the space above an operating slide (c). Between discharges the operating slide is pressed upwards by coil springs. It is now forced downwards by the liquid pressure, thereby opening discharge valves (d) from the space below the sliding bowl bottom (a) so that the operating liquid in this space flows out.

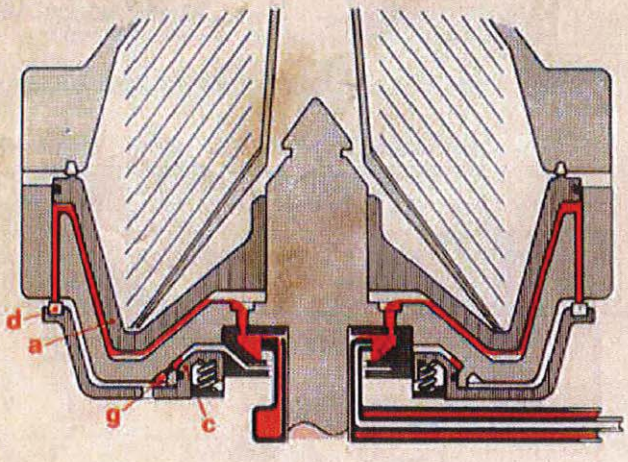
EJECTING FUNCTION

EJECTION CYCLE

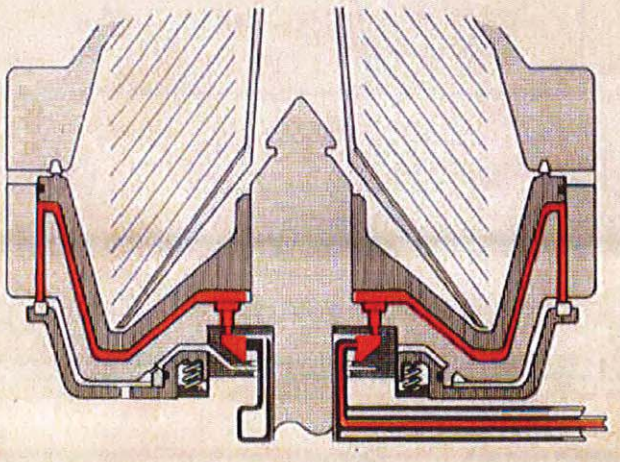


Ejection

When the pressure exerted by the operating liquid against the underside of the sliding bowl bottom diminishes, the latter is forced downwards and opens so that the sludge is ejected from the bowl through the sludge ports in the bowl wall. The operating liquid on the upper side of the operating slide flows out through a nozzle (g). This nozzle is always open but so small that the outflow is negligible in view of the rapid inflow shown in the foregoing illustration.



The coil springs force the operating slide (c) upwards again, which closes the discharge valves (d) from the space below the sliding bowl bottom (a). Operating liquid is supplied through the outer, wider tube, but only enough to flow to the space below the sliding bowl bottom (a) and force the latter upwards so that the bowl is closed. (Any surplus supply of operating liquid flows through the channel to the operating slide, opening the bowl again).

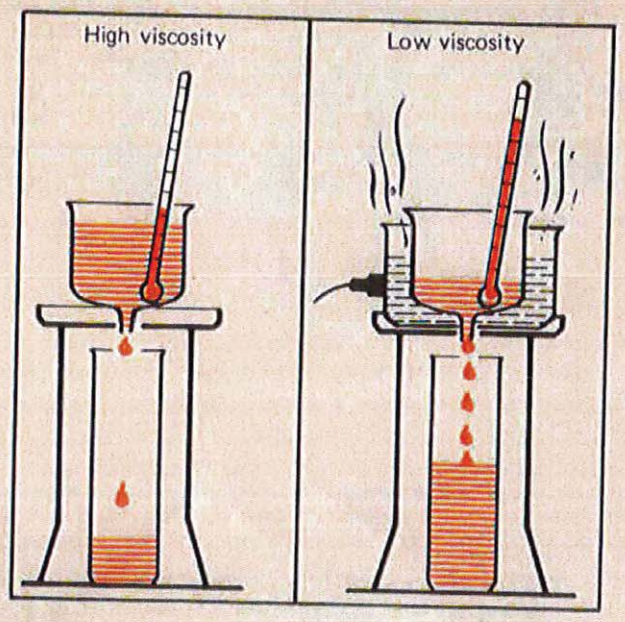


After ejection

The discharge cycle is accomplished when the situation is identical with that shown in the first illustration in the series (but for the absence of sludge). The outer, wider tube is now closed, whereas the inner, narrower operating liquid intake is still open. The paring disc device counter-balances the static pressure from the operating liquid supply. The situation is identical with that shown in the first illustration of the series but for the difference that the sludge discharge cycle is now accomplished.

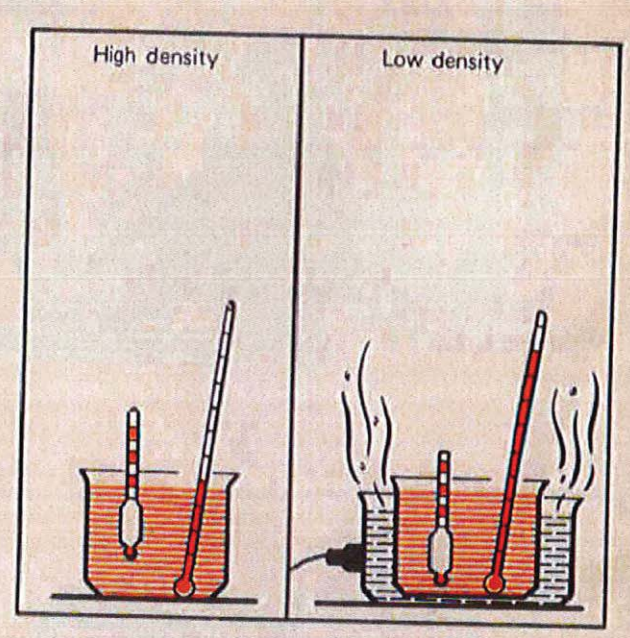
SEPARATING RESULTS

FACTORS INFLUENCING SEPARATION



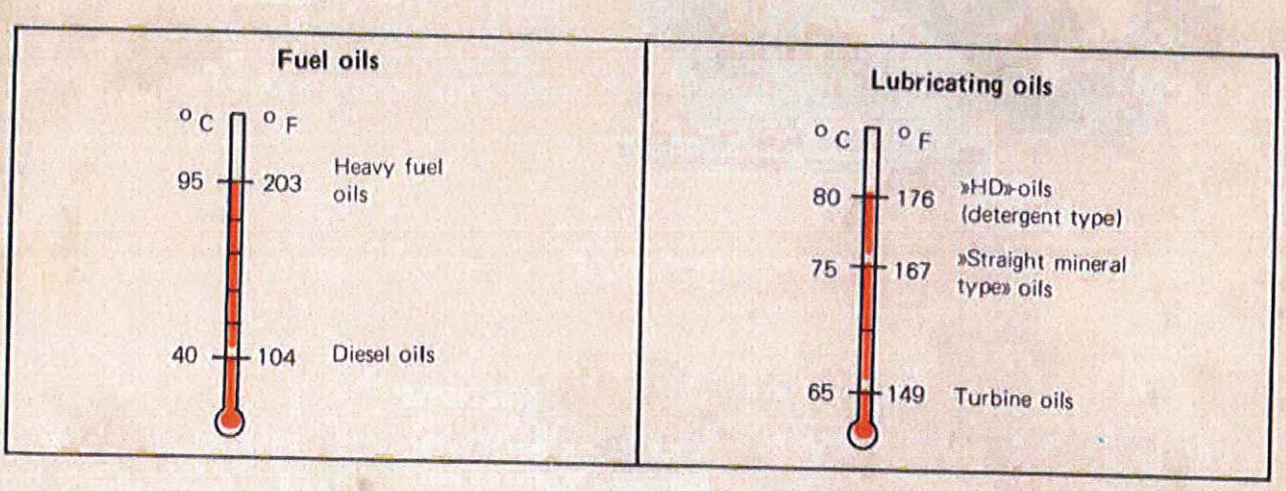
1 Viscosity

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 will be the separation. The difference can be increased by raising the separating temperature.



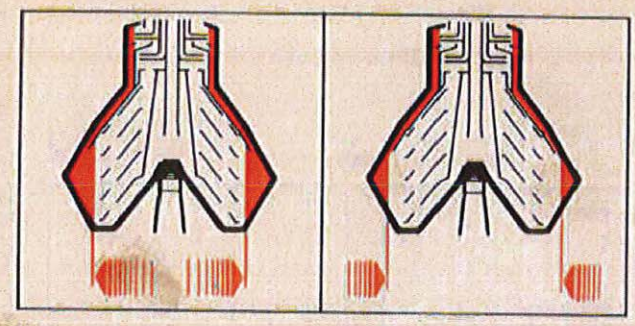
3 Separating temperature

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

4 Rate of throughput:

see recommendations on page 5:3.

5 Optimum utilization of machine.

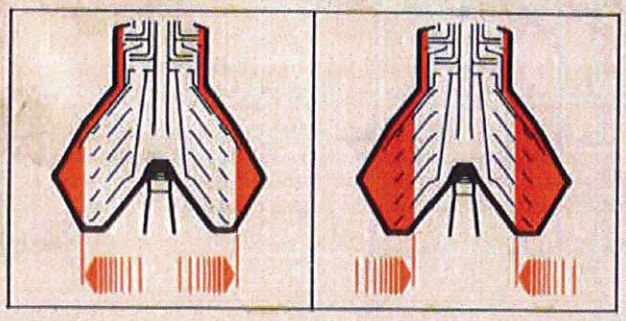


Correct position

Wrong position – liquid seal broken

6 Position of interface

The interface between the liquid seal (water) and the oil should be positioned as close as possible to the bowl periphery. However, the interface 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.



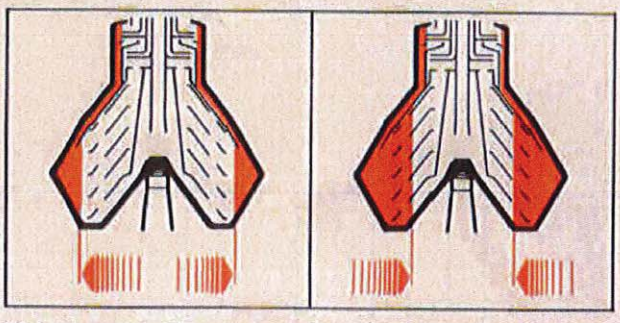
High viscosity/density

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.

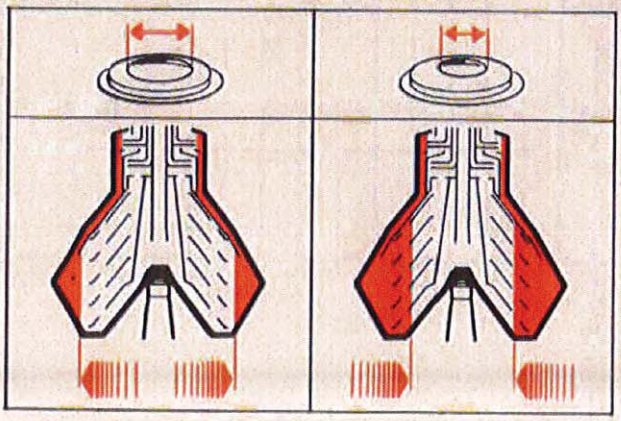


High throughput/ high back pressure

Low throughput/ low back pressure

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 high back pressure, and a low one respectively, 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

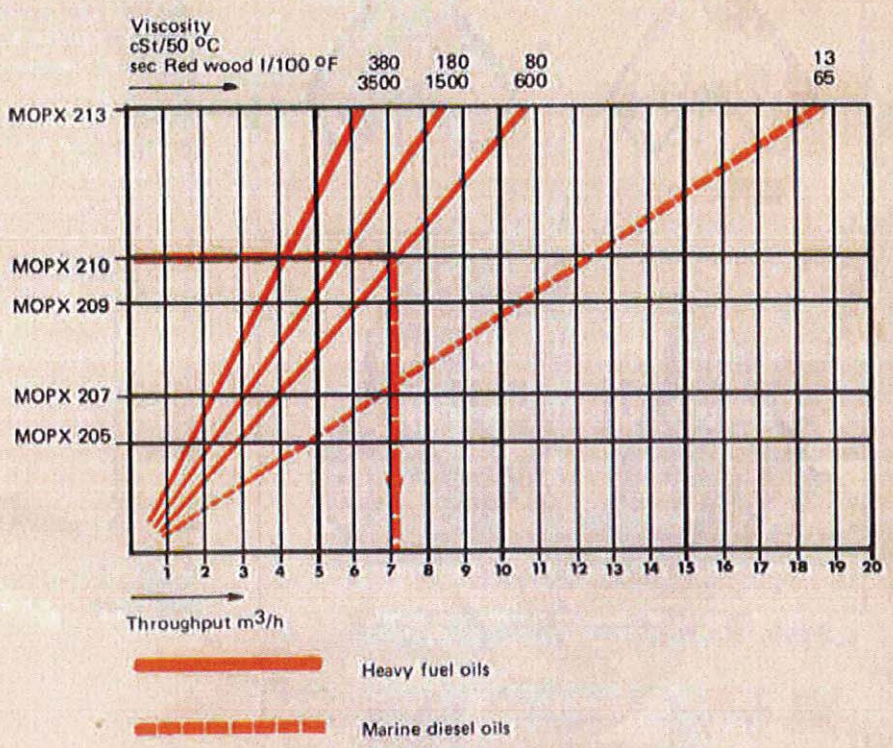
THROUGHPUT – TIME IN CENTRIFUGAL FIELD

Bad separating results may be due to excessive throughput.

Fuel oil

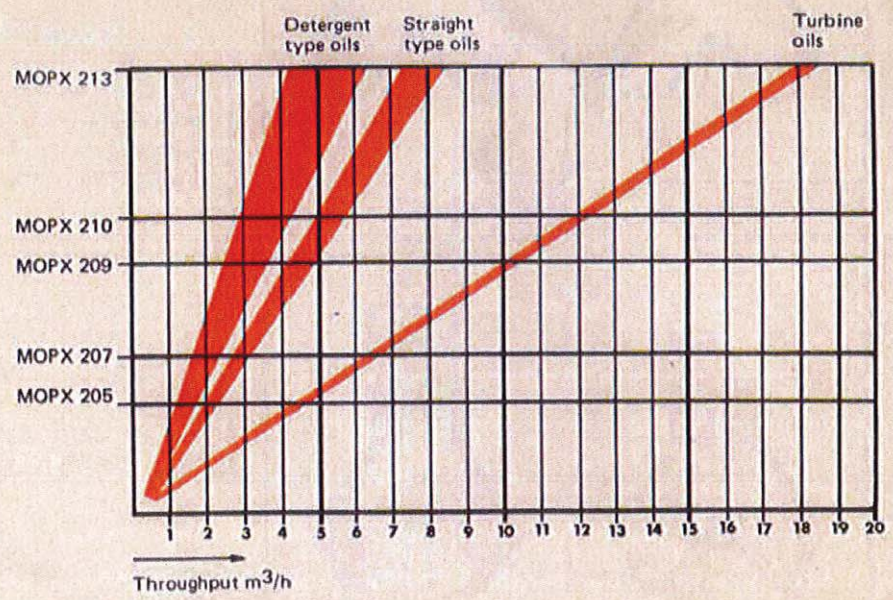
The nomogram shows the rated throughput of fuel oils at a separating temperature of ca. 40 °C for diesel oils and ca. 95 °C for heavier oils.

Example:
Rated throughput of fuel oil with a viscosity of 80 cSt/50 °C R1/100 °F is 7000 lit/h for a MOPX 210.



Lubricating oil

The nomogram shows the rated throughput of lubricating oils at a separating temperature of ca. 80 °C for HD-oils, (detergent), ca. 75 °C for straight mineral oils, and ca. 65 °C for turbine oils.



SELECTION OF GRAVITY DISC MOPX 205

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

The hole diameter of the disc to be tried first 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 in the liquid seal in the bowl or an emulsification in the water outlet.

Where the density of the oil is known at any temperature between 15° - 70°C, the hole diameter of the disc to be tried first at separating temperatures up to 100 °C can be found out from the nomogram.

X = separating temperature in °C and °F

Y = oil density

Ø = hole diameter of gravity disc in mm

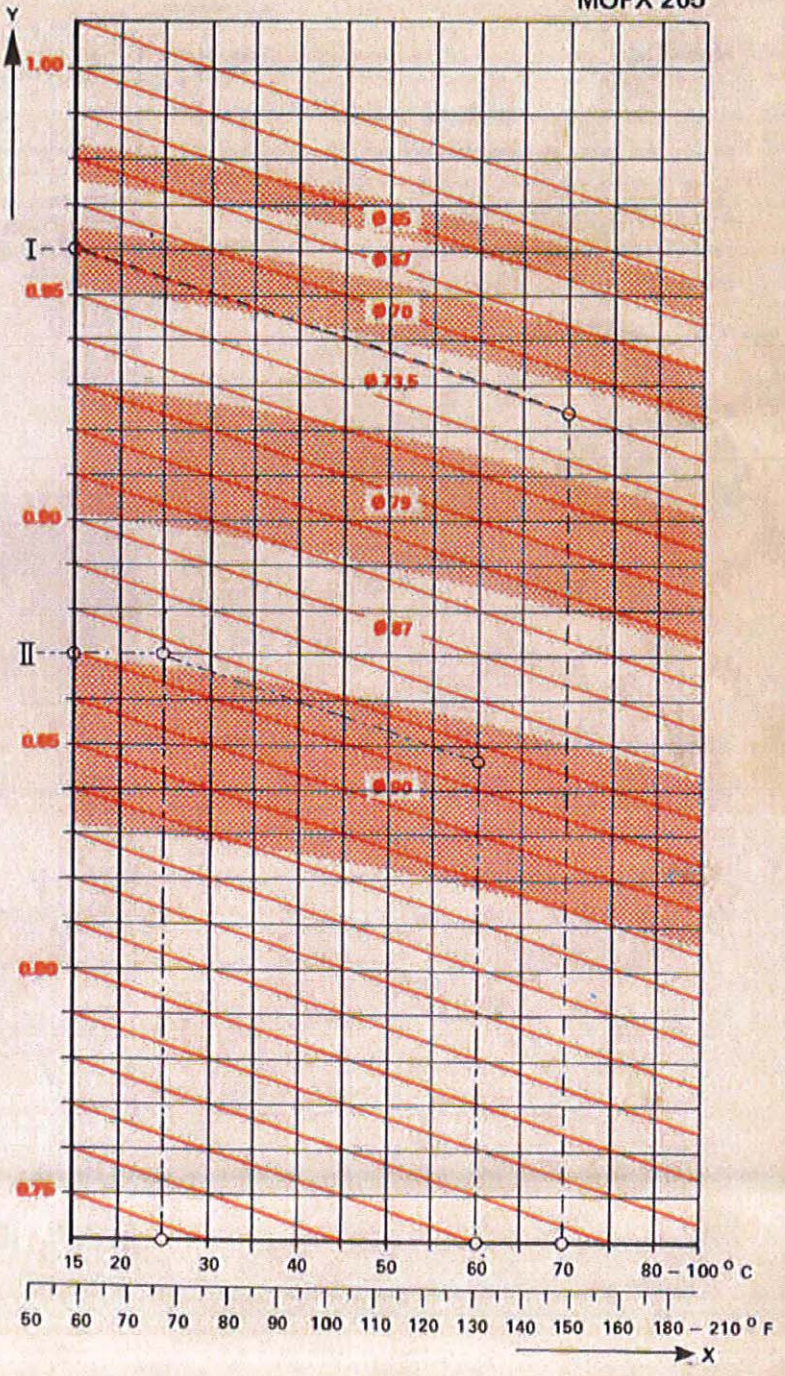
Example I in nomogram

Reference in graph	----------
Density of oil	0.96 at 15 °C (60 °F)
Separating temperature	70 °C (160 °F)
Hole diameter	Ø 73.5 mm

Example II in nomogram

Reference in graph	– . – . – . – . – .
Density of oil	0.87 at 25 °C (75 °F)
Separating temperature	60 °C (140 °F)
Hole diameter	Ø 90.0 mm

MOPX 205



SEPARATING RESULTS

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 given temperature is known.

The hole diameter of the disc to be tried first 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 in the liquid seal in the bowl or an emulsification in the water outlet.

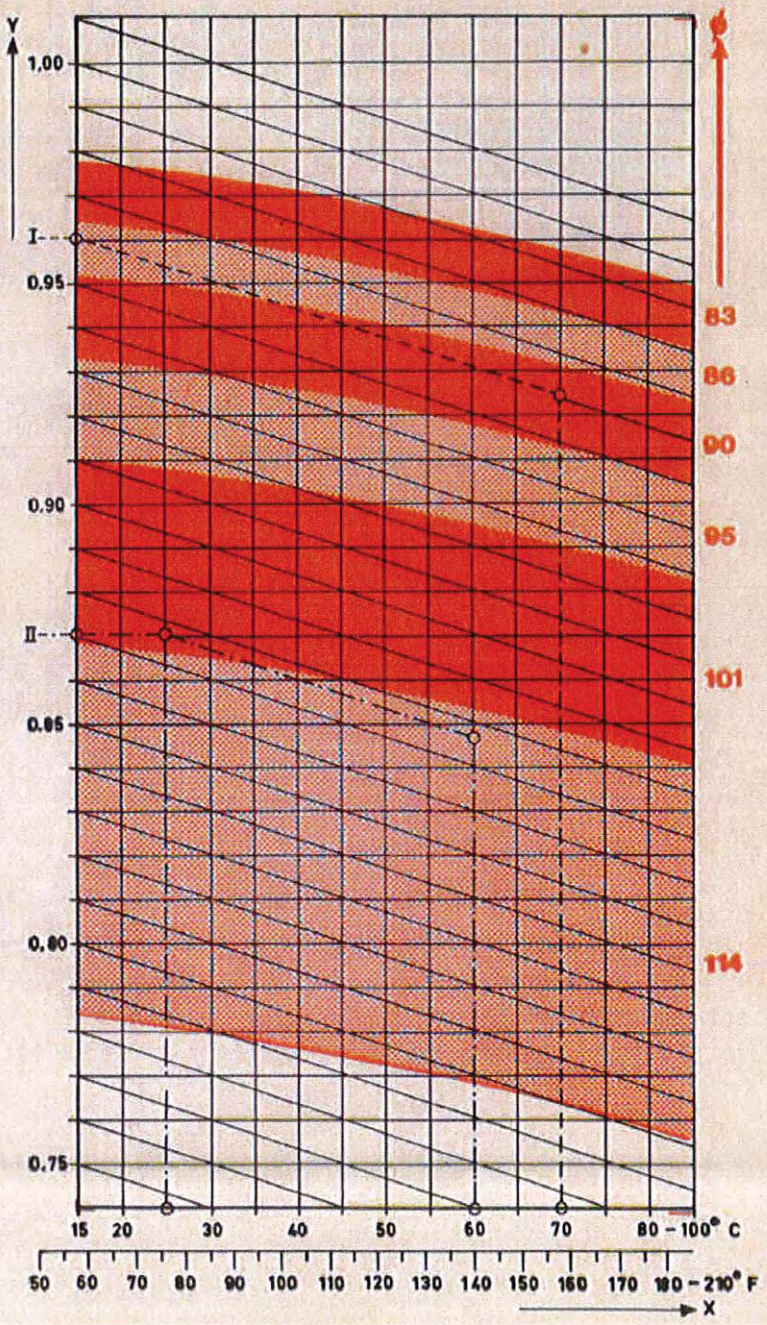
MOPX 207

Where the density of the oil is known at any temperature between 15° - 70°C, the hole diameter of the disc to be tried first at separating temperatures up to 100 °C can be found out from the nomogram.

X = separating temperature in °C and °F

Y = oil density

Ø = hole diameter of gravity disc in mm



Example I in nomogram

Reference in graph	----------
Density of oil	0.96 at 15 °C (60 °F)
Separating temperature	70 °C (160 °F)
Hole diameter	Ø 90 mm

Example II in nomogram

Reference in graph	– . – . – . – . – .
Density of oil	0.87 at 25 °C (75 °F)
Separating temperature	60 °C (140 °F)
Hole diameter	Ø 114 mm

SELECTION OF GRAVITY DISC

MOPX 209/210

The nomogram is divided into three parts: A, B and C.

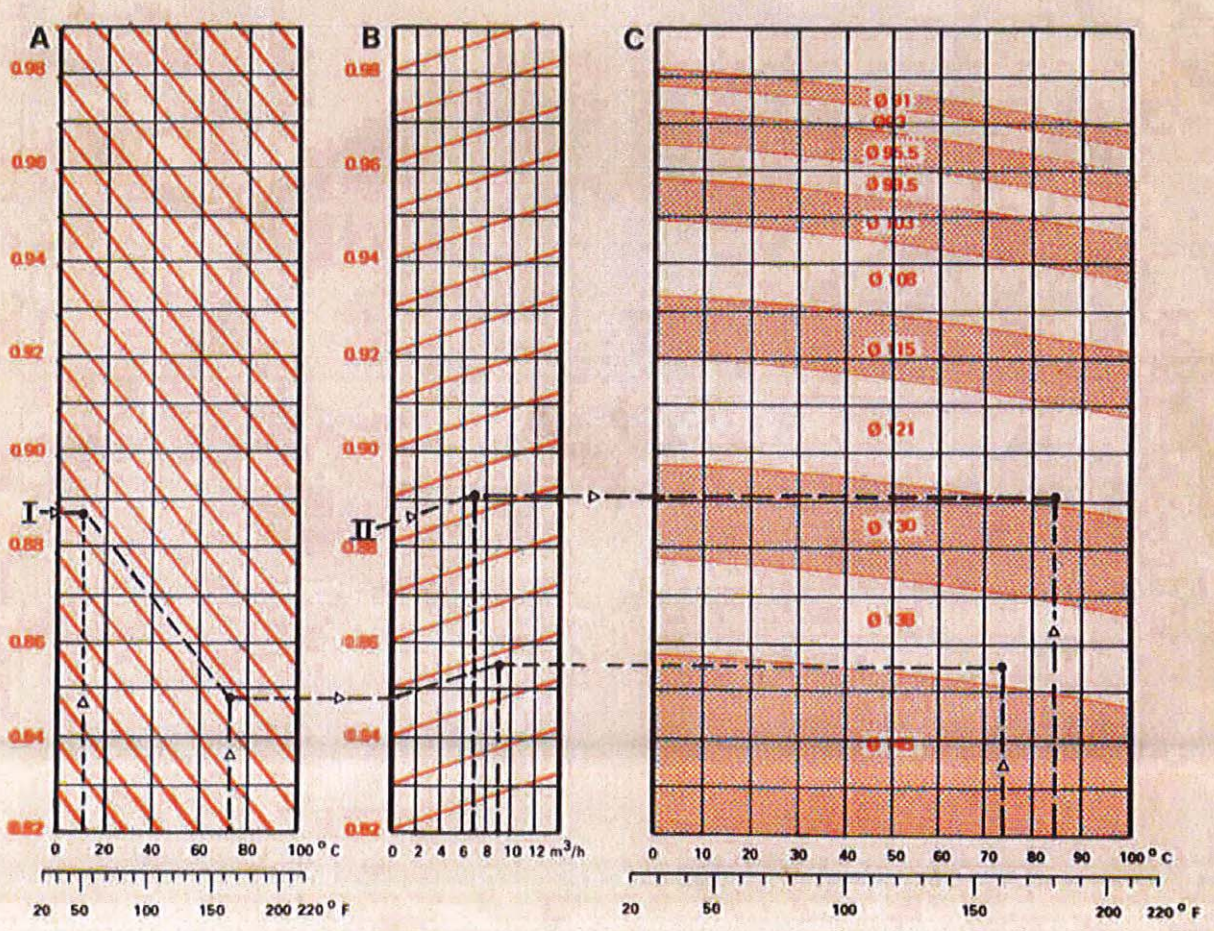
A If the density of the oil is known at a temperature other than the separating temperature: Seek the density at separating temperature in part A of the nomogram. See example I.

B If the density at separating temperature is known: Use the nomogram from part B incl. See example II. Trace the coloured lines to the vertical sight line representing the intended throughput.

C The intersection point between a horisontal sight line from part B of the nomogram and a vertical sight line indicating the chosen separating temperature lies in the coloured or white field which represents the hole diameter of the sought gravity disc.

Examples in nomogram	I	II
Reference in graph	----	- - -
Density of oil at 15 °C	0.888	
Density of oil at separating temperature		0.885
Separating temperature °C	75	85
Throughput m^3/h	9	7
Hole diameter of gravity disc in mm	138	121

MOPX 209/210



SEPARATING RESULTS

SELECTION OF GRAVITY DISC

MOPX 213

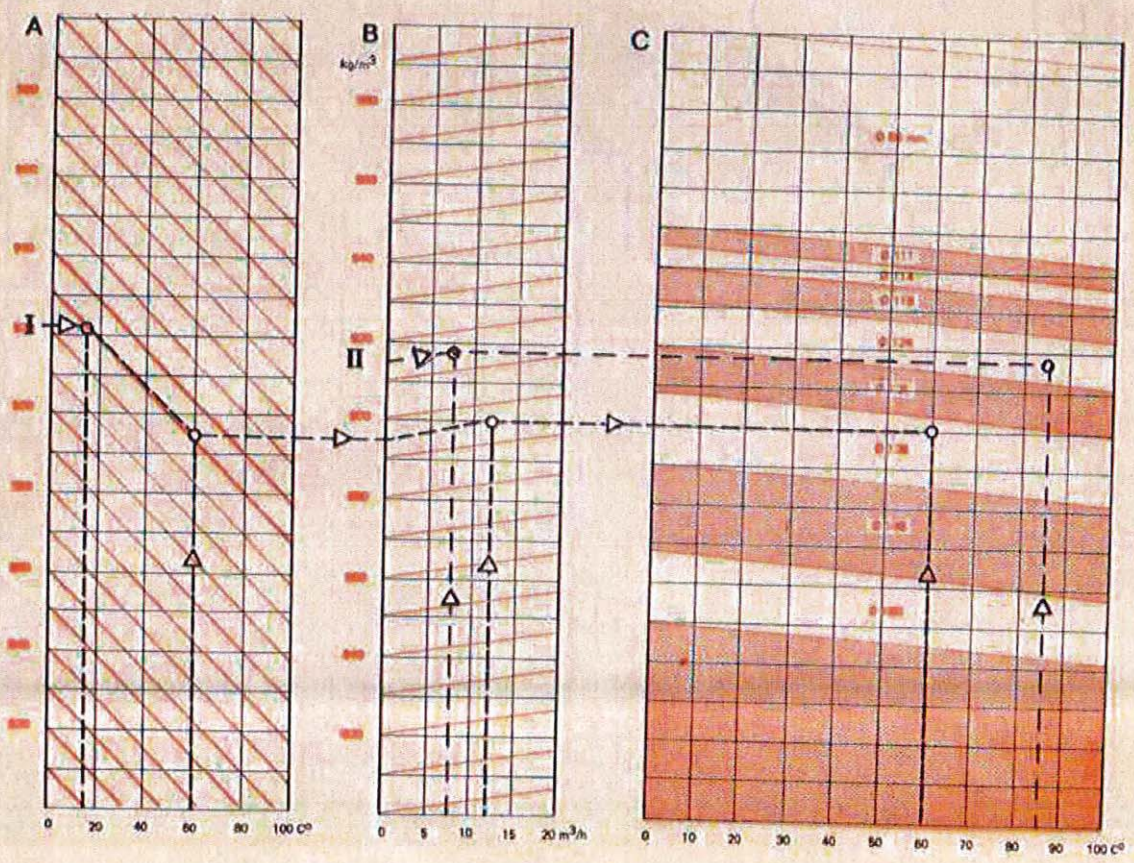
The nomogram is divided into three parts: A, B and C.

A If the density of the oil is known at a temperature other than the separating temperature: Seek the density at separating temperature in part A of the nomogram. See example I.

B If the density at separating temperature is known: Use the nomogram from part B incl. See example II. Trace the coloured lines to the vertical sight line representing the intended throughput.

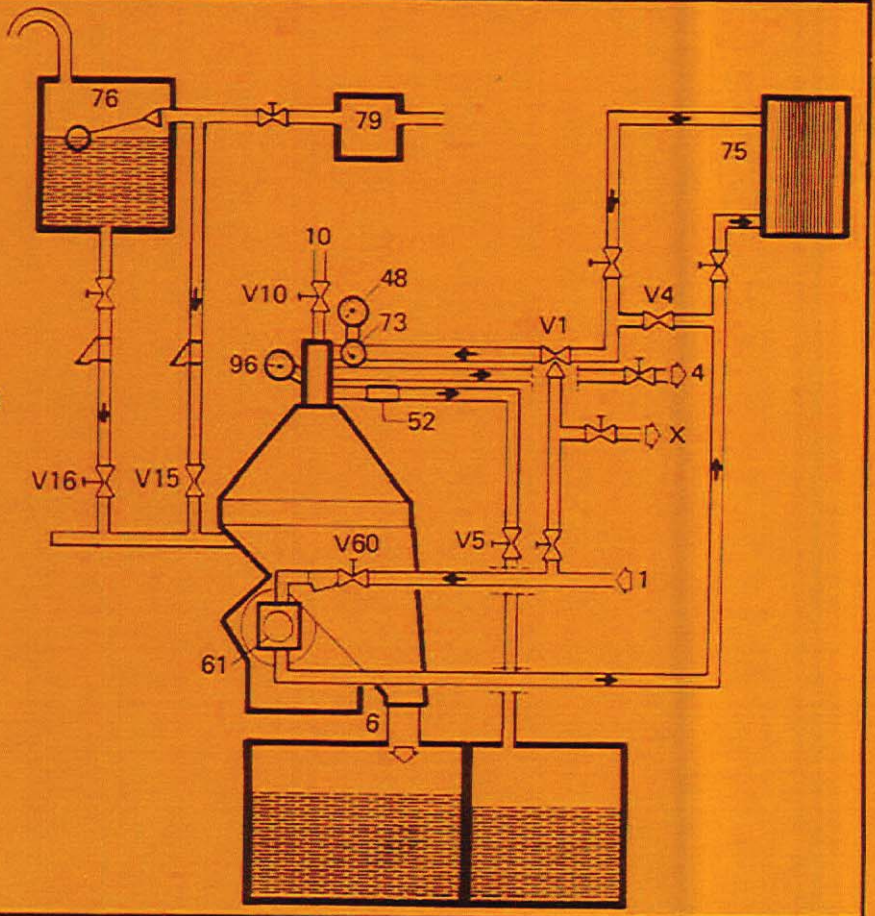
C The intersection point between a horisontal sight line from part B of the nomogram and a vertical sight line indicating the chosen separating temperature lies in the coloured or white field which represents the hole diameter of the sought gravity disc.

Examples in nomogram	I	II
Reference in graph	----	----
Density of oil at 15 °C	0.922	
Density of oil at separating temperature	0.895	0.915
Separating temperature °C	60	85
Throughput m^3/h	12	7.5
Hole diameter of gravity disc in mm	Ø 138	Ø 124



OPERATING ROUTINE – MOPX

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



1	Unseparated oil	V1	Selector valve for unseparated oil
4	Separated oil	V5	Valve for water outlet
6	Sludge outlet	V10	Valve for added water (liquid seal)
10	Addition of water (liquid seal)	V15	Valve for opening-water
48	Flow meter	V16	Valve for closing-water
52	Sight glass	V60	Control valve ahead of pump
61	Pump	X	Recirculation to tank (alternative)
73	Thermometer		
75	Heater		
76	Operating water tank		
79	Dehardening filter		
96	Pressure gauge		

BEFORE STARTING

Check that

- The bowl has been properly cleaned and is fitted with suitable parts from the alternative equipment below.

Purification without back pressure device for interface control:	**Purification with** back pressure device for interface control:

FILLING

Liquid seal for purification

- Open valve V10 and add sealing liquid
- Close the valve when liquid is visible in sight glass 52
- Open valves V4 and V5
- Set three-way valve V1 for supply of unseparated oil to the machine
- Set a suitable flow with control valve V60 ahead of the pump. Check

Smallest level ring Gravity disc according to nomogram.	**Largest** level ring Gravity disc according to nomogram.
Clarification: Largest level ring Smallest gravity disc supplied.	

- 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 Recirculation to tank or heater has been arranged
- o Control valve V60 ahead of pump is slightly open to prevent the pump from running dry.

STARTING

- o Start the motor. If abnormal vibration occurs during the running-up period, stop the machine and check for proper assembly and cleaning.
- o Check the speed
- o Close the bowl by opening valve V16 for closing-water. Wait some twenty or thirty seconds until the bowl is closed. Filling can now take place.

with flow meter 48

- o Check the separating temperature—read thermometer 73
- o Adjust the back pressure (P = 1.5 bar minimum) in the oil outlet with the aid of valve V4 and pressure gauge 96.

EMPTYING BOWL DURING OPERATION

- o Shut off the supply of unseparated oil— valve V1
- o Open valve V15. Wait in this position until an emptying sound can be heard. Close the valve immediately after this
- o Wait some twenty or thirty seconds until the bowl is closed.

Closing times:

MOPX 205	approx. 10 - 20 seconds
MOPX 209/210	approx. 30 - 40 seconds
MOPX 207	approx. 20 - 30 seconds
MOPX 213	approx. 50 - 60 seconds

Refill the bowl—see FILLING.

STOPPING

- o Shut off the heater
- o Shut off the supply of unseparated oil to the machine by resetting three-way valve V1 to recirculation
- o Close valve V16 for the closing-water
- o Open valve V15 for the opening-water. Close the valve immediately after the bowl has emptied
- o Stop the motor
- o Apply the brake
- o Release the brake when the bowl has stopped
- o Never undo any part of the machine until the bowl has come to a standstill.

EMERGENCY STOP	If the flow of process liquid ceases, so that the bowl vibrates or if vibration occurs for some other reason, switch off any programme equipment, add water as soon as possible by closing valve V15 and opening V10 and V16. Then stop the machine (full bowl) and clean the bowl.

TROUBLE TRACING

Mechanical function

INDICATION										CAUSE	REMEDY
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		
■										Bowl out of balance due to: bad cleaning — incorrect assembling — bad tightening of lock ring — bowl assembled with parts from several machines. Vibration-damping rubber washers worn out Top bearing spring broken	Stop immediately and establish cause Badly tightened lock ring involves fatal danger Renew washers every second year Exchange all these springs
			■							Height position of paring disc or bowl spindle is wrong	Stop and adjust
		■								Normal occurence 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
								■		Brake lining worn or oily	Replace
									■	Condensation	Drain water
									■	Bowl casing drain obstructed	Clean
									■	Leakage at top bearing	Replace seal ring
				■						Transmission wrong Motor speed inappropriate in view of machine	Stop immediately and rectify faults

■ — To be checked in the first place

TROUBLE TRACING
Separating function

INDICATION									
In clarification and purification				In purification					
Liquid flows out through bowl casing drain and/or sludge outlet	Bowl opens unintentionally during operation	Bowl fails to open for ejection	Unsatisfactory sludge ejection	Unsatisfactory separation	No separation of oil and water	Outgoing oil contains water	Outgoing water contains oil	Ejected sludge and water contains oil	
							■	■	
						■			
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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	Replace
	■	Seal ring between upper and lower connecting pieces in outlets is defective	Replace
	■	Wrong level ring	Purification: small hole pitch diam. level ring Clarification: large hole pitch diam. level ring
■		Bowl speed too low	Make sure brake off, examine motor and power transmission
■		Sludge space in bowl filled	Clean
■		Bowl disc set clogged	Clean
		Valves closed	Open valves and adjust to suitable throughput
■		Dirty oil contains water	Assemble and operate the machine as a purifier
	■	Bowl incorrectly assembled	
		Ejection in progress	None (normal)
		Operating water tank placed too high	See installation drawing
		Operating water tank placed too low	See installation drawing
		Seal rings in control paring disc device defective	Exchange
		Seal ring in operating slide defective	Replace
		Valve plugs defective	Replace
		Seal ring in sliding bowl bottom defective	Replace
		Seal ring at gravity disc defective	Replace
		Operating water strainer clogged	Clean

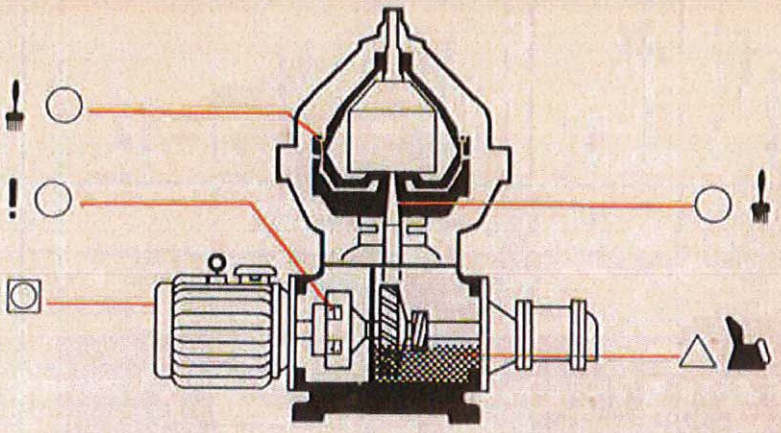
OPERATION

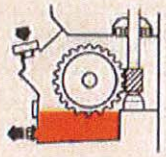
LUBRICATION SCHEDULE

○ **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 quantity lit. (UK.gals)	SAE 40 cSt at 210 °F 13-16.8 °E at 50 °C 10-15	SAE 50 cSt at 210 °F 16.8-23 °E at 50 °C 15-23
	MOPX 205	4.1 (0.9)		
	MOPX 207	7.5 (1.6)		
	MOPX 209/210/213	12.0 (2.6)		

Separating temperature

15-70 °C 60-160 °F

15-95 °C 60-205 °F

!	Lubricate ball bearings sparsely with ball bearing grease.
	Apply molydenum disulphide grease to the lock ring joint of the bowl and, very sparsely, to the bowl spindle tapered end.

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 FR & O	Ursa Oil ED 40 Taro XD 40, DP 40 Regal GR & O	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		

Molybdenum disulphide paste

Molykote universal paste 1000
Molykote paste G rapid