

FRAMO

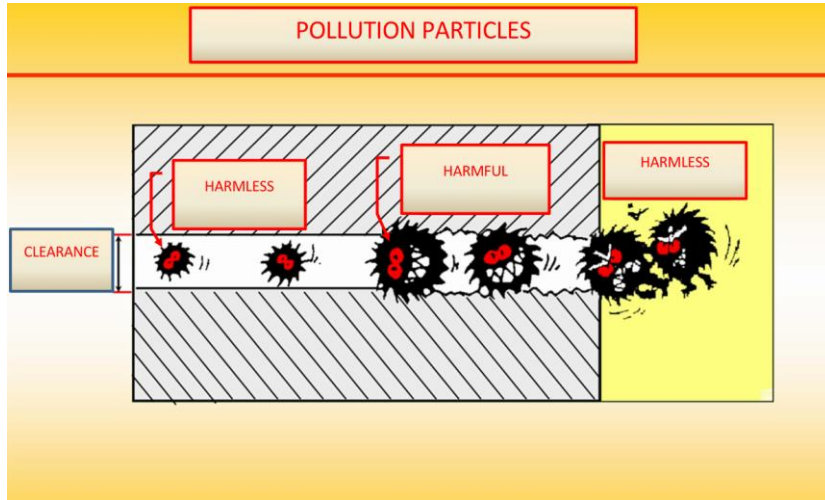
an Alfa Laval brand

Hydraulic Oil Cleanliness and Filtration



- Oil sample every 3rd month
- Particle counting ISO 4406
- Never mix the hydraulic oil with lub oil
- Pressure drop over filter combined with particle counting is the only safe indicator when to change filter elements
- New Filters with bigger dirt capacity give longer service intervals and improved economy
- Cheap non-original filters are always costly in the end

Oil Cleanliness - Filtration



Our recommended maximum level of particles is:
ISO 4406 code 16/12:1999

This means:

Number of particles per ml $\geq 6\mu\text{m}$: 320 – max. 640

Number of particles per ml $\geq 14\mu\text{m}$: 20 – max. 40

Normal FRAMO filters have a Beta Ratio = $\beta_{12} \geq 1000$
This means if 1000 particles of $12\mu\text{m}$ or bigger comes into the filter only one passes through. Beta factor is the filter's ability to stop the particles.

$$\beta = \frac{\text{Particles in}}{\text{Particles out}}$$

Oil Cleanliness - Filtration

1000 ppm = 0,1%

300 ppm = 0,03%



The maximum water content is: 300 ppm

Make sure the viscosity is within limits:

❑ VG46: min. 38,0 cSt

❑ VG32: min. 28,8 cSt

If viscosity drops below acceptable limit you must replenish with VG68 (or VG100 if necessary)

Understanding of ISO 4406:99

Example Particle Count		Number of particles per ml.		
Size (Microns)	Count of part. larger than size. Per ml	More than	Up to and including	Code/ Rating
4	1855	80 000	160 000	24
6	322	40 000	80 000	23
10	95	20 000	40 000	22
14	32	10 000	20 000	21
20	19	5 000	10 000	20
50	6	2 500	5 000	19
75	2	1 300	2 500	18
100	0	640	1 300	17
		320	640	16
		160	320	15
		80	160	14
		40	80	13
		20	40	12
		10	20	11
		5	10	10
		2,5	5,0	9
		1,3	2,5	8
		0,64	1,3	7
		0,32	0,64	6
		0,16	0,32	5

322 particles
> 6µm / ml

32 particles
> 14µm / ml

= ISO 16/12

Hydraulic Oil Specifications

No. 1400-0068-4
Date/sign.: 03Jul89/BL
Page: 1 of 1
Rev. M: 24Nov15/RSH

ANTI WEAR OIL WITH VISCOSITY INDEX (VI) IMPROVER (VI greater than 95) FOR APPLICATION ABOVE AMBIENT TEMPERATURE minus 26°C			General specification
Company	Trade name		
EXXONMOBIL	DTE 25		
SHELL	TELLUS S2 M 46		
CHEVRON	RANDO OIL HD 46		
ANTI WEAR OIL WITH VISCOSITY INDEX (VI) IMPROVER (VI greater than 140) FOR APPLICATION ABOVE AMBIENT TEMPERATURE minus 35°C			- DIN 51524 Part 2 for anti-wear hydraulic oils type HLP. - Sperry Vickers 35VQ25 A11XX20 test as described in Sperry Vickers form M-2952-S/694. - FZG A/8,3/90 test, load stage 10 according to DIN 51354 part 2. - Viscosity ISO VG 46. According to ISO 3448. - Viscosity index. Min. 95. According to ISO 3448. - Pour point, Max. minus 26°C. According to DIN 51597 or DIN ISO 3016 or ASTM D97. - The oil shall last as long as the operational life for Framo cargo pumping system.
Company	Trade name		
ANTAR	VISGA 46	*	
BP	ENERGOL SHF HV 46	*	
CASTROL	HYSPIN AWH-M 46	*	
EXXONMOBIL	DTE 15 M	*	
CHEVRON	RANDO OIL HD Z 46	*	
	CLARITY SYNTHETIC HYDRAULIC OIL AW 46	**	
SHELL	TELLUS S2 V 46	*	
TOTAL	VISGA 46 / EQUIVIS ZS 46	*	
GULF OIL MARINE	GULFSEA HYDRAULIC HVI PLUS 46	*	
FUCHS	RENOLIN B 46 HVI	*	

Trade names and general specification for hydraulic oils for use in Framo hydraulic systems (ISO VG 46)

If another hydraulic oil is intended used, Framo must be contacted.

Never mix different hydraulic oils!

Formulation of different oils is a continuously changing process. The oils listed here are according to information available to Framo meeting general specification stated in this paper. It is, however, the responsibility of each oil company to specify hydraulic oils meeting this specification.

Re-branded oil is not acceptable.

*) If these oils are to be used, oil viscosity for initial filling and filling of storage tank to be 50-55 cSt at 40°C. If necessary by mixing with ISO VG 68 oil.

**) This oil must never be mixed with higher viscosity oil.

Cold Starting

If the oil temperature is below 20°C, circulate the oil (through the heating and venting valve installed in the system) for heating with only one power pack running. According to fig. 1

Depending on the installation, operation of the heating and venting valve is locally at the valve or remotely controlled from control panel

Operation temperature for Framo Systems

Hydraulic oil temp. (°C)	
70	
60	Alarm temperature 60°C
55	Optimum range Normal operating range: 20-60°C
50	
40	
30	
20	
10	Limited operation. System to be heated Hydraulic pressure approximately 100 bar.
0	
-5	
-10	Limited operation. System to be heated Hydraulic pressure approximately 60 bar.
-20	
-30	

High viscosity index oils (VI >140). Pour point, max. -35°C
(Based upon hydraulic oil viscosity ISO VG-46 according to ISO 3448)

Filter Change – Oil Monitoring

- Closed system A4V – Old version
- Closed system A4V – Latest version
- Open system A4V
- A2V system
- Service Bulletin # 12
- Oil Monitoring and Inspection Program, Service Bulletin # 35
- Air venting in hydraulic system



SERVICE BULLETIN #35

FRAMO MARINE CARGO PUMPING SYSTEM

Oil monitoring and inspection



Oil Monitoring and Inspection Program (OMP) includes:

Oil sampling – Oil analysis – Filter condition – Annual Inspection – Pre-Docking Inspection



Oil monitoring and inspection



Oil Monitoring and Inspection Program (OMP) includes:

Oil sampling – Oil analysis – Filter condition – Annual Inspection – Pre-Docking Inspection

The Oil Monitoring and Inspection Program

has proven to be a cost effective condition based maintenance system.

By monitoring the condition of the cargo pumping system, this will give an improved lifetime of the components in the system.

With the Oil Monitoring and Inspection Program (OMP), Framo offer assistance for cost control and optimal operation.

The Oil Monitoring and Inspection Program

includes Oil Monitoring,

Annual Inspections and Pre-Docking Inspections. The program will be managed by one of the Framo service stations and dedicated personnel will follow up each ship.

We will:

- Supply Framo sample bottle kit annually, with instruction for sampling and labels for shipping.
- Provide recommended sampling and attendance schedule.

- Perform trend analysis of the different tests and send the Framo Oil Monitoring Report to ship and customer.
- Perform scheduled inspection and highlight recommended action / spare parts, if any.
- Available information related to oil analysis, performed inspections and consumption statistics, might be discussed during meetings with our customer.



Framo test laboratory

Oil monitoring and inspection

**Oil Monitoring and Inspection Program (OMP) includes:**

Oil sampling – Oil analysis – Filter condition – Annual Inspection – Pre-Docking Inspection

The program comprise the following:

The program includes a total of 4-four oil samples annually, in which there are 3-three Level 1 analysis and 1-one Level 2 analysis. A separate sampling valve is a standard installation by Framo.

Please study our recommended oil sampling procedure, 1400-0063-4, carefully prior oil sampling.

Oil Monitoring - Level 1:

- Particle counting and water content test, quarterly. The oil sample will be analysed at a Framo test laboratory and observed results reported according to ISO 4406-1999
 - Number and size of particles. Recommended limit is ISO -/16/12
 - Water content will be reported according to Karl Fisher ASTM

E-1064. Recommended limit is below 300 PPM.

Microscopic analysis will be carried out if higher amount of particles are observed during automatic counting. Tailor made comments and recommendations will be given in each Framo Oil Monitoring Report.

Oil Monitoring - Level 2:

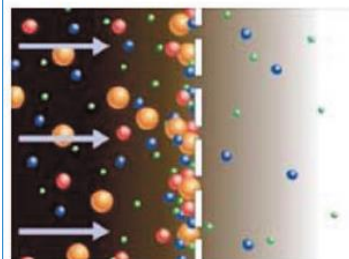
- 1-one full analysis will be done annually, and will in addition to particle counting and water content, comprise the following:
 - Viscosity test at 40°C
 - Total acid number, (TAN).
 - Phosphor, ppm. (P)
 - Zinc, ppm. (Zn)
 - Calcium, ppm. (Ca)

Filter condition:

As we all know, the cleanliness of the oil, as well as the general oil condition, is very important for the lifetime of the Framo Cargo Pumping System. In this respect, please keep in mind that:

- Our systems are equipped with full flow filters, securing that all circulated oil is filtrated.
- Particle counting, combined with pressure drop measurements over the filter is the only safe indicator on when to change the filter element(s).
- Framo is using a depth filter, which means that these are not cleanable at all.

Please make sure that you use only genuine Framo filters.

**Surface Filtration**

The Framo main filter is a so called depth filter. Glass fiber and metal are the materials used. Depth filters cannot be cleaned and are regarded as disposable elements.

**Depth Filtration**

Oil monitoring and inspection

**Oil Monitoring and Inspection Program (OMP) includes:**

Oil sampling – Oil analysis – Filter condition – Annual Inspection – Pre-Docking Inspection

Annual Inspection:

Framo will provide skilled engineers to attend your ship worldwide in order to perform a visual inspection on board your vessel, together with representatives from the vessels crew.

The inspection will comprise the following:

- Visual inspection of hydraulic power unit.
- If possible, perform a visual inspection of manual wear indicators.
- Check for air in the system and de-aerate if necessary.
- Inspect the system for leakages, abnormal noise etc.
- Visual inspection and evaluation of hydraulic deck piping and valves, including quick coupling stations for the portable pump.
- Visual inspection of cargo pumps top plates, including FCV / STC valves.
- Evaluation of purging routines of the cargo pumps cofferdam.
- Visual inspection of Framo portable pump with accessories.
- Visual inspection of standard pumps and other Framo delivered equipment.

- Control of Framo toolbox incl. special tools and the pressure testing kit / manometer set.
- Inspection and evaluation of spare part inventory as well as stock location.
- Evaluation of planned maintenance records.
- Following the survey, a detailed inspection report including recommended action / spare parts, will be sent to the customer.

Pre-Docking Inspection:

Framo will provide skilled engineers to attend your ship worldwide in order to evaluate the condition of the entire Framo cargo pumping system, prior to docking. The Pre-Docking Inspection is preferably carried out prior to a discharge operation, if possible. The Pre-Docking Inspection can also be replaced with an On-board Training session. For that, a short voyage is recommended.

The inspection will comprise the following:

- If possible, test all cargo pumps against closed cargo valve in order to evaluate condition of the pumps and control valves (depending port authority and type of cargo).



Genuine spare-parts

- Purge cofferdam on all cargo pumps (depending on type of cargo).
- If possible, test each hydraulic power pack.
- If possible, test the hydraulic control system, alarm and shutdown functions.
- Visual inspection and evaluation of hydraulic deck piping and valves, including coupling stations for the portable pump.
- Inspection and test of portable pump, if possible.
- If possible, test-run the ballast pumps and tank cleaning pumps.
- Inspection of spare part inventory and Framo toolbox incl. special tools and the pressure testing kit / manometer set.

Oil monitoring and inspection

**Oil Monitoring and Inspection Program (OMP) includes:**

Oil sampling – Oil analysis – Filter condition – Annual Inspection – Pre-Docking Inspection

- Following the survey, a detailed inspection report with repair recommendations, followed by our quotation for recommended spare parts, will be sent to the customer. This will help the ship's superintendent in preparing the docking activities on the Framo system and at the same time keep the maintenance cost down.
- In the year when Pre-Docking Inspection is carried out, it is not deemed necessary to also carry out an Annual Inspection.
- Pre-Docking Inspection can also be combined with On Board Training.

You will get:

- Secured optimal performance of your Framo cargo pumping system.
- Reduced maintenance costs.
- Increased lifetime of the hydraulic components.
- Better possibility to plan the maintenance and to have an indication of required spare parts.
- Documentation of the system condition.

In order to secure smooth cooperation from both parties, your vessel (s) will have to:

- Collect 3-three oil samples per year and send same to

a Framo service station for further analysis. Shipping costs will be at customer's account. Our target is to collect 1-one oil sample during the Annual / Pre-Docking Inspections.

- Contact us prior to attendance in ports where we are located, if your vessel is due for inspections. We will act accordingly, as long as we have available capacity. We are also able to attend vessels in other ports. More info below.

Port attendance:

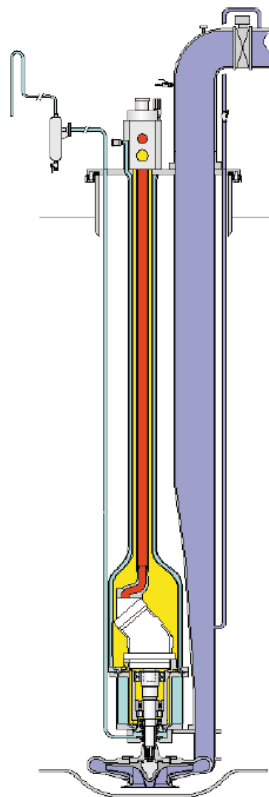
Please note that the costs of inspection included in the Oil Monitoring and Inspection Program are based on the inspection being carried out in ports where Framo have an office (Rotterdam, Houston, Singapore, Bergen, Shanghai, Busan, Tokyo, Rio de Janeiro - City Harbor and Dubai area).

For attendance outside Framo ports:

Tickets, hotel, subsistence allowance, travelling expenses and driving pre-paid by us will be charged at cost face value.

For traveling and waiting time we will charge the actual hours, limited to a maximum amount pr. calendar day.

For any further information regarding our services, please do not hesitate to contact any of the Framo service stations.





Oil Monitoring and Inspection Program (OMP) includes:

Oil sampling – Oil analysis – Filter condition – Annual Inspection – Pre-Docking Inspection

OUR FINDINGS – HIGHLIGHTS

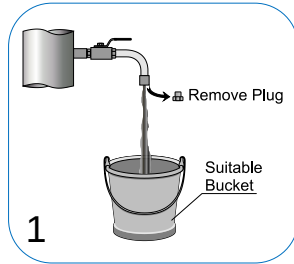
The intention with our comments is to highlight items of concern before these become critical.

Our target is to maintain a reliable condition, safe operation and extended lifetime of Your Framo Cargo Pumping System.

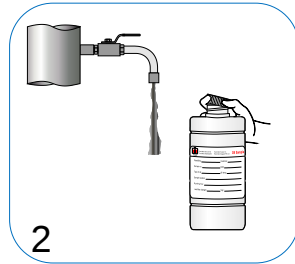
We will use our knowledge in order to recommend correct and safe operation, but also action / replacement whenever needed.

Oil Sampling and Forwarding Procedure

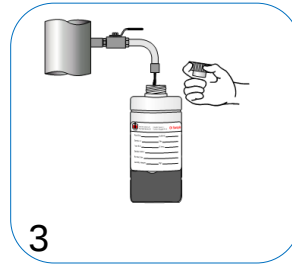
To get a quick and correct answer for your oil sample, it is important that the oil sample is taken shortly before it can be shipped. Operate the system for at least 30 minutes prior to taking the sample, preferably during discharge operation.



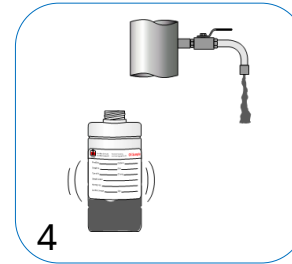
Remove plug.
Open the sample valve and
flush out a few litres.



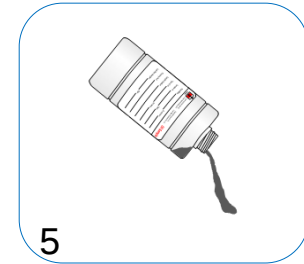
Open the sample container.
Don't touch the sample valve.



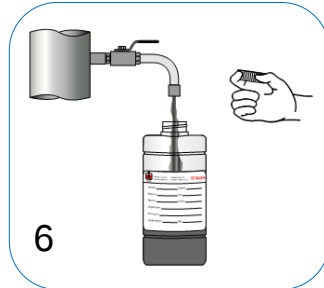
Fill up 1/3 of container



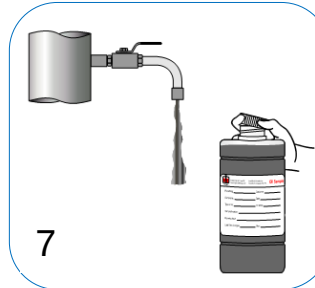
Rinse container



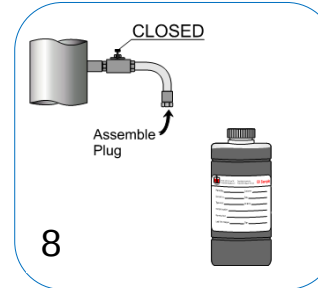
Discard fluid



Fill up the sampling container.
NB! Keep the cap in your hand
to avoid soil/dirt.



Cap the sampling container
immediately.



Close the sample valve.
NB! Assemble the plug.

Fill in the sample label and
place it on the sampling
container.

Send the oil sample in the
carton container to nearest
Framo office.

**To have a quick shipment,
use DHL or similar.**

Important information when collecting oil samples from a Framo hydraulic system, and forward this to a Framo station.

In order for us to maintain the correct history of your good vessel, we would like to highlight some important details that need to be added to the bottle label.



Framo Services AS
Framo Nederland BV

Framo Houston Inc
Framo Singapore Pte Ltd

Oil Sample

VESSEL NAME			
VESSEL IMO no. / Framo o.no.			
OIL TYPE			
SAMPLING DATE	(DD.MM.YYYY)		
SAMPLE POINT	Framo Sample Valve ☐	Return ☐	Suction ☐
TYPE OF TEST:	Part. Check (L1) ☐	Full Check (L2) ☐	
ACTIVITY:	OMP: ☐	Sep. P.O.: ☐	Commissioning: ☐
LAST FILTER CHANGE	(DD.MM.YYYY)		
SAMPLED BY	Vessel Staff ☐ Framo ☐ Sign.: _____		

Fill in the **IMO no.** – **Framo o.no.** can also be used in all correspondence with Framo

Please add the **correct oil type.**

Fill in the **sampling date** – DD.MM.YYYY

Inform on the **sampling point** – Framo sampling valve is recommended.

Type of test is normally scheduled on your vessels worksheet, given by Framo. We will have 3 x L1 and 1 x L2 annually.

Activity: If your vessel is enrolled in our program, use OMP. If not, use Sep. P.O. (Commissioning is for Framo personnel only)

A very important item: Please add the last date for main filter replacement. We trust that this information is available on board.

When above label is completed as requested, we ensure that we are able to serve you in the best possible way.

HYDRAULIC OIL TESTING

	Limit/ref.	Cause and effect	Action required if level is exceeded
Particles	Code 16/12 (max. level)	High particle level will cause excessive wear of hydraulic components and malfunction of hydraulic system.	Replace filter cartridges. Contact Framo Services for assistance.
Viscosity	Lower limits: VG 46: 38 cSt at 40°C 6 cSt at 100°C VG 32: 28 cSt at 40°C 5 cSt at 100°C	Reduced viscosity indicates: - High shear load / insufficient shear stability. - Mixing with another liquid. Increased viscosity indicates: - Excessive oxidation. - Mixing with another liquid.	Replenish with same oil type VG 100 oil (ISO VG 68 alternatively) Oil sample to be sent to oil supplier to check for other liquids. Action to be taken in cooperation with Framo Services and oil supplier.
Water	300 ppm	High water content will: - Increase wear - Increase corrosion - Damage the additive package/clog filters for some types of hydraulic oils.	- Check for leaking oil cooler and water content in storage tank. - Use oil purifier to reduce water content. Contact Framo Services for help.

Framo Oil Monitoring Report - Full Oil Analysis

Doc no. OMSE-16-M-56341

Customer

Installation

FM Salesorder no

System

Framo Cargo Pumping System

Particle counting reported according to ISO 4406 – 1999 edition.
 Water content tested according to ASTM E-1064.

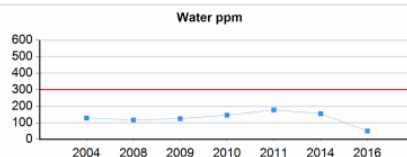
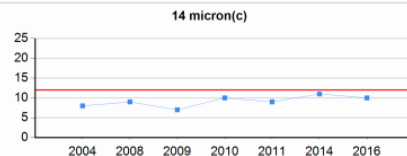
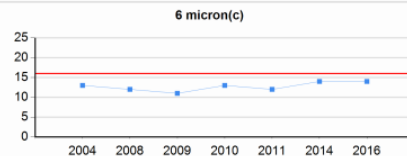
Normal	✓
Marginal	
Critical	

Sampling result

Last sample

Service Order no.	
Customer ref/P.O.No	Oil Monitoring Program
Sample Date	03. jan 2016
Parameters Level 1 and 2	
Iso class (16/12)	14/10
6 µm (c) (limit 640)	105
14 µm (c) (limit 40)	10
Water, ppm (limit 300)	50
Parameters Level 2 (annually)	
Viscosity at 40°C cSt	45,40
Total Acid No	0,51
Strong Acid No	
Phosphorous (P) ppm	398
Zinc (Zn) ppm	341
Calcium (Ca) ppm	76
Chlorides (Cl) ppm	
Sodium (Na) ppm	
Last filter change	
HPU system (if several)	N/A
Sample point	Framo sample point
Sample bottle type	Framo bottle
Oil type	Shell Tellus S2 V 46
Analysed by	FMSE
Sampled by	VESSEL

Historical overview



Comments to last sample:

The amount of particles in the analyzed oil sample is within recommended maximum level given by ISO 4406, code ~16/12. The water content is within the maximum limit of 300 ppm. The viscosity and the hydraulic additives are within normal values. No further action needed at this stage.

Framo Oil Monitoring Report

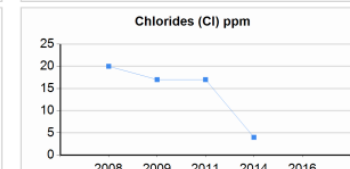
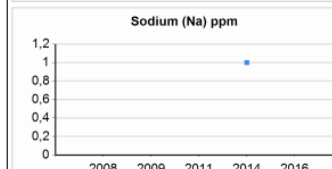
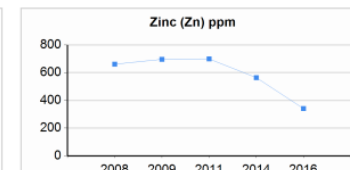
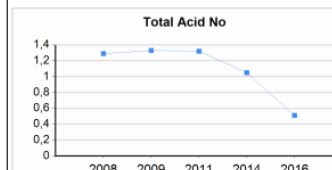
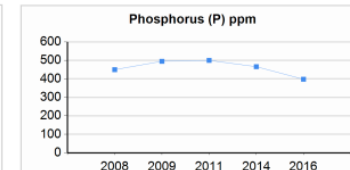
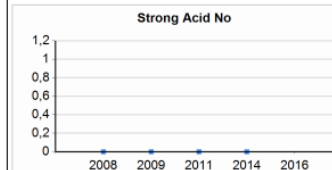
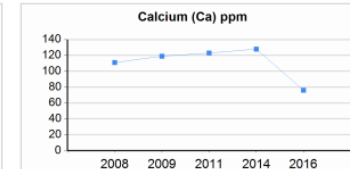
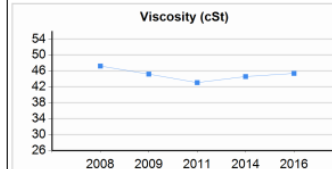
Customer

Installation

FM Salesorder no

System

Framo Cargo Pumping System



This certificate is automatically generated from Framo Oil Monitoring System.

Jonny Tonheim
 Framo Services AS
 Florvågevegen 39, NO-5305 FLORVÅG
 Norway

Jonny Tonheim
 Project Engineer
 Fax: +47 55 99 93 82
 Phone: +47 55 99 92 00
 Email: service@framo.no

Analytical Report Key

Automatic Particle Counting (APC)

Particle analysis is carried out by the **automatic particle counting method**. An APC device is able to count and measure particles in the fluid by means of laser light. This method which operates on the light blocking principle provides information on the distribution of the number and size of solid particles.

ISO 4406-2 classification shows the cumulative counts / ml sample, which means that all particles larger than a given size are counted.

Acceptance level of contamination by solid particles in a Framo hydraulic system is according to ISO 4406-1999 edition: -/16/12.

For Framo systems there is no limit for particles > 4µmØ.

Acceptance level for particles > 6µmØ - ISO Code 16, max 640 particles / ml.

Acceptance level for particles > 14µmØ - ISO Code 12, max 40 particles / ml.

The result consists of two numbers from 1 to more than 20.

Take for instance ISO -/16/12: 16 and 12 refer to an amount of particles larger than respectively 6 µmØ and 14 µmØ per 1 ml of hydraulic oil.

See ISO table.

Water Content by coulometric Karl Fisher Titration

Acceptance level for water content is 300 ppm.

Viscosity test at 40° C

A measure of the resistance of a fluid to flow. It describes the internal friction of a moving fluid, commonly referred to as the thickness of oil. Viscosity test at 40° C to be performed according to ASTM D 445 or ASTM D 7042.

Minimum acceptance level for viscosity are:

VG46 oil: Min 38 cSt

VG32 oil: Min 28,8 cSt

Total Acid No TAN

Total Acid number is a measure of acidic constituents that are present as additives or as degradation products formed during service such as oxidation products. Certain oils have an inherent acidity level related to their additive chemistry. Increasing acidity may be

indicative of the presence of organic acids derived from oil oxidation. The total acid number is a specific number for each hydraulic oil type and varying from 0,1 to 2,5. If the TAN value is rising, this indicates acid contamination or oxidation of the hydraulic oil.

Strong Acid No SAN.

The strong acid number tells us if there are any strong acid in the hydraulic oil. Normally the SAN value is 0. Strong Acid Number is only tested if Total Acid Number is too high or if there is reason to believe that the oil is contaminated by acid by for example visual observation, smell, color etc.

Element analysis.

A spectrometric analysis is used to quantify the hydraulic oil anti wear additives. Normally the additive elements are Phosphor, Zinc and Calcium. A decreased level of additives will cause increased wear in the system. All oil companies have its own composition of base oil, additives and chemical catalysts. Each type of hydraulic fluid is therefore unique. Mixing of different hydraulic oils can result in reduction of the hydraulic fluid properties.

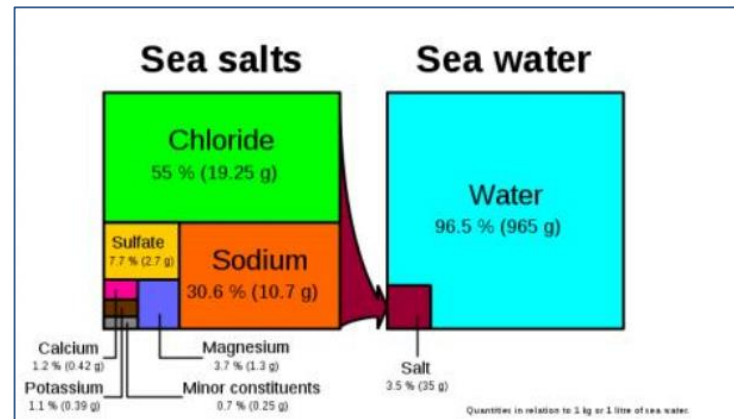
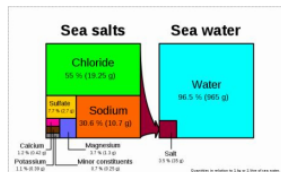
Chlorides in hydraulic oil/free water.

If the water content in the hydraulic oil is above the saturation point, the free water will be checked for chlorides. If the water content is below the saturation point, the level of chlorides can be calculated based on the result from the element analysis for sodium (see figure). Max limit for chlorides is 25 ppm. If Framo assume high level of chlorides based on calculations from sodium level, it will be highlighted in the report.

Maximum Contamination Limits

Based on cumulative counts / 1 ml sample

ISO Code	More than	Up to and including
0	0	0,01
1	0,01	0,02
2	0,02	0,04
3	0,04	0,08
4	0,08	0,16
5	0,16	0,32
6	0,32	0,64
7	0,64	1,3
8	1,3	2,5
9	2,5	5
10	5	10
11	10	20
12	20	40
13	40	80
14	80	160
16	320	640
17	640	1300
18	1300	2500
19	2500	5000
20	5000	10000
21	10000	20000
22	20000	40000
23	40000	80000
24	80000	160000
25	160000	320000
26	320000	640000



Air free hydraulic system gives:

- Increased life time of components
- Reduced damage of components
- Reduced maintenance
- Reduced pressure peaks / «hunting» in the system
- Air venting must be a part of your Periodical Maintenance Program

And is important after every service

Necessary time for air venting after service/repair must be included in total scope of work, even if time schedule is limited.

Service Bulletin #12

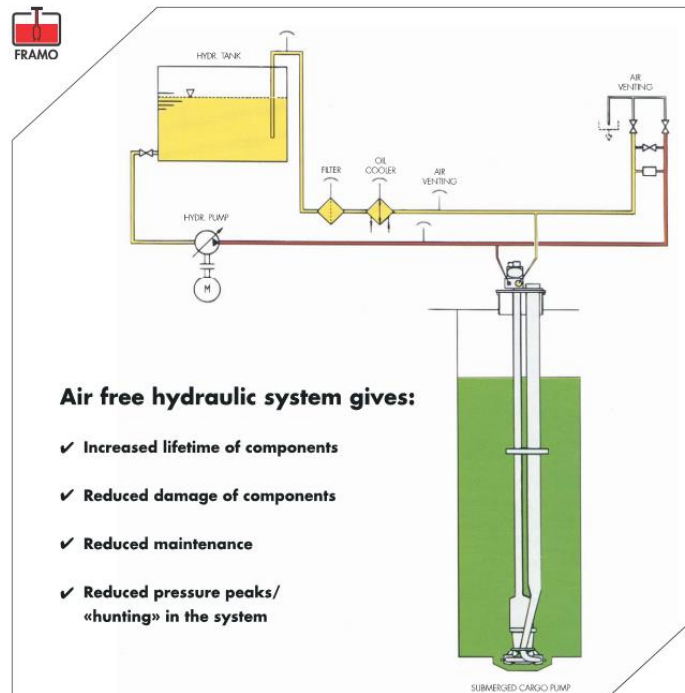
Frank Mohn Services AS

No. 12 - 1994

Service Bulletin

Keep you up to date with the latest news from Frank Mohn Services AS

Air Venting in Hydraulic System



Air free hydraulic system gives:

- ✓ Increased lifetime of components
- ✓ Reduced damage of components
- ✓ Reduced maintenance
- ✓ Reduced pressure peaks/
«hunting» in the system



Service Bulletin #12

GENERAL

In this Service Bulletin we would like to highlight the importance of keeping your Hydraulic System “**air free**”, to avoid failure and in the worst case break-down of components.

Air in a hydraulic system is a contamination and is critical to the performance and lifetime.

Design practice of the hydraulic system foresees neither air in the oil nor air as free pockets in the piping system.

During commissioning at the shipyard, after oil filling and flushing, air venting is an important part of the “start-up procedure”.

Air venting must be a part of your Periodical Maintenance Program, and is important after every service.

Any air in the system will accumulate to “high points” in the system where vent cocks shall be installed.

Necessary time for air venting after service/repair must be included in the total scope of work, even if time schedule is limited.

HOW TO PREVENT AIR ENTERING INTO THE SYSTEM

- Do not open a hydraulic system unless service/repair is required.
- After service/repair the air shall be vented as close to the actual component as possible to avoid any “locked-in” air pocket(s) to be mixed into the oil after start-up.
 - Air vent the component prior to opening service valves(s).
- Check that all connections, o-rings, gaskets, shaft seals and threads are tight.
 - Air can be sucked in from any opening to atmosphere.

Service Bulletin #12

Air venting on the variable pump

Vent. valve on filterbox

Air venting on
Flow Control (FCV)
valve for submerged
cargo pump

«High point» vent.
valves at the end
of hydraulic
main lines

Vent on the return line
after service on cargo pump.
Note: Include time for venting

Main Hydraulic Lines

Main Hydraulic Power Packs,
Tank, Cooler, Filter, etc.

BOW THRUSTER

Air venting on remote-control lines

SUBMERGED CARGO PUMP

Service Bulletin #12

HOW TO DETECT AIR IN THE SYSTEM

	Remark
• Cargo Pump will not start from remote.	Possible
• Level variations in the hydraulic oil tank at different system pressure.	Yes
• Backflow to hydraulic oil tank during stand still.	Yes
• Foaming in the hydraulic oil tank.	Yes
• Oil sample "milky"/white, or air bubbles mixed into the oil.	Yes
• Abnormal noise from hydraulic pumps or motors.	Possible
• Uncontrolled pressure variations (hunting) during operation.	Possible
• Pressure peaks/shock in the system during start/stop of consumers.	Possible

HOW TO AIR VENT THE SYSTEM

Use vent cocks installed in the piping system and on components.
- Take the necessary time for air venting.

- In a closed loop system with feed pumps or pilot pumps, air venting shall be done while these are running.
- Even if air venting after service of component has been carried out, repeat the air venting when the hydraulic oil temperature has reached 50 - 55 °C.



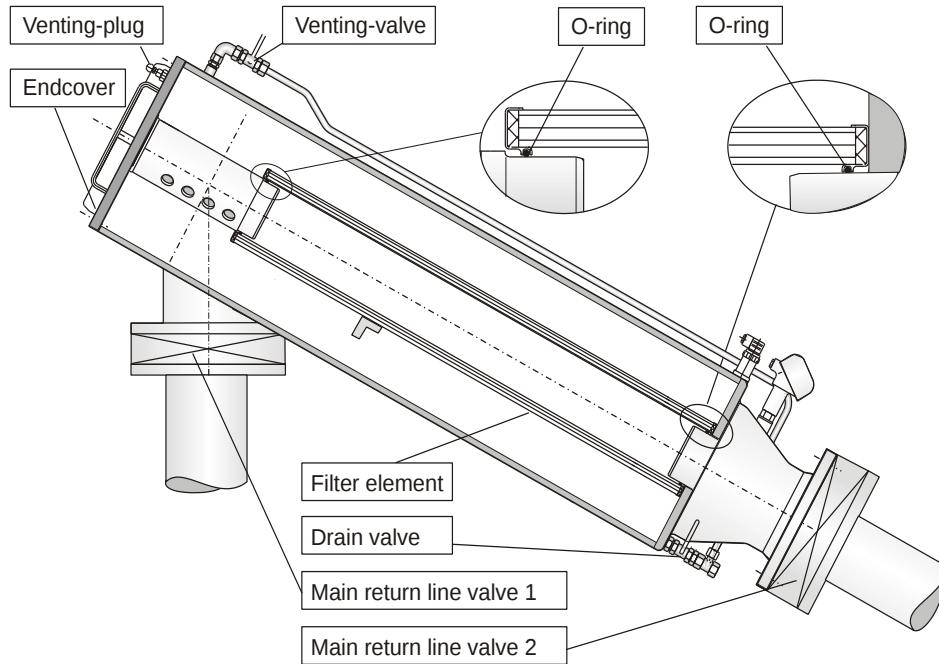
Oil filling is critical for mixing air into the system.

For a system delivered today we include a combined/compact Filling Unit with filter to ensure correct oil filling. This unit is permanently hooked-up to the vessel's storage tank.

From our program today we can offer a Filling Unit as above for easy installation on board an old model hydraulic system.

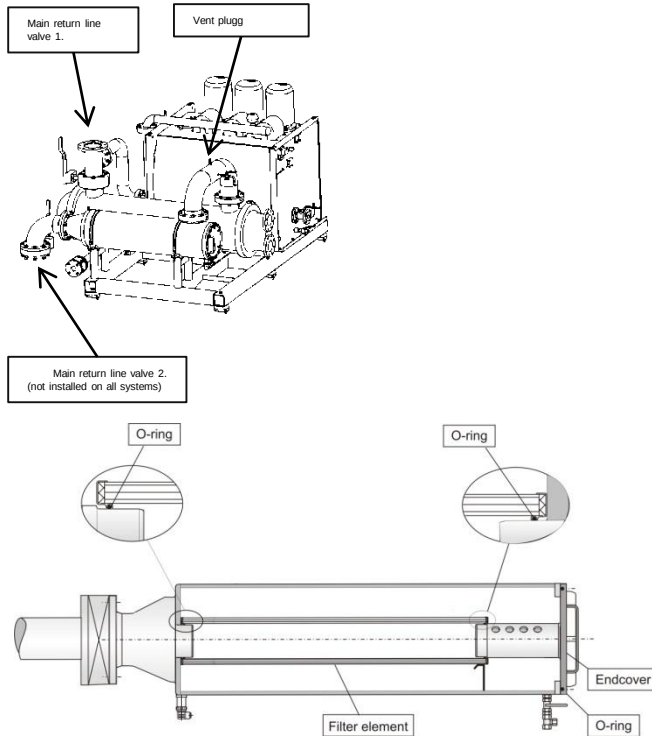


Tilted Mounting of Filter Box



1. Stop all power packs. Keep one feed pump running.
2. Close main return line valves 1 and 2.
3. Open drain valve and venting plug. The oil in the filter chamber drains to tank.
4. Dismantle end cover and remove the filter elements. Note: **Filter element is not cleanable.**
5. Install the new filter elements and end cover. (Ensure that O-rings are in place and not damaged).
6. Close the drain valve. Open main return line valves. Close vent plug and open venting valve.
7. When filter house and return pipes are completely filled with oil, close the vent valve.

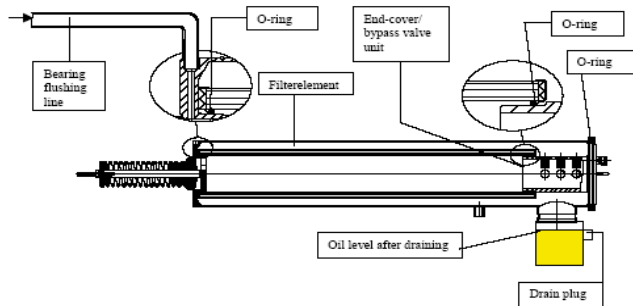
Replacement of Framo Filter Element



1. Stop all power packs. Keep one feed pump running.
2. Close main return line valve 1 (and 2 if installed.)
3. Open drain valve and venting plug. The oil in the filter chamber drains to tank.
4. Dismantle end cover and remove the filter elements. Note: **Filter element is not cleanable.**
5. Install the new filter elements and end cover.(Ensure that o-rings are in place and not damaged).
6. Close the drain valve. Open main return line valve(s).
7. When filter house and return pipes are completely filled with oil, close the vent plug.



Replacement of Framo Filter Element



6. Install the new filter elements and end cover/ bypass unit. Put the arm into the element during installation to fit the element into position. Note: Contaminated filter element is not cleanable.
7. Note: Check that bearing flushing valves are open
8. Start jockey pump
9. Run the jockey pump a few minutes (the filter house is self venting) before starting the power packs
10. Open the main return line valve and power unit can be started

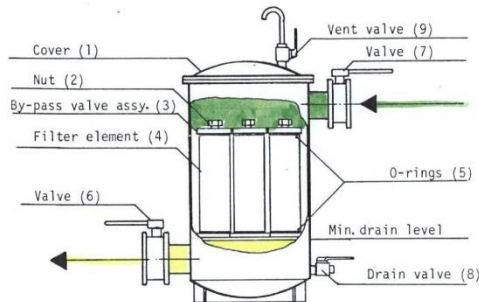
1. Purge cargo pumps cofferdams
2. Stop all power packs and the jockey pump
3. Close main return line valve
4. Open the drain plug and drain the oil in the filter chamber. Have the new element with O-rings ready for replacement. Filter can be installed in both directions
5. Dismantle end cover/bypass unit and remove the filter element

There will be leakage of approx. 0,3 l/min coming into the filter box. This oil is flowing through the bearing flushing lines for the hydraulic pumps and into the filter box. The leakage can be stopped by closing the bearing flushing service valves. (One 1/4" ball valve for each hydraulic pump located behind the pumps.)
It is not recommended to close these valves for normal filter replacement but prepare the job for quick filter change.

Replacement of Framo Filter Element

CHANGING OF FRAMO 12 MICRON ABS. FILTERS

DURING CHANGING OF FILTERS, CLEANLINESS IS THE MOST IMPORTANT FACTOR REGARDING THE EFFICIENCY AND RELIABILITY OF A HYDRAULIC SYSTEM.



A. For closed hydraulic systems, proceed as follows:

1. Depressurize system and stop power packs.
2. Close valves (6) and (7).
3. Open vent-valve (9) and drain valve (8) and drain to min drain level.
4. Close drain valve (8).
5. Remove top cover (1), nuts (2) and by-pass valve assembly (3).
6. Remove elements (4).
7. Discard the elements and their o-rings.

THE FILTER ELEMENTS ARE NOT CLEANABLE.

8. Wet o-rings (5) on replacement filter element with clean oil, and mount filter elements in filterhouse. Take care not to strike or scrape filter-elements against the flange of the filterhouse.
9. Fit by-pass valve assembly (3), nut (2) and cover (1).
10. Open valve (7) and vent valve (9).

NEVER OPEN VALVE (6) BEFORE FILTERHOUSE IS COMPLETELY FILLED AND VENTED I.E. NO AIR BLEEDS FROM VALVE (9).

11. Open valve (6).



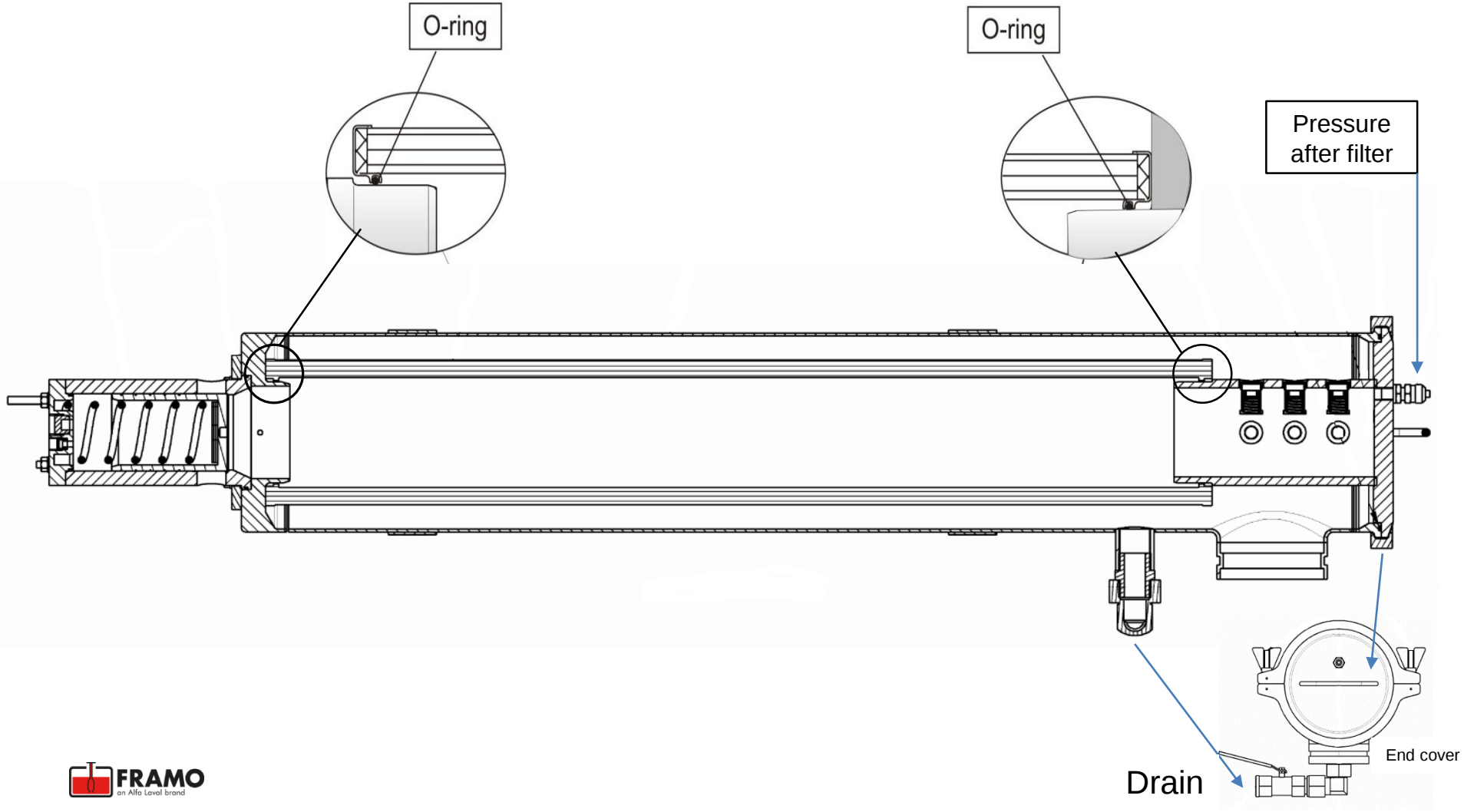
O-ring

O-ring

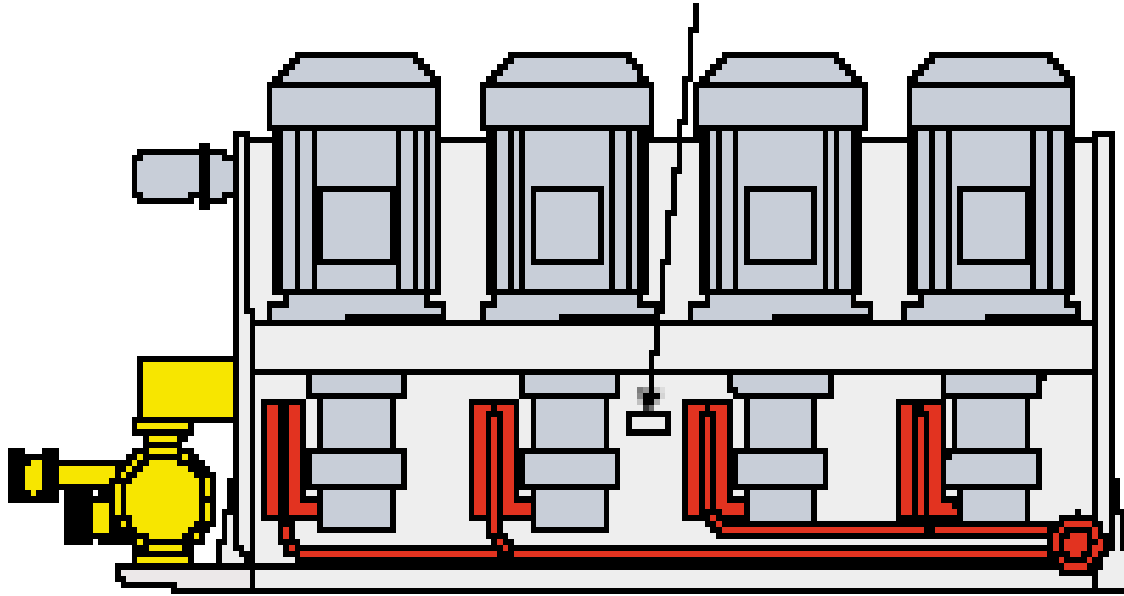
Pressure
after filter

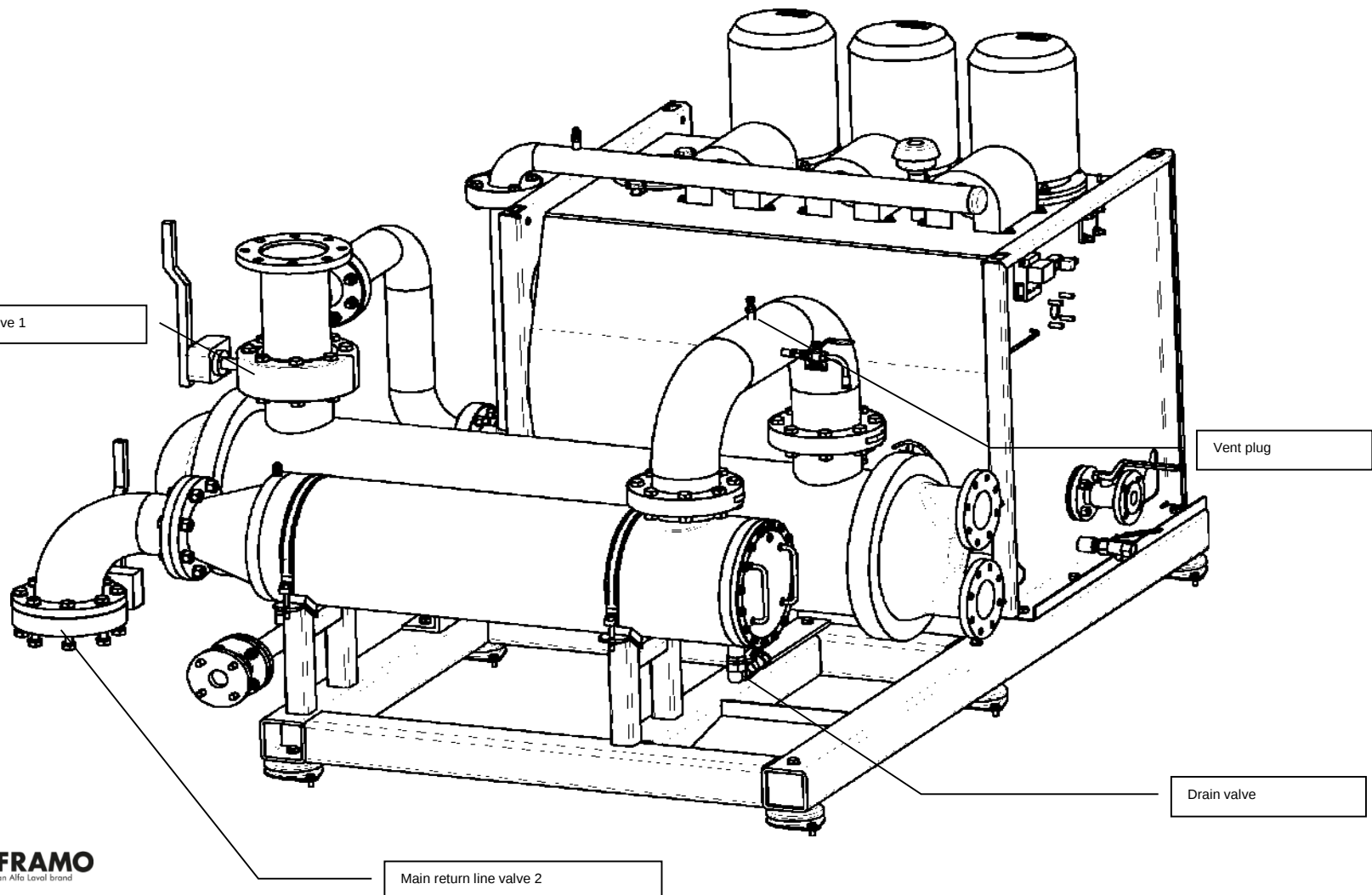
Drain

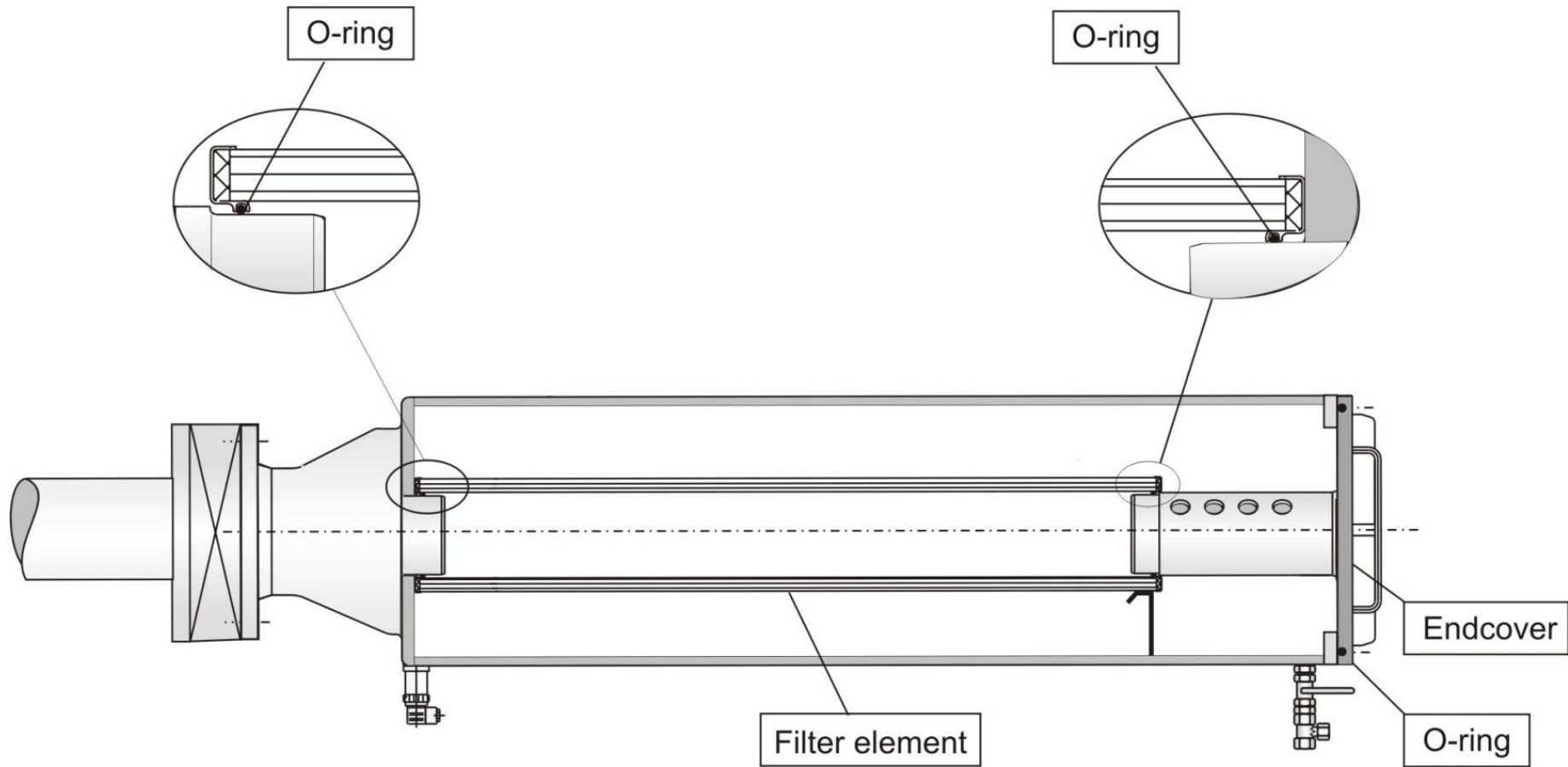
End cover



Bearing flushing valves









Framo Oil Monitoring Report - Full Oil Analysis

Doc no. OMNL-14-M-2148

Customer PRIME MARINE MGT. LTD.
 Installation MORAY
 FM Salesorder no 611587/1
 System Framo Cargo Pumping System

Normal	✓
Marginal	
Critical	

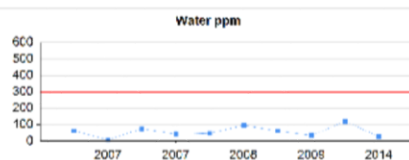
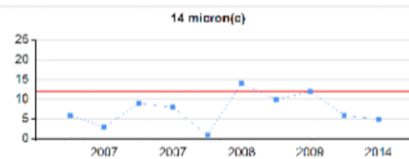
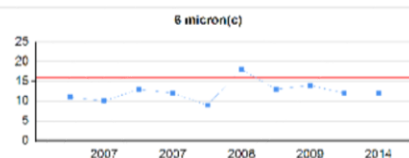
Particle counting reported according to ISO 4406 – 1999 edition.
 Water content tested according to ASTM E-1064.

Sampling result

Last sample

Service Order no.	9.775.291
Customer refP.O.No	Annual program
Sample Date	25. apr 2014
Parameters Level 1 and 2	
ISO class (15/12)	12/5
5 µm (c) (limit 640)	23,26
14 µm (c) (limit 40)	0,3
Water, ppm (limit 300)	29
Parameters Level 2 (annually)	
Viscosity at 40°C cSt	41,59
Total Acid No	0,18
Strong Acid No	
Phosphorous (P) ppm	275
Zinc (Zn) ppm	125
Calcium (Ca) ppm	10
Chlorides (Cl) ppm	
Sodium (Na) ppm	
Last filter change	15. aug 2006
HPU system (if several)	N/A
Sample point	Framo sample point
Sample bottle type	Framo bottle
Oil type	FAMM Rando HDZ 46
Analyzed by	FMNL-BV
Sampled by	VESSEL

Historical overview



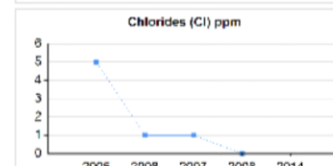
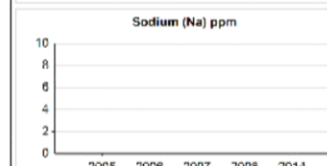
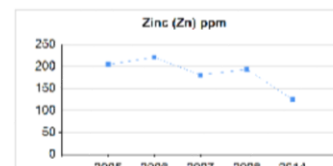
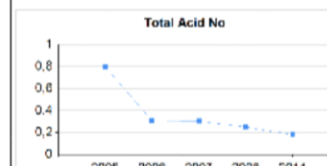
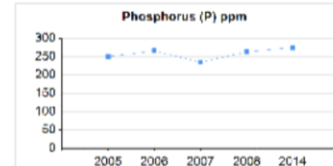
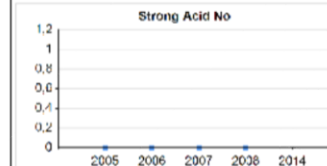
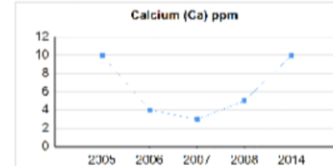
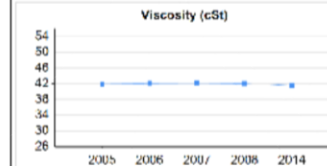
Comments to last sample:

The amount of particles in the sample is within the recommended level given by ISO Standard 4406, code 16/12 and the water content within the maximum limit of 300 ppm.
 The chemical analysis gives values that are within the used oil limits of the given oil type.
 No action is required at this stage.



Framo Oil Monitoring Report

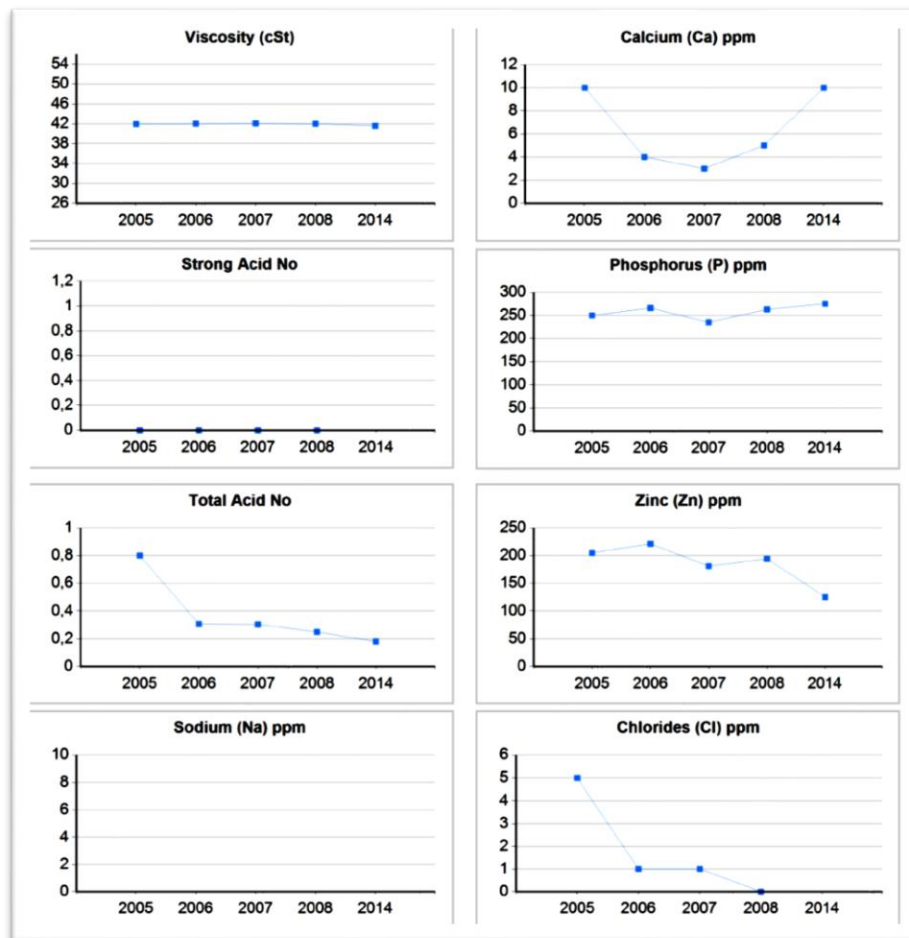
Customer PRIME MARINE MGT. LTD.
 Installation MORAY
 FM Salesorder no 611587/1
 System Framo Cargo Pumping System



This certificate is automatically generated from Framo Oil Monitoring System.

Frank Mohn Nederland BV
 Edisonweg 18 NL-3200 AH Spijkensse
 The Netherlands

Ostensen, Terje
 Project Engineer
 Fax: +31 (0)181 611193
 Phone: +31 (0)181 619311
 Email: nederland@framo.no



Viscosity Test at 40°C

A measure of the resistance of a fluid to flow. It describes the internal friction of a moving fluid, commonly referred to as the thickness of oil.

Viscosity test at 40°C to be performed according to ASTM D 445 or ASTM D 7042.

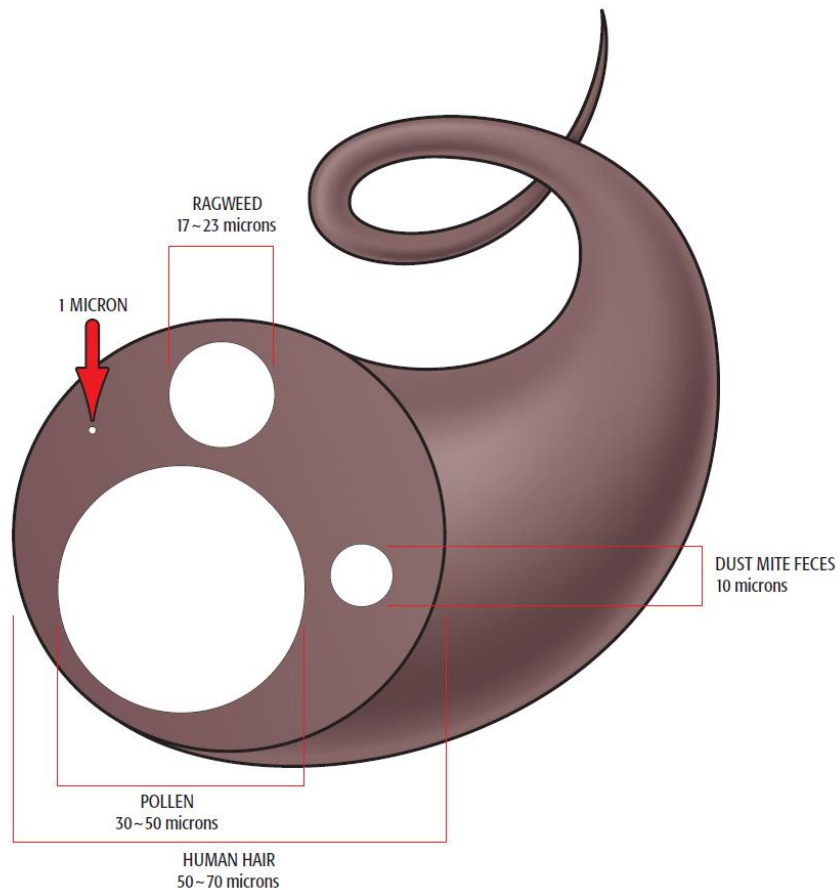
Minimum acceptance level for viscosity are:

VG46 oil: Min 38 cSt

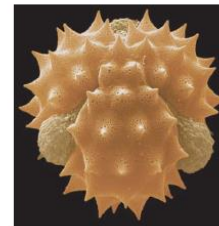
VG32 oil: Min 28,8 cSt

How Big is a Micron?

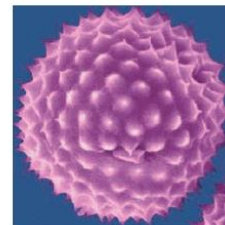
Human hair comparisons



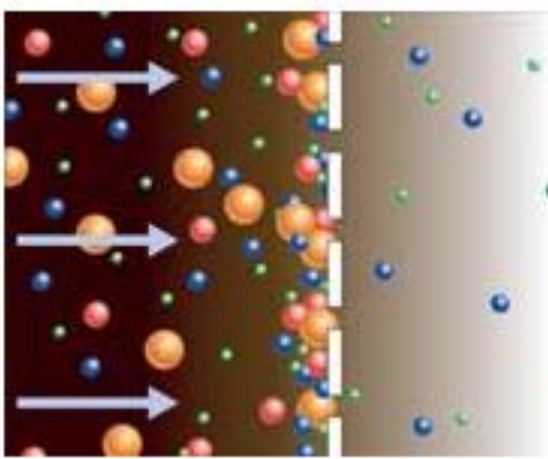
DUST MITE CARCASS
250 microns



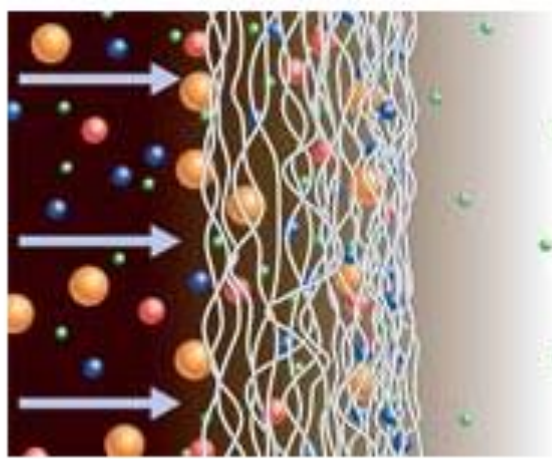
POLLEN
30~50 microns



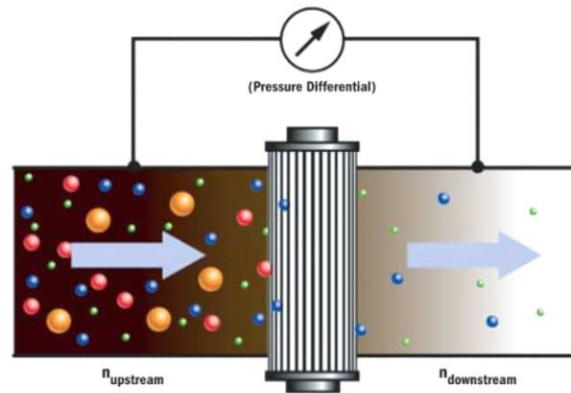
RAGWEED
17~23 microns



Surface Filtration



Depth Filtration



$$\beta_x = \frac{n_{Upstream} \geq X \mu m}{n_{downstream} \geq X \mu m}$$