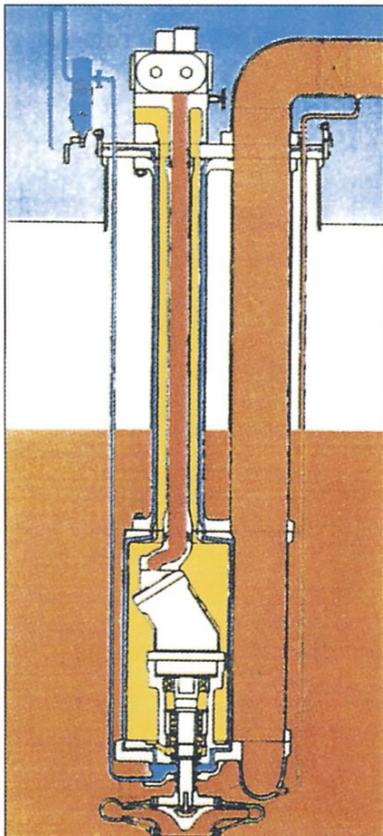


Operation of Framo Cargo Pumps



- ✓ **Filling through pump**
Note max. 8 bar cargo pressure
- ✓ **Before and after discharging**
Purge pump's cofferdam
- ✓ **Discharging**
Regulate cargo flow & pressure by pump speed, not by cargo valve
- ✓ **Circulation through deck heater**
Start pump before heat medium is on
Stop pump after heat medium is off
- ✓ **Stripping**
At lowest possible back pressure
- ✓ **Tank washing**
Adjust pump capacity to meet flow from washing machines



Operation of FRAMO Cargo Pumping System

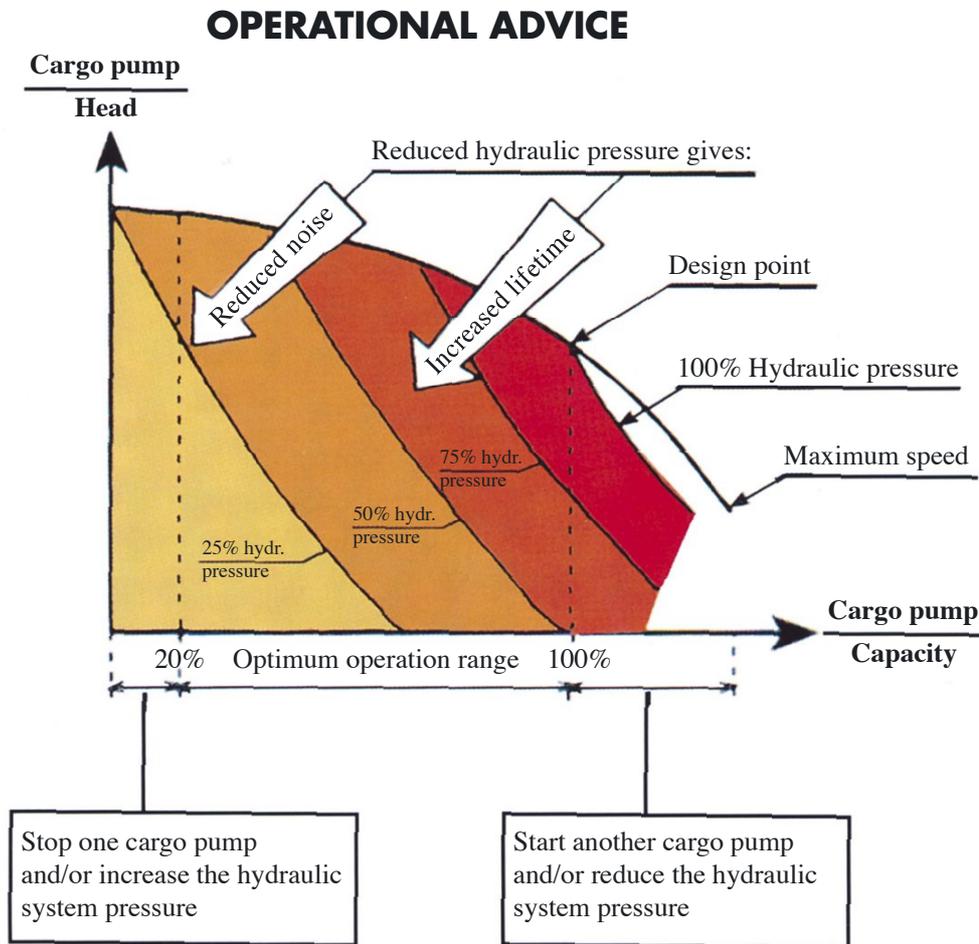
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Operational advice

Operation of the cargo pumps in its optimum operation range is imperative to get maximum lifetime out of the pumps and to operate at minimum noise.

As presented in the curve below, when the operation point moves downwards left, these goals are achieved.

The Framo Regulating System regulates the speed at its maximum setting and at lower range at constant hydraulic pressure. This gives you the possibility to get maximum discharge pressure and also high capacity - at low hydraulic pressure, by combining more or less cargo pumps running in parallel, as shown in the curve.



The different operations are described STEP by STEP in this procedure.



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Contents:

- 1.0 Loading the cargo tanks
- 2.0 Discharging of parcel cargoes
- 3.0 Discharging of homogeneous cargoes (parallel pumping)
- 4.0 Cargo heating by deck mounted heaters
- 5.0 Stripping
- 6.0 Tank cleaning

1.0 LOADING THE CARGO TANKS

Correct operation of pumps and valves is essential to avoid pressure surges in a cargo pipeline system during loading. Pressure surges may cause severe damage to the pipeline, hoses, metal arms and cargo pumps. Pressure surges will be excessive if a valve is closed too quickly and especially where long pipelines and high flow rates are involved.

Note: If a separate drop line is installed, we recommend to load through the drop line only.

If this is not possible due to valve arrangement, use following procedures to avoid pressure peaks in the cargo piping during loading.

1.1 Procedure for loading through the drop line and cargo pump

- 1.1.2 Keep manifold valve closed until the cargo reach the manifold.
- 1.1.3 Open the manifold valve partly to fill cargo line on deck.
- 1.1.4 ** Open the cargo pump discharge valve and drop line valve slowly, until you reach maximum capacity, or maximum 8 bar cargo pressure, measured at the top of the pump. For minimum opening time, see table on page 4.
- 1.1.5 Continue to load through the drop line and the cargo pump.

1.2 Procedure for loading through the cargo pump without drop line

- 1.2.1 Keep manifold valve partly closed until the cargo reach the manifold.
- 1.2.2 Open manifold valve partly, to fill cargo line on deck.
- 1.2.3 ** Open cargo pump discharge valve slowly. For minimum opening time, see table on page 4.
- 1.2.4 ** Open the manifold valve slowly until you reach maximum capacity, or maximum 8 bar cargo pressure, measured at the top of the pump. For minimum opening time, see table on page 4.
- 1.2.5 Continue to load through the cargo pump.



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Note 1: *Maximum acceptable loading pressure is 8 bar at the pump's top cover plate. During the initial stages of loading into each individual tank the flow rate in its branch line should not exceed a linear velocity of 1 metre/ second.*

Note 2: *For sampling procedures, ref. charterers' requirements.*

Note 3: *If the loading has been stopped and the cargo valves closed, it is important to restart the loading by following the same procedure as described above!*

Note 4: *For some ships like OBO's, it might be necessary to load through the pump only, until the cargo is above the drop line outlet. This because the drop line outlet is high above the tank top.*

****)** *Valves which control liquid flow should be opened slowly. The time taken for power operated valves to move from open to shut and from shut to open should be checked regularly at their normal operating temperatures.*

Minimum opening time for cargo valves:

Cargo pump type	Cargo pipe diameter (mm)	Minimum opening time (seconds)
SD50 – SD100	< 100	10
SD100 – SD125 – SD150	100 – 150	15
SD150 – SD200	151 – 200	20
SD200 – SD 250	201 – 250	25
SD300 – SD350	251 – 400	30
SD350	> 400	45

2.0 DISCHARGING OF PARCEL CARGOES

- 2.1 Start the hydraulic power plant and increase the hydraulic system pressure to approximately 150 bar. If the hydraulic oil temperature is below 20 °C, circulate the oil for heating at maximum 100 bar prior to raising the hydraulic system pressure to 150 bar.
- 2.2 Start the cargo pump slowly and let it run with hydraulic pressure 40-50 bar for approximately 1-2 minutes with closed cargo pump valve.
- 2.3 Raise the pump's discharge pressure above manifold pressure to avoid "back flow" (overpumping). Then open the cargo pump discharge valve.
- 2.4 Increase the hydraulic motor pressure until required discharge pressure or capacity is achieved. If required, increase the hydraulic system pressure.
- 2.5 Follow the same procedure for the next parcel. Ensure that enough hydraulic power is available. If not, the hydraulic pressure will drop, and the capacity/ head will be reduced.
- 2.6 The hydraulic system pressure should be maximum 15 bar above the highest consumer pressure in order to minimize energy consumption, noise level and wear and tear.

Note: *Remember to purge the cofferdam before and after using the cargo pump!*



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3.0 DISCHARGING OF HOMOGENOUS CARGOES (parallel pumping)

- 3.1 Start the hydraulic power plant and increase the hydraulic system pressure to approximately 150 bar. If the hydraulic oil temperature is below 20 °C, circulate the oil for heating at maximum 100 bar prior to raising the hydraulic system pressure to 150 bar.
- 3.2 Connect as many shore lines of ample size as possible. A low back pressure on shore side will have a positive influence on capacity and power consumption. The pipe losses (discharge pressures) are increasing when the capacities are increasing.
- 3.3 Start the cargo pump slowly and let it run with hydraulic pressure 40-50 bar for approximately 1-2 minutes with closed cargo pump discharge valve.
- 3.4 Raise the pump's discharge pressure above manifold pressure to avoid "back flow" (overpumping). Then open the cargo pump discharge valve. If vibration occurs, it may help to open the stripping valve for approximately 5 minutes.
- 3.5 Follow the same procedure for the next pump(s). Ensure that enough hydraulic power is available. If not, the hydraulic pressure will drop and the capacity/ head will be reduced.
- 3.6 Increase the hydraulic motor pressure (pump speed) until required discharge pressure or capacity is achieved. If required, increase the hydraulic system pressure.
- 3.7 The hydraulic system pressure should be maximum 15 bar above the highest consumer pressure (cargo pumps) in order to minimize energy consumption, noise level and wear and tear.
- 3.8 Pump capacity should be controlled by the pump hydraulic pressure, not by throttling the cargo discharge valve or any other valve in cargo piping system. This can be achieved easily by keeping all cargo pump controllers in maximum position and regulate the main hydraulic system pressure until required discharge rate is achieved. If necessary, each cargo pump must be balanced individually by decreasing/ increasing cargo pump hydraulic pressure.
- 3.9 Generally, we recommend to run as many pumps in parallel as practical, at a reduced hydraulic pressure, rather than just a few pumps at maximum hydraulic pressure. See fig. 1.
- 3.10 At the end of the discharge, the cargo pump may run dry or suck air through vortex, which will be indicated by vibration in pump and hunting in the hydraulic pressure. This can easily be avoided by reducing the cargo pump hydraulic pressure through this sequence.



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4.0 CARGO HEATING BY DECK MOUNTED HEATERS

- 4.1 Open inlet/ outlet valves for deck cargo heaters. If separate heating power packs are installed, put all cargo pump controllers for heated tanks in maximum position. Push button for cargo heating mode, and start the required number of heating power packs. If the “main” power packs are to be used, make sure that system pressure is set to correct value, 50-60 bar, refer data in the Framo Instruction Manual.
- 4.2 Make sure that cargo is circulating through the heater before opening steam inlet valve.
- 4.3 Minimize heating during voyage - save energy.
Heat loss is basically proportional to the temperature difference between cargo and ambient air/ sea. Permit drop in temperature at beginning of the voyage either by no heating or use exhaust gas boiler only, and then raise temperature in due time prior to arrival at port/ discharging. When cargo is not heated, the drop in temperature will typically be 1-2 °C per day (24 h) only. Most heating systems are designed to raise temperature by 5-6 °C per day. (Refer data in the Framo Instruction Manual).

Note: Never heat without necessary cargo flow through heater, this to overheating/ carbonizing.

For maximum allowable cargo temperature, see cargo data sheet.

Start cargo pump before valve for heating medium is opened.

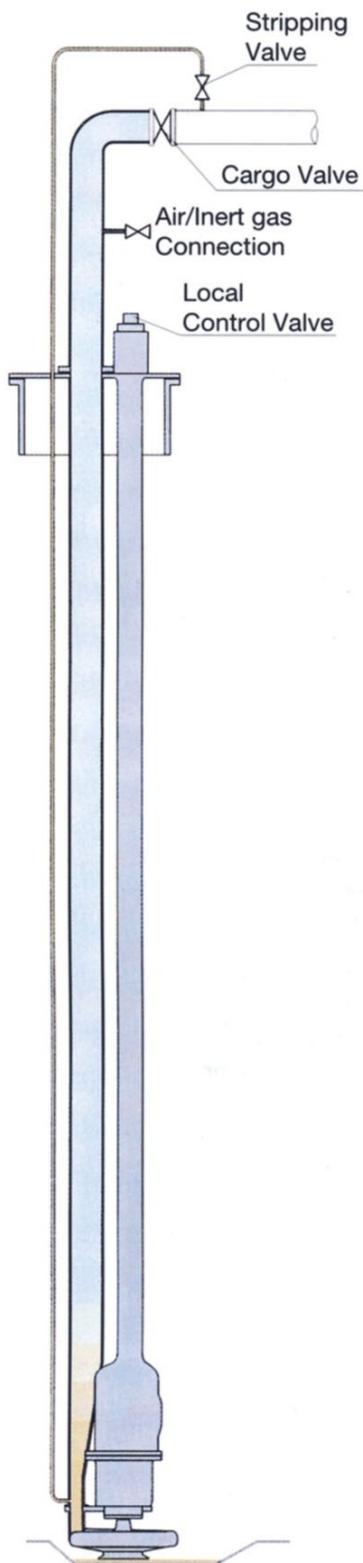
Shut off overheating medium before pump is stopped.

- 4.4 Do not heat and discharge simultaneously.
The cargo temperature will drop by 1-2 °C per day only, without heating, so the temperature drop during unloading time of a tank is neglectible. Therefore, stop heating and close valves on “heating line” during discharge, otherwise most of the cargo will pass through heater and into tank again.
- 4.5 Cleaning of heaters.
The heaters are fitted with connections for steam cleaning. Washing water used for tank cleaning can also be pumped through heater, however, do *not* use sea water for cleaning of Framo / BENDEK heater because stainless steel material is very sensitive to chloride corrosion at temperatures above 60 °C.
Drain heater properly afterwards.



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5.0 STRIPPING

- 5.1 Reduce the cargo pump hydraulic pressure to approximately 100* bar, at the end of discharging, or when the pump starts to lose suction, indicated by vibrations and hydraulic pressure pulsations.
- 5.2 Empty the cargo tank at reduced hydraulic pressure (100 bar). Throttling of cargo valve may improve the stripping result.
- 5.3 When the cargo tank is empty, close the cargo valve and stop the pump.
- 5.4 The best stripping result is obtained with lowest possible manifold back pressure.
Purge cargo deck line, close manifold valve and relieve deck line pressure to minimize back pressure during stripping of cargo pump.
- 5.5 Start the pump locally and increase pressure to approximately 80 - 100 bar.
- 5.6 Connect the air/ inert-gas supply to the cargo pipe and adjust air/ inert gas pressure to 1 bar + static height, normally 2-4 bar.
- 5.7 Purge until the pipestack is empty. Recognized by frequent speed variations of pump. The stripping time can be reduced by closing purging during high speed periods.
- 5.8 Close stripping valve.
- 5.9 Repeat the stripping sequence if necessary.
- 5.10 Stop purging, and stop the cargo pump.
- 5.11 Purge the pump's cofferdam.

Note: * Pump speed (hydraulic pressure) depends on discharge head, specific gravity and viscosity of the cargo and differs from ship to ship. Ideal speed must therefore be based upon experience on board.



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6.0 TANK CLEANING

- 6.1 To keep a dry tank top and still avoid dry running during tank washing, the tank cleaning machines capacity (flow into tank) and the cargo pump's capacity (flow out of tank) must be equal. Reduce the cargo pump hydraulic pressure until the capacities are balanced.
- 6.2 Before tank cleaning is finished, close pump's cargo discharge valve and open stripping valve to allow an increase in water level. Run the pump at approximately 110 bar against closed cargo pump discharge valve for 1-2 minutes to clean the cargo pump.
- 6.3 Remember to flush the pump and tank with fresh water if sea water has been used for tank cleaning.



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