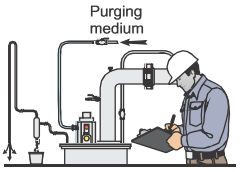
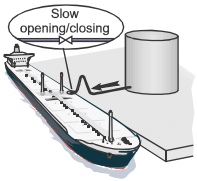
Important rules for cargo operation

Purging
Purge the pump's cofferdam according to the operation manual for cargo pumps. Record the purging results in the Framo purging form.

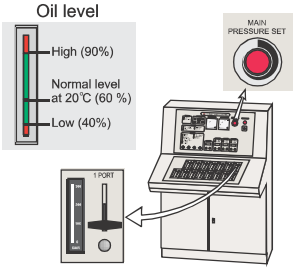


Loading
Start loading slowly to avoid pressure peaks in the cargo line.

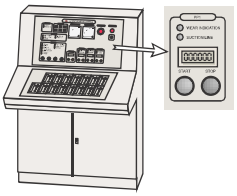
Max. loading pressure
8 bar at the pump.



Check before start
- Hydraulic oil level on digital indicator(%), hydraulic system tank.
- Cooling water pump and ventilation fan running.
- Main pressure set and pump controls in minimum position.



System operation
Start and run the number of power packs required for the consumers in operation. See technical data for oil delivery and consumption.

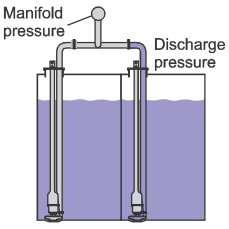


If the outdoor temperature is below 20°C, open the heating and venting valve for heating with only one power pack running at reduced hydraulic system pressure,ref. Service Manual.

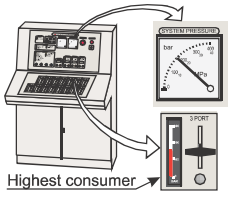
When consumers are stopped, reduce number of power packs in operation accordingly.

Always leave one feed pump/the jockey pump running to keep the hydraulic system pressurized and free from air.

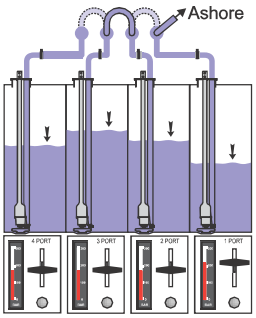
Pump start
Always start the cargo pump with the discharge valve closed. Increase the cargo discharge pressure above manifold pressure before opening the discharge valve to avoid backflow/overpumping.



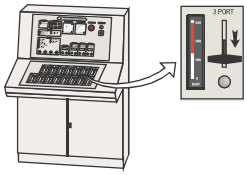
Adjusting system pressure
Set the system pressure to approximately 20 bar above the highest consumer (hydraulic motor).



Pumping in parallel
It is recommended to run as many pumps in parallel as practical at a reduced hydraulic pressure, rather than a few pumps at maximum hydraulic pressure.

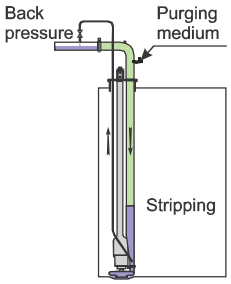


End of discharging
Reduce pumping capacity at the end of discharge.
(to avoid hunting)



Stripping
Run the pump at approximately 60 - 120 bar. Strip against the lowest possible back pressure.

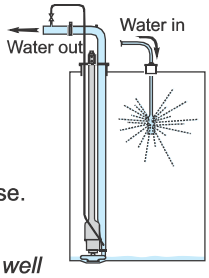
Empty deck line improves the stripping result.



Tank cleaning
Keep sufficient water level to avoid loss of suction (hunting).

Tank cleaning with seawater must be followed by a thoroughly rinse with fresh water to remove chlorides.
If hot seawater is used, cool immediately with cold seawater before fresh water rinse.

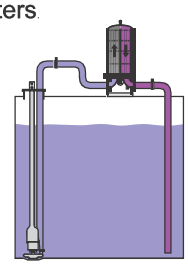
Note!
Remains of cleaning water in the suction well must be removed to avoid galvanic corrosion.



Cargo heating
For ships with deck mounted cargo heaters.

Always make sure of sufficient cargo circulation by operation of the cargo pump(s) before opening heating medium to the cargo heater(s).

It is recommended to run the pumps by system pressure control with pump controls in max. position.

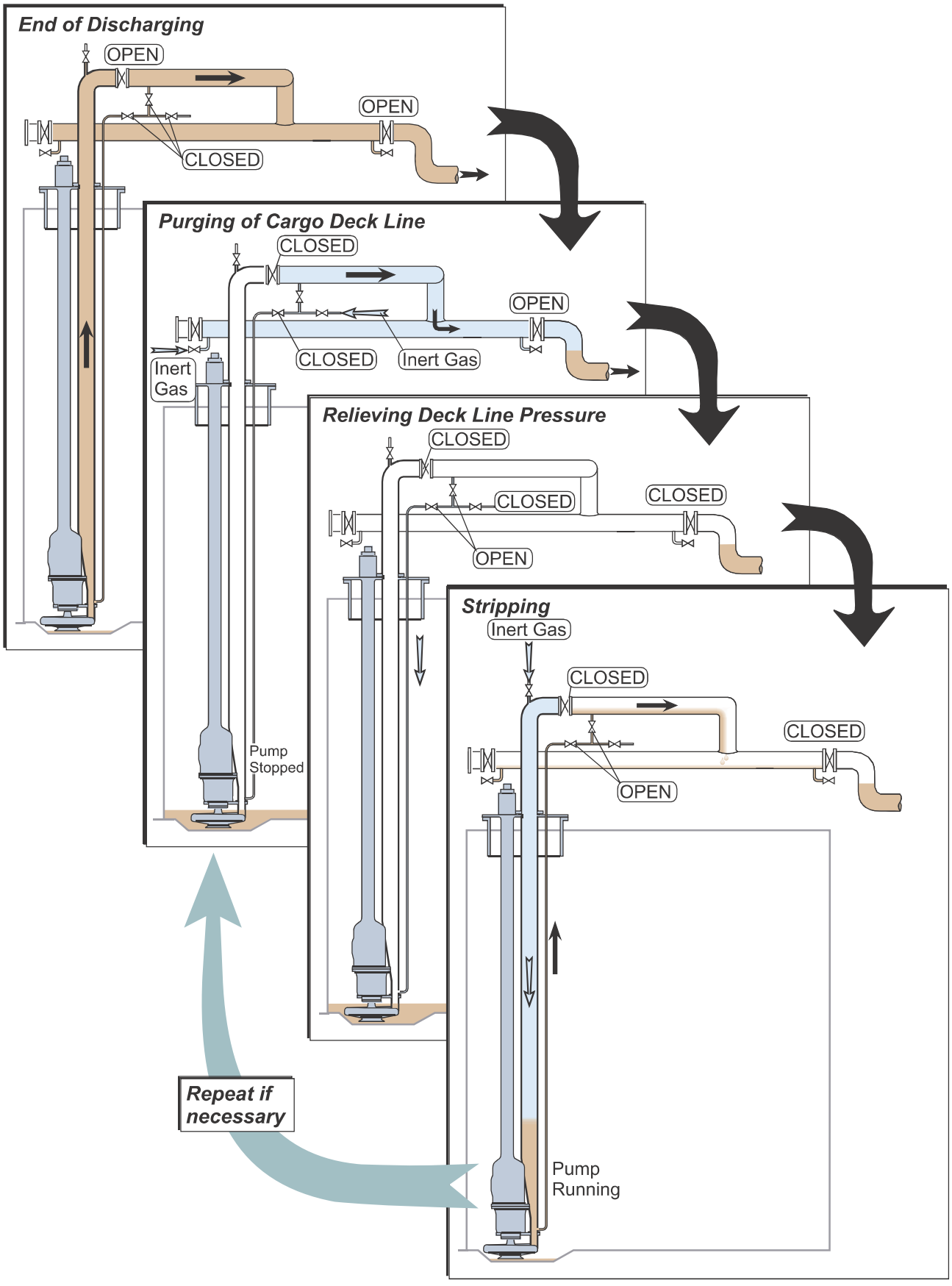


For more specific details, see Framo Service Manual

FRAMO

STRIPPING PROCEDURE

No.1000-0122-4
Date/Sign: 20Feb97/AGAa



FRAMO Frank Mohn Services AS

Pumping Theory

Pump Curves

Positive Pumps

Centrifugal Pumps

Parallel Pumping with Centrifugal Pumps

Centrifugal Pumps in Serie

How to use the Performance Diagrams

Actual Performance Diagrams

6. PERFORMANCE CURVES

A capacity diagram shows the relationship between capacity, head, speed, hydr. pressure, efficiency etc. for a certain type of pump. Normally our diagrams show head, speed and hydr. pressure operating at the hydr. motor in the pumps as a function of the water capacity. (Refer diagrams 258-47-4) and 277-1-4 at the end of chapter 6).

6.1. THE DIFFERENCE BETWEEN A POSITIVE PUMP, AND A CENTRIFUGAL PUMP.

The difference between a positive pump (screw pump, piston pump) and a centrifugal pump is shown in diagram 6.1. A and 6.1.B.
As shown in fig. 6.1.A. the capacity of a positive pump is almost constant and independent of the head. The decrease in capacity is very small when the back pressure rises, and this is due to small internal leakages in the pump itself.
When looking at fig. 6.1.B. it is seen that the capacity of a centrifugal pump varies very much with the head. If the head is very low (when pumping justover the rail for example) the capacity is large. But if the head is very high, the capacity reaches zero.

6.2. THE USE OF THE CAPACITY DIAGRAM AND THE CORRECTION CHART FOR LIQUIDS WITH HIGH VISCOCITY (drg. 101—101—2).

A capacity diagram shows pumping capacity against discharge head and the corresponding hydr. pressure. The diagram is based on water pumping (sp. g. 1.0). When liquids with other sp. g. and/or viscosities shall be pumped, the data on the diagram must be correct according to the correction charg. drg. no. 101—101—2. To illustrate the use of the capacity diagram see the diagram in fig. 6.2. which is an example chosen at random.

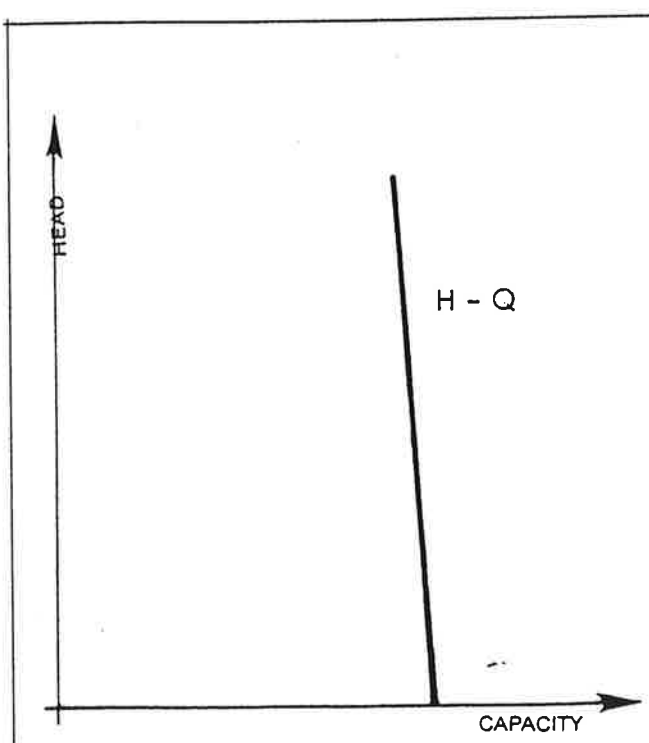


FIG. 6.1.A.
POSITIVE PUMP

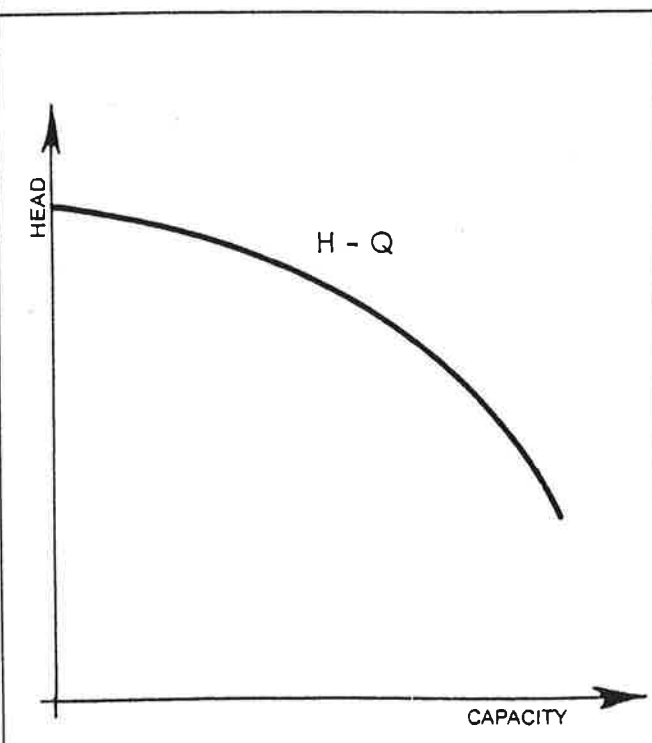


FIG. 6.1.B.
CENTRIFUGAL PUMP

6.3. RUNNING OF CENTRIFUGAL PUMPS IN PARALLEL.

If running two identical centrifugal pumps in parallel (i.e. on common cargo line) one should believe that the capacity would be twice as much as for one pump. and if running three pumps the capacity would be three times greater than for one pump and so on, as indicated in diagram 6.3.A.

But this is not really true. The reason is that pressure losses in the cargo line, which is a function of the capacity, is added to the static head (i.e. the height between the ship and the cargo tanks ashore) as shown in diagr. 6.3.B.

Diagr. 6.3.B. will do if the pumps are running at the same speed and if the oillevel in the cargo tanks are almost the same. But if one pump is working under worse conditions than the other ones you will have a situation as indicated in diagram 6.3.C.

As you will see the increase in the total capacity is less for each pump you connect to the common line than shown in fig. 6.3.A.
If you connect many pumps to the line, the profit for the last ones will be almost zero.

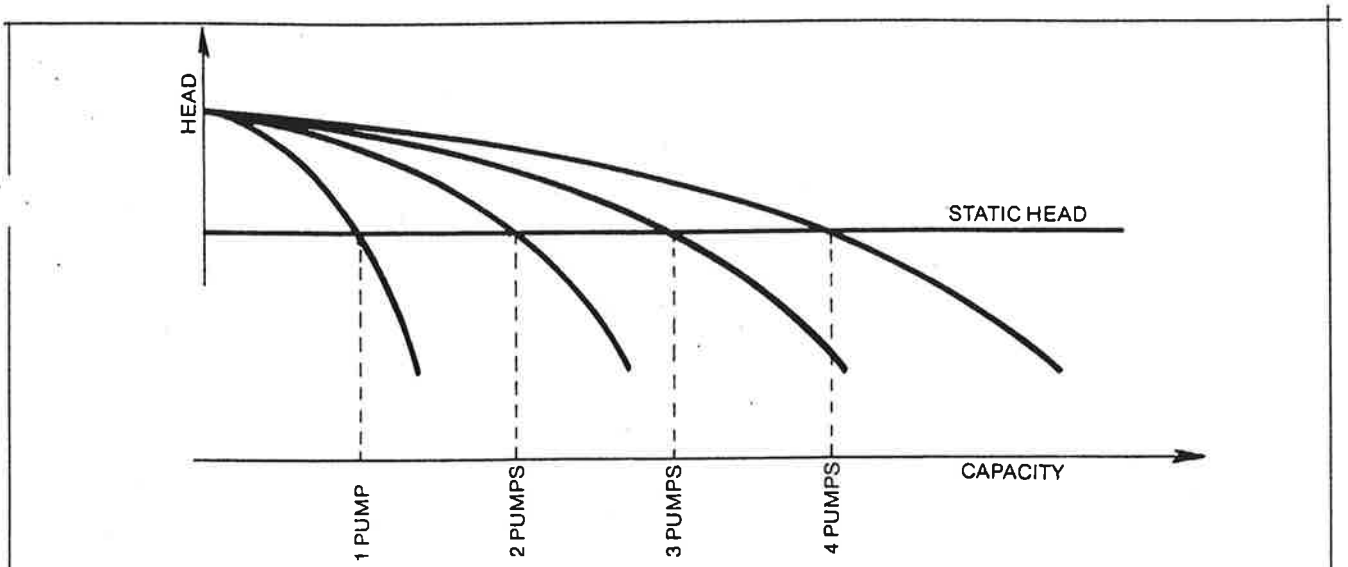


FIG. 6.3.A.

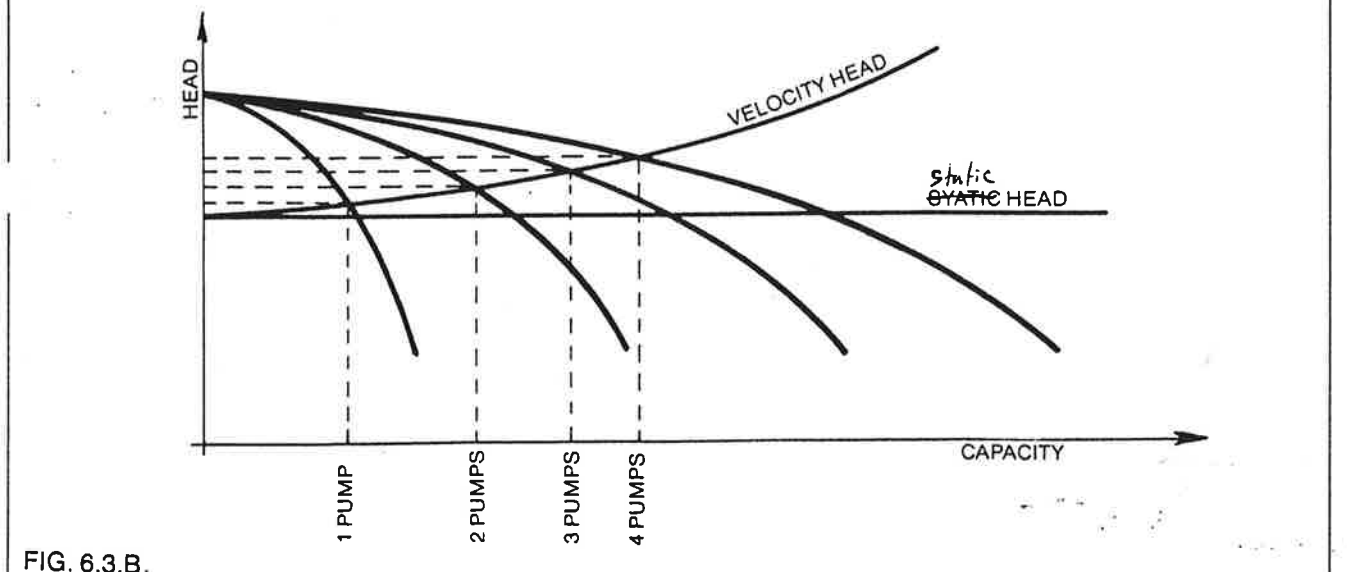


FIG. 6.3.B.

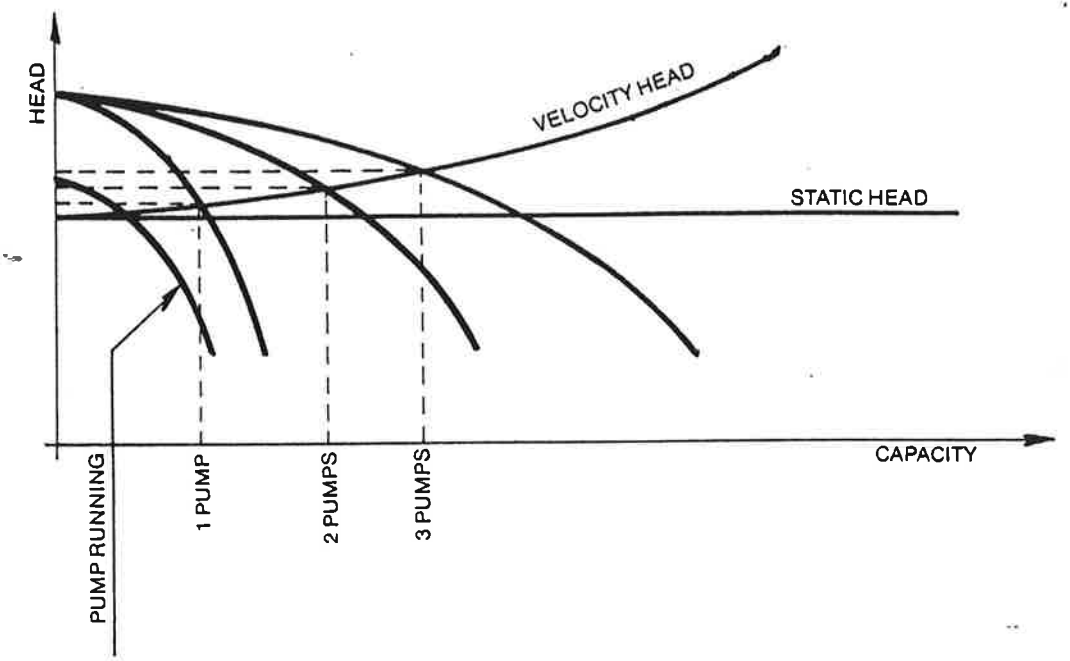


FIG. 6.3.C.

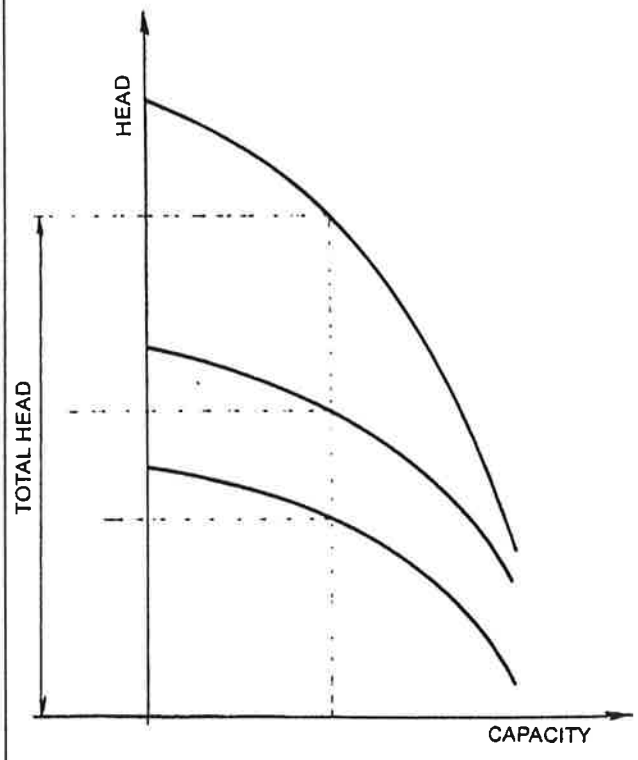


FIG. 6.4.

As you will see, the pump that are running at redused speed (the 4. pump) is not able to pump any cargo into the cargo line at all. The max. head (at zero capacity) for this pump is less than back pressure in the cargo line, and the three other pumps will pump some cargo into the cargo tank where the 4.th pump is situated.
FIG. 6.3.C.

6.4. RUNNING OF CENTRIFUGAL PUMP IN SERIES.

When you are connecting two centrifugal pumps in series, i.e. the outlet connection of one pump is connected to the inlet of another pump, you can simply add the heads in the capacity diagram of the pumps as shown in diagr. 6.4.

The two (ore more) pumps do not have to be identical when you are connecting centrifugal pumps in series.

A standard performance diagram is based on pump test with fresh water (sp.g. 1.0 and viscosity 1.0 cSt).

Head is measured on pump head (static head and friction loss in pipe stack not included).

For cargoes with same viscosity but different specific gravity, only the hydraulic pressure to be corrected:

$p_{corrected} = p_{freshwater}$ x sp.gr.

The differential pressure in diagram is the pressure drop across the hydraulic motor.

$p = p_{inlet} - p_{return}$

p_{inlet} and p_{return} depends on conditions, but in general:

p_{inlet} = hydr. system pressure
– 12 bar (loss in valves and pipes)

P_{return} = hydr. system return pressure
+ 3 bar (loss in valves and pipes)

(Pressure losses in valves and pipes can vary from system to system.)

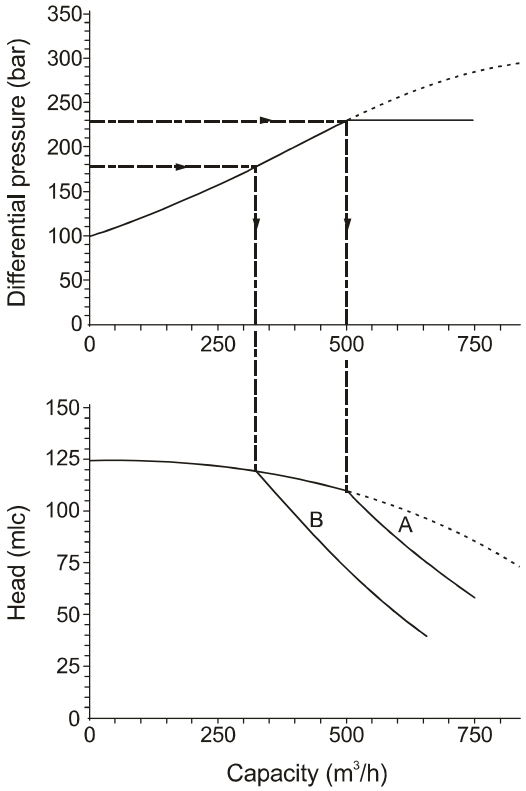


Fig. 1

Example:
Cargo with sp.gr. 1.3, viscosity 1.0 cSt.

Hydr. system pressure = 250 bar.
Hydr. return pressure = 6 bar.

For hydr.motor:
p = (250-12) – (6+3) = 229 bar.

Static head Hst (cargo surface to manometer) Hst = 10 m

What is max. capacity and head without speed drop?

229 bar / 1.3 = 177 bar on curve based on water.

From diagram, max. capacity and head without speed drop will be approx. 325 m3/h and 120 mlc (B).

Manometer reading at sp.g. 1.3 will be :
(120 – Hst) x 1300 kg/m³ x 9.81 m/s² = 1.4 MPa (14 bar)

If cargo back pressure is reduced, capacity and head will follow curve (B) on fig.1, approx. parallel to the drop curve (A) for fresh water.

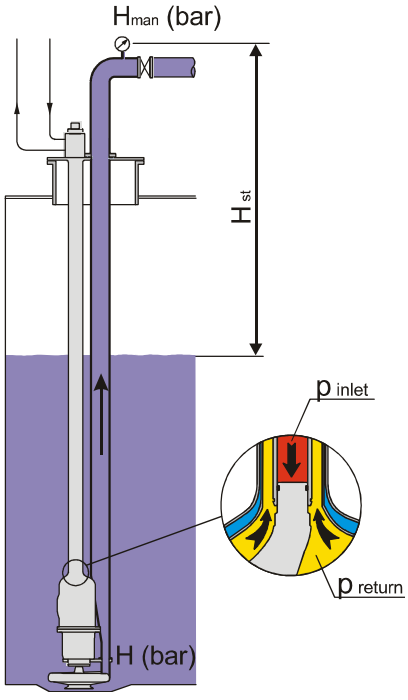
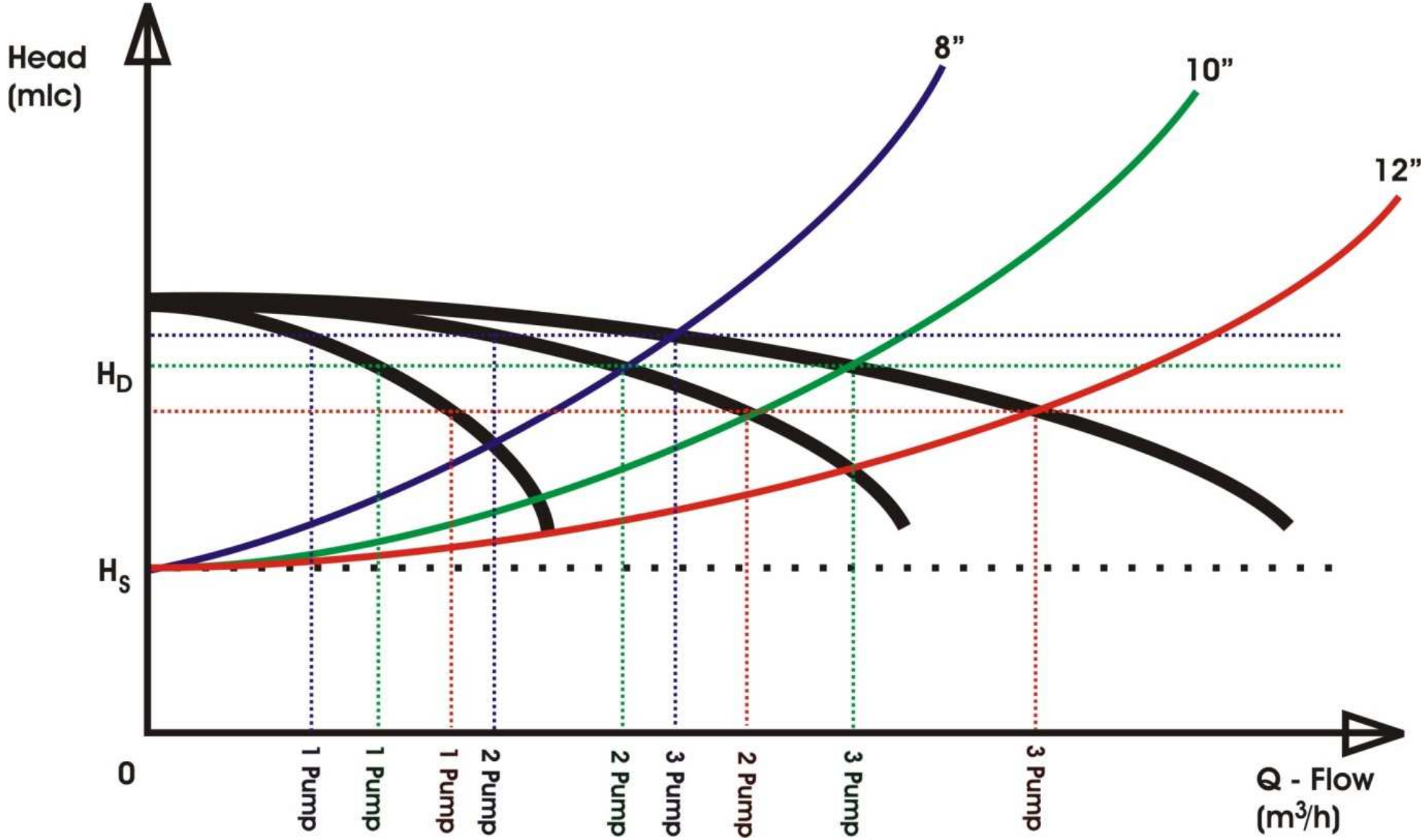


Fig. 2

Parallel pumping, sentrifugal pumps



Pumping Diagram

Example 1

- ✓ Pumping with 195 bar at STC valve
- ✓ 7,5 bar cargo pressue at pump
- ✓ Specific Gravity of cargo = 1,0

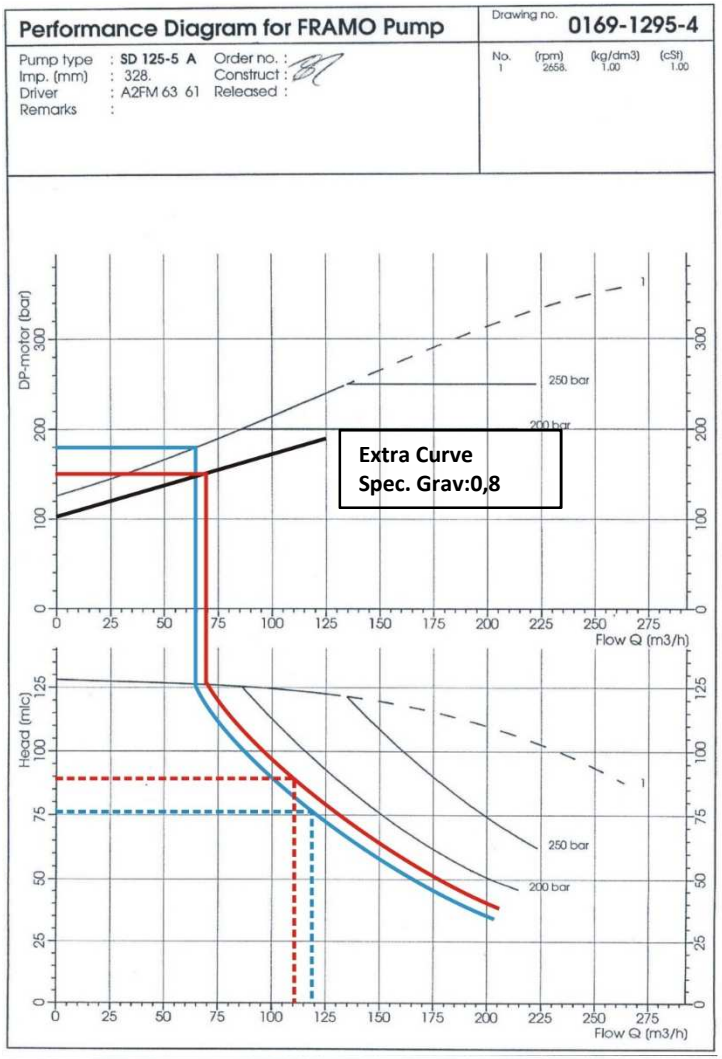
Delta p (motor)=
195 bar – 6 bar – 9 bar
= 180 bar

Return pressure

Drop valve and in lines

Head (mlc)=
$\frac{7{,}5 \text{ bar} \times 10}{1{,}0 \times 0.981}$ = 76,5

Specific Gravity



Example 2

- ✓ Pumping with 165 bar at STC valve
- ✓ 7,0 bar cargo pressue at pump
- ✓ Specific Gravity of cargo = 0,8

Delta p (motor)=
165 bar – 6 bar – 9 bar
= 150 bar

Return pressure

Drop in valve and lines

Head (mlc)=
$\frac{7{,}0 \text{ bar} \times 10}{0{,}8 \times 0.981}$ = 89

Specific Gravity

Evaluation Test

For Framo Cargo Pumps

Test procedure

- Each cargo pump to be tested against closed discharge valve.
- Hydraulic system pressure to be at maximum.
- Record hydraulic pressure at control valve and cargo pressure at top cover plate.

Corrections

- Ullage and specific gravity.

Control of results

- Check the results against the actual pumping curve

Possible wear and tear

- Increased wear ring clearance.
- Control valve is not compensating.
- Worn out hydraulic motor

Evaluation of results

- Normal cargo pressure – hydraulic pressure too high =
  Increased wear ring clearance.

- Cargo pressure too low – hydraulic pressure too low=
  Reduced pump speed caused by:
  Bad control valve or bad hydraulic motor.

- Cargo pressure too high – hydraulic pressure too high = Overspeed caused by control valve (compensator).

PUMP TEST – EVALUATION FORM

All cargo pumps with cargo in tanks to be run against closed cargo valve.

Expected cargo pressure in bar is: $\frac{\text{(mlc-ullage) xSp.gr x 0,981}}{10}$

Hydraulic pressure in bar: $\frac{\text{P (bar) x Sp.Gr.}}{\text{Design sp.gr.}}$

Tank No	Pump type	SpG (kg/dm3)	Viscosity cSt	Ullage U (m)	Cargo pressure Recorded Pr (bar)	Cargo pressure Expected Pe (bar)	Hydraulic pressure Recorded CPr (bar)	Hydraulic pressure Expected CPe (bar)	System Pressure Hydr. Oil temp. REMARKS
1	SD 125	1	1	0	12,5		125		
2	SD 125	1,2	1	11	13,8		180		
3	SD 125	1	1	8	11,8		179		
4	SD 125	0,7	1	1	10,2		105		
5	SD 125	0,9	1	2	9,7		90		
6	SD 125	0,83	1	2	8,5		112		
7	SD 125	1,7	1	1	21,3		213		

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PUMP TEST – EVALUATION FORM

All cargo pumps with cargo in tanks to be run against closed cargo valve.

Expected cargo pressure in bar is: $\frac{\text{(mlc-ullage) xSp.gr x 0,981}}{10}$

Hydraulic pressure in bar: $\frac{\text{P (bar) x Sp.Gr.}}{\text{Design sp.gr.}}$

Tank No	Pump type	SpG (kg/dm3)	Viscosity cSt	Ullage U (m)	Cargo pressure		Hydraulic pressure		System Pressure
					Recorded Pr (bar)	Expected Pe (bar)	Recorded CPr (bar)	Expected CPe (bar)	Hydr. Oil temp. REMARKS

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Performance Diagram for FRAMO Pump

Drawing no. **0169-1295-4**

Pump type : **SD 125-5 A** Order no. :
Imp. (mm) : 328. Construct :
Driver : A2FM 63 61 Released :
Remarks :

No.	(rpm)	(kg/dm3)	(cSt)
1	2658.	1.00	1.00