MAN Energy Solutions
Future in the making

Hydraulic Power Supply

(HPS)

PrimeServ Academy Copenhagen

MAN PrimeServ

Learning objectives

Upon completion of this module you …

– will be able to recognize the various parts in the HPS system.

– will be able to explain the HPS system.

Agenda

Hydraulic Power Supply (HPS)

1 System

2 Filter unit

3 Startup pumps

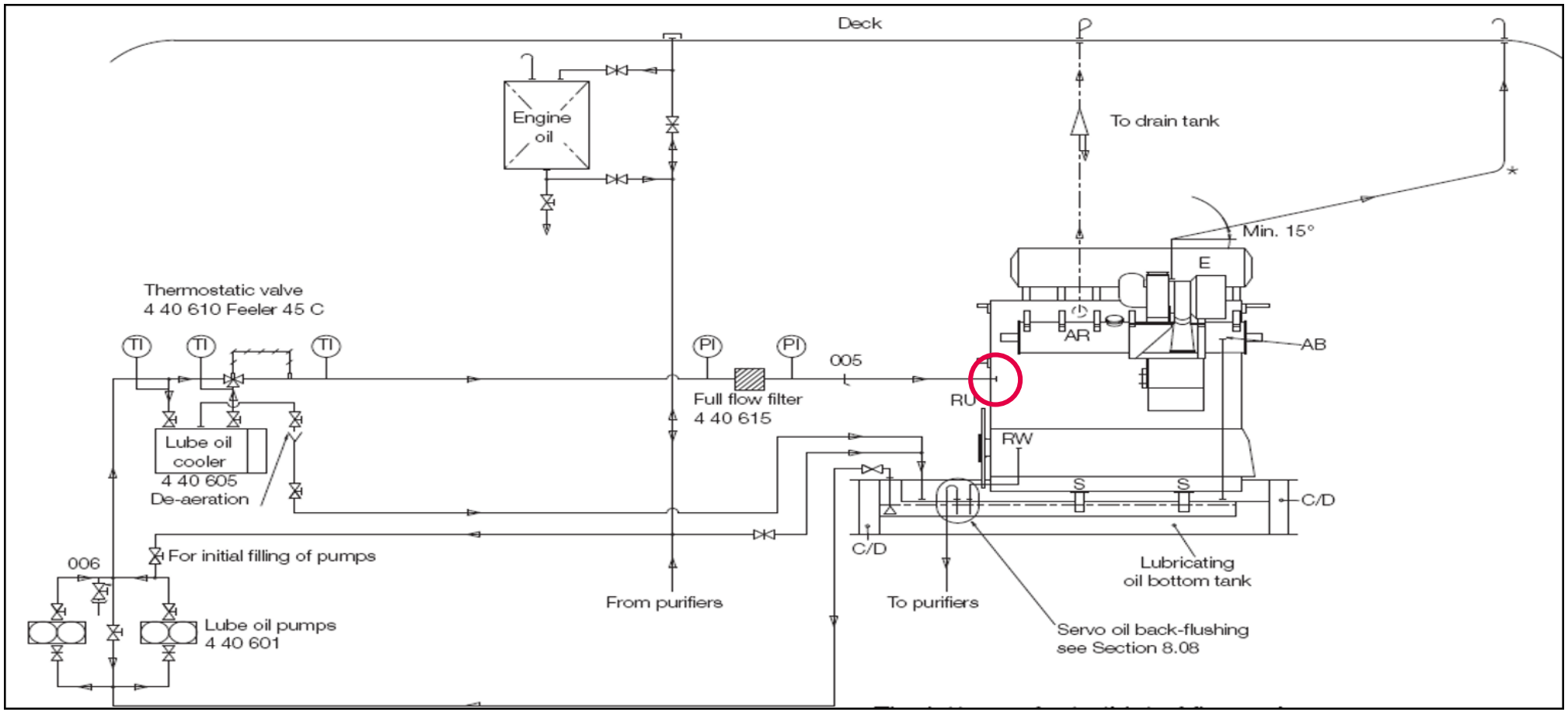
4 Engine driven pumps

5 Valve block

6 Electric driven pumps

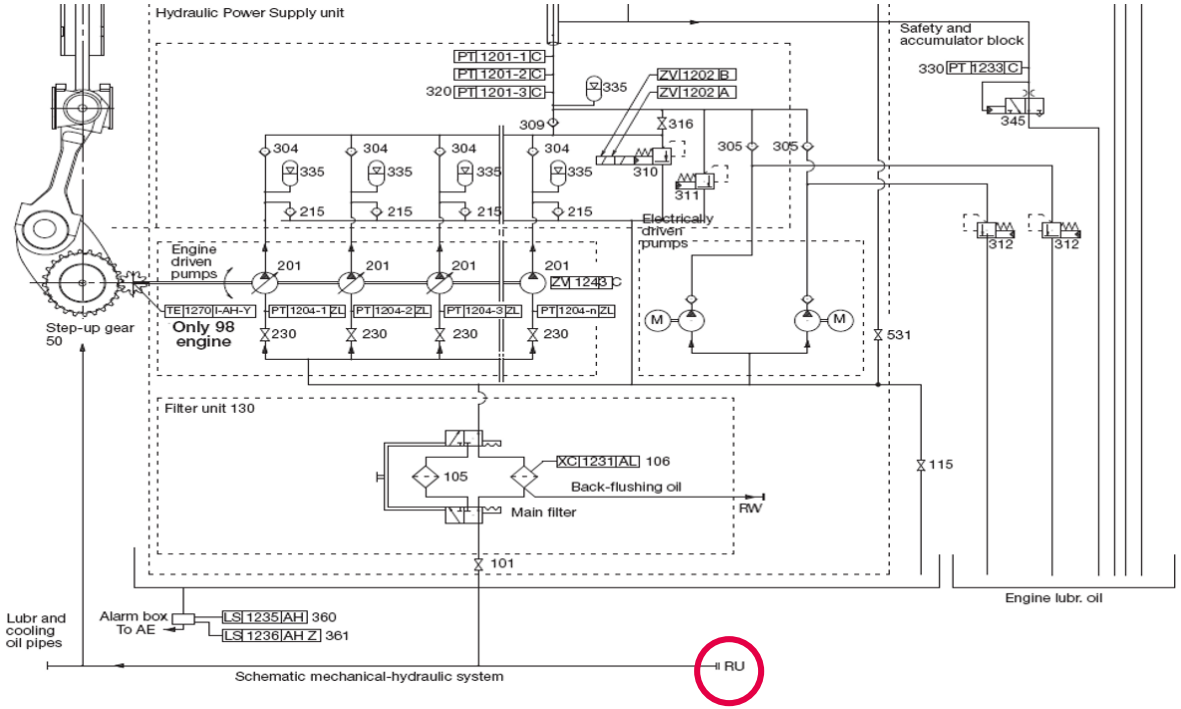
Hydraulic Power Supply (HPS)

System – Lubricating and cooling oil system



Hydraulic Power Supply (HPS)

System – Integrated hydraulic system (standard)

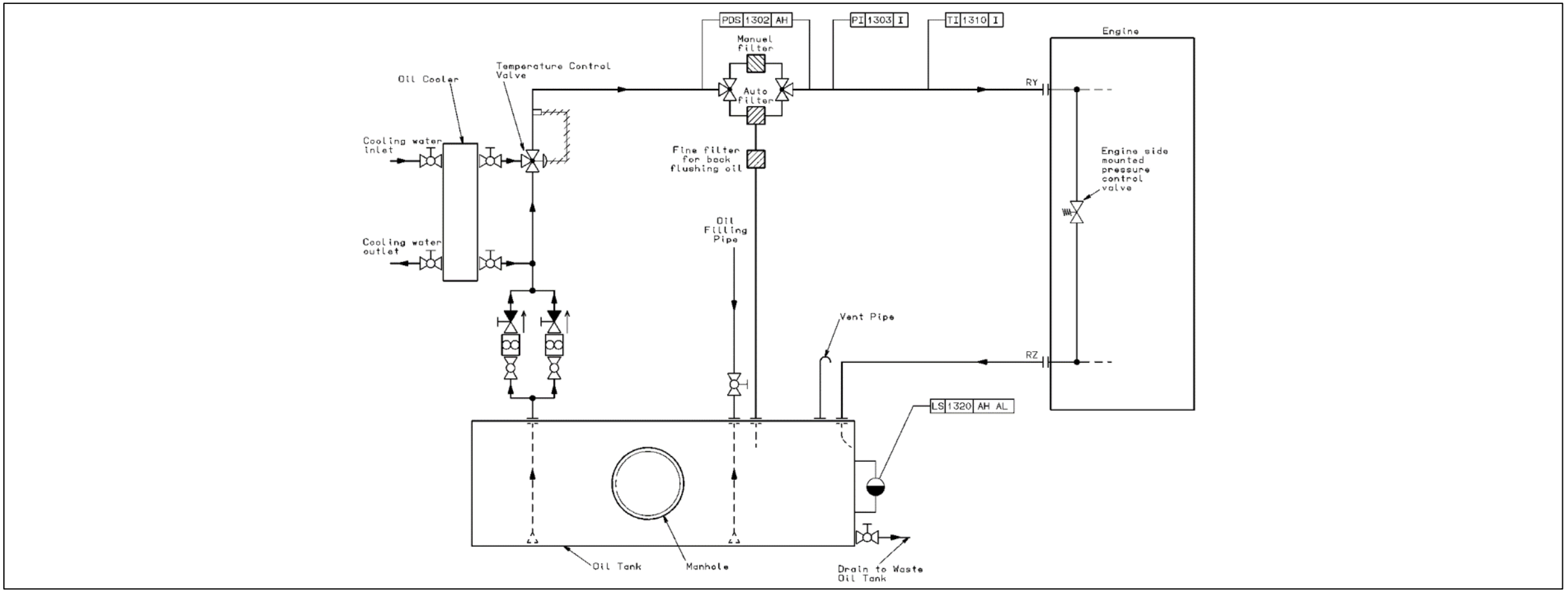


Contamination of hydraulic oil must not exceed:

- **ISO 4406: 16 / 13**
- **NAS Code: 7 or 8**

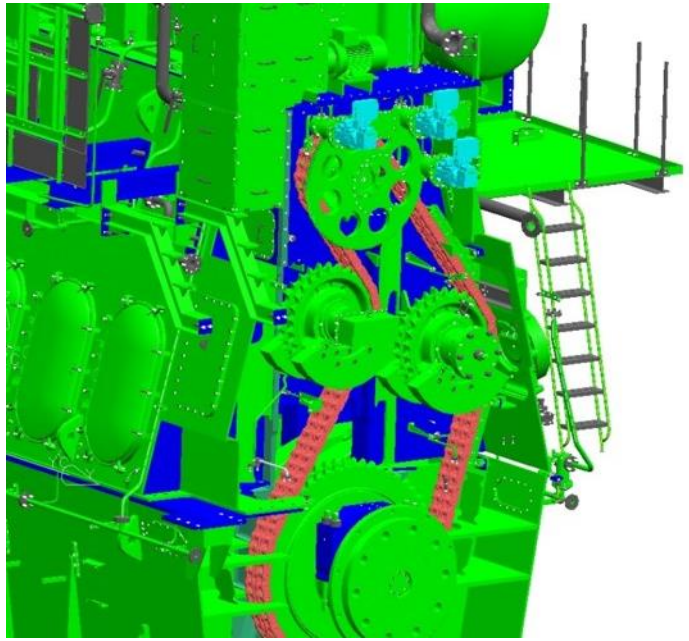
Hydraulic Power Supply (HPS)

System – Separate hydraulic system (option)

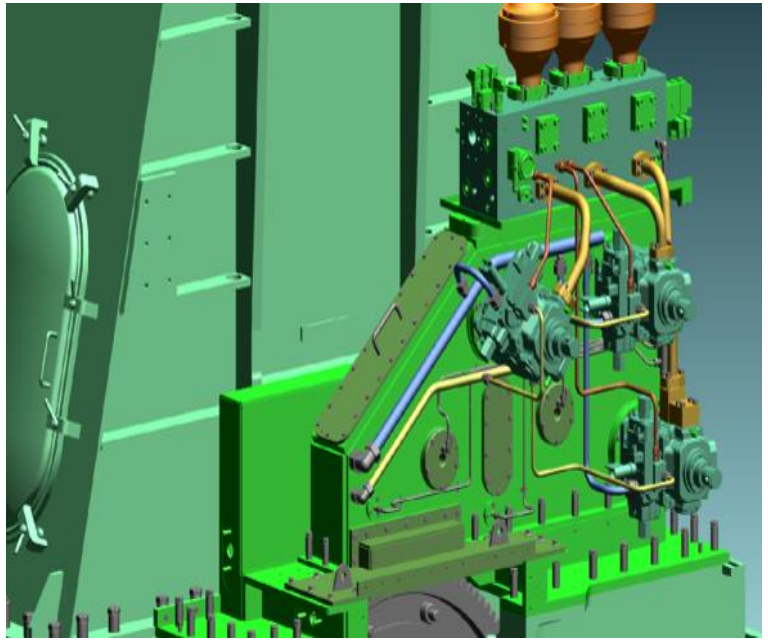


Hydraulic Power Supply (HPS)

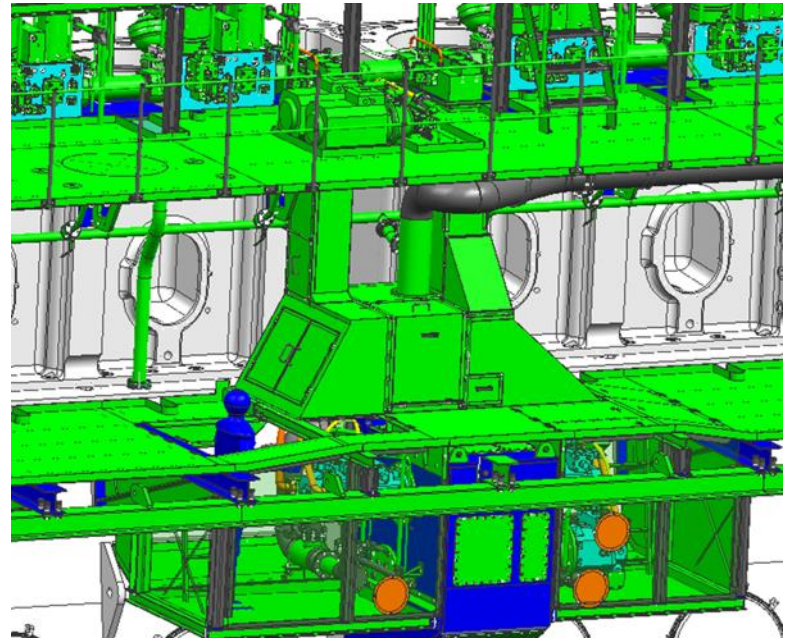
System - Engine driven hydraulic pumps; Three different setups



Aft with chain drive in case of a bore size more than 50



Aft with gear box in case of a bore size of 50 and less



Between cylinder 6 and 7 for engines with a bore size of 90 or 98 and with more than 9 cylinders

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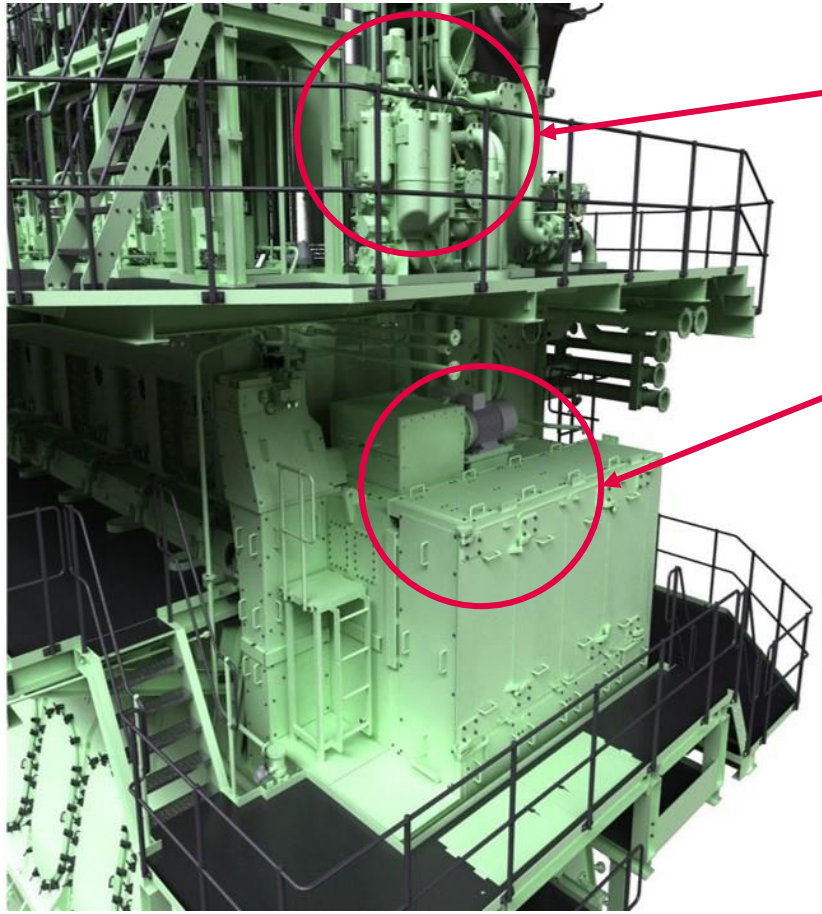
Hydraulic Power Supply (HPS)

Filter unit

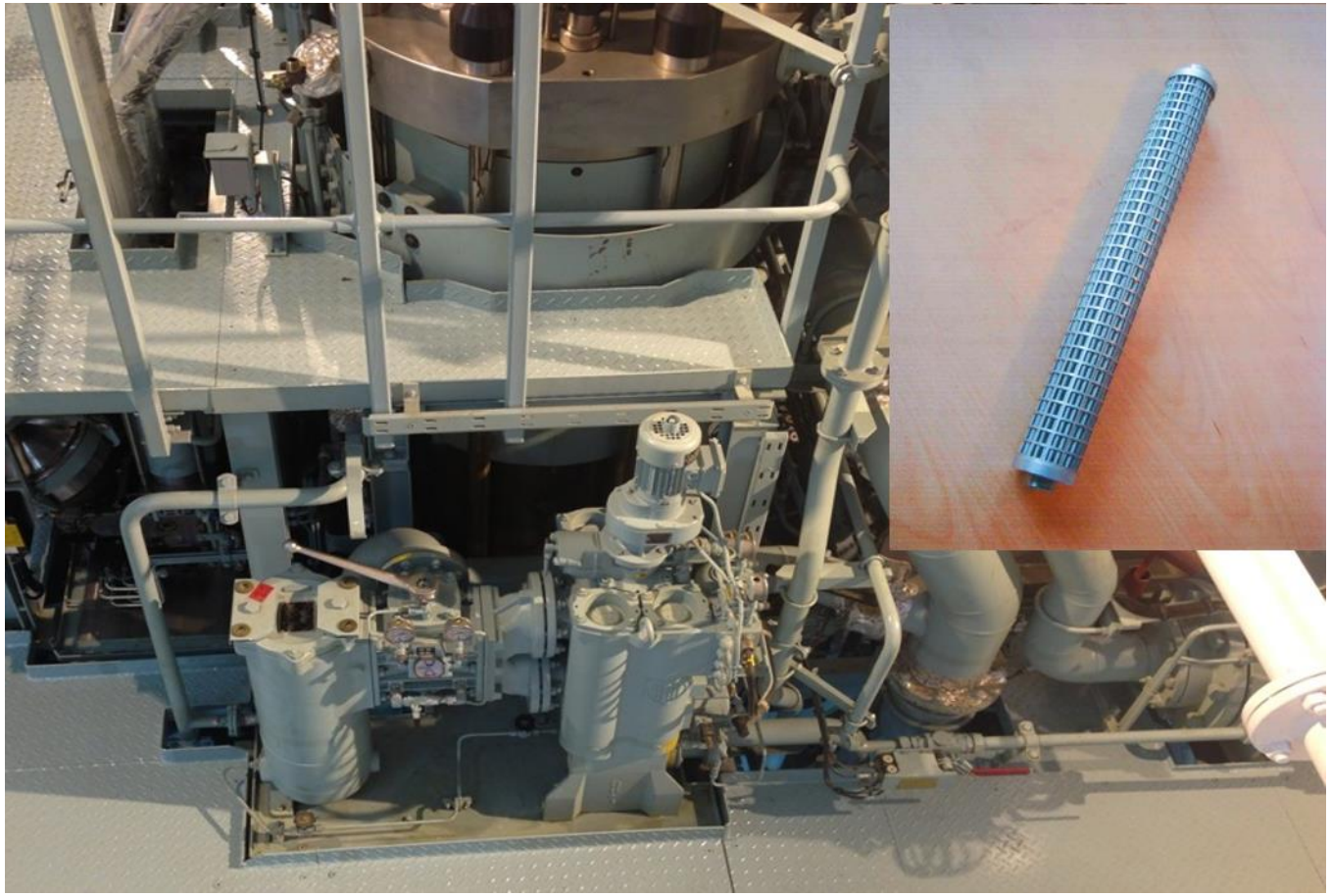


Automatic backflush filter

Hydraulic Power Supply (HPS) and startup pumps

Hydraulic Power Supply (HPS)

Filter unit – Boll & Kirch ver. 6.64



Hydraulic Power Supply (HPS)

Filter unit - Cartridges

6 µm filter cartridge:

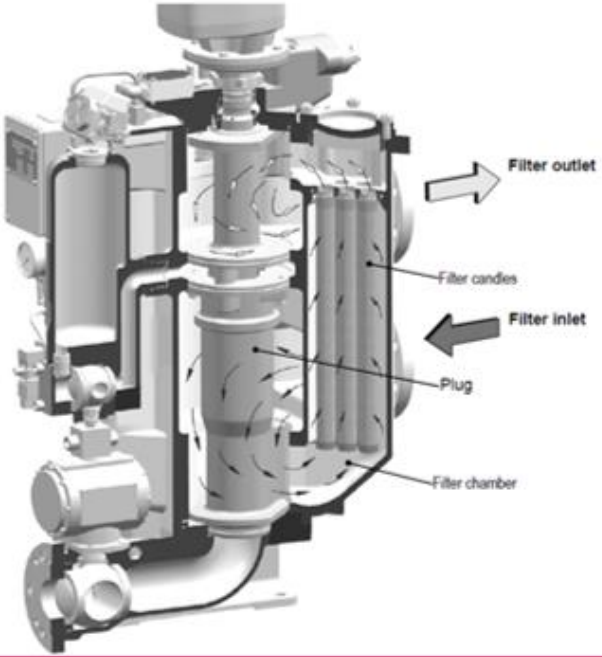
09 / 06 = production month / year

1341146 = filter cartridge ID

Sintered filter material

Hydraulic Power Supply (HPS)

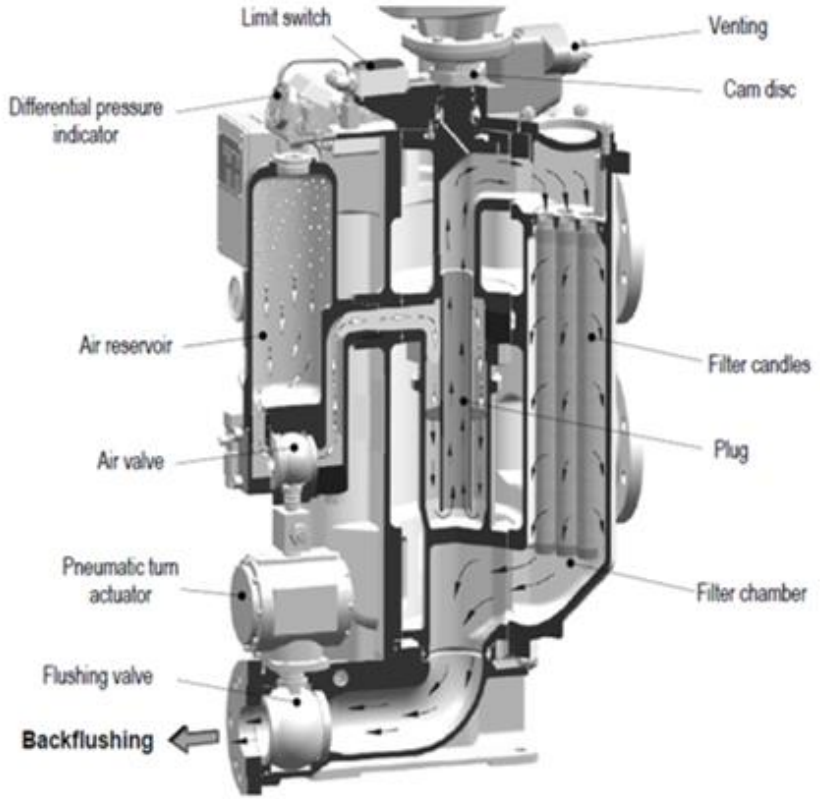
Filter unit – Layout and principle



Backflushing, initiated at interval of every 60 minutes.

Pressure dependent backflushing, initiated at dP=0,6 bar.

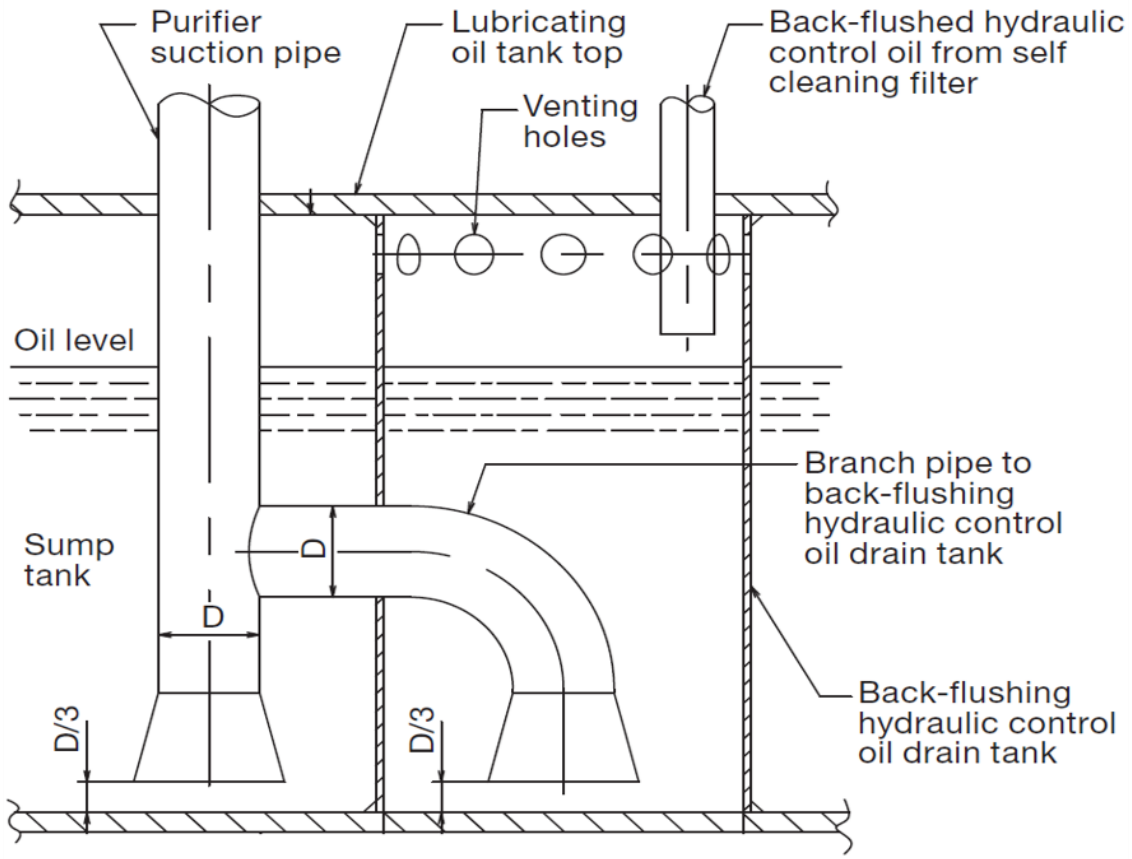
Pressure dependent alarm, initiated at dP=0,8 bar.

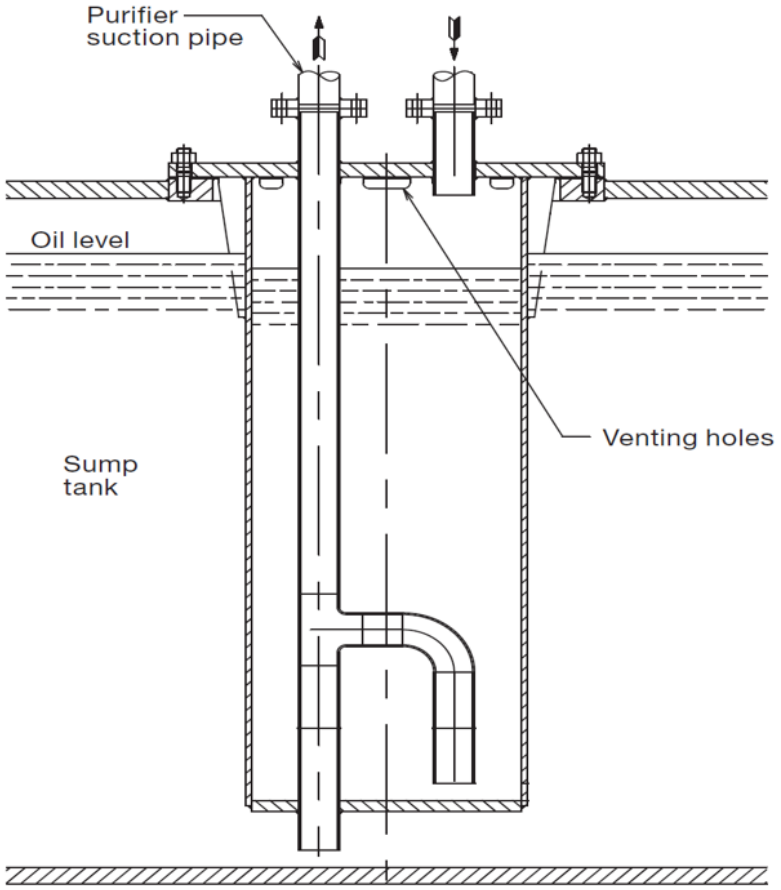


Back flushing process

Hydraulic Power Supply (HPS)

Filter unit – Back flush line to sump tank





Agenda

Hydraulic Power Supply (HPS)

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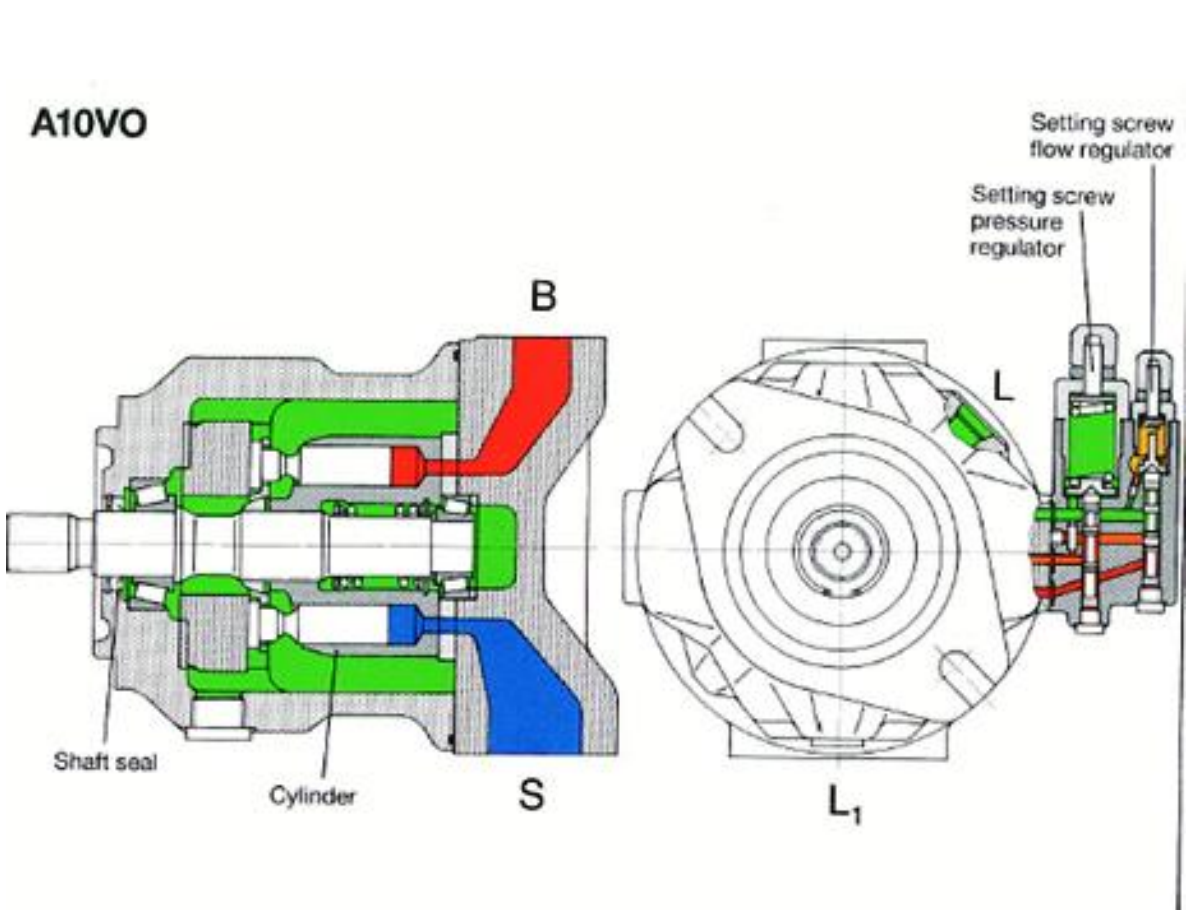
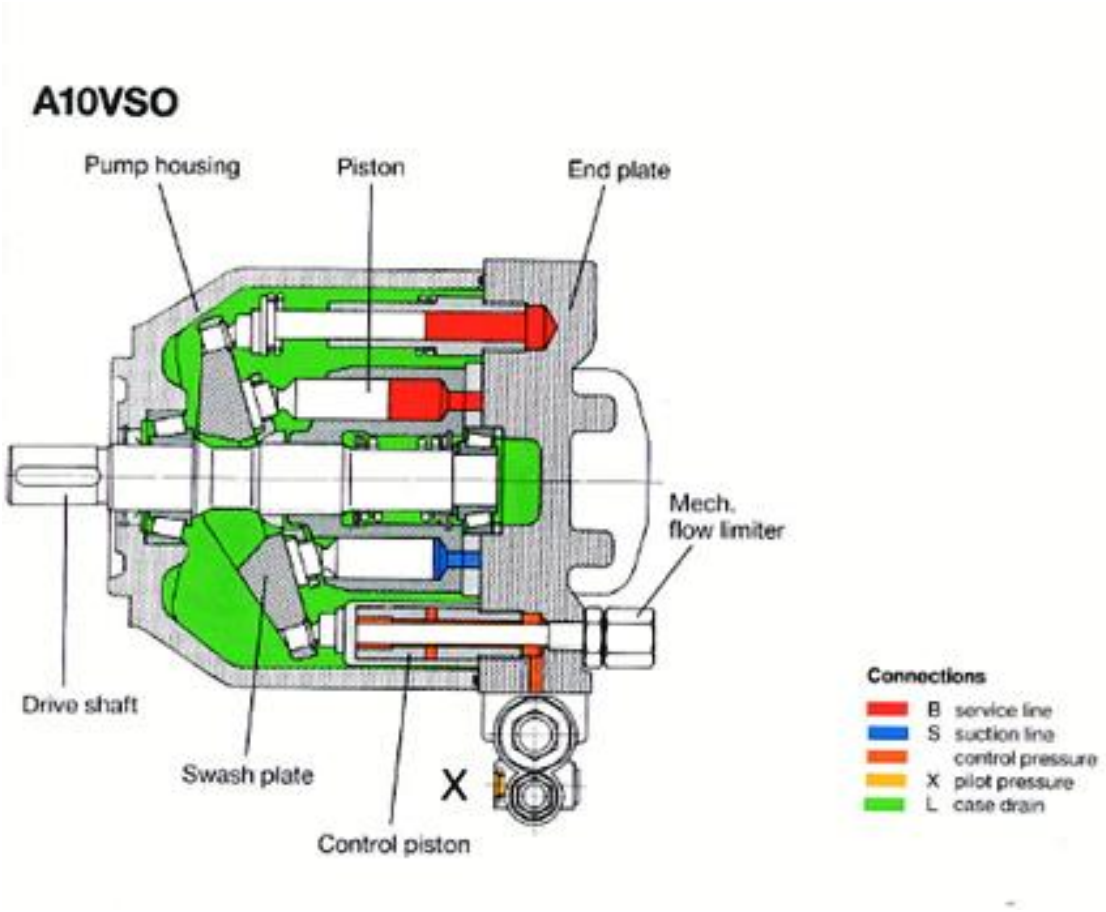
6 Electric driven pumps

Hydraulic Power Supply (HPS)

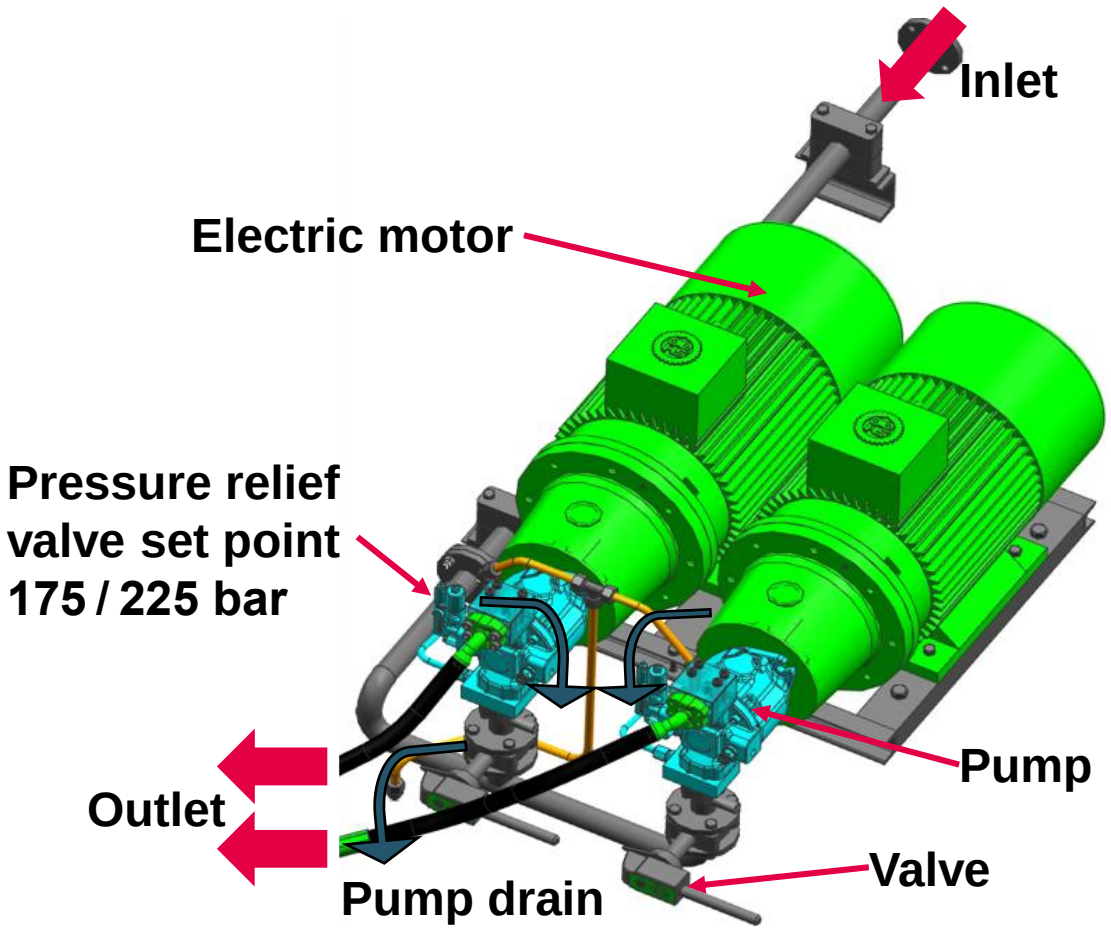
Startup pumps – Pump designs





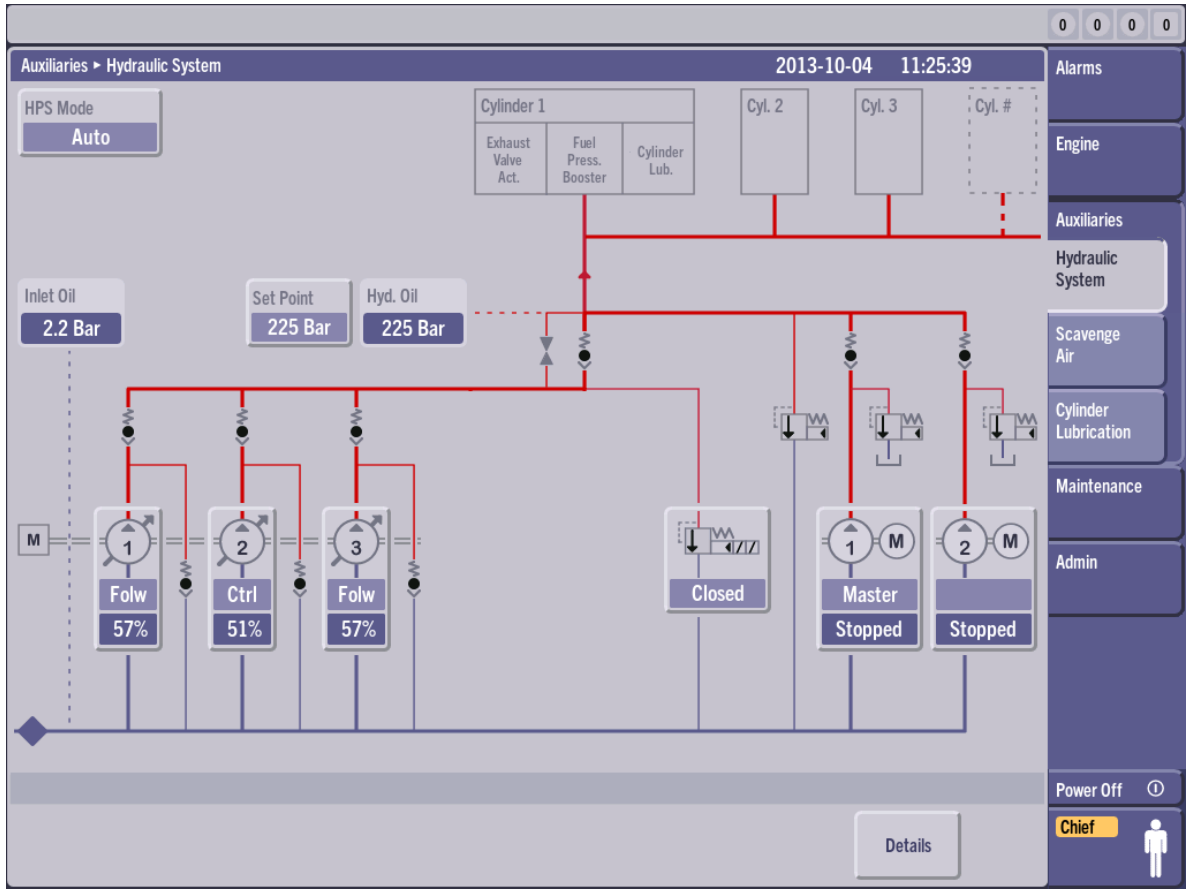
Hydraulic Power Supply (HPS)

Startup pumps – Layout



Hydraulic Power Supply (HPS)

Startup pumps – Control



Automatic mode

- Master pump running at engine standby (both pumps are running during pressure build up)
- Stopped at finish with engine
- Stopped via timer at a specified engine RPM (default 15% MCR)

Agenda

Hydraulic Power Supply (HPS)

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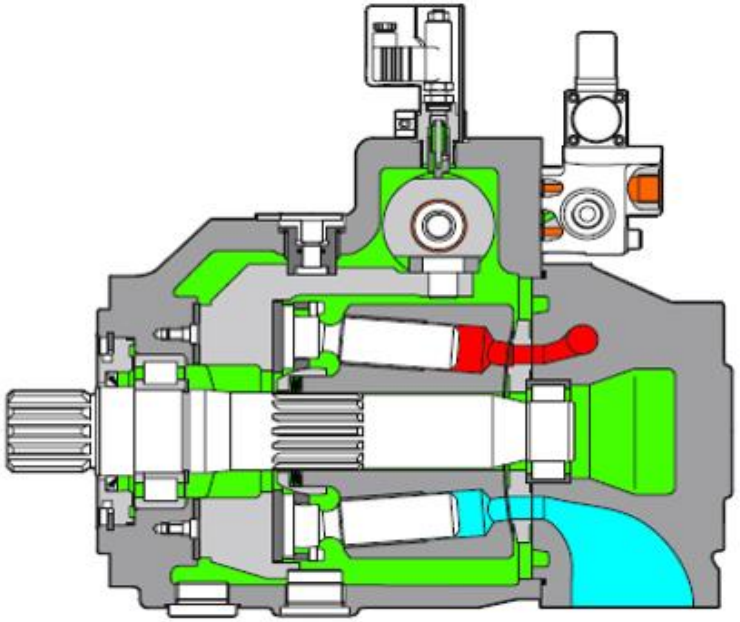
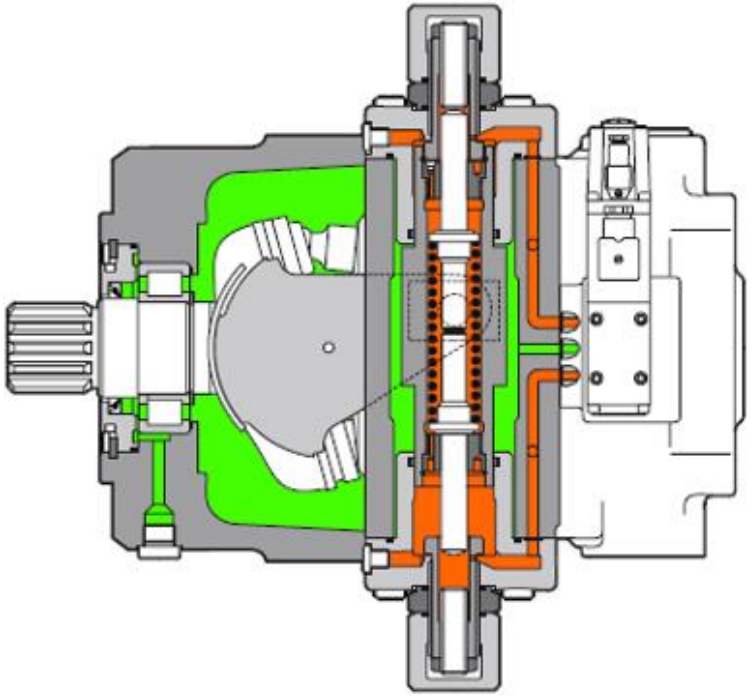
Hydraulic Power Supply (HPS)

Engine driven pumps – Axial piston pumps



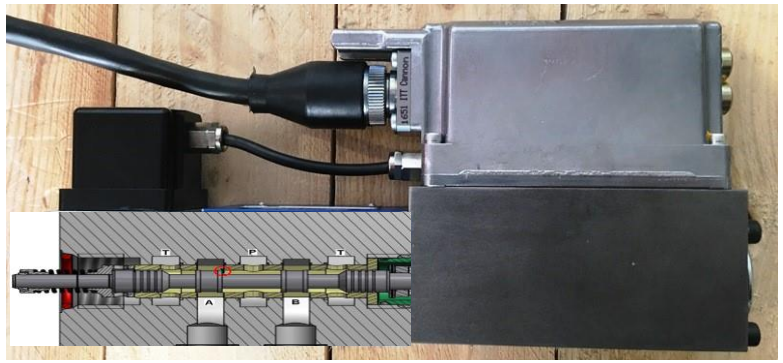
Axial Piston Pump – A4VSO xxx
HS3xxx… (Bosch - Rexroth)

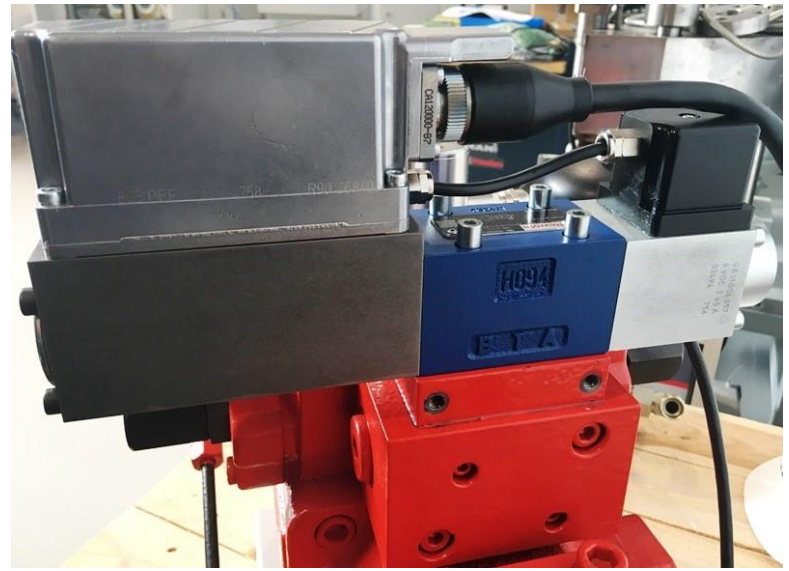
Inlet, 2 Bar
Outlet, 300 Bar
Control pressure
Case drain



Hydraulic Power Supply (HPS)

Engine driven pumps – Pilot valves either Parker or MOOG

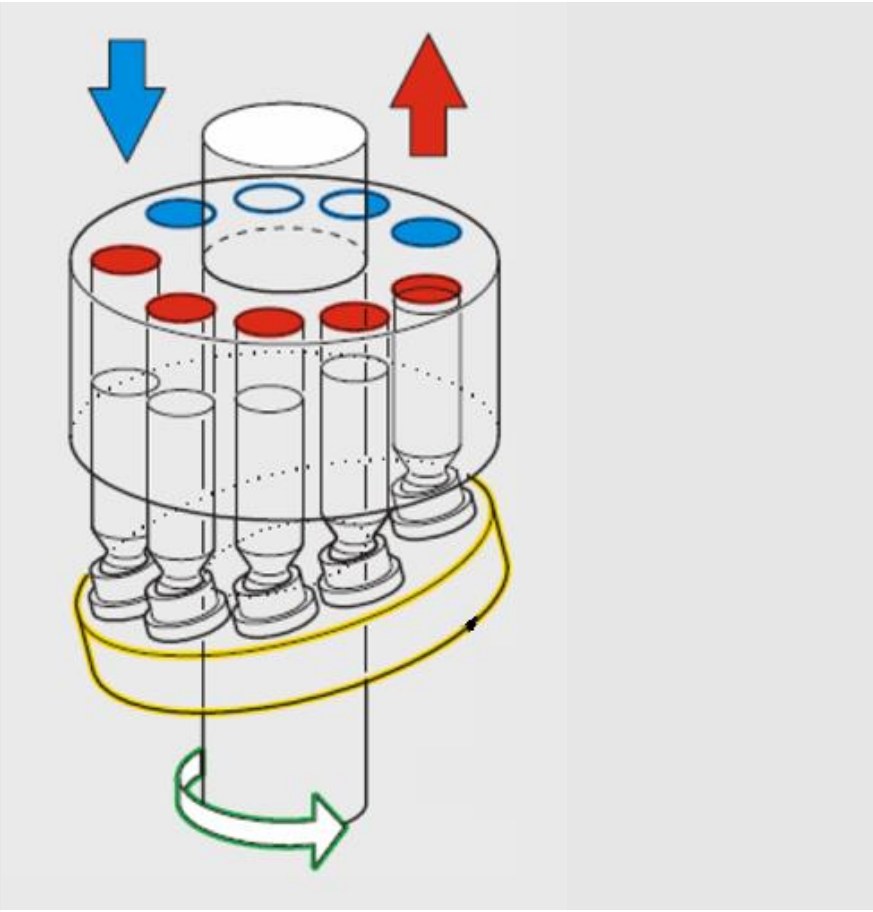




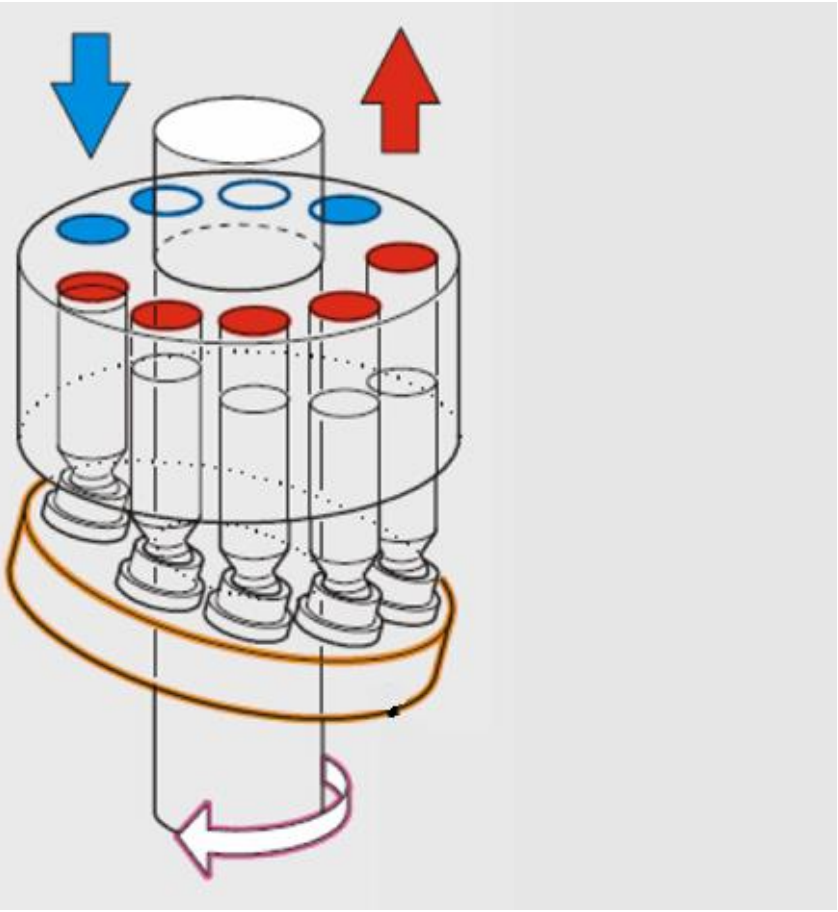
Hydraulic Power Supply (HPS)

Engine driven pumps – Swash plate principle

Ahead

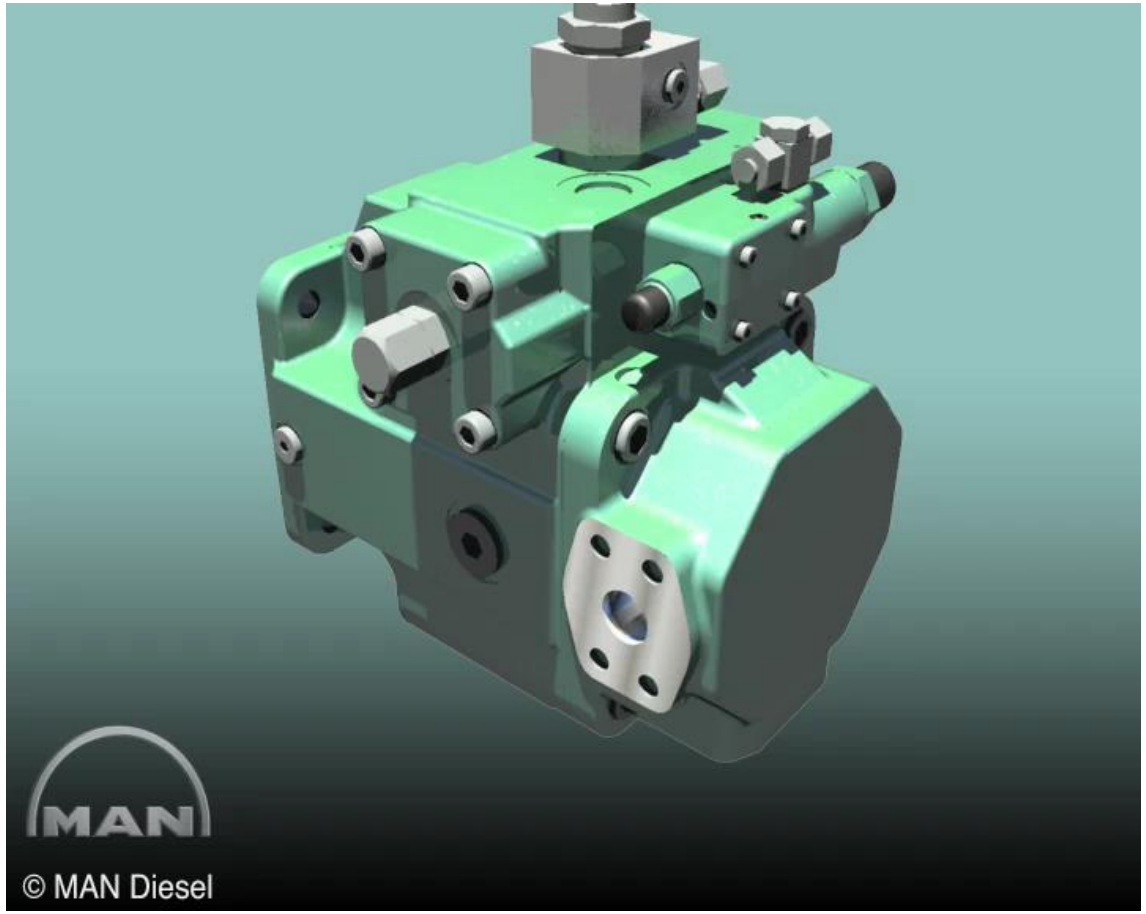


Astern



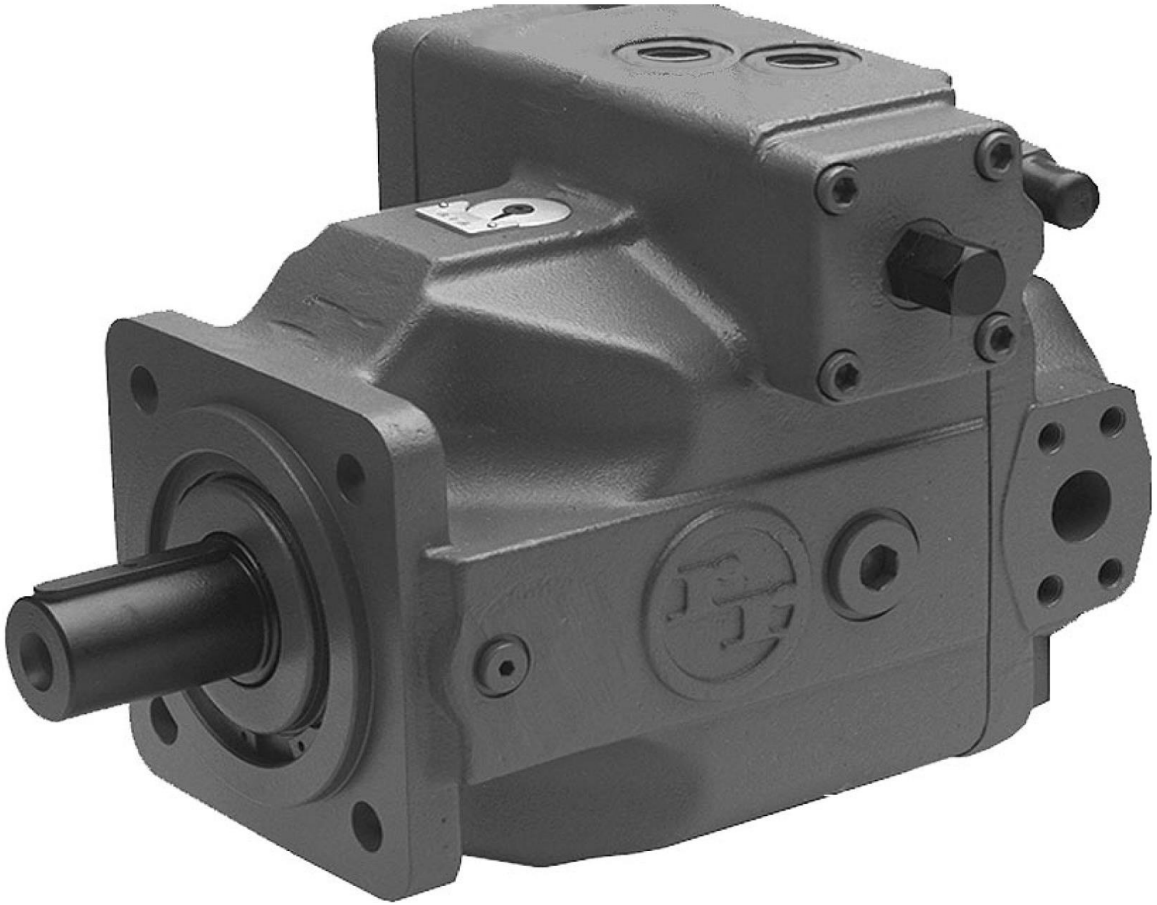
Hydraulic Power Supply (HPS)

Engine driven pumps – Swash plate principle



Hydraulic Power Supply (HPS)

Engine driven pumps – Sizes



Pump sizes

125 cm3/rev - three pumps

180 cm3 /rev - three pumps

250 cm3 /rev - three pumps

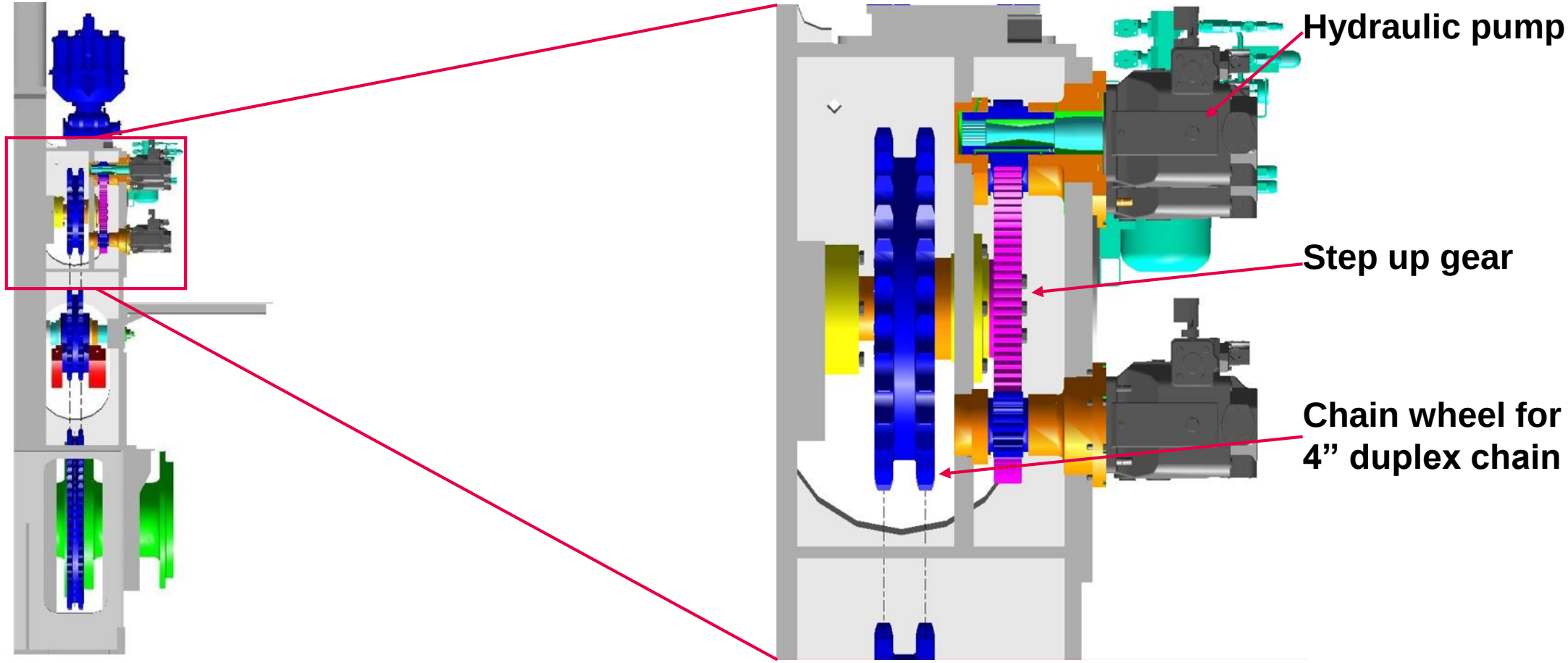
355 cm3 /rev - three pumps

500 cm3 /rev - three to five pumps

(750 cm3 /rev - three to five pumps)

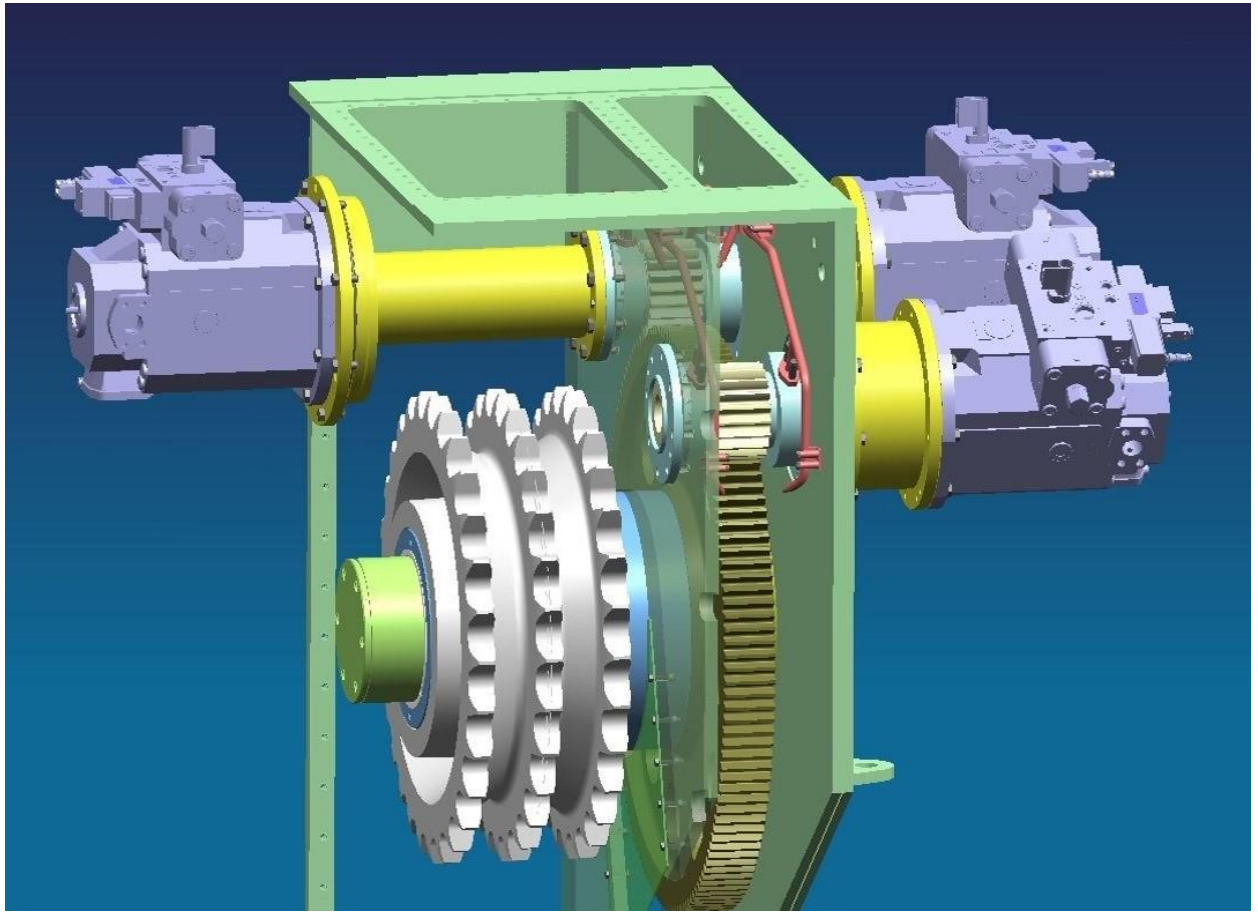
Hydraulic Power Supply (HPS)

Engine driven pumps – Gear box



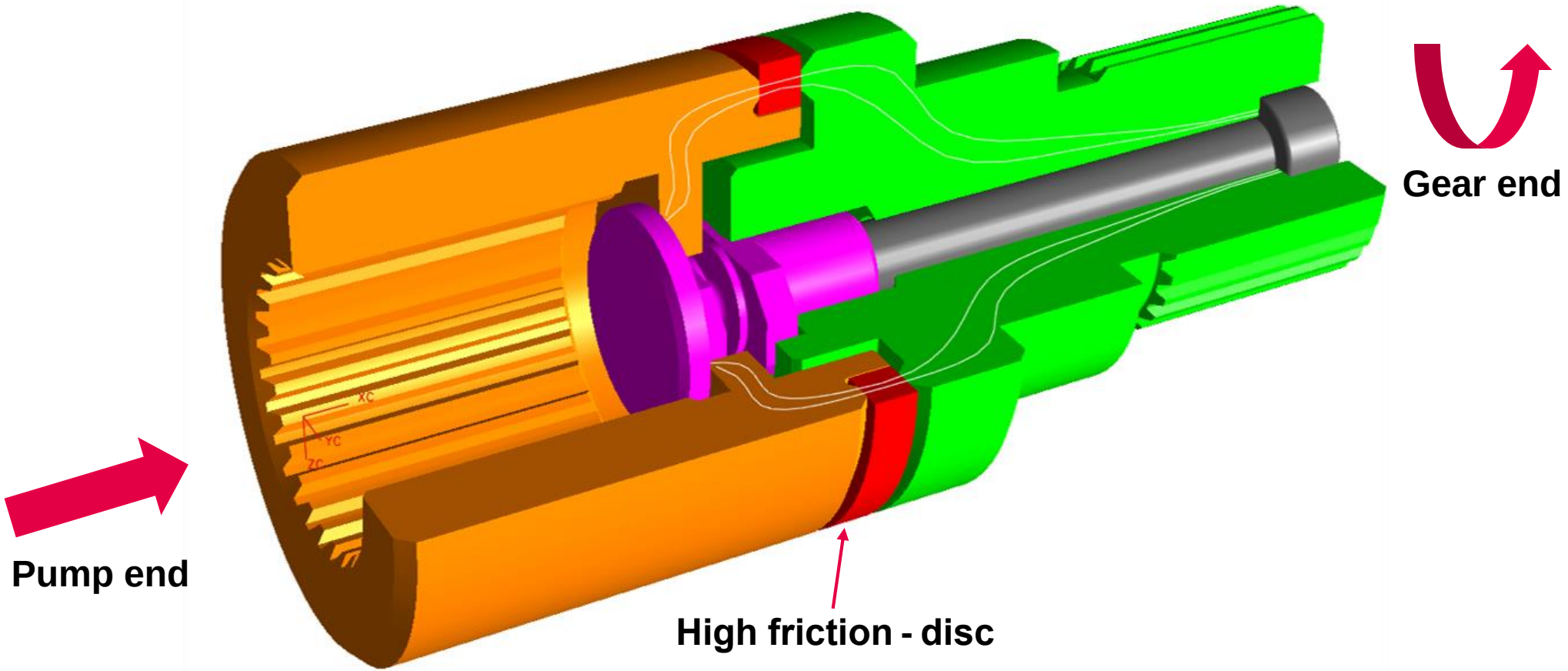
Hydraulic Power Supply (HPS)

Engine driven pumps – Gear box



Hydraulic Power Supply (HPS)

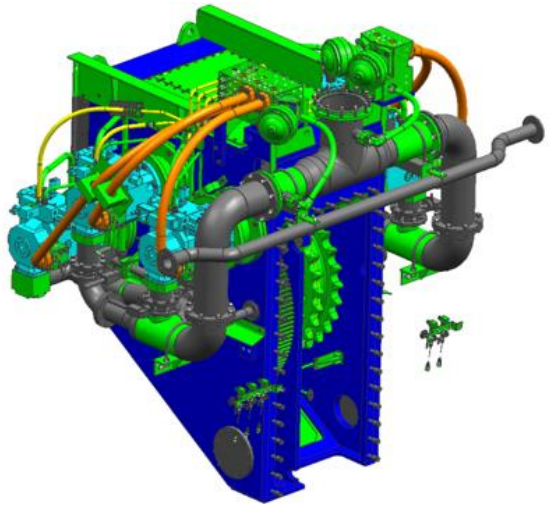
Engine driven pumps – Safety shaft principle



Hydraulic Power Supply (HPS)

Engine driven pumps – Complete HPS 12K98ME Mark 4

HPS high pressure hoses five years date of manufactory!



Hydraulic Power Supply (HPS)

Engine driven pumps – 200 / 300 bars system

210 Bar → 300 Bar

Working pressure increased from 210 bar to 300 bar resulting in:

HPS:

Necessary pump size reduced from 355 cc. to 250 cc.

Only three pumps needed

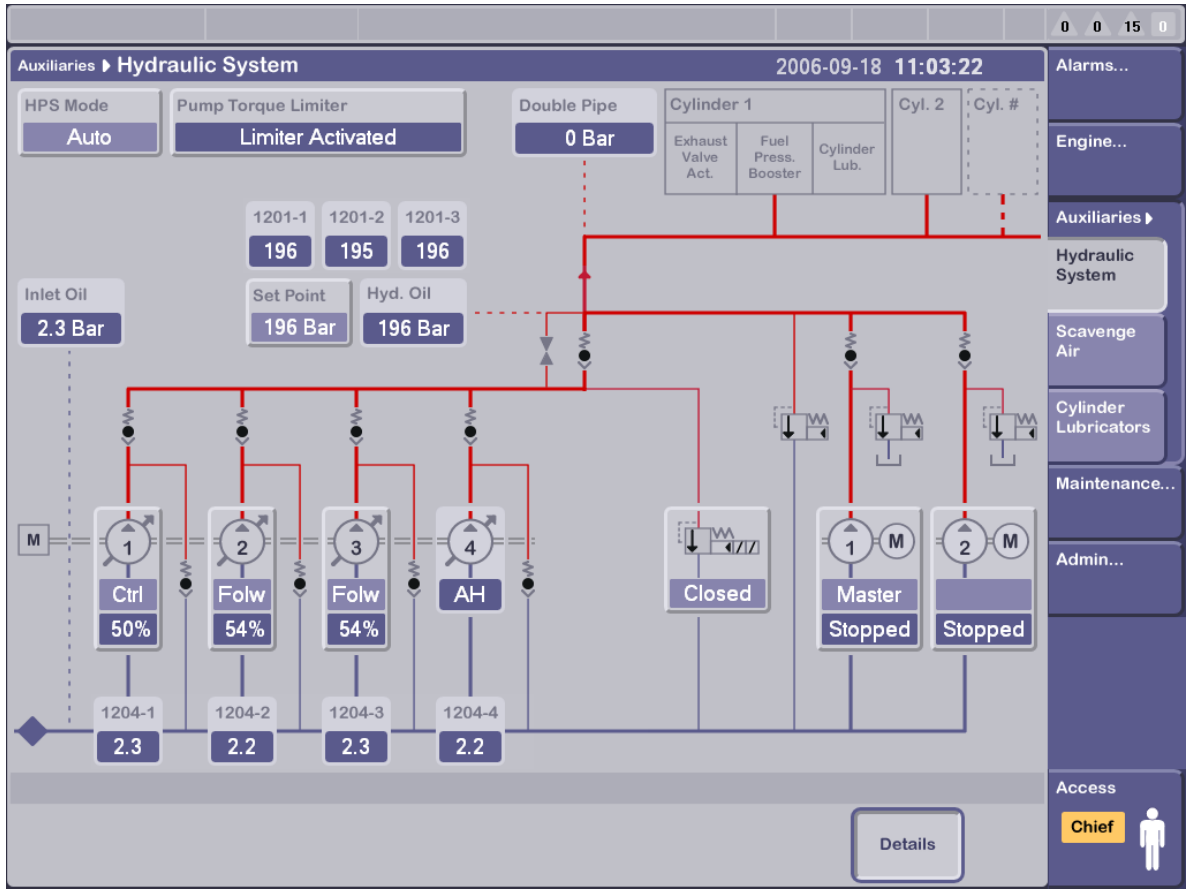
Same pipe and hose dimensions

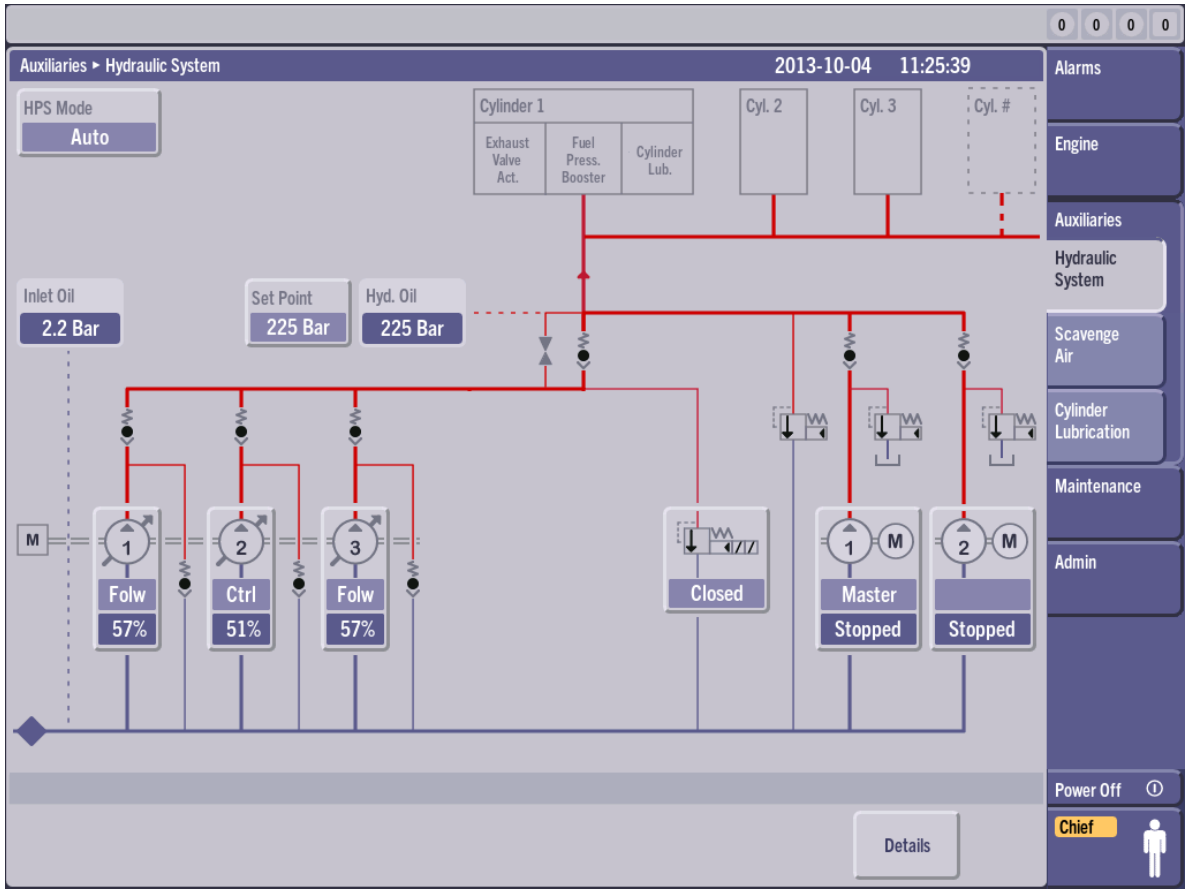
This is because of the relation between Q' (flow) and pressure (p) shown by the equation:

P= Q'x p, where P is the power generated by the pump, the power consumption is the same; therefore a higher pressure will result in a lower flow.

Hydraulic Power Supply (HPS)

Engine driven pumps – 200 / 300 bars system



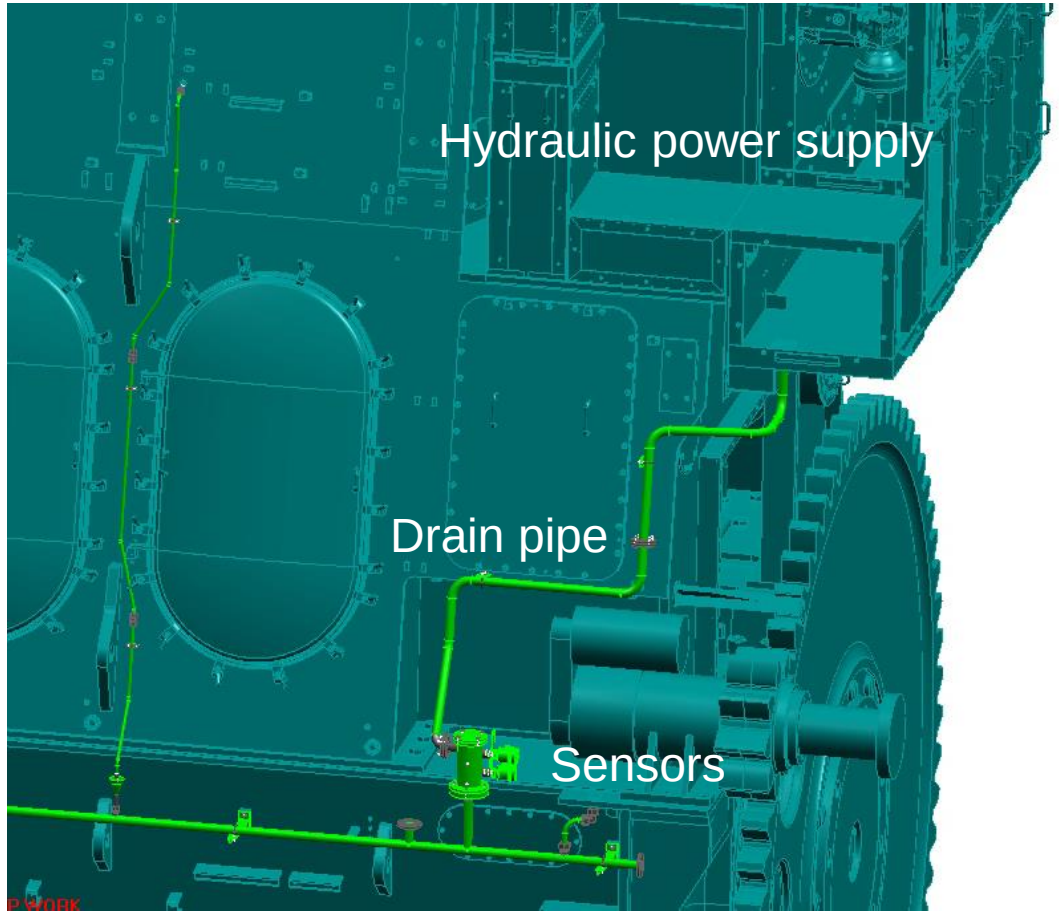


Hydraulic Power Supply (HPS)

Engine driven pumps – Pressure sensors

Hydraulic Power Supply (HPS)

Engine driven pumps – Leak detection



“vibrating fork” type
LS 1235 = Alarm
LS 1236 = Cancelable shut down

Hydraulic Power Supply (HPS)

Engine driven pumps – Summary

In case of control failure of a pump, the swash plate will be forced to +100% AHEAD direction cause of default position of pilot valve.

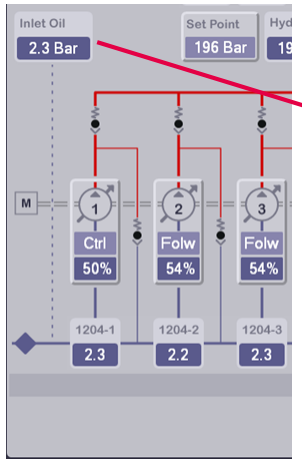
Pump No. 1 is controlled by ACU 1, pump 2 by ACU 2 and pump 3 by ACU 3.

Pump Nos. 1, 2, and 3 have their own sensor for system pressure, connected to their controlling ACU.

All pumps have sensors for suction pressure.

If the pressure is too low, or all sensors are failing, a SHUTDOWN will be activated.

High pressure shutdown: 145 bar / 175 bar



Alarm:
0,7 bar low oil pressure
0,5 bar shut down

Deviation alarm:
Sensor value deviates more than one bar from the other.

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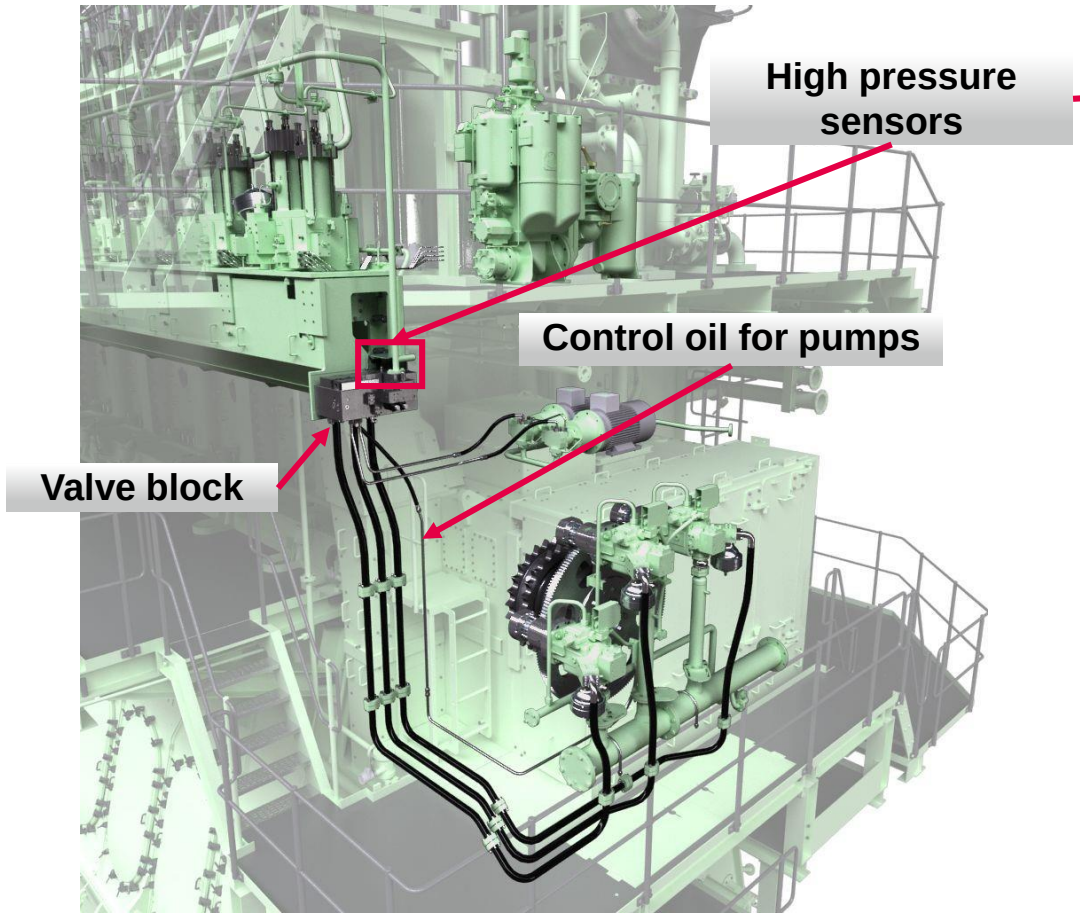
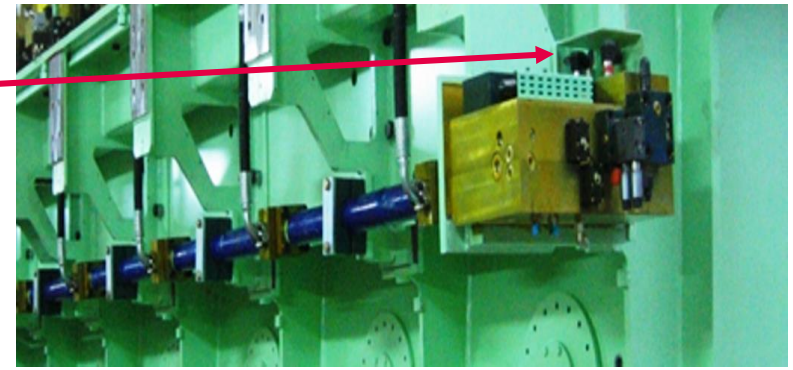
Hydraulic Power Supply (HPS)

Valve block – Standard HPS



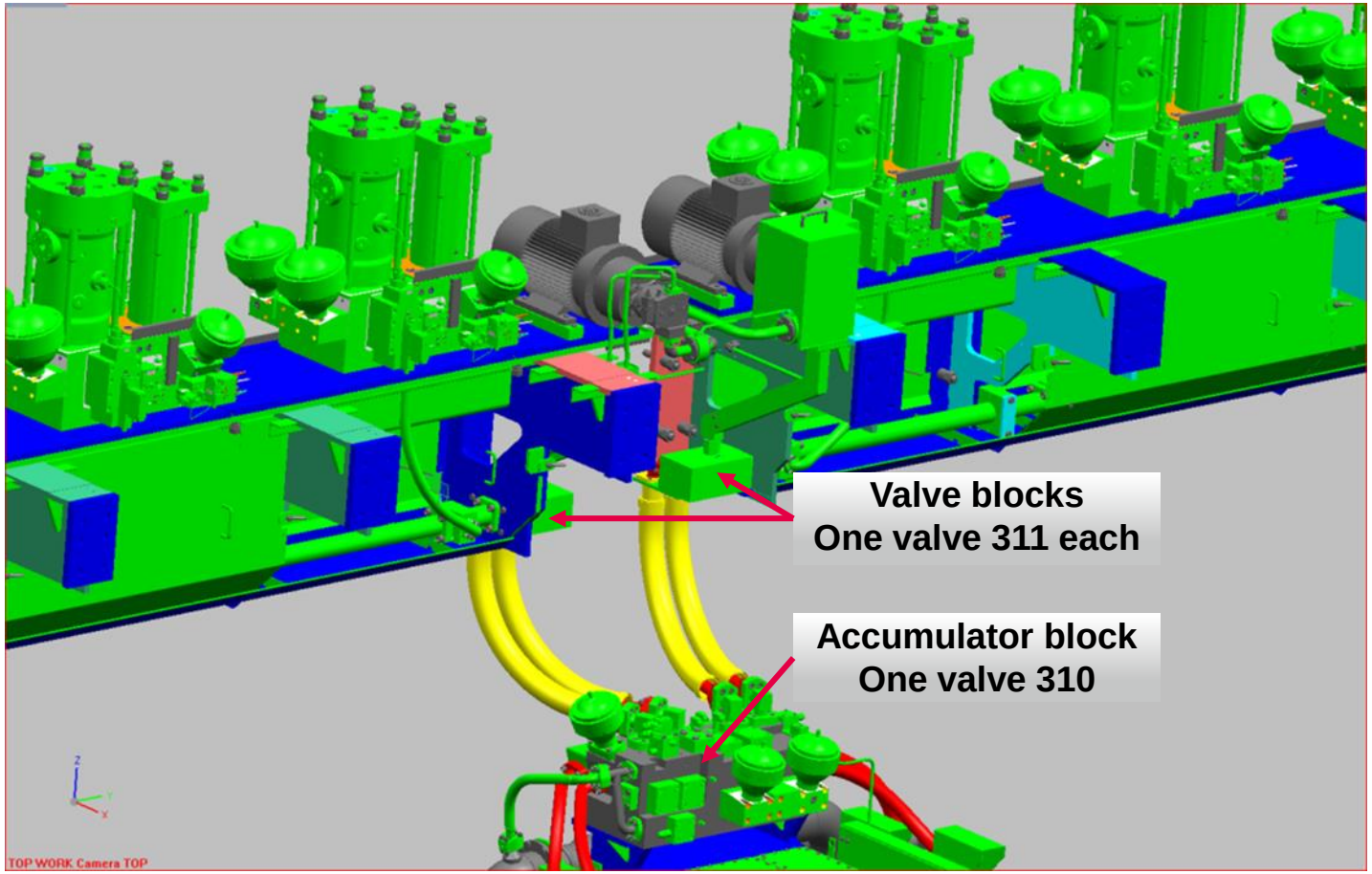


Safety & shutdown valves
310 and 311

Opening pressure:
310: 230 / 310 bar or by ACU1 & 3 (shutdown)
311: 250 / 315 bar

Hydraulic Power Supply (HPS)

Valve block – HPS between cylinder 6 and 7



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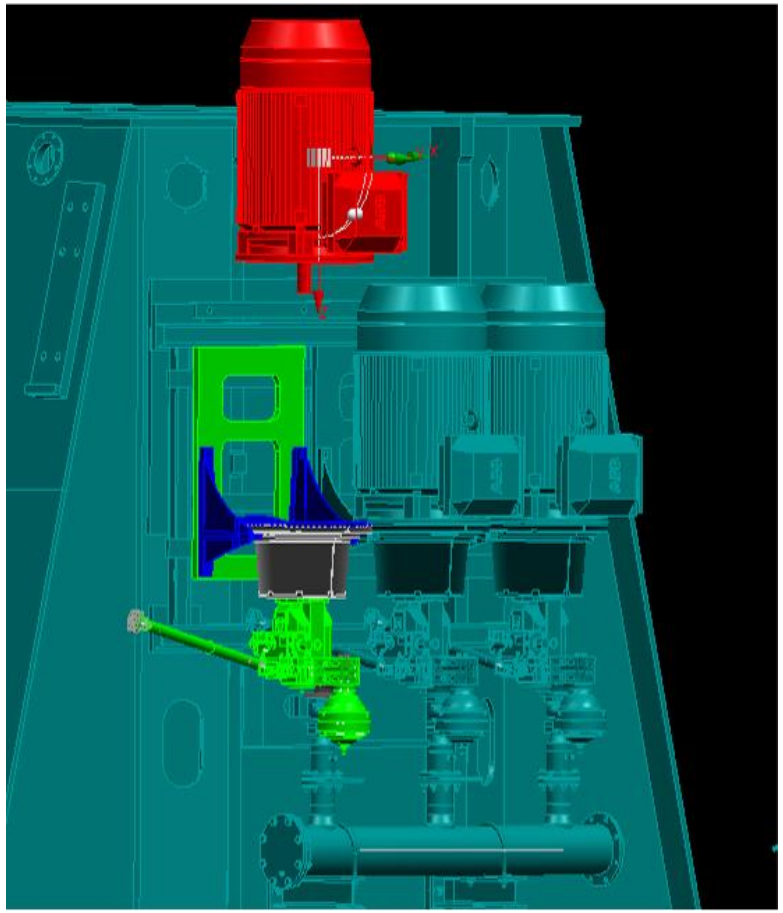
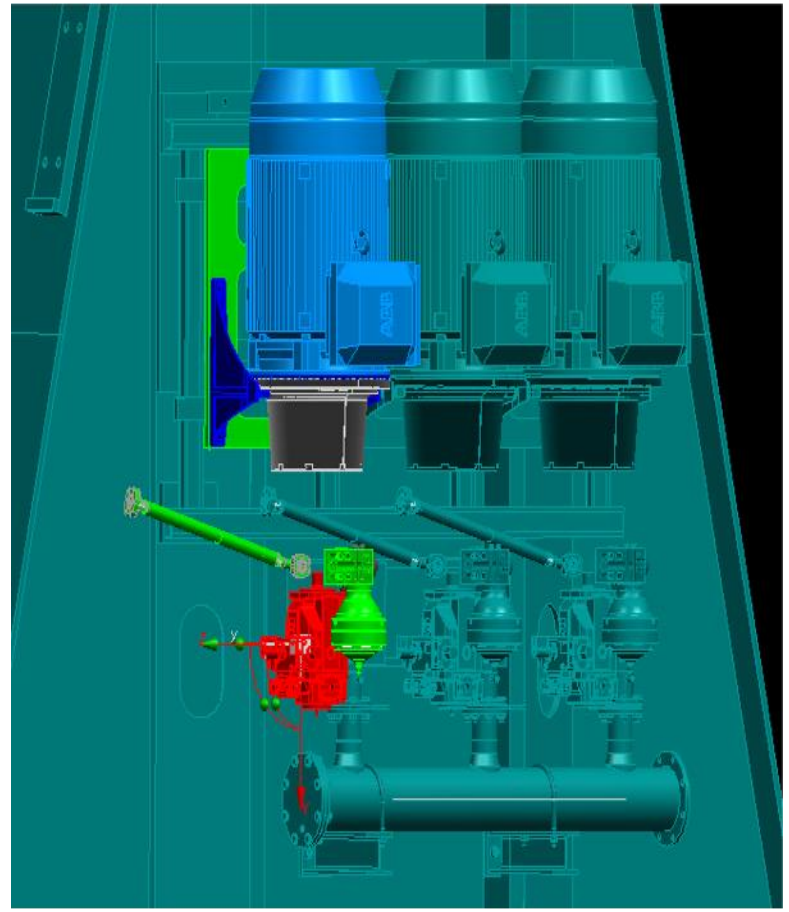
Hydraulic Power Supply (HPS)

Electric driven pumps



Overhaul and maintenance

Disassembly for main components



Hydraulic Power Supply (HPS)

Electrical driven pumps - Operation

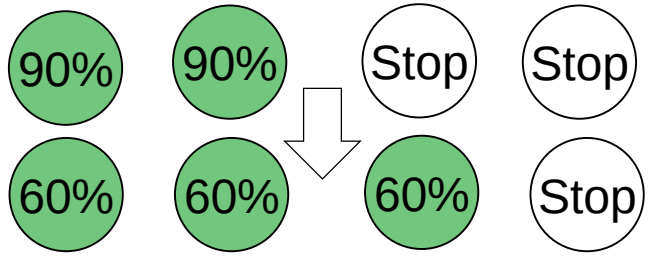
– As an example, if there are four electric driven pumps installed on the engine.

– Two pumps are running at stand - by.

– When engine load increased, next pumps are started automatically with time delay of approximately 2.5 sec. at above 90% of each electric driven pump and share the total swash plate %.

Example: Two pumps running

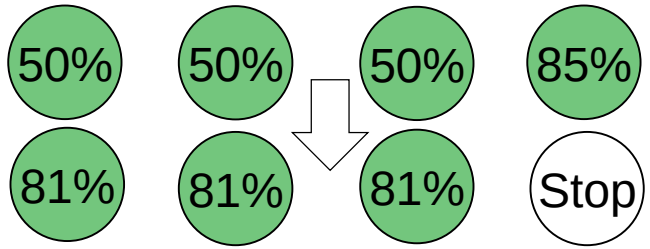
Three pumps running



– One pump is stopped automatically with time delay of approx. 15 sec. at below 50% of each elec. driven pump.

Example: Four pumps running

Three pumps running



– No. 4 pump is fixed displacement pump
– Max. 85% due to mech. stopper

– Start / stop percentage can be changed without notice.

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