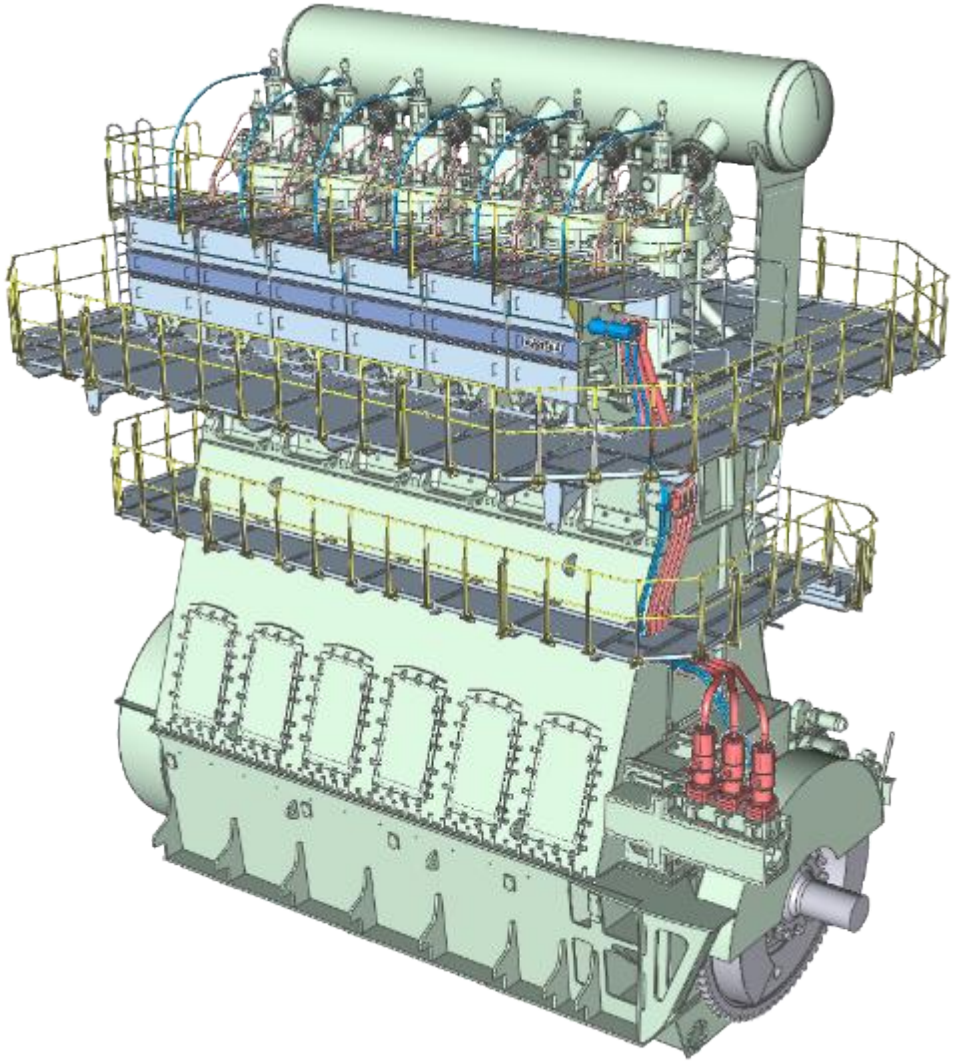
UNIC DF Training

Mech. Components & Hydraulic systems
(RT-flex50/X52/X62/X72DF Specific Parts only for Diesel running)

Overview

Fuel Injection

Exhaust Valve actuation



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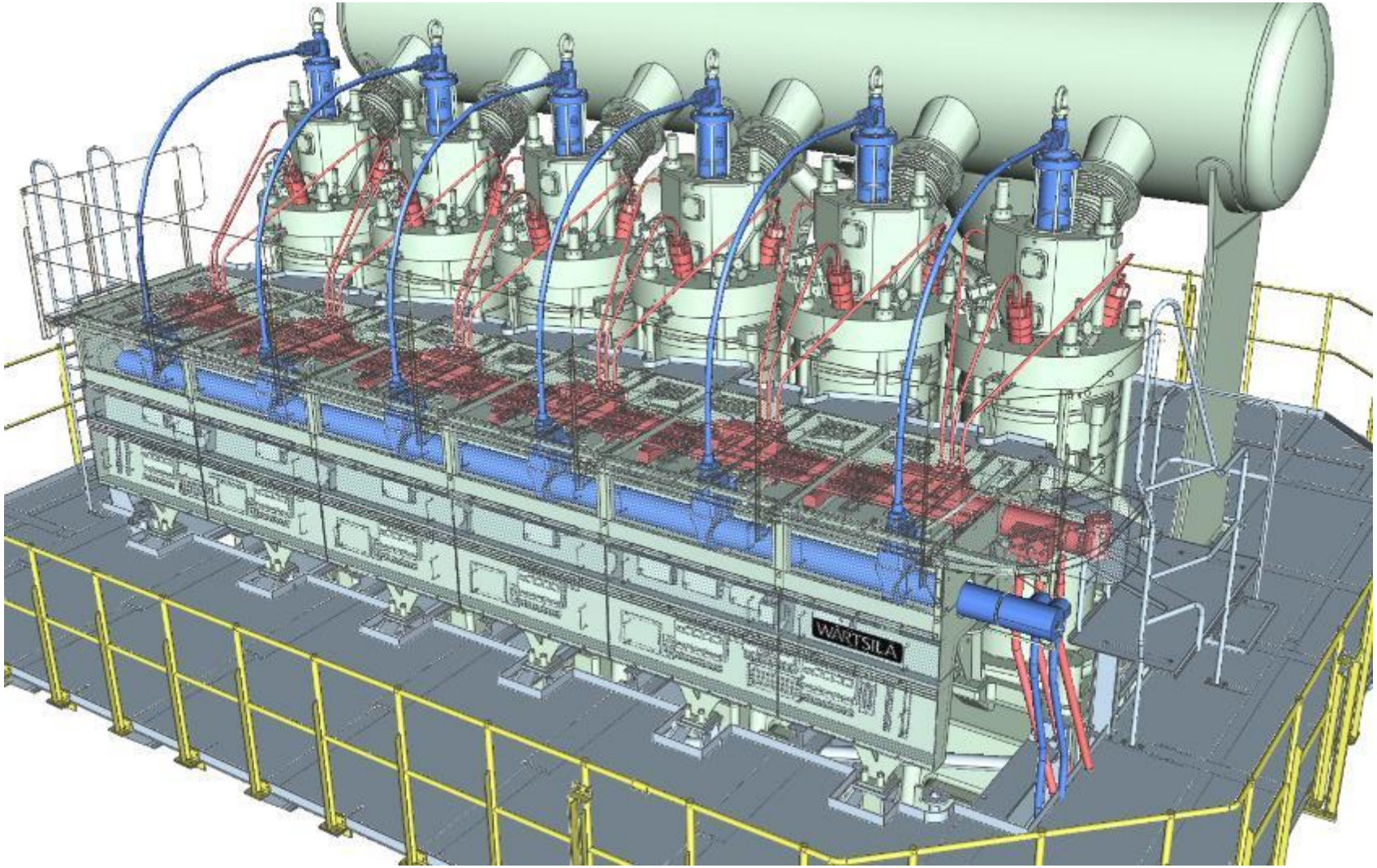
Overview

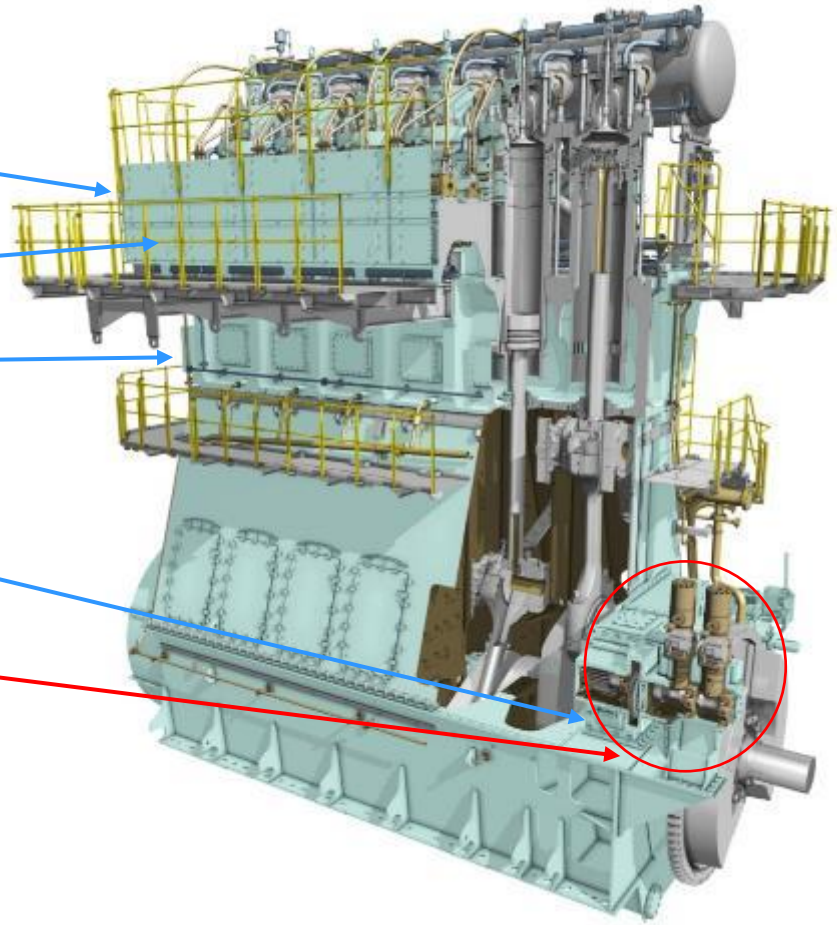


Overview

flex50/X52/62/72 Specific Parts

flex50/X52/62/72 specific Components

- Rail unit
  - Fuel rail
  - Servo rail
- Engine Control System hardware
  - Electronic modules
  - Local control
  - Speed measuring system
- Supply unit
  - Fuel pumps
  - Servo oil pumps



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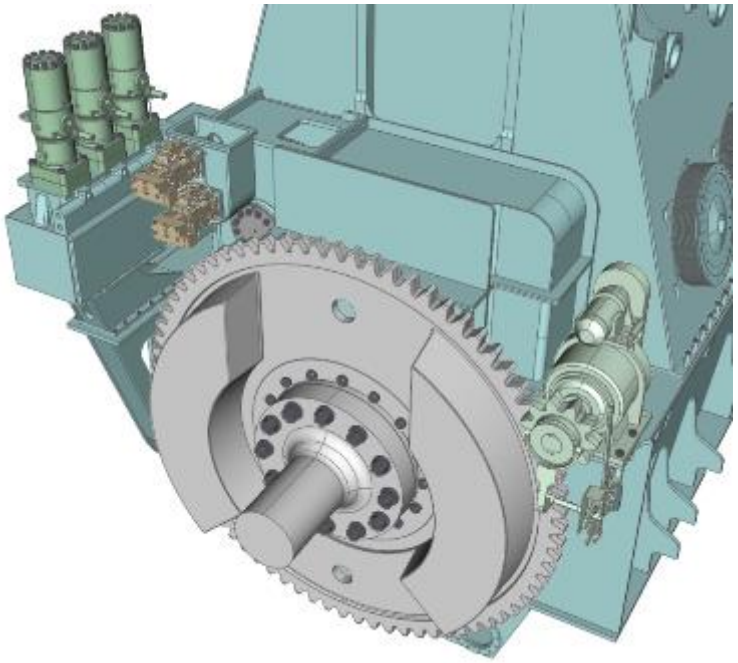
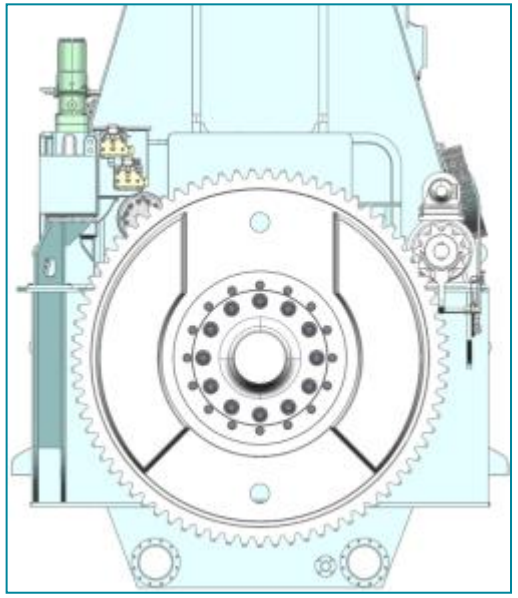
Supply Unit

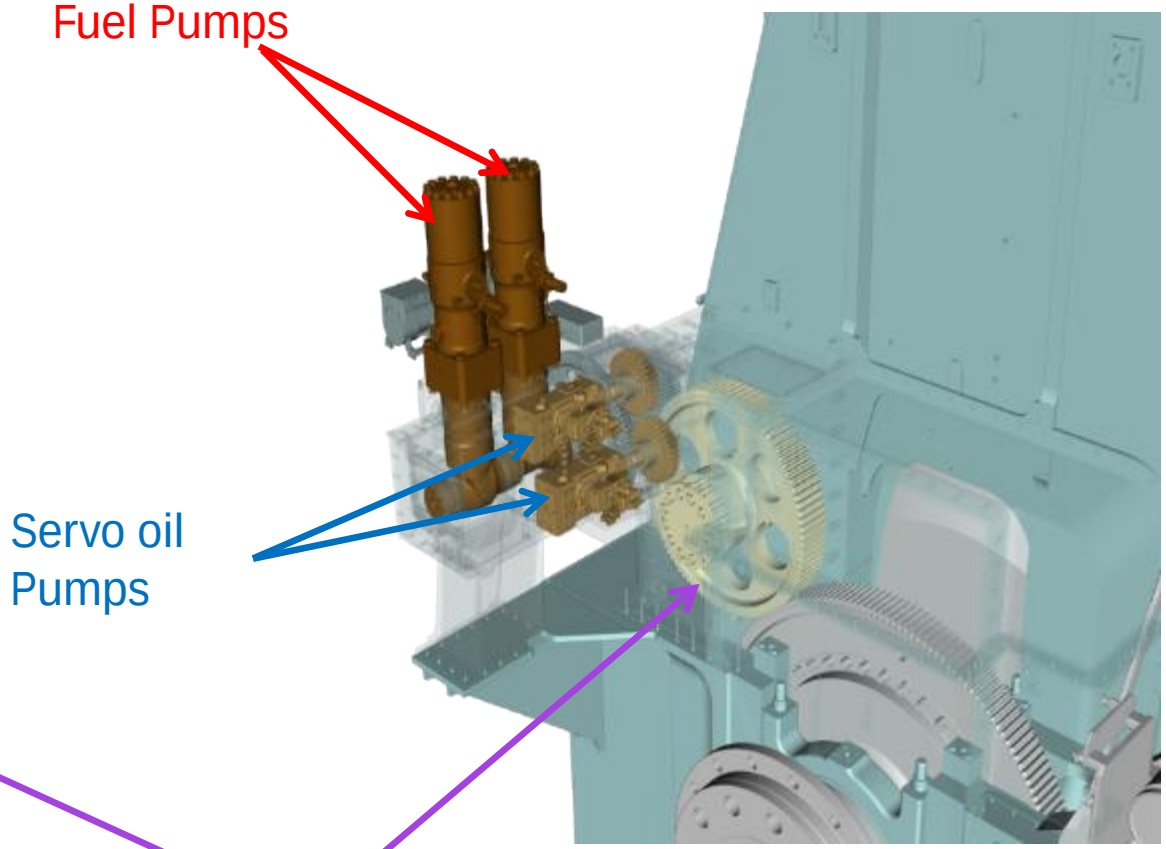
Fuel and servo oil pumps

- Compact design at the engine driving end
- Combined arrangement of heavy fuel oil and servo oil supply in one housing
- Fuel oil supply
  - Pressure up to 1000 bar
  - 2-3 fuel pumps
- Servo oil supply
  - Pressure up to 300 bar (50DF: 200 bar)
  - Axial piston type oil pumps
  - 2 pumps





Supply Unit



The fuel- and servo pumps are driven by the crankshaft via intermediate wheel

Supply Unit – flex50DF / X52DF

Supply Unit – X62/72DF

Supply Unit – X62/72DF

Supply Unit – X62/72DF

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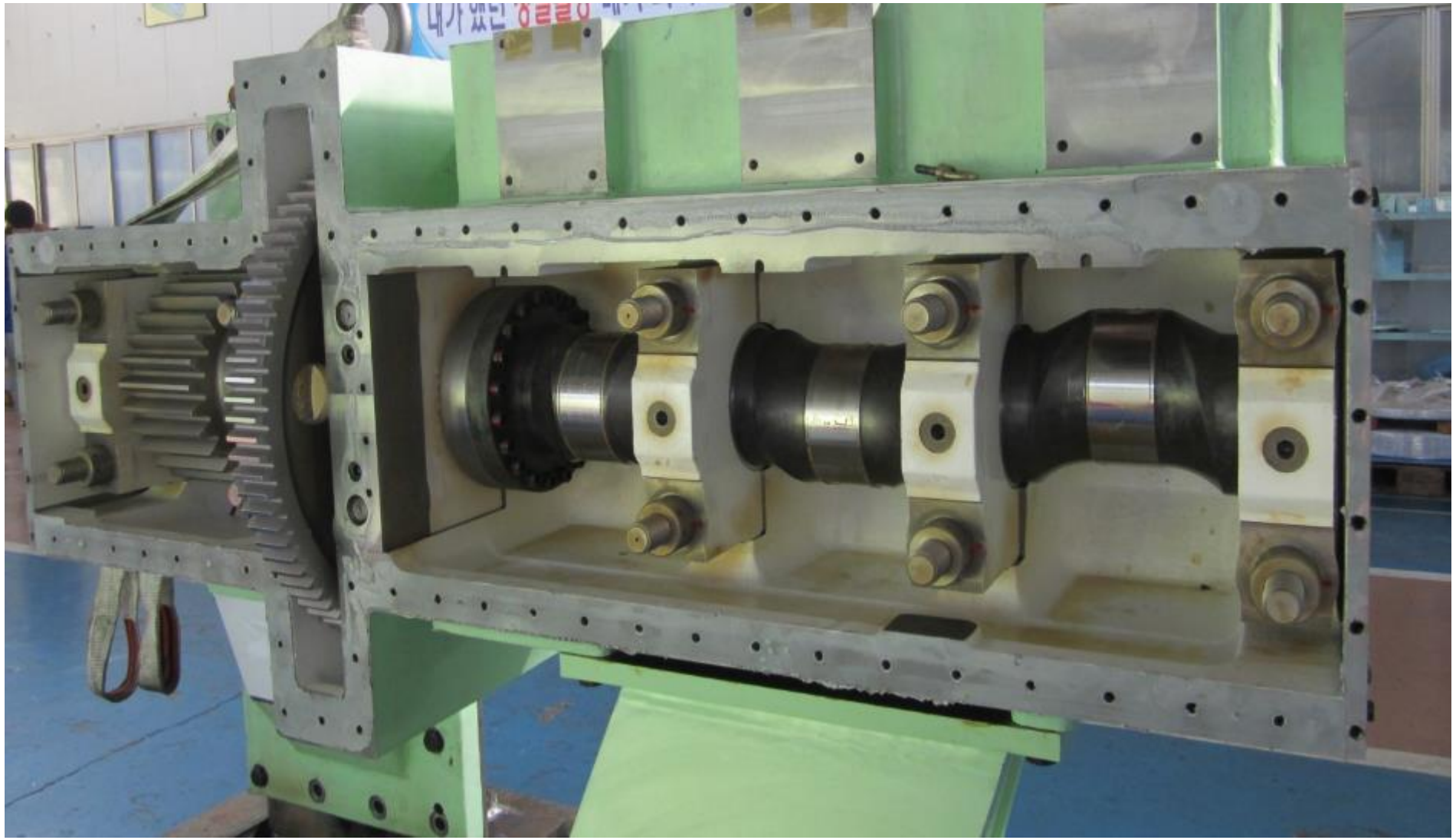
Supply Unit – X62/72DF



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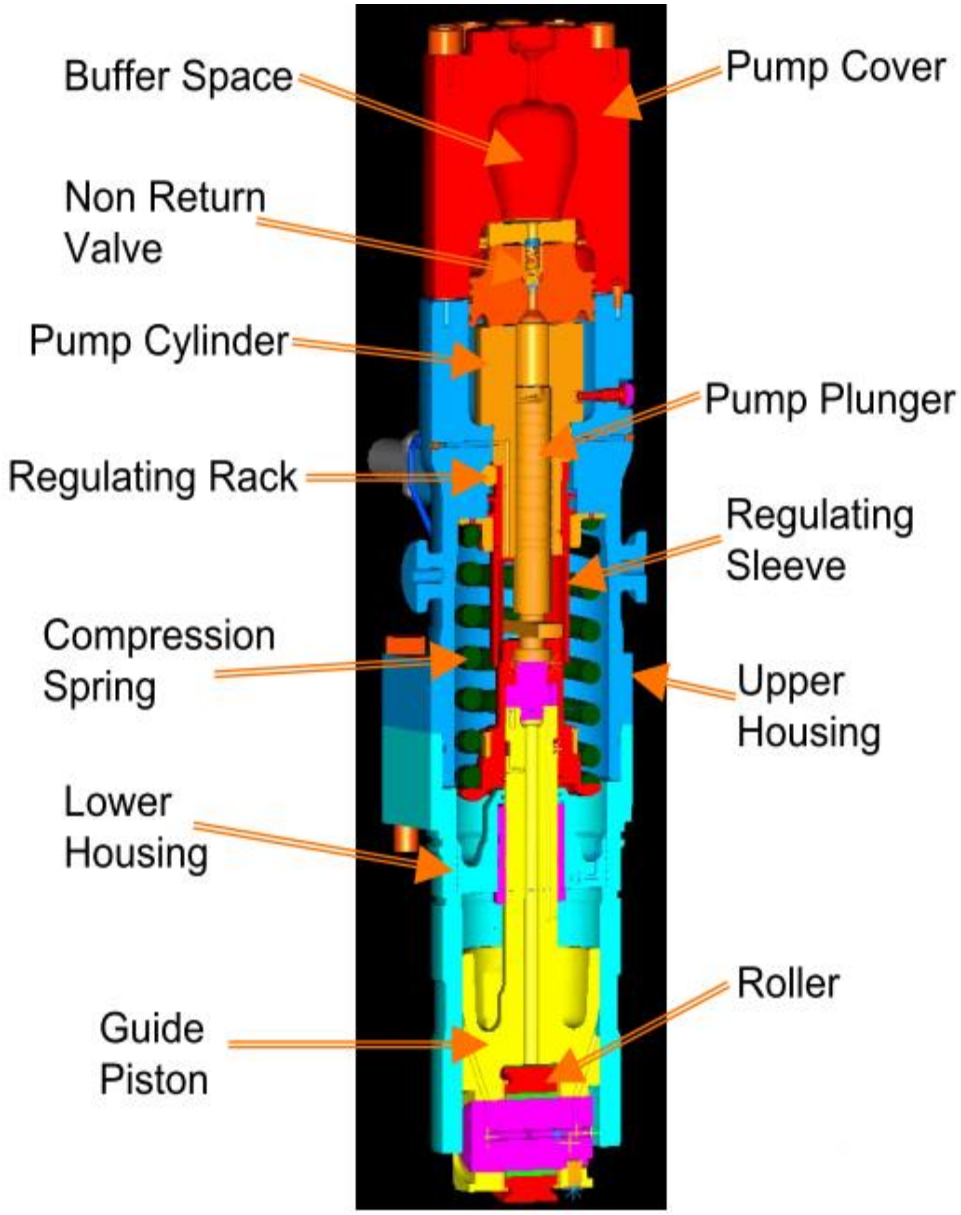
Supply Unit

Fuel Pump

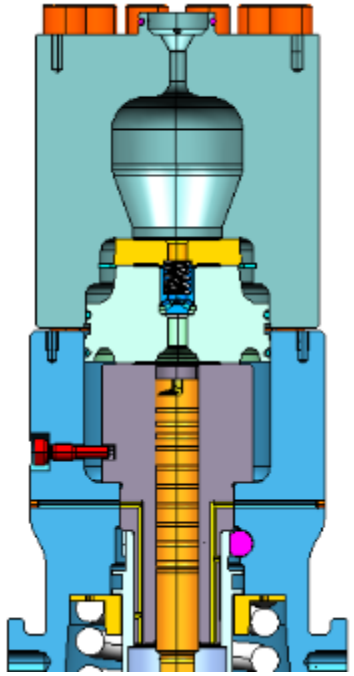
- The jerk-type fuel pumps deliver variable quantity of fuel to the fuel rail pipe in order to maintain the demanded fuel rail pressure
- To change the feeding quantity, the pump plunger is turned by the regulating rack
- The guide piston/roller assembly and regulating sleeve are lubricated by main bearing oil



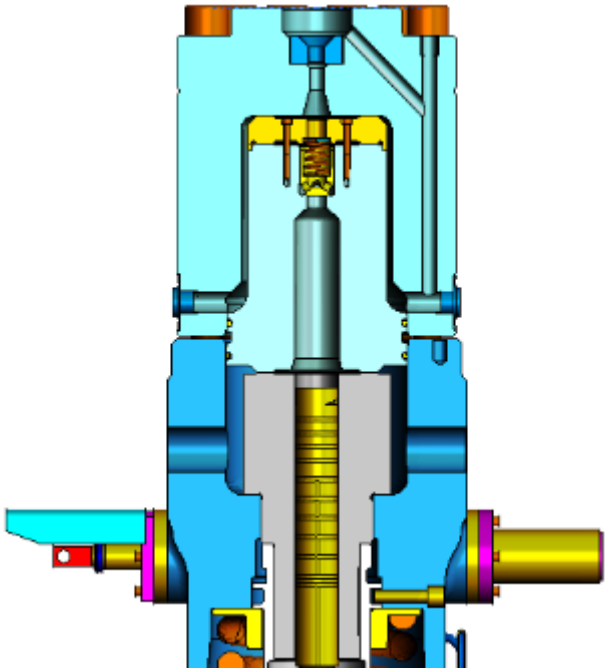
Supply Unit

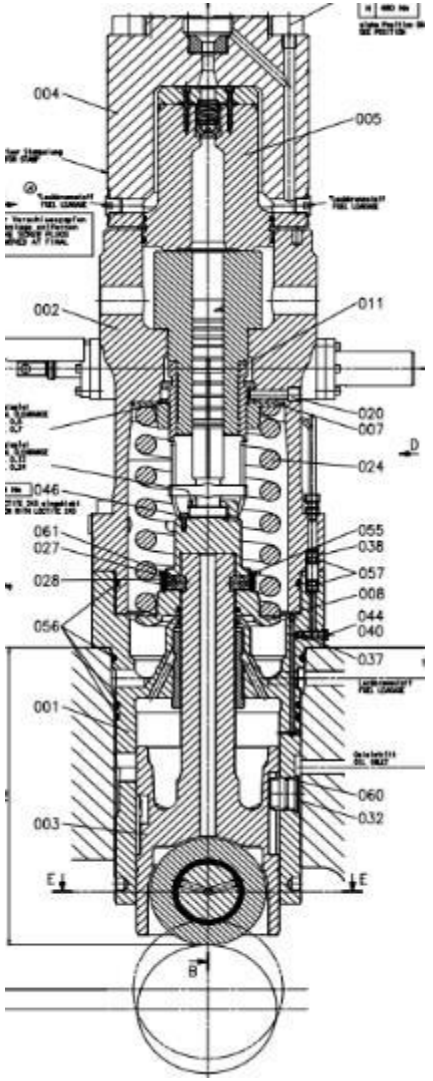
Fuel Pump, X62 & X72

V4 Fuel pump



X4 Fuel pump



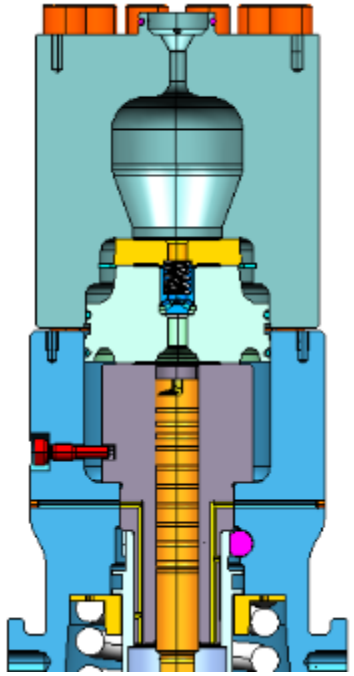


- X4 fuel pump based on standard RT-flex pump but with latest improvements.
- Increased volume between Plunger and NRV for improved damping of forces on roller & spring (dynamic force reduced by ~20 %)

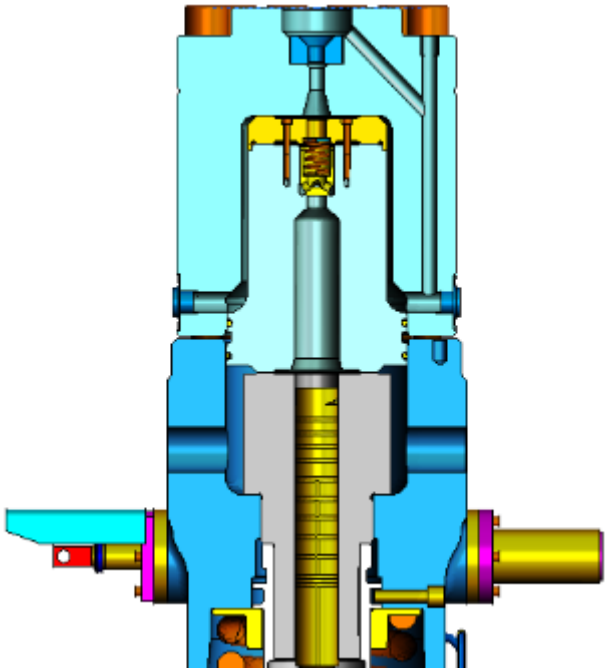
Supply Unit

Fuel Pump, X62 & X72

V4 Fuel pump



X4 Fuel pump



- X4 fuel pump based on standard RT-flex pump but with latest improvements.
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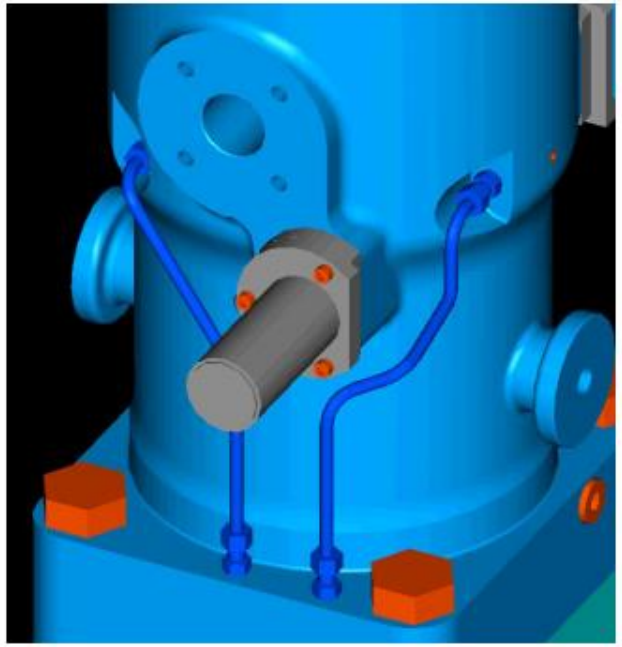
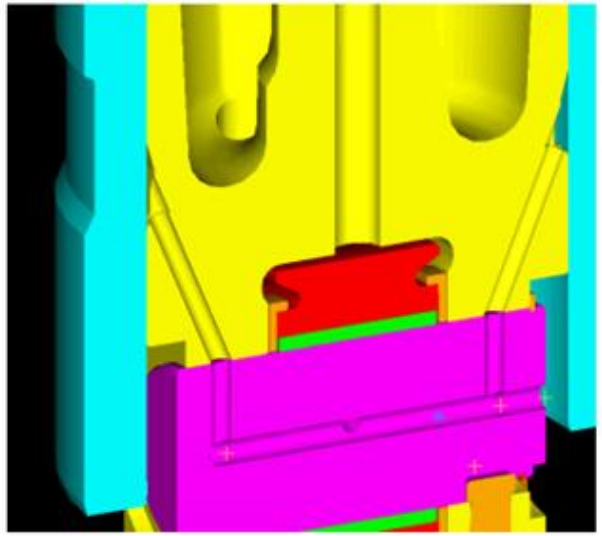
Supply Unit

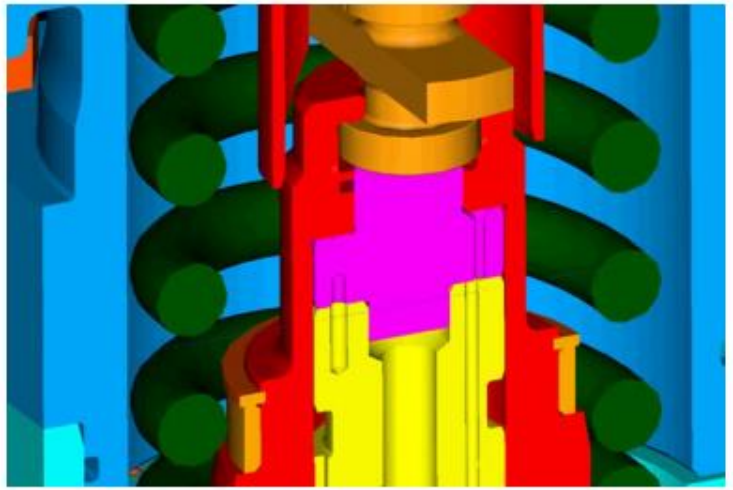
Fuel Pump



L.O. Piping from / to
Regulating Sleeve



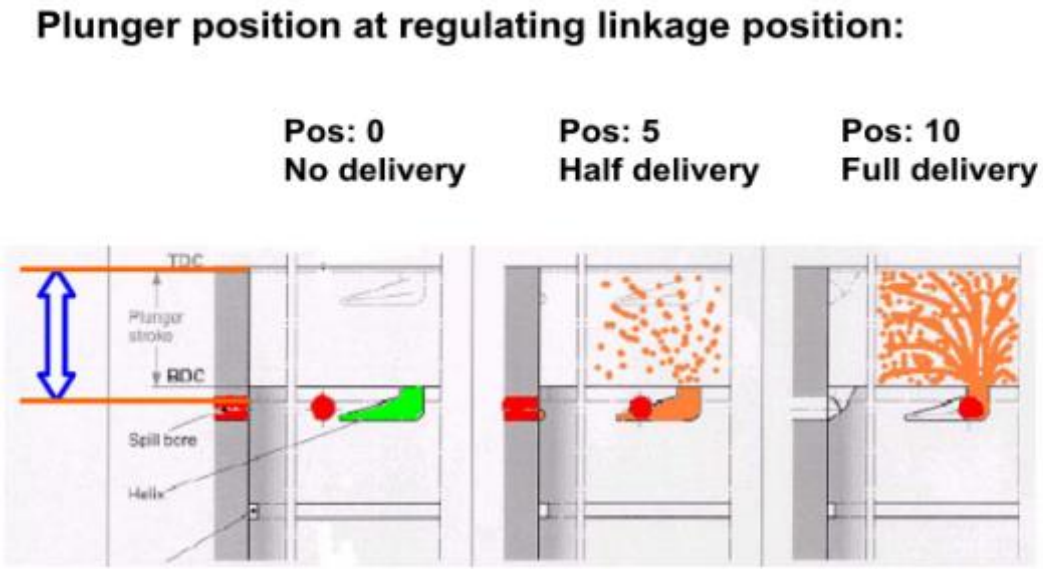
Guide Piston and Roller

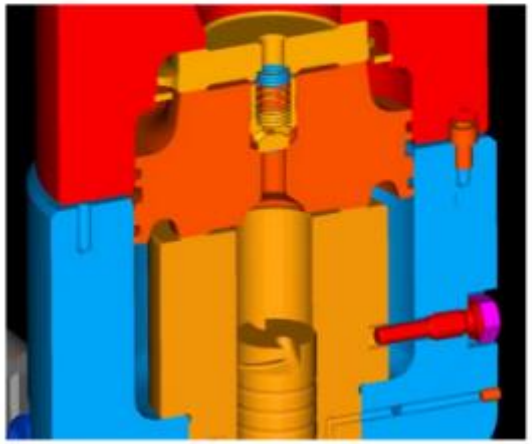


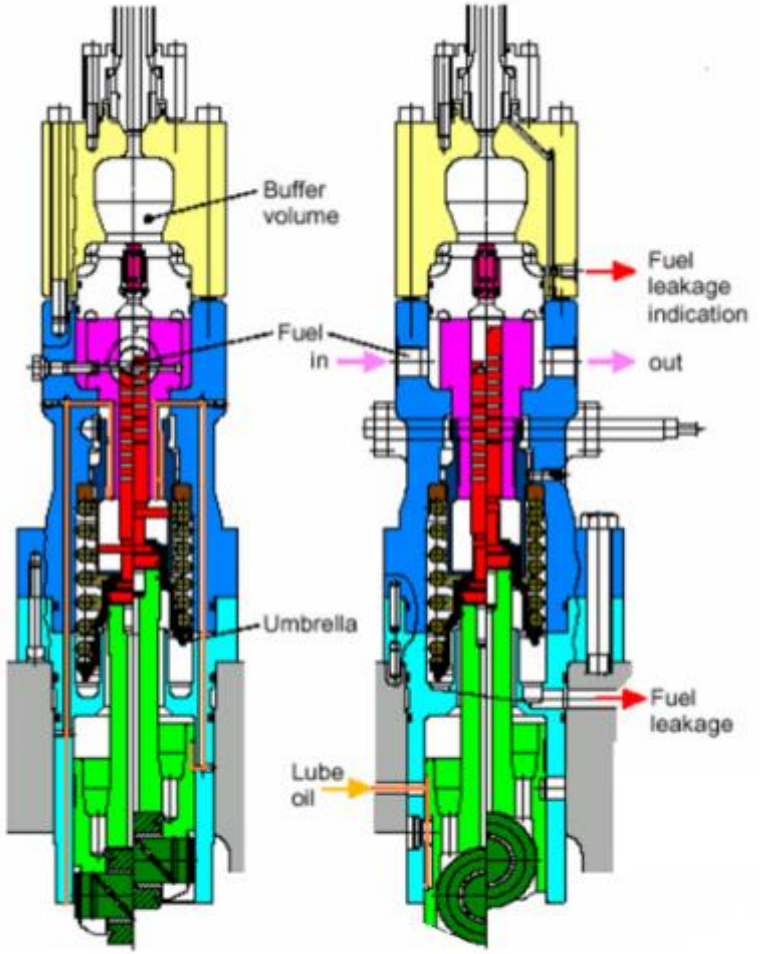
Plunger and Thrust Piece

Supply Unit

Fuel Pump







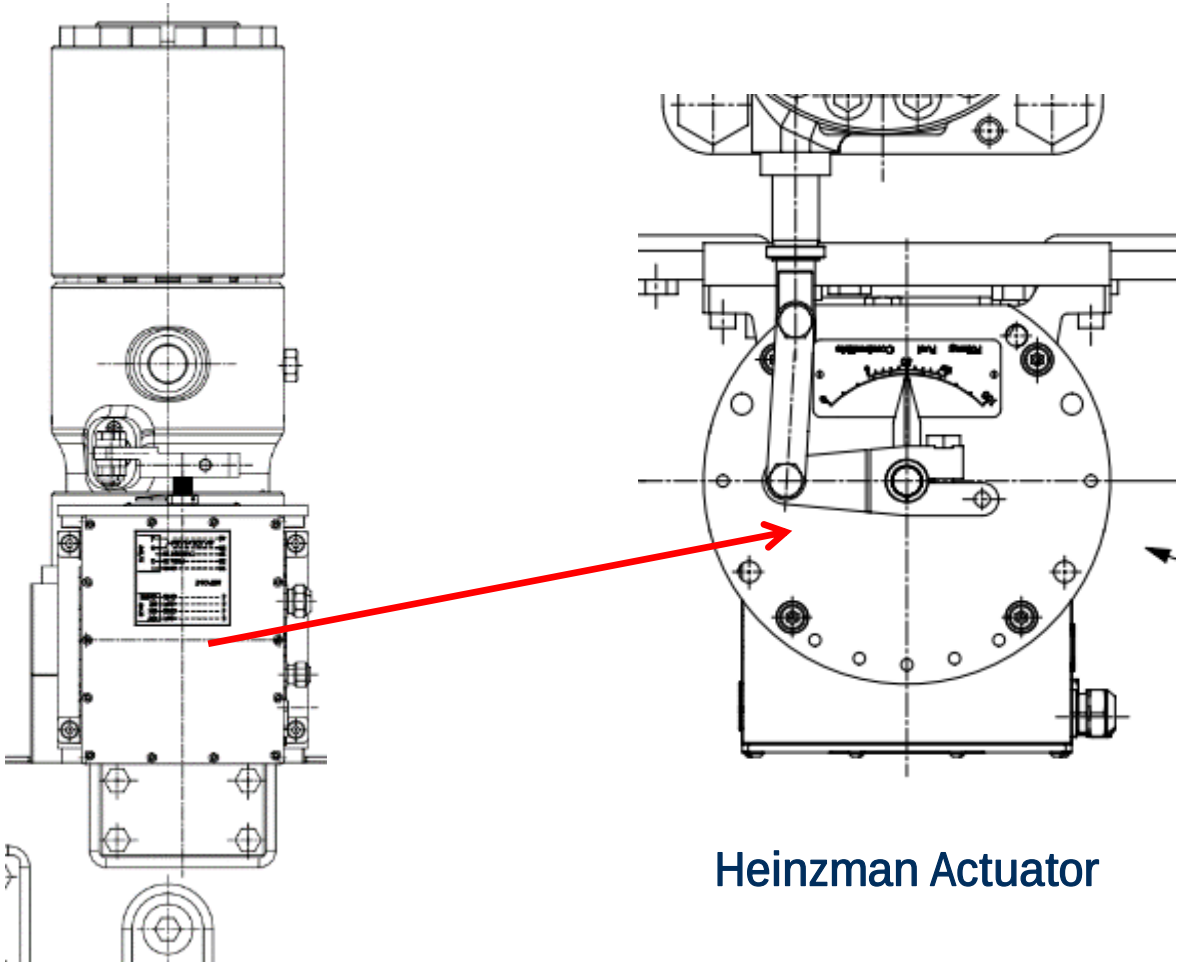
Supply Unit

Fuel Pump

Maximum achievable engine power with one fuel pump failed				
flex50 / X52 Engines				
Number of cylinders	5 Cylinder	6 Cylinder	7 Cylinder	8 Cylinder
Number of fuel pumps / plunger Ø	2 / 35	3 / 32	3 / 34	3 / 36
Max. engine power	56%	94%	90%	88%
X62 Engines				
Number of cylinders	5 Cylinder	6 Cylinder	7 Cylinder	8 Cylinder
Number of fuel pumps / plunger Ø	2 / 40	2 / 44	2 / 46	3 / 42
Max. engine power	47%	48%	43%	81%
X72 Engines				
Number of cylinders	5 Cylinder	6 Cylinder	7 Cylinder	8 Cylinder
Number of fuel pumps / plunger Ø	2 / 46	3 / 42	3 / 46	3 / 46
Max. engine power	45%	79%	71%	66%

Supply Unit

Fuel Pump Actuator – flex50DF / X52DF



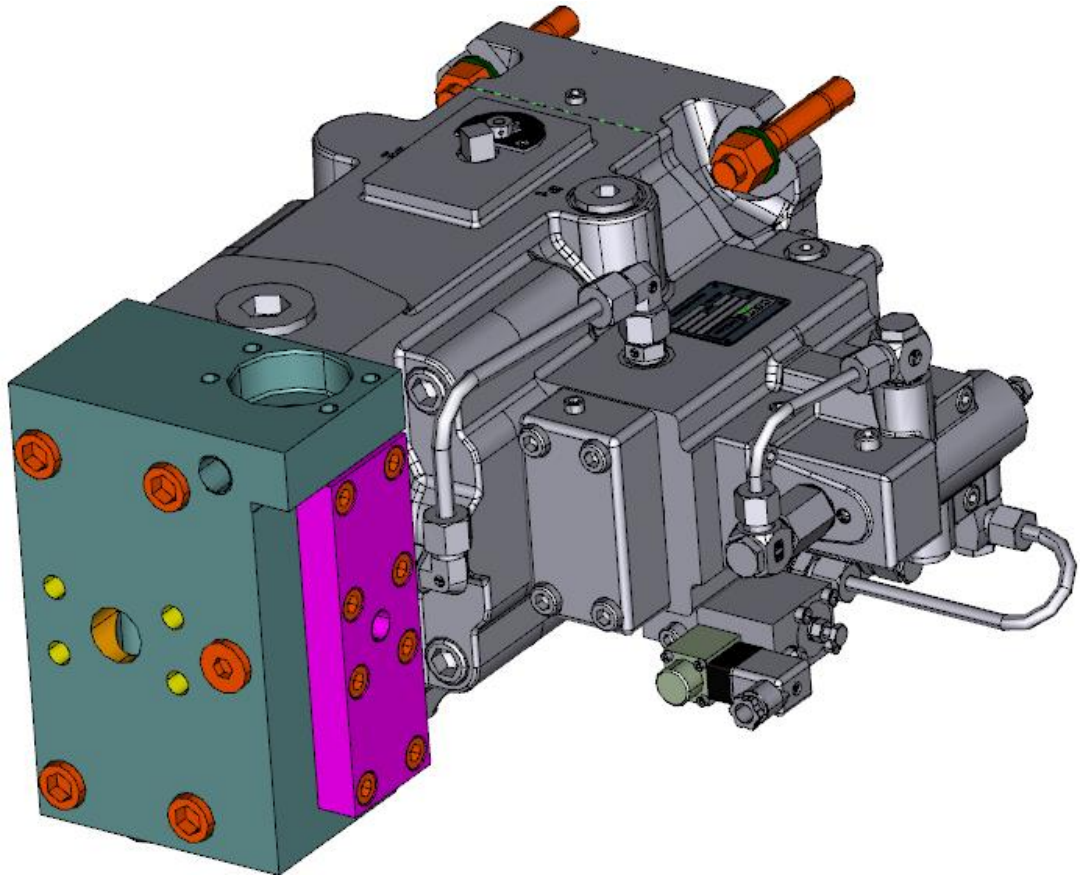
Heinzman Actuator

Supply Unit

Fuel Pump Actuator

Supply Unit

Servo Oil Pump



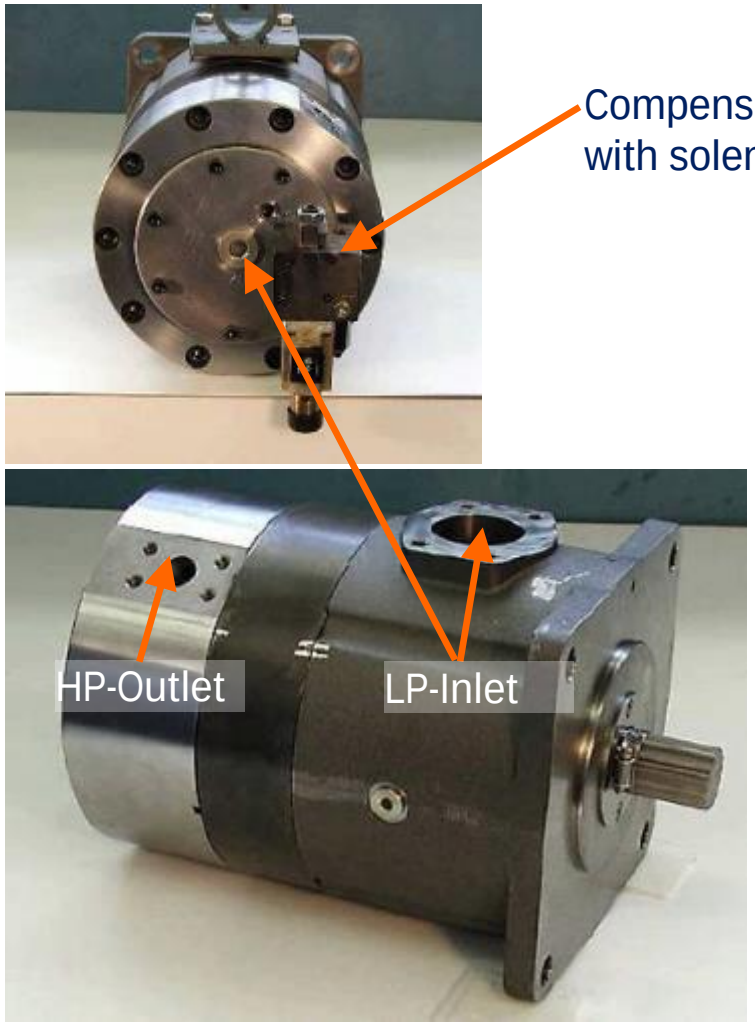
- HAWE Axial Piston Pumps
- Servo oil pressure up to 300bar

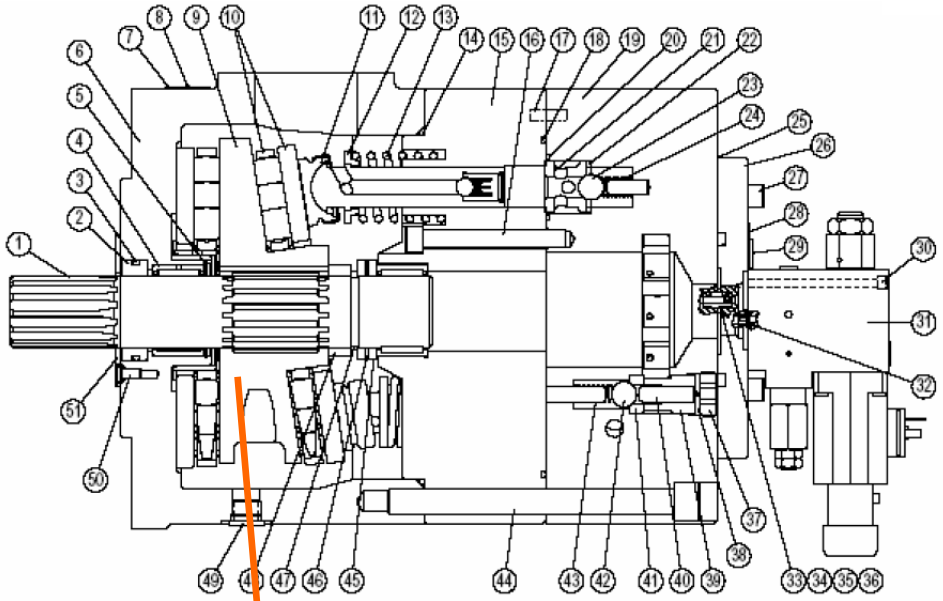
Supply Unit

Bosch S.O pump

Supply Unit

Dynex S.O pump for flex50DF / X52DF

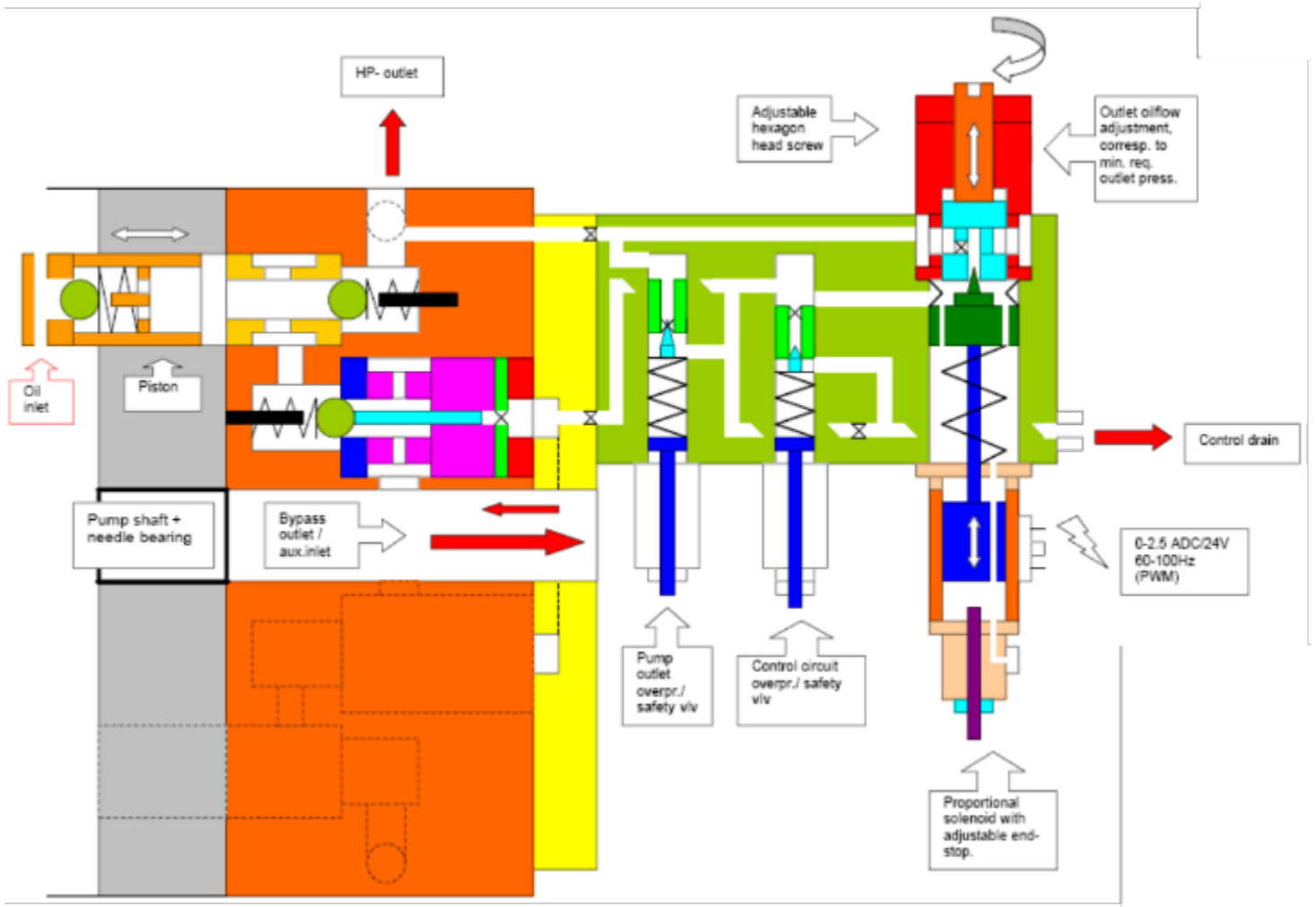




- Dynex Axial Piston Pumps
- Servo oil pressure up to 300bar

Supply Unit

Dynex S.O pump for flex50DF / X52DF

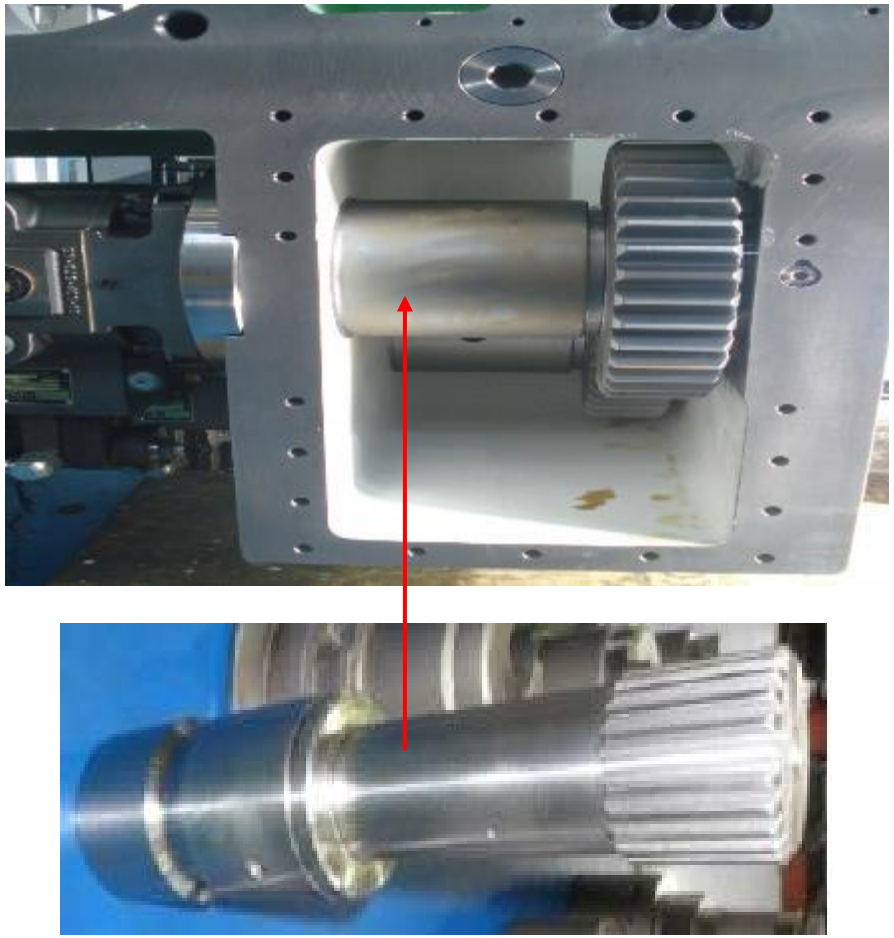


Supply Unit

Servo Oil Pump

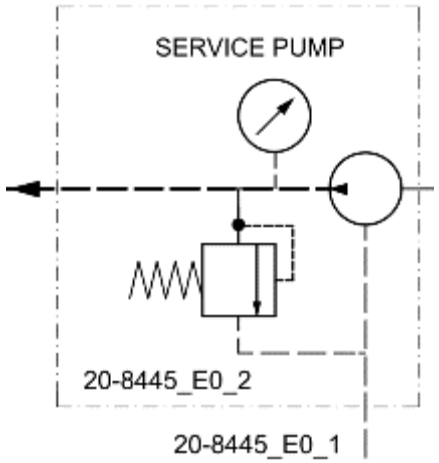
- The Servo Oil supply unit is driven by the crankshaft, via an intermediate gearwheel

- The servo oil pumps are driven by individual pinions, having a “mechanical fuse” (reduced diameter on carried shaft between pinion gear and servo pump), in order to protect the gear-drive in case of a pump seizure



Servo Oil Service Pump

- Service pump to pressurise servo oil rail after service work
- Testing of exhaust valve functions at engine standstill
- Manual cylinder lubrication at engine standstill
- Must not be running while engine running



flex50

X52

X62 & X72

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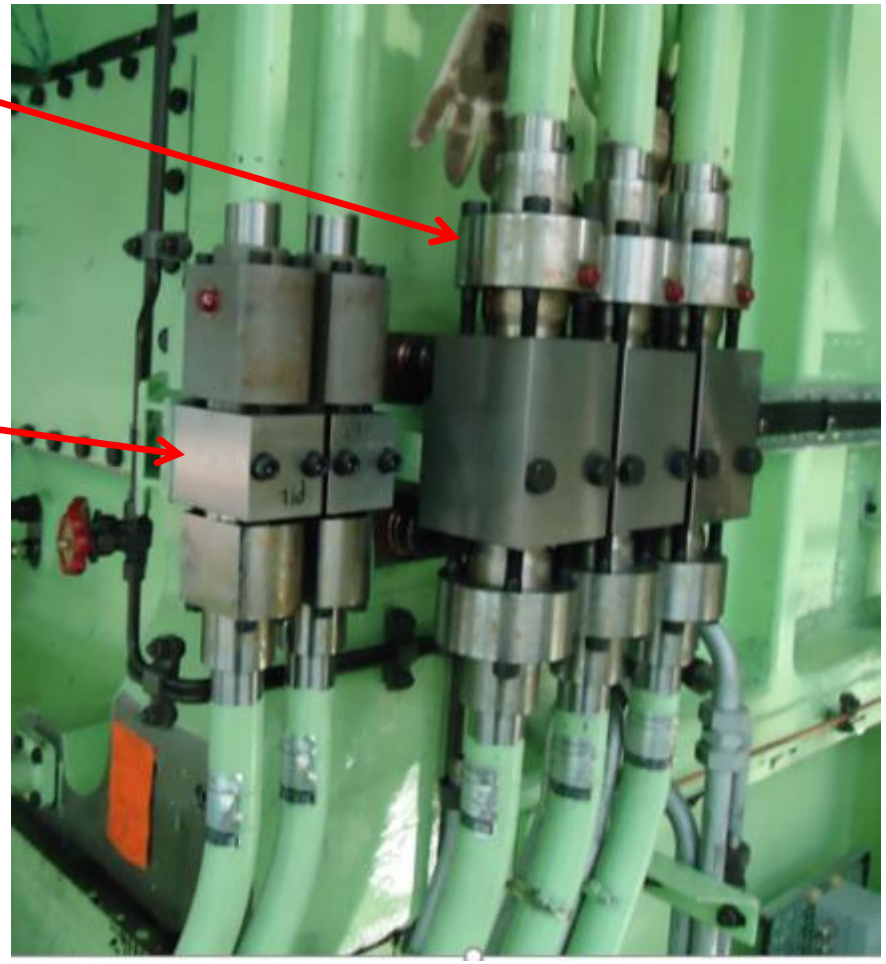
Rising Pipes

flex50DF / X52DF

Fuel oil rising pipes

Servo oil rising pipes

X62/72DF



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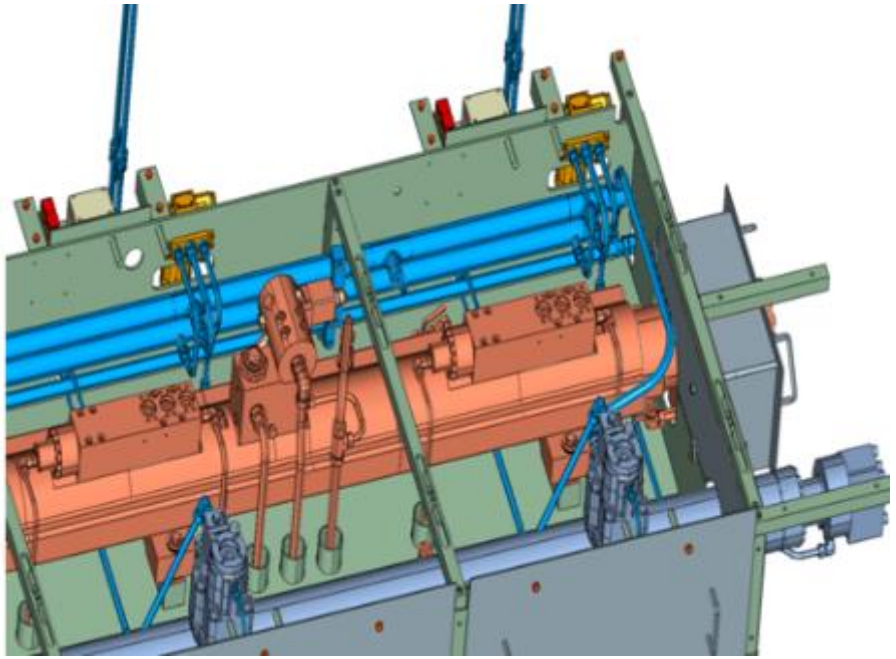
Rail Unit

- Fuel oil rail:
  ~ 600 - 1000 bar fuel delivered by the fuel pumps of the supply unit.
  For each cylinder, there is an Flow Limiting Valve.
  The rail is heated by a trace heating piping system.

- Servo oil rail:
  ~ 80 - 300 bar (50DF: 200 bar) servo oil, delivered by the servo oil pumps of the supply unit, depending on engine load.
  For each cylinder there is a Valve Control Unit (VCU).

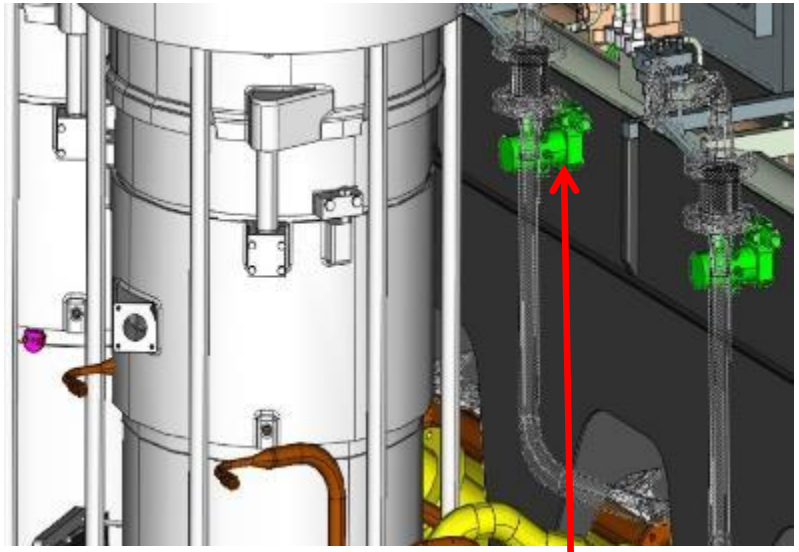
- Mini-Rail:
  60 bar servo oil regulated by pressure regulating valve and supplied from No.1 VCU (50DF: from SO Rail FE side, between #N & #N-1)

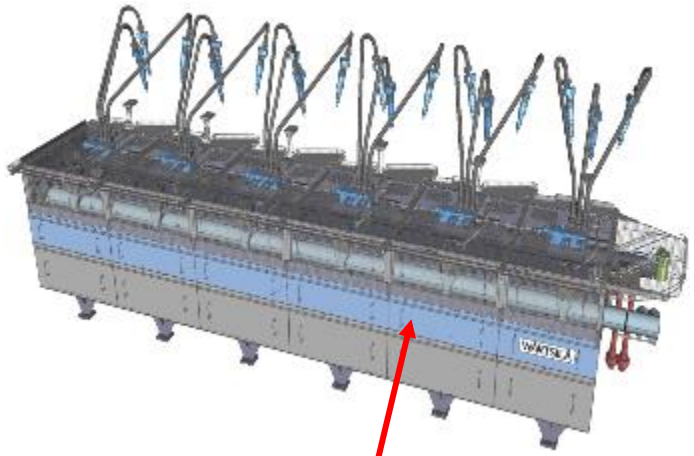
- Cylinder oil rail
  Cylinder oil from Cylinder oil daily tank

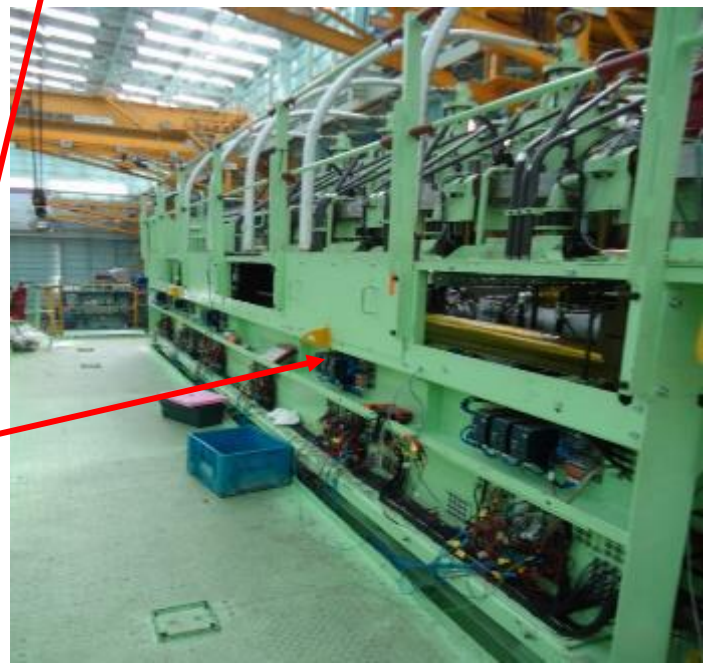


- Additional return/leakage piping:
  - Injector lub oil supply
  - Fuel return & leakage pipe from injectors
  - Servo oil return
  - Main bearing oil pipe

Rail Unit







- Rail unit contains cylinder lubrication pumps
- Power supplies attached in separate housing within rail unit

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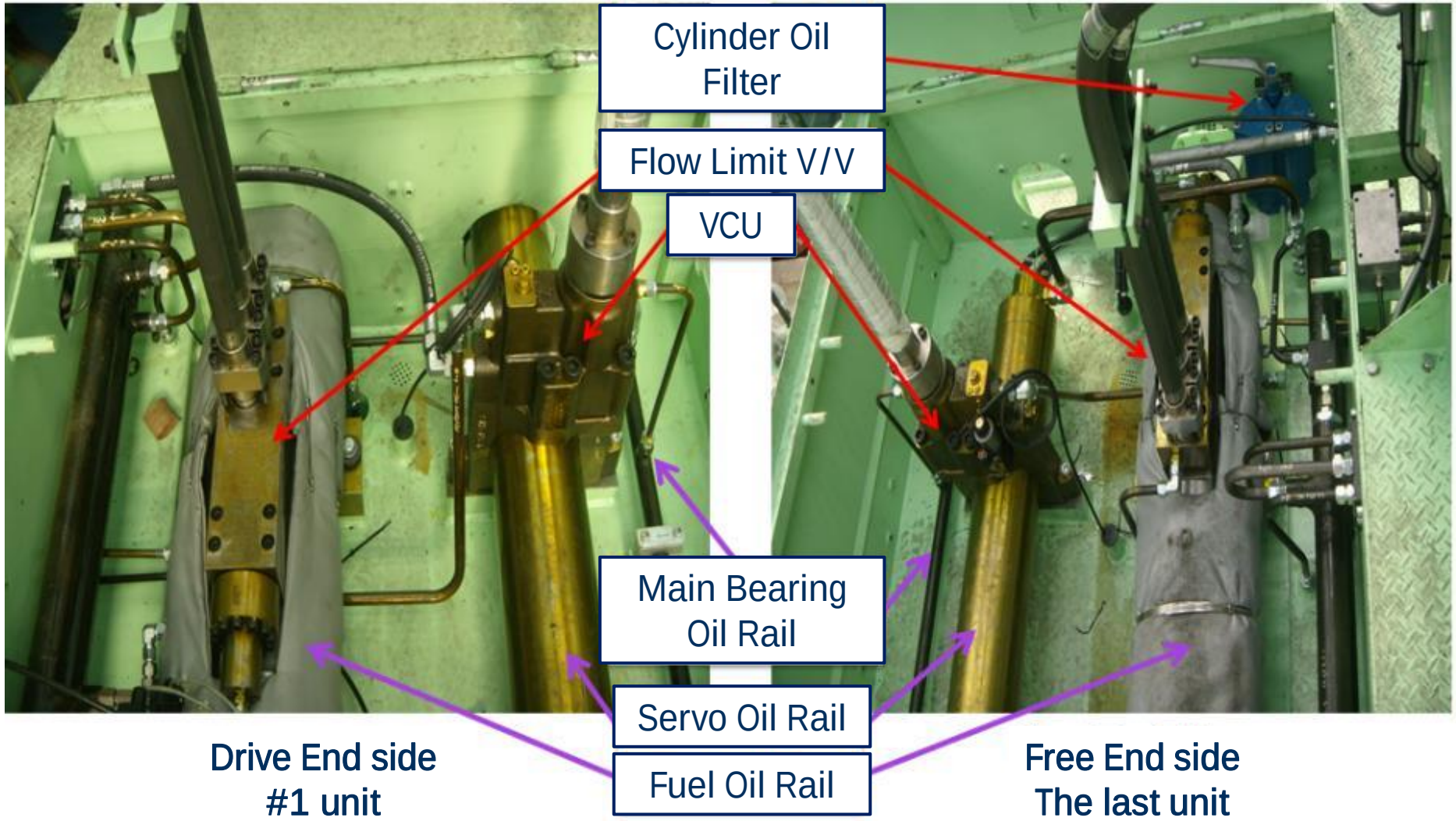
Rail Unit



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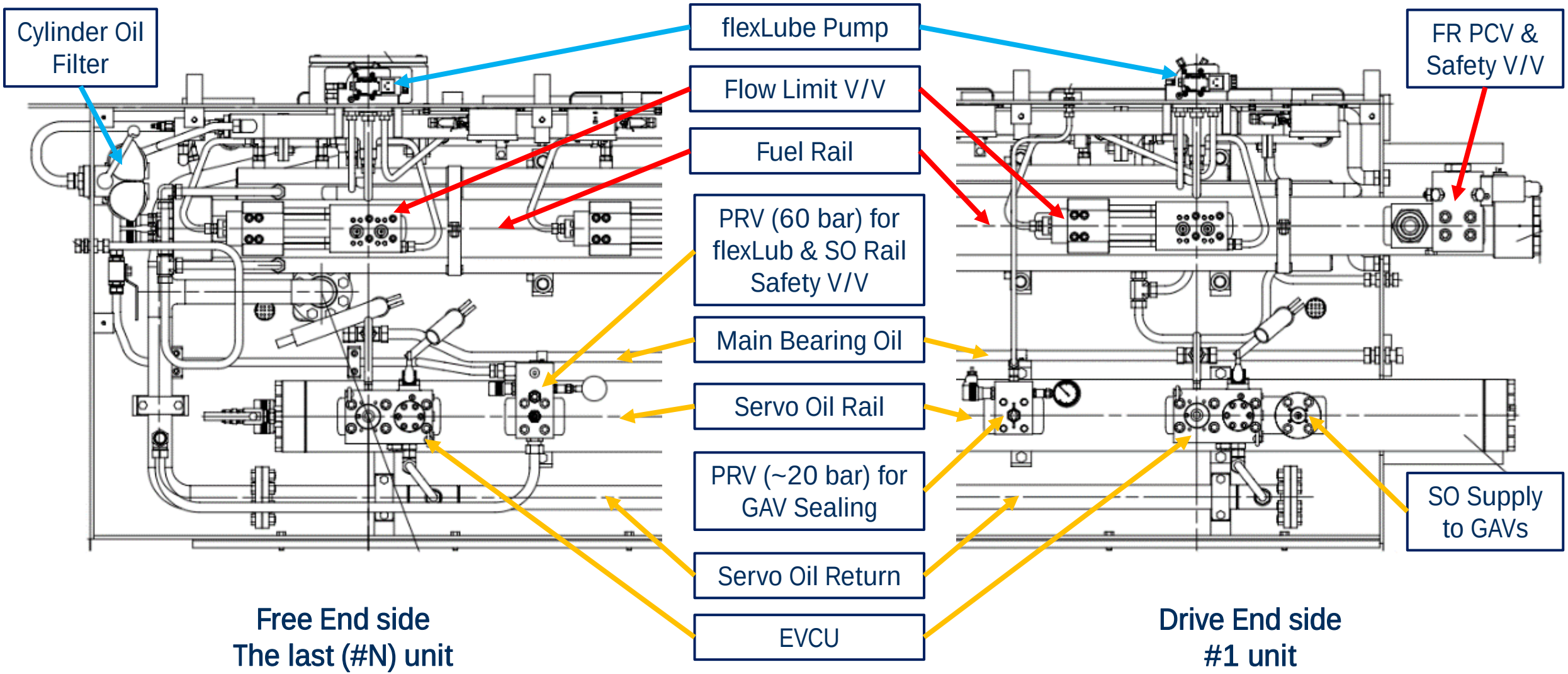
Rail Unit, flex50DF



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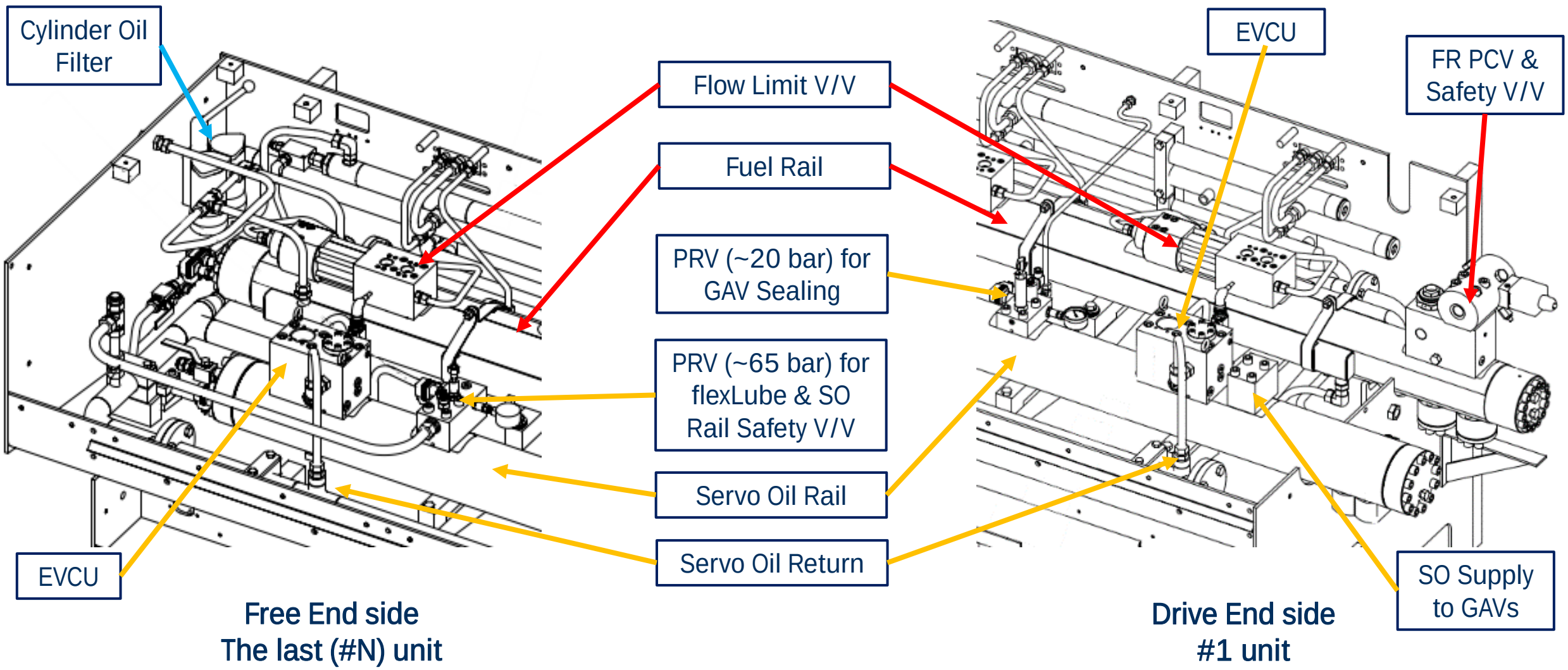
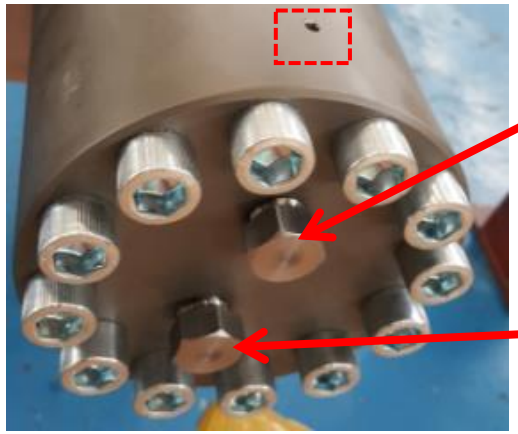
Rail Unit, flex50DF



Rail Unit, flex50DF

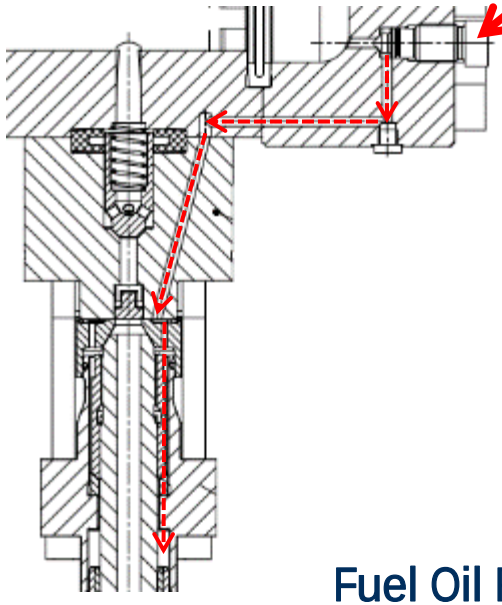
Drive End side
#1 unit

Rail Unit, flex50DF – DE side

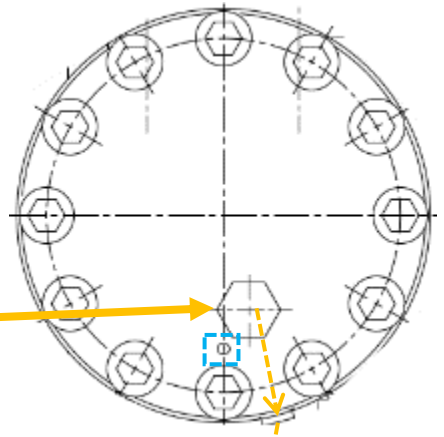


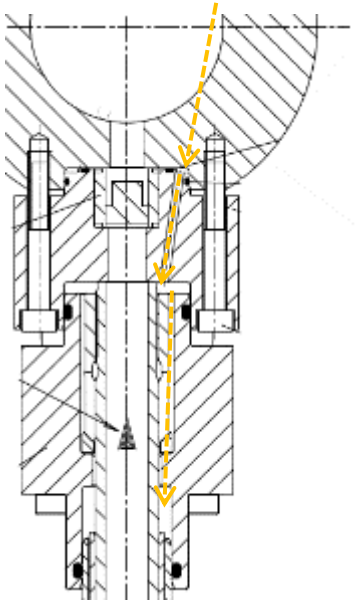
Air Vent Plug

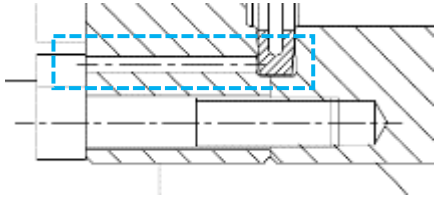
Drain Plug



Fuel Oil Rail







Servo Oil Rail

Rail Unit – Drive End Side

X52DF

X62/72DF

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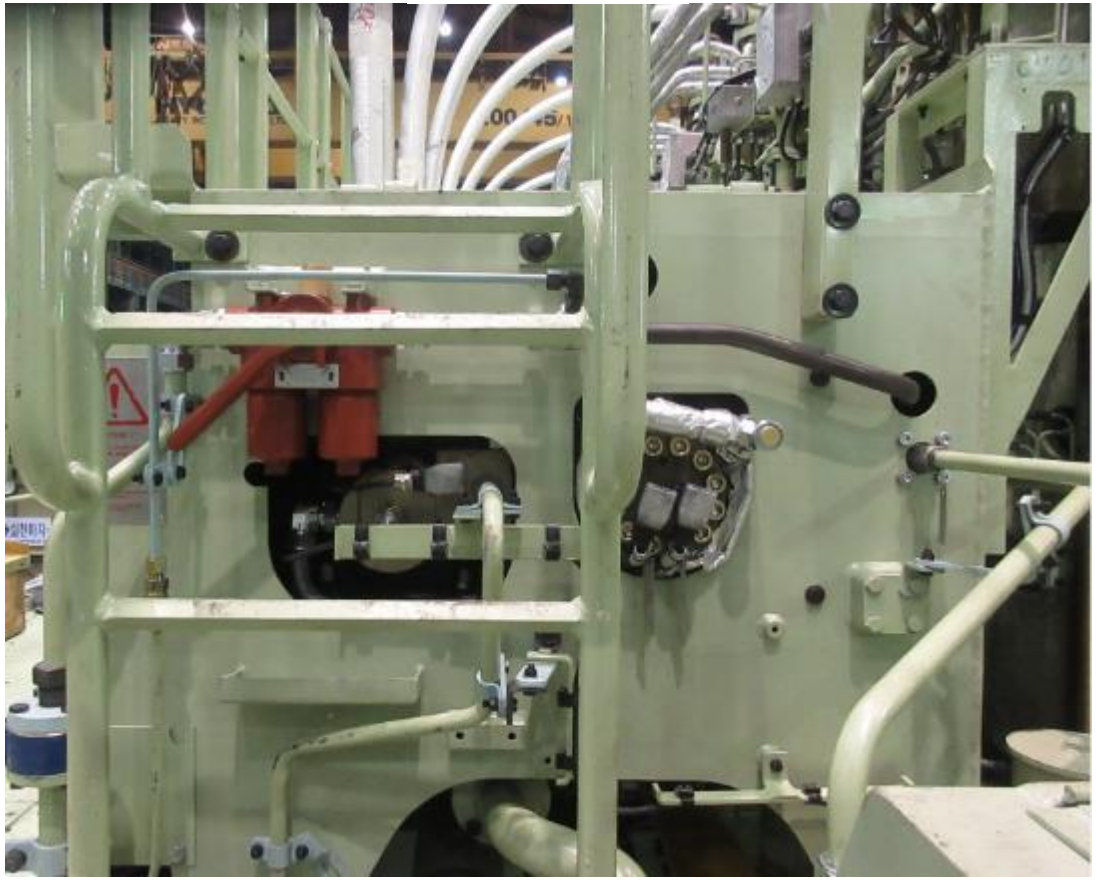
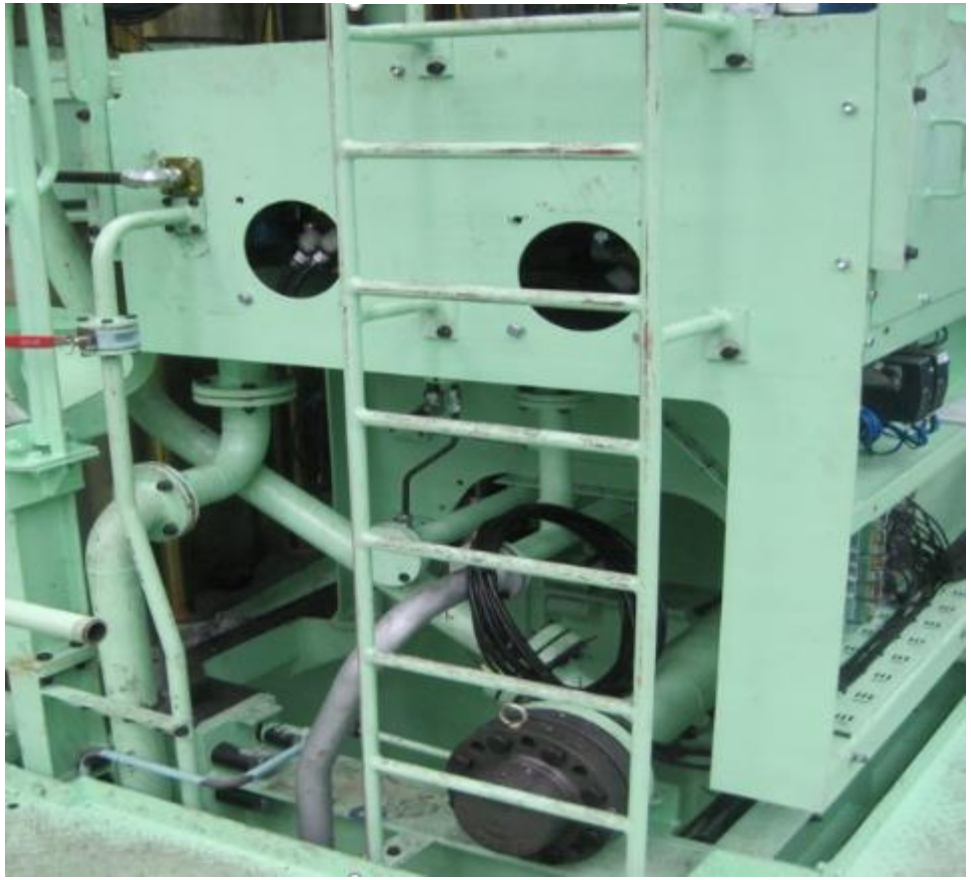
Rail Unit – Free End Side

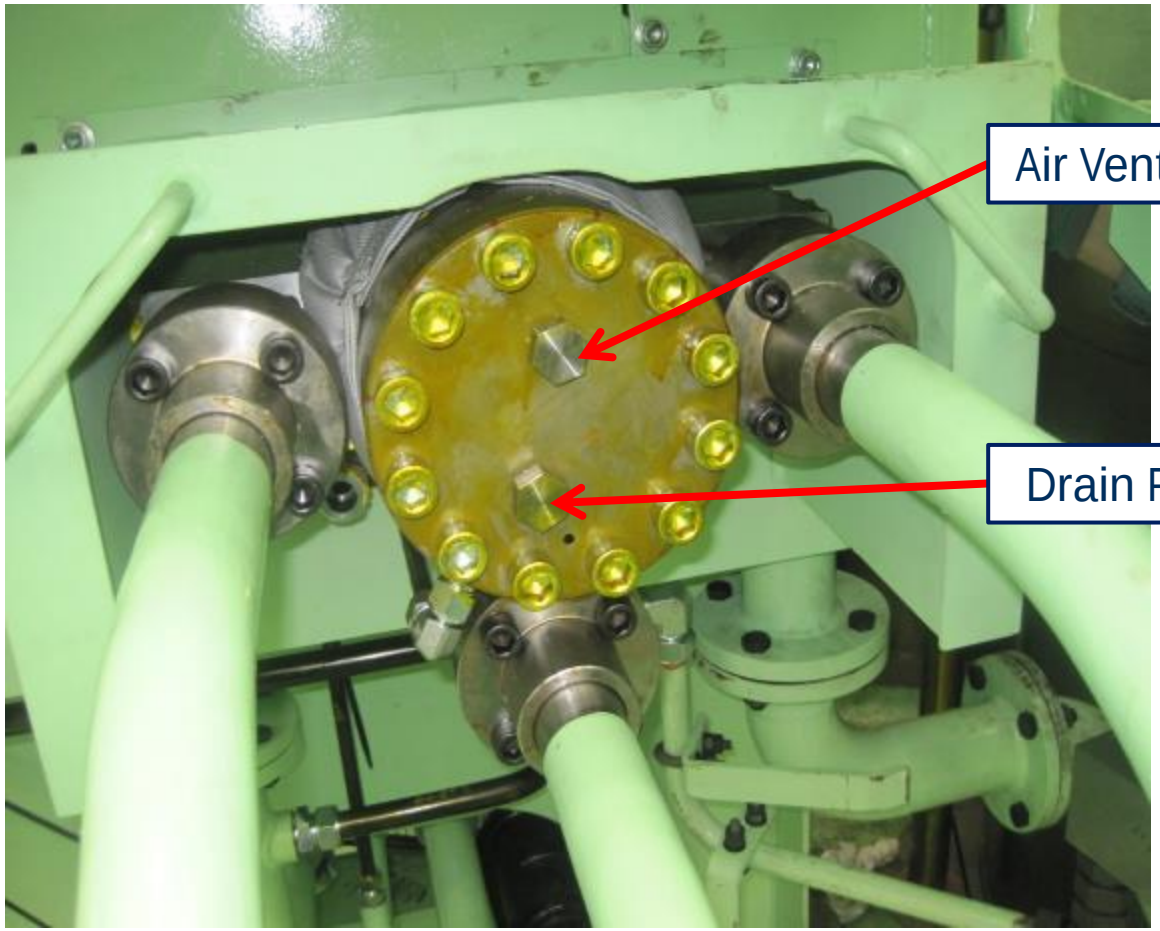
X52DF



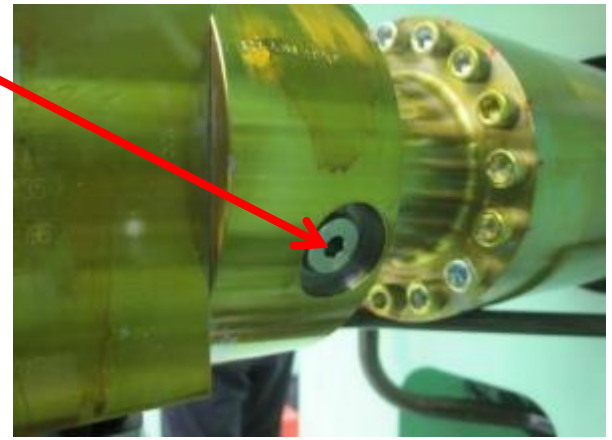
X62/72DF



Rail Unit



Fuel Oil Rail



Servo Oil Rail

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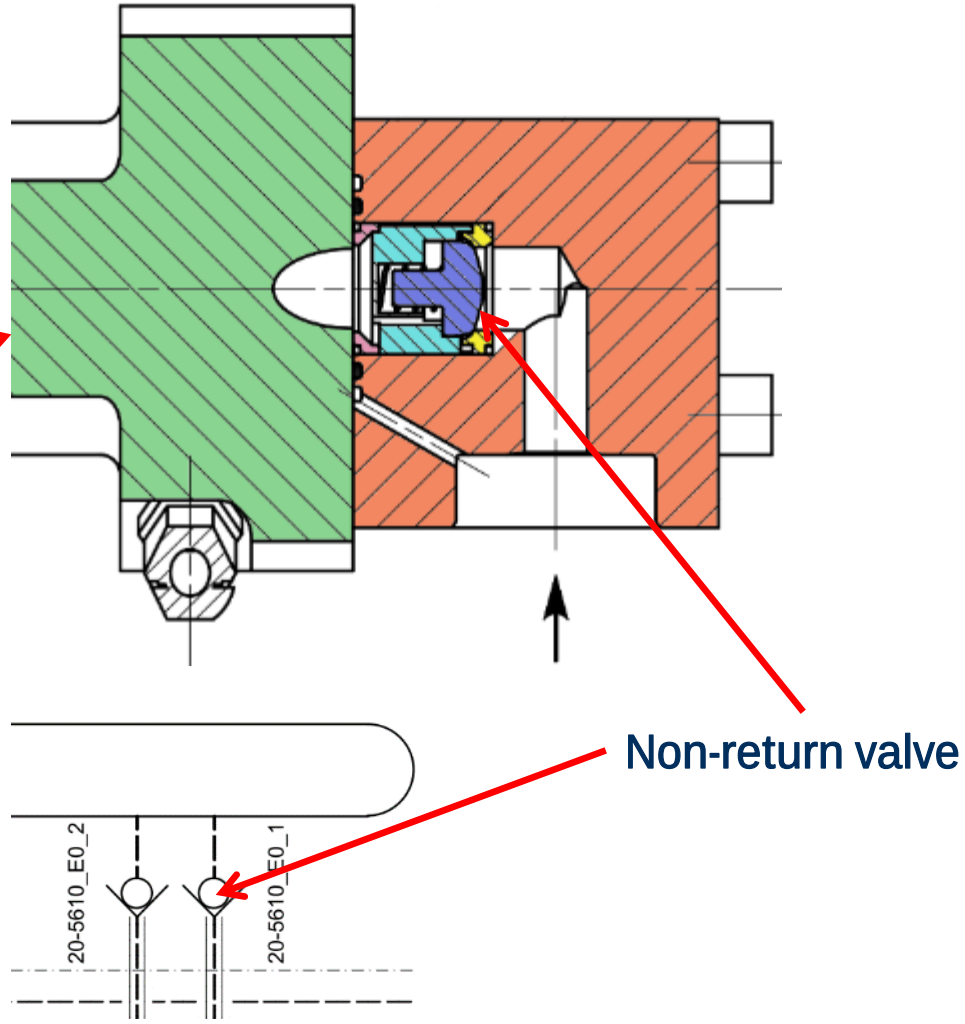
Rail Unit

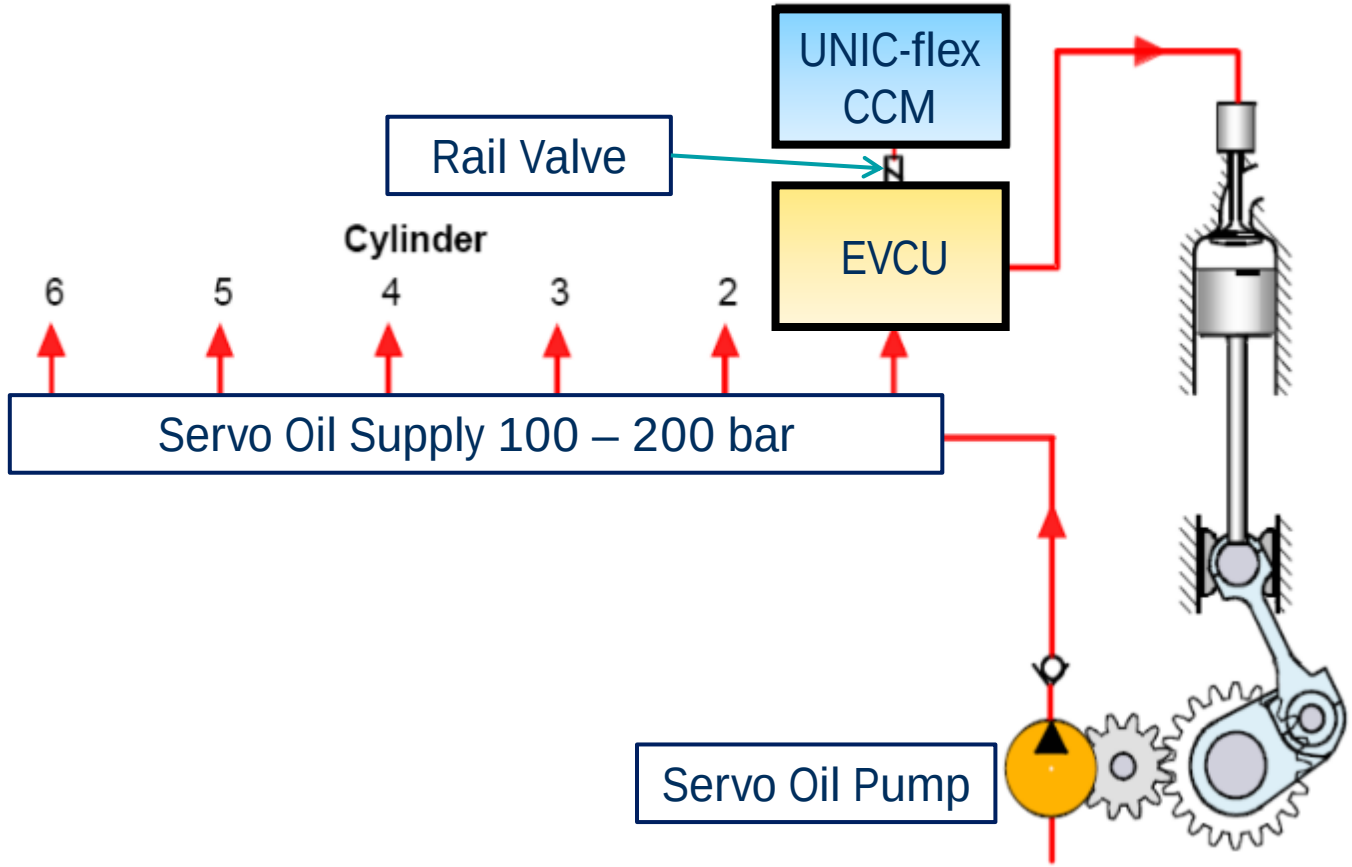
Servo Oil Inlet



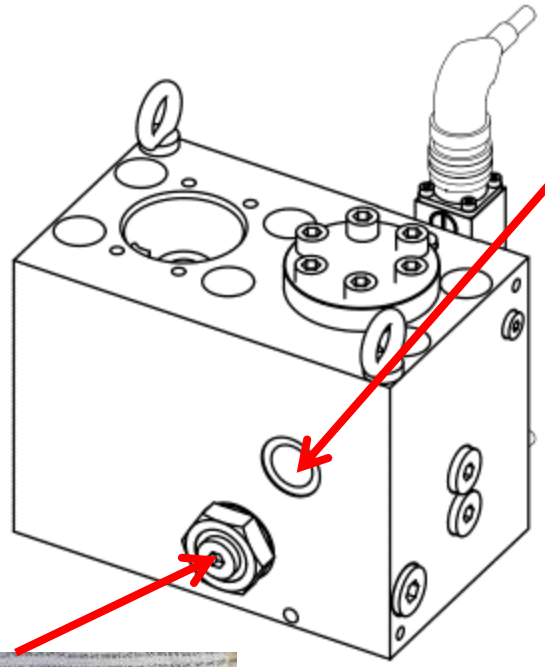
EVCU, flex50DF

Exhaust valve actuation

- Full flexibility of EXV open & close timing
- Electro-hydraulically controlled
- Pre-controlled by rail valve
- VCU is directly sitting on servo oil rail



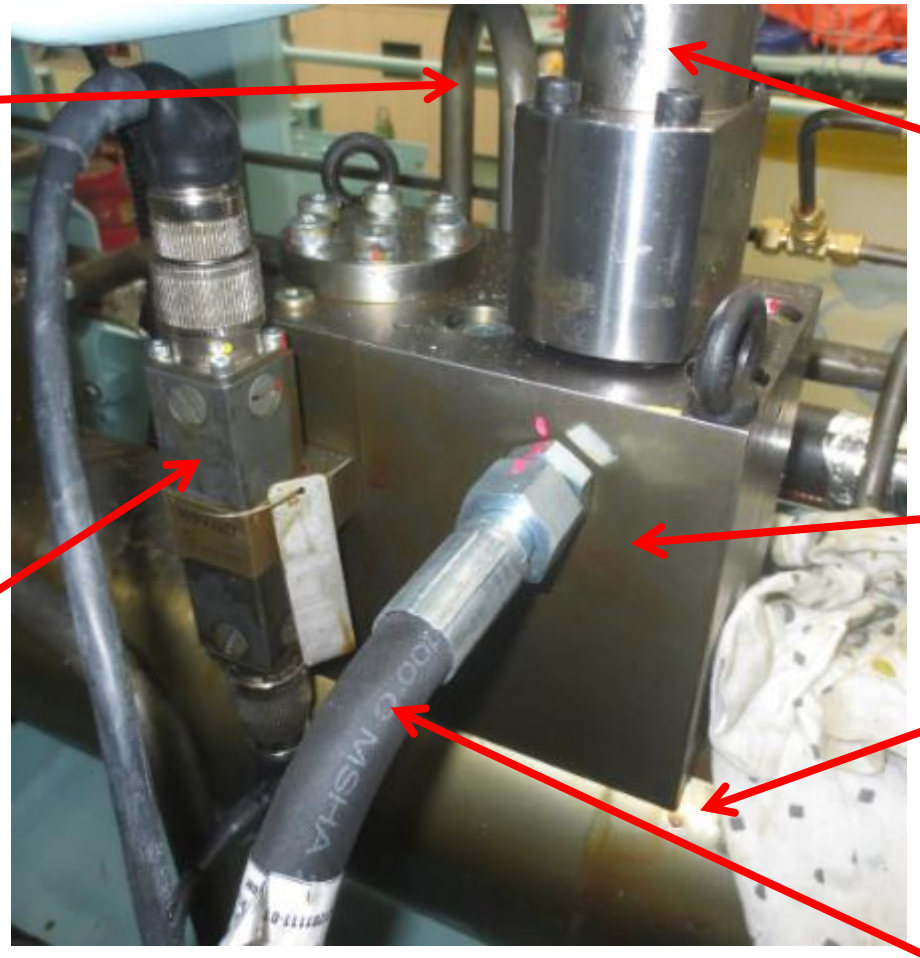
EVCU, flex50DF



Oil Filter

SO Return

Rail Valve



Hi Press Pipe to EXV

EVCU

Servo Oil Rail

Main Bearing Oil Inlet

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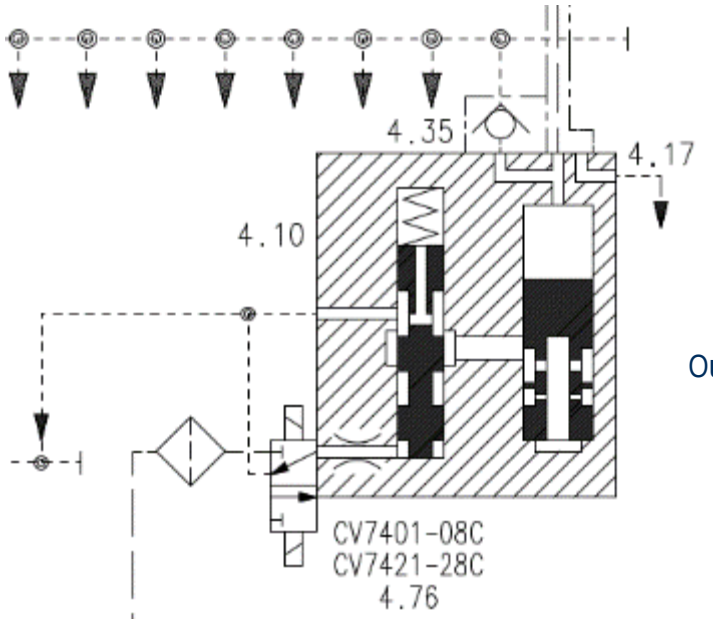
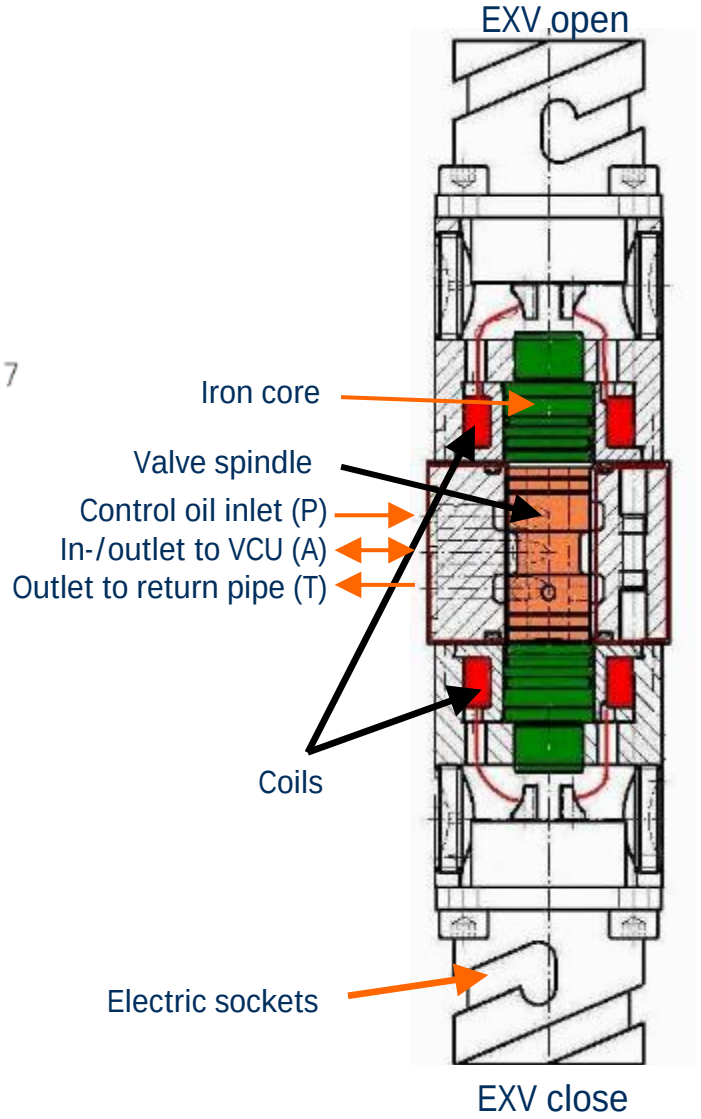
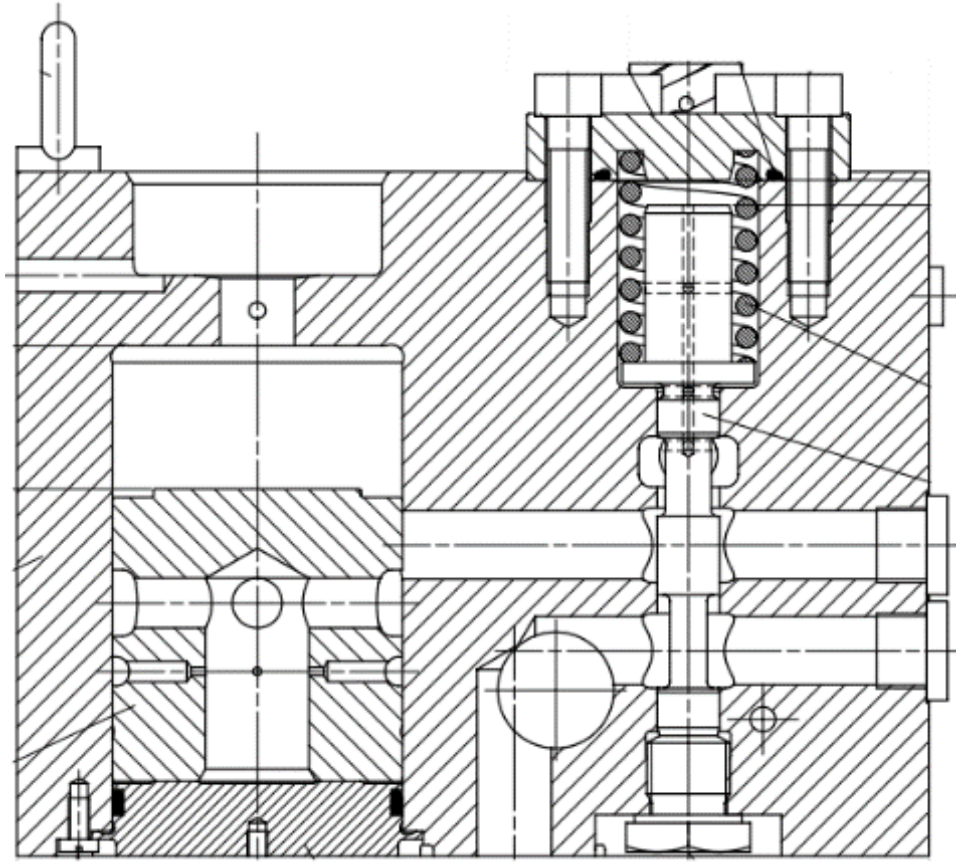
EVCU, flex50DF







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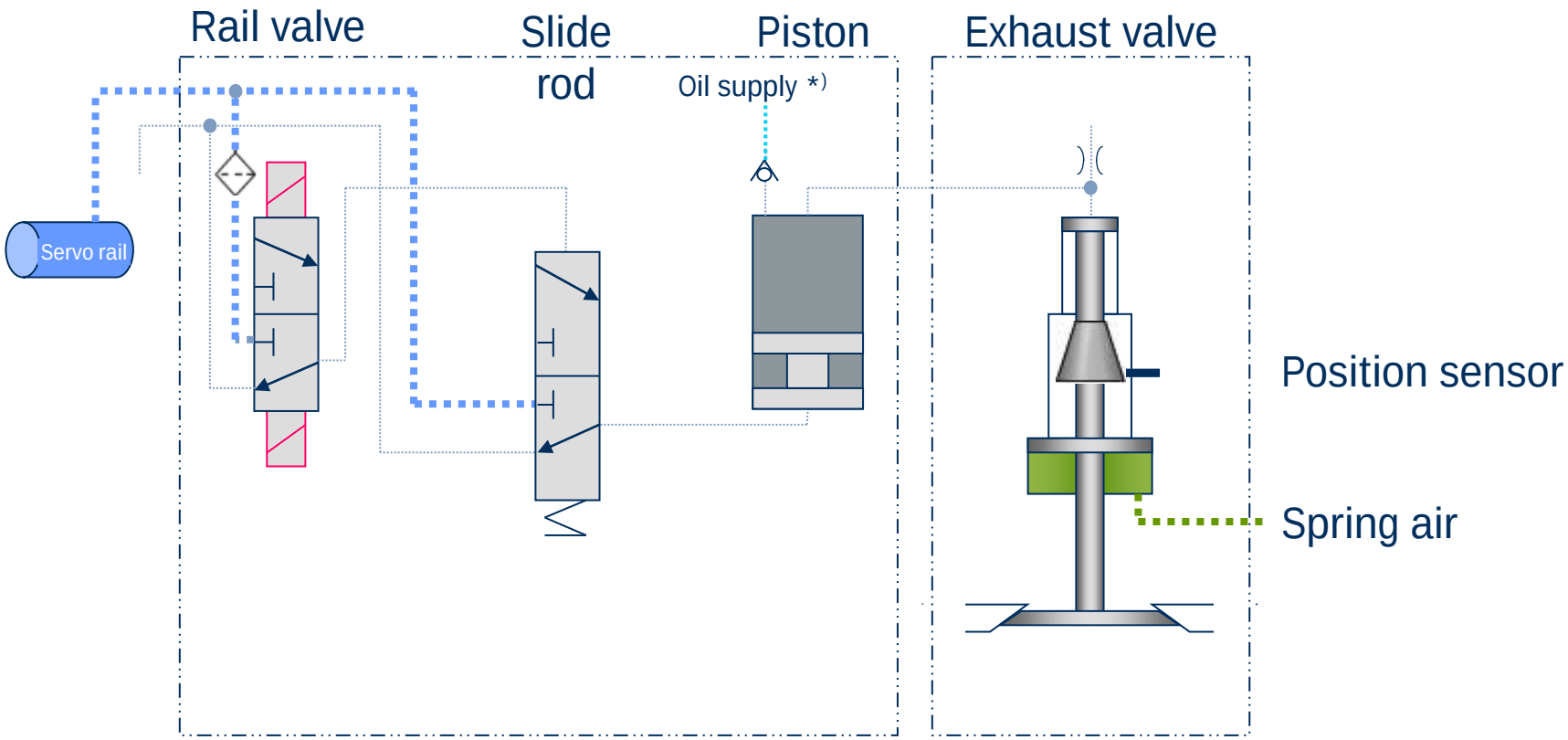
EVCU & EXV Working, flex50DF



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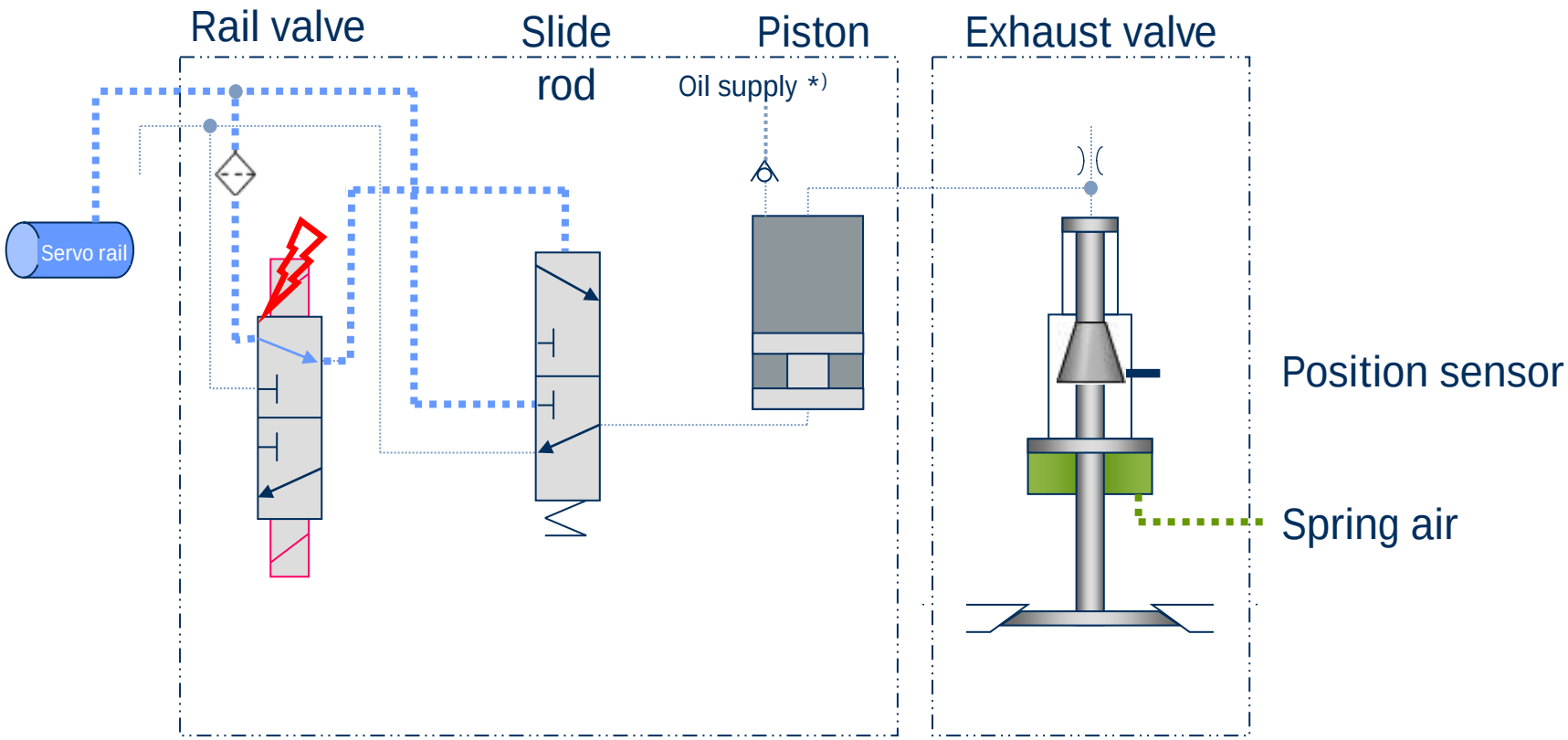
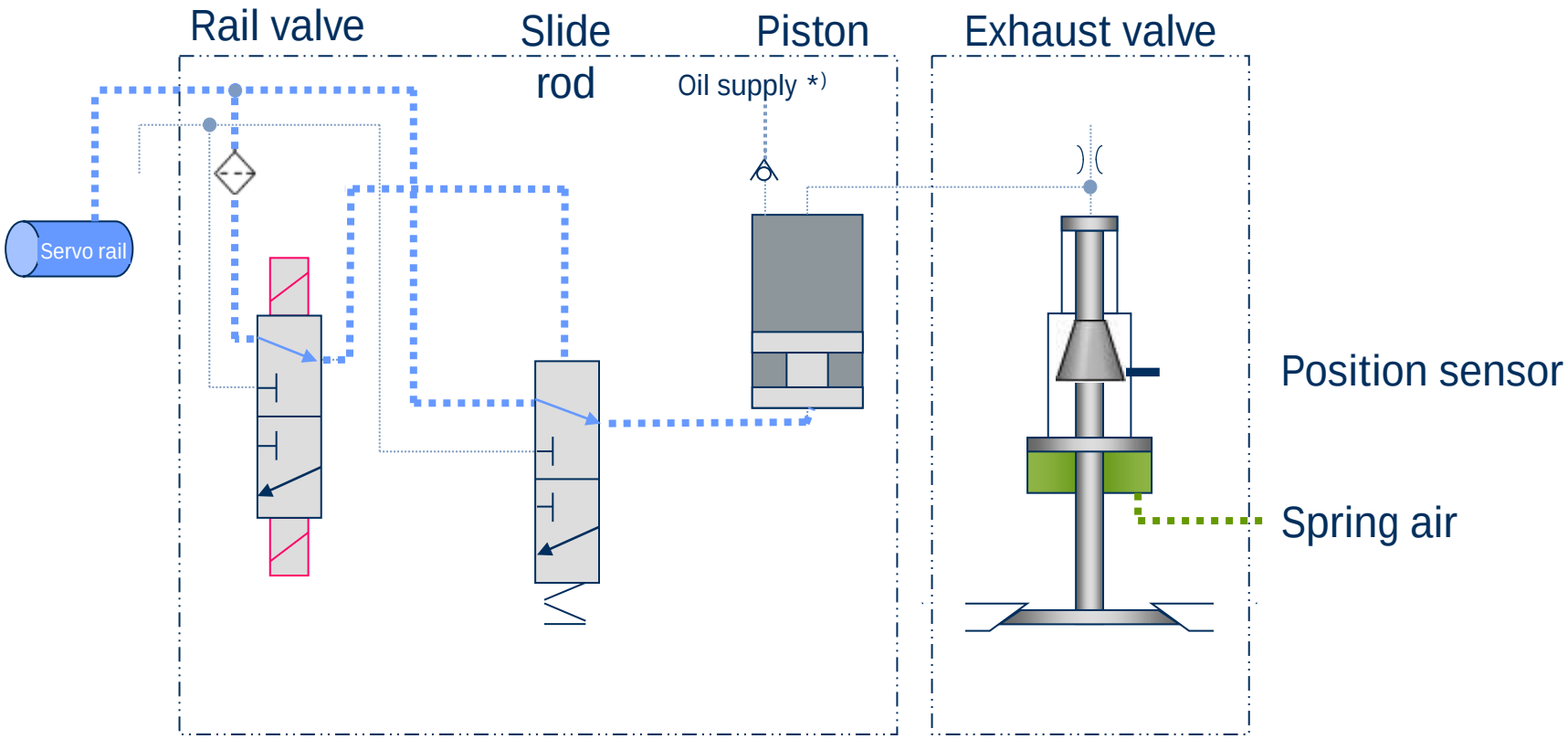
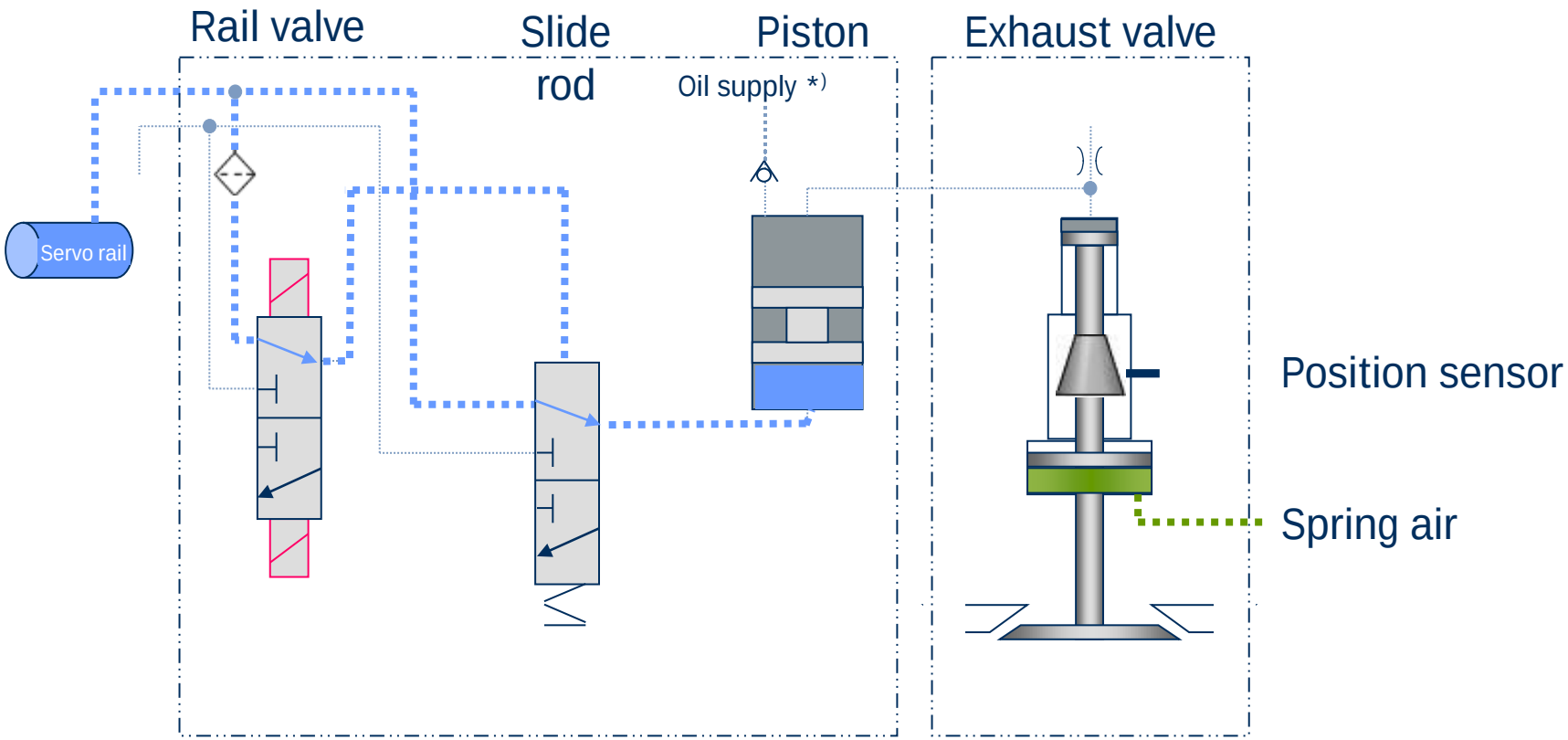


EVCU & EXV Working, flex50DF



EVCU & EXV Working, flex50DF



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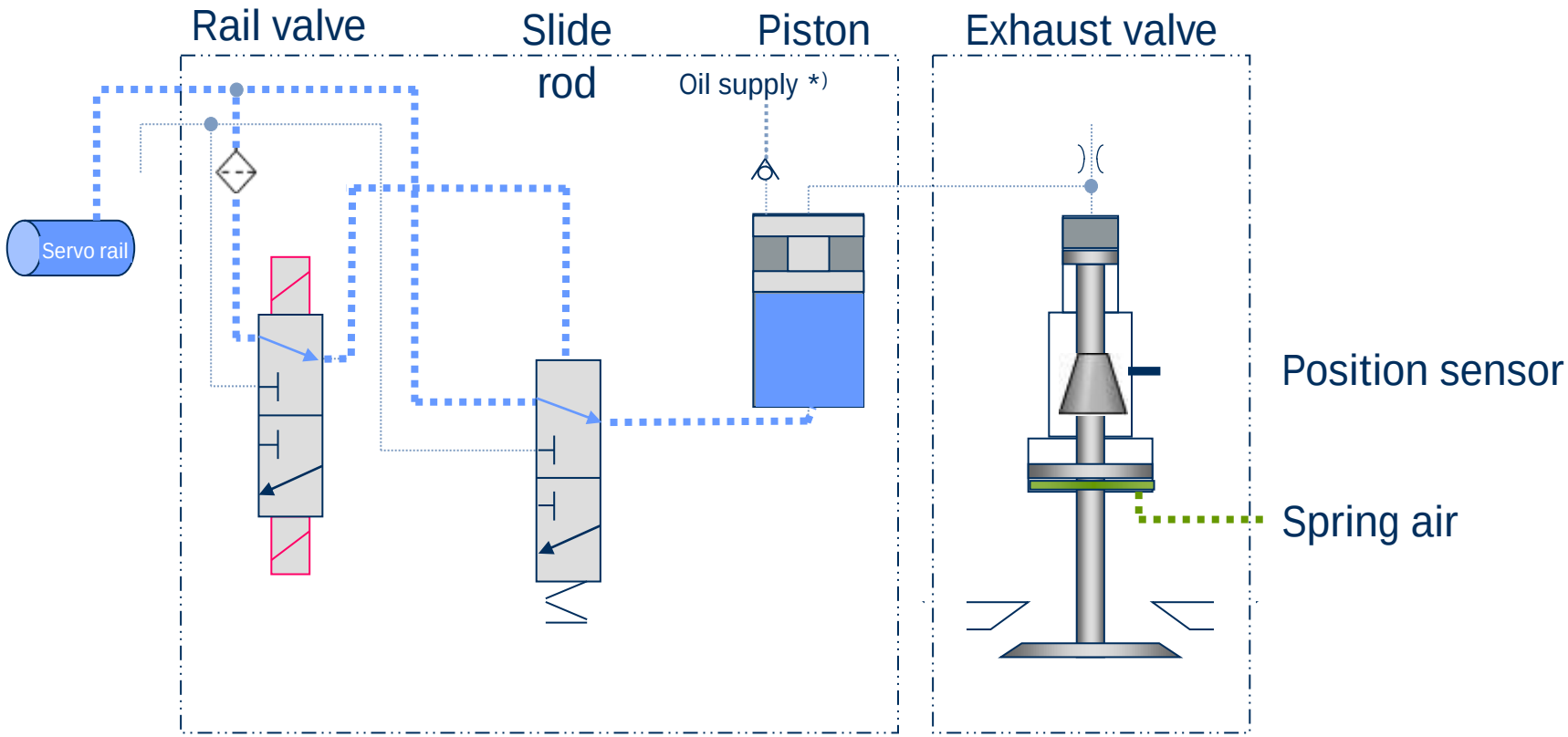
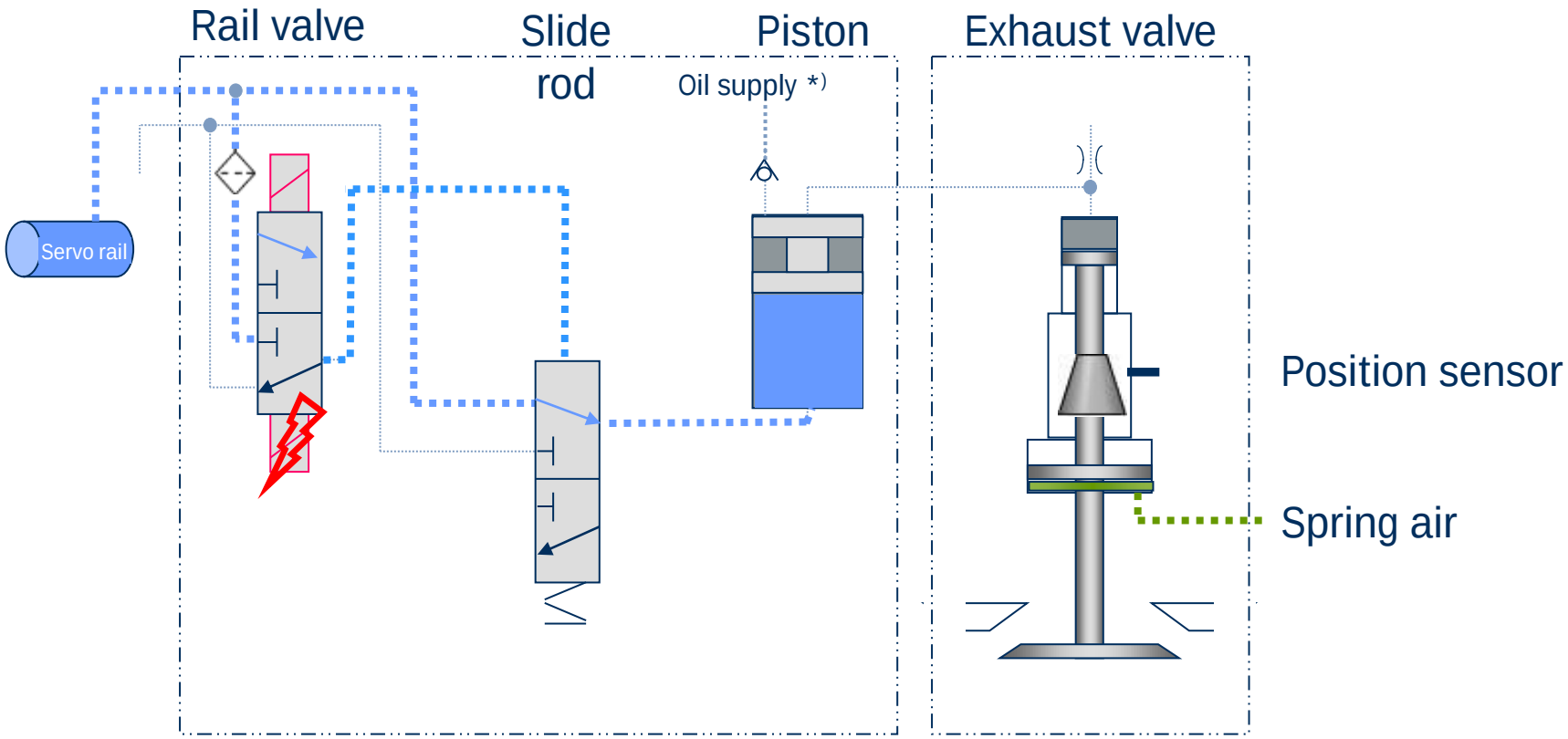
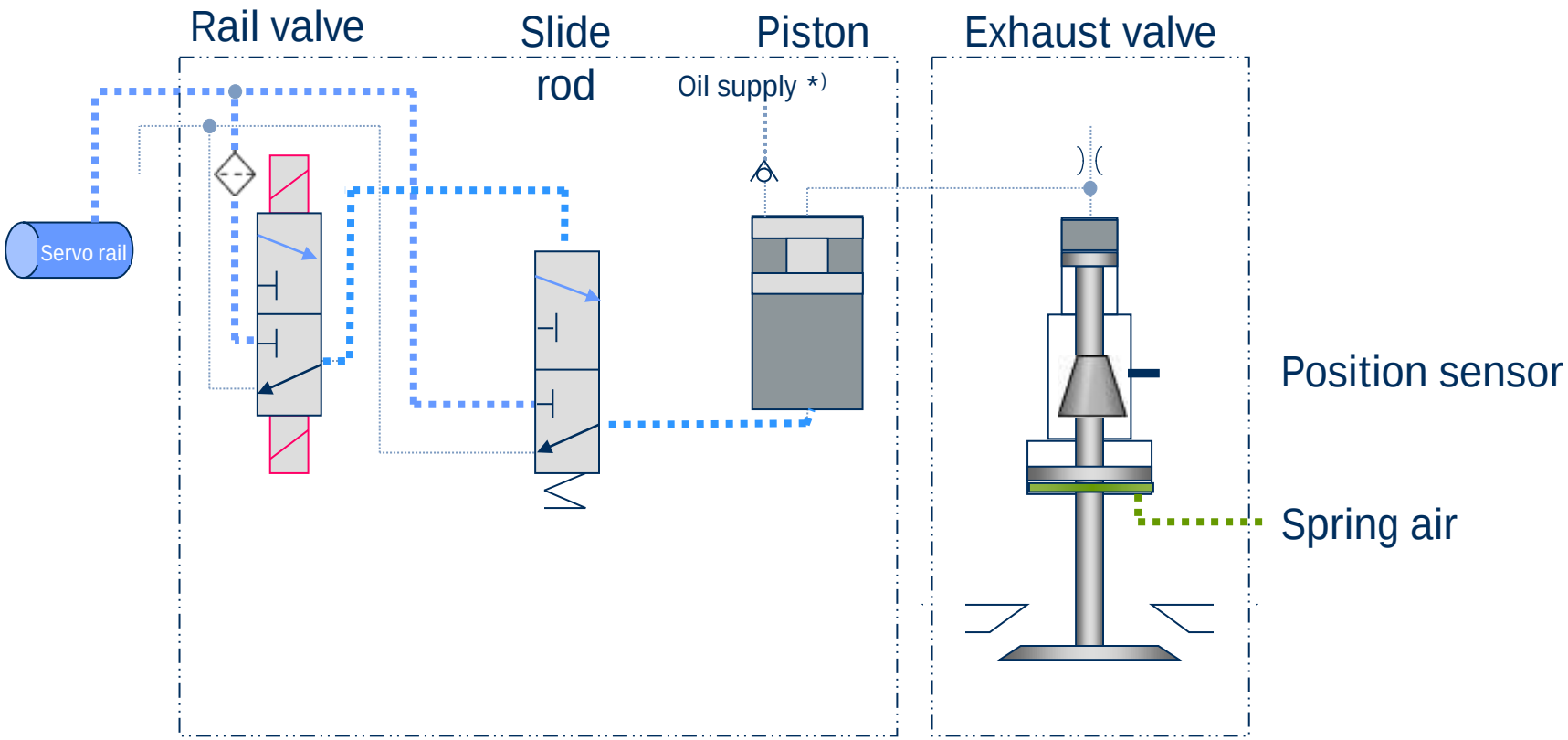


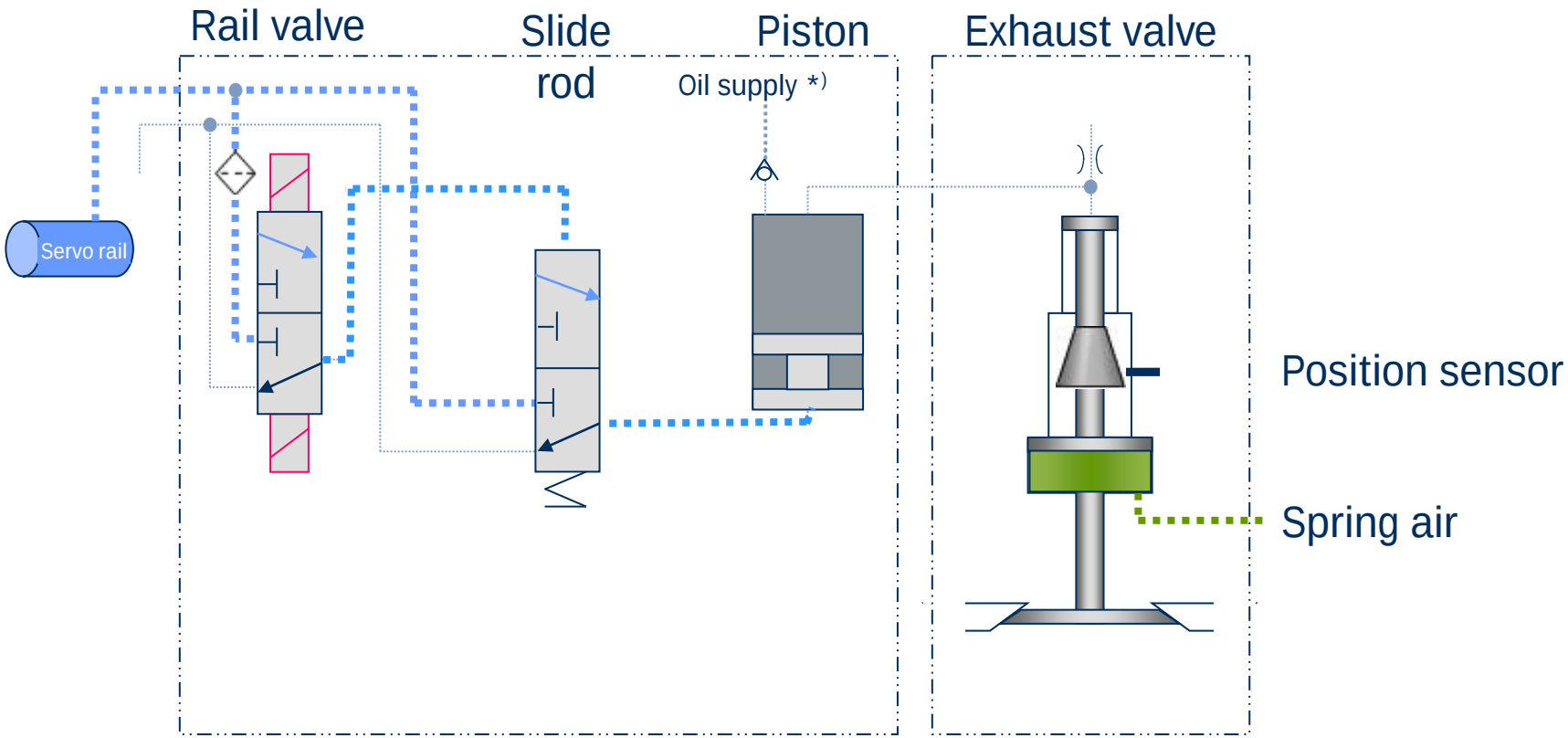
EVCU & EXV Working, flex50DF



EVCU & EXV Working, flex50DF



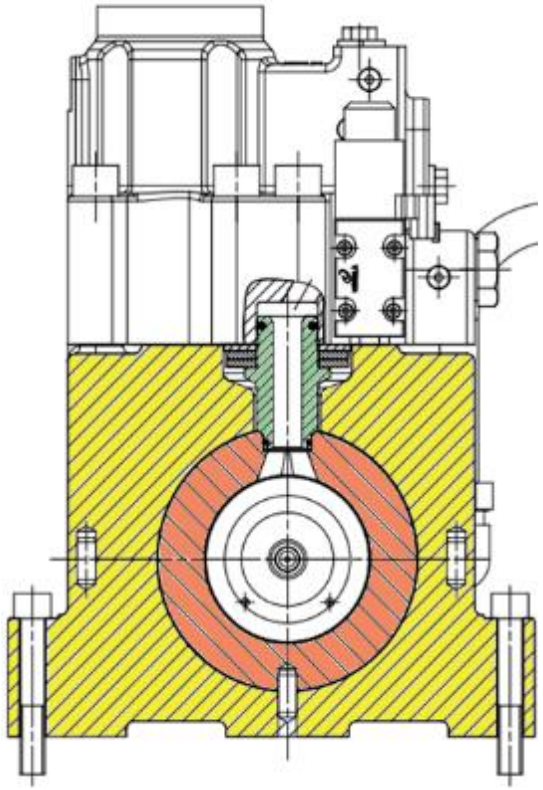
EVCU & EXV Working, flex50DF

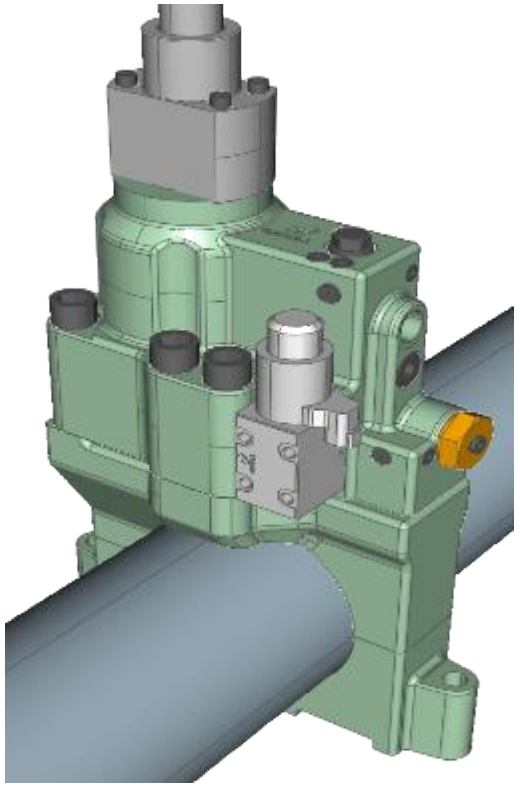


VCU

Exhaust valve actuation

- Full flexibility, electronically controlled
- Standard product acts as rail valve
- Servo oil rail screwed single pipe & welded design available
- VCU clamped to rail
- Same body for X62DF & X72DF





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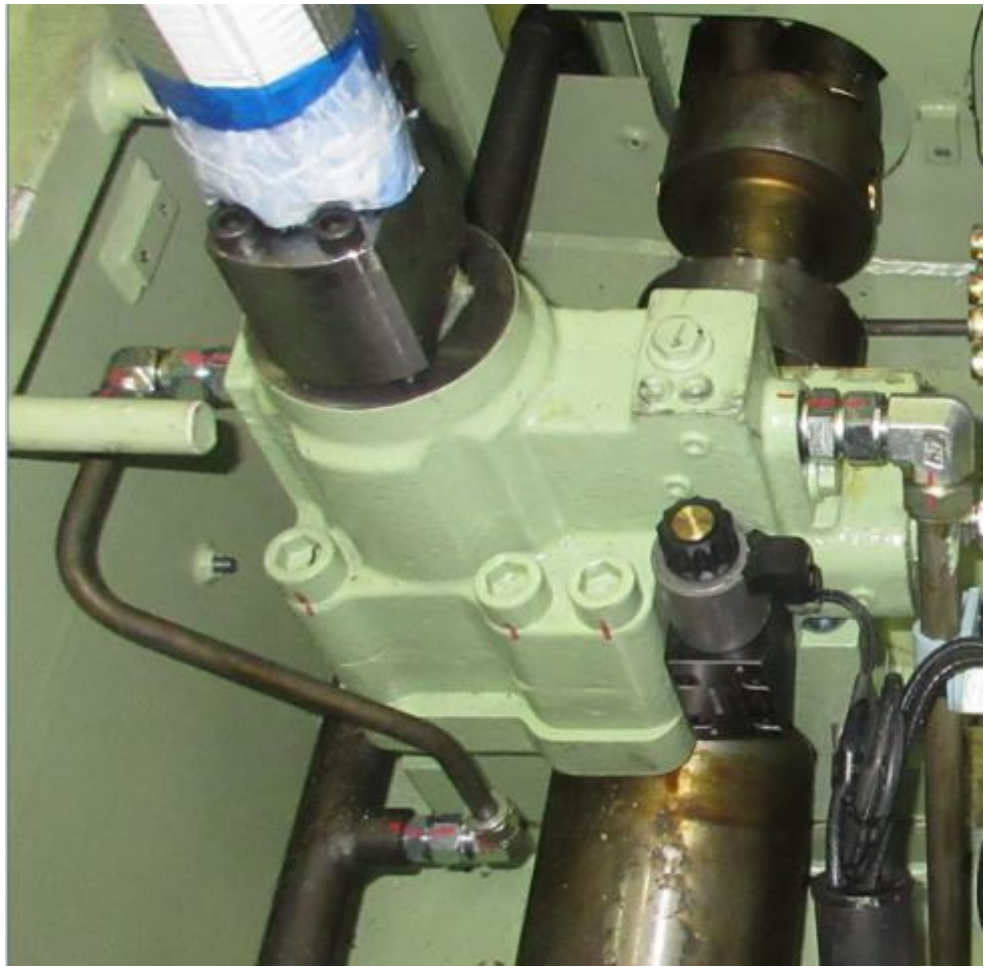
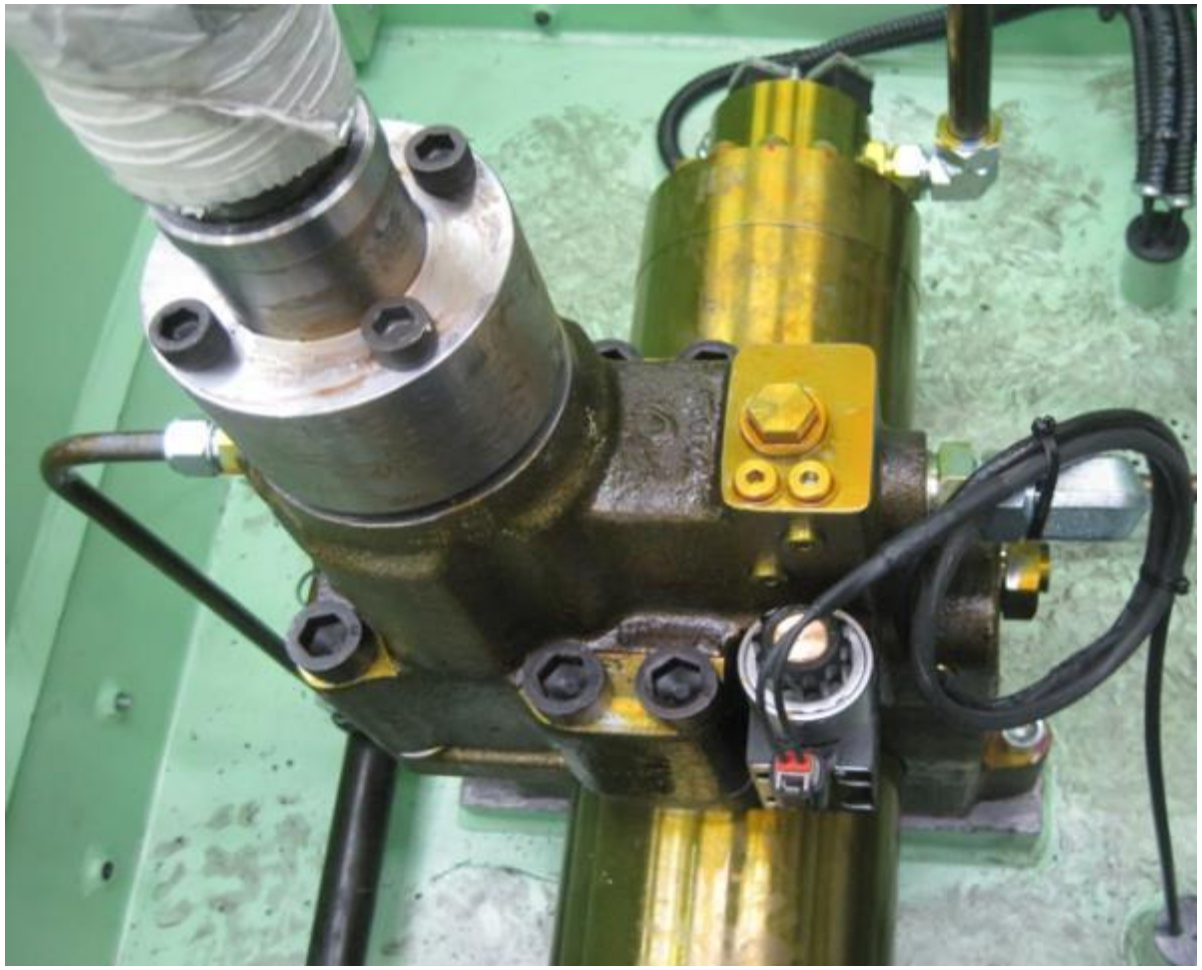
VCU

X52DF

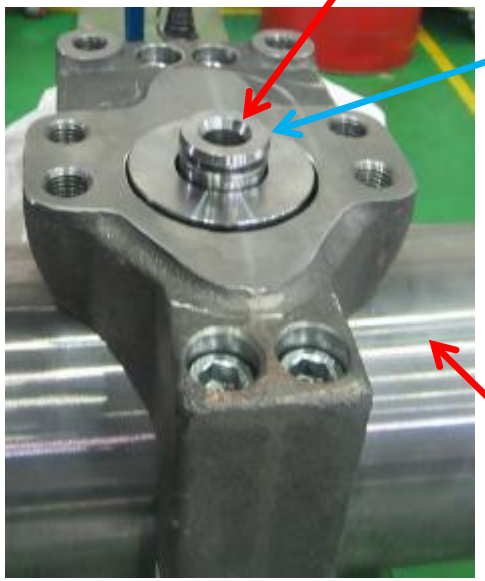


X62/72DF

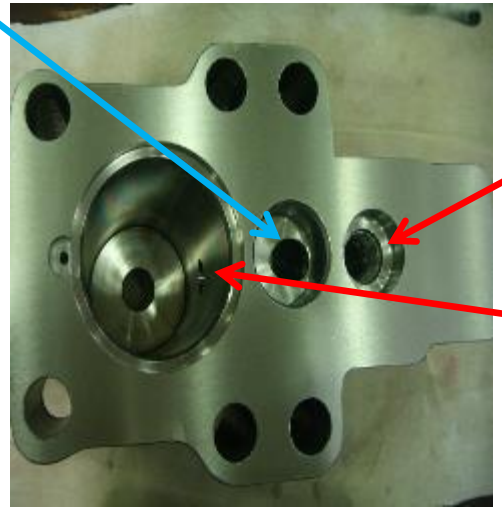


VCU

Connecting piece between VCU holder and VCU



Servo oil supply into VCU



Slide rod

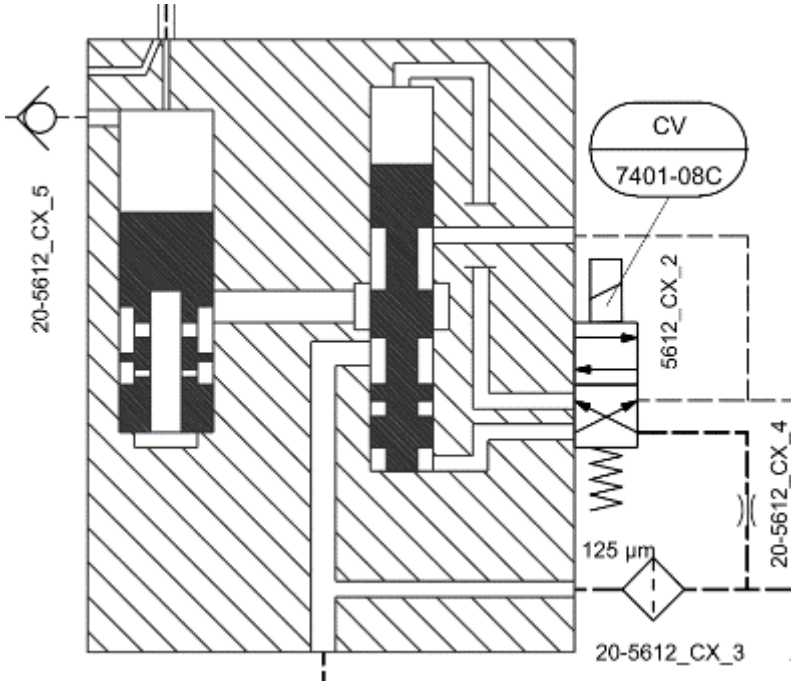
Main piston

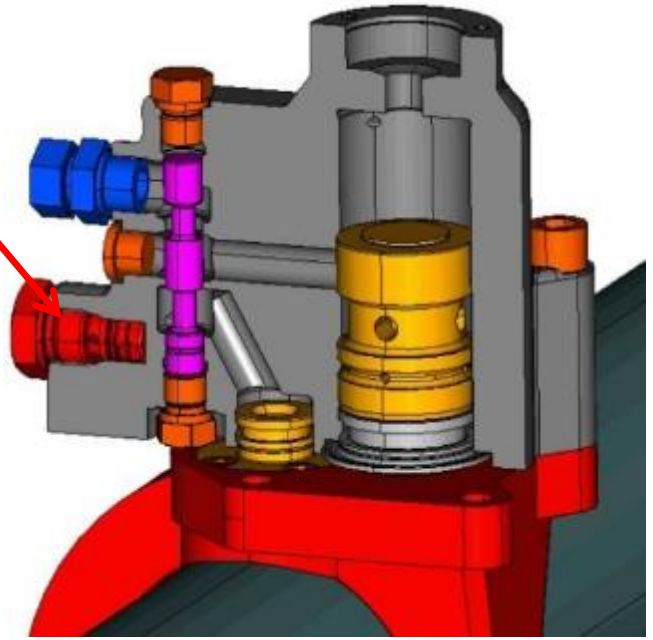
Servo rail

VCU

- Weight: 30 kg
- Casted Housing
- External oil filling

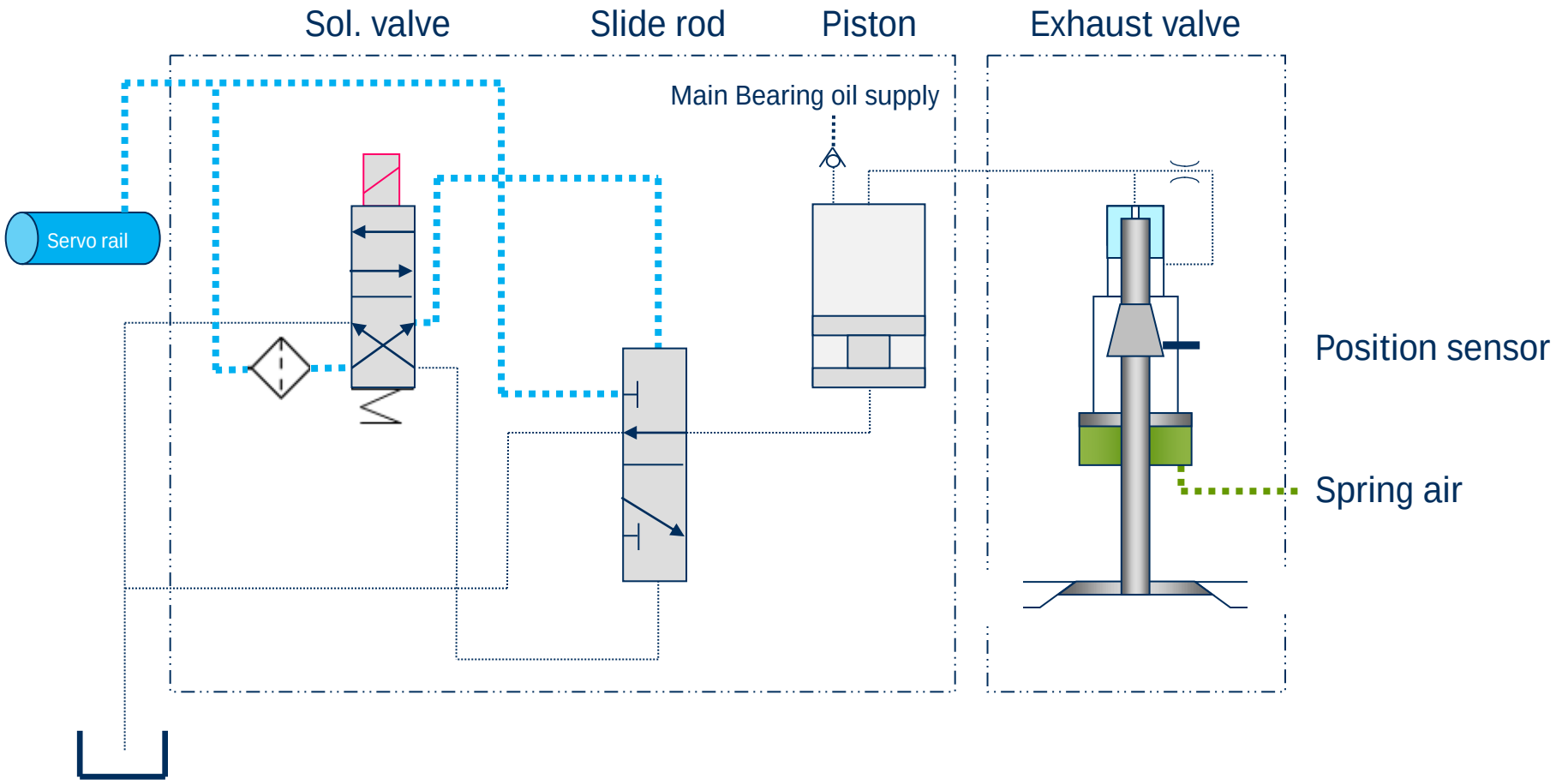
VCU oil filter





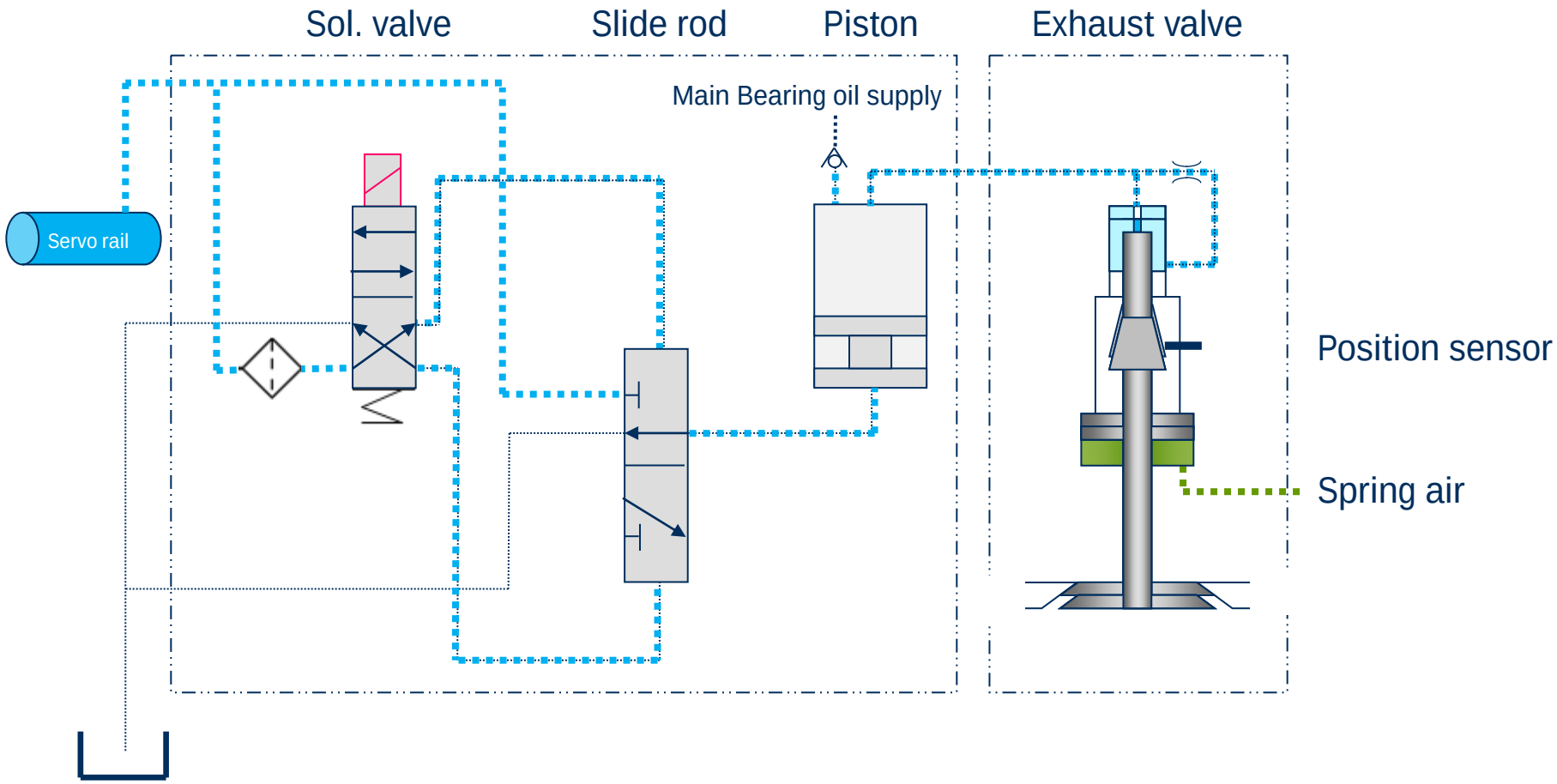
VCU

VCU-Hydraulic Function

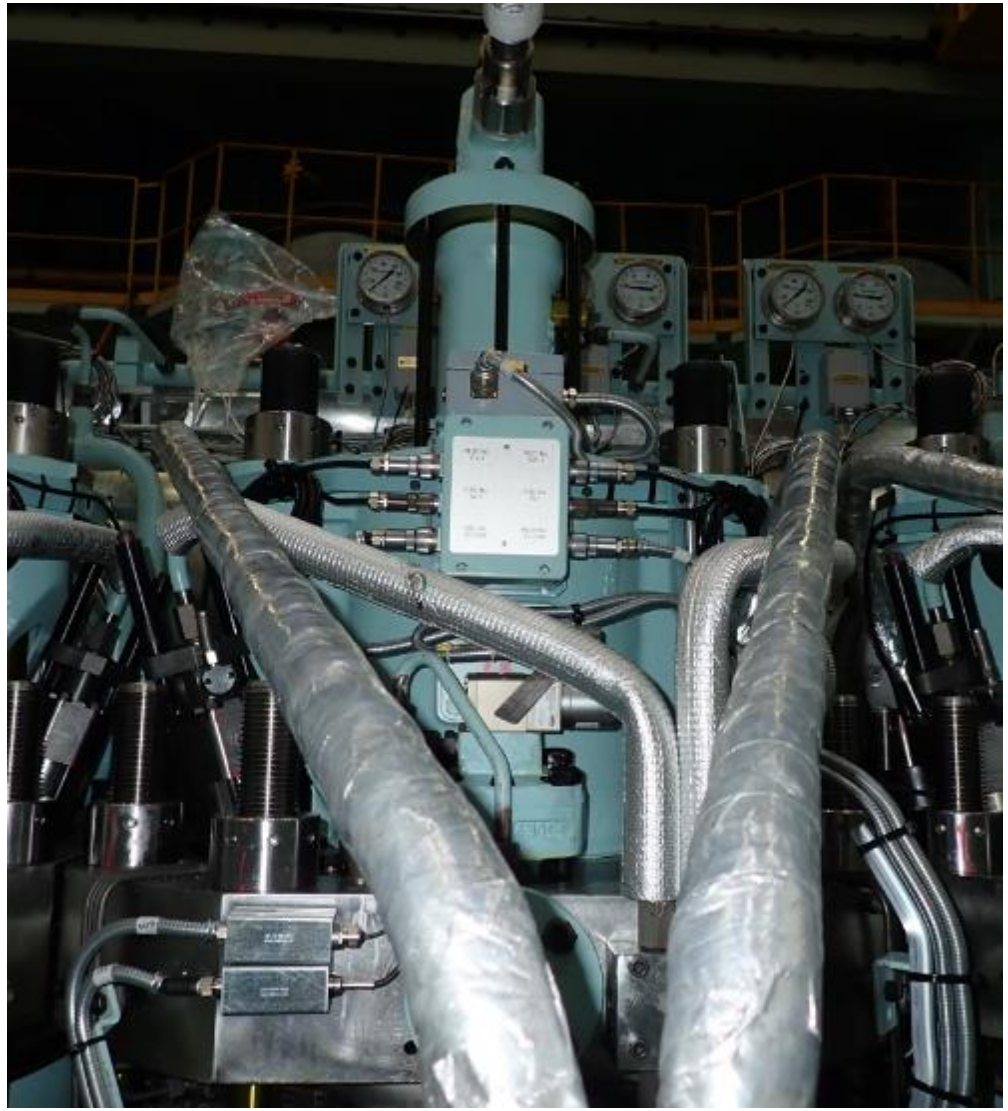


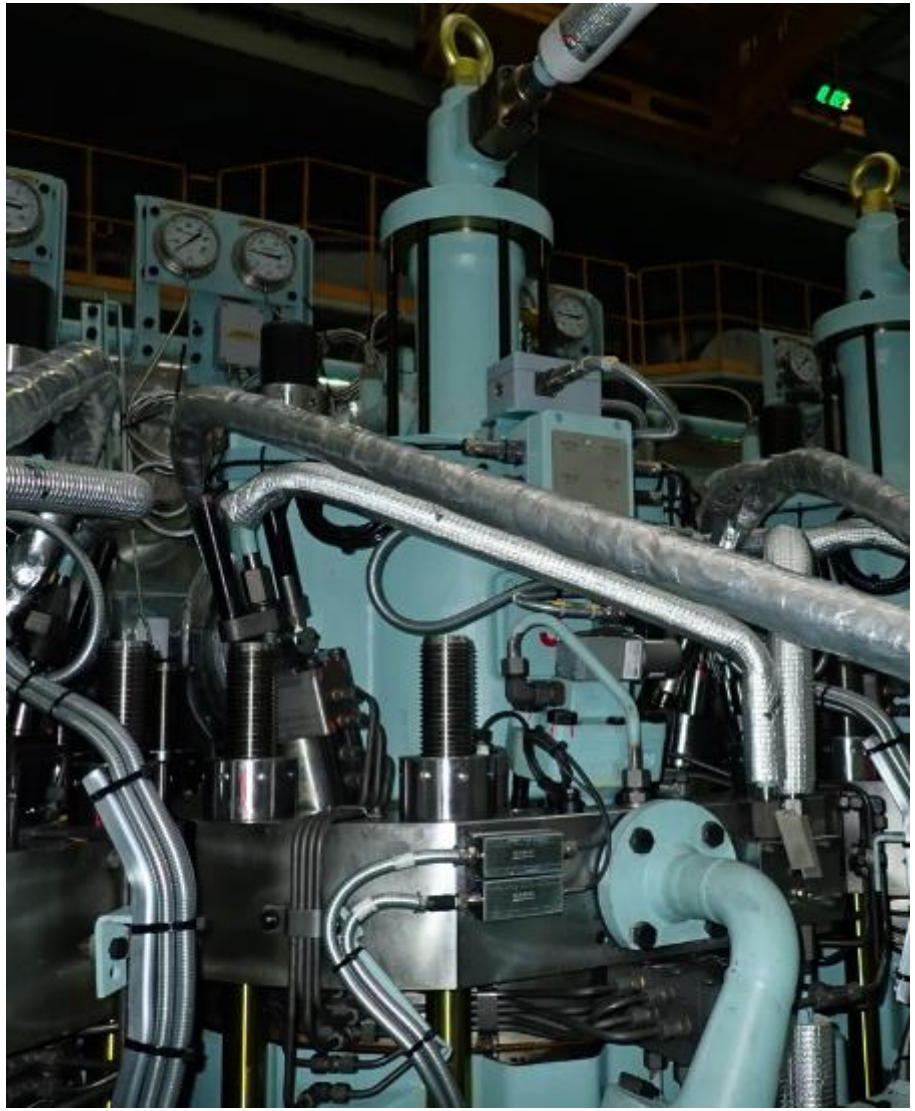
VCU

VCU-Hydraulic Function



Exhaust Valve

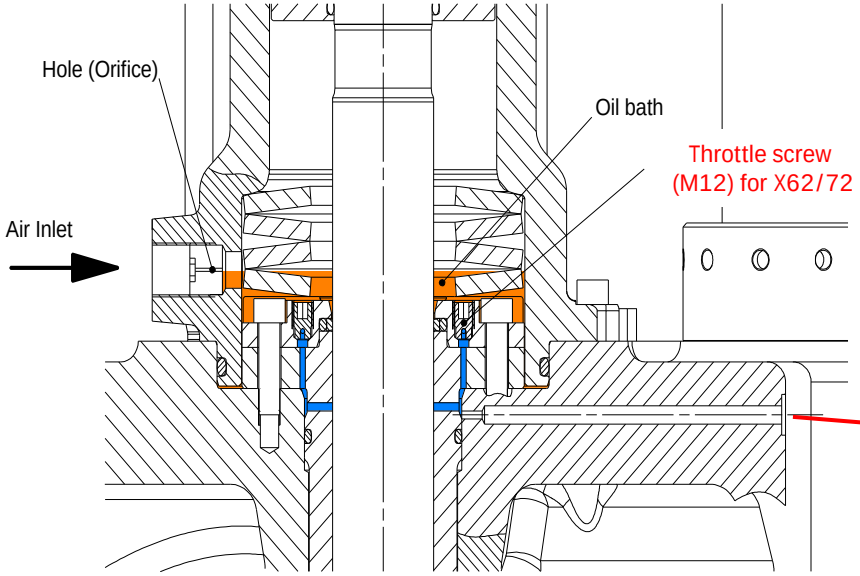


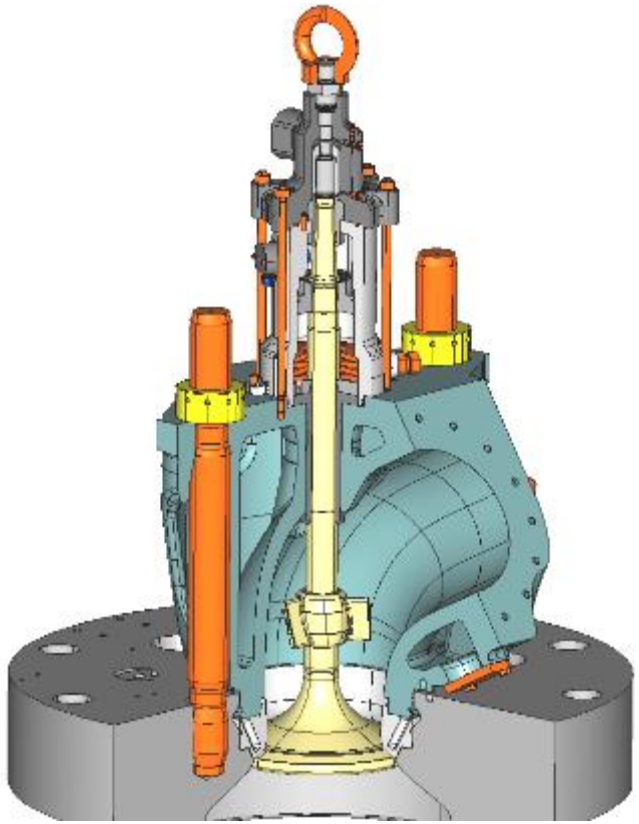


Exhaust Valve

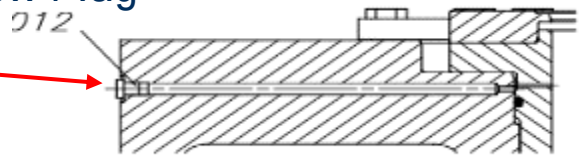
Exhaust valve

- Outlet angle of valve cage 60° / 75°
- Fixation of valve cage to cylinder cover with 2 bolts
- Double piston in the valve drive
- Valve spindle lubrication with system oil





Screw Plug

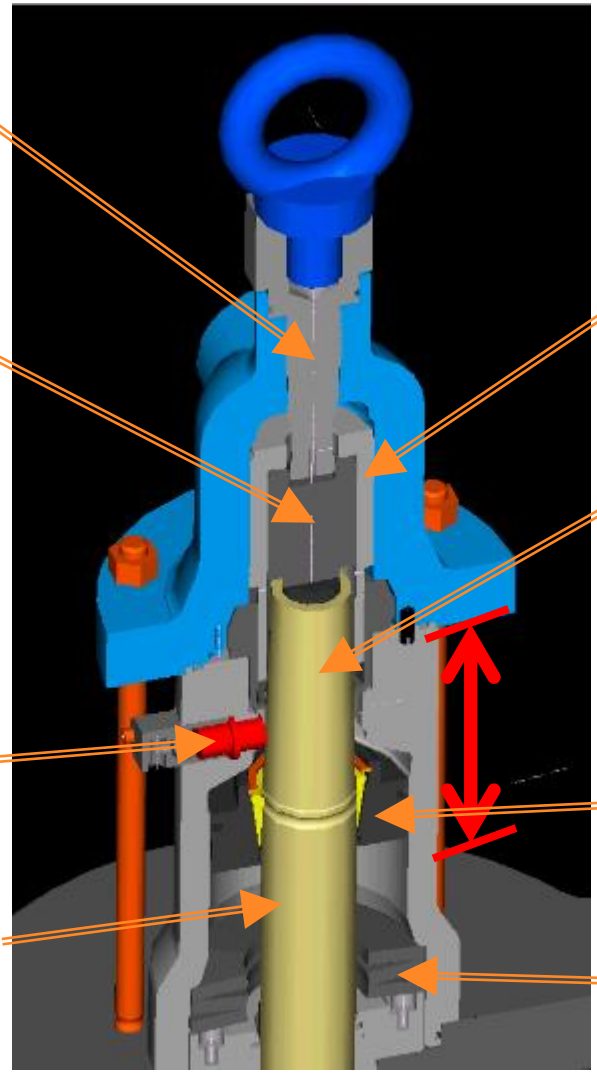


Exhaust Valve

Exhaust Valve Drive

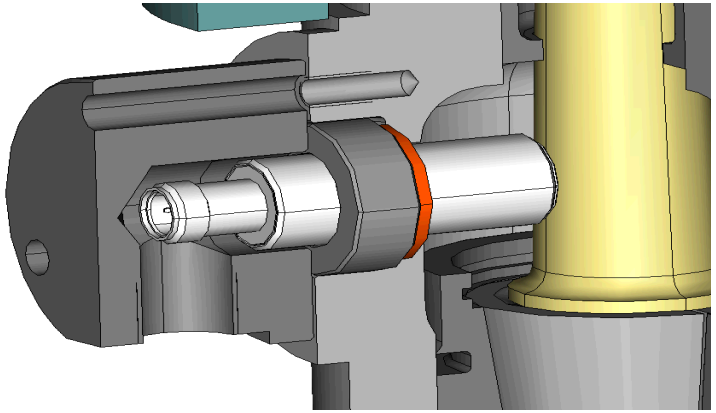
Main differences to a conventional valve drive

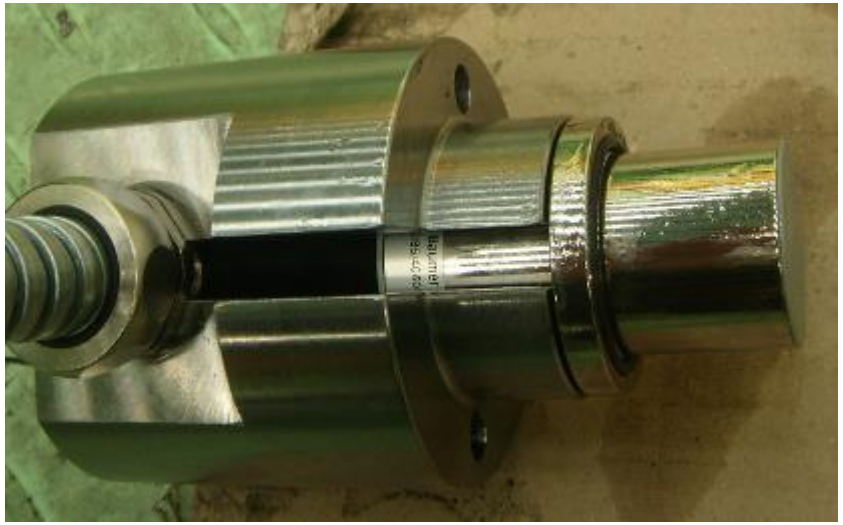
- The exhaust valve is actuated by a double piston drive, in order to save oil volume
- The stroke sensor monitors exhaust valve open / close stroke
- The valve spindle has cone shape on top side for stroke sensor
- Air spring piston runs directly in the housing
- The disc spring package is dampening opening stroke in case of low air spring pressure



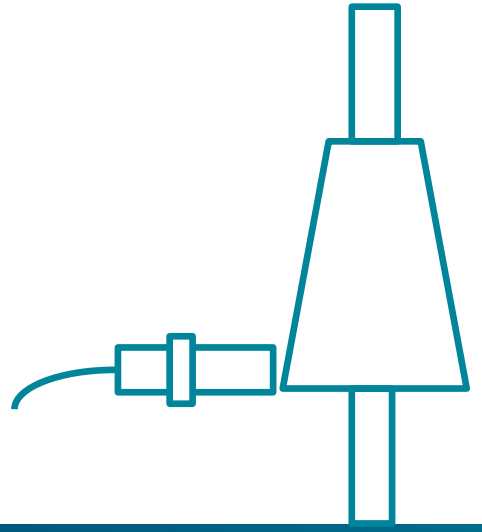
Exhaust Valve

Exhaust Valve Drive





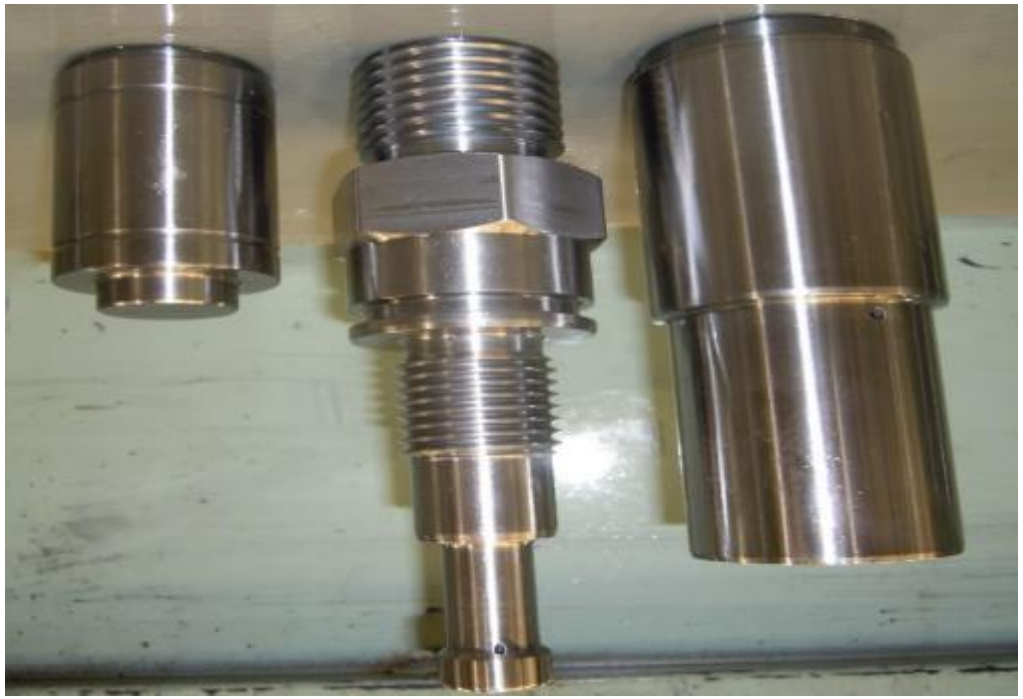
- The current position of the exhaust valve spindle is measured by a sensor in the upper housing
- The sensor is measuring the air gap between sensor and cone shaped top part of exhaust valve spindle
- The 4 – 20 mA signal is used as a feedback for the control system



Exhaust Valve

Exhaust Valve Drive

X72 Exhaust Valve



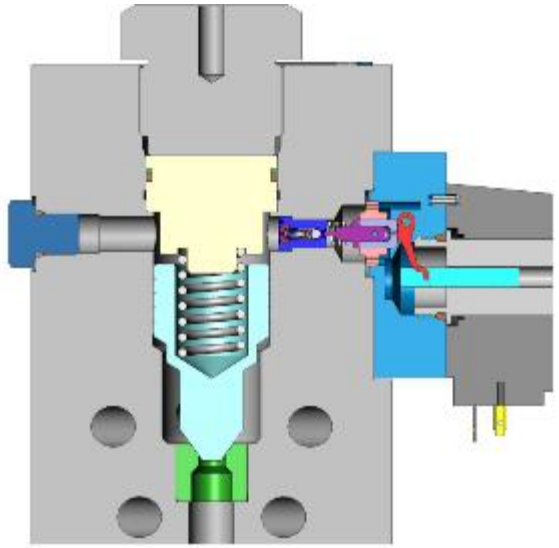
Inner oil piston

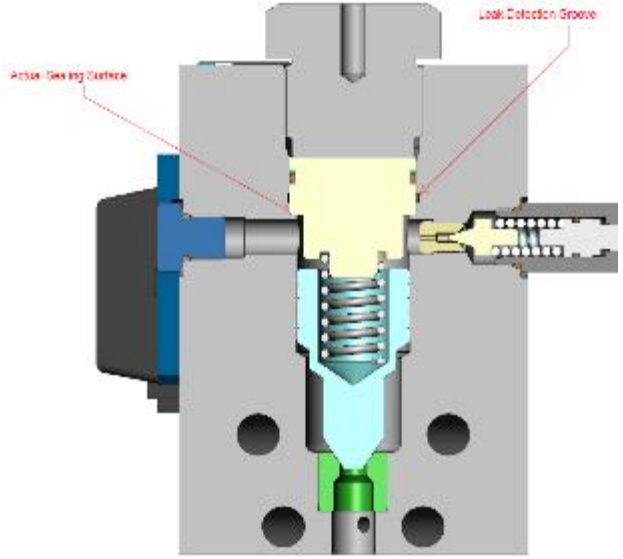
Damper

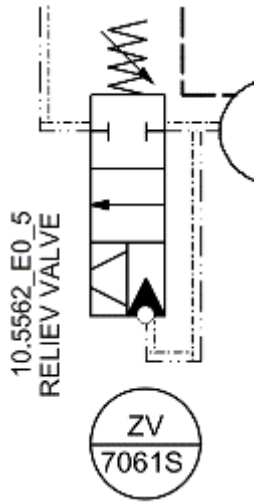
Outer oil piston

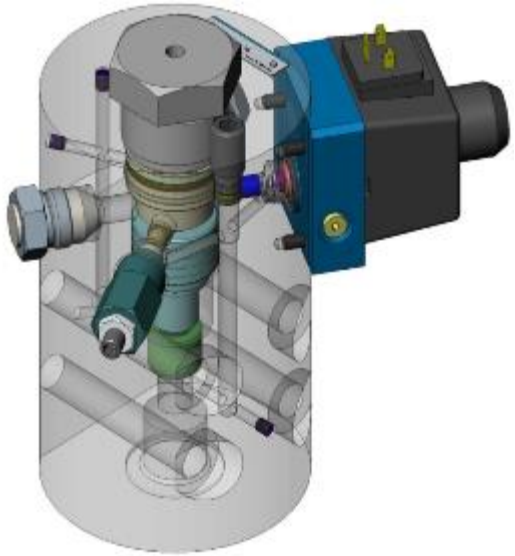
Fuel Pressure Control Valve

- First stage overpressure (1050 bar)
- Second stage overpressure(1150 bar)
- Actuation via 24V solenoid from Safety system



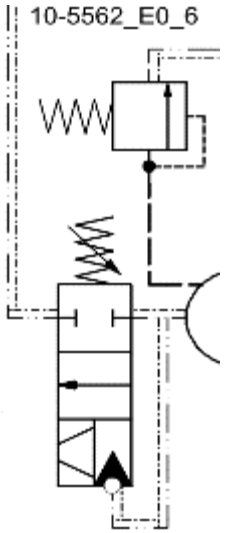


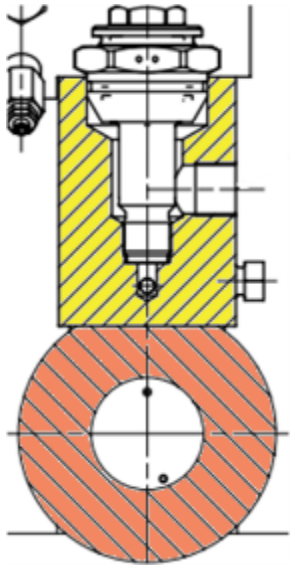


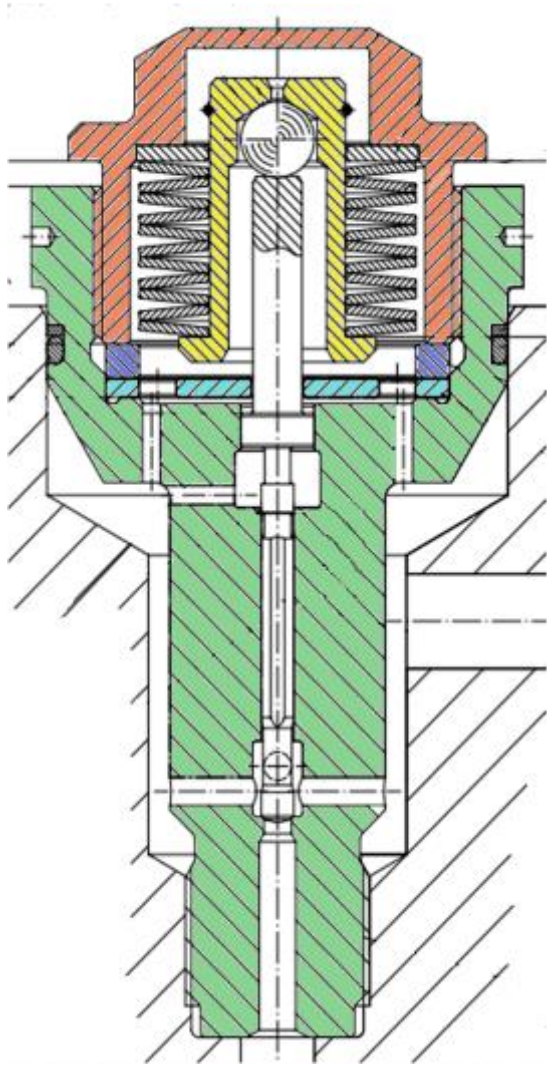


Fuel Safety Valve

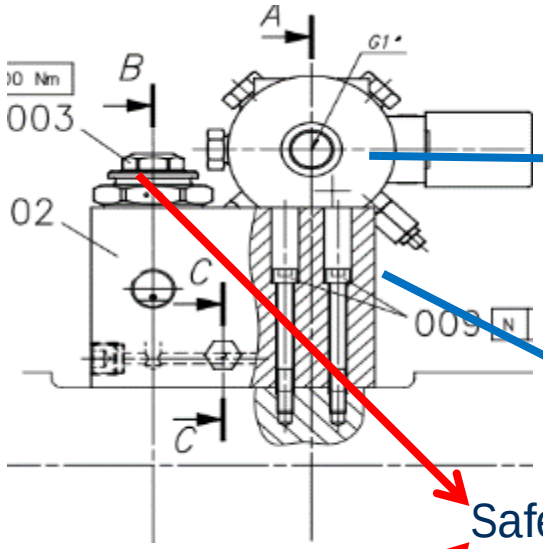
- Safety valve setting pressure(1250 bar)
- Alarm monitored by leakage sensor (LS3446A)
- Last chance for overpressure
  (protect pumps and fuel system)





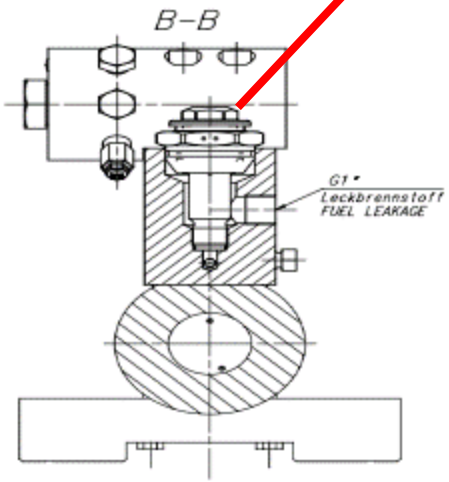


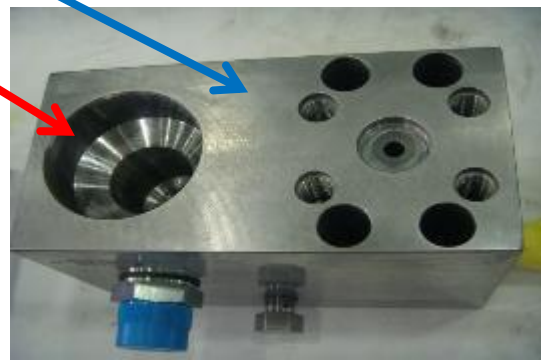
Fuel PCV with Safety valve



Fuel pressure control valve

Safety valve





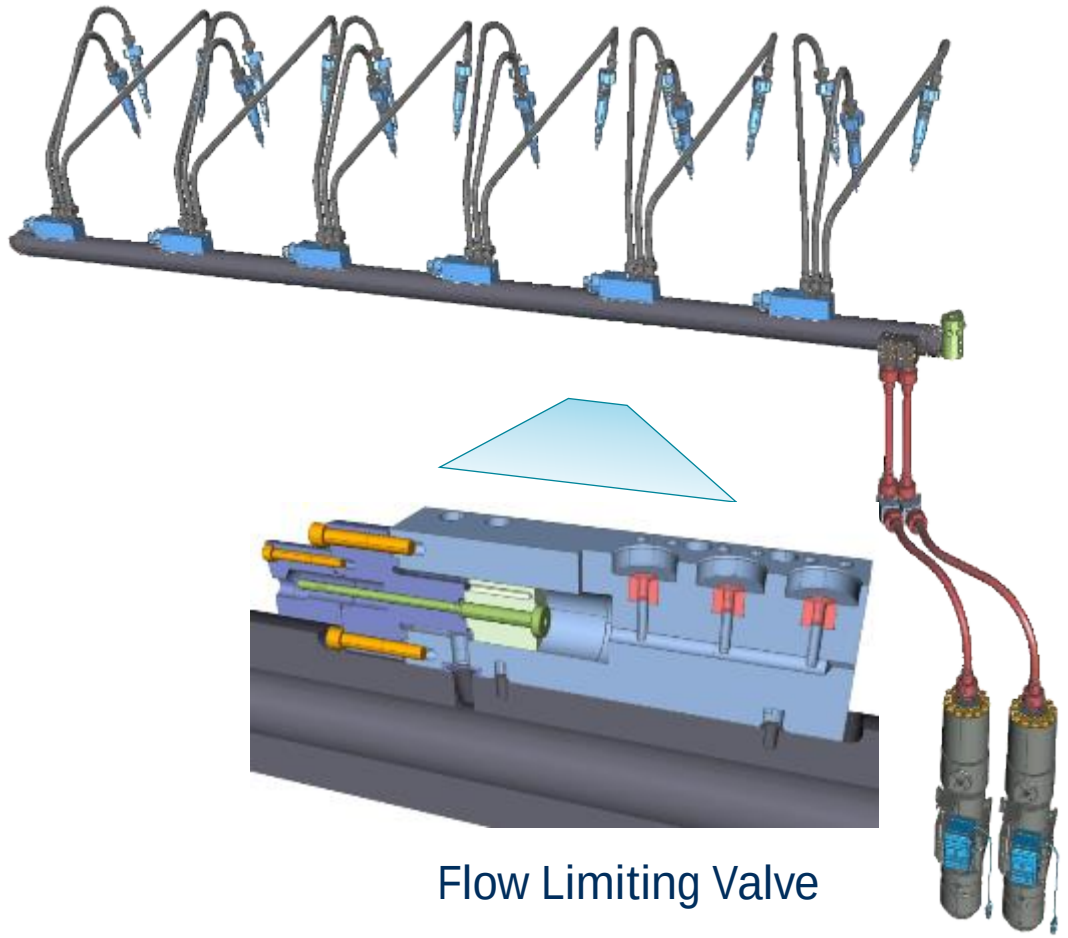
Valve Block

Fuel PCV with Safety valve

Fuel Injection

Fuel injection

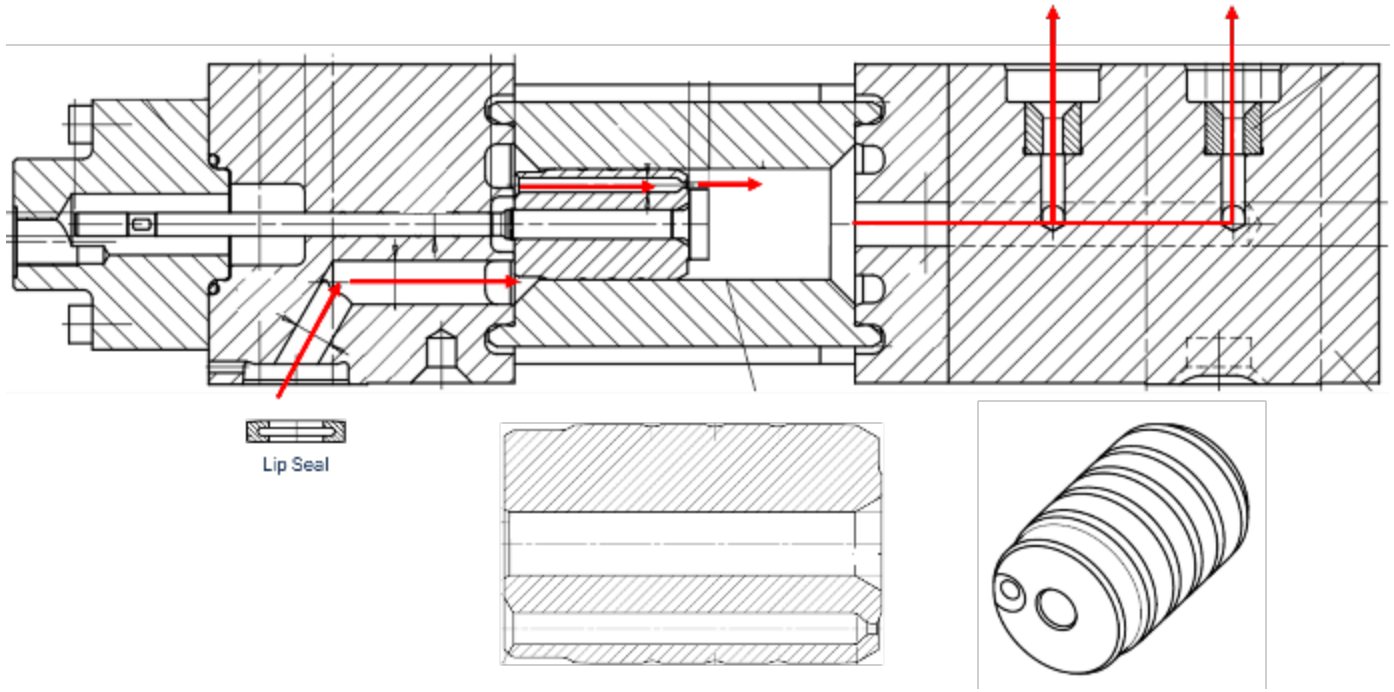
- Time controlled injectors from L'Orange
  - Three solenoid actuated injectors per cylinder for optimized injection control at all engine loads
- Mechanical fuel flow limiting valves
- Well proven non return valves in case of rising pipe breakage
- Single wall fuel rail (round bore)



Flow Limiting Valve

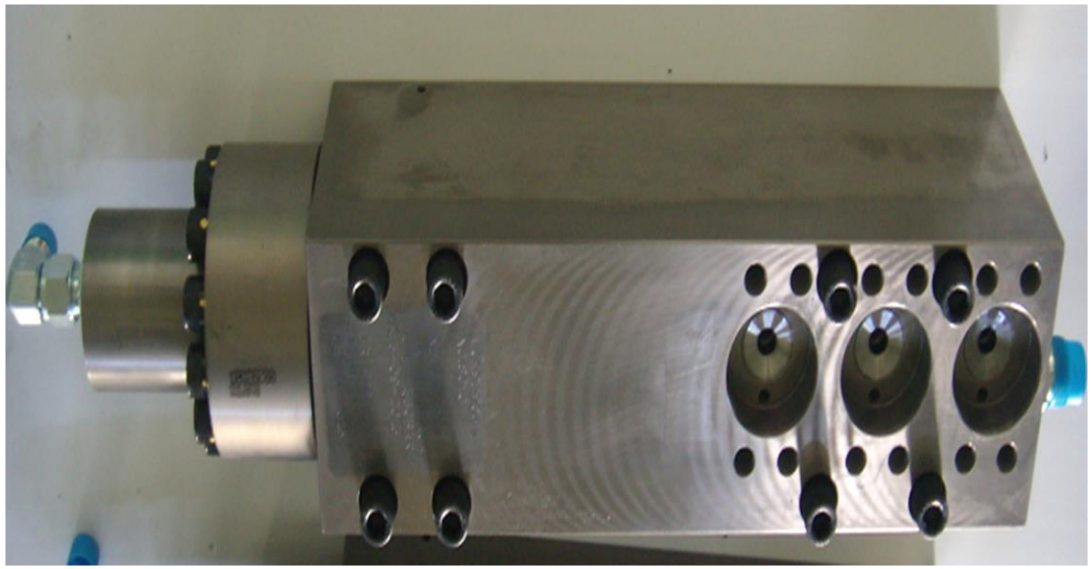
Fuel Injection

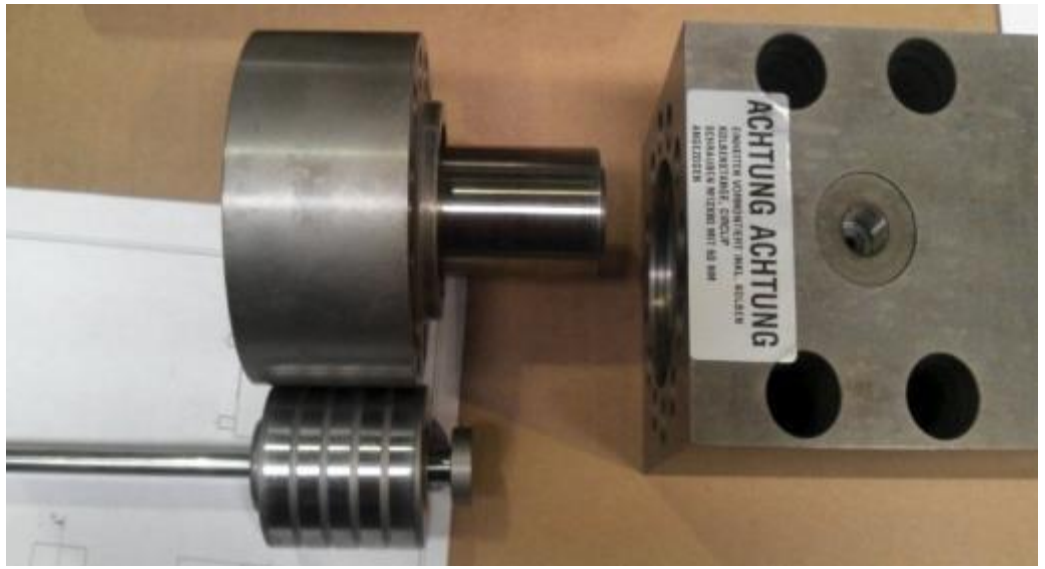
Flow Limiting Valve, flex50DF



Fuel Injection

Flow Limiting Valve

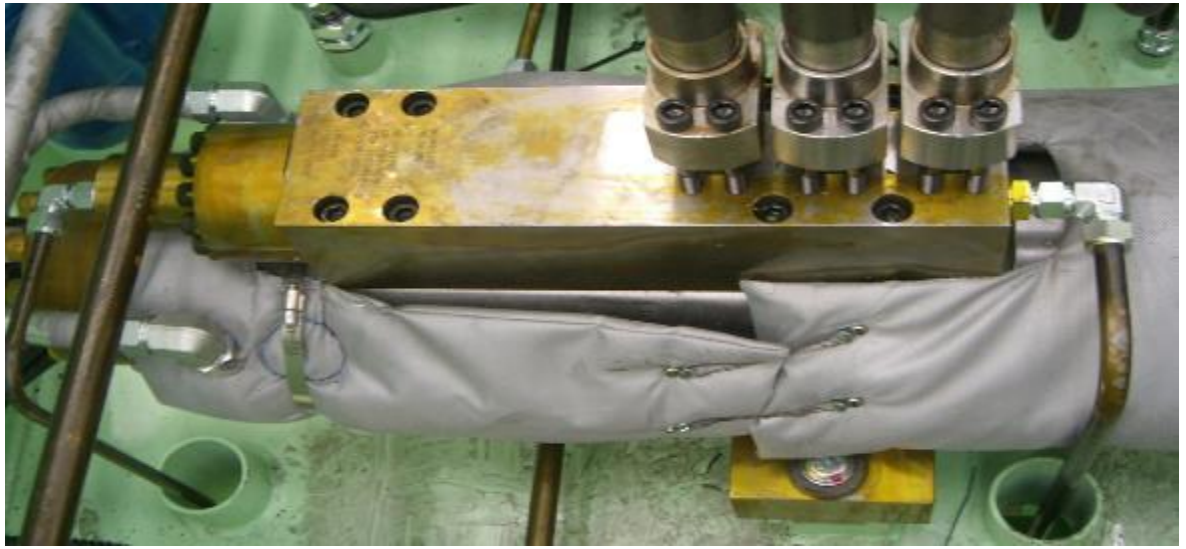




Fuel Injection

- **Fuel injector** with integrated injection control, leading to a compact design

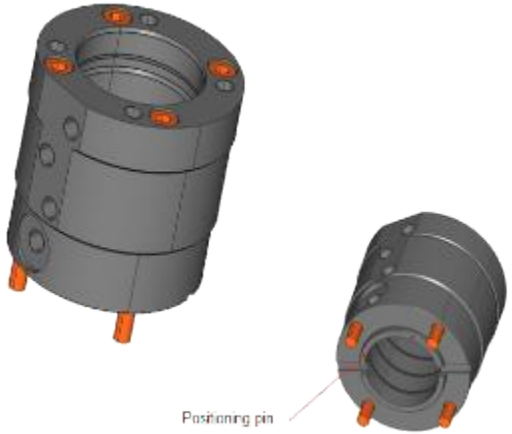
- **Flow Limiting Valve to** ensure system safety by cutting-off injection on a specific cylinder in case of a heavy fuel leak

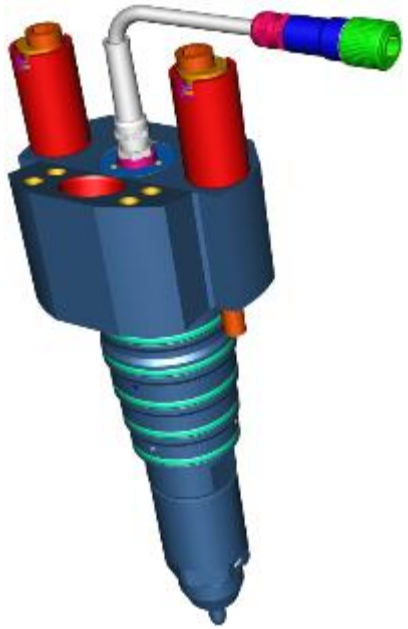


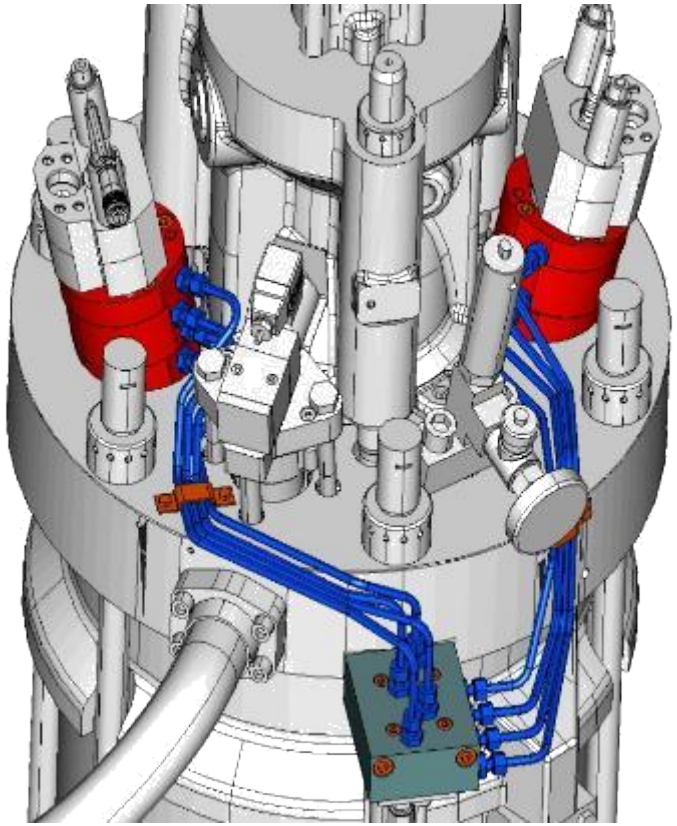
Fuel Injection

Fuel Injection Piping

- One high pressure pipe per nozzle
- Four low pressure pipes to each fuel injector holder sleeve
- Fuel injectors can be removed without disconnecting the low pressure pipes







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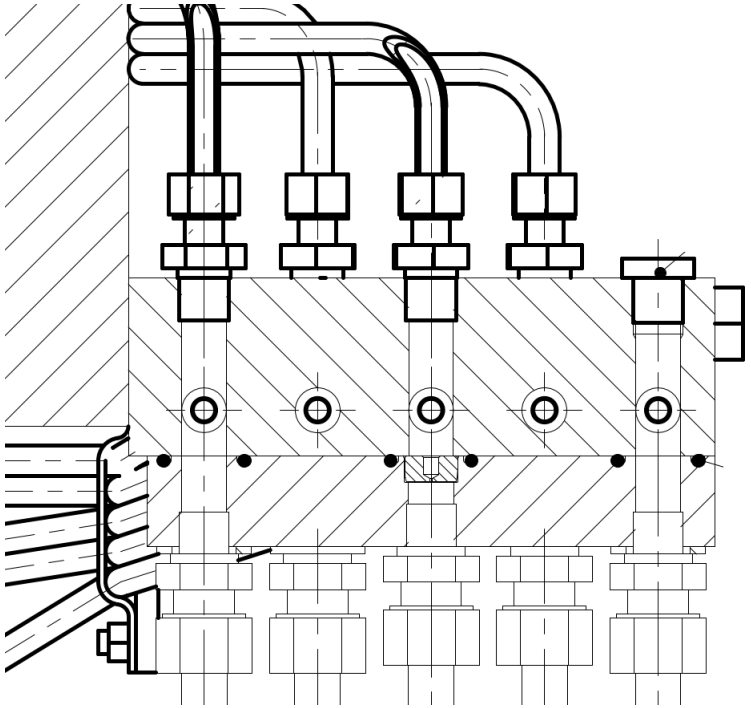
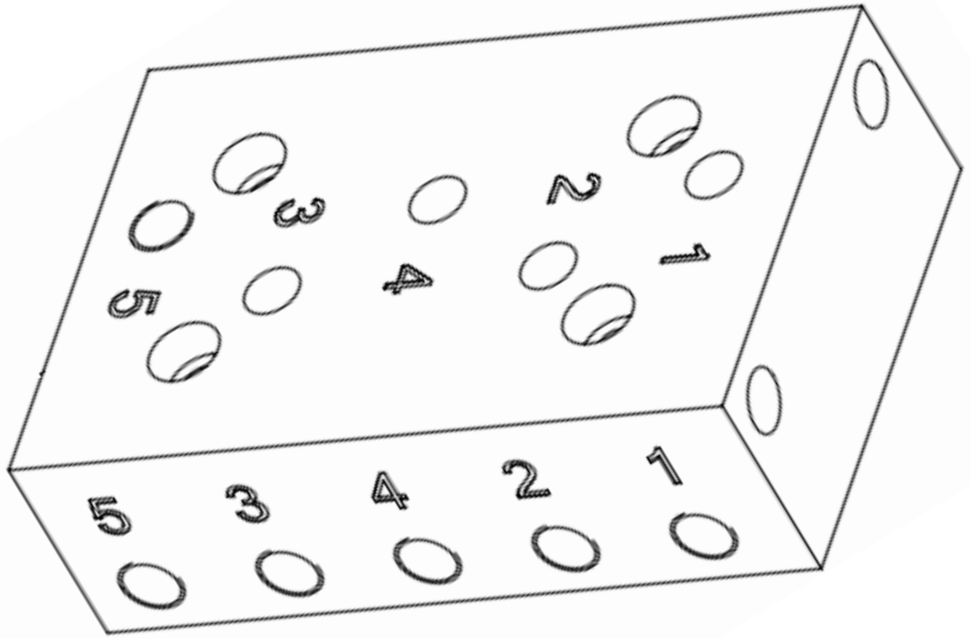
Fuel Injection

Fuel Injection Piping

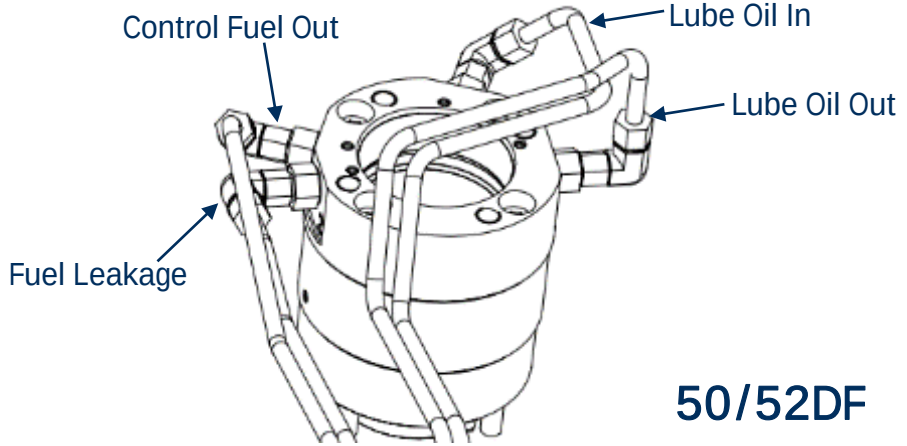




Fuel Injection

Injector and Sleeve

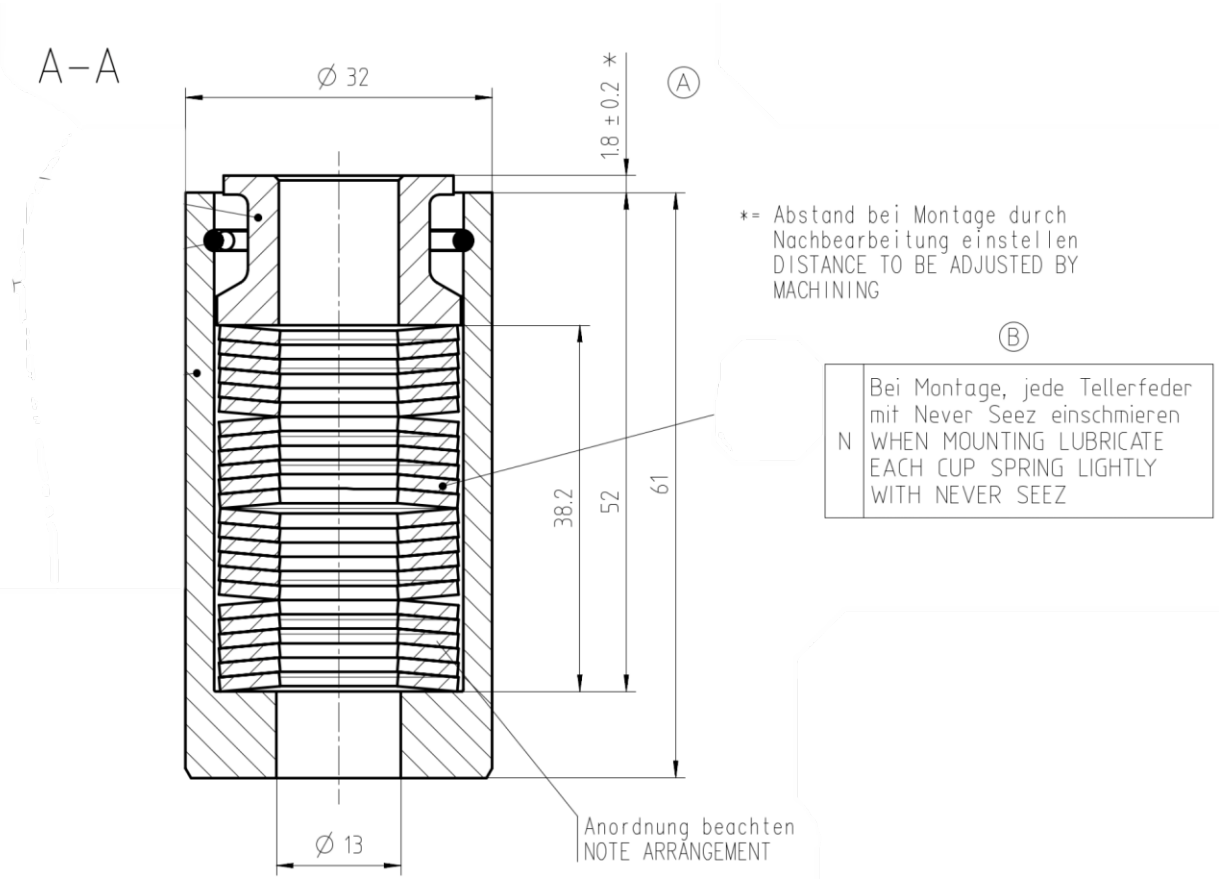
62/72DF

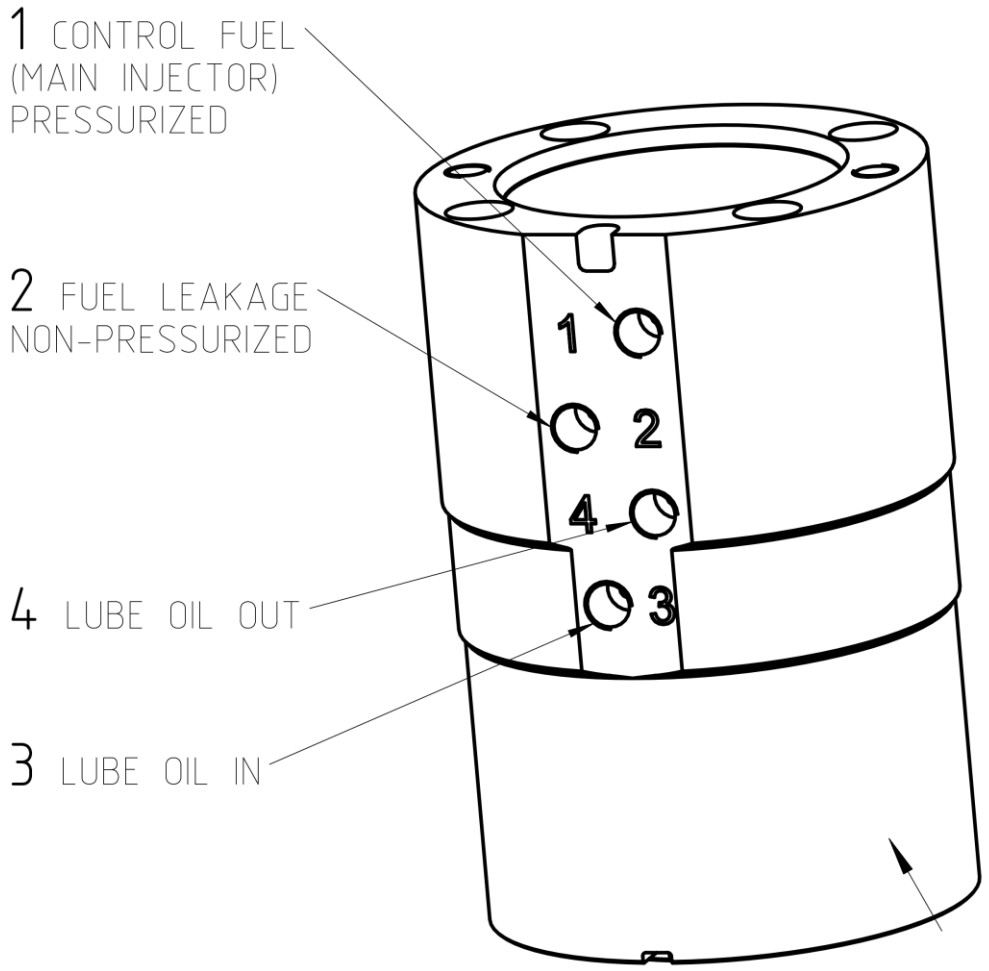


50/52DF

Fuel Injection

Injector and Sleeve





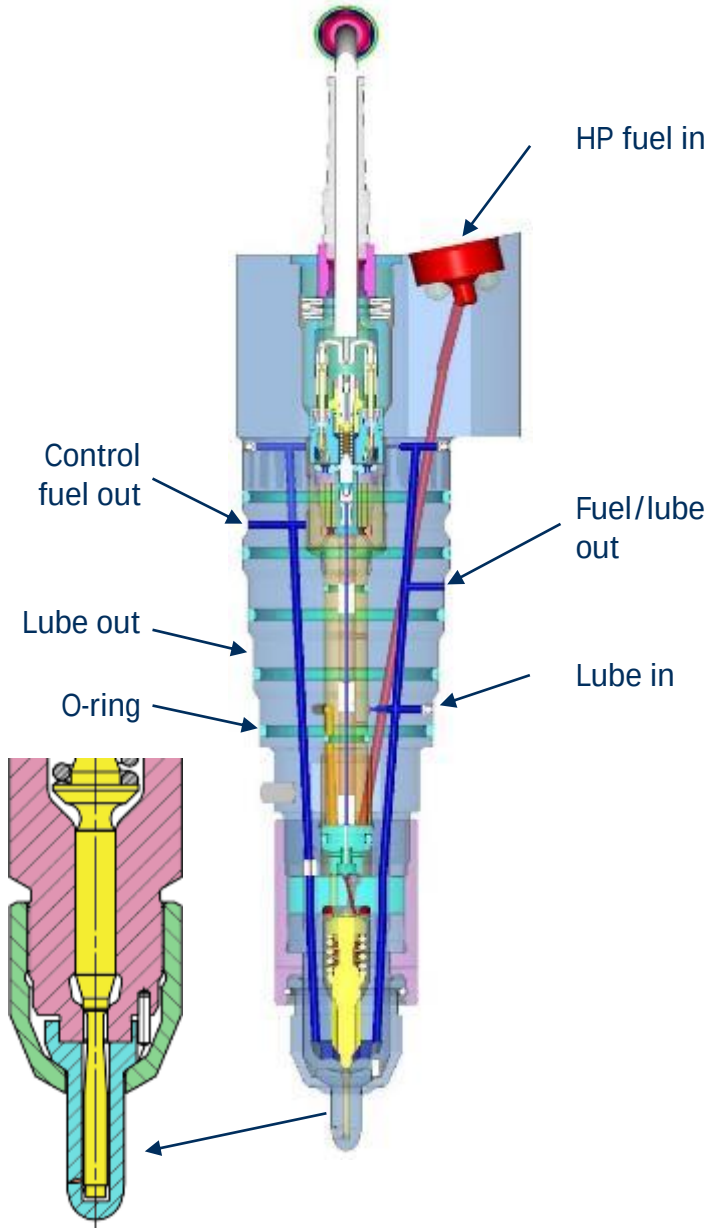
Fuel Injection

Injector and Sleeve

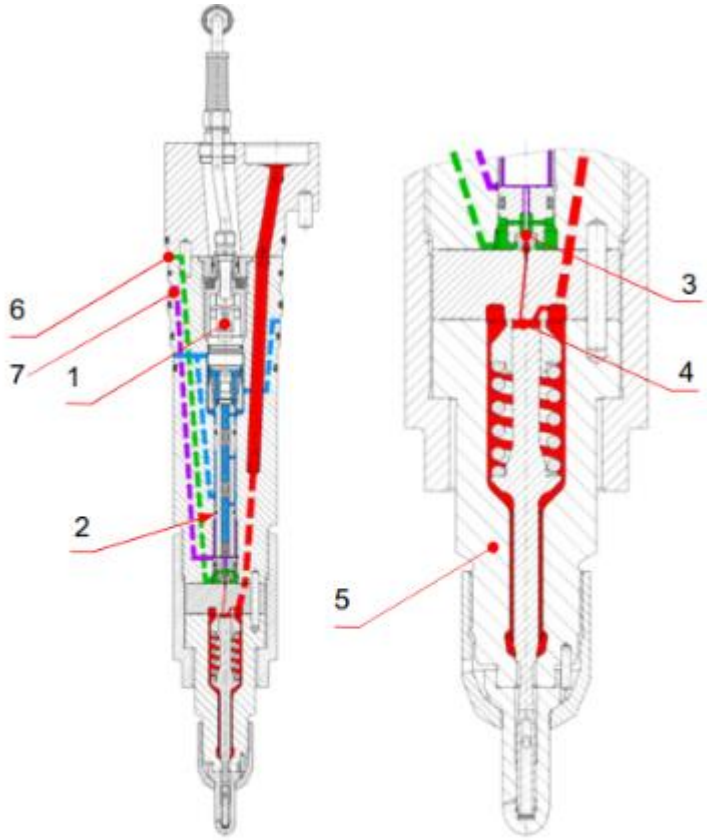
Fuel Injection

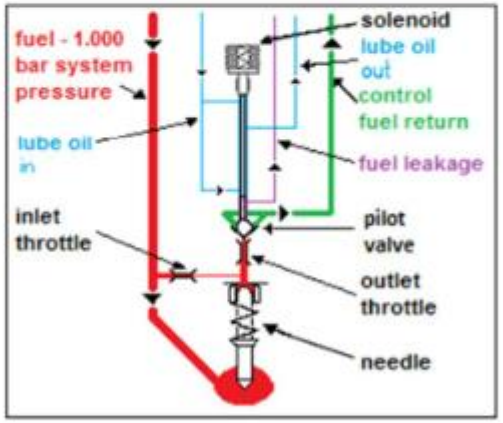
New injection valve concept

- **Solenoid actuated** injector for optimised injection control at all engine load
- **Validated** component, based on medium speed engine technology (1600 bar, high frequency injection)
- **Same inner parts** for X35/40 and X52/62/72



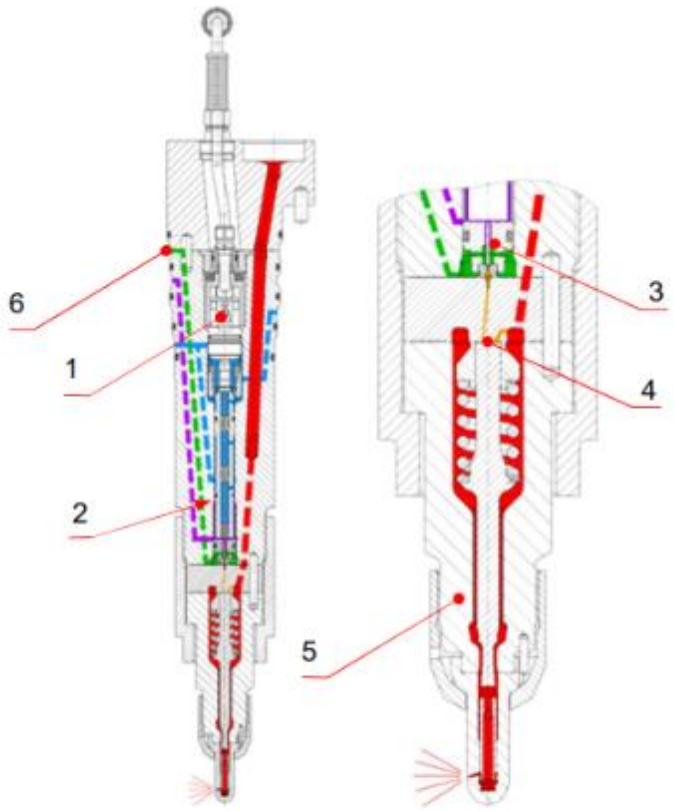
Fuel Injection Valve, Closed

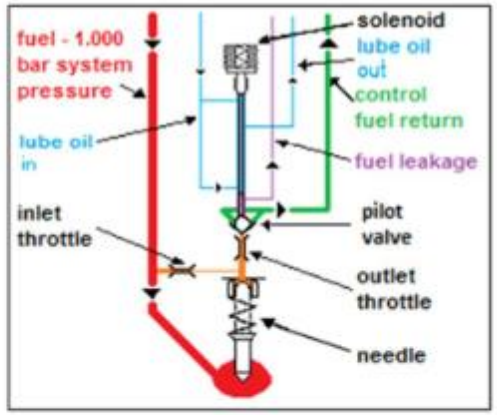




1. *Solenoid and springs set*
2. *Control element*
3. *Pilot valve with outlet throttle*
4. *Control chamber*
5. *Nozzle*
6. *Control fuel return*
7. *Fuel leakage*

Fuel Injection Valve, Opened



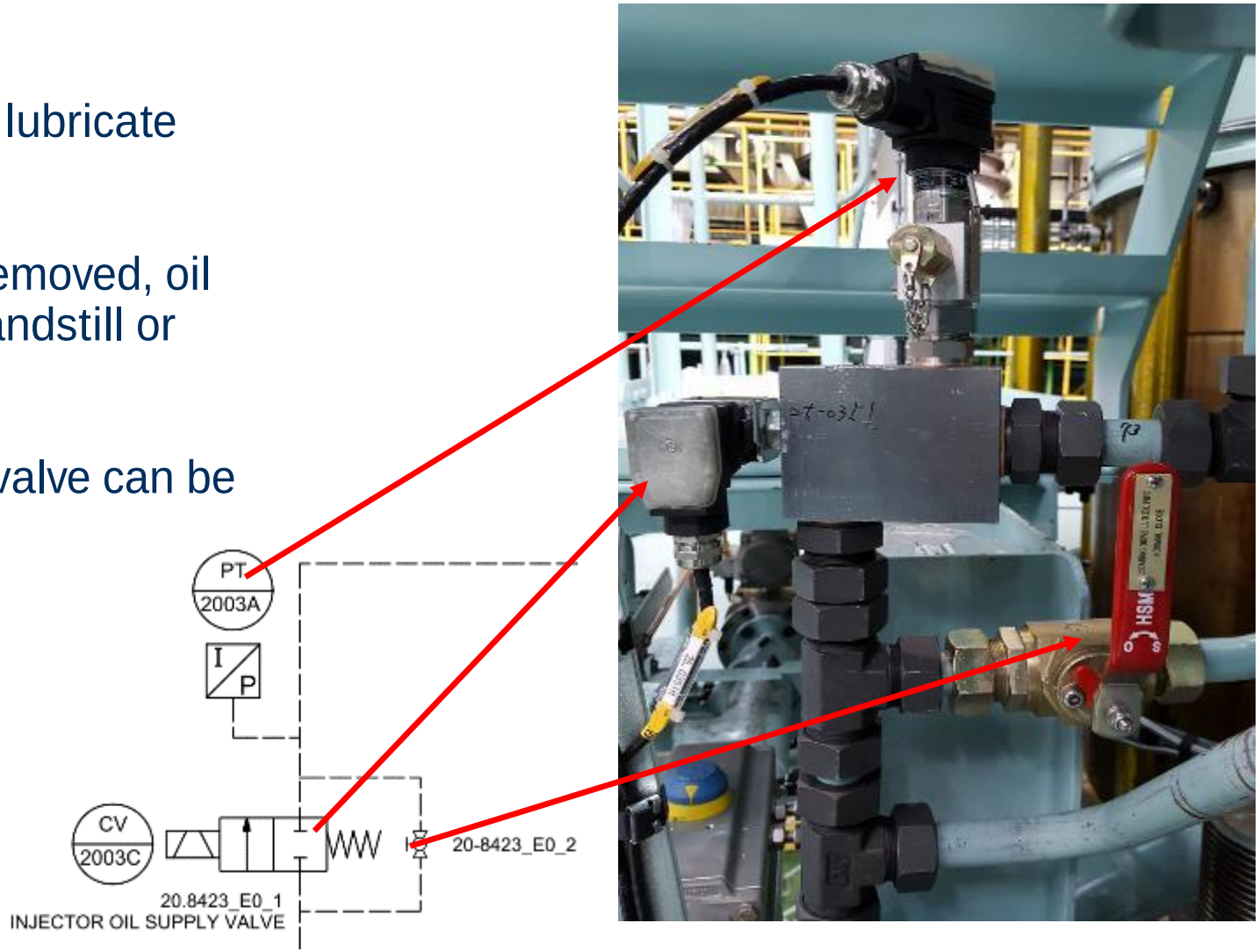


1. *Solenoid and springs set*
2. *Control element*
3. *Pilot valve*
4. *Control chamber*
5. *Nozzle*
6. *Control fuel return*

Fuel Injection

Injector lubrication

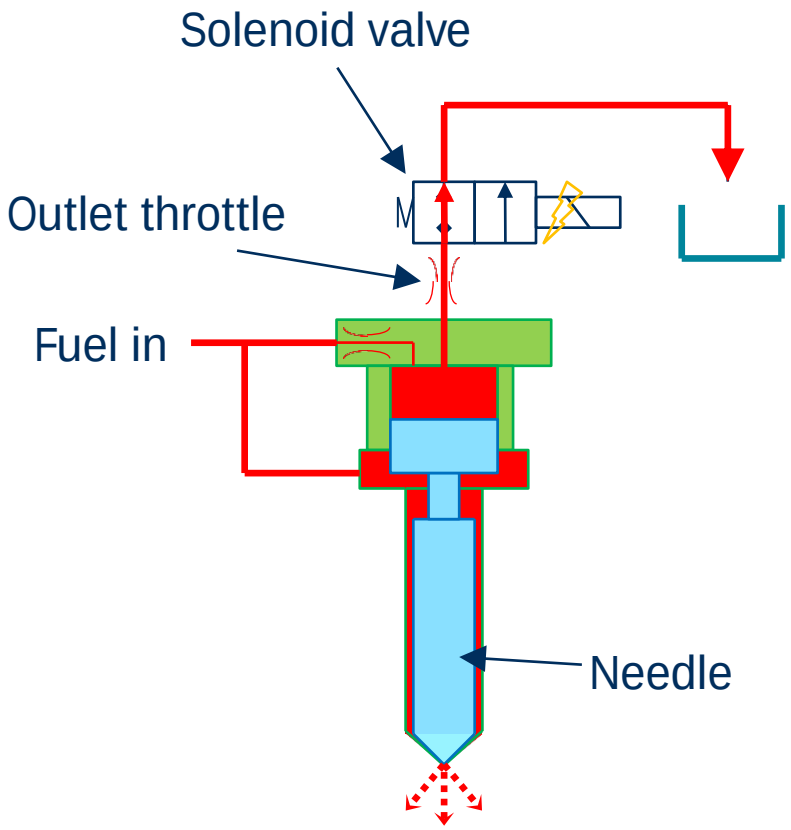
- Oil from main oil supply is used to lubricate and cool the injectors
- To prevent oil spill when injector removed, oil supply blocked while engine at standstill or power failure
- In case of malfunction, a by-pass valve can be opened



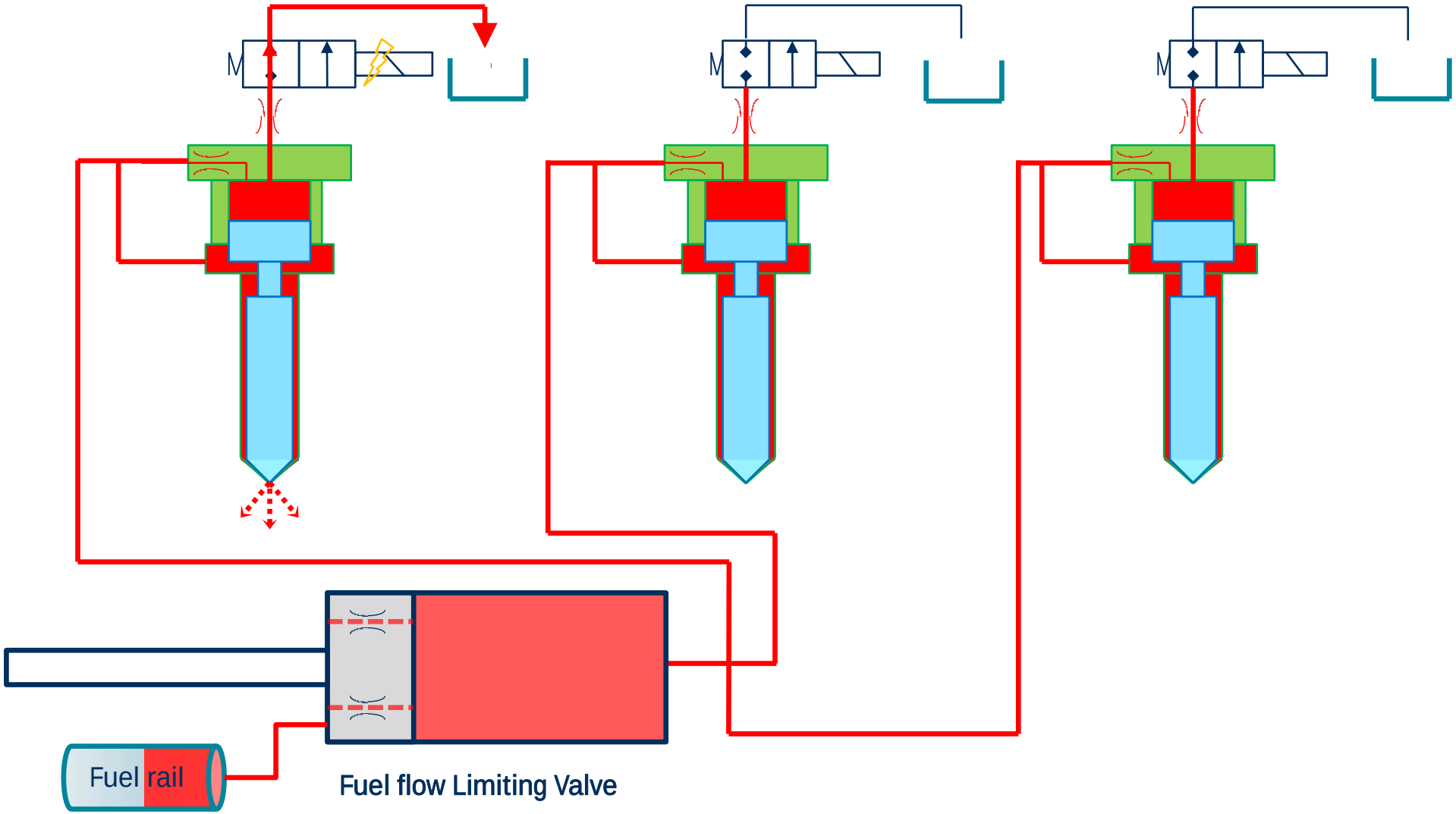
Fuel Injection

Fuel Injection-Time Control

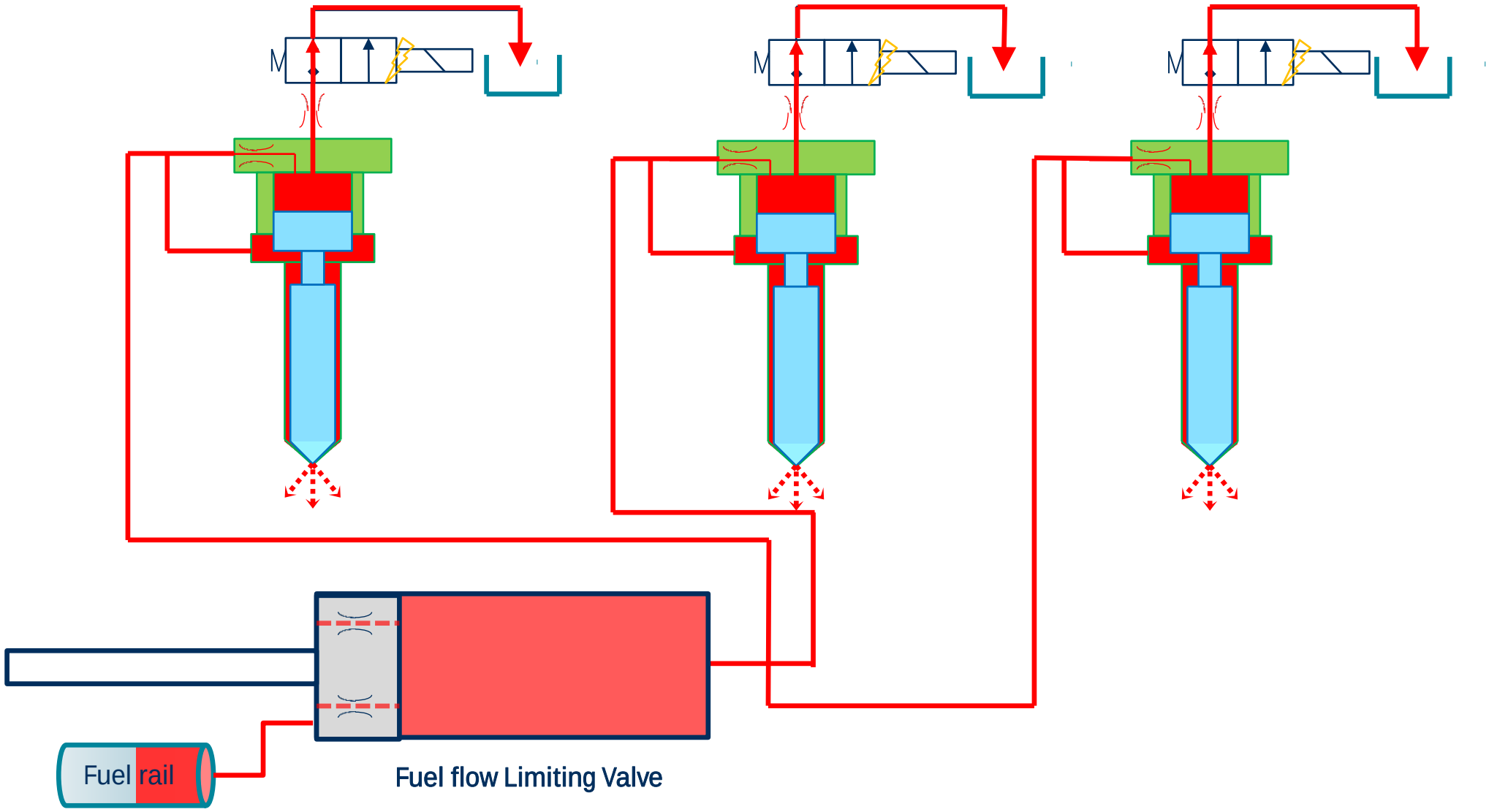
- Fuel nozzle is closed by the needle pressed down by fuel pressure
- Injection is triggered by a PWM signal, controlling a solenoid valve
- Fuel is released via the outlet throttle and needle lifted up
- Fuel is sprayed into the cylinder till the solenoid closes



Fuel Injection Valve, 1 Injector working

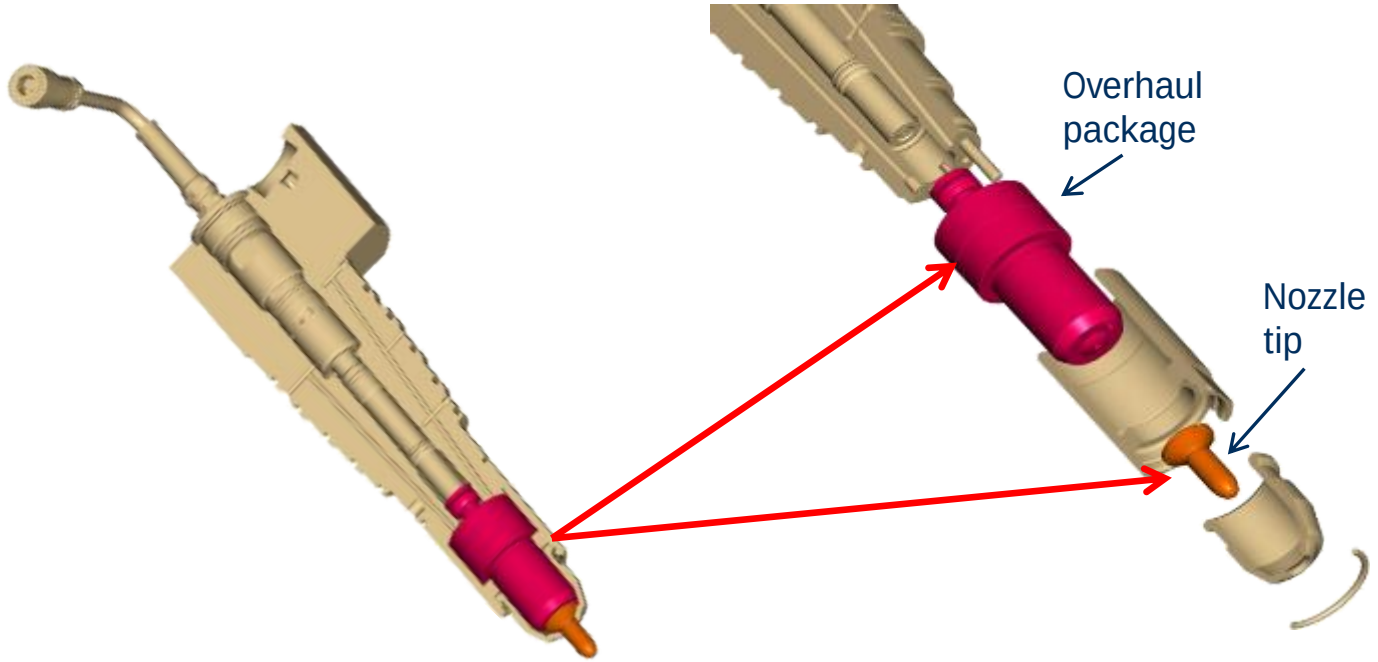


Fuel Injection Valve, All Injectors working



Fuel Injection

- Lower part (wear part) of the injector is calibrated in factory as a package
- Exchange on board by the crew
- No adjustment on board – easy exchange and maintenance



Fuel Injection

FAST Injector

WIN GD
Winterthur Gas & Diesel

Service Letter	SL-0050
Date:	2023-01-27
Implementation:	Immediately

Proper mounting instructions for main fuel injectors

For WinGD X62, X62-B, X62DF, X62DF-2.1, X72, X72-B, X72DF and X72DF-2.1 engines

Maintenance Information:

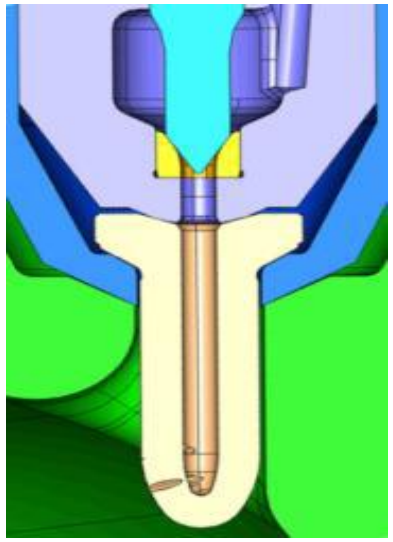
Woodward L'Orange main fuel injector needle sticking

WinGD has introduced a new fuel injector technology able to reduce emissions and fuel consumption by improving fuel injection performance:

"FAST"

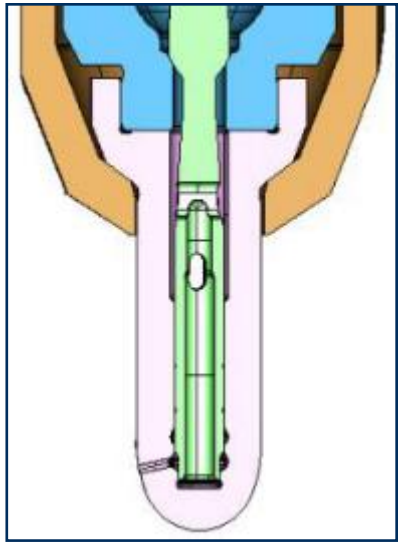
Fuel Actuated Sac-less Technology

Available for new engines and for retrofit on RT-flex engines



Non-FAST

FAST



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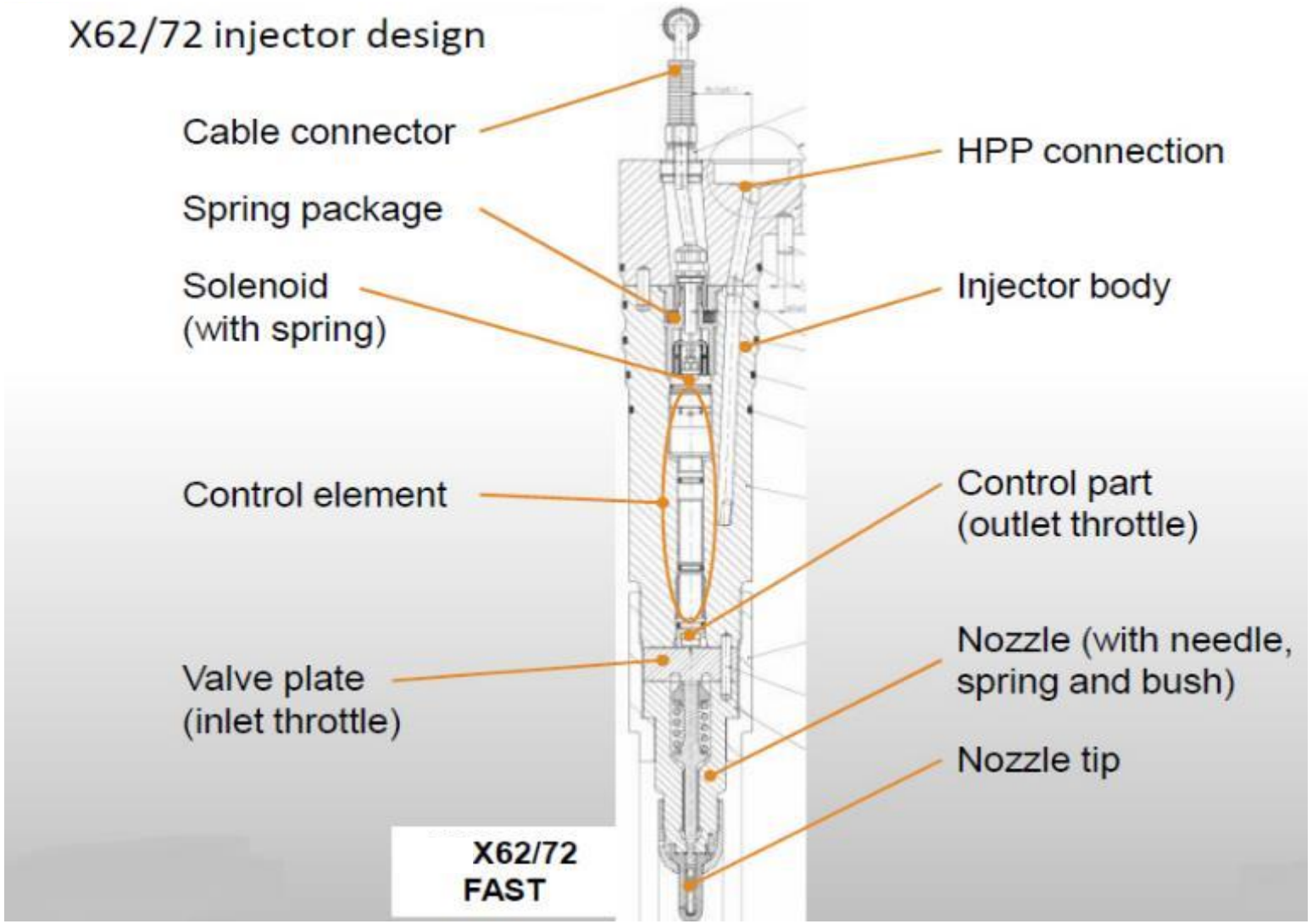
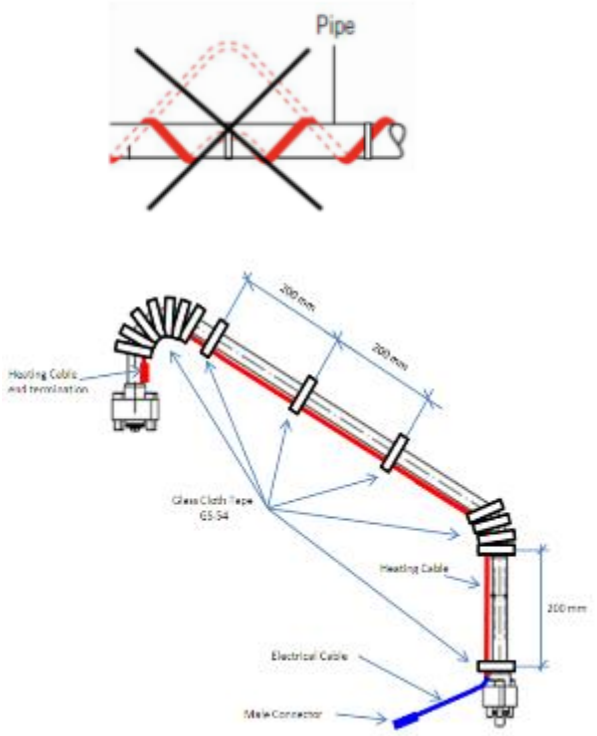
FAST Injector

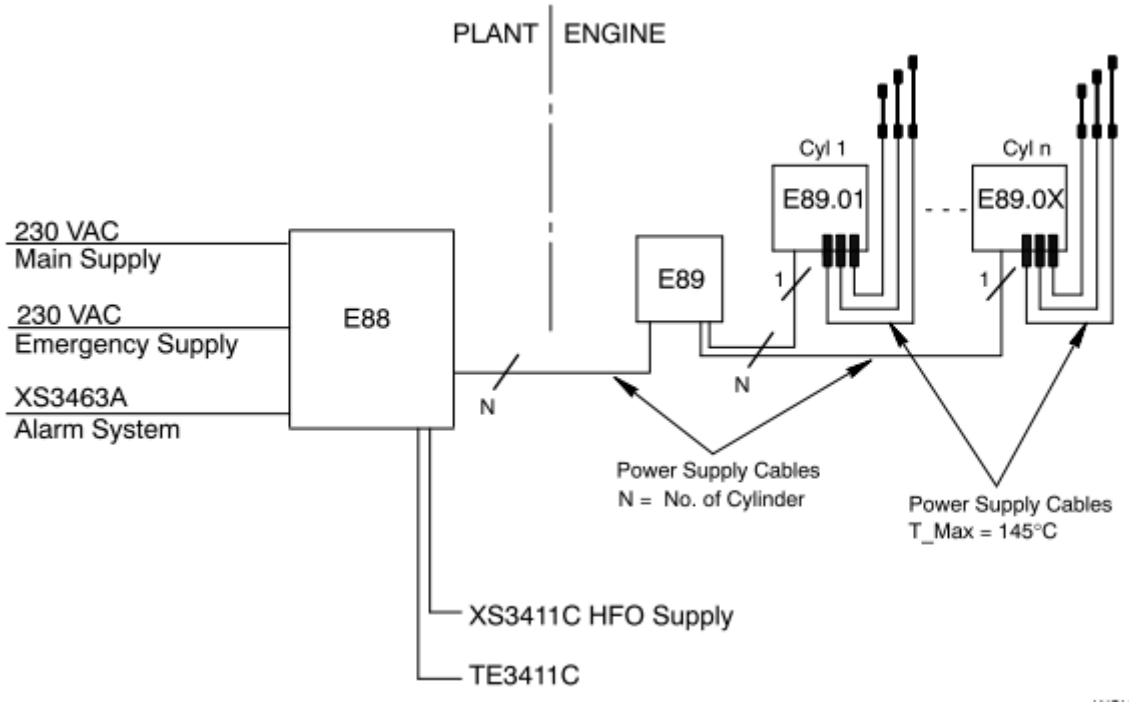


Fuel Injection

Electrical Trace Heating System

The electrical trace heating system heats the fuel injection pipes to the target temperature of 130°C ± 10% and keeps this temperature stable.





Fuel Injection

Electrical Trace Heating System

When the engine operates with:

- Marine Diesel Oil (MDO): The heating cables must be set to off.
- Heavy Fuel Oil (HFO): It is recommended that the heating cables are set to on. This keeps the HFO at the correct temperature.

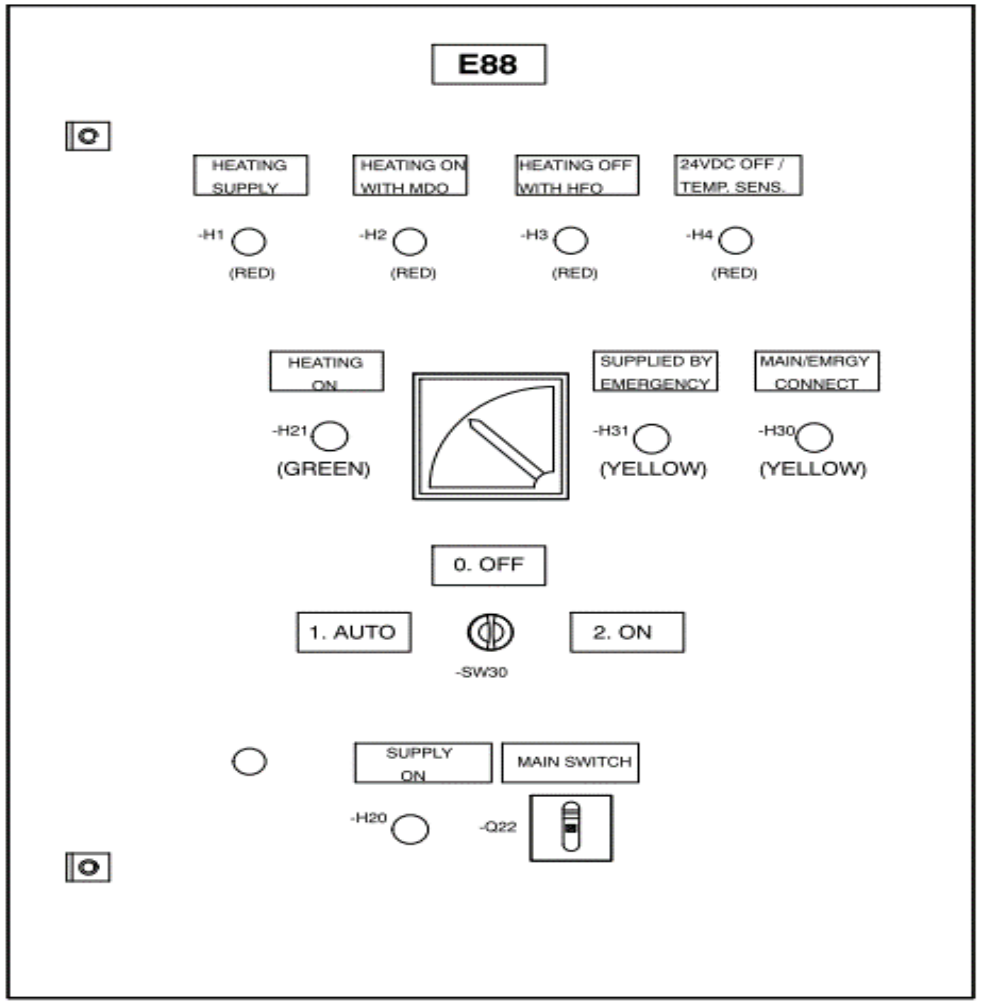
In the control box E88, you set the switch to the applicable position as follows:

- On
- Off
- Auto.

In Auto mode, the temperature measured on the fuel inlet pipe, sets the electrical system to on and off.

Fuel Injection

Electrical Trace Heating System



ICC (Cyl. Press. Sensor) previous execution

Intelligent Comb. Control (ICC)

- One permanent installed sensor per cylinder head for measuring of compression and firing pressure
- Closed loop control on time controlled injection system
- Same sensor can be used for **Intelligent Combustion Monitoring** (ICM) as well
- ICC sensor without gas-pocket in combustion chamber on DF engines

WIN GD
Winterthur Gas & Diesel

Service Letter SL-0003-2

Date: 2022-12-12

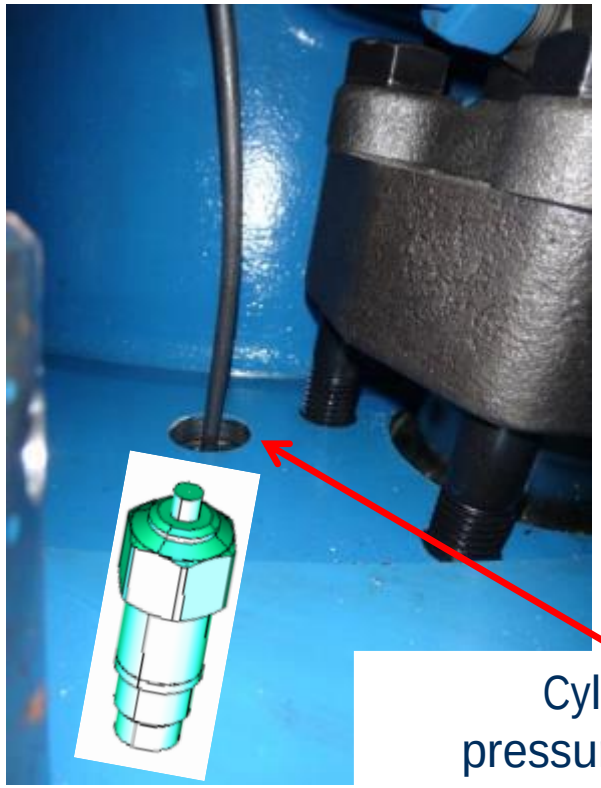
Cleaning of Kistler cylinder pressure sensors and installation of sensor adapters

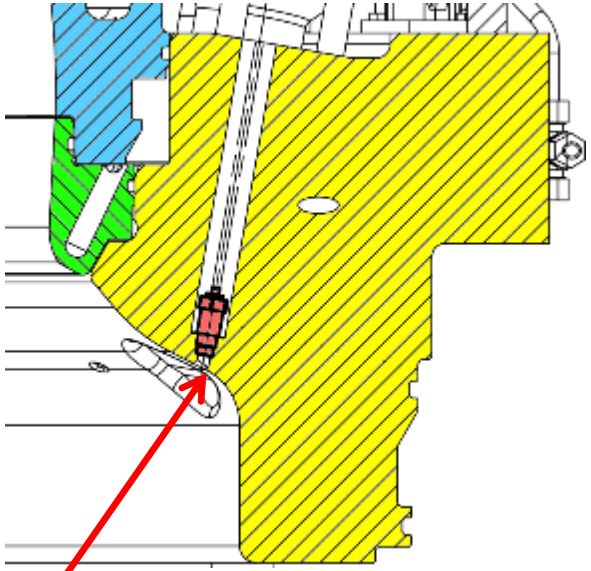
Implementation: Immediately

WinGD RT-flex50DF, X62DF and X72DF engines ordered before August 2019, which are equipped with M14 Kistler cylinder pressure sensors

Operational Information:

Procedure for cleaning M14 Kistler cylinder pressure sensors. Repair method for damaged sensor threads in the cylinder cover and implementation of a retrofit adapter for these sensors.





Cylinder pressure sensor

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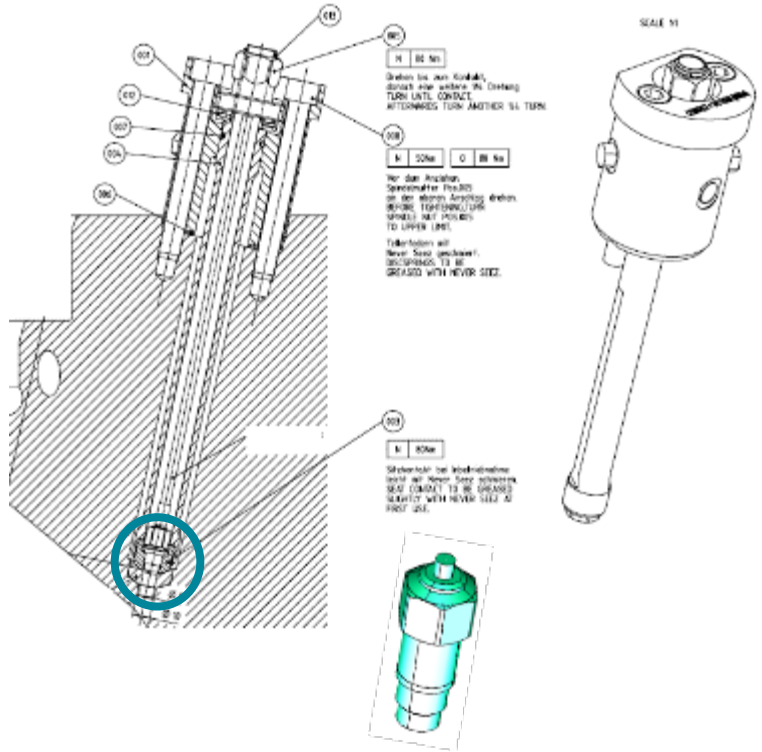
ICC (Cyl. Press. Sensor) today Standard

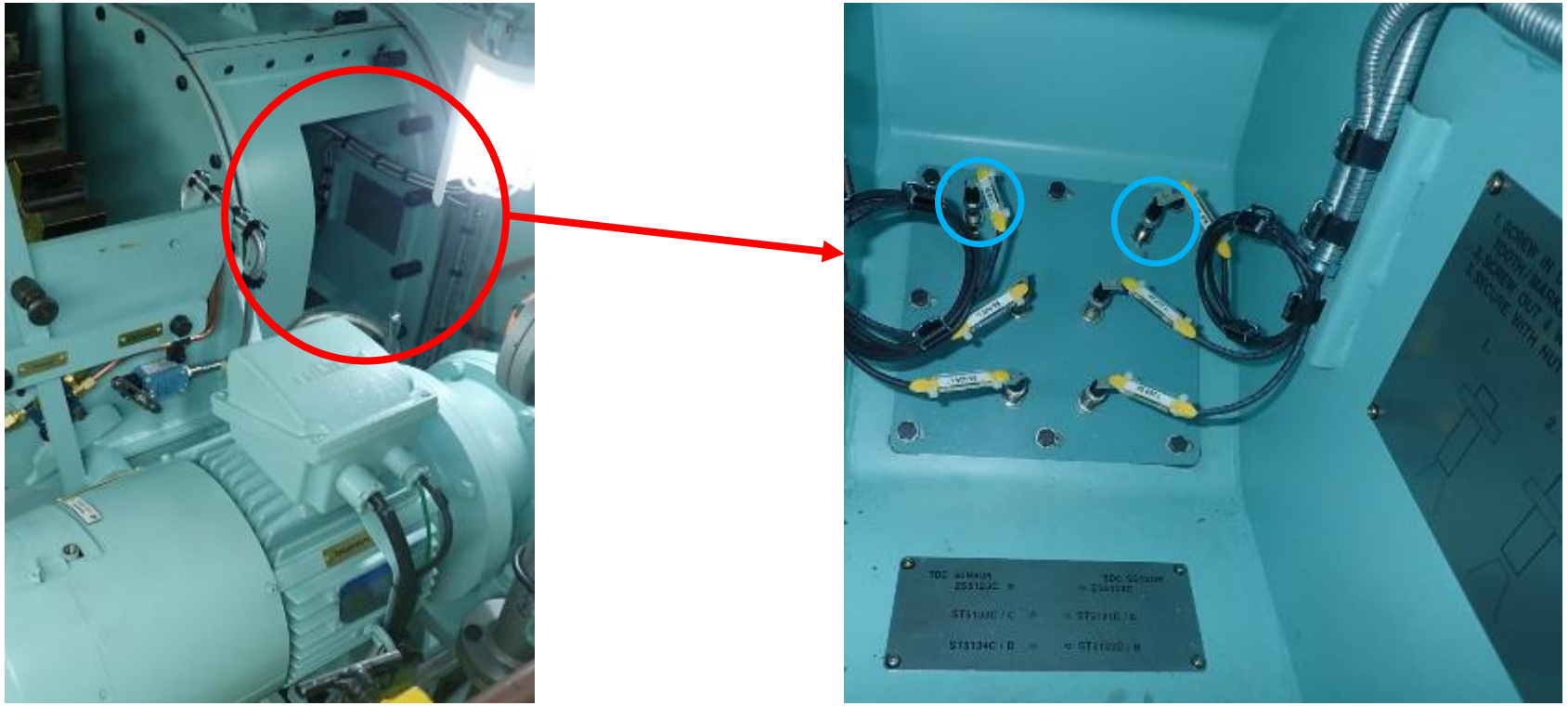
Intelligent Comb. Control (ICC)

- One permanent installed sensor per cylinder head for measuring of compression and firing pressure
- Closed loop control on time controlled injection system
- ICC sensor without gas-pocket in combustion chamber on DF engines
- Cylinder pressure sensor on bottom of relief valve

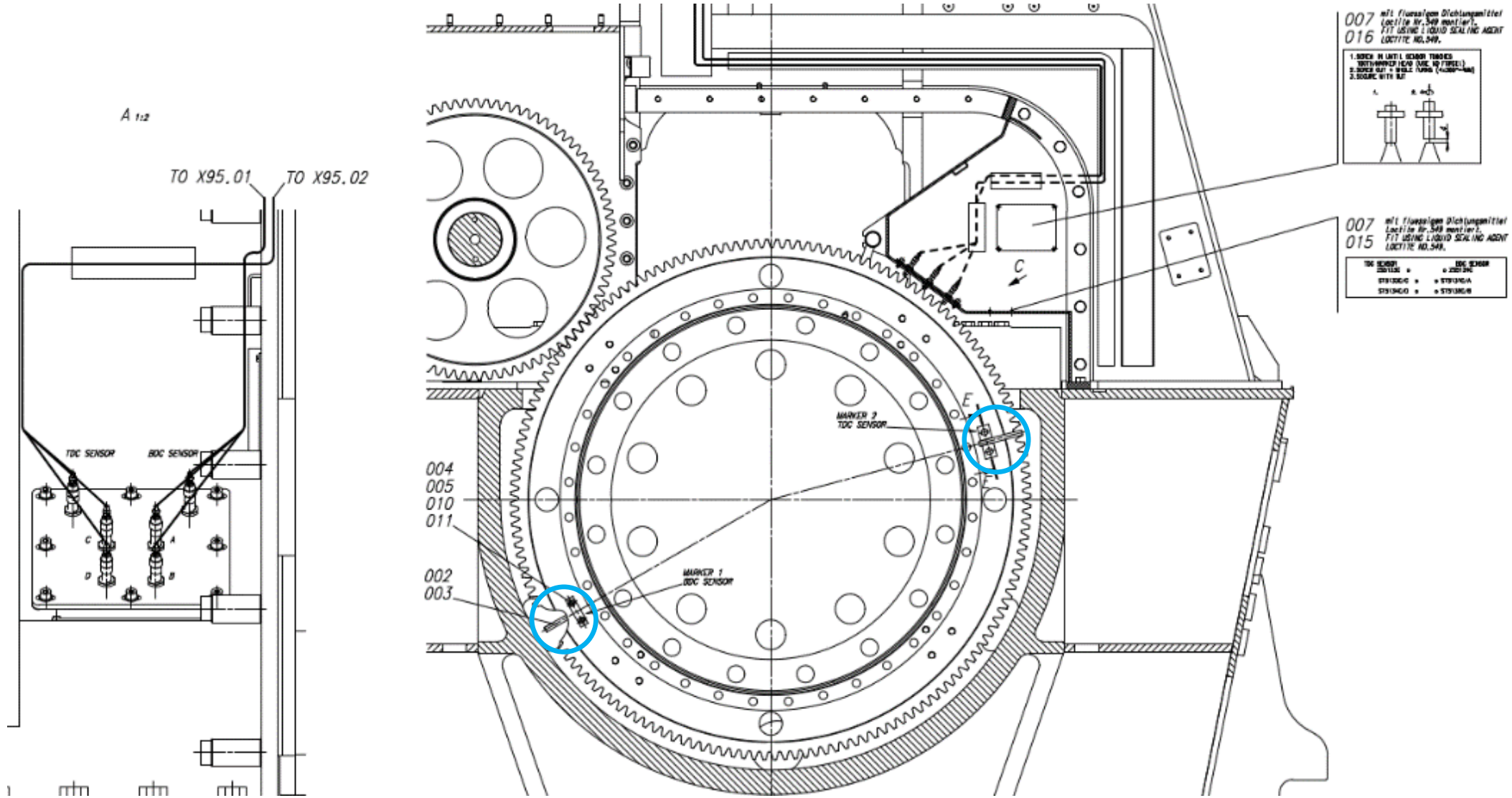


Speed- and Crank Angle Sensors, RT-flex50DF

- All pickup sensors are installed on crankshaft gearwheel
- Two reference signal sensors sense TDC- and BDC markers for crank angle calculation



Speed- and Crank Angle Sensors, RT-flex50DF



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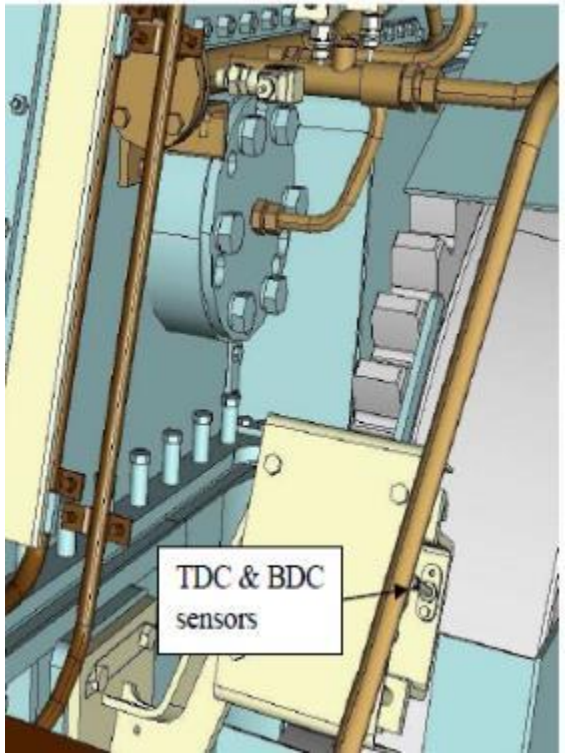
Speed- and Crank Angle Sensors

- Four sensors are installed on the intermediate wheel
- Two sensors sense TDC and BDC by markings on the flywheel



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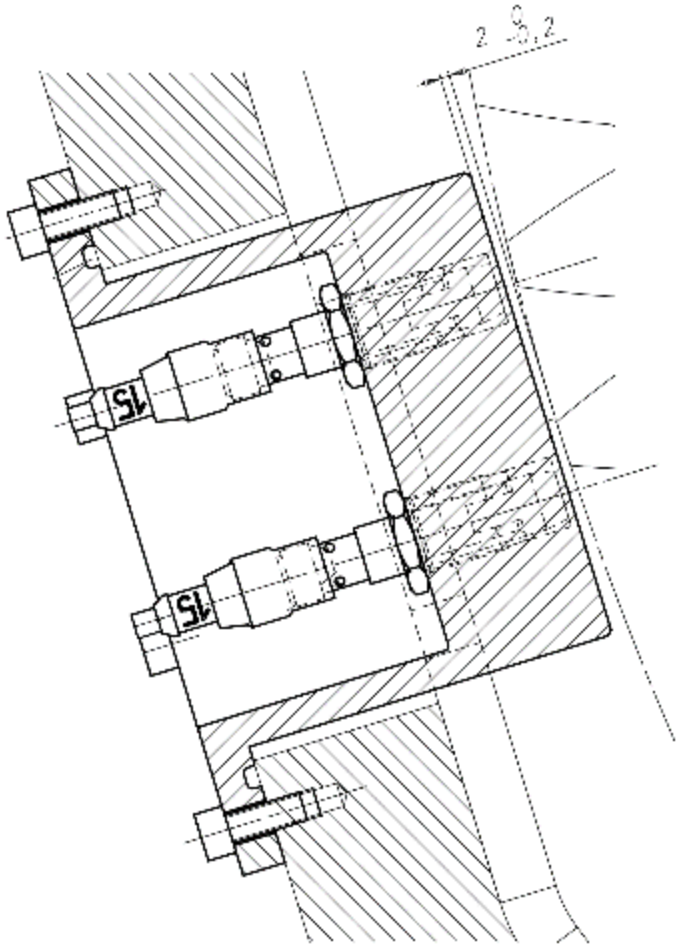
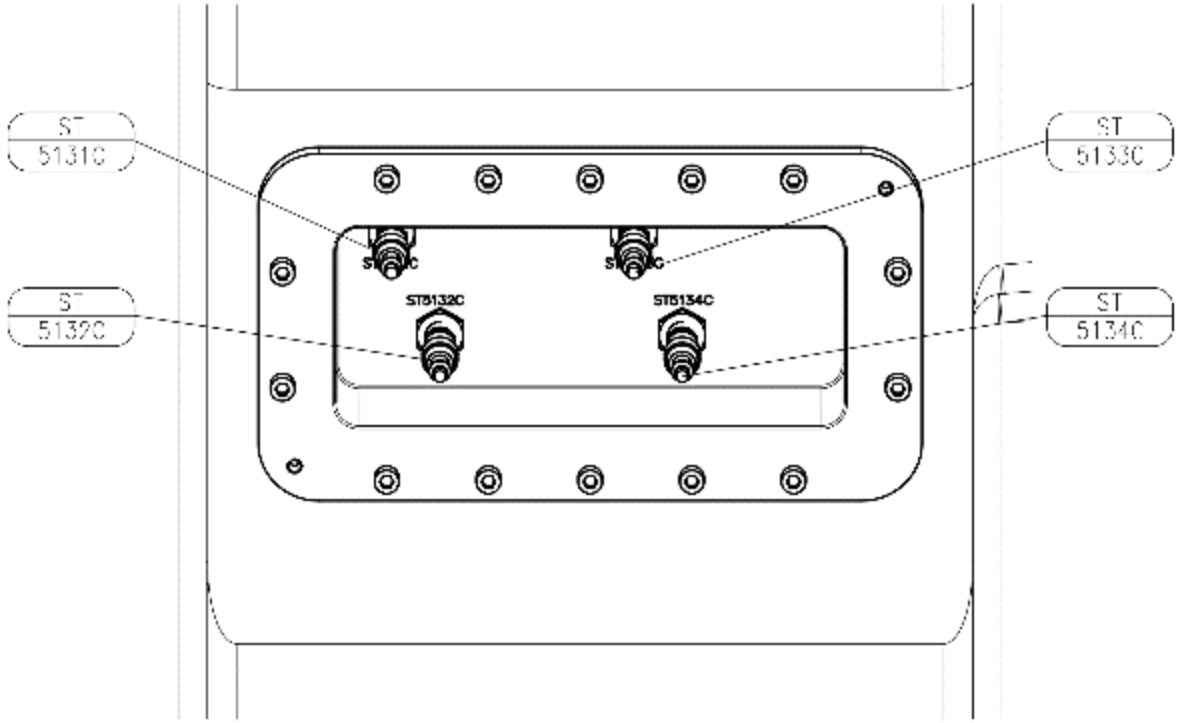
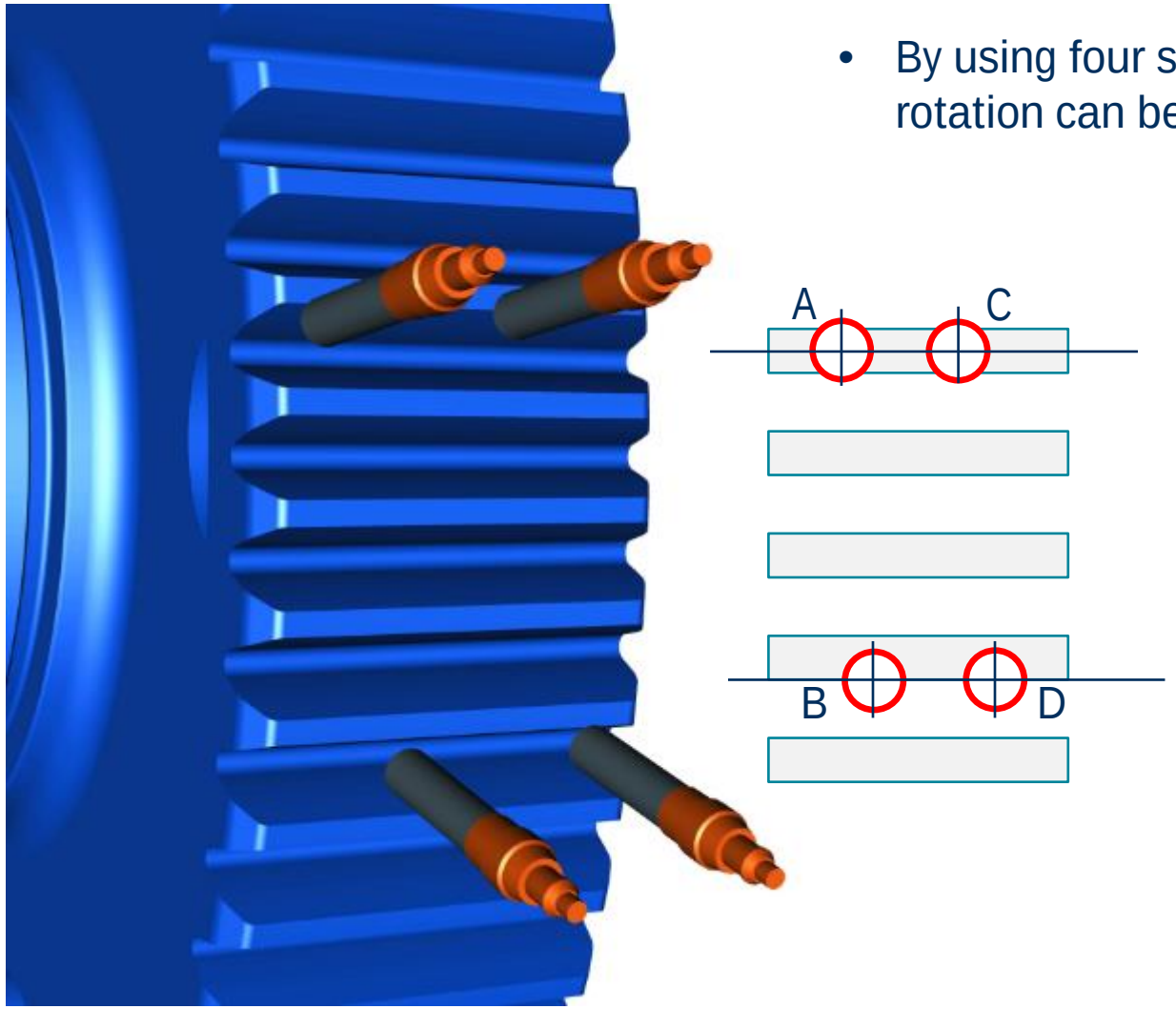
Speed- and Crank Angle Sensors





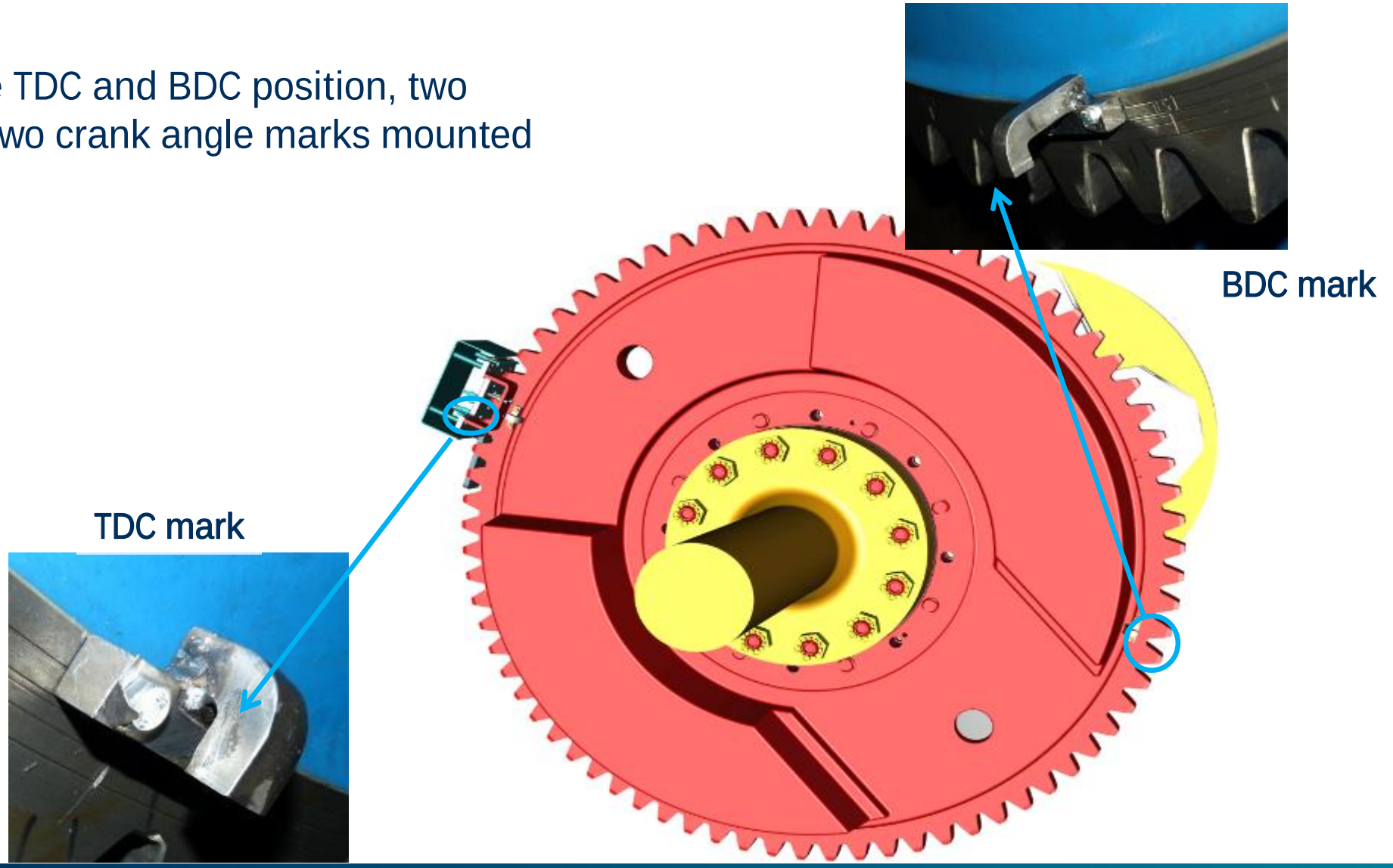
Speed- and Crank Angle Sensors



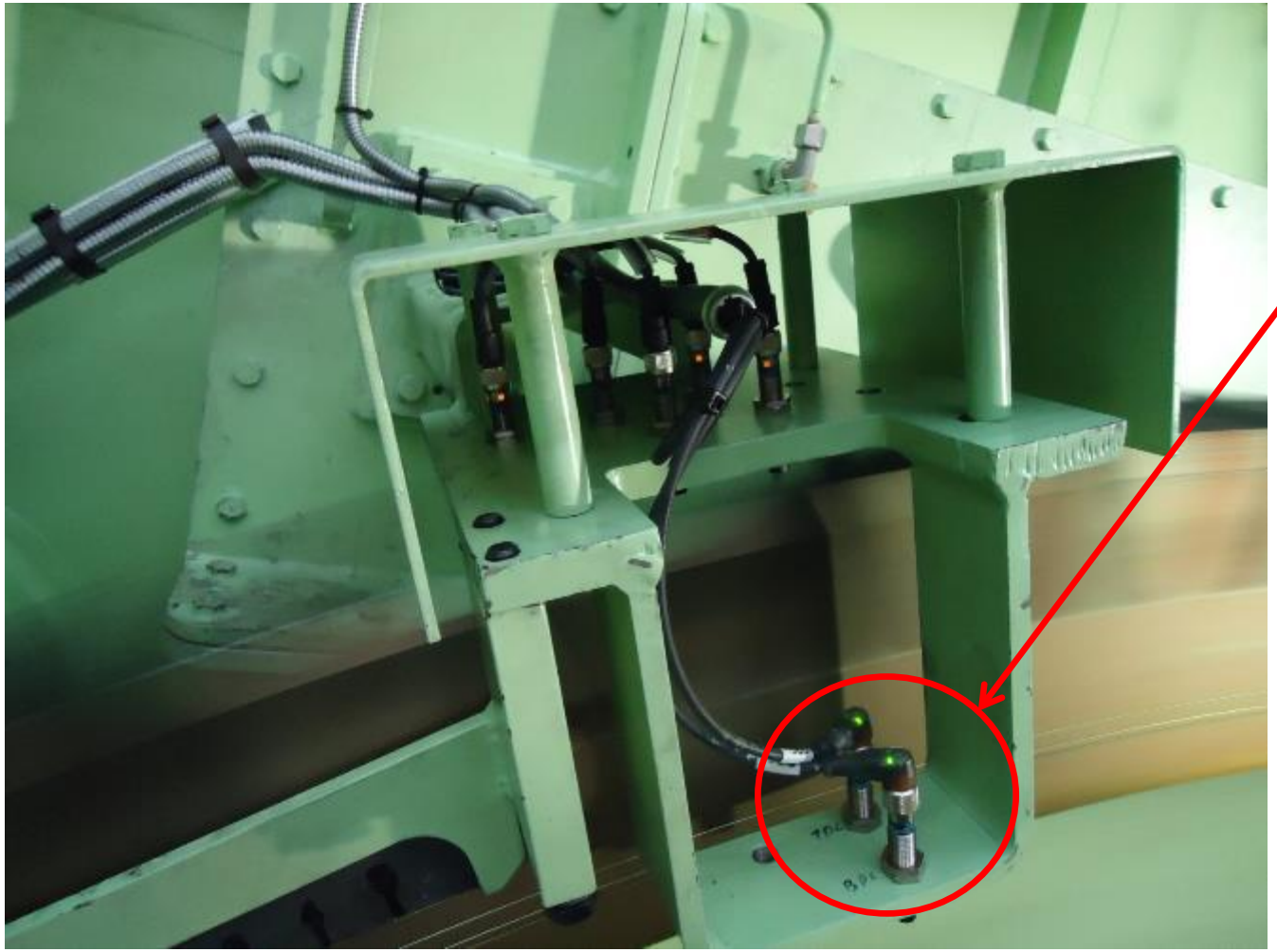
- By using four sensors, speed and sense of rotation can be detected
  - Faulty sensors can easily be changed
  - Tooth midpoint is used for calculations to avoid influences from mechanical installation and actual speed
  - Theoretical max. CA deviation:
    - max ± 0.5 deg at 7 rpm
    - max ± 0.1 deg at 15 rpm

Speed- and Crank Angle Sensors

For indicating the TDC and BDC position, two sensor read the two crank angle marks mounted on the flywheel



Speed- and Crank Angle Sensors



TDC & BDC
Pick-up sensors

UNIC-flex Hardware Modules

- LDU-20, Local Display Unit
  - 2 units per engine
  - external bus interfacing local user interface
- CCM-20, Cylinder Control Module
  - 2 unit per cylinder
  - cylinder functions
  - distributed engine functions
- MCM-11, Main Control Module
  - 1 unit per engine
  - external bus interfacing
  - engine speed control
- IOM-10, Input Output Module
  - 1 unit per engine
  - Data acquisition unit

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UNIC-flex Hardware Modules

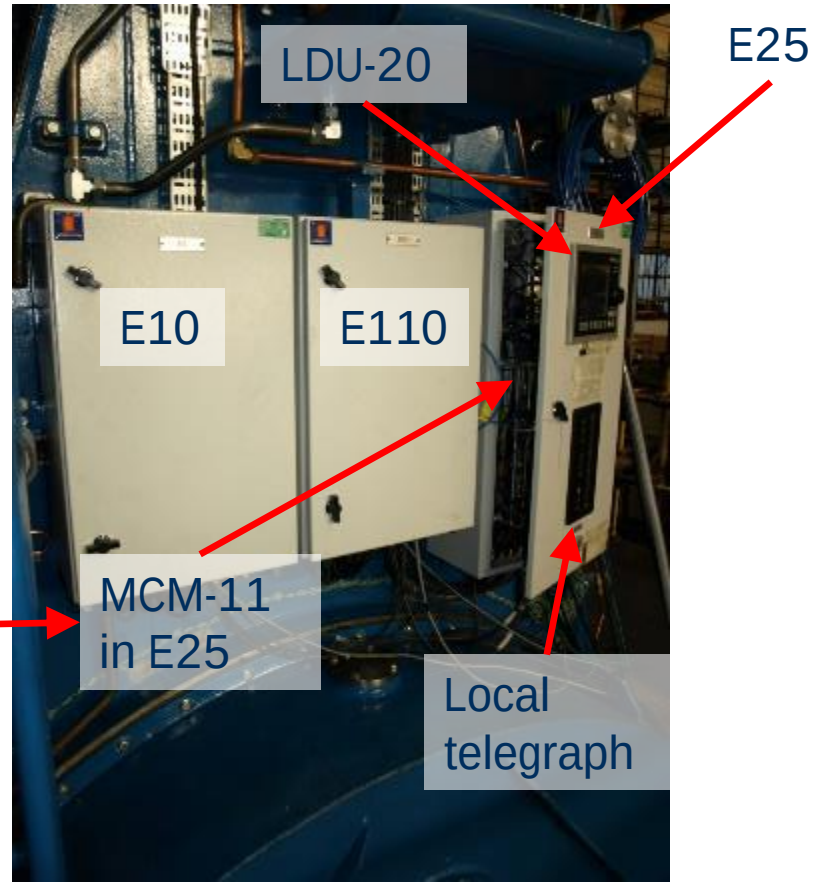
Cylinder Control Modules

X72 DF

UNIC-flex Hardware Modules

Local Manoeuvring Stand

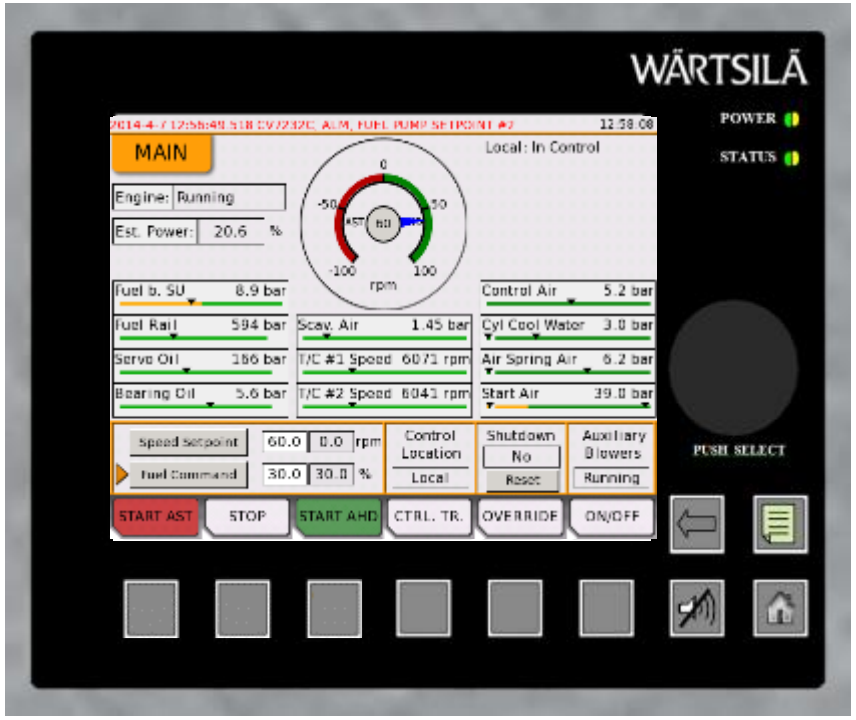
- The E25 box contains one Main Control Module (MCM-11) and a Local Display Unit (LDU-20)
- The MCM-11 is taking care of the engine speed control, digital interface to CCM-20's and control room equipment
- The E10 is the control terminal box
- E110 is the alarm terminal box



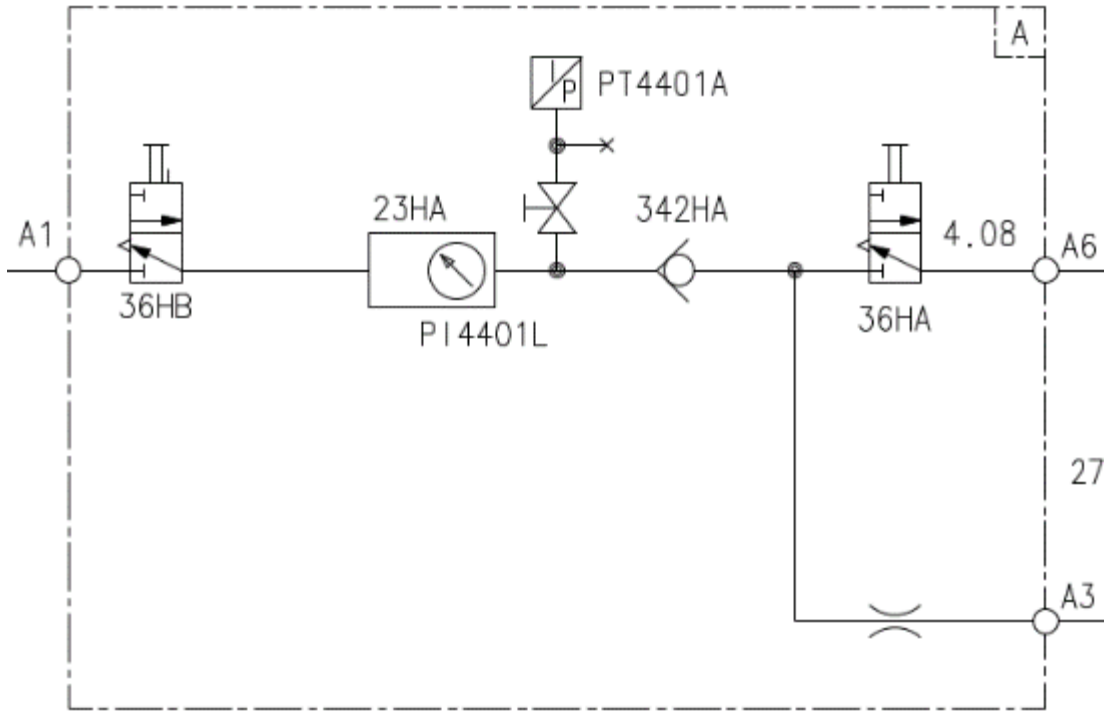
UNIC-flex Hardware Modules

Local Display Unit LDU-20

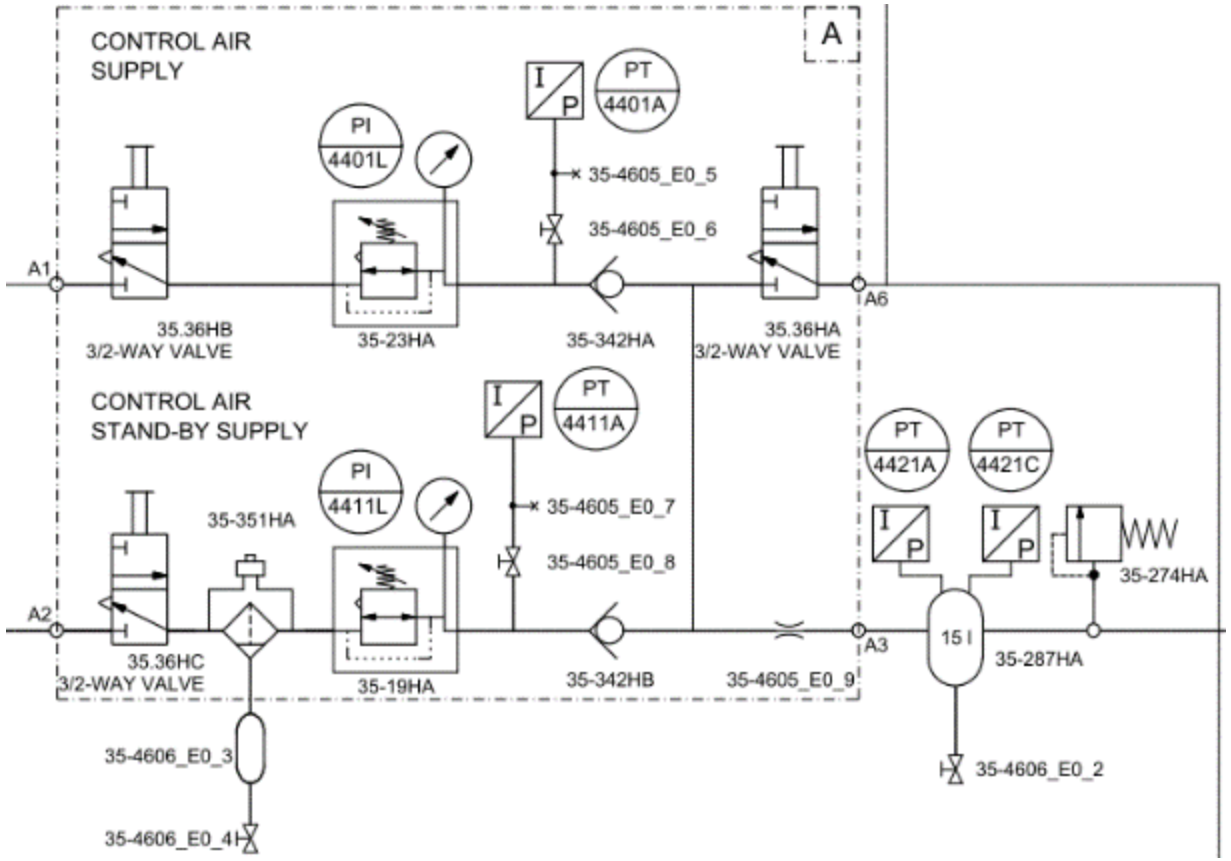
- The Local Display Unit (LDU-20 panel) is the interface to UNIC-flex
- It is integrated into the E25 local manoeuvring stand from where the engine can be operated in case of emergency
- One more LDU-20 is installed in the engine control room



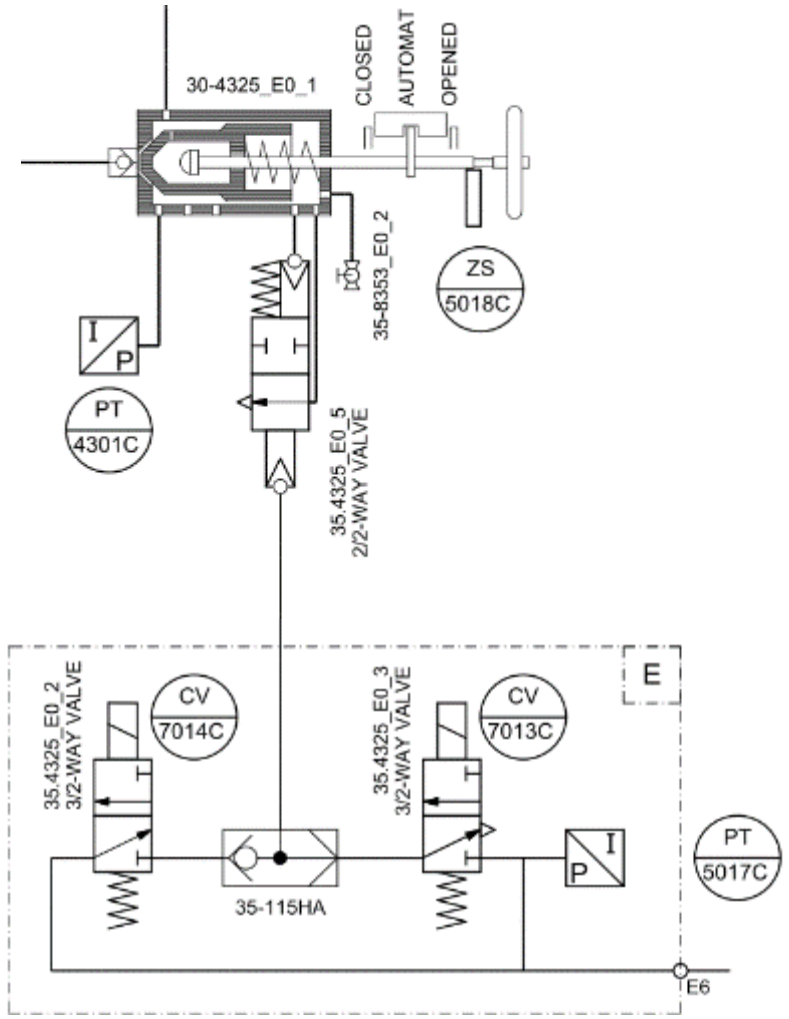
Control Air Supply Unit, flex50DF



Control Air Supply Unit

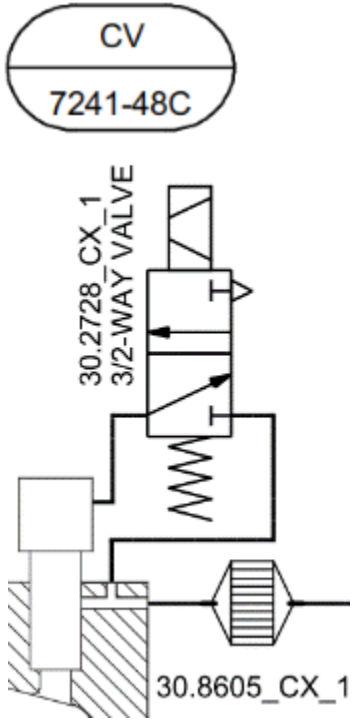


Main Starting Valve

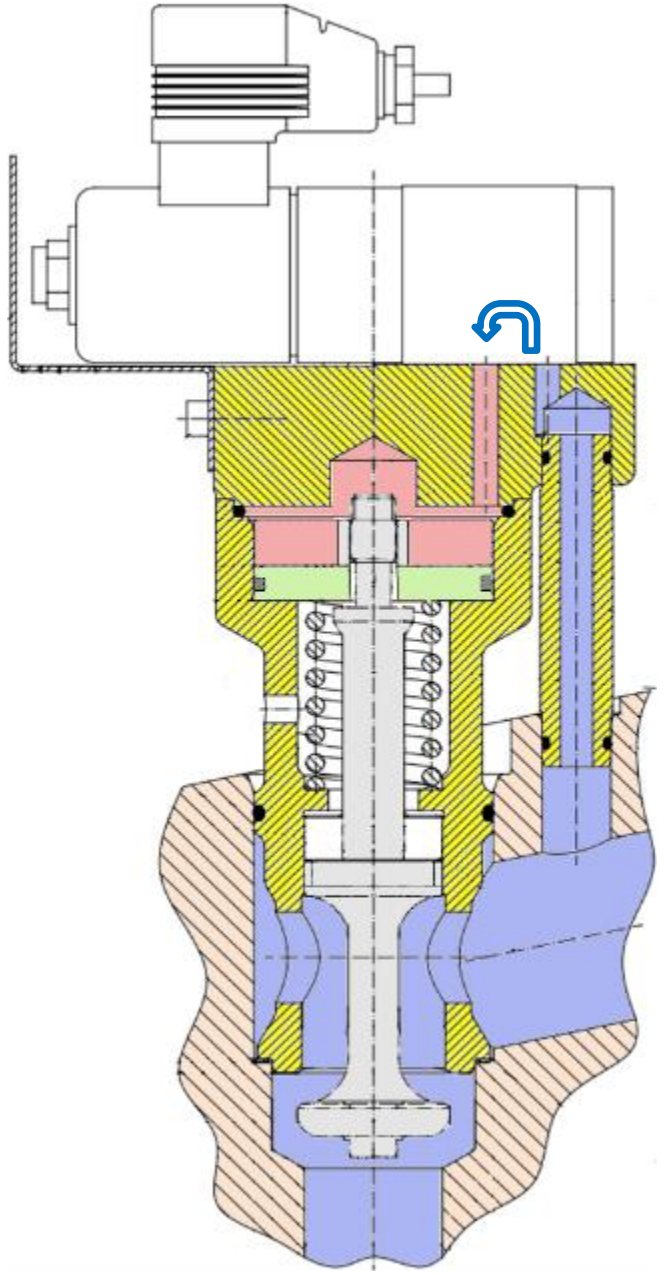


Pilot Starting Valve

The pilot starting valve is opened by an electric signal



Pilot Starting Valve



Shaft Locking Device for twin propeller

WIN GD
Winterthur Gas & Diesel

Service Letter	SL-0037-1
Date:	2023-02-15
Implementation:	Immediately

Locked shaft, windmilling and opposed operation of twin-engine installations

WinGD twin-engine installations

Operational Information: