ENGINE OIL SYSTEM

OVERVIEW

The Lubrication System supplies filtered, non-regulated pressure oil to lubricate engine bearings, gears and accessory drives under all operating conditions.

Oil is also used to clean engine parts, cool heated part surfaces, and warm engine fuel to prevent icing.

The system consists of five interactive subsystems, shown below.

Safety Conditions

WARNING

BE CAREFUL WHEN YOU WORK ON THE ENGINE AFTER SHUTDOWN, THE ENGINE AND ENGINE OIL CAN STAY HOT FOR A LONG TIME. IF YOU DO NOT OBEY THIS WARNING, INJURY CAN OCCUR.

REFER TO THE MSDS FOR ALL MATERIAL USED AND THE MANUFACTURER'S SAFETY INSTRUCTIONS FOR EQUIPMENT USED. IF YOU DO NOT OBEY THIS WARNING, INJURY CAN OCCUR.

CAUTION

YOU MUST USE A SECOND WRENCH TO HOLD THE MATING PARTS WHEN YOU LOOSEN OR TIGHTEN THE TUBE NUTS. IF YOU DO NOT OBEY THIS CAUTION, YOU CAN TWIST OR DAMAGE THE TUBES.

DO NOT LET FUEL SPILL ON THE ENGINE. YOU MUST IMMEDIATELY REMOVE UNWANTED FUEL WITH A CLOTH. THE FUEL CAN CAUSE DAMAGE TO SOME ENGINE PARTS.

System	Function
Storage	• Maintains adequate oil supply
Distribution	• Sends oil where and when necessary • Cleans and filters unwanted material before oil is used • Removes heat from the engine, using heat exchangers
Scavenge	• Removes oil from bearing compartments and returns it to the tank
Breather	• Releases bearing compartment air pressure resulting from heat expansion and bearing buffer ventilation
Indicating	• Provides information about oil quantity, temperature and pressure

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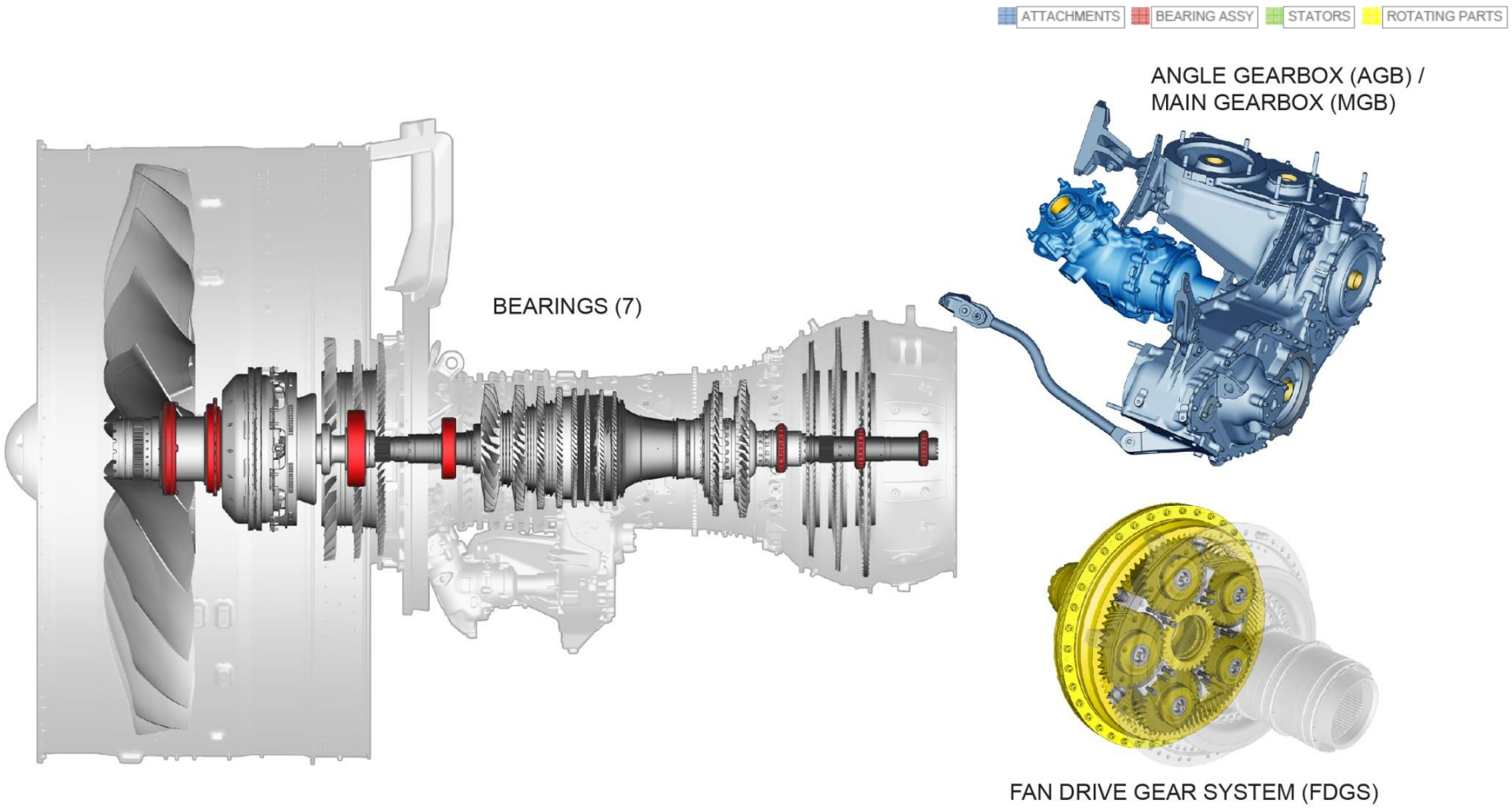


PRIMARY OIL-DEPENDENT COMPONENTS

STORAGE SYSTEM

Overview

The Storage System consists of a pressurized hot oil tank, which stores the oil and supplies it to the engine's Oil Distribution System.

Oil tank features include:

- filler neck assembly
- tank cap
- deaerator
- pressurization valve
- oil quantity sight glass
- strainer
- drain plug.

The oil tank assembly is located on the fan case at approximately 9:00. The pressurized assembly has a capacity of 35 quarts.

The filler neck assembly provides a port for servicing the oil tank. A deaerator in the tank removes air bubbles as the oil goes into the tank.

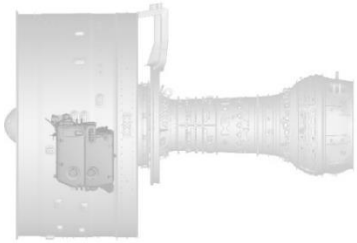
A pressure relief valve in the tank releases air and oil pressure to the de-oiler in the Main Gearbox when necessary.

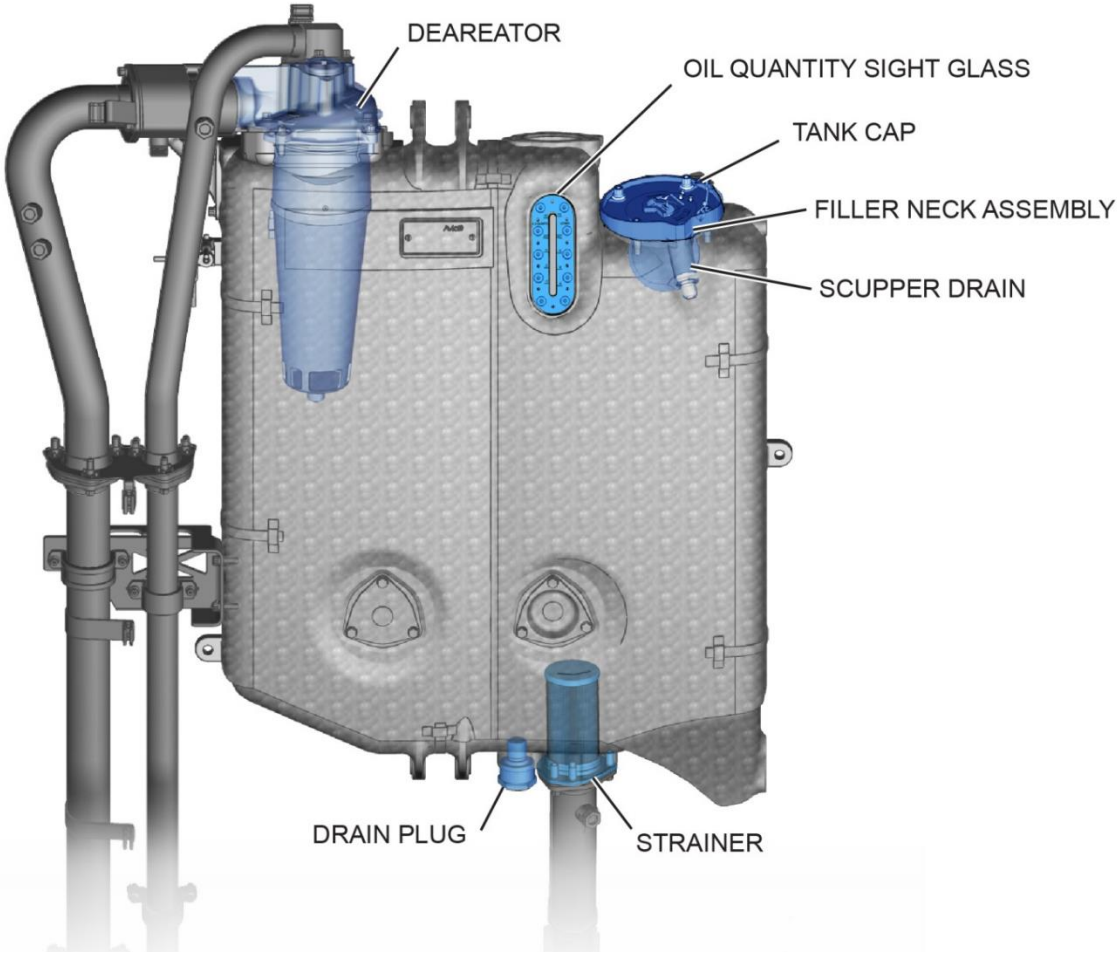
A hinged cap on top of the tank allows for oil servicing. A scupper drain vents spills overboard through the drain mast.

A sight glass shows the oil quantity in the tank and provides a visual indication of the number of quarts or litres to be added.

A connection for a level indicator is positioned on top.

A strainer prevents impurities from entering the oil flow, and a drain plug can be removed to drain the oil.




DEAREATOR
OIL QUANTITY SIGHT GLASS
TANK CAP
FILLER NECK ASSEMBLY
SCUPPER DRAIN
DRAIN PLUG
STRAINER

Filler Neck Assembly

Purpose:

The filler neck assembly provides a securable and sealable port for servicing the oil tank assembly.

Location:

The assembly is attached to the oil tank housing.

Description:

Four bolts attach the assembly to the oil tank housing. An O-ring around the assembly provides oil sealing between it and the tank housing.

The filler neck assembly has a wire mesh and flapper valve at its base. The wire mesh screen provides protection from large debris entering the oil tank assembly.

The flapper valve is mounted on a hinge that allows the valve to open from the weight of the oil during oil servicing, and close from the weight of the flapper valve after servicing is complete.

Operation:

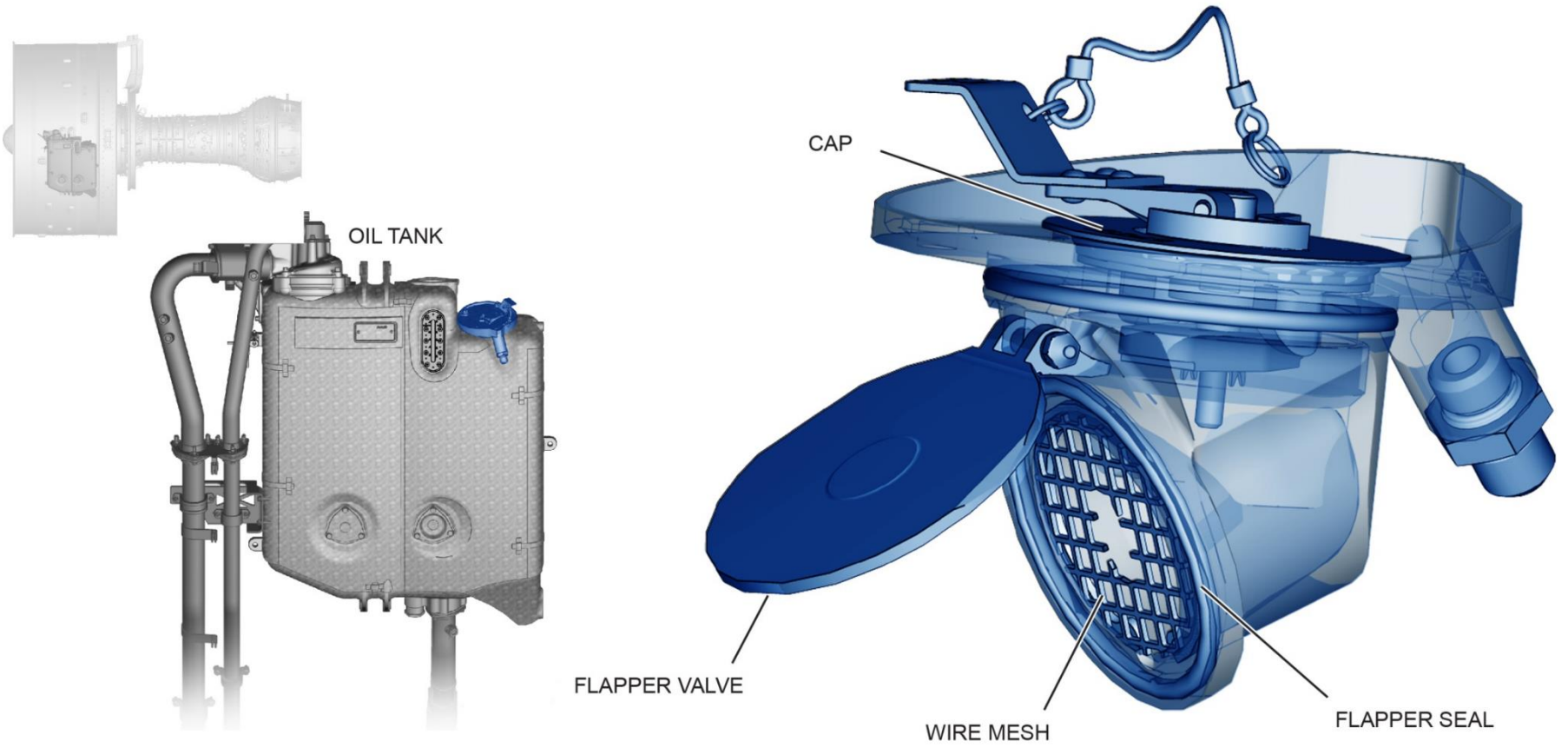
During engine operation, the internal pressure developed inside the oil tank assembly keeps the flapper valve in the closed position, preventing rapid loss of oil in the event the cap is not properly installed.

The cap is secured in the installed position by a spring-loaded lock.

To prevent loss, a cable attaches the cap to the filler neck assembly.

Oil spillage is retained by a rim around the filler neck assembly and empties out the drainage port that is attached to an oil drain tube.

The rim is an integral part of the filler neck assembly.


OIL TANK
CAP
FLAPPER VALVE
WIRE MESH
FLAPPER SEAL

Tank Cap

Purpose:

The oil tank is serviced through the oil tank cap.

Location:

The cap is located on the rear outboard corner on top of the tank.

Description:

The tank cap is secured in the installed position by a hinged, spring-loaded lock.

A flapper valve in the manual gravity fill port prevents rapid oil loss in the event the tank cap is not correctly installed.

The cap is sealed to the tank with a packing.

A metal strainer between the cap and flapper prevents large size debris from entering the tank during servicing.

Operation:

The cap can be removed for servicing by manually lifting the lever to release the lock.

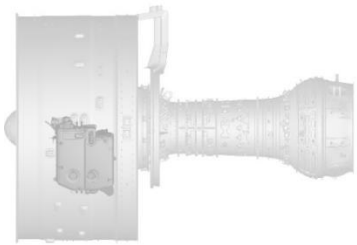
Safety Conditions

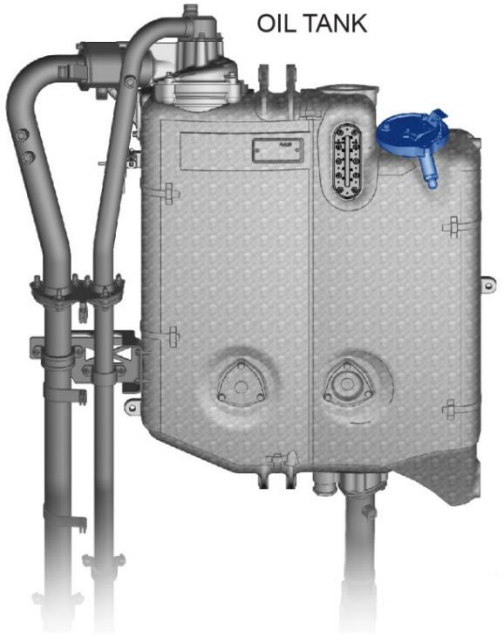
WARNING

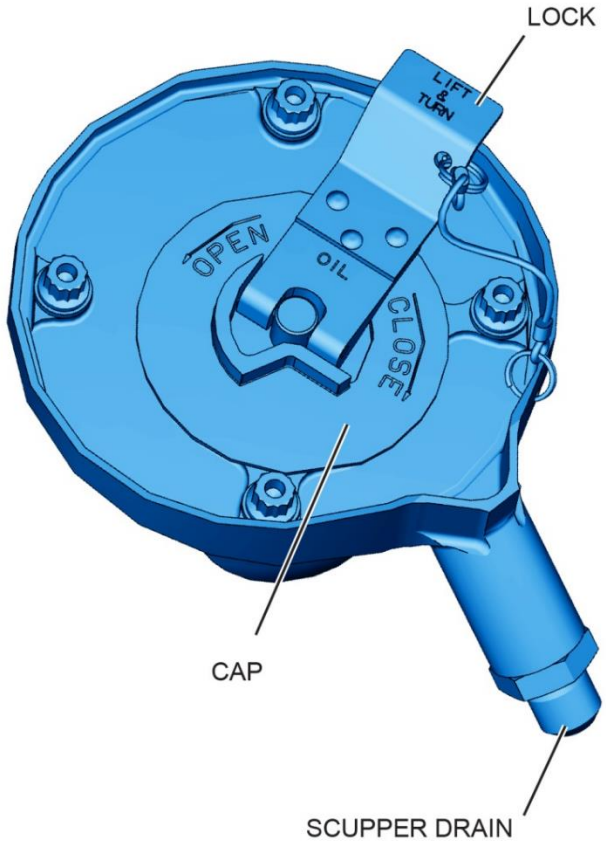
DO NOT OPEN THE OIL TANK CAP UNTIL FIVE MINUTES MINIMUM AFTER ENGINE SHUTDOWN. THIS WILL LET THE PRESSURE BLEED OFF. IF YOU DO NOT OBEY THIS WARNING, HOT OIL CAN BURN YOUR EYES AND SKIN.

CAUTION

YOU MUST USE A SECOND WRENCH TO HOLD THE MATING PARTS WHEN YOU LOOSEN OR TIGHTEN THE TUBE NUTS. IF YOU DO NOT OBEY THIS CAUTION, YOU CAN TWIST OR DAMAGE THE TUBES.




OIL TANK


LOCK
LIFT & TURN
OPEN
OIL
CLOSE
CAP
SCUPPER DRAIN

Deaerator

Purpose:

The deaerator removes air from the scavenge oil returned to the oil tank assembly, and maintains its pressurization.

Location:

The deaerator is installed inside the oil tank housing.

Description:

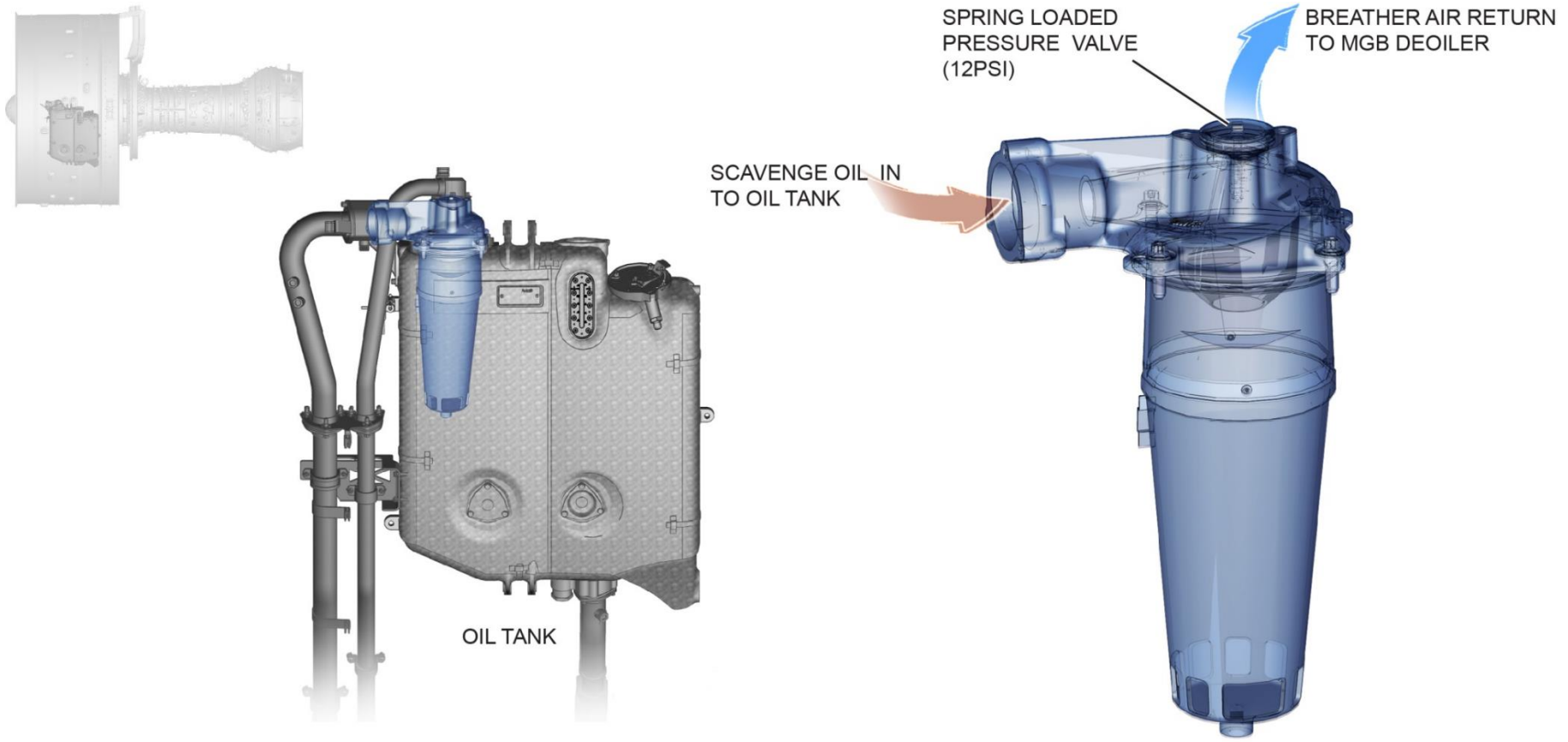
Four bolts attach the deaerator to the oil tank housing.

A pressurization valve installed in the top of the deaerator is spring activated and maintains a pressure of 12 psi in the oil tank assembly.

Operation:

Air-saturated oil enters the deaerator and follows a circular passageway where the oil is separated from the air.

The air removed from the scavenge oil is vented to the engine's Main Gearbox Assembly through the main oil tank deaerator vent tube.


SPRING LOADED
PRESSURE VALVE
(12PSI)
BREATHER AIR RETURN
TO MGB DEOILER
SCAVENGE OIL IN
TO OIL TANK
OIL TANK

Oil Quantity Sight Glass

Purpose:
The oil quantity sight glass provides visual indication of the oil level in the oil tank.

Location:

The sight glass is located directly to the left of the fill port.

Description:

Ten screws attach the sight glass to the oil tank assembly.

The tank is marked in both U.S. quarts and in litre gradations.

Operation:

The tank is serviced according to the oil level.

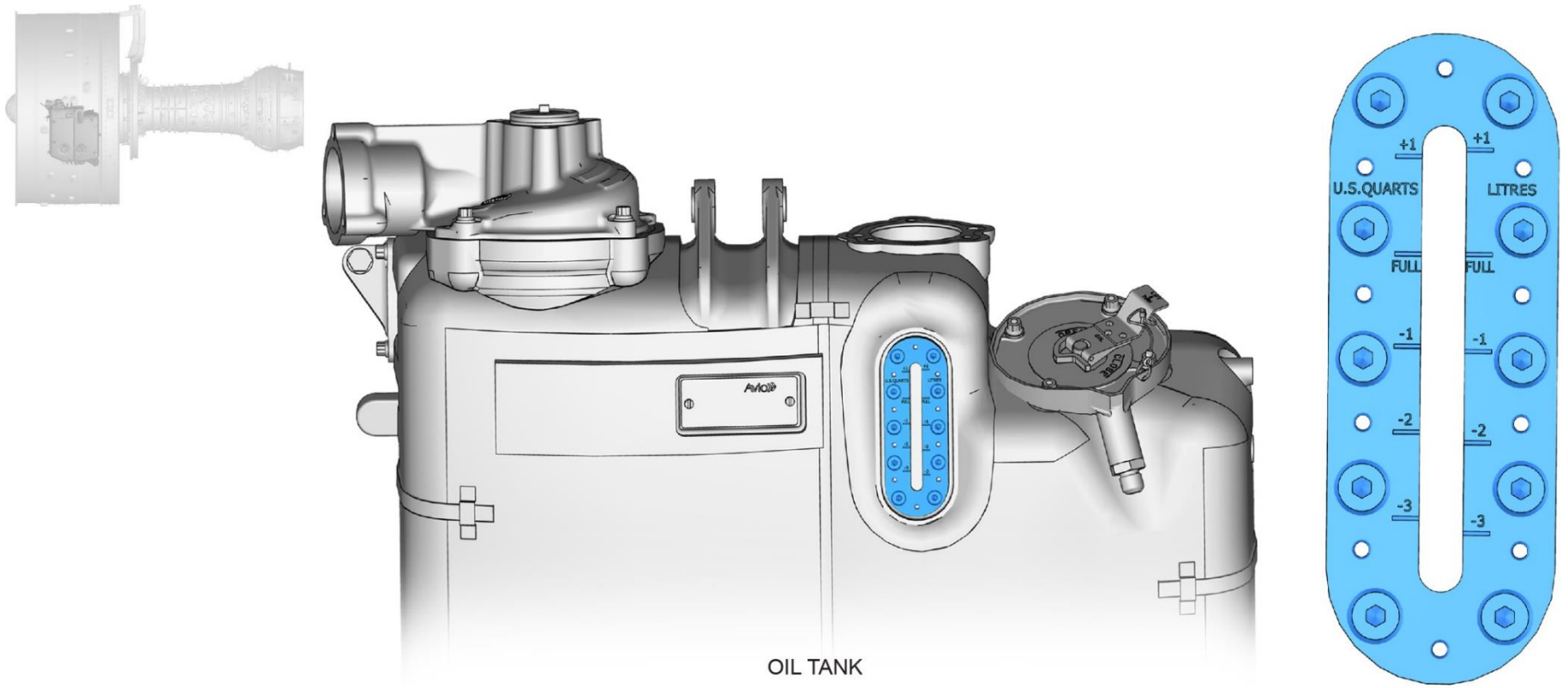
Markings and their indications for each level are shown in the table at right.

Safety Conditions

WARNING

YOU MUST OBEY ALL THE LOCAL STANDARD SAFETY PRECAUTIONS

Marking	Indication
FULL	At appropriate fill level
+1qt/l	Overfilled
-1, -2, -3 qt/l	Servicing required



OIL TANK

Oil Tank Strainer

Purpose:

The oil tank strainer prevents introduction of large debris into the Lubrication System.

Location:

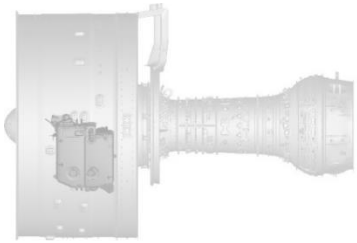
The strainer is installed at the oil pump supply port at the bottom of the oil tank housing.

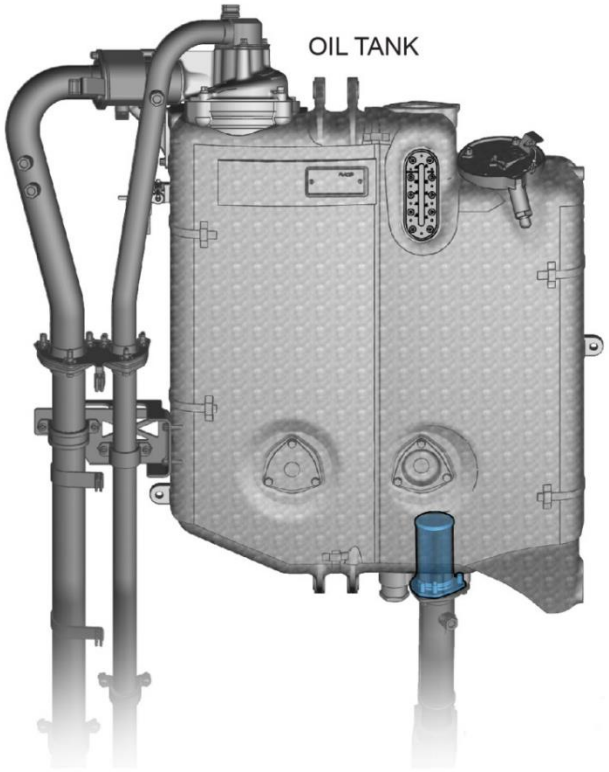
Description:

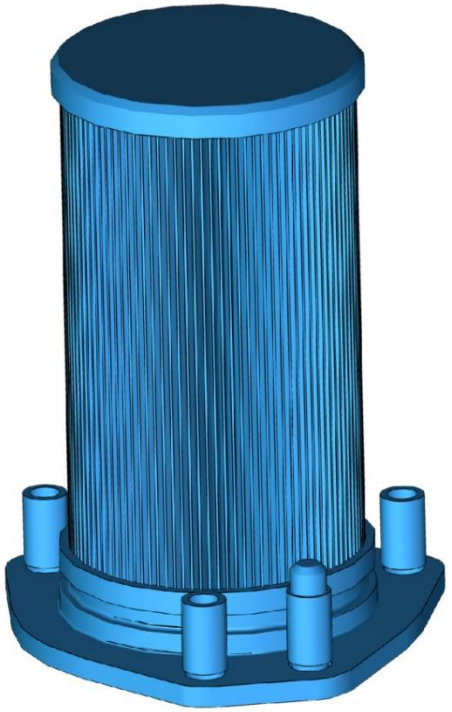
The stainless-steel strainer has a mesh to filter debris.

The strainer is mounted to the oil tank housing with three bolts.

An O-ring installed at the bottom of the strainer prevents leakage.




OIL TANK



Oil Tank Drain Plug

Purpose:

The drain plug is removed to empty the oil tank.

Location:

The drain plug is located at the bottom of the oil tank.

Description:

The drain plug is threaded into the drain plug port, which is integral to the oil tank housing. An O-ring around the drain plug prevents oil leakage.

Operation:

When the drain plug is removed, the O-ring is inspected and replaced if damaged.

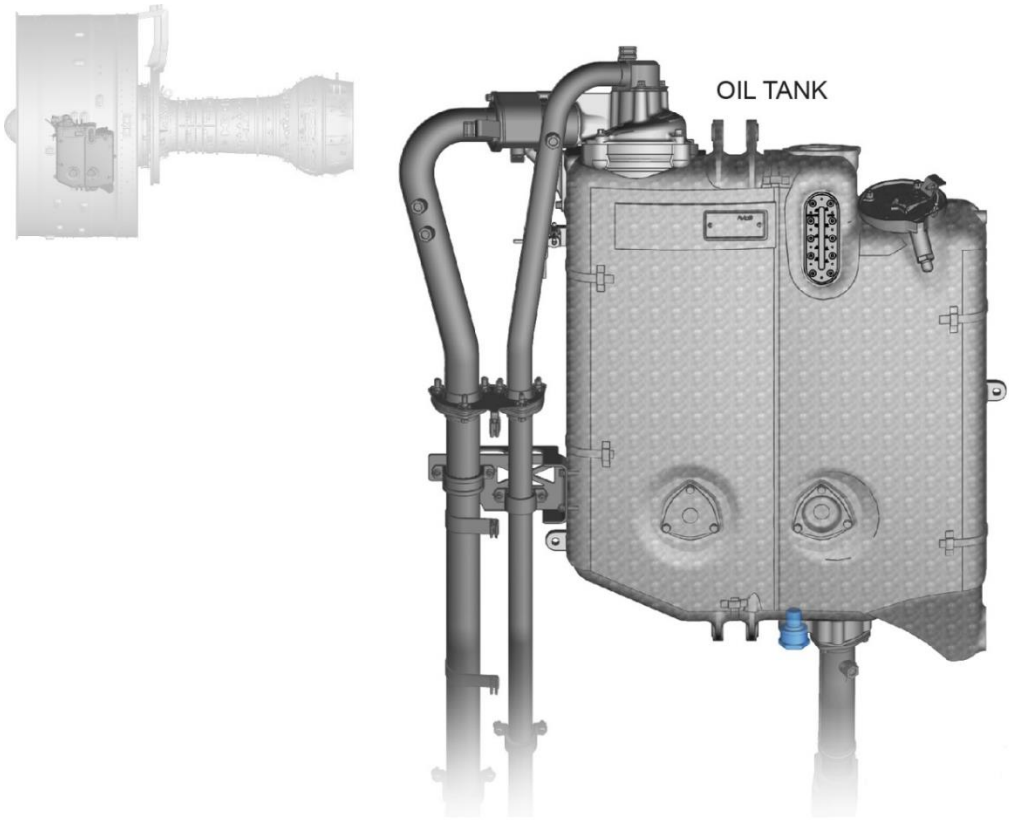
Safety Conditions

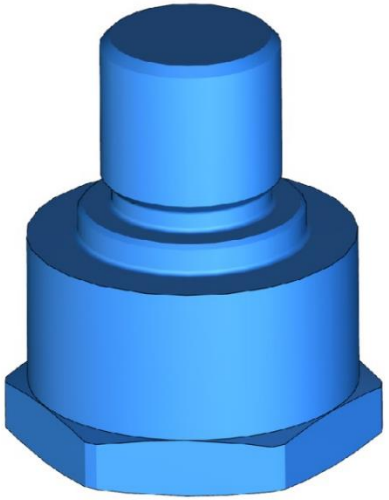
WARNING

IF POSSIBLE, KEEP FUEL AND OIL AWAY FROM YOUR SKIN. USE PROTECTIVE CLOTHES. FUEL AND OIL CAN DRY YOUR SKIN AND CAUSE SKIN IRRITATION.

CAUTION

DO NOT DRY MOTOR OR OPERATE THE ENGINE WITHOUT SUFFICIENT OIL. THIS CAN CAUSE DAMAGE TO THE ENGINE.


OIL TANK



DISTRIBUTION SYSTEM

Overview

The Distribution System supplies non-regulated pressure oil to lubricate, cool, and clean engine bearings, gears, and accessory drives.

The system has both primary distribution and auxiliary oil lubrication operations.

The auxiliary capability provides a secondary source of oil for the journal bearings in case of negative gravity or windmill conditions.

Primary Distribution

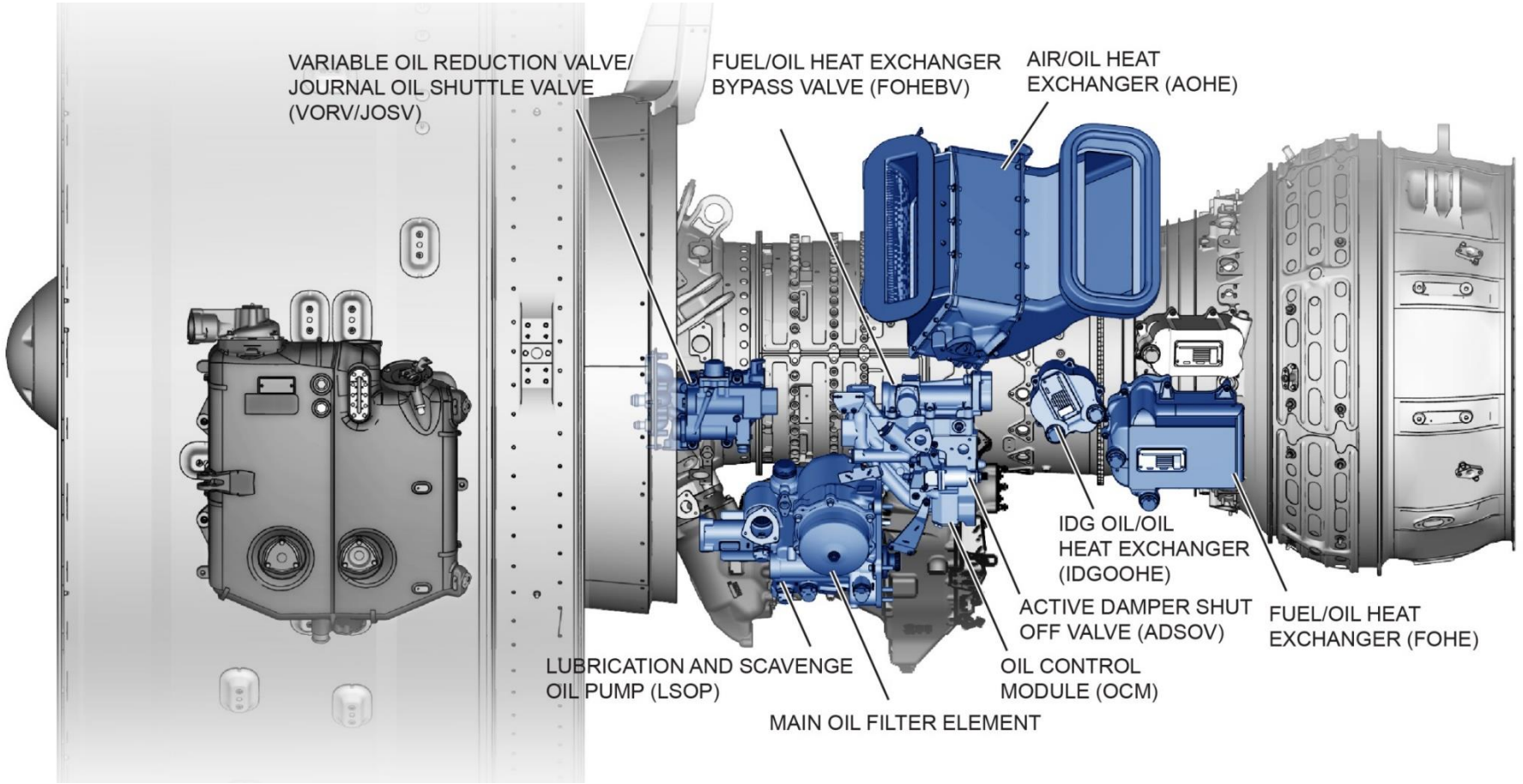
Components are listed below.

- Lubrication and Scavenge Oil Pump LSOP
- Main oil filter element
- Variable Oil Reduction Valve VORV
- Journal Oil Shuttle Valve JOSV
- Oil Control Module OCM
- Active Damper Shut-Off Valve ADSOV
- Air/Oil Heat Exchanger AOHE
- Fuel/Oil Heat Exchanger FOHE
- Fuel/Oil Heat Exchanger Bypass Valve FOHEBV
- IDG Oil/Oil Heat Exchanger IDGOOHE
- Last chance oil strainers

Auxiliary Lubrication

Components include:

- auxiliary tank
- dual-stage fan oil pump.


VARIABLE OIL REDUCTION VALVE/
JOURNAL OIL SHUTTLE VALVE
(VORV/JOSV)
FUEL/OIL HEAT EXCHANGER
BYPASS VALVE (FOHEBV)
AIR/OIL HEAT
EXCHANGER (AOHE)
IDG OIL/OIL
HEAT EXCHANGER
(IDGOOHE)
ACTIVE DAMPER SHUT
OFF VALVE (ADSOV)
FUEL/OIL HEAT
EXCHANGER (FOHE)
LUBRICATION AND SCAVENGE
OIL PUMP (LSOP)
OIL CONTROL
MODULE (OCM)
MAIN OIL FILTER ELEMENT

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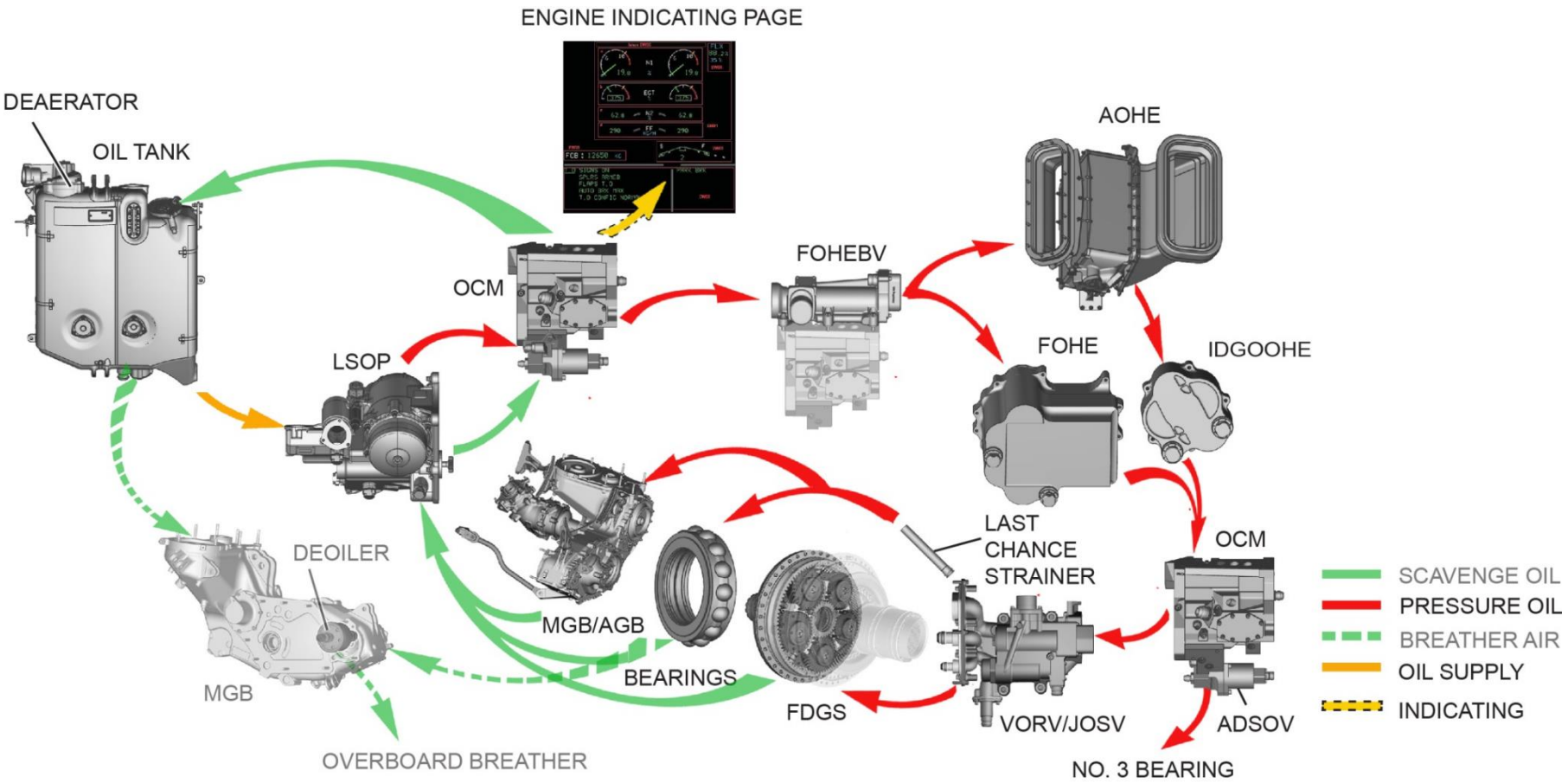


DISTRIBUTION SYSTEM OIL FLOW

OIL SUPPLY

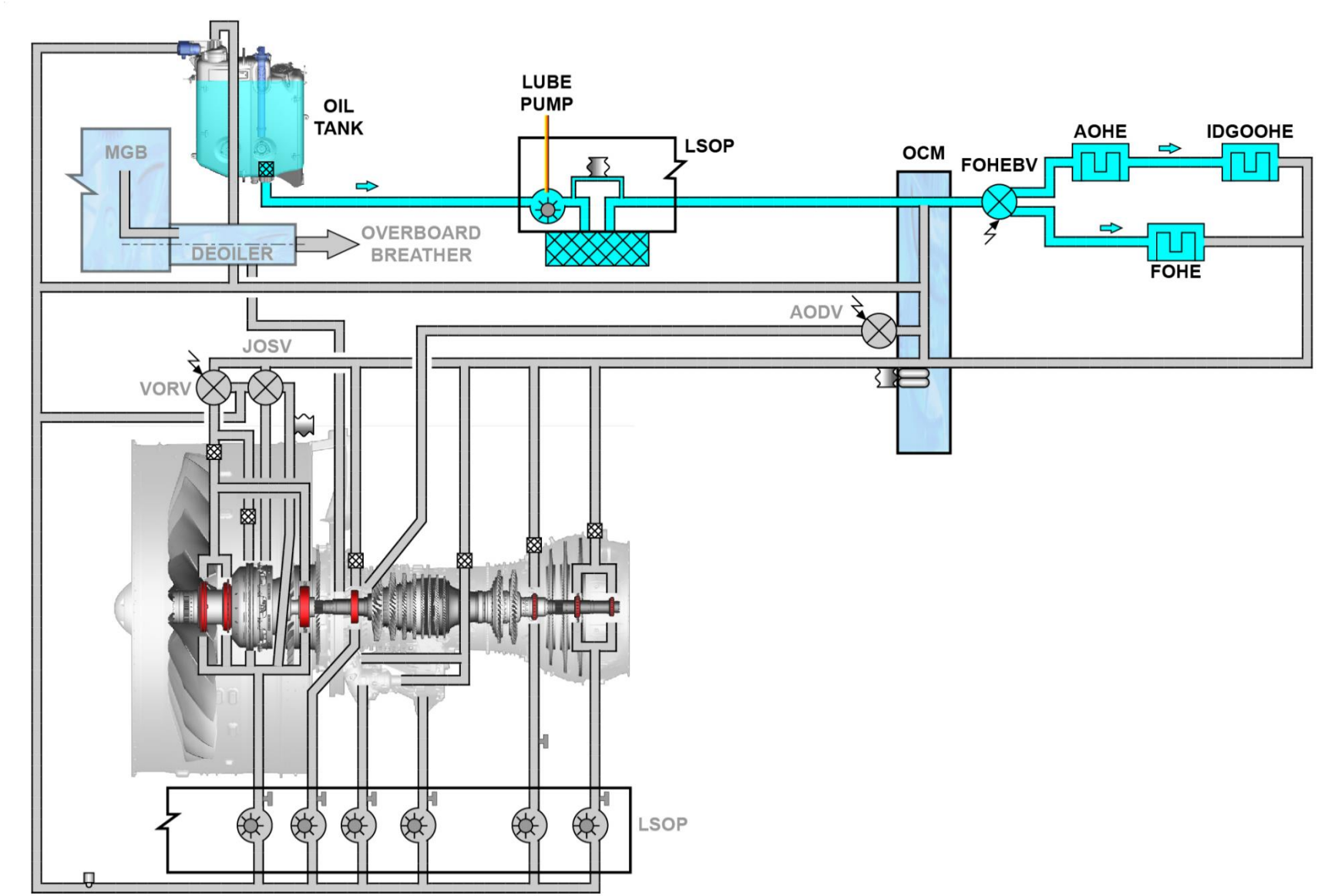
Oil flows from the pressurized oil tank to the lube pump in the Lubrication and Scavenge Oil Pump (LSOP).

The pressurized oil is directed to the main oil filter and to the Oil Control Module (OCM).

The main part of the filtered oil flows to the Fuel/Oil Heat Exchanger Bypass Valve (FOHEBV) which modulates the oil flow between the AOHE and the FOHE.

The oil flow that is directed to the AOHE also flows through the IDGOOHE.

The FOHEBV is electrically controlled and monitored by the Electronic Engine Control (EEC) according to fuel temperature.


OIL
TANK
LUBE
PUMP
LSOP
MGB
OCM
FOHEBV
AOHE
IDGOOHE
DEOILER
OVERBOARD
BREATHER
FOHE
AODV
JOSV
VORV
LSOP

Oil from the heat exchangers is sent via the OCM to the No. 3, 4, 5, 6 bearings and to the AGB and MGB.

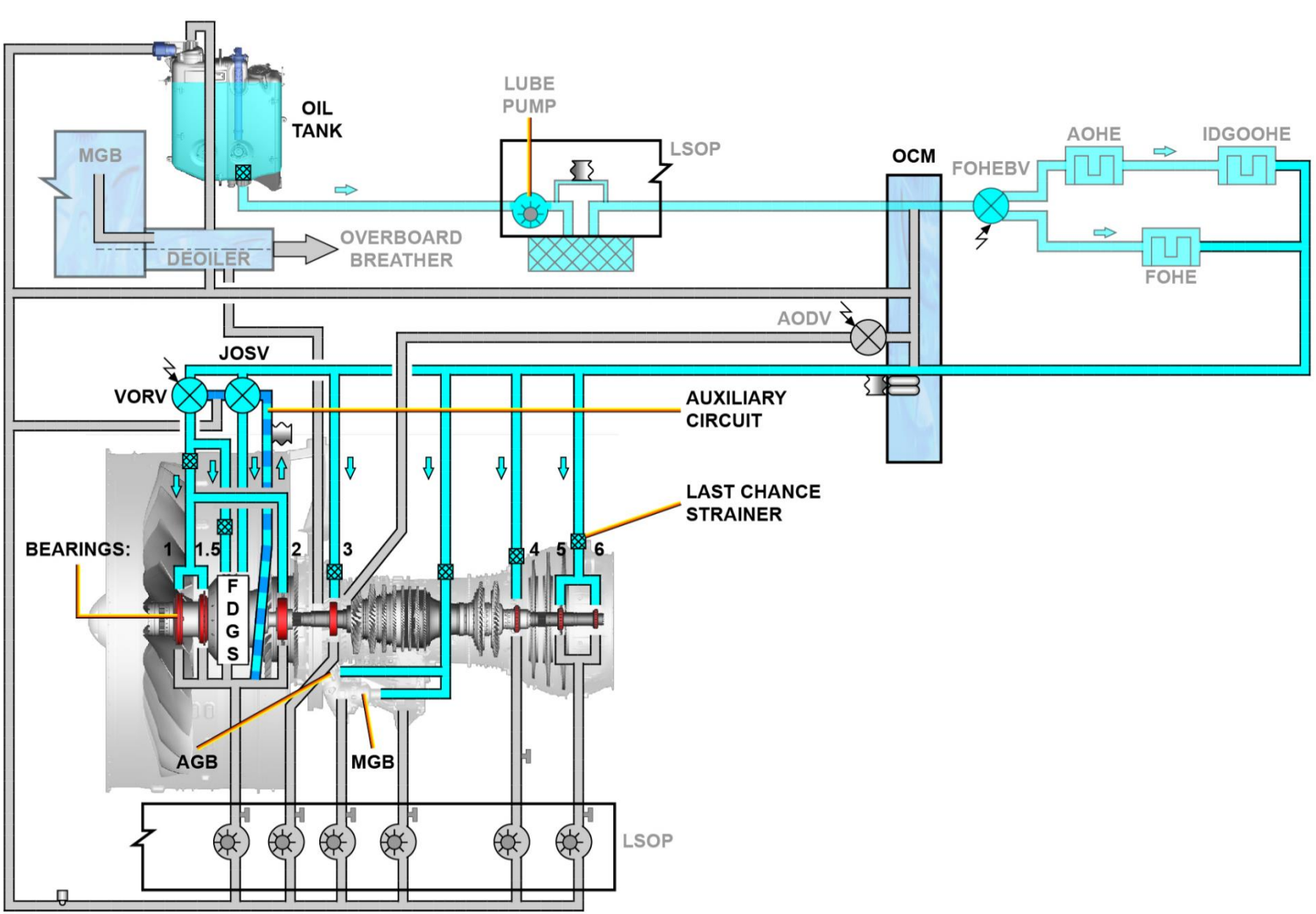
Oil is also sent to the Variable Oil Reduction Valve (VORV) / Journal Oil Shuttle Valve (JOSV) which modulates the flow of oil to the No. 1, 1.5, 2 and Fan Drive Gear System (FDGS) based on engine power settings.

The VORV is electrically controlled and monitored by the EEC to bypass part of the oil flow to the front bearings at low power setting.

The JOSV is a mechanical device that keeps a continuous supply of oil to the fan drive journal bearings from the main oil supply in normal condition or from the auxiliary oil supply in windmill or zero or negative gravity conditions.

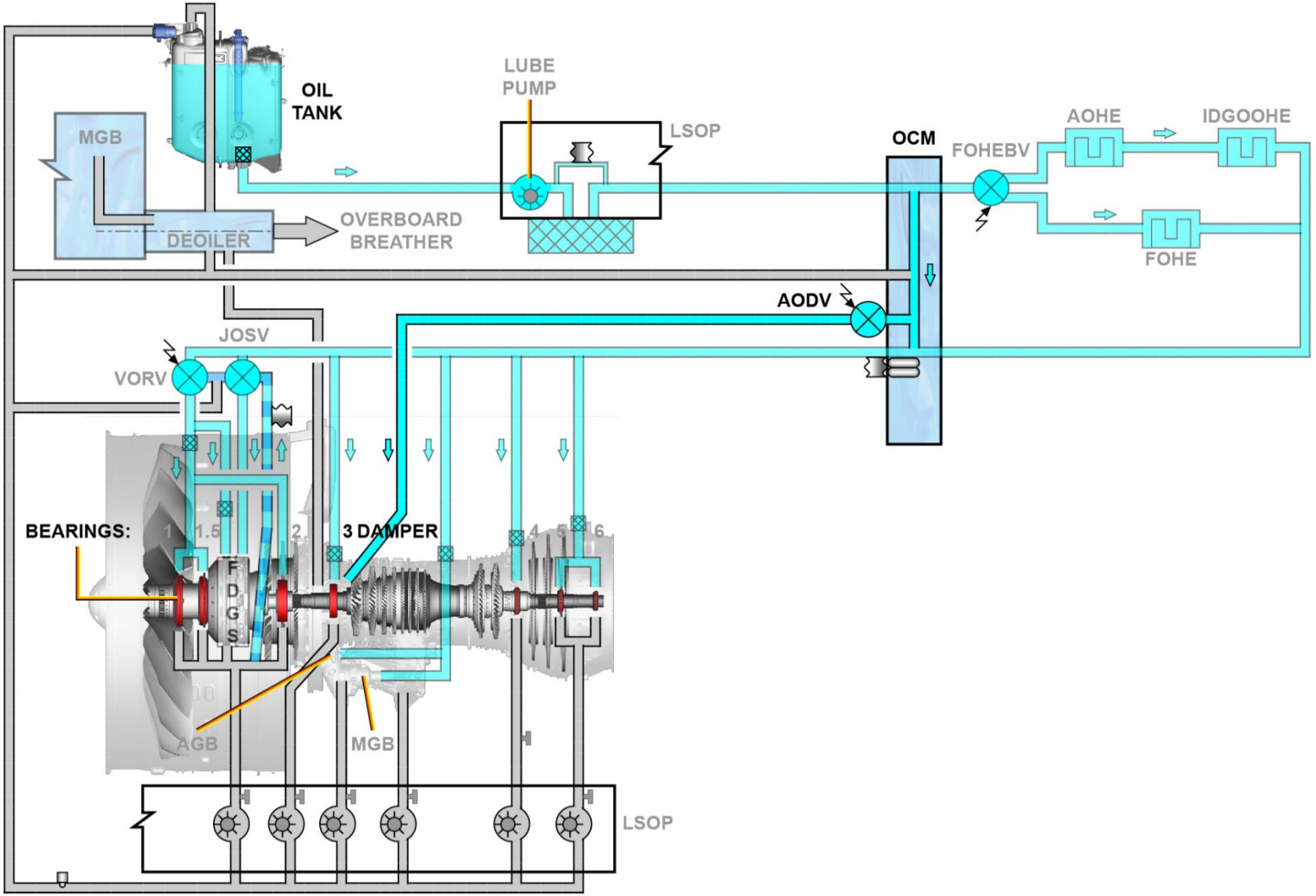
Nozzles in the main bearing compartments and gearboxes supply the oil to the different bearings, gears, seals, and accessory drive splines.

Last chance strainers are provided at the entrance to the compartments to protect the oil nozzles from debris introduced to the oil system downstream of the main oil filter.


OIL
TANK
LUBE
PUMP
LSOP
MGB
DEOILER
OVERBOARD
BREATHER
OCM
FOHEBV
AOHE
IDGOOHE
FOHE
AODV
JOSV
VORV
AUXILIARY
CIRCUIT
LAST CHANCE
STRAINER
BEARINGS:
1
1.5
2
3
4
5
6
F
D
G
S
AGB
MGB
LSOP

The other part of the filtered oil is sent through the Active Oil Damper Valve (AODV) to the No. 3 bearing damper for N2 vibration control.

The AODV is electrically controlled by the EEC to supply oil to the damper during starting and acceleration and shut it off at high power.


OIL
TANK
LUBE
PUMP
LSOP
MGB
DEOILER
OVERBOARD
BREATHER
OCM
FOHEBV
AOHE
IDGOOHE
FOHE
AODV
JOSV
VORV
BEARINGS:
1
1.5
2
3 DAMPER
4
5
6
F
D
G
S
AGB
MGB
LSOP

OIL SCAVENGE AND VENTING

The engine oil scavenge system is used to return the hot lubrication oil to the tank through the LSOP.

The LSOP has six scavenge pumps that are used to pull scavenge oil from the:

No. 1, 1.5, 2 bearing and FDGS,

No. 3 bearing compartment,

No. 4 bearing compartment,

No. 5 and 6 bearing compartment,

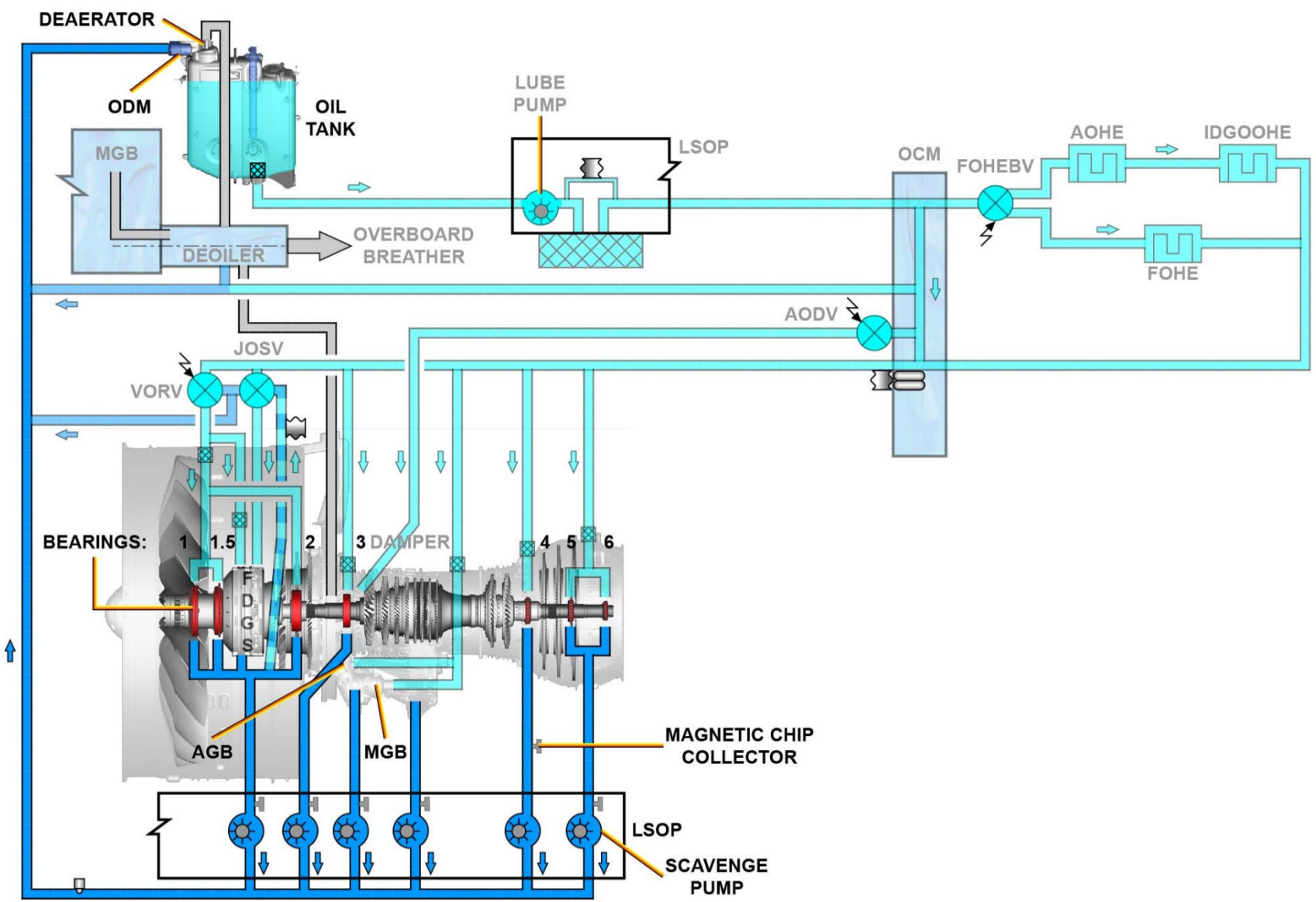
MGB,

AGB.

Six magnetic chip collectors, installed upstream of the scavenge pumps, catch ferrous metal particles.

The scavenge pumps send the scavenge oil to the oil tank through the Oil Debris Monitor (ODM) and the deaerator.

The ODM senses the size and quantity of ferrous and non-ferrous particles in the scavenge oil system and the corresponding signal is processed by the Prognostic Health Monitoring Unit (PHMU).

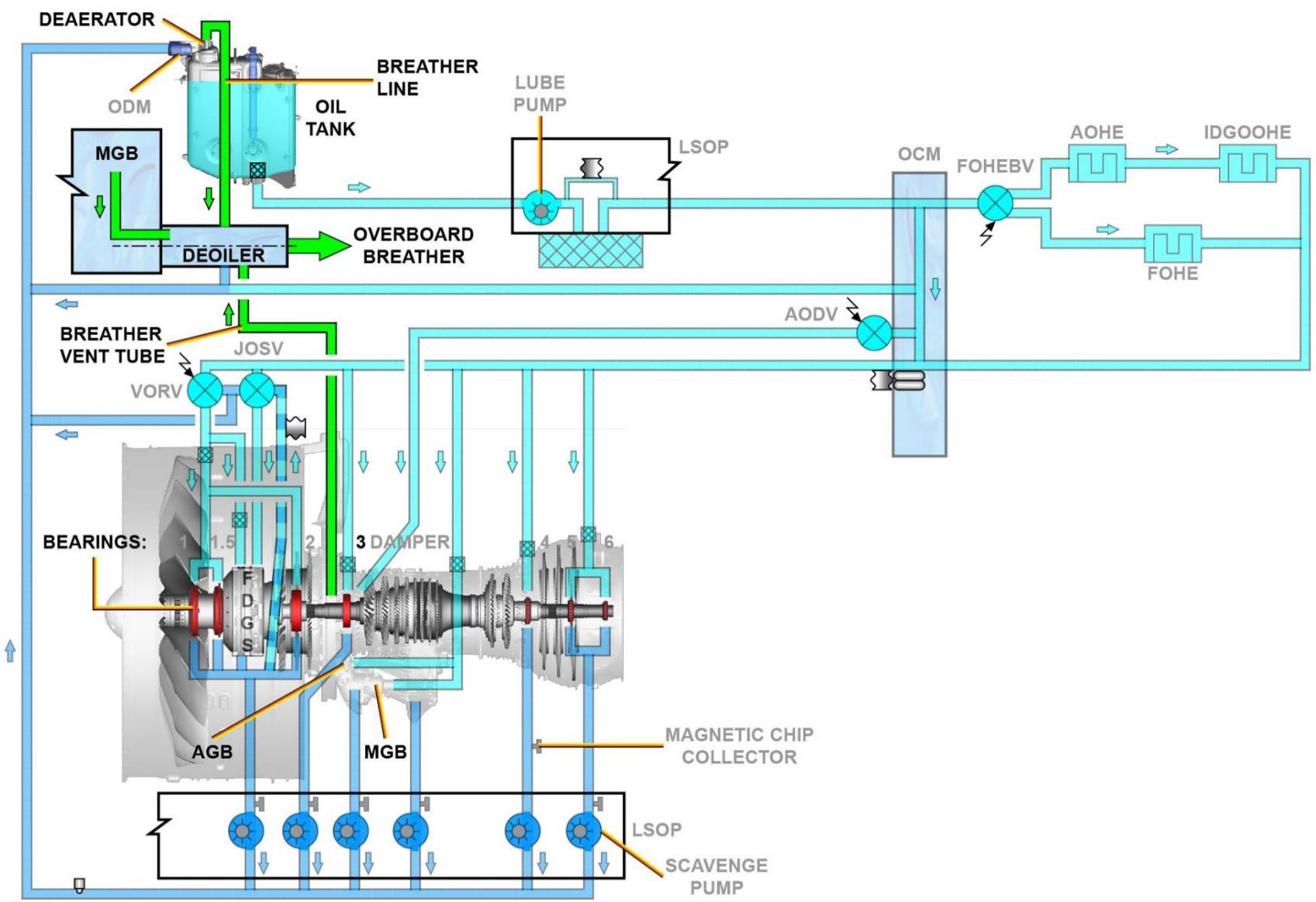

DEAERATOR
ODM
OIL TANK
MGB
DEOILER
OVERBOARD BREATHER
LUBE PUMP
LSOP
OCM
FOHEBV
AOHE
IDGOOHE
FOHE
AODV
JOSV
VORV
BEARINGS:
1
1.5
2
3 DAMPER
4
5
6
F
D
G
S
AGB
MGB
MAGNETIC CHIP COLLECTOR
LSOP
SCAVENGE PUMP

The engine oil breather system is used to remove sealing air from the bearing compartments, separate the air from the oil, and vent it overboard.

In the tank, the deaerator is a static component that separates the air that is mixed with the scavenged oil.

Part of the air is used to pressurize the tank and the excess is sent to the centrifugal de-oiler.

The de-oiler is mechanically connected and driven by the MGB and receives the air/oil mist internally from the MGB, from the tank by the breather line and from the No. 3 bearing compartment by a dedicated breather vent tube.


DEAERATOR
ODM
BREATHER LINE
OIL TANK
MGB
DEOILER
OVERBOARD BREATHER
LUBE PUMP
LSOP
OCM
FOHEBV
AOHE
IDGOOHE
FOHE
AODV
BREATHER VENT TUBE
JOSV
VORV
BEARINGS:
1
1.5
2
3 DAMPER
4
5
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F
D
G
S
AGB
MGB
MAGNETIC CHIP COLLECTOR
LSOP
SCAVENGE PUMP

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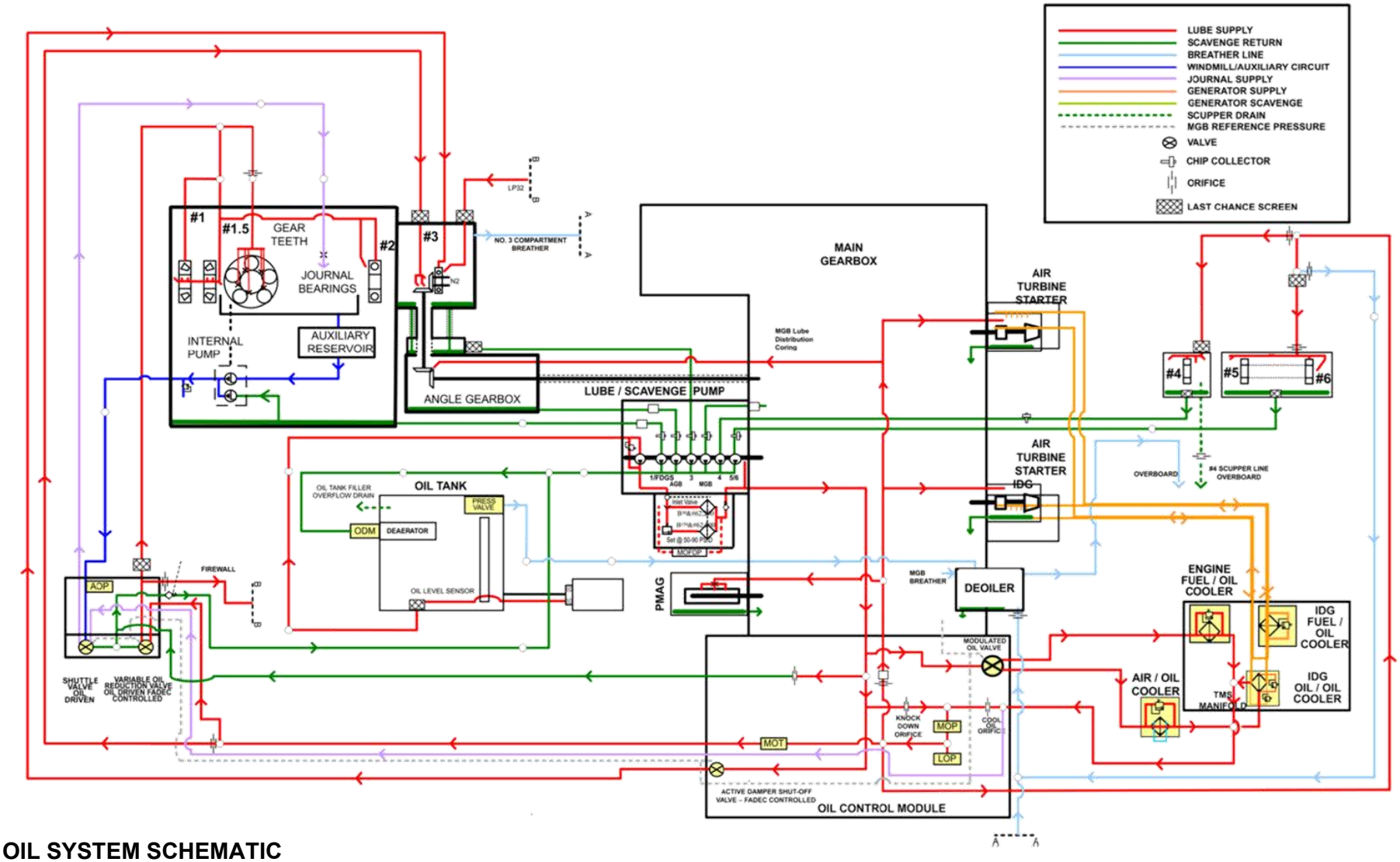


OIL SYSTEM SCHEMATIC

Lubrication and Scavenge Oil Pump (LSOP)

Purpose:

The Lubrication and Scavenge Oil Pump pressurizes oil and sends it from the oil tank to the engine bearings, seals, gears and accessory drives. It also returns scavenge oil to the oil tank.

Location:

The pump is installed on the left front side of the Main Gearbox.

Description:

The pump has seven positive displacement, gear-type pump stages. One stage supplies pressure oil, and the other six stages scavenge oil.

The six scavenge pump stages receive oil through a combination of external tubes and MGB core passages.

Each stage is turned by the MGB at a speed proportional to N2.

The pump's splined drive shaft is inserted to a splined drive in the gearbox and attached with captive bolts.

A face seal is used between the pump and the gearbox.

A guide pin on the pump housing helps with installation of the pump and seal.

The pump has a relief valve to limit the maximum main oil pressure to protect system components downstream of the pump.

Operation:

1. A single pressure pump stage delivers oil supply to oil dependent components at pressures that vary with the engine's N2 speeds.

2. The six scavenge pumps return oil from all bearing compartments, the FDGS compartment, the Angle Gearbox, and the Main Gearbox.

Safety Conditions

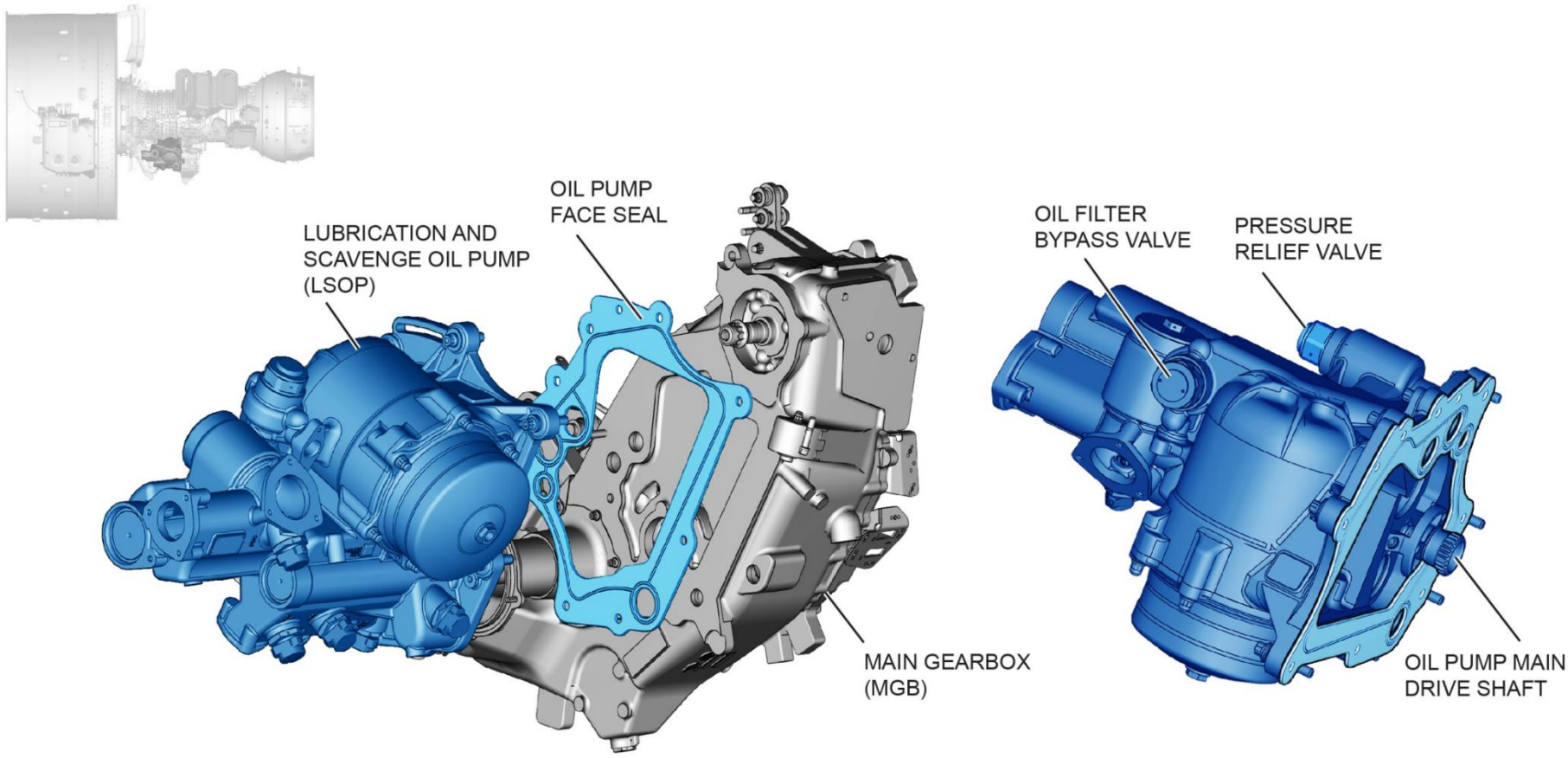
CAUTION

HOLD THE WEIGHT OF THE OIL PUMP DURING THE INSTALLATION.

DO NOT LET THE OIL PUMP HANG ON THE DOWEL PINS OR DRIVE SHAFT WITHOUT THE BOLTS ENGAGED. IF YOU DO, THE OIL PUMP COULD DISENGAGE FROM THE GEARBOX AND DROP.

THE OIL PUMP WEIGHT IS APPROXIMATELY 66 LBS (30 KGS). IF YOU DO NOT OBEY THIS CAUTION, YOU CAN DAMAGE THE OIL PUMP.

BE CAREFUL WHEN REMOVING THE OIL PUMP. MAKE SURE THERE IS NO INTERFERENCE WITH THE OIL PUMP DRIVESHAFT WITH ANY OF THE OTHER PARTS. IF YOU DO NOT OBEY THIS CAUTION, DAMAGE TO THE OIL PUMP AND ENGINE CAN OCCUR.


LUBRICATION AND
SCAVENGE OIL PUMP
(LSOP)
OIL PUMP
FACE SEAL
MAIN GEARBOX
(MGB)
OIL FILTER
BYPASS VALVE
PRESSURE
RELIEF VALVE
OIL PUMP MAIN
DRIVE SHAFT

Main Oil Filter Element

Purpose:

The main oil filter element removes solid contaminants from the pressurized oil sent from the Lubrication and Scavenge Oil Pump.

Location:

The main oil filter element is located on the Lubrication Scavenge and Oil Pump.

Description:

The component has a disposable, non-cleanable dual element design that uses a filter within a filter.

The filter element is a reverse-flow type, meaning that oil flows from the inner diameter of the filter to the outside.

The primary element has a 30-micron rating for fine filtration.

The secondary element has a 150-micron rating for coarse filtration.

Operation:

The oil filter housing has an anti-drain-back feature for servicing.

An oil filter differential pressure sensor will trigger a filter clog message to display in the cockpit.

Primary oil filter bypass may occur during cold starting. If the primary filter becomes clogged, the bypass valve will open, allowing oil to flow through the secondary element.

A clogged primary filter is indicated to the cockpit through a differential pressure sensor. Because there is a secondary element, an in-flight shut down is not necessary.

A small spring-loaded metal tab is attached to the bottom of the inner diameter of the cover as a mistake-proofing feature for changing the filter element. When the oil filter cover is removed and the oil filter element is not present in the cover, the metal tab will protrude from the cover.

This helps to prevent installation of the cover to the oil pump housing if an oil filter is not installed.

When properly installing an oil filter into the housing, the metal tab is held down inside the cover the by the oil filter element. This allows the maintenance technician to correctly install the oil filter cover to the housing.

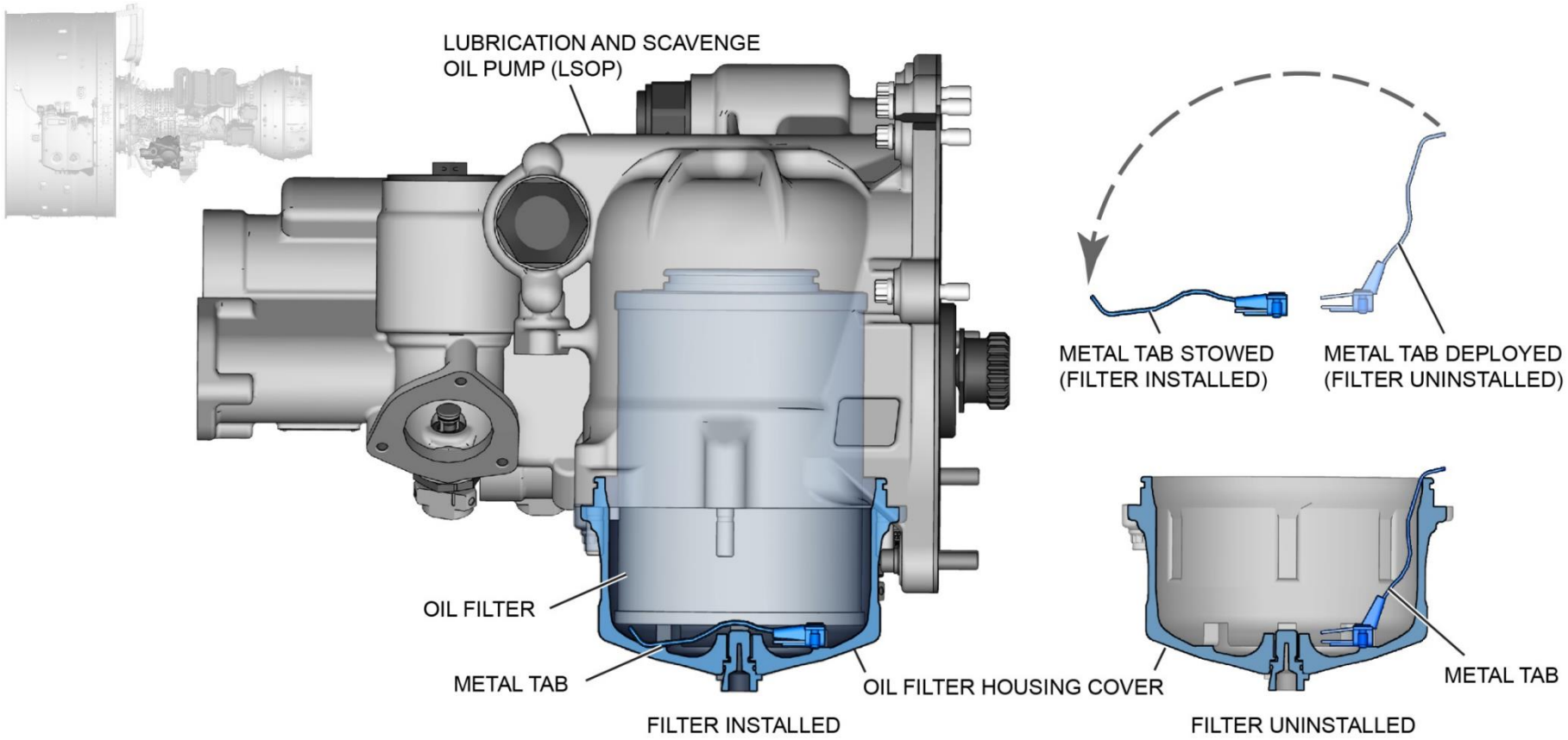
An inlet shutoff valve prevents engine operation without a filter installed.

Safety Conditions

WARNING

WAIT 5 MINUTES TO MAKE SURE THAT THE OIL SYSTEM IS NOT PRESSURIZED BEFORE DOING THIS PROCEDURE.

IF YOU DO NOT OBEY THIS WARNING, INJURY CAN OCCUR.


LUBRICATION AND SCAVENGE
OIL PUMP (LSOP)
METAL TAB STOWED
(FILTER INSTALLED)
METAL TAB DEPLOYED
(FILTER UNINSTALLED)
OIL FILTER
METAL TAB
OIL FILTER HOUSING COVER
METAL TAB
FILTER INSTALLED
FILTER UNINSTALLED

Variable Oil Reduction Valve (VORV)

Purpose:

The Variable Oil Reduction Valve allows the diversion of supply oil from the Fan Drive Gear System to the oil tank.

Location:

The VORV is located on the CIC firewall at 9:00.

Description:

The VORV is an electro-mechanical device controlled by the EEC.

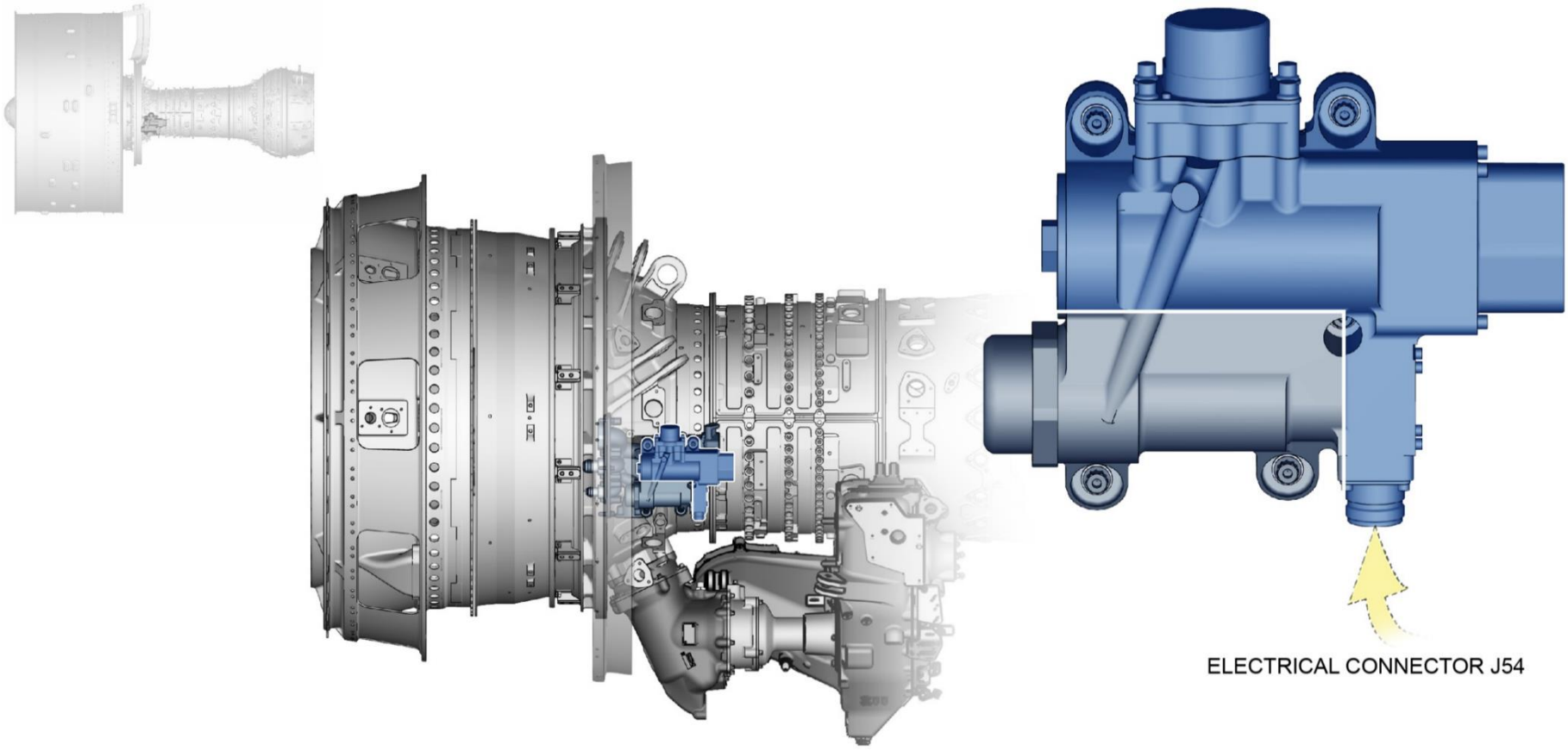
The valve is fully modulated by means of an Electro Hydraulic Servo Valve (EHSV). Valve position feedback to the EEC is provided by a Linear Variable Differential Transformer (LVDT).

Operation:

Maximum oil flow to lubricate the gear faces of the FDGS is required only at take-off.

At cruise, oil flow is reduced and sent back to the oil tank. Less oil flowing to the gears reduces the oil heat load and increases fan drive gearbox efficiency.

When in the failsafe position the valve reverts to maximum oil flow.


ELECTRICAL CONNECTOR J54

Journal Oil Shuttle Valve (JOSV)

Purpose:

The Journal Oil Shuttle Valve senses oil pressure to the FDGS journal bearings, and maintains a continuous supply of oil to the bearings under all conditions.

Location:

The JOSV is installed on the JOSV/VORV manifold located at 9:00 on the CIC firewall.

Description:

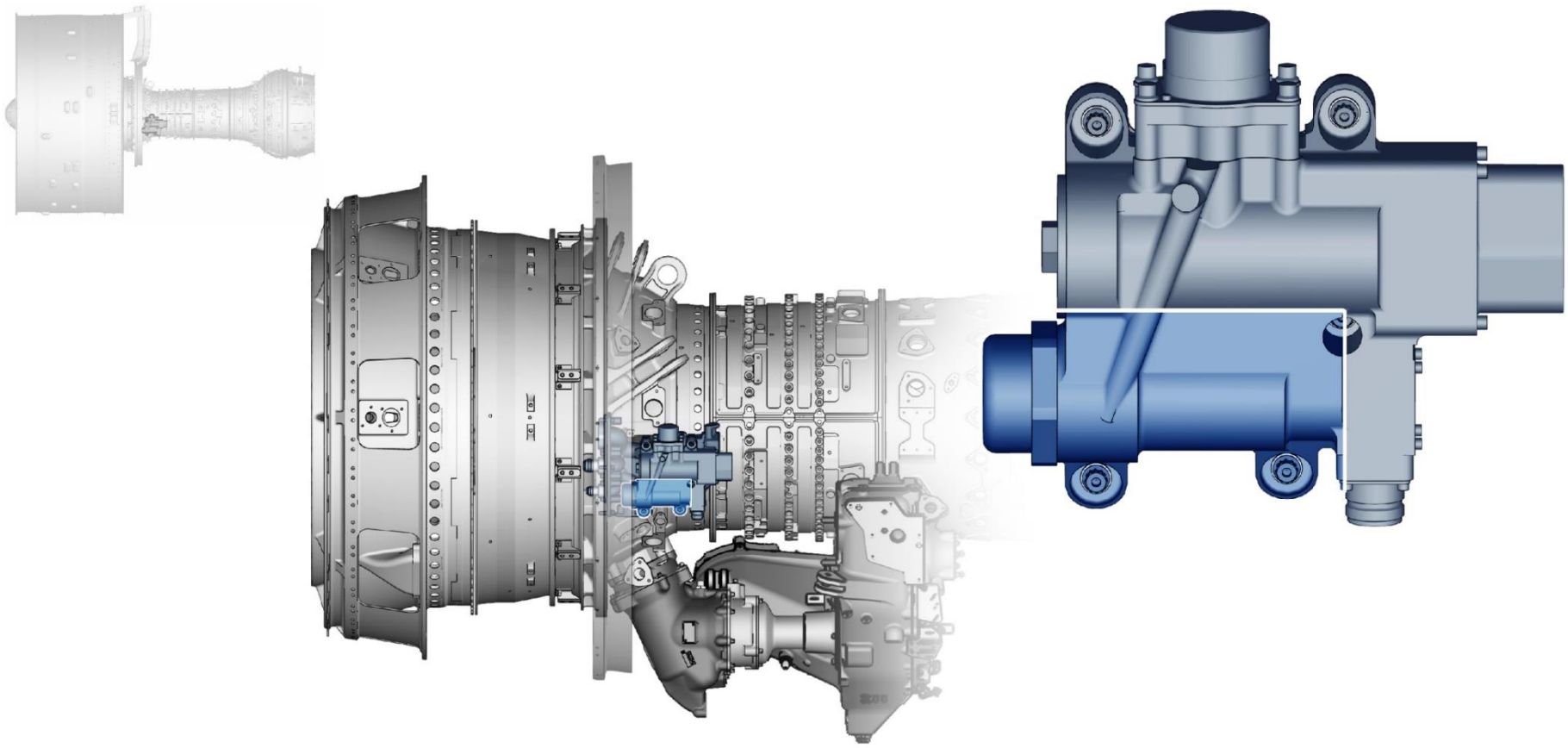
The JOSV is a mechanical, two-position device that directs oil flow from the main oil or emergency oil supply to the journal bearing.

The valve has no EEC control or feedback.

Operation:

The JOSV is passively controlled by comparison of main oil pressure against gearbox vent pressure.

When oil pressure is normal, the primary oil goes to the journal bearings. If oil pressure decreases below design limits, the JOSV sends oil from the Auxiliary Lubrication System to the journal bearings.



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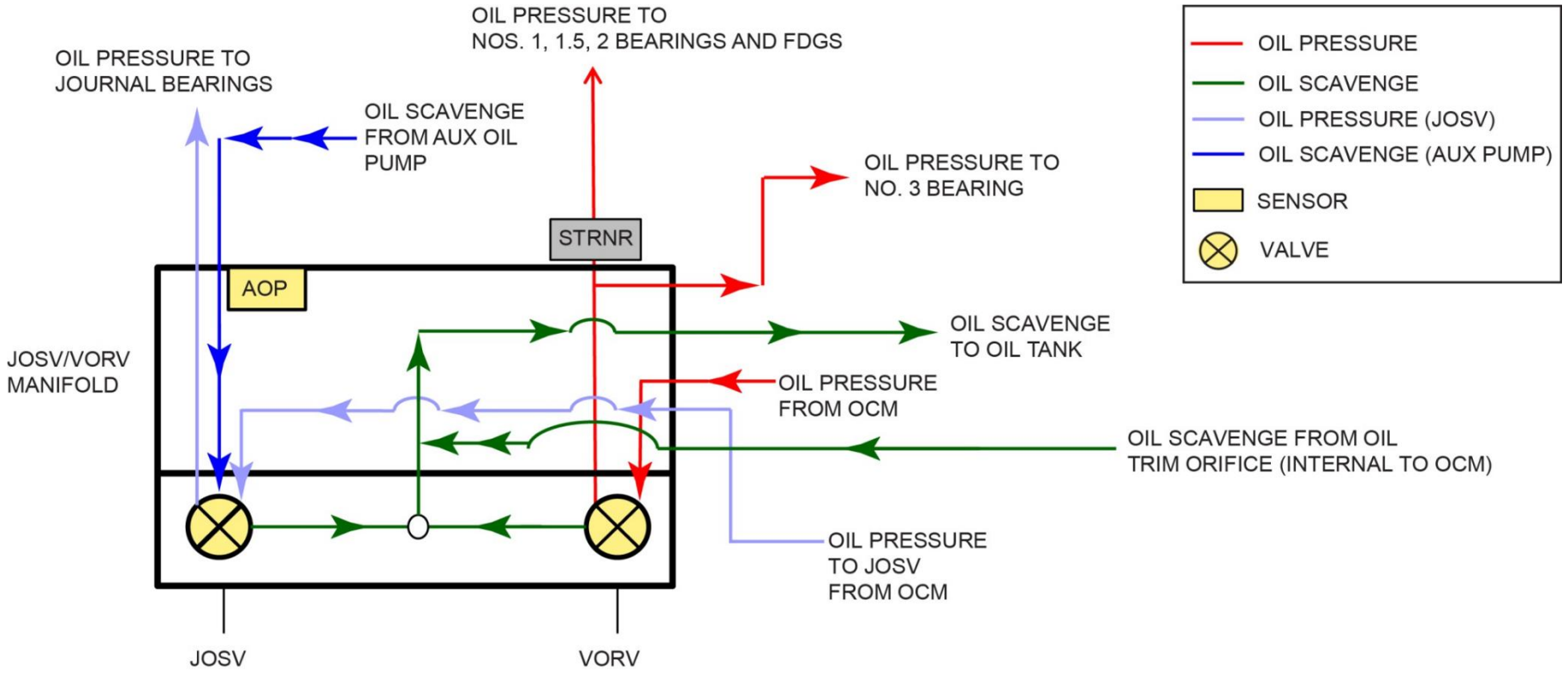


VORV/JOSV SCHEMATIC

Oil Control Module (OCM)

Purpose:

The Oil Control Module receives pressurized, filtered oil from the Lubrication and Scavenge Oil Pump and distributes the oil to the various engine compartments and heat exchangers through internal cored passages and tubes.

Location:

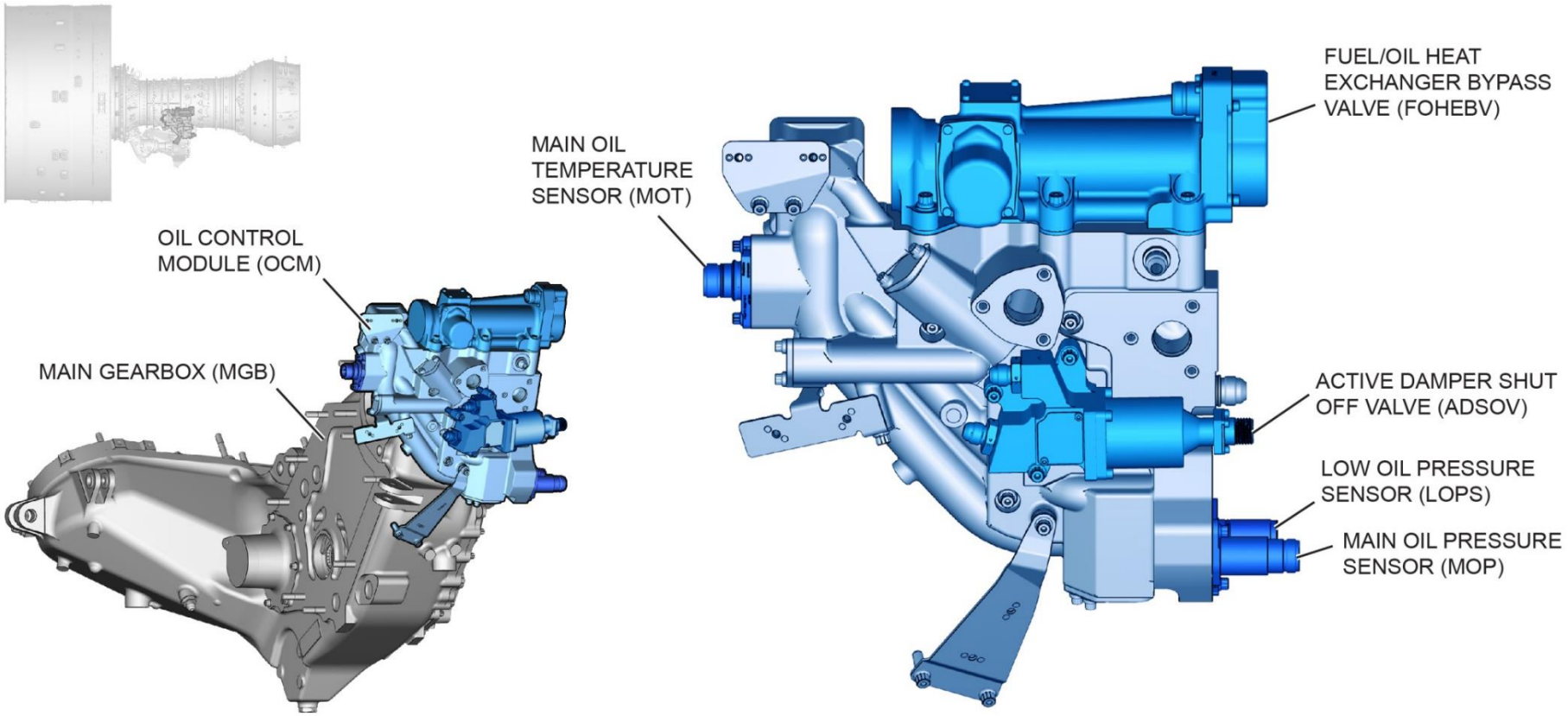
The OCM is located on the left side of the Main Gearbox.

Description:

The OCM greatly reduces the number of external oil lines required to deliver pressurized oil.

It services oil components in both the Distribution and Indicating subsystems. See the table for details.

Oil Components Mounted to OCM		
Distribution System	• Active Damper Shut-Off Valve	ADSOV
	• Fuel/Oil Heat Exchanger Bypass Valve	FOHEBV
Indicating System	• Low Oil Pressure Sensor	LOPS
	• Main Oil Pressure sensor	MOP
	• Main Oil Temperature sensor	MOT


OIL CONTROL
MODULE (OCM)
MAIN GEARBOX (MGB)
MAIN OIL
TEMPERATURE
SENSOR (MOT)
FUEL/OIL HEAT
EXCHANGER BYPASS
VALVE (FOHEBV)
ACTIVE DAMPER SHUT
OFF VALVE (ADSOV)
LOW OIL PRESSURE
SENSOR (LOPS)
MAIN OIL PRESSURE
SENSOR (MOP)

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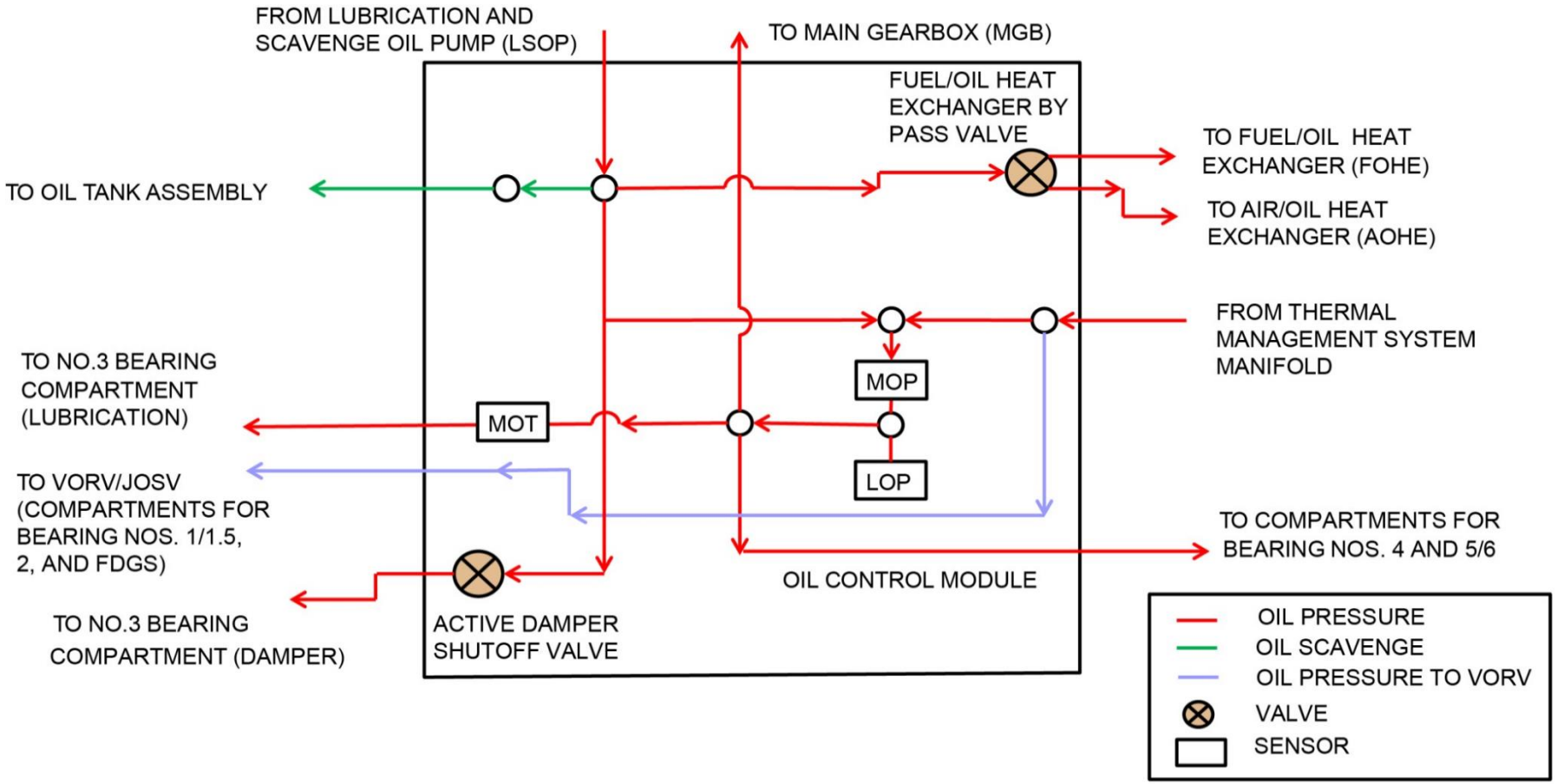


OIL CONTROL MODULE SCHEMATIC

Active Damper Shut-off Valve (ADSOV)

Purpose:

The ADSOV controls oil flow to the No. 3 Bearing damper.

Location:

The valve is located on the left side of the engine and mounted to the bottom part of the OCM.

Description:

The ADSOV performs these functions:

- limits high spool (N2) vibration
- optimizes No. 3 Bearing loads during all phases of operation
- provides bowed rotor protection at sub-idle.

Operation:

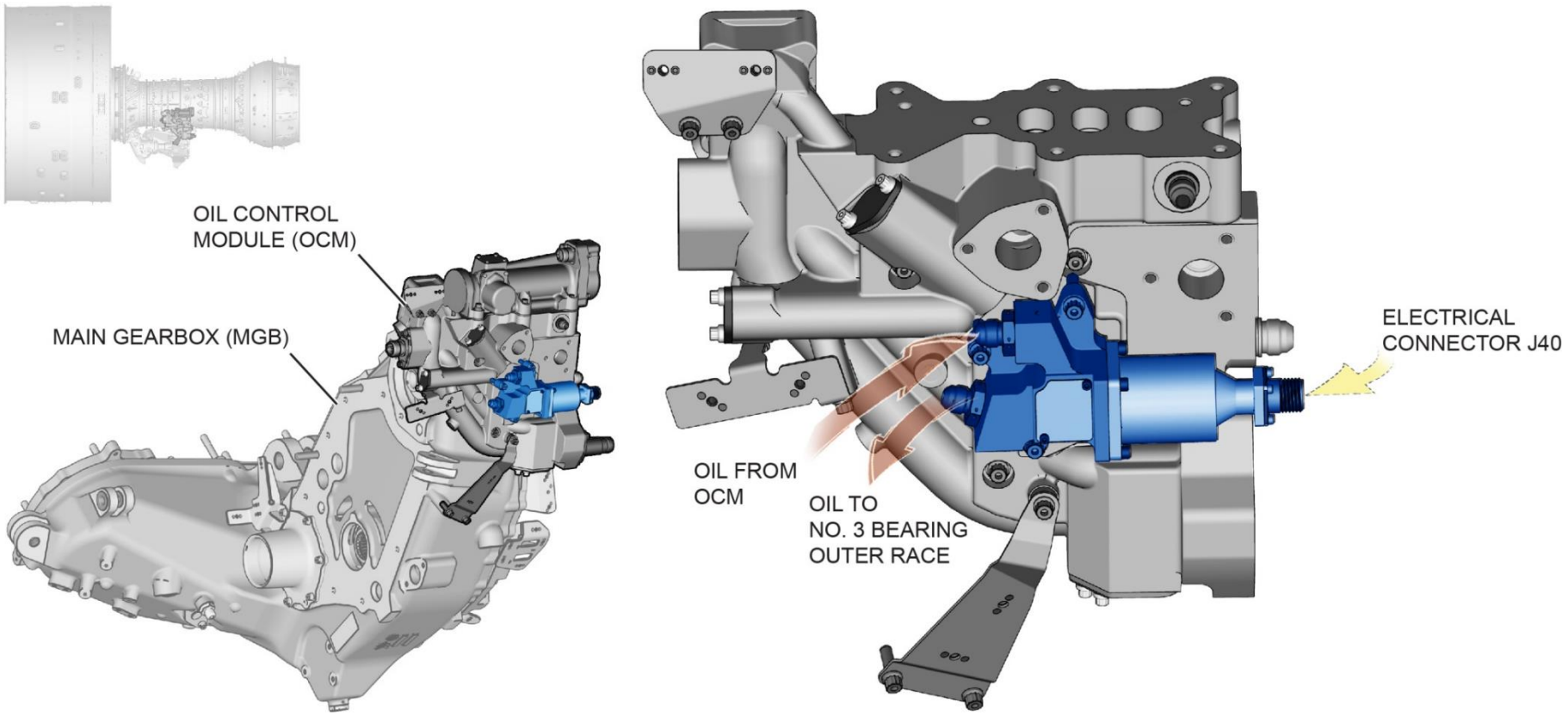
The valve is a dual-coil solenoid scheduled on or off by either channel of the EEC.

The valve will provide an open or closed position of damper oil flow when the engine is running.

Valve positioning is a function of N2 speed.

See the chart for additional details.

Damper Position	ADSOV Condition	Supply Oil to No. 3 Damper
ON	De-energized	Flowing
OFF	Energized	No flow


OIL CONTROL
MODULE (OCM)
MAIN GEARBOX (MGB)
ELECTRICAL
CONNECTOR J40
OIL FROM
OCM
OIL TO
NO. 3 BEARING
OUTER RACE

Air/Oil Heat Exchanger (AOHE)

Purpose:

The Air/Oil Heat Exchanger uses fan air to cool the engine oil.

Location:

The assembly is attached to the engine at 11:00 next to the diffuser case.

Description:

The AOHE is a fin-and-plate type heat exchanger with a mechanical bypass valve. Inlet and exhaust ducts are attached to front and aft flanges of the exchanger.

A constant flow of engine oil and cooling air passes through the exchanger during operation.

The engine oil cooled by the AOHE reduces the amount of heat that must be transferred from the oil to the fuel in the FOHE.

Oil flow through the AOHE is controlled by the FOHEBV.

Operation:

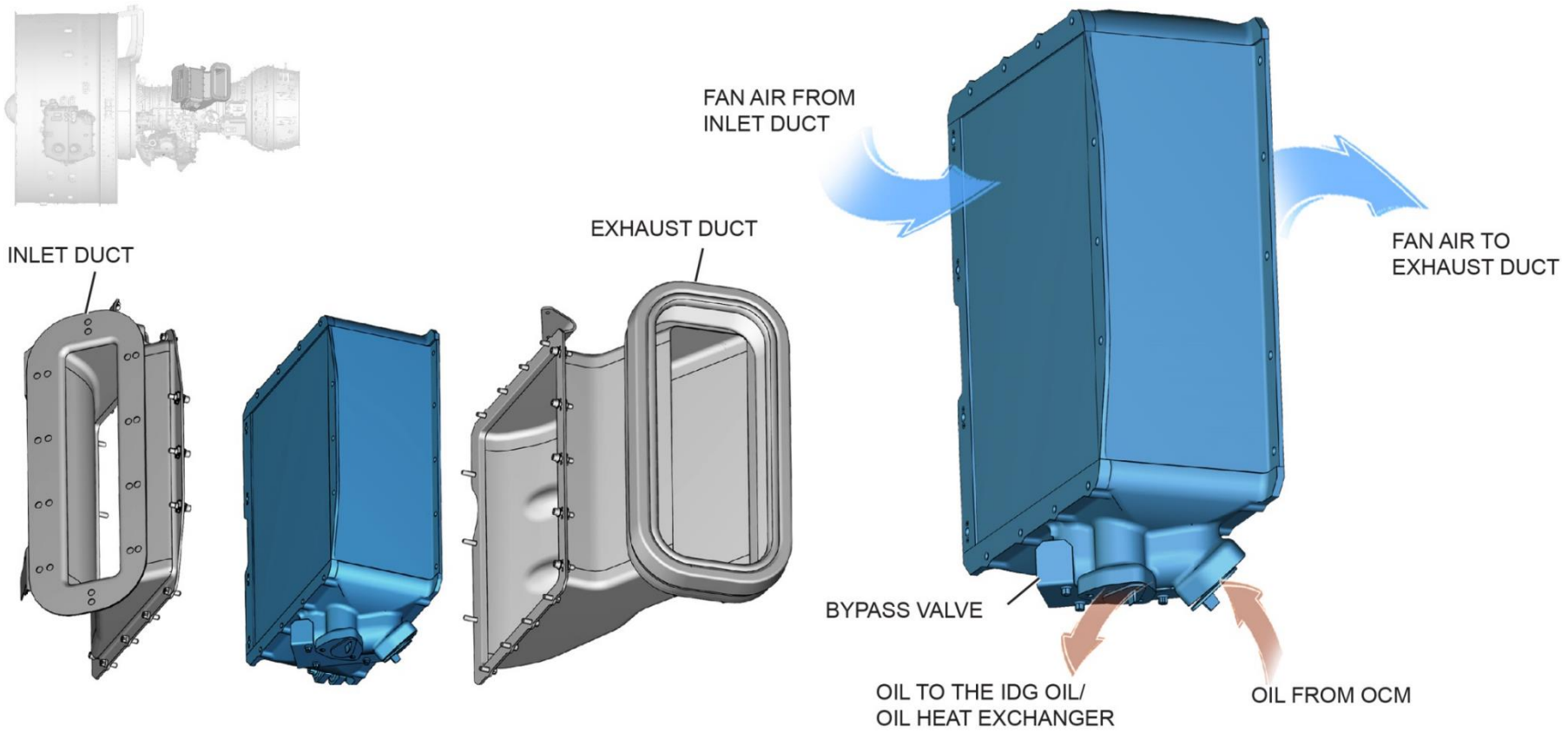
1. Fan bypass air is delivered to the inlet side of the AOHE through the inlet duct, then leaves through the exit duct into the bypass airflow.

The cool fan air flows through thin aluminium fins and through aluminium plates with passageways.

2. The oil flows through the passageways in the aluminium plate, which transfers the heat to the fins.

This heat is then transferred to the cool air.

A passive spring-and-valve oil bypass diverts oil around the AOHE if the oil side of the exchanger becomes clogged.


INLET DUCT
EXHAUST DUCT
FAN AIR FROM
INLET DUCT
FAN AIR TO
EXHAUST DUCT
BYPASS VALVE
OIL TO THE IDG OIL/
OIL HEAT EXCHANGER
OIL FROM OCM

Fuel/Oil Heat Exchanger (FOHE)

Purpose:

The Fuel/Oil Heat Exchanger transfers heat from engine oil to prevent ice formation in the fuel.

Location:

The FOHE is mounted to the Thermal Management System (TMS) manifold on the Turbine Intermediate Case at 9:00.

Description:

The Fuel/Oil Heat Exchanger is a stacked plate design with plates that contain internal flow passages for fuel and oil.

The plates are stacked in alternating order and brazed together.

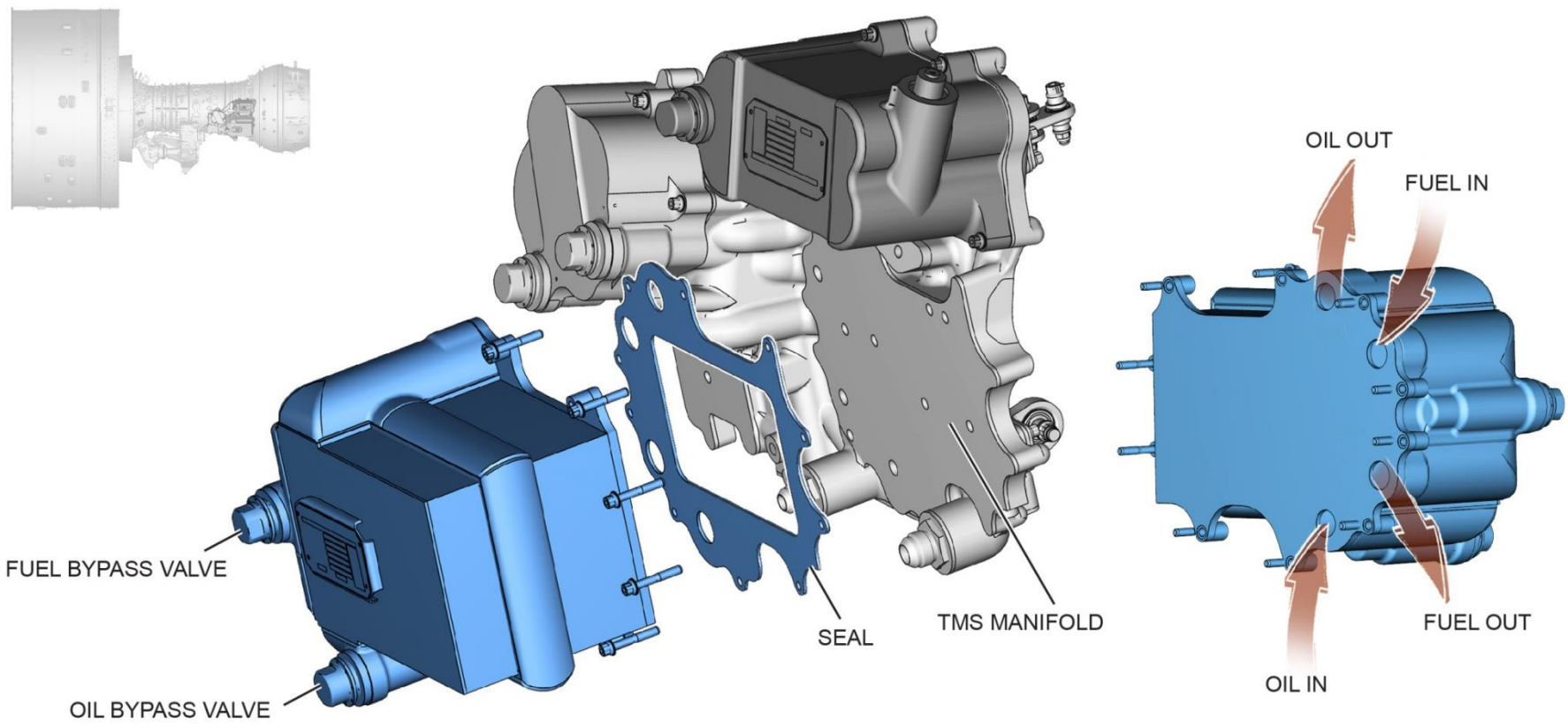
The plates are made from aluminium for its light weight and high thermal conductivity.

Operation:

1. During operation, heat transfers from the oil to the fuel as they circulate through the plates.

2. A passive oil bypass spring valve causes oil to bypass the FOHE if the oil side becomes clogged.

3. When incoming fuel pressure increases because of ice in the fuel, a spring-loaded valve will open and allow fuel to bypass the oil cooler.


FUEL BYPASS VALVE
OIL BYPASS VALVE
SEAL
TMS MANIFOLD
OIL OUT
FUEL IN
FUEL OUT
OIL IN

Fuel/Oil Heat Exchanger Bypass Valve (FOHEBV)

Purpose:

The FOHEBV controls and distributes oil flow between the Fuel/Oil Heat Exchanger and the Air/Oil Heat Exchanger.

Location:

The FOHEBV is attached to the Oil Control Module.

Description:

The dual-channel FOHEBV is controlled by the EEC. Valve position feedback is also provided to the EEC via Linear Variable Differential Transformer (LVDT) on one channel.

Six bolts attach the FOHEBV to the OCM. A seal plate is installed between the valve and the OCM to prevent oil leakage.

Oil enters the FOHEBV inlet port through a cored passage in the OCM. Oil exits the FOHEBV through a separate outlet port and goes back into a separate core passage in the OCM.

Valve position is based primarily on fuel temperature.

Oil flow increases to the FOHE if fuel temperature is low.

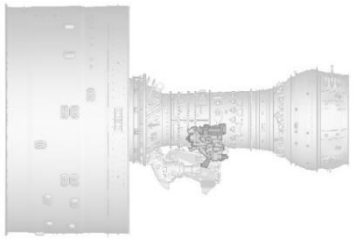
The failsafe position is maximum flow to the FOHE, or 92.5 percent of total oil flow.

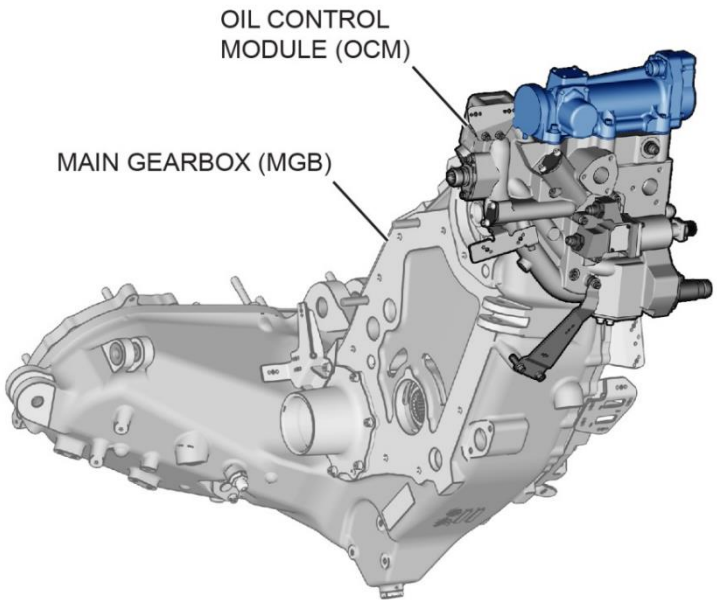
Operation:

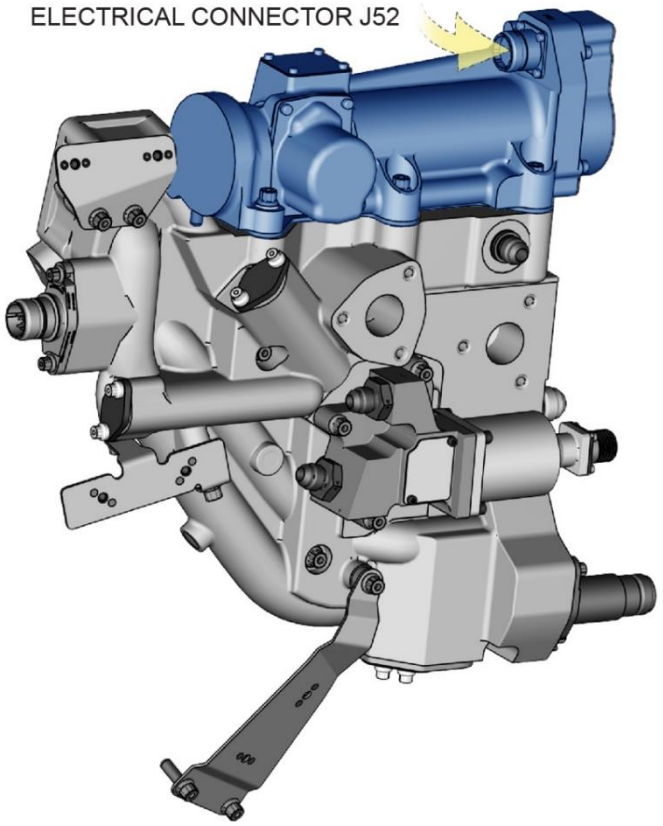
1. The FOHEBV increases oil flow to the AOHE if the fuel temperature is greater than a specified value.

2. The increased oil flow to the AOHE decreases the oil flow through the FOHE, reducing the amount of heat transfer to the fuel in the FOHE.

3. The bypass valve will distribute a minimum of 7.5 percent of the engine oil to the AOHE during engine operation.




OIL CONTROL
MODULE (OCM)
MAIN GEARBOX (MGB)


ELECTRICAL CONNECTOR J52

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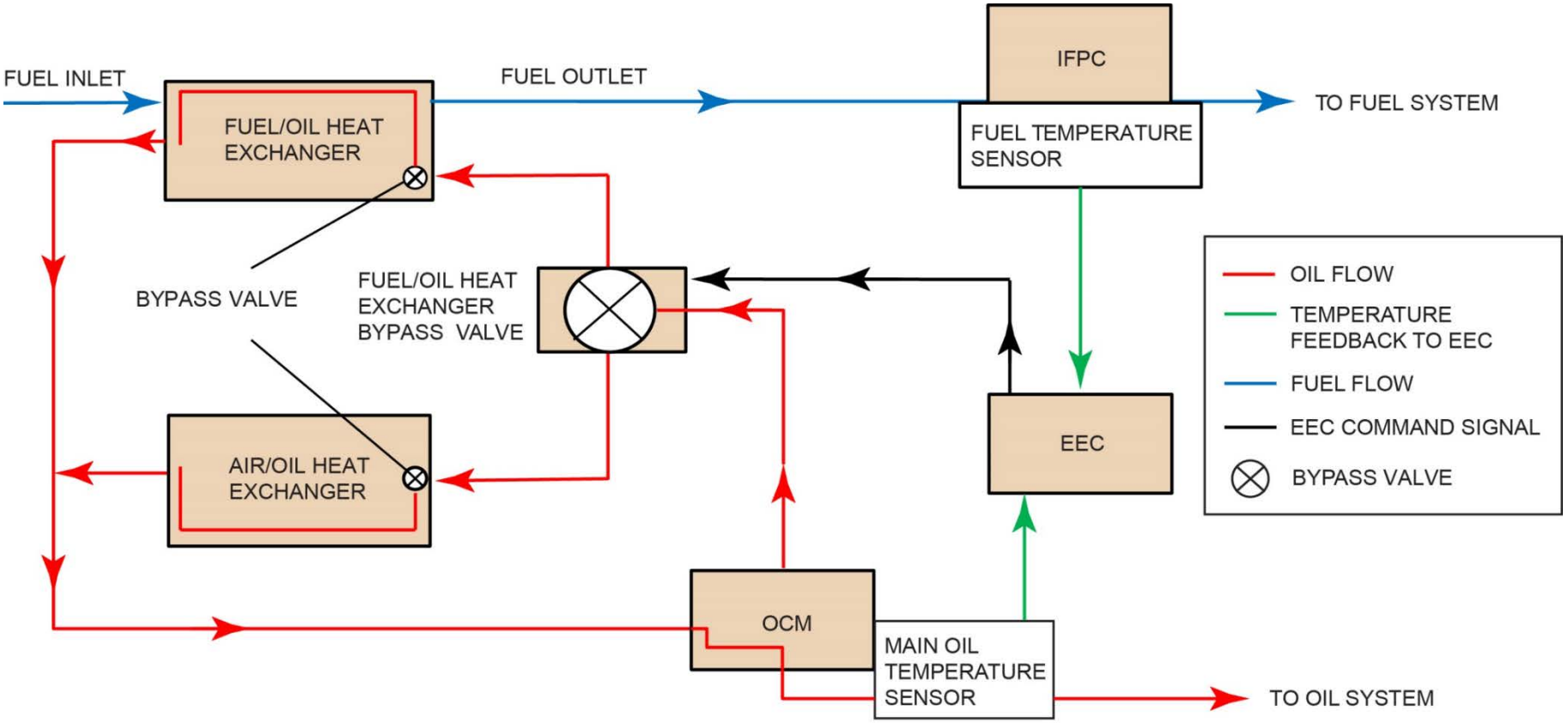


HEAT EXCHANGERS SCHEMATIC

IDG Oil/Oil Heat Exchanger (IDGOOHE)

Purpose:

The IDGOOHE uses engine oil to cool IDG oil.

Location:

The IDGOOHE is mounted to the Thermal Management System Manifold at 9:00.

Description:

Proper temperature of IDG oil is critical for frequency control, as well as for lubrication of IDG bearings and gears.

Heat is transferred from the IDG's self-contained, passive oil system to the oil/oil heat exchanger.

Operation:

In hot conditions, oil flows from the IDG to the core of the oil/oil heat exchanger, transferring heat.

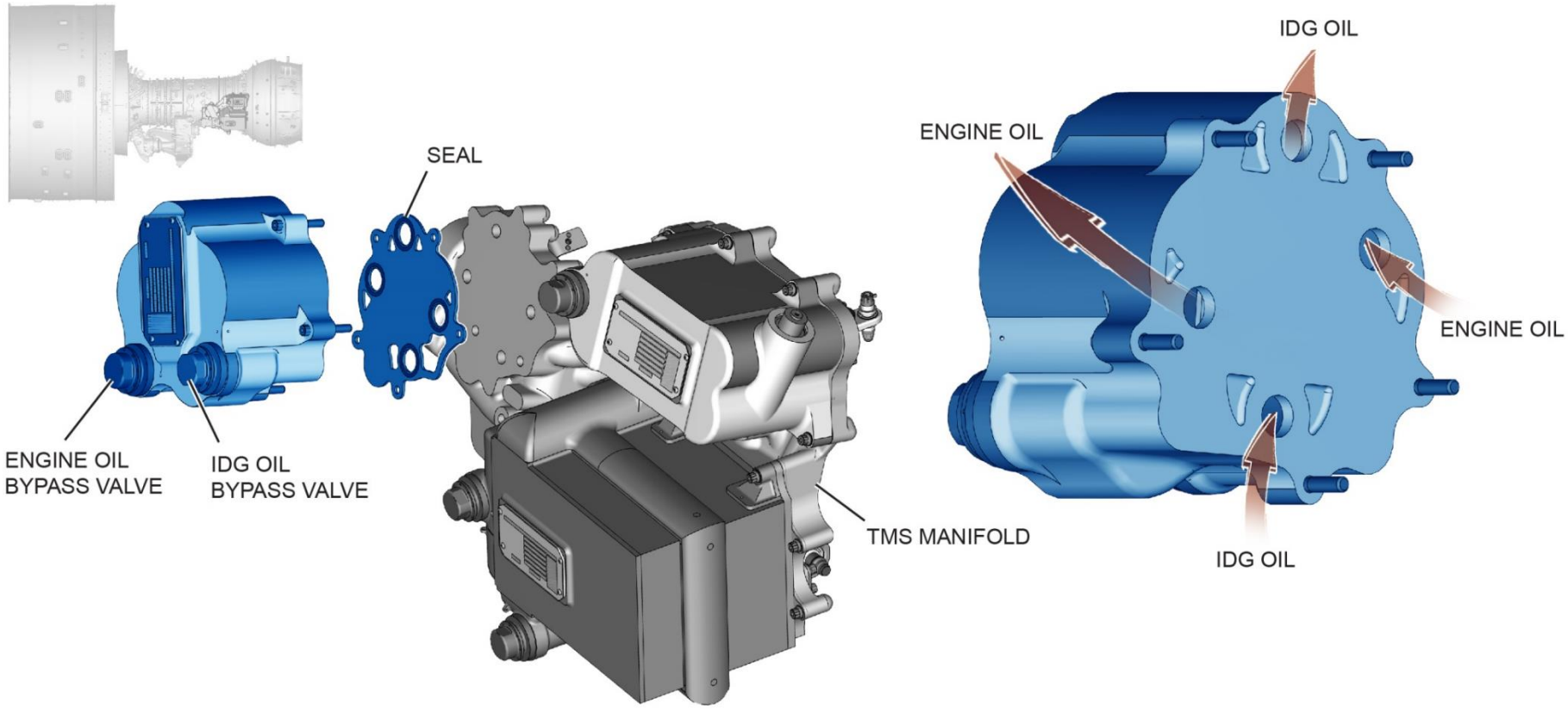
This usually occurs when the engine is at idle and the generator oil system is hotter than the engine oil system.

Safety Conditions

WARNING

WAIT 5 MINUTES MINIMUM TO MAKE SURE THAT THE OIL SYSTEM IS NOT PRESSURIZED BEFORE REMOVAL.

IF YOU DO NOT OBEY THIS WARNING, INJURY CAN OCCUR.


SEAL
ENGINE OIL
BYPASS VALVE
IDG OIL
BYPASS VALVE
TMS MANIFOLD
IDG OIL
ENGINE OIL
ENGINE OIL
IDG OIL

Last Chance Oil Strainers

Purpose:

Large particles can enter the oil supply beyond the main oil filter on the Oil Control Module. Last chance oil strainers prevent these particles from entering bearing compartments and clogging oil nozzles.

Location:

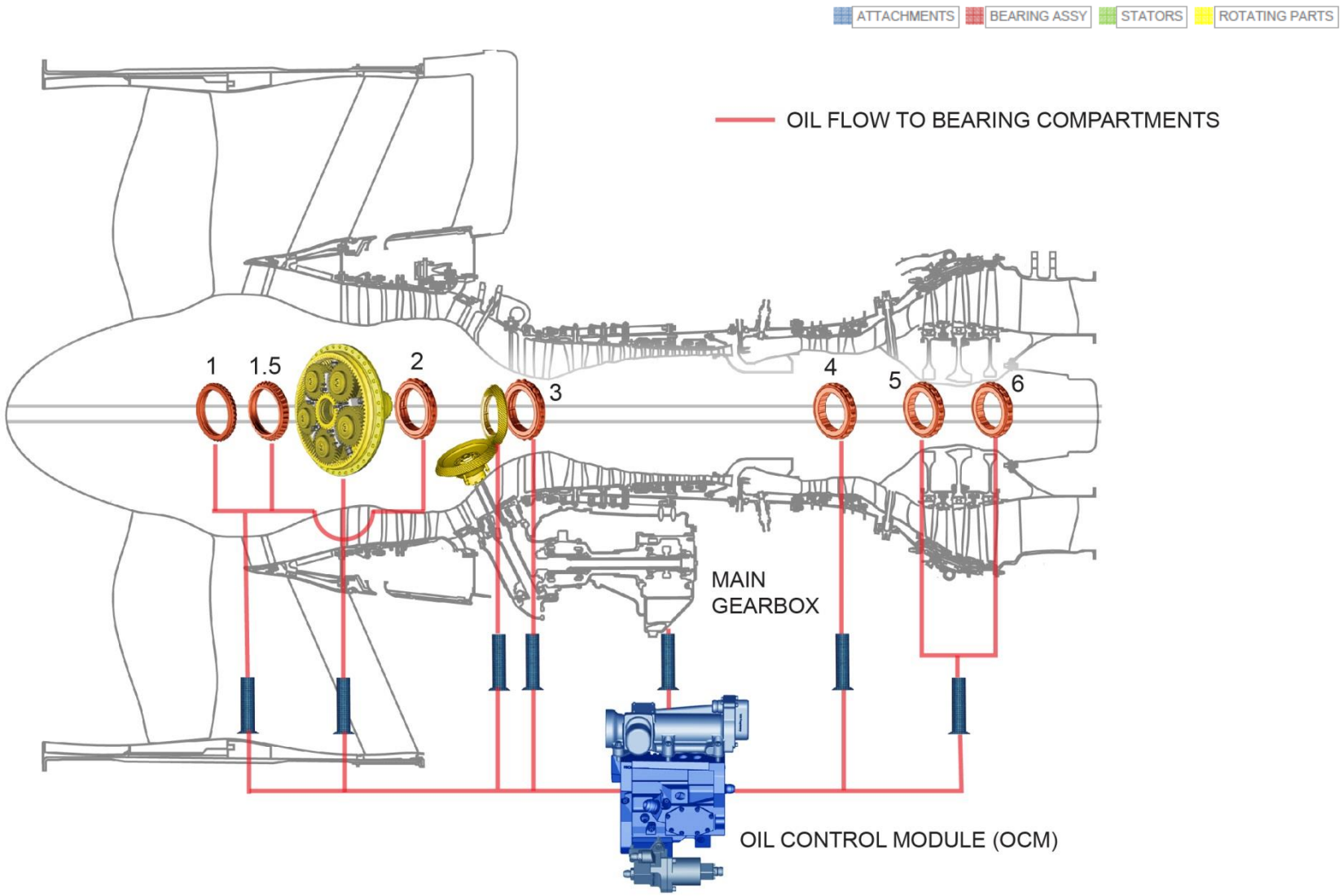
Strainer locations for bearing compartments and the Main Gearbox are shown at right.

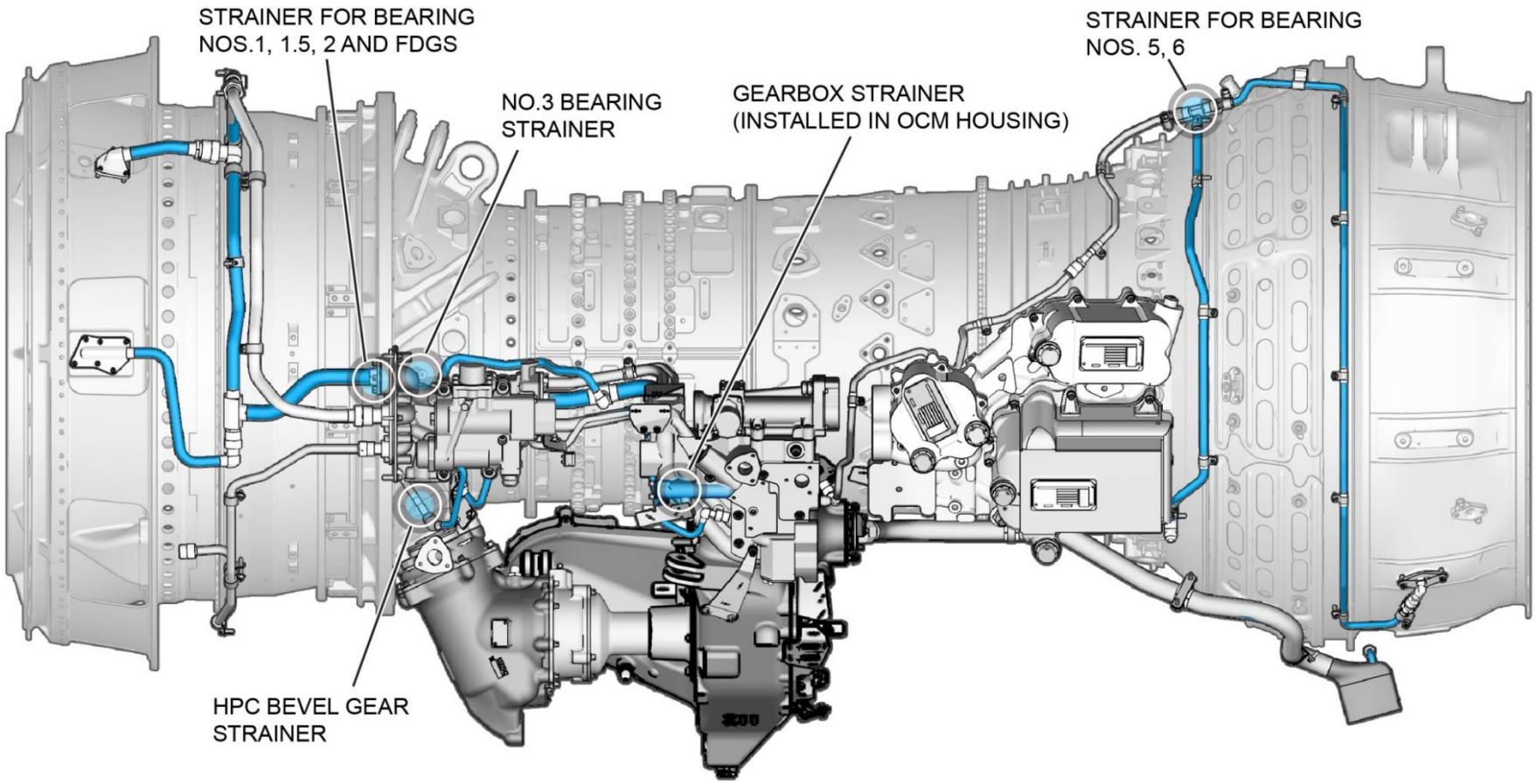
Description:

Strainers are a metal mesh type that fit inside the oil pressure supply tubes and are referred to as in-line strainers.

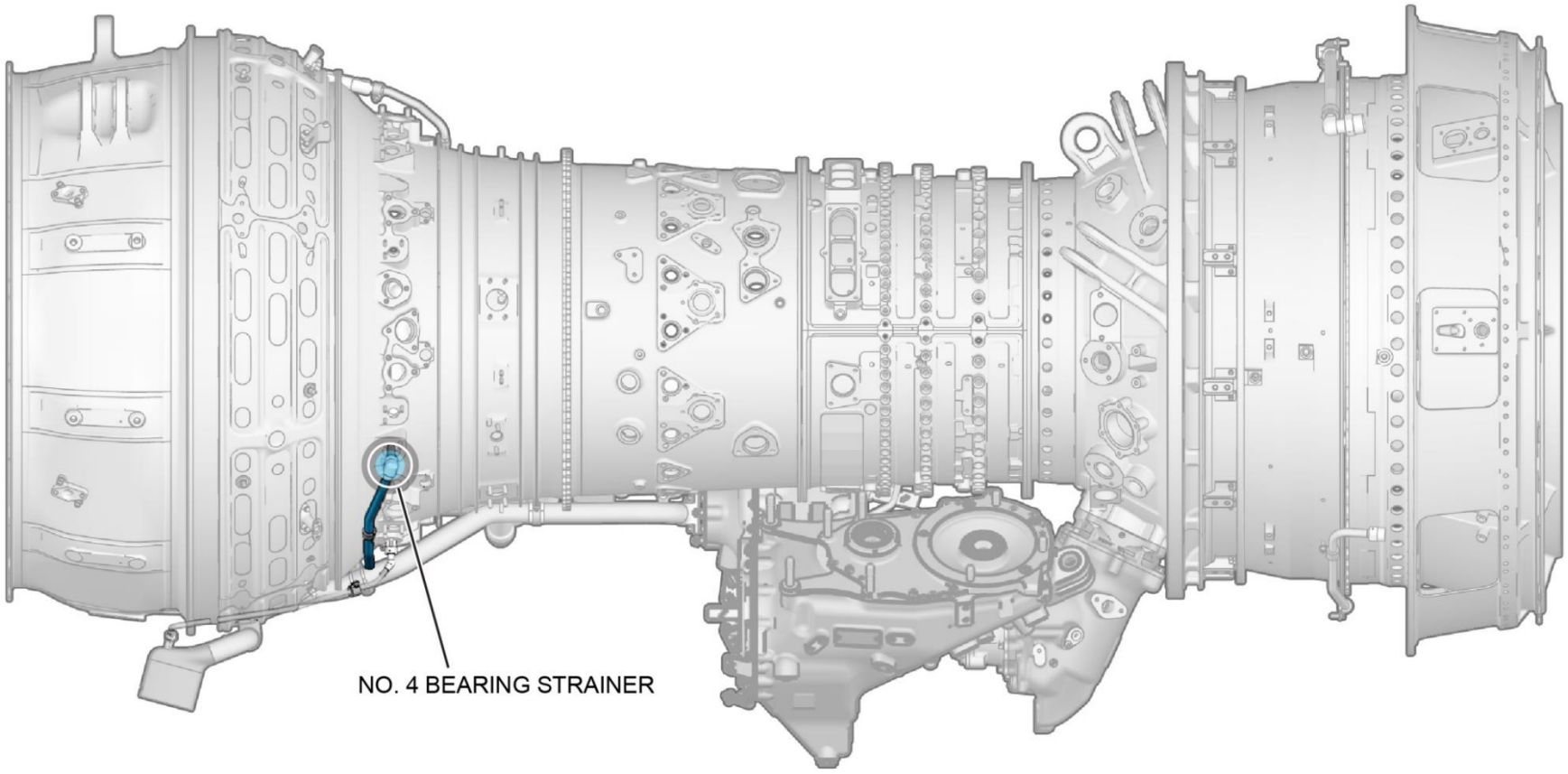
They can be removed, inspected, cleaned and replaced during line maintenance, but this is not required under normal engine operation.

Component	Oil Strainer Location
Bearing nos. 1, 1.5, 2	Oil pressure tube for all three bearings
Fan Drive Gear System	FDGS oil pressure tube
No. 3 Bearing	No. 3 Bearing oil pressure tube
No. 4 Bearing	No. 4 Bearing pressure tube
Bearing nos. 5 and 6	No. 5 Bearing oil pressure tube
Main Gearbox	Mounted to the OCM housing


ATTACHMENTS
BEARING ASSY
STATORS
ROTATING PARTS
OIL FLOW TO BEARING COMPARTMENTS
1
1.5
2
3
4
5
6
MAIN
GEARBOX
OIL CONTROL MODULE (OCM)



LAST CHANCE OIL STRAINER LOCATIONS (LEFT SIDE)



LAST CHANCE OIL STRAINER LOCATION (RIGHT SIDE)

Auxiliary Lubrication System

The Auxiliary Lubrication System protects the FDGS journal bearings from low oil pressure conditions that could cause loss of oil.

These include windmilling operation (in flight or on the ground) and zero gravity or negative gravity events.

The system is located on the support housing for bearing nos. 1/1.5 and consists of the following components:

- fan drive gear train
- windmill/auxiliary pump
- sprag clutch gear assembly
- auxiliary reservoir.

The dedicated windmill/auxiliary dual-stage fan oil pump is in the front bearing compartment and driven by the fan rotor.

The pump continuously draws oil from a dedicated auxiliary reservoir and compartment sump located in the front bearing compartment.

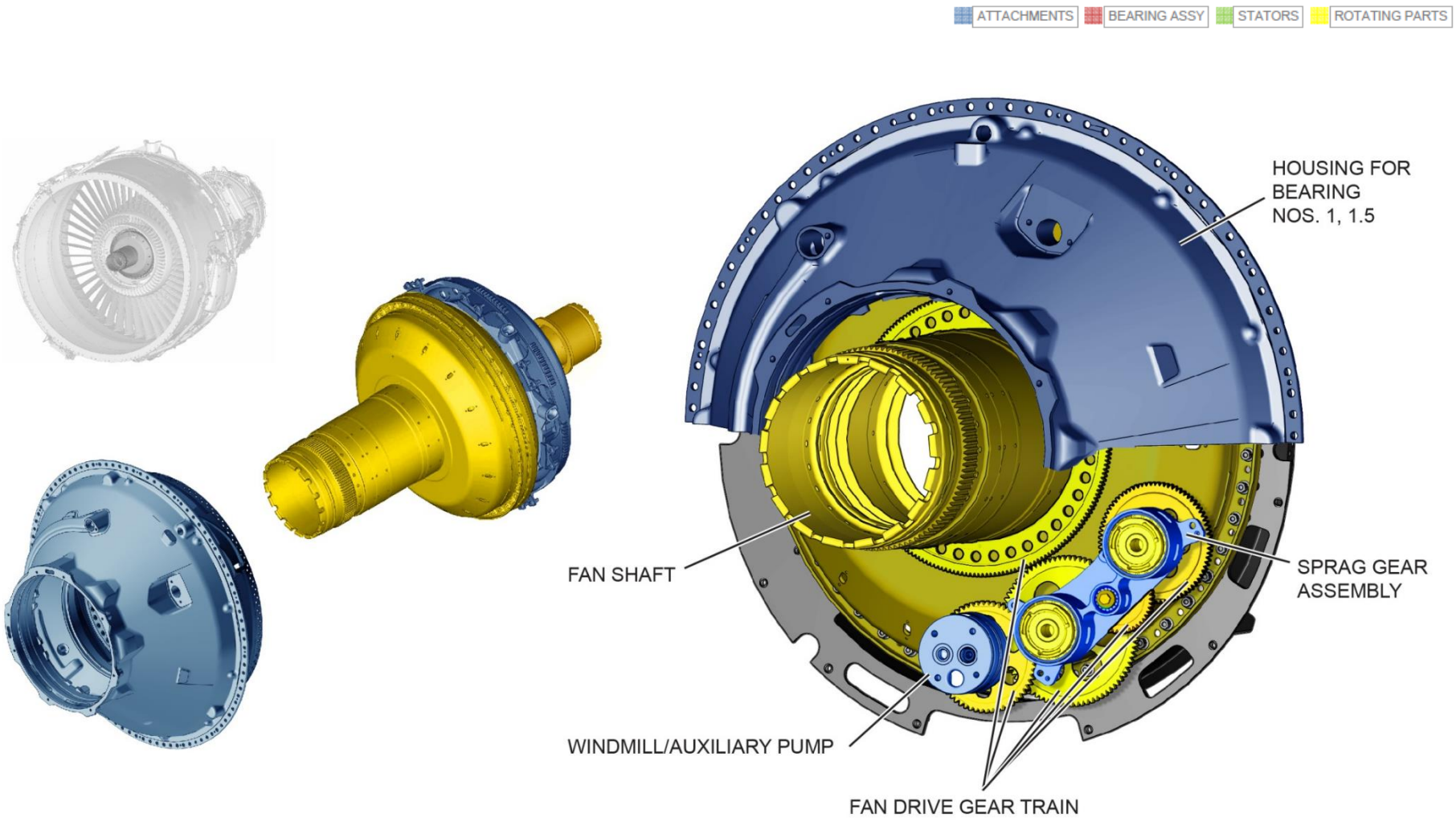
The auxiliary reservoir is part of the casting of the support for bearing nos. 1/1.5.

In normal conditions the pump sends the reservoir and sump oil to the Journal Oil Shuttle Valve (JOSV), which directs the oil back to the oil tank.

In low pressure conditions the JOSV directs the oil to journal bearings, ensuring their lubrication.

During zero or negative gravity events the pump draws oil from the auxiliary reservoir, which is continuously replenished by oil slung from the gear system into the reservoir.

During windmill operations, the pump draws oil through the compartment sump, which is continually replenished by oil cast off from the gear system and main shaft bearings.


ATTACHMENTS
BEARING ASSY
STATORS
ROTATING PARTS
HOUSING FOR BEARING NOS. 1, 1.5
FAN SHAFT
SPRAG GEAR ASSEMBLY
WINDMILL/AUXILIARY PUMP
FAN DRIVE GEAR TRAIN

Fan Drive Gear Train

Purpose:

The Fan Drive Gear Train is a system of gears that ensures the windmill/auxiliary pump is protected from reverse windmill conditions.

Location:

The fan drive gear train is located inside the support for bearing nos. 1/1.5 and on the fan shaft.

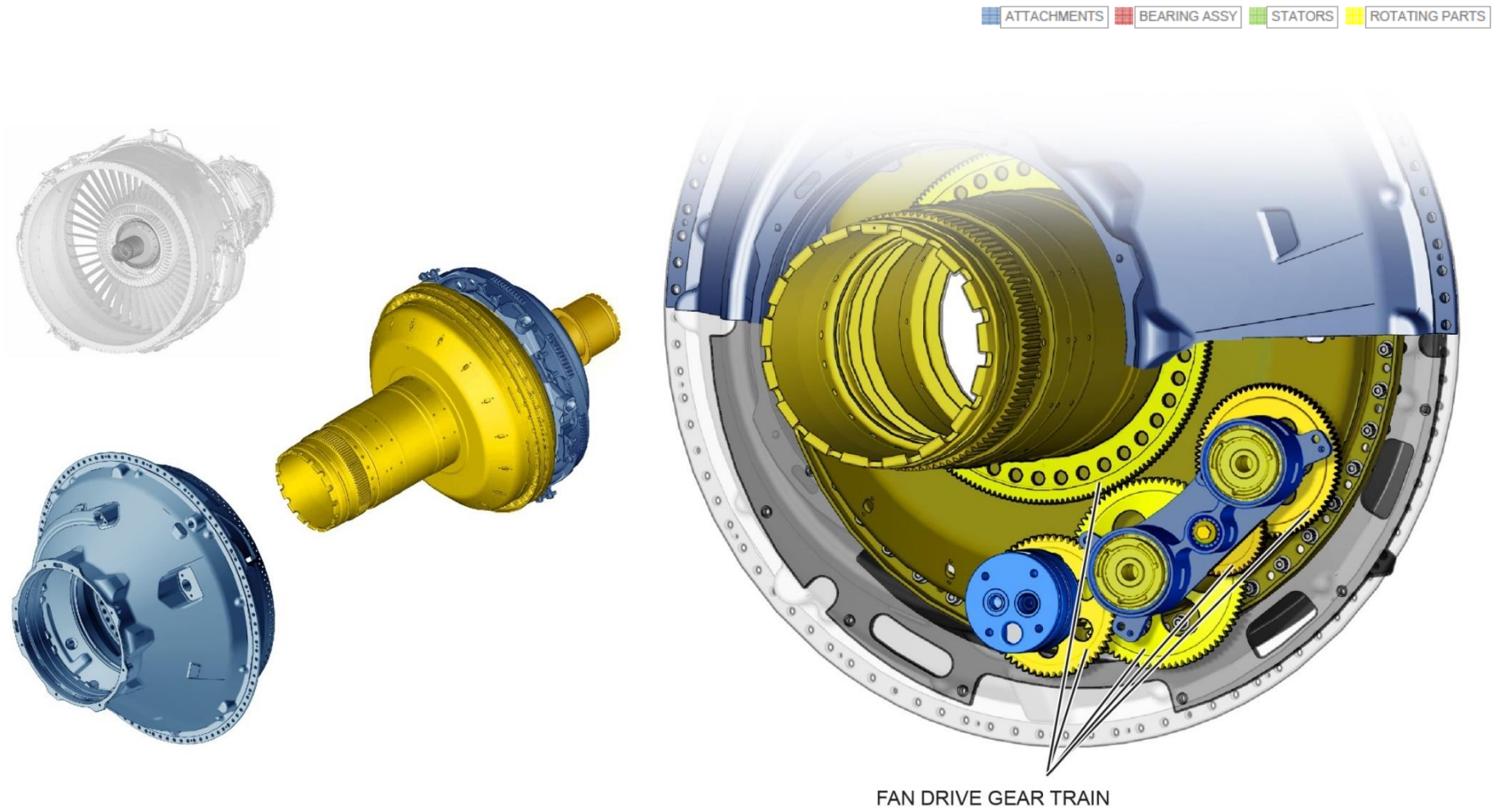
Description:

The fan drive gear train connects the windmill/auxiliary pump to the fan shaft.

Whenever the fan is turning, the windmill/auxiliary pump is sending oil to the FDGS journal bearing operation.

Torque transfers from the fan shaft gear through the fan drive gear train.

Torque is transferred next to the windmill/auxiliary pump gear, and to the pump itself through a splined shaft.


ATTACHMENTS
BEARING ASSY
STATORS
ROTATING PARTS
FAN DRIVE GEAR TRAIN

Windmill/Auxiliary Pump

Purpose:

The windmill/auxiliary pump is a dedicated dual-stage fan oil pump that supplies oil to journal bearings during low-pressure oil conditions.

Location:

The pump is located on the support for bearing nos. 1 and 1.5.

Description:

The pump consists of two stages with separate feeds and a common discharge.

One stage feed is connected to the auxiliary oil reservoir in the support for bearing nos. 1 and 1.5.

The other stage feed is connected to the oil in the bottom, or sump, of the bearing compartment.

Operation:

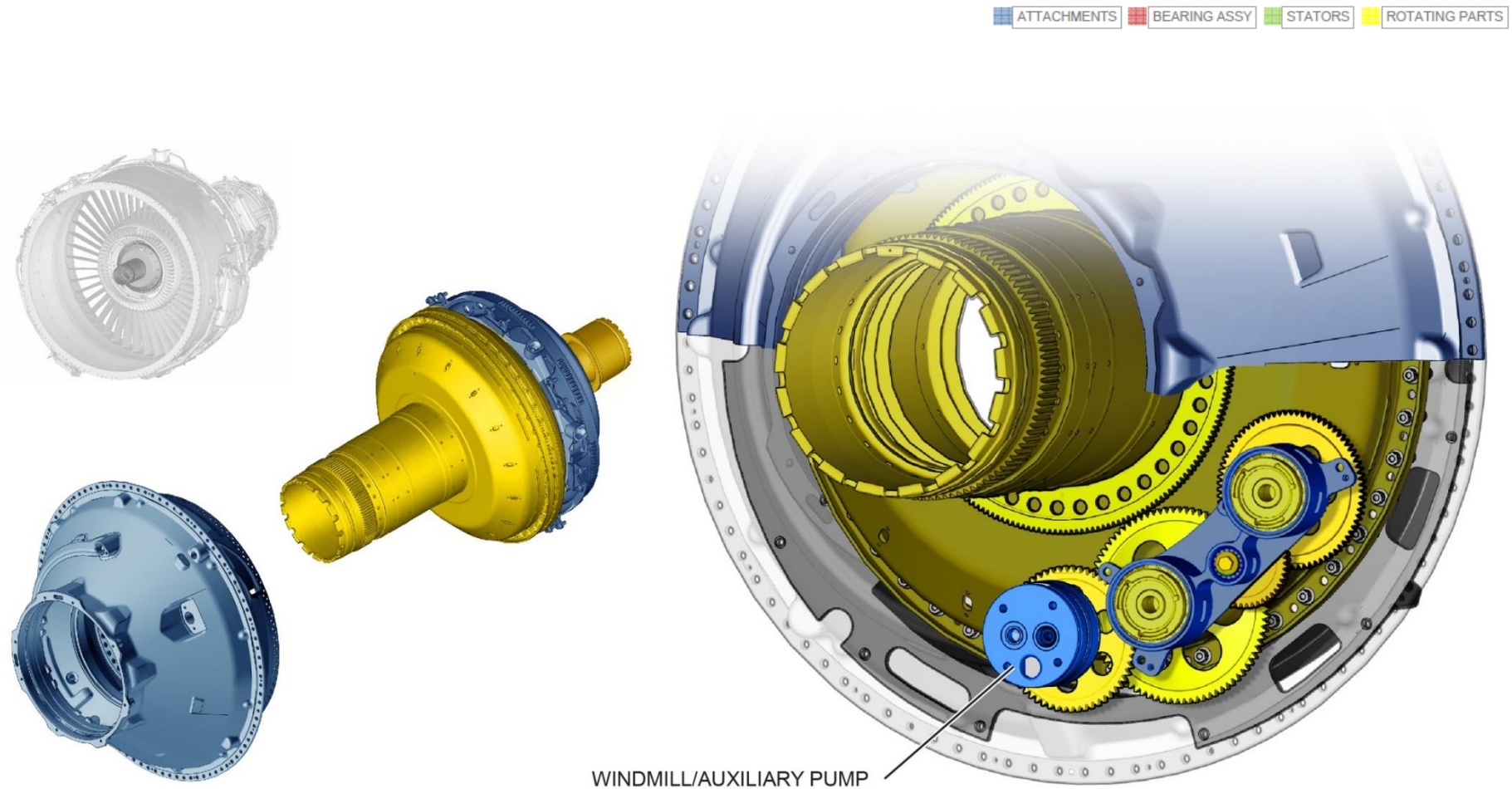
See the table at right for a summary of oil flow in various operating conditions.

In normal conditions when the Lubrication and Scavenge Oil Pump pressure supplies the FDG bearings sufficiently, oil from the windmill/auxiliary pump is directed back to the main oil tank by the JOSV.

In low oil pressure conditions, such as zero gravity or negative gravity events, the pump stage connected to the auxiliary reservoir pumps oil to the journal bearings through the JOSV.

Under windmill conditions, oil from the sump stage is pumped by the windmill/auxiliary pump to the journal bearings through the JOSV.

Operating Condition	Oil Drawn From	Oil Sent To
Normal	Windmill/auxiliary pump	Oil tank
Zero and negative gravity	Auxiliary reservoir	Journal bearings
Windmill	Sump	


ATTACHMENTS
BEARING ASSY
STATORS
ROTATING PARTS
WINDMILL/AUXILIARY PUMP

Sprag Clutch Gear Assembly

Purpose:

The sprag clutch gear assembly keeps the auxiliary oil pump gear turning in the same direction during windmill conditions, regardless of the direction in which the fan shaft turns.

Location:

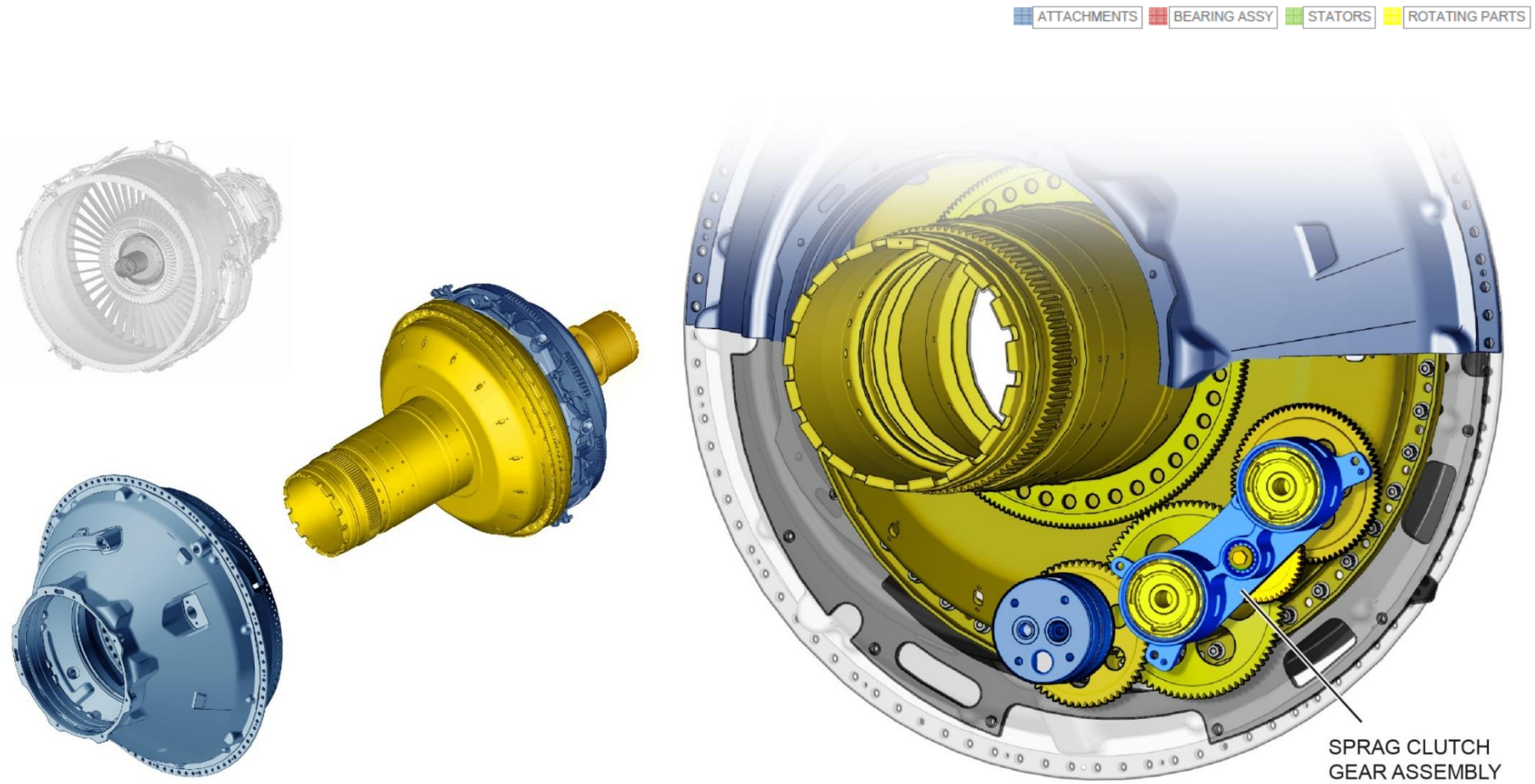
The assembly is mounted at 7:00 inside the 1/1.5 bearing support housing.

Description:

The sprag gear clutch assembly consists of a steel housing, two sprag clutch bearings and one roller bearing.

Operation:

All three bearings are pressed onto shafts turning spur gears that mesh with each other.


ATTACHMENTS
BEARING ASSY
STATORS
ROTATING PARTS
SPRAG CLUTCH
GEAR ASSEMBLY

Auxiliary Oil Reservoir

Purpose:

Oil in this reservoir is directed to journal bearings during zero gravity or negative gravity events.

Location:

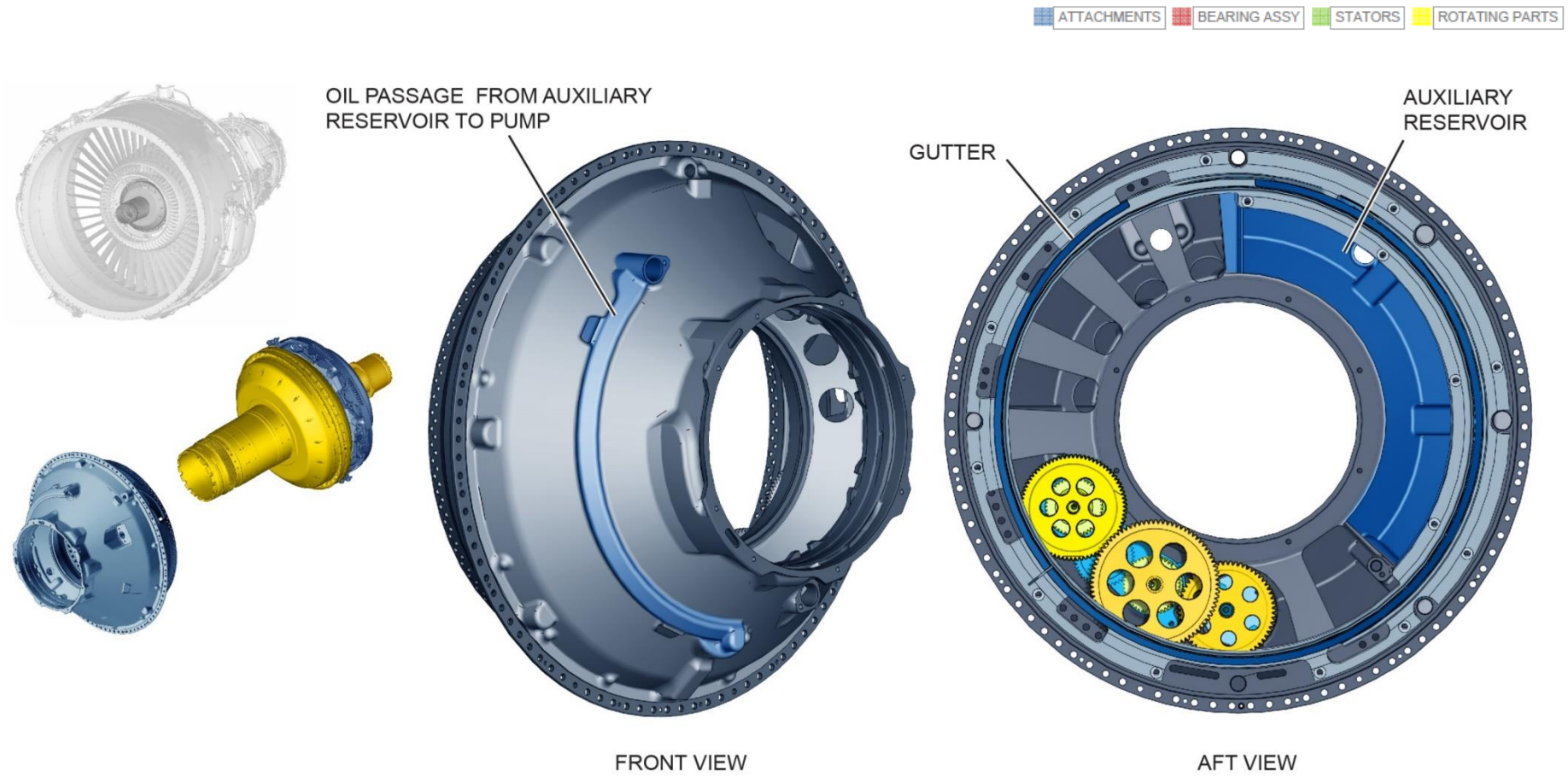
The reservoir is in the compartment for bearing nos. 1 and 1.5.

Description:

Centrifugal action of the ring gear set drives oil into the gutter and then into the auxiliary oil reservoir.

Operation:

Oil is directed out of the reservoir to the auxiliary oil pump and to the journal bearings through passageways cast into the bearing support.


ATTACHMENTS
BEARING ASSY
STATORS
ROTATING PARTS
OIL PASSAGE FROM AUXILIARY RESERVOIR TO PUMP
GUTTER
AUXILIARY RESERVOIR
FRONT VIEW
AFT VIEW

SCAVENGE SYSTEM

The Scavenge System pumps the oil from the bearing compartments and gearboxes back to the oil tank.

The system consists of a Lubrication and Oil Scavenge Pump (LSOP).

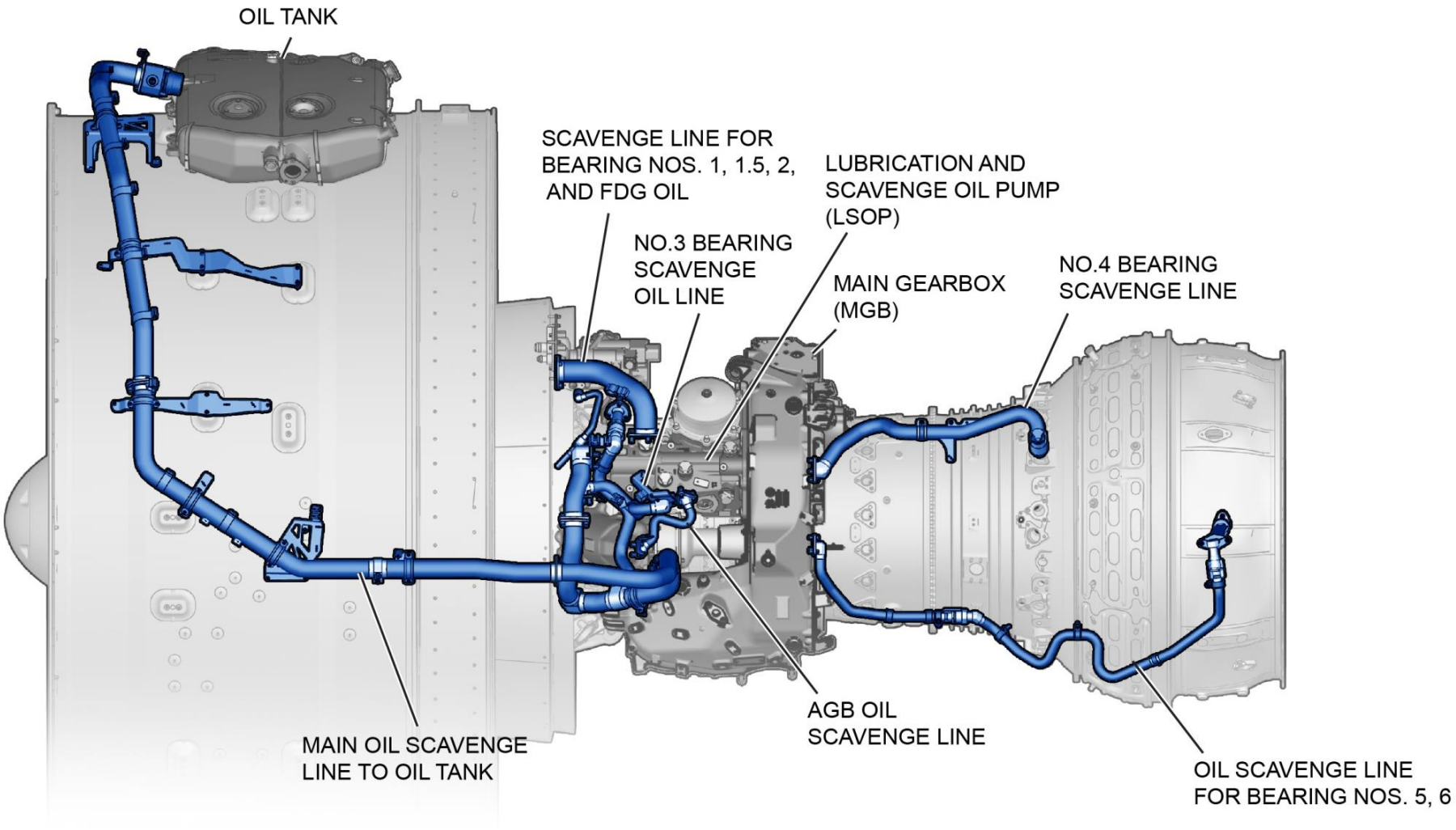
The pump has six stages that return oil from the areas listed below.

- Front bearing compartment servicing the FDGS and bearing nos. 1, 1.5 and 2
- No. 3 Bearing compartment
- No. 4 Bearing compartment
- Compartment for bearing nos. 5 and 6
- Main Gearbox
- Angle Gearbox

The stages send scavenged oil to the oil tank, where a deaerator separates the air that has mixed with the oil.

Air that is separated from the oil pressurizes the oil tank. Note that the Main Gearbox requires no external scavenge line.

The system also has six magnetic chip collectors.


OIL TANK
SCAVENGE LINE FOR BEARING NOS. 1, 1.5, 2, AND FDG OIL
LUBRICATION AND SCAVENGE OIL PUMP (LSOP)
NO.3 BEARING SCAVENGE OIL LINE
MAIN GEARBOX (MGB)
NO.4 BEARING SCAVENGE LINE
MAIN OIL SCAVENGE LINE TO OIL TANK
AGB OIL SCAVENGE LINE
OIL SCAVENGE LINE FOR BEARING NOS. 5, 6

Magnetic Chip Collectors

Purpose:

The Lubrication and Scavenge Oil Pump has six magnetic chip collectors.

The collectors catch ferrous metal particles in the scavenge oil which are used to diagnose system problems.

Location:

Five of the collectors are located on the LSOP and a sixth is found on the No. 4 Bearing scavenge return tube.

Each area listed below has its own collector.

- Front bearing compartment, servicing the FDGS and bearing nos. 1/1.5 and 2
- No. 3 Bearing compartment
- No. 4 Bearing compartment
- Compartment for bearing nos. 5 and 6
- Main Gearbox
- Angle Gearbox

Description:

The collector assembly consists of a collector probe and probe housing. The probe housing has a spring-loaded check valve so there is no leakage when a detector is removed.

The six chip collectors are bayonet-type plugs that can be removed and examined at regular intervals or on-condition.

Operation:

When the probe is inserted to the housing, the check valve is forced open, exposing the probe tip to the oil flow. When the probe is removed for inspection the check valve closes, preventing oil from leaking out of the system.

Safety Conditions

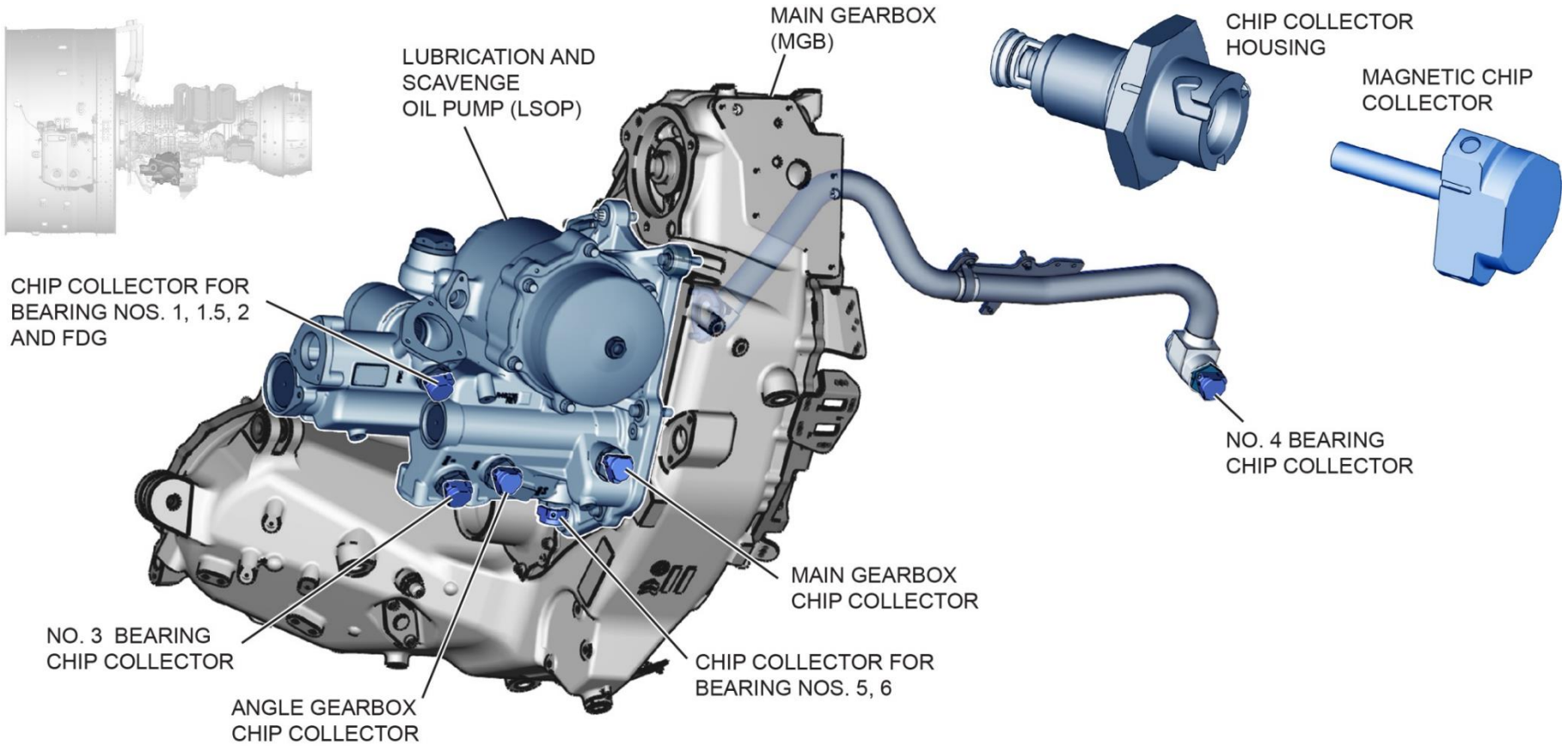
WARNING

WAIT 5 MINUTES MINIMUM TO MAKE SURE THAT THE OIL SYSTEM IS NOT PRESSURIZED BEFORE DOING THE REMOVAL PROCEDURE. IF YOU DO NOT OBEY THIS WARNING, INJURY CAN OCCUR.

CAUTION

YOU MUST REMOVE THE COLLECTOR PROBE BEFORE YOU REMOVE THE REMAINDER OF THE ASSEMBLY. DO NOT REMOVE THE COLLECTOR ASSEMBLY IN ONE STEP. IF YOU DO NOT OBEY THIS CAUTION, DAMAGE TO THE ASSEMBLY CAN OCCUR.

YOU MUST INSTALL THE MAGNETIC PROBE AFTER YOU INSTALL THE REMAINDER OF THE ASSEMBLY. DO NOT INSTALL THE MAGNETIC CHIP COLLECTOR AS A COMPLETE ASSEMBLY. IF YOU DO NOT OBEY THIS CAUTION, DAMAGE TO THE ASSEMBLY CAN OCCUR.


MAIN GEARBOX
(MGB)
LUBRICATION AND
SCAVENGE
OIL PUMP (LSOP)
CHIP COLLECTOR
HOUSING
MAGNETIC CHIP
COLLECTOR
CHIP COLLECTOR FOR
BEARING NOS. 1, 1.5, 2
AND FDG
NO. 4 BEARING
CHIP COLLECTOR
MAIN GEARBOX
CHIP COLLECTOR
NO. 3 BEARING
CHIP COLLECTOR
CHIP COLLECTOR FOR
BEARING NOS. 5, 6
ANGLE GEARBOX
CHIP COLLECTOR

BREATHER SYSTEM

During engine operation, sealing air flows into the bearing compartments.

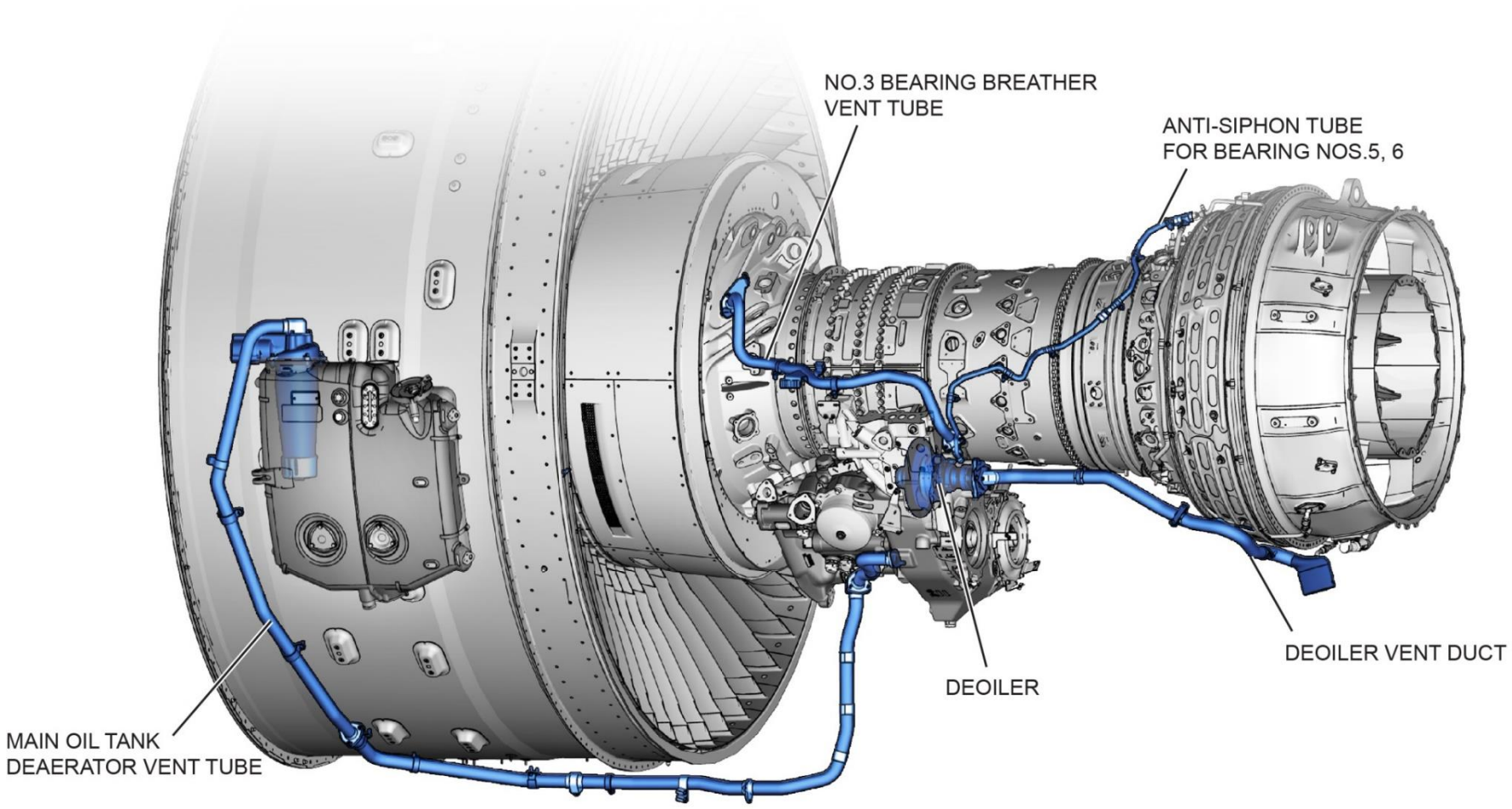
The sealing air must be vented to allow a continuous flow.

The sealing air that vents is referred to as *breather air*.

The Breather System removes air from the bearing compartments, separates the breather air from the oil, and vents the air overboard.

Components are shown below.

- Deoiler
- Deoiler vent duct
- No. 3 Bearing breather vent tube
- Main oil tank deaerator vent tube
- Anti-siphon tube for bearing nos. 5 and 6


NO.3 BEARING BREATHER
VENT TUBE
ANTI-SIPHON TUBE
FOR BEARING NOS.5, 6
DEOILER VENT DUCT
DEOILER
MAIN OIL TANK
DEAERATOR VENT TUBE

Deoiler and Deoiler Vent Duct

Purpose:

The de-oiler separates air from scavenge oil.

Location:

The de-oiler is integral to the Main Gearbox and is located on the left side.

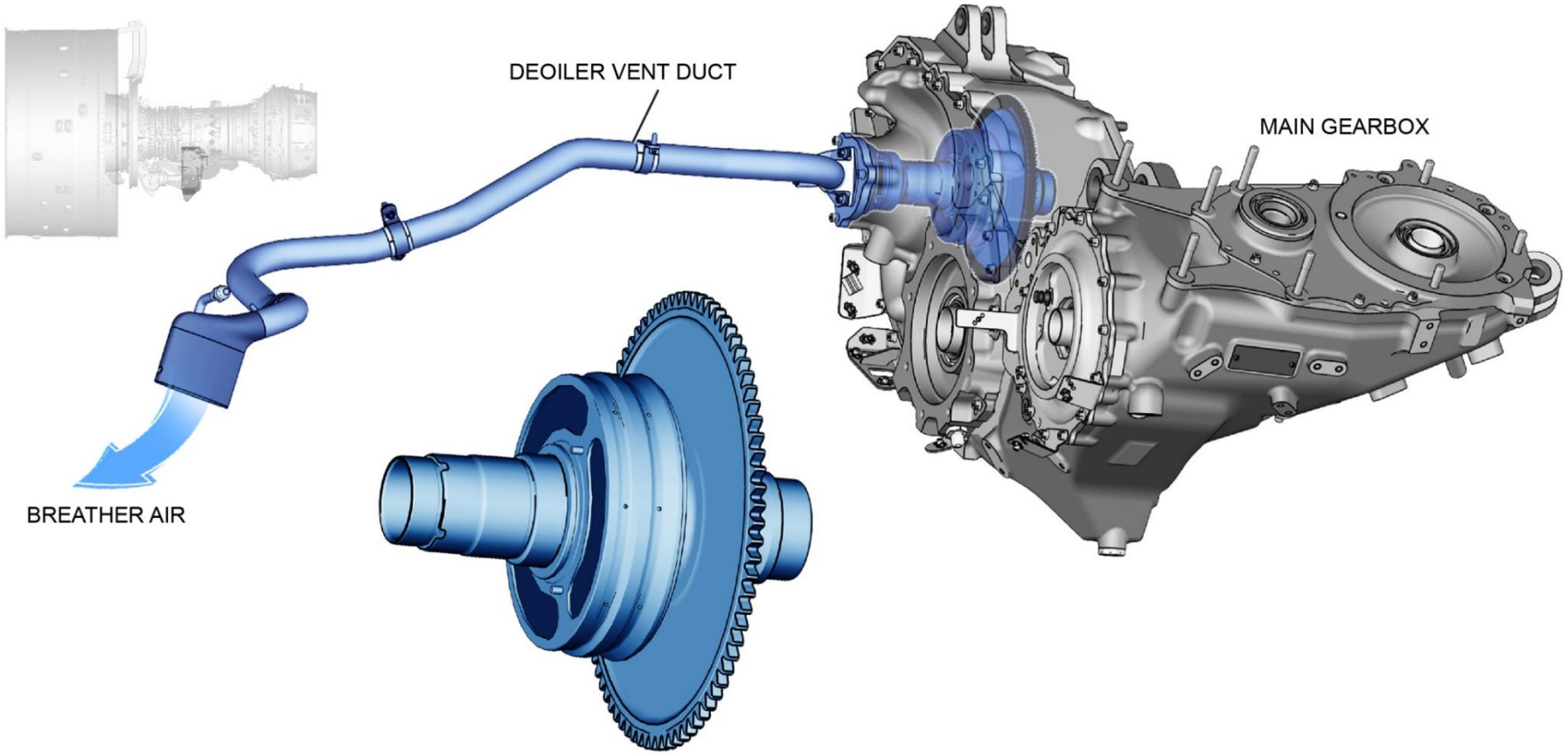
Description:

Torque is applied to the de-oiler rotor drive gear from the MGB.

The rotor captures oil mist residing in the MGB, and through centrifugal action the oil is separated from the air.

The oil-soaked breather air is vented into the MGB from the compartments for bearing nos. 5, 6 and 3, and from the oil tank.

The separated oil flows into the MGB sump to the LSOP, and the air flows out of the MGB through the de-oiler vent duct.


DEOILER VENT DUCT
MAIN GEARBOX
BREATHER AIR

No. 3 Bearing Breather Vent Tube

Purpose:

The No.3 Bearing breather vent tube sends breather air directly from the bearing compartment to the de-oiler in the Main Gearbox.

Location:

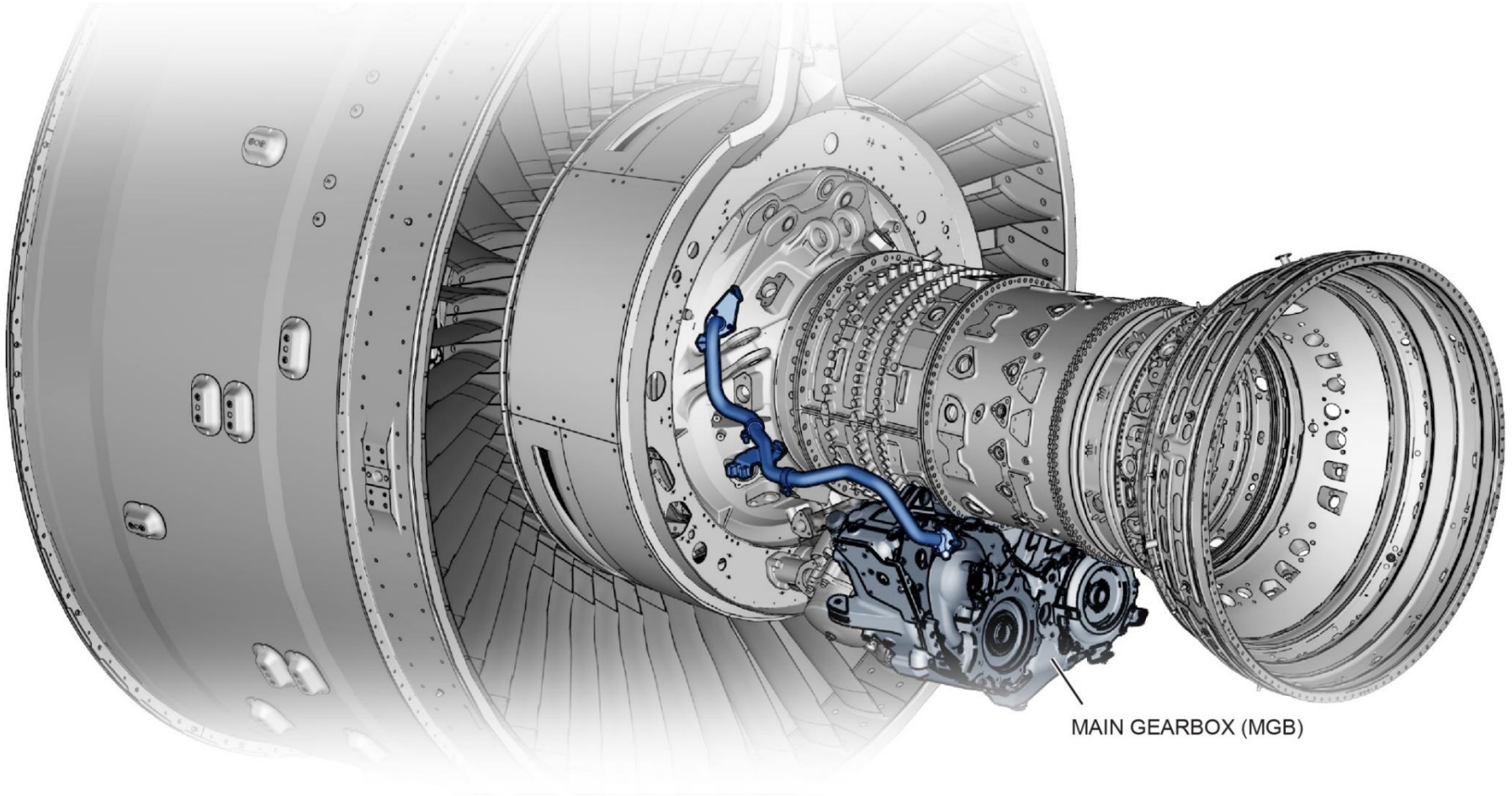
The vent tube is attached to the CIC at 10:00 and to the rear of the Main Gearbox.

Description:

Air enters the No. 3 Bearing compartment from between the carbon seal and face seal, flowing through the compartment and removing heat.

The airflow carries some of the oil that is used in the bearing compartment, lubricating the bearings in the form of a mist.

The No. 3 Bearing vent tube vents this breather air directly to the de-oiler in the Main Gearbox.


MAIN GEARBOX (MGB)

Main Oil Tank Deaerator Vent Tube

Purpose:

The main oil tank deaerator vent tube vents tank pressure greater than 12 psi from the main oil tank.

Location:

The tube is connected to the oil tank deaerator and the Main Gearbox.

Description:

Sealing air for all bearing compartments excluding bearing nos. 5 and 6 mixes with scavenge oil and flows back to the oil tank.

A static deaerator in the oil tank separates the oil from the air.

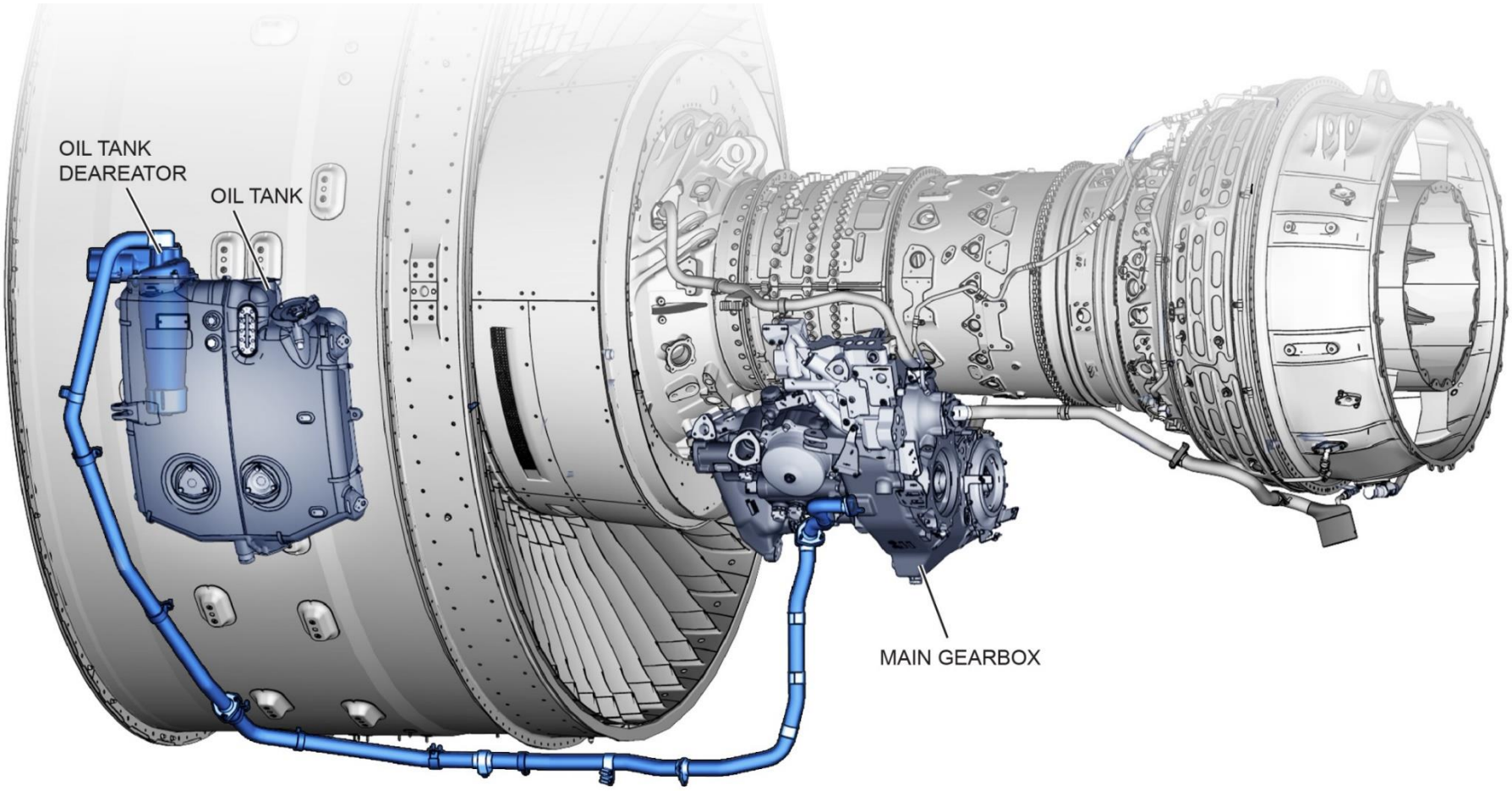
The released air pressurizes the oil tank.

Operation:

Pressure in the tank is controlled by a spring-loaded closed, mechanical poppet valve.

The valve opens to release excess pressure in the tank and sends the excess air/oil mist to the de-oiler that is internal to the Main Gearbox.

Breather air from the Main Gearbox flows internally to the de-oiler vent tube.


OIL TANK
DEAREATOR
OIL TANK
MAIN GEARBOX

Anti-Siphon Tube for Bearing Nos. 5, 6

Purpose:

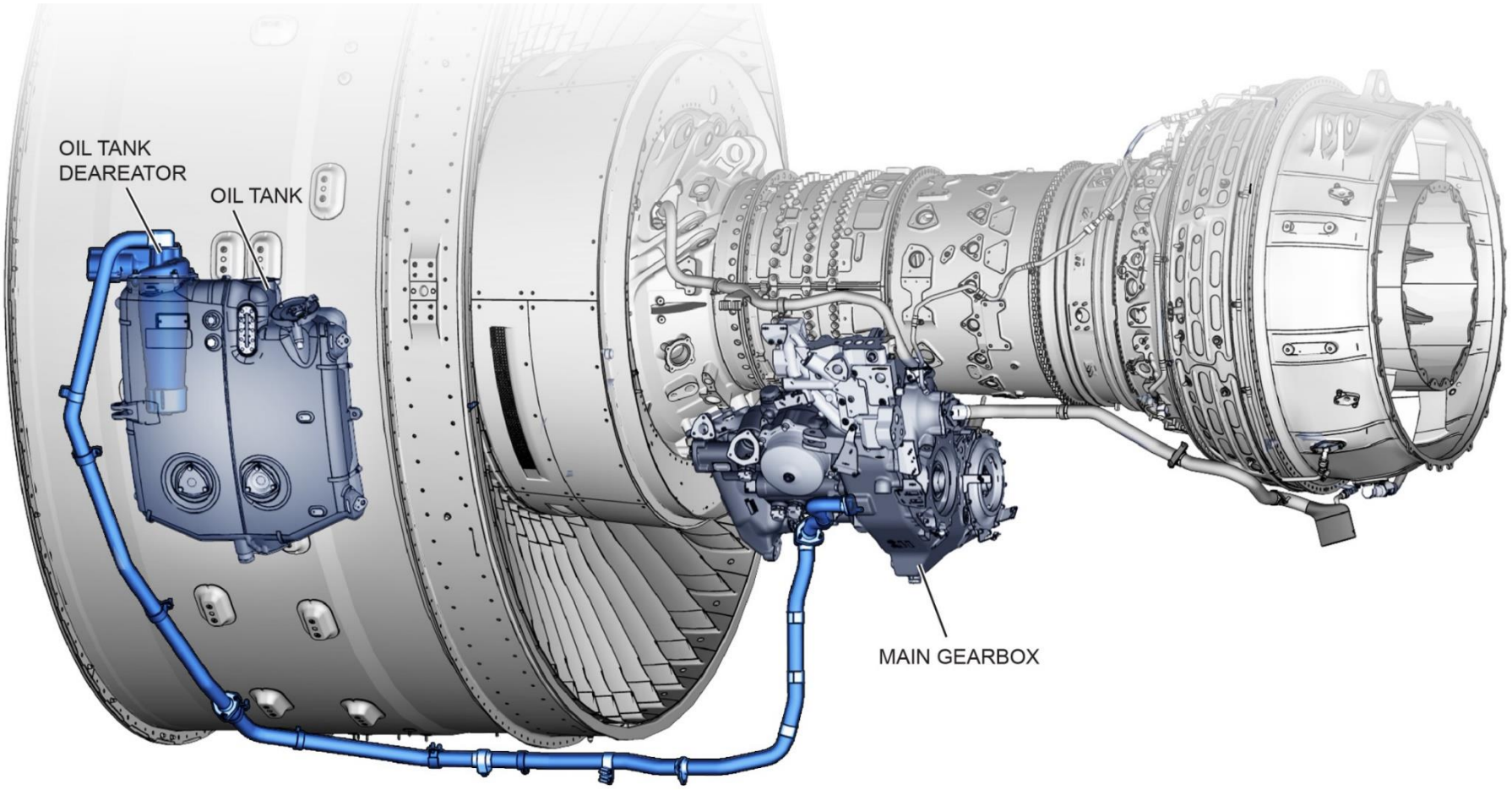
The anti-siphon tube allows some oil to remain present in the pressure tube for bearing nos. 5 and 6 after the engine is shut down.

Location:

The anti-siphon tube is on the left side of the engine core. It attaches to the oil pressure “T” fitting for bearing nos. 5 and 6, and to the No. 3 Bearing breather tube.

Description:

The effect of allowing oil to remain in the anti-siphon tube after shutdown prevents coking in the bearing pressure tube.


OIL TANK
DEAREATOR
OIL TANK
MAIN GEARBOX

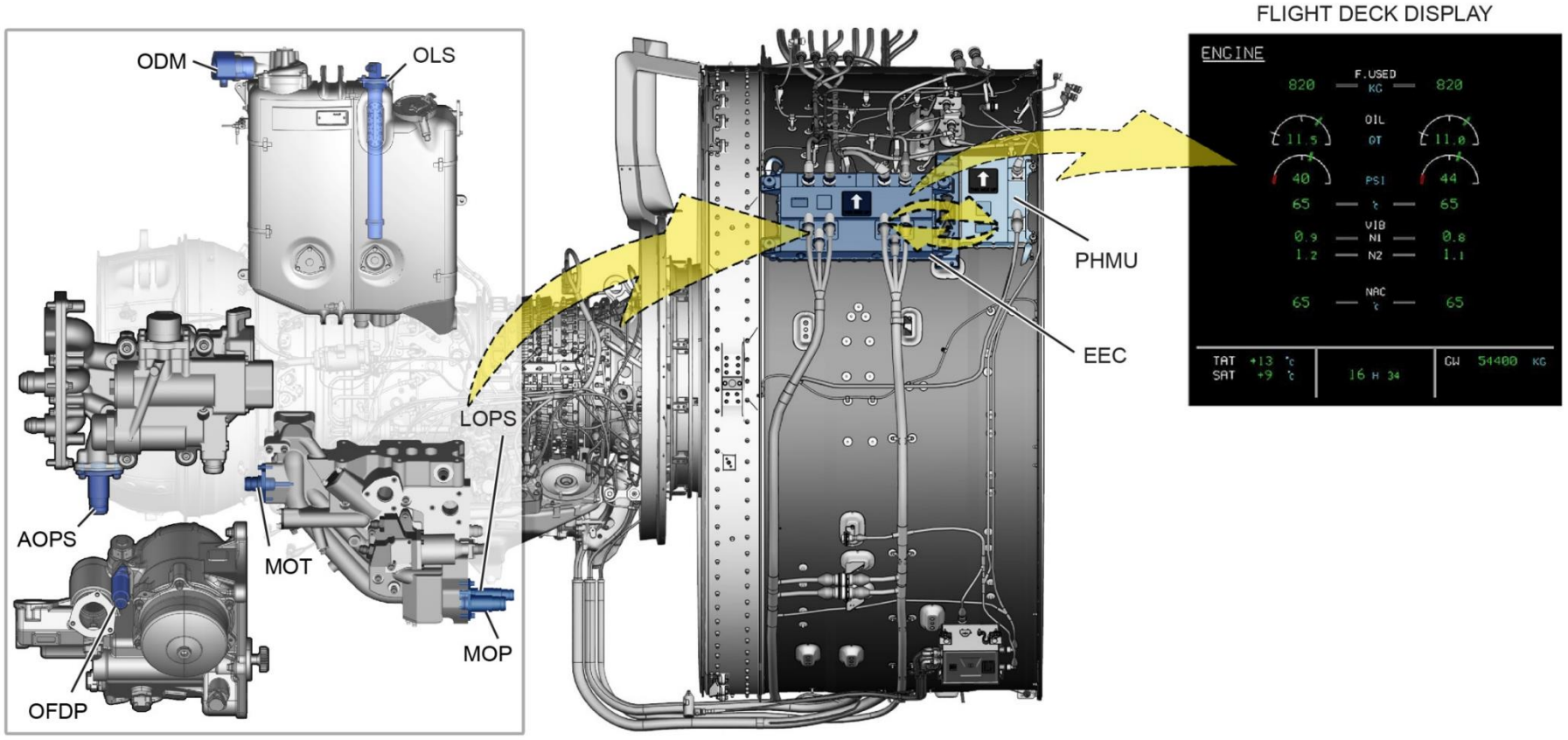
INDICATING SYSTEM

The Indicating System monitors Lubrication System conditions and alerts the flight crew to potential problems.

Components in the system send signals to the Electronic Engine Control (EEC), which in turn notifies the flight deck's Electronic Centralized Aircraft Monitoring System (ECAM).

Sensors are listed below.

- Oil Level OLS
- Oil Filter Differential Pressure OFDPS
- Oil Debris Monitor ODM
- Main Oil Temperature MOT
- Main Oil Pressure MOP
- Low Oil Pressure LOPS
- Auxiliary Oil Pressure AOPS


ODM
OLS
LOPS
AOPS
MOT
MOP
OFDP
PHMU
EEC
FLIGHT DECK DISPLAY
ENGINE
F.USED
KG
820
820
OIL
OT
11.5
11.0
PSI
40
44
65
65
VIB
N1
0.9
0.8
N2
1.2
1.1
NAC
65
65
TAT +13 °C
SAT +9 °C
16 H 34
GW 54400 KG

OIL MONITORING AND INDICATING

The oil monitoring and indicating system comprises:

- Oil Level (OL) indicating,
- Oil Debris Monitoring (ODM),
- Main Oil Temperature (MOT) indicating,
- Main Oil Pressure (MOP) indicating,
- Low Oil Pressure (LOP) indicating,
- Oil Filter Differential Pressure (OFDP),
- Auxiliary Oil Pressure (AOP) indicating.

OIL LEVEL INDICATING

The oil level sensor is installed on the top of the oil tank.

It is of the magnetic float and reed switch type.

The signal proportional to the oil level is sent to the EEC channel B.

OIL DEBRIS MONITORING

The Oil Debris Monitoring (ODM) sensor is installed between the main oil scavenge line and the deaerator in the oil tank.

It detects any type of pollution that crossed its electromagnetic field.

The signal corresponding to the ferrous and non-ferrous debris is processed by the PHMU.

The PHMU calculates the number of particles in a given time period and sends it to the EEC channel A.

The EEC compares the data to predefined values and generates a maintenance signal.

MAIN OIL TEMPERATURE INDICATING

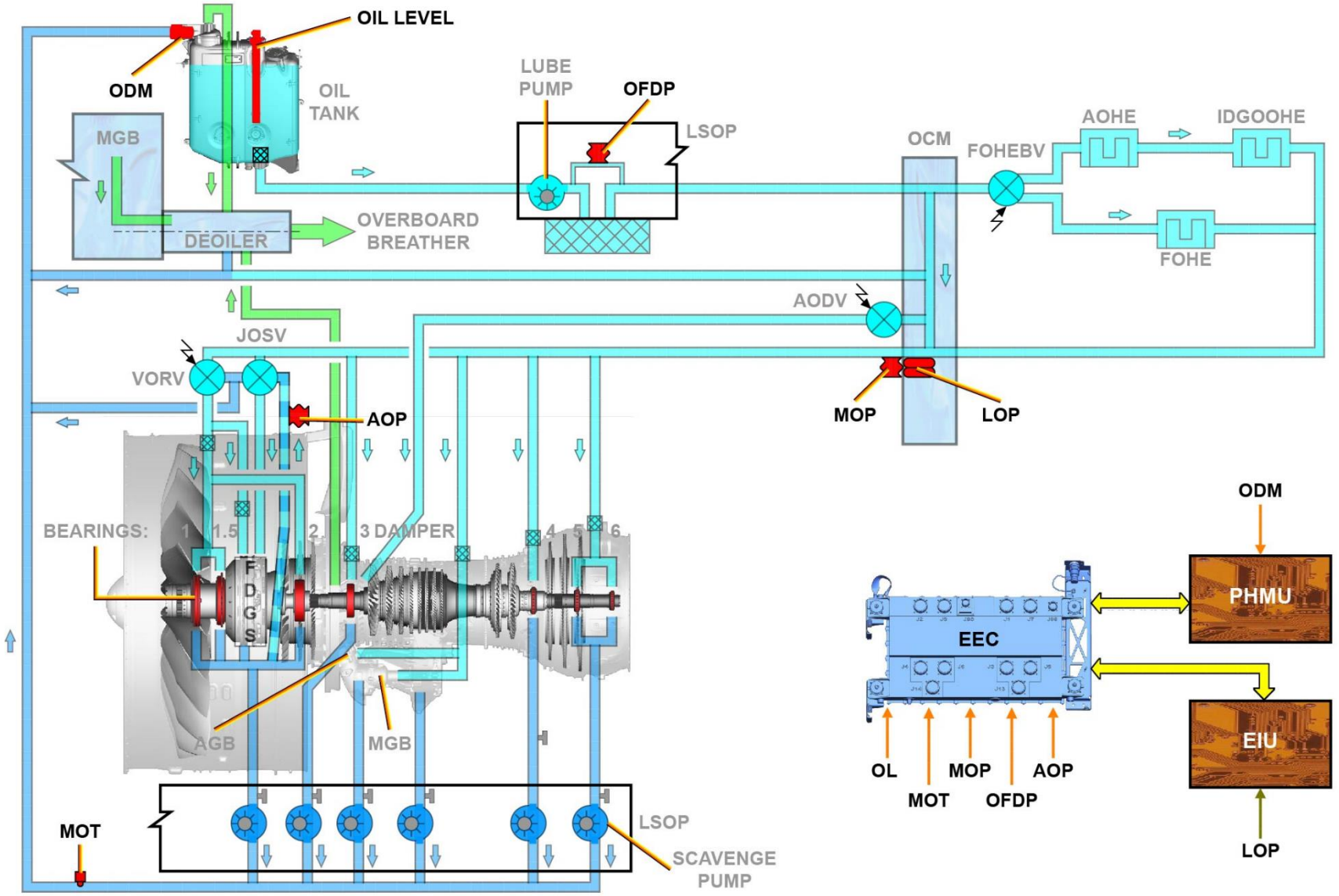
The dual oil temperature sensor is installed on the OCM.

It measures the scavenge oil temperature in the scavenge oil line and sends the signals to both EEC channels.

MAIN OIL PRESSURE INDICATING

The dual main oil pressure sensor is installed on OCM.

It measures the pressure on the oil supply line and sends the signals to both EEC channels.


OIL LEVEL
ODM
OIL TANK
MGB
DEOILER
OVERBOARD BREATHER
LUBE PUMP
OFDP
LSOP
OCM
FOHEBV
AOHE
IDGOOHE
FOHE
AODV
JOSV
VORV
AOP
MOP
LOP
BEARINGS:
1
1.5
2
3 DAMPER
4
5
6
F
D
G
S
AGB
MGB
MOT
LSOP
SCAVENGE PUMP
ODM
PHMU
EEC
EIU
OL
MOT
MOP
OFDP
AOP
LOP

LOW OIL PRESSURE INDICATING

The low oil pressure switch is installed on OCM.

It detects low oil pressure condition on the oil supply line and sends the signals to the Engine Interface Unit (EIU).

OIL FILTER DIFFERENTIAL PRESSURE

The oil filter differential pressure sensor is installed on the OCM, adjacent to the oil filter.

The differential pressure signal is sent to both EEC channels.

When the differential pressure across the filter is more than the specified limit, a maintenance signal is generated.

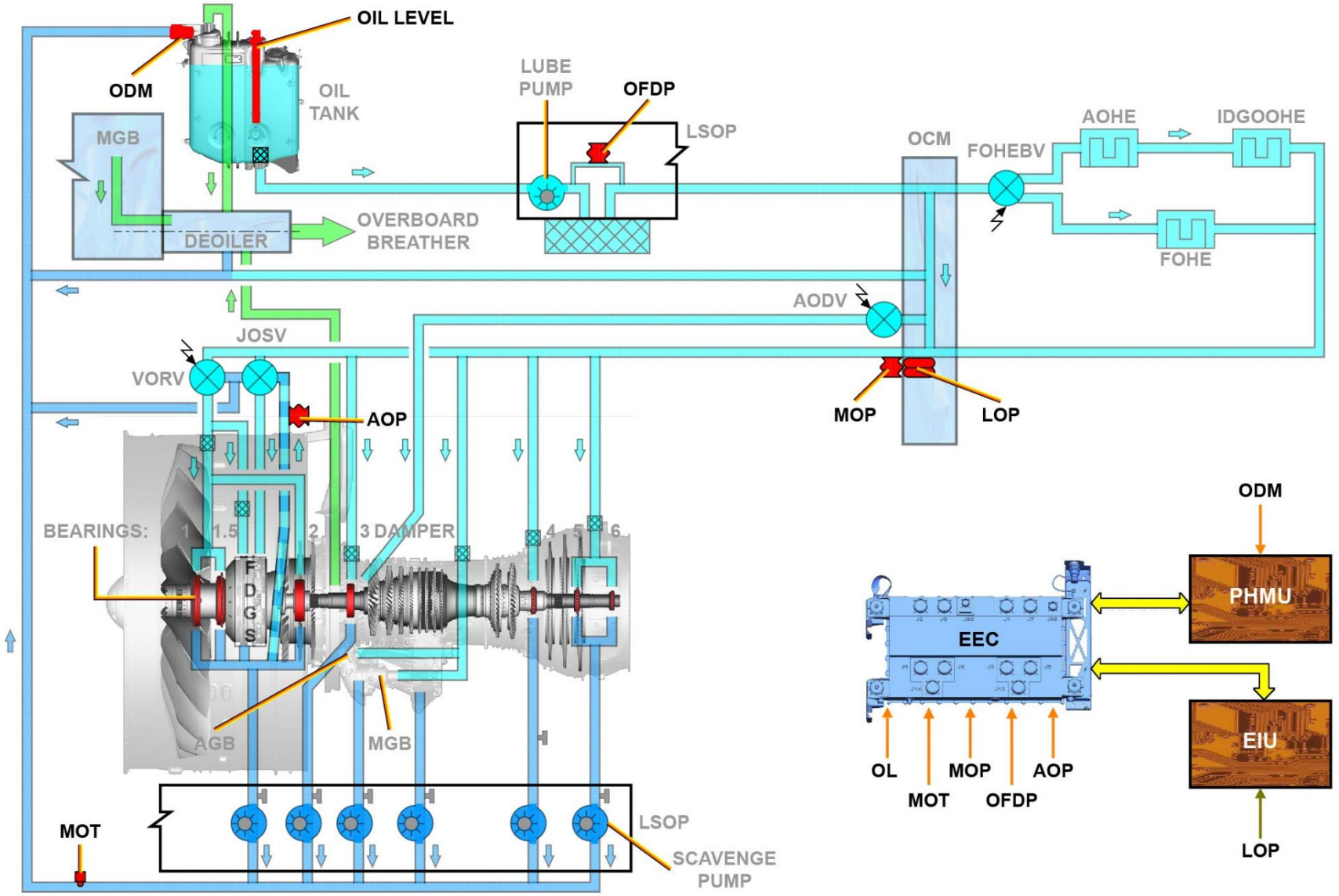
When the differential pressure across the primary oil filter element is too much, the filter bypass valve will open.

The pressurized oil then will go directly to the secondary filter and an oil filter bypass signal is also generated.

AUXILIARY OIL PRESSURE INDICATING

The dual auxiliary oil pressure sensor is installed on the VORV / JOSV assembly.

It measures the pressure of the auxiliary oil supply for the journal bearings of the FDGS and sends it to both EEC channels to detect failures in the JOSV or the oil auxiliary pump.


OIL LEVEL
ODM
OIL TANK
MGB
DEOILER
OVERBOARD BREATHER
LUBE PUMP
OFDP
LSOP
OCM
FOHEBV
AOHE
IDGOOHE
FOHE
AODV
JOSV
VORV
AOP
MOP
LOP
BEARINGS:
1
1.5
2
3 DAMPER
4
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6
F
D
G
S
AGB
MGB
MOT
LSOP
SCAVENGE PUMP
ODM
PHMU
EEC
EIU
OL
MOT
MOP
OFDP
AOP
LOP

Oil Level Sensor (OLS)

Purpose:

The Oil Level Sensor indicates the oil level within the oil tank.

Location:

The sensor is internal to the oil tank.

Description:

The sensor is a single channel transducer with a magnetic float and reed switch configuration.

A hollow tube is welded to the top mounting plate and has an integral bottom mounting flange that fits into a mating flange inside the bottom of the oil tank assembly.

The hollow tube contains a magnetic ball float and a circuit board.

The length of the circuit board contains a series of switches.

A single electrical connector is attached to the top mounting plate.

The mounting plate is secured to the top of the oil tank assembly with three bolts. An O-ring beneath the mounting plate prevents leakage.

The OLS must be replaced if it is removed on-wing or during a shop visit.

Operation:

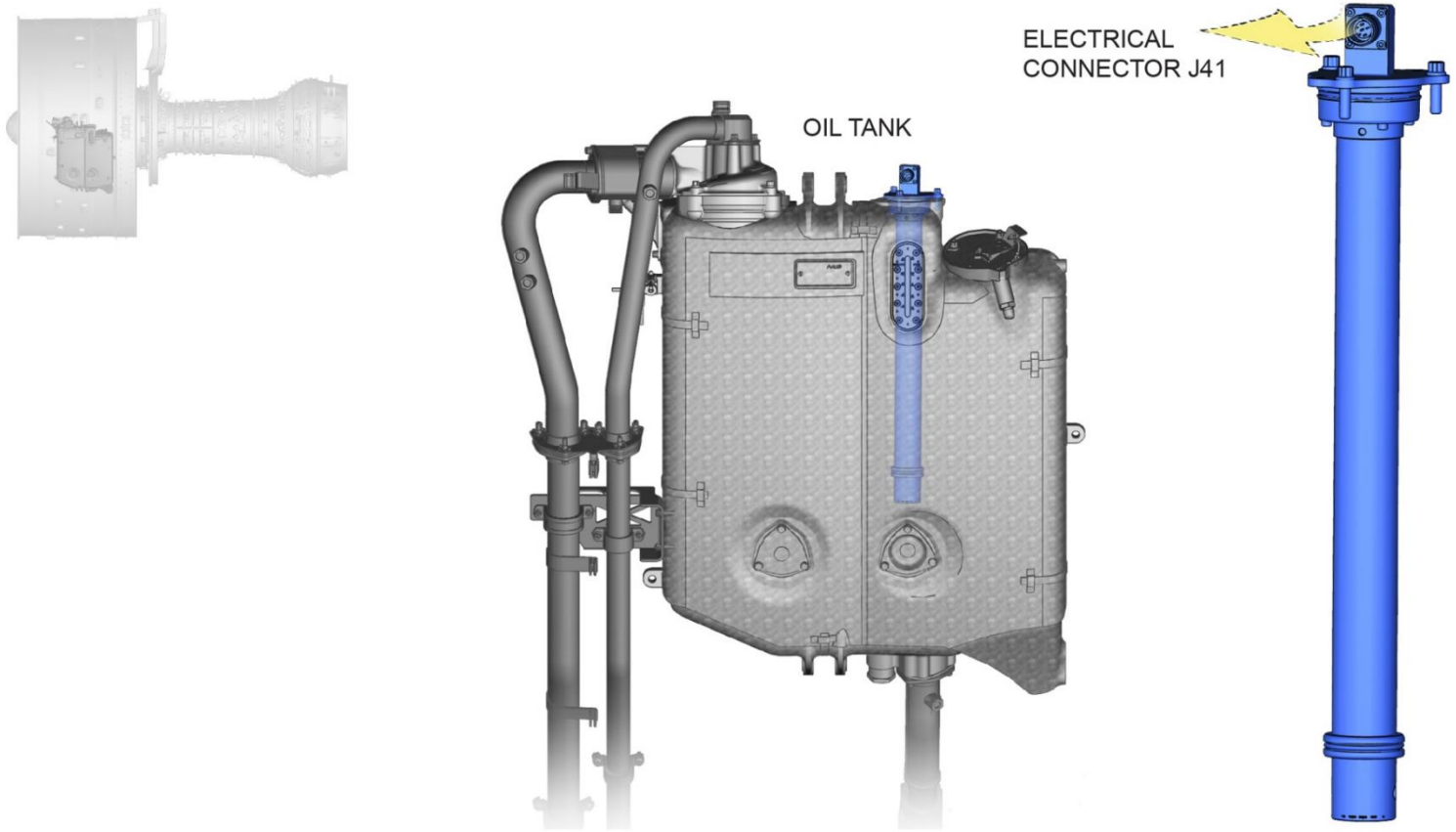
The magnetic field produced by the magnetic float closes and opens each switch as it passes them while floating on the oil surface.
The sensor then outputs a single channel signal to the EEC using a DC voltage that correlates to the oil level in the tank.

Safety Conditions

WARNING

DO NOT OPEN THE OIL TANK CAP UNTIL 5 MINUTES MINIMUM AFTER ENGINE SHUTDOWN.

THIS WILL LET THE PRESSURE BLEED OFF. IF YOU DO NOT OBEY THIS WARNING, HOT OIL CAN BURN YOUR EYES AND SKIN.


ELECTRICAL
CONNECTOR J41
OIL TANK

Oil Filter Differential Pressure Sensor (OFDPS)

Purpose:

The Oil Filter Differential Pressure Sensor measures the difference in oil pressure upstream and downstream of the oil filter.

Location:

The OFDPS is secured to the Lubrication and Scavenge Oil Pump.

Description:

Two bolts secure the OFDPS to the LSOP. Two O-rings are installed beneath the mounting flange to prevent oil leakage.

The O-rings must be replaced If the OFDPS is removed on-wing or during a shop visit.

The dual-channel sensor consists of an electrical connector and two independent, electrically isolated sensing elements contained within a sealed stainless steel body that protects the sensing elements from damage.

Each sensing element consists of a diaphragm with strain gages bonded to the surface and is connected to the electrical connector.

Operation:

When pressure is applied, the strain gages change resistance, altering the output voltage.

This output voltage for each sensing element correlates directly to oil differential pressure and is sent to the Electronic Engine Control (EEC).

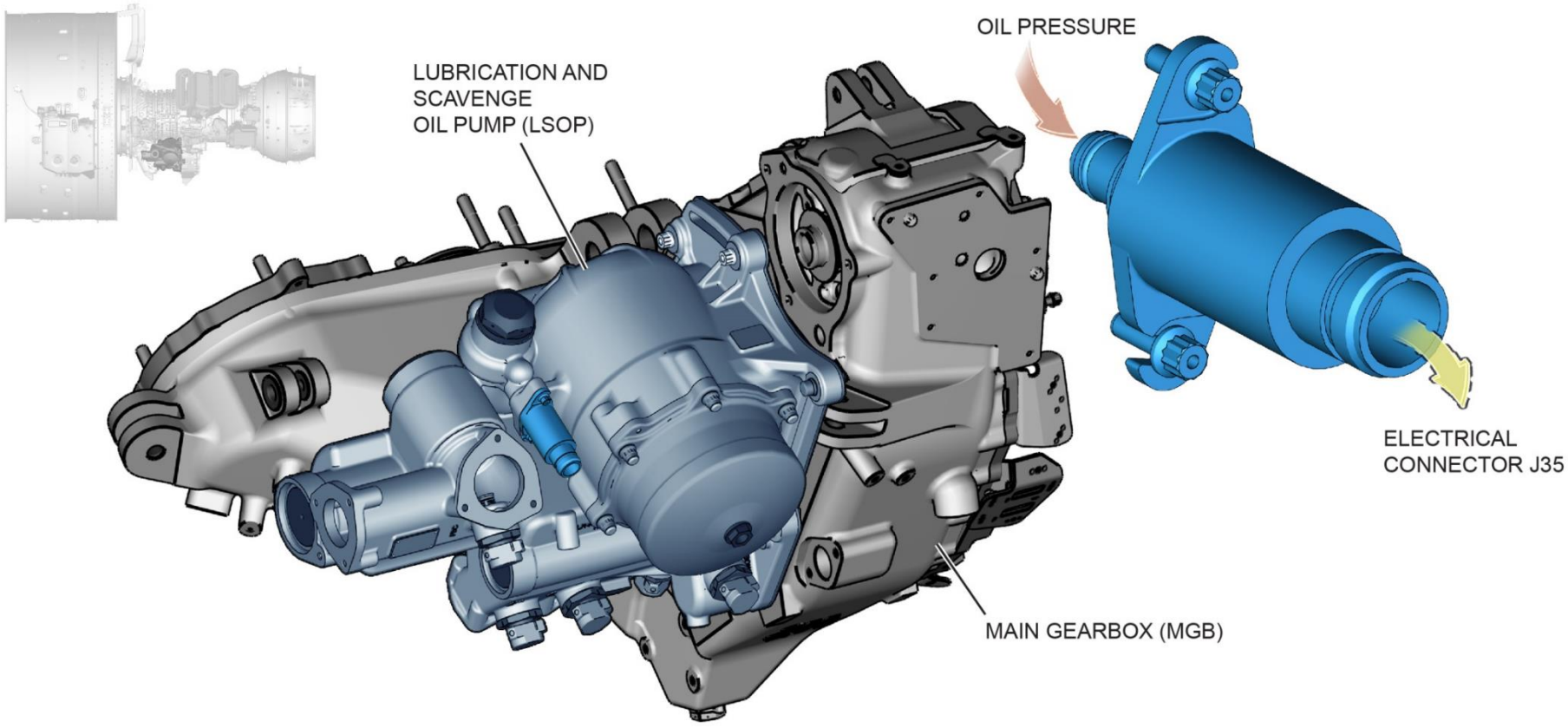
The EEC uses this signal to set a maintenance message or an “oil filter clogged” message, depending on the differential pressure value.

Safety Conditions

CAUTION

WHEN YOU LOOSEN OR TIGHTEN THE CONNECTOR THERE IS LIMITED CLEARANCE BETWEEN PARTS.

IF YOU DO NOT OBEY THIS CAUTION, DAMAGE TO THE ENGINE CAN OCCUR.


OIL PRESSURE
LUBRICATION AND
SCAVENGE
OIL PUMP (LSOP)
ELECTRICAL
CONNECTOR J35
MAIN GEARBOX (MGB)

Oil Debris Monitor (ODM)

Purpose:
The Oil Debris Monitor (ODM) detects and measures metallic debris in the Lubrication System.

Location:

The ODM is installed between the main oil scavenge line and the deaerator in the oil tank assembly.

Description:

The ODM is a single-channel, in-line sensor that is non-repairable.

It consists of a sensing element, a stainless-steel body that shields the sensing element from damage, a mounting flange, and an electrical connector. O-rings prevent oil from entering the unit.

The ODM is secured by three bolts which also secure the oil scavenge line to the deaerator.

An O-ring provides oil sealing at the deaerator interface and a face seal provides oil sealing at the oil scavenge line interface.

Both the O-ring and face seal must be replaced if the ODM is removed on-wing or during a shop visit.

Operation:

The ODM creates an electromagnetic field through which scavenge oil flows. When metallic particles are present in the scavenge oil, the sensing element produces a characteristic signal.

The amplitude of the signal is proportional to the particle size.

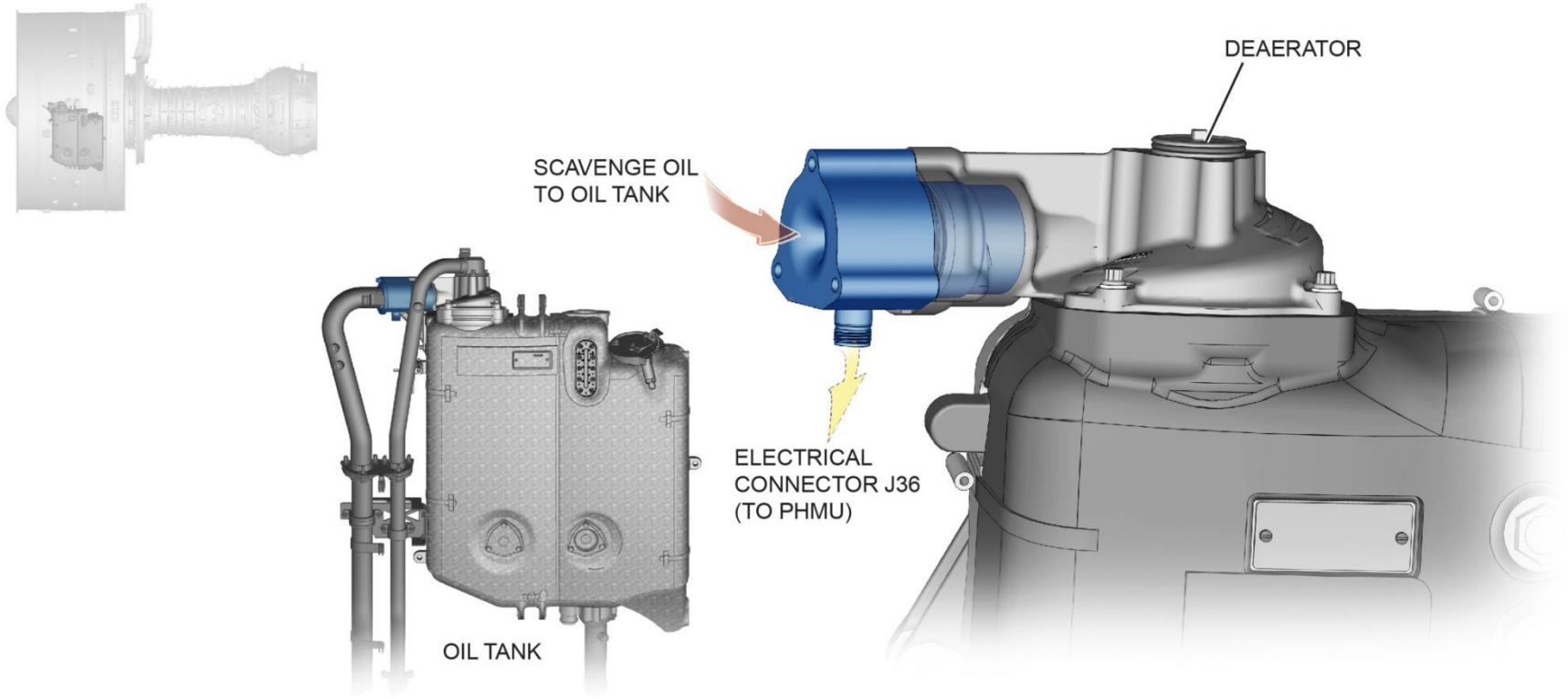
Its phase allows the signal processing electronics of the Prognostics Health and Management Unit (PHMU) to differentiate between a ferrous and non-ferrous particle.

Ferrous material passing through the electromagnetic field strengthens the field, and non-ferrous material passing through weakens the field.

This effect creates two unique signatures used by the PHMU to differentiate the types of particles.

The PHMU processes the signal from the ODM and issues a chip generation rate (the number of chips counted in each period).

The chip generation rate signal is then sent to the EEC, where the rate is compared to predetermined values and the appropriate maintenance message or cockpit signal is sent to the EIU.


DEAERATOR
SCAVENGE OIL
TO OIL TANK
ELECTRICAL
CONNECTOR J36
(TO PHMU)
OIL TANK

Main Oil Temperature (MOT) Sensor

Purpose:

The Main Oil Temperature (MOT) Sensor measures the temperature of the oil.

Location:

The sensor is installed on the OCM.

Description:

The dual-channel sensor consists of two independent, electrically isolated sensing elements; a stainless-steel body with mounting flange and a protective tube that shields the sensing elements from damage; and one electrical connector.

Components are assembled as a hermitically sealed unit that is non-repairable.

Oil temperature is measured by two independent Resistance Temperature Detector (RTD) sensing elements.

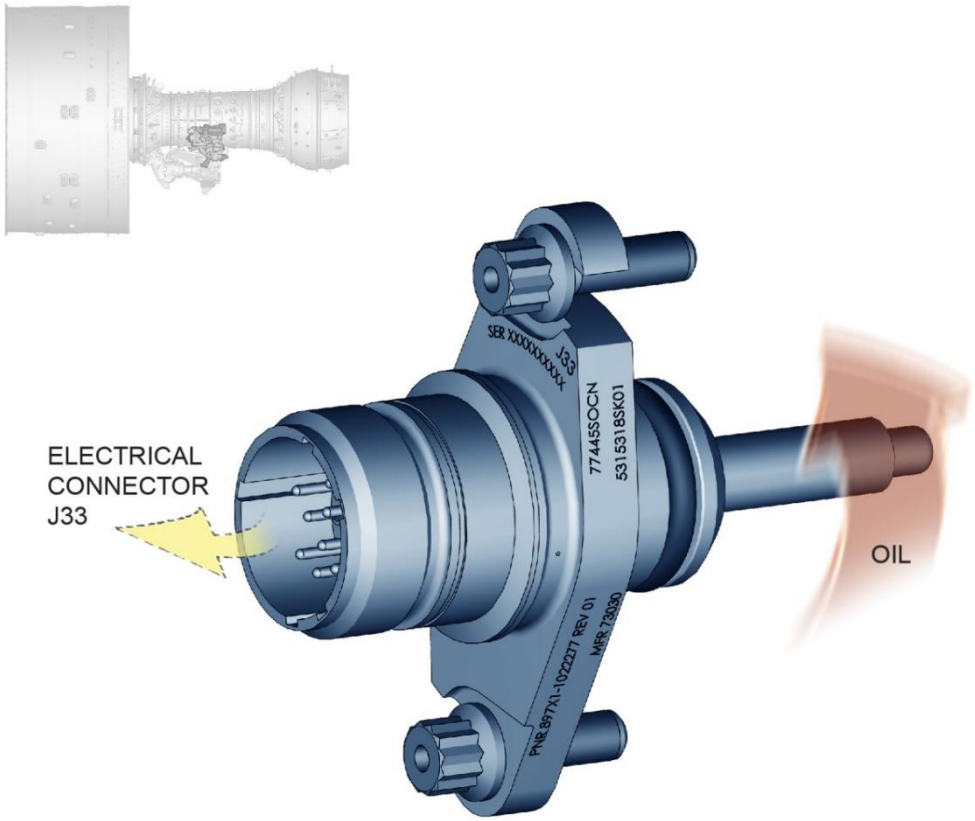
The MOT sensor is secured to the OCM with two bolts. An O-ring is installed beneath the mounting flange to prevent oil leakage.

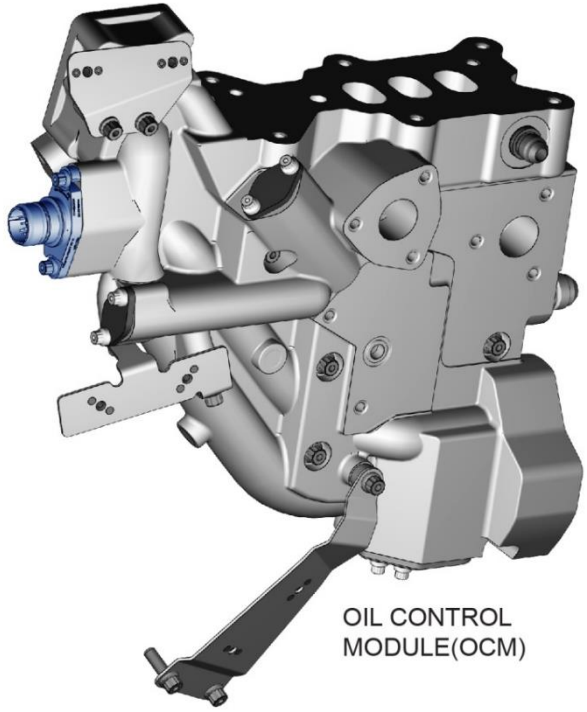
The O-ring must be replaced if the MOT sensor is removed on-wing or during a shop visit.

Operation:

As the temperature of the sensing element changes, the electrical resistance alters, causing the voltage across the element to change proportionally.

Each sensing element is connected to a single electrical connector and sends the oil temperature signal (voltage) to the EEC over separate channels A and B. Both channels share the same electrical connector.


ELECTRICAL
CONNECTOR
J33
OIL


OIL CONTROL
MODULE(OCM)

Main Oil Pressure (MOP) Sensor

Purpose:

The Main Oil Pressure sensor measures oil pressure on the supply side of the Lubrication System.

Location:

The sensor is installed on the Oil Control Module.

Description:

The dual-channel sensor consists of two independent, electrically isolated sensing elements; a stainless-steel body with a mounting flange, and which shields the sensing elements from damage; and one electrical connector.

Each sensing element consists of a diaphragm with strain gages bonded to the surface.

The MOP sensor is secured to the Oil Control Module (OCM) with two bolts.

An O-ring is installed beneath the mounting flange to prevent oil leakage.

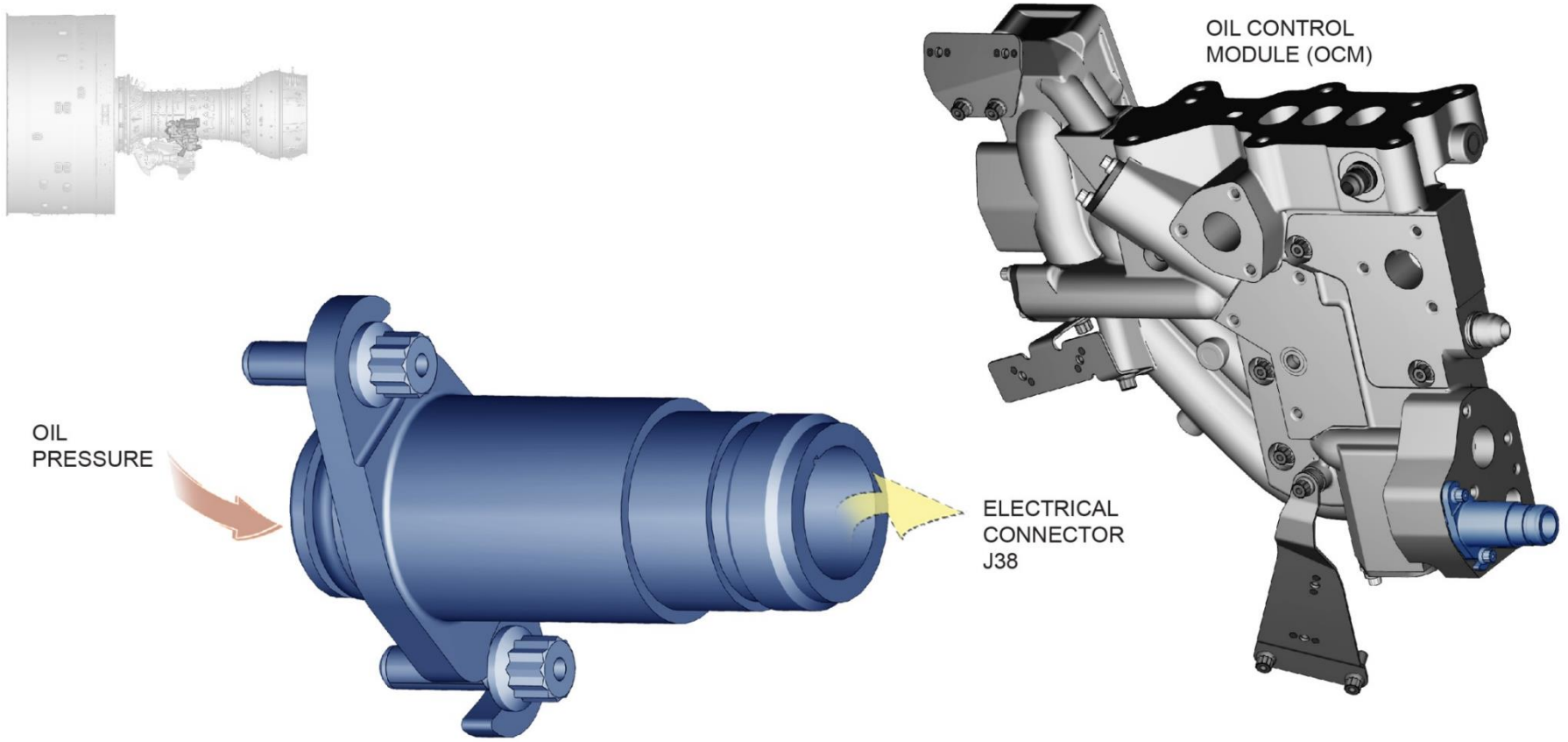
The O-ring must be replaced if the MOP sensor is removed on-wing or during a shop visit.

Operation:

When pressure is applied, the strain gages change resistance, altering the output voltage.

This output voltage correlates directly to oil pressure. Each sensing element is connected to a single electrical connector and sends the oil pressure signal to the Electronic Engine Control (EEC) over separate channels A and B.

Both channels share the same electrical connector.


OIL CONTROL
MODULE (OCM)
OIL
PRESSURE
ELECTRICAL
CONNECTOR
J38

Low Oil Pressure Sensor (LOPS)

Purpose:

The Low Oil Pressure Sensor sends a low oil pressure signal directly to the Engine Interface Unit (EIU) when oil pressure has been reduced to a level below which engine operation is not recommended.

Location:

The LOPS is mounted to the bottom of the OCM on the supply side of the Lubrication System downstream of the MOP sensor.

Description:

The LOPS consists of a diaphragm sensing element, a spring, a mechanical switch, a stainless-steel body, and one electrical connector.

The stainless-steel body, chosen for its strength and resistance to corrosion, has a mounting flange and shields the internal components from damage.

An O-ring is installed beneath the mounting flange to prevent oil leakage.

The O-ring must be replaced if the LOPS is removed on-wing or during a shop visit.

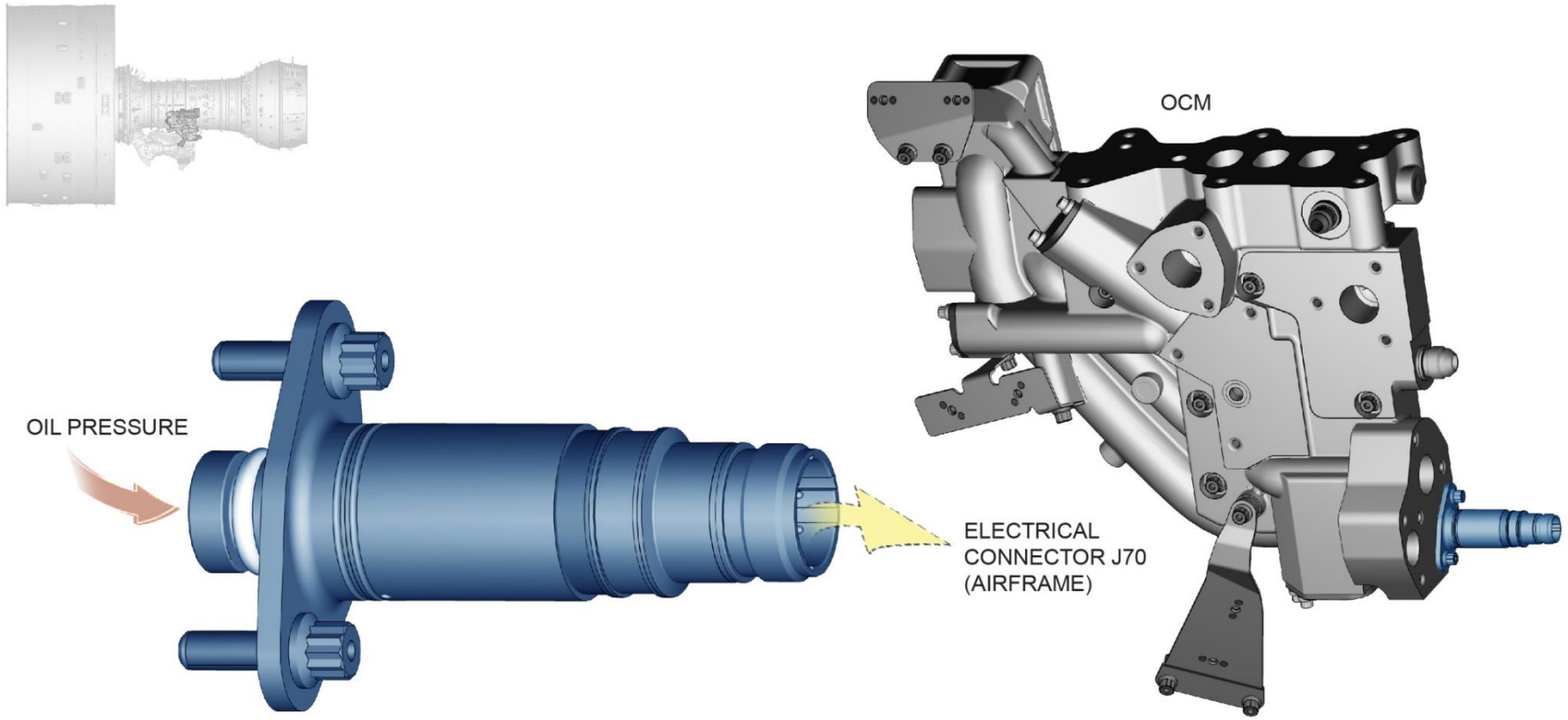
Operation:

The mechanical switch is always in the closed (actuated) position during engine operation and when oil pressure is applied to the diaphragm sensing element.

However, when the engine is operating and the applied oil pressure decreases below a predetermined design value, the spring force on the diaphragm is greater than the applied oil pressure on the diaphragm-sensing element.

This allows the spring to displace the diaphragm and open the mechanical switch to the de-actuated position.

The low oil pressure electrical signal is then sent to the EIU, bypassing the EEC.


OCM
OIL PRESSURE
ELECTRICAL
CONNECTOR J70
(AIRFRAME)

Auxiliary Oil Pressure Sensor (AOPS)

Purpose:

The Auxiliary Oil Pressure Sensor detects latent failures in the Journal Oil Shuttle Valve or the windmill/auxiliary pump.

Location:

The AOP Sensor is secured to the manifold for the Variable Oil Reduction Valve and the Journal Oil Shuttle Valve.

Description:

The dual-channel sensor measures the pressure of the oil being delivered to the journal bearings in the fan drive gearbox under normal, windmill, and negative-G conditions.

The measurement detects latent failures in the JOSV or the windmill/auxiliary pump.

The sensor consists of two independent, electrically isolated sensing elements, one electrical connector, and a stainless-steel body with a mounting flange, which shields the sensing elements from damage.

The sensor is secured with two bolts to the VORV/JOSV manifold.

The O-ring must be replaced if the sensor is removed on-wing or during a shop visit.

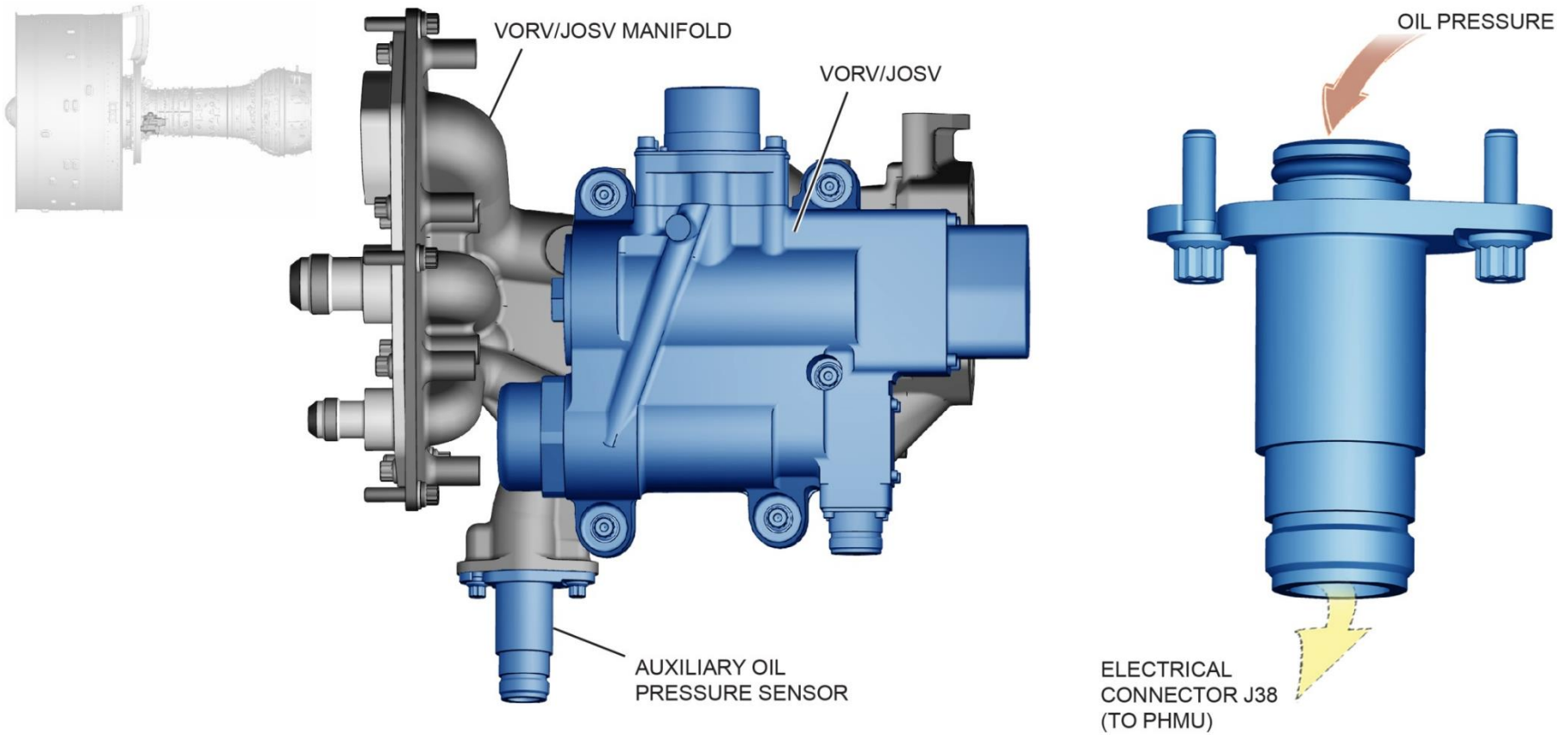
Operation:

Each sensing element consists of a diaphragm with strain gages bonded to the surface.

When pressure is applied, the strain gages change resistance, altering the output voltage.

This output voltage correlates directly to oil pressure.

Each sensing element is connected to a single electrical connector and sends the oil pressure signal to the EEC over separate channels A and B. Both channels share the same electrical connector.


VORV/JOSV MANIFOLD
VORV/JOSV
AUXILIARY OIL
PRESSURE SENSOR
OIL PRESSURE
ELECTRICAL
CONNECTOR J38
(TO PHMU)

Flight Deck Display

The flight deck ECAM Secondary Engine Parameters page displays Lubrication System conditions for both engines, using three separate display pages depending on the type of information:

Engine Indicating, Engine Status and Maintenance Mode (Interactive Mode).

The table gives details about the display for each page.

Page	Display Type	Display Condition
Secondary Engine Page	• Oil pressure, temperature and quantity	Engine is in operation
Status Page	• Details about the cause of the ECAM message	Must be selected by the crew in order to be viewed
MCDU	• Faults for oil pressure, temperature and quantity	Can only be displayed in “interactive” mode

Oil pressure displayed on the Secondary Engine page is measured in pounds per square inch (PSI) and temperature in degrees Centigrade (°C).

These parameters will change colour on the display if they start to go outside of the normal range.

Green: Normal range

Green pulsing: If pressure exceeds OIL HIGH PRESSURE ADVISORY

Amber: Approaching red line limit that signals low oil temperature

Red: Red line limit

Oil quantity displayed on the Secondary Engine page is measured in quarts (QTS).

The display changes colour depending on condition.

Green: Normal range

Green pulsing If quantity drops below advisory level

Amber: Quantity below limit

Red: Red line limit


ENGINES
F.USED
80
KG
80
OIL
14.0
QT
14.0
90
PSI
90
145
°C
145
0.8
VIB N1
0.8
1.2
N2
1.2
NAC
°C
0
400
TAT +25 °C
SAT +25 °C
13 H 28
GW 50000 KG

LUBRICATION SYSTEM SERVICING

Oil Tank Procedure

To check and refill the engine oil to the correct level, open the oil tank access door on the left fan cowl door at approximately 9:00.

If the oil level in the sight glass is below the FULL mark, replenish the oil as follows.

1. Lift up the T-handle on the oil tank cap and open the cap.

2. Put a fluid drain collector/container (approximately 5 gal/(20 L) under the end of the scupper drain line under the engine.

3. If necessary, insert a small screw driver through one of the 0.25 inch (6.35 mm) holes in the oil tank inlet screens and open the oil tank flapper valve.

4. Continue to hold the flapper valve open and add the correct engine oil into the filler neck until no more oil can be added without overflow into the scupper drain.

5. The stable oil level in the sight glass will now be in the full mark range.

Note: if the aircraft is not parked on a level, the oil level indication in the sight glass is affected and may be above the full mark.

This is acceptable.

The oil system is serviced correctly if no more oil can be added without overflow into the scupper drain.

Safety Conditions

WARNING

BE CAREFUL WHEN YOU OPEN THE FLAPPER VALVE. OIL CAN SPRAY OUT WHEN THE VALVE IS FIRST OPENED.

IF YOU DO NOT OBEY THIS WARNING, HOT OIL CAN BURN YOUR EYES AND SKIN.

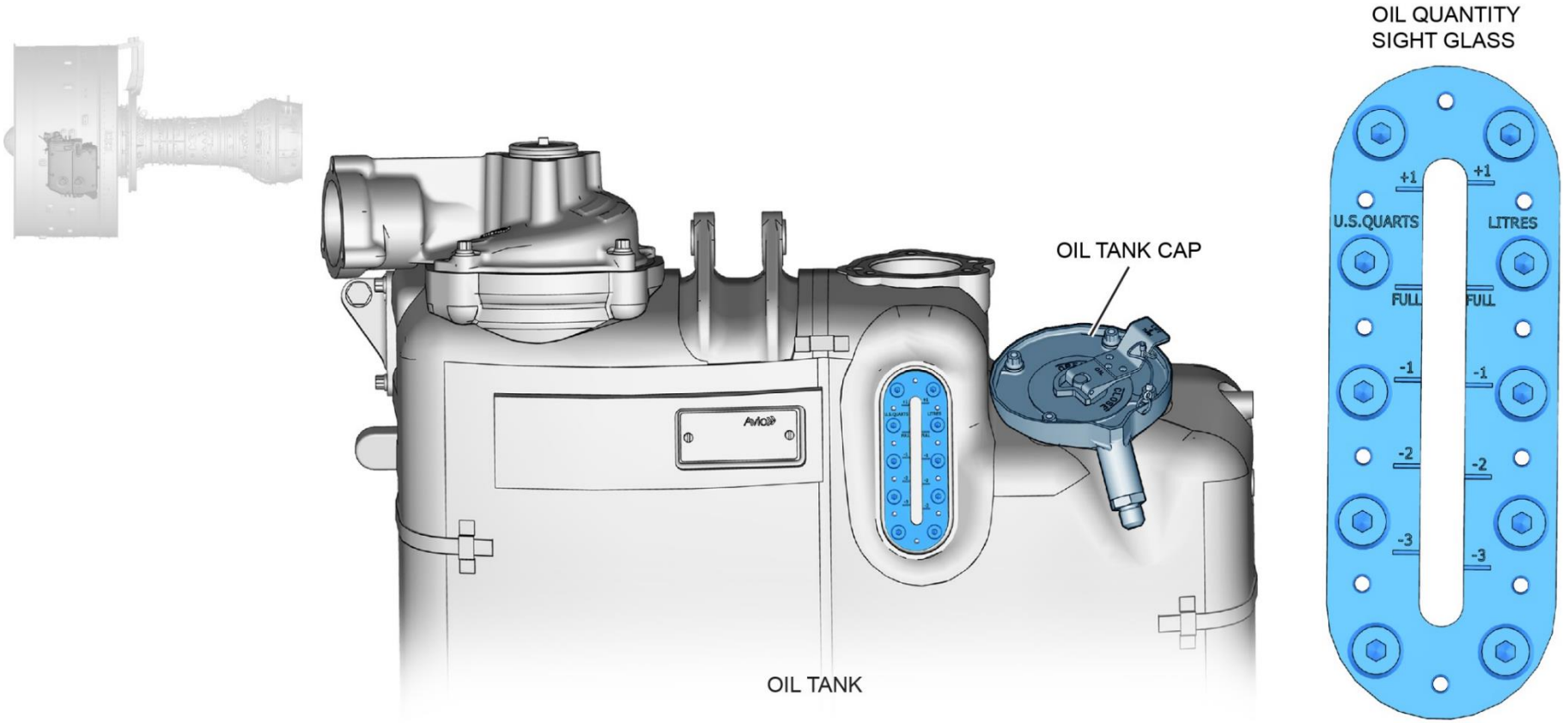
CAUTION

BE CAREFUL THAT YOU DO NOT DAMAGE THE FLAPPER VALVE IF YOU USE A SCREWDRIVER TO OPEN IT.

MAKE SURE THAT YOU CLOSE THE OIL TANK CAP COMPLETELY. MAKE SURE

THAT THE OIL TANK CAP LEVER IS DOWN AND LOCKED.

IF YOU DO NOT, OIL CAN COME OUT OF THE TANK AND AN IN-FLIGHT SHUTDOWN CAN OCCUR.


OIL QUANTITY
SIGHT GLASS
OIL TANK CAP
OIL TANK
+1
+1
U.S.QUARTS
LITRES
FULL
FULL
-1
-1
-2
-2
-3
-3

Oil Tank Procedure (Cont.)

6. Close the cap to seat and push down on the T-handle until the locking pin fully engages the lock pin hole.

7. Close the cap to seat and push down on the T-handle until the locking pin fully engages the lock pin hole.

Note: The handle will be parallel to the cap when the pin is completely engaged.

8. Record the amount of oil you added.

9. Wipe clean the area with a lint−free cotton cloth.

10. Close the oil tank access door on the left.

Safety Conditions

WARNING

WAIT 5 MINUTES MINIMUM TO MAKE SURE THAT THE OIL SYSTEM IS NOT PRESSURIZED BEFORE DOING THIS PROCEDURE. IF YOU DO NOT OBEY THIS WARNING, INJURY CAN OCCUR.

IF POSSIBLE, KEEP FUEL AND OIL AWAY FROM YOUR SKIN. USE PROTECTIVE CLOTHES. FUEL AND OIL CAN DRY YOUR SKIN AND CAUSE SKIN IRRITATION.

CAUTION

YOU MUST EXAMINE THE OIL LEVEL BETWEEN 15 MINUTES AND TWO HOURS AFTER ENGINE SHUTDOWN.

IF YOU DO NOT, THE OIL LEVEL SIGHT GLASS INDICATION WILL NOT BE ACCURATE.

YOU MUST ONLY USE ENGINE OIL SPECIFIED IN THE SERVICE BULLETIN

THE MIXING OF DIFFERENT BRANDS OF APPROVED OILS IS NOT RECOMMENDED BUT IS PERMITTED WITHIN THE LIMITS SPECIFIED IN THE SERVICE BULLETIN.

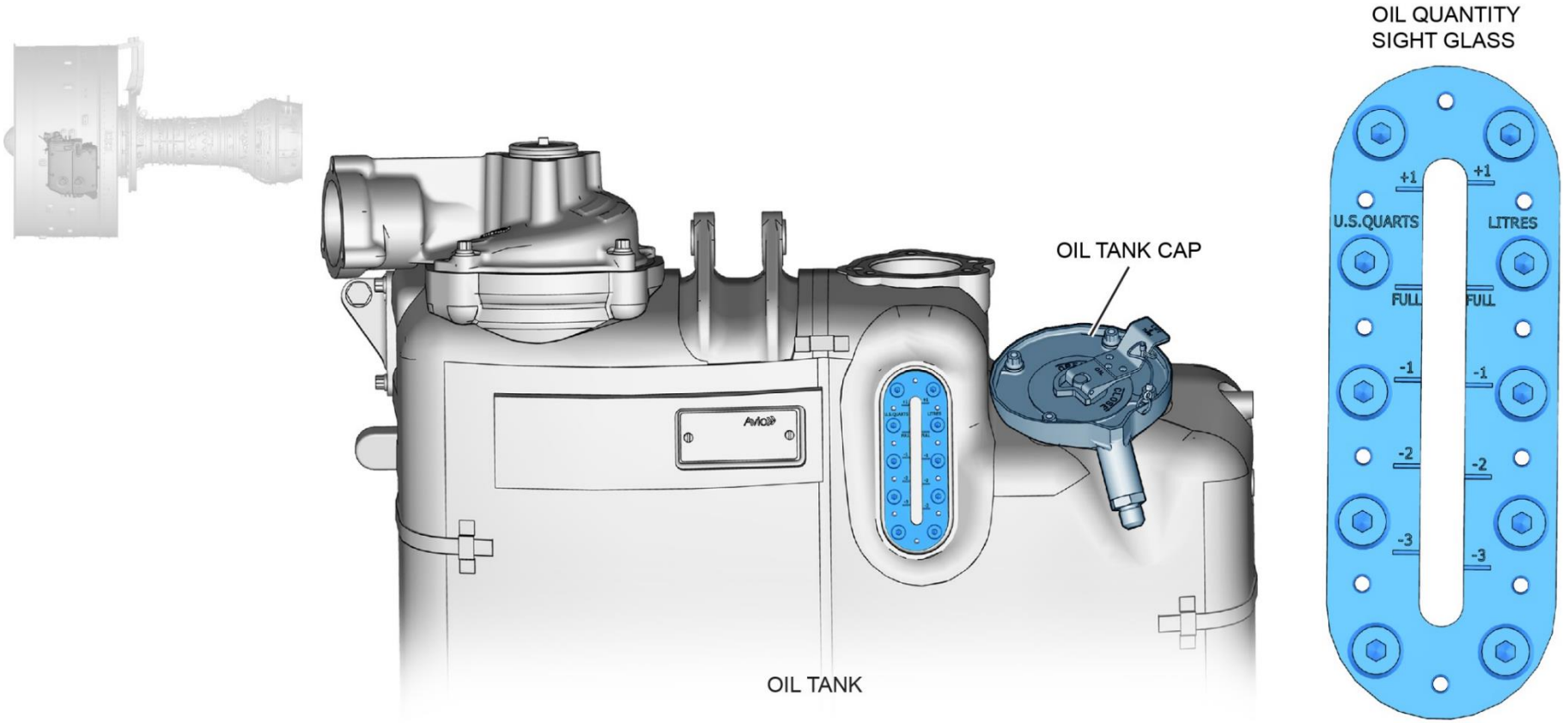
THE USE OF UNAPPROVED TYPES OR BRANDS OF OILS IS NOT PERMITTED AND CAN CAUSE DAMAGE TO THE ENGINE.

DO NOT DRY MOTOR OR OPERATE THE ENGINE WITHOUT SUFFICIENT OIL. THIS CAN CAUSE DAMAGE TO THE ENGINE.

DO NOT ADD OIL AFTER MOTORING OR AFTER LOW POWER OPERATION IN EXTREMELY COLD ENVIRONMENTS (-34° F) (-37 ° C) OR BELOW.

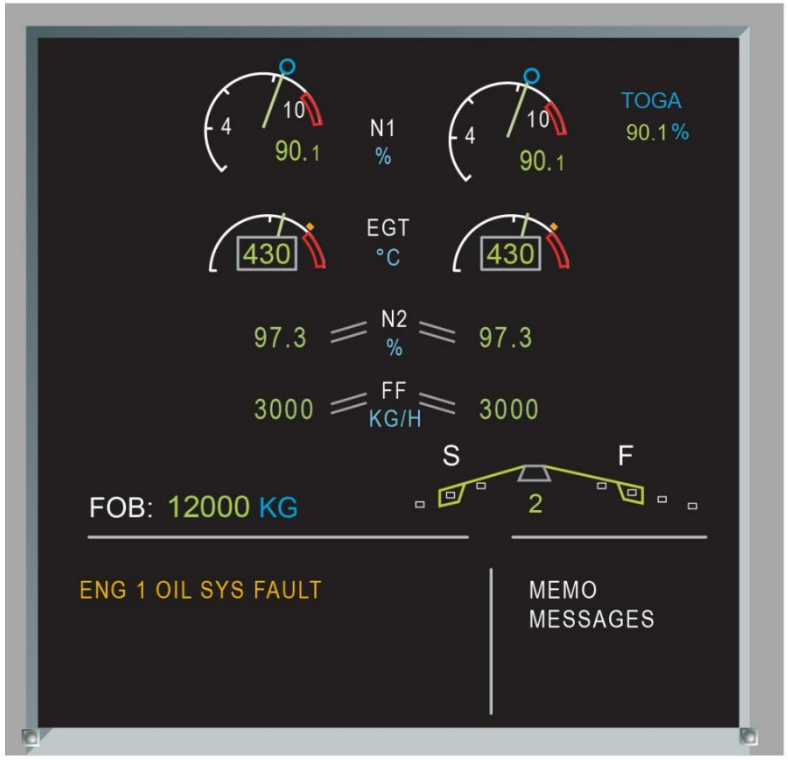
THERE CAN BE UP TO A 3.5 QUART (3.3 LITER) REDUCTION (GULP) IN THE STATIC OIL LEVEL UNDER THESE CONDITIONS. DO THE OIL LEVEL CHECK AFTER THE ENGINE IS OPERATED AT TEMPERATURE AS SPECIFIED IN THE SERVICING TASK.

IF YOU DO NOT DO THIS, YOU CAN OVER SERVICE THE ENGINE OIL SYSTEM.


OIL QUANTITY
SIGHT GLASS
OIL TANK CAP
OIL TANK
+1
+1
U.S.QUARTS
LITRES
FULL
FULL
-1
-1
-2
-2
-3
-3

INTENTIONALLY BLANK

FLIGHT CREW INITIAL WARNING



INTERACTIVE MODE FOR MAINTENANCE ACTION

SAMPLE ECAM MESSAGES FOR ATA 79

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