ENGINE AIR SYSTEM

OVERVIEW

The Air System controls engine airflow to perform five major functions:

increase engine operability and stability

pressurize and seal bearing compartments

cool engine parts

improve fuel efficiency

remove ingested debris from the airstream.

The Air System is made up of five subsystems.

Details are shown below, including air sources that are used to perform system functions.

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 ALL 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		Air Source	Function
Compressor Variable Vane Control	• LPC Variable Inlet Guide Vane Control	Primary airflow	Adjusts angle of compressor airflow to optimize performance, prevent surge, and improve starting
	• HPC Variable Vanes		
Compressor Bleed Air	• 2.5 Bleed Air System Assembly	Station 2.5 and HPC 6^{th} Stage	Vents compressor air to increase stability, eliminate foreign object damage, and improve starting
	• HPC Bleed Air		
Turbine Cooling Air		HPC 3^{rd} and 6^{th} stages	Provides continuous flow of HPC bleed air to cool HPT and LPT parts
Engine Bearing Cooling	• Buffer Cooling	HPC 3^{rd} Stage and Station 2.5	Cools, seals, and pressurizes bearing compartments
	• Bearing Ventilation		
Active Clearance Control		Fan	Uses fan bypass air to cool HPT and LPT cases, reducing blade tip clearance for improved fuel efficiency

AIR SUBSYSTEMS

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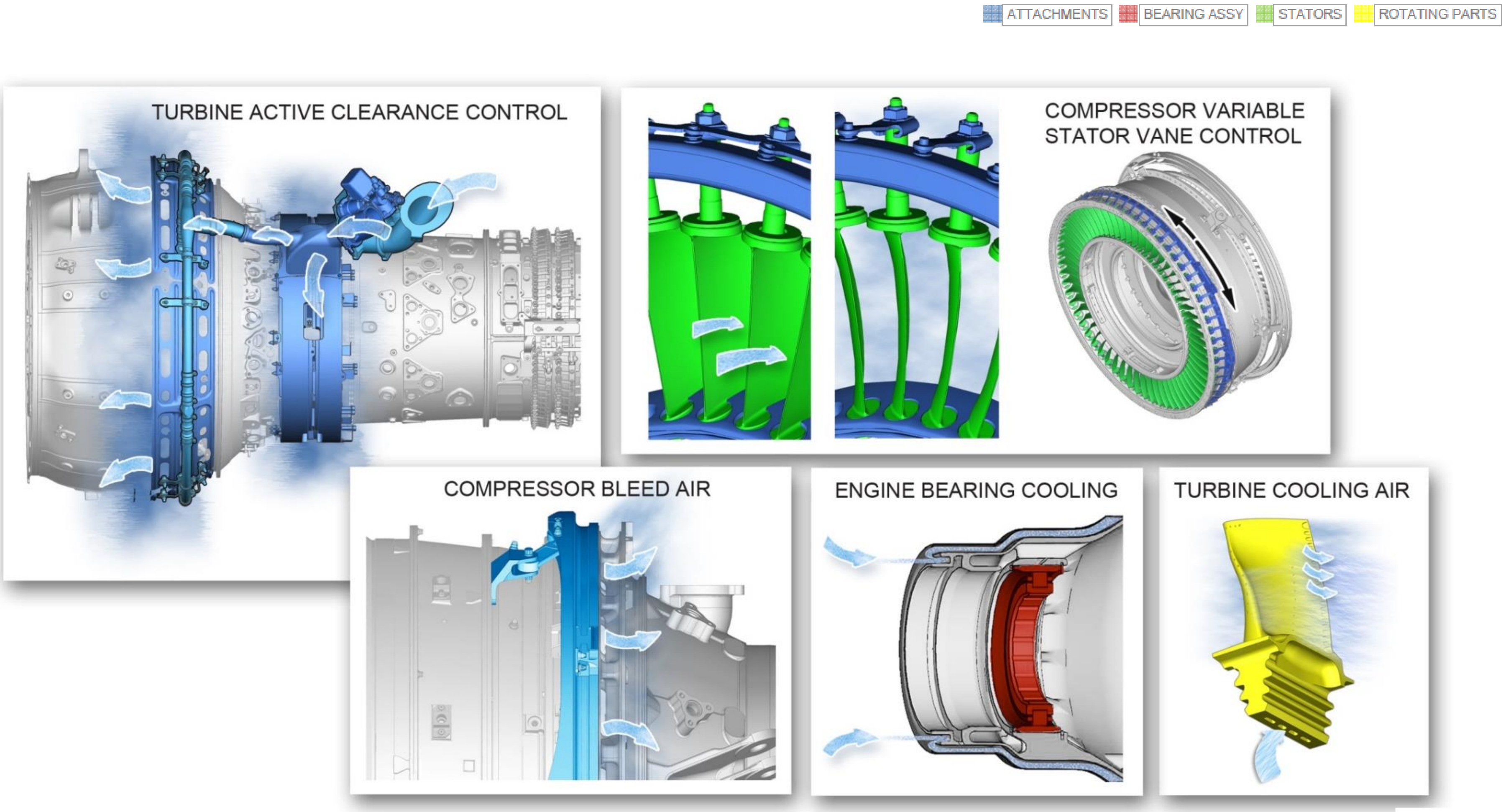


AIR SUBSYSTEMS

AIR SYSTEM DESCRIPTION/OPERATION

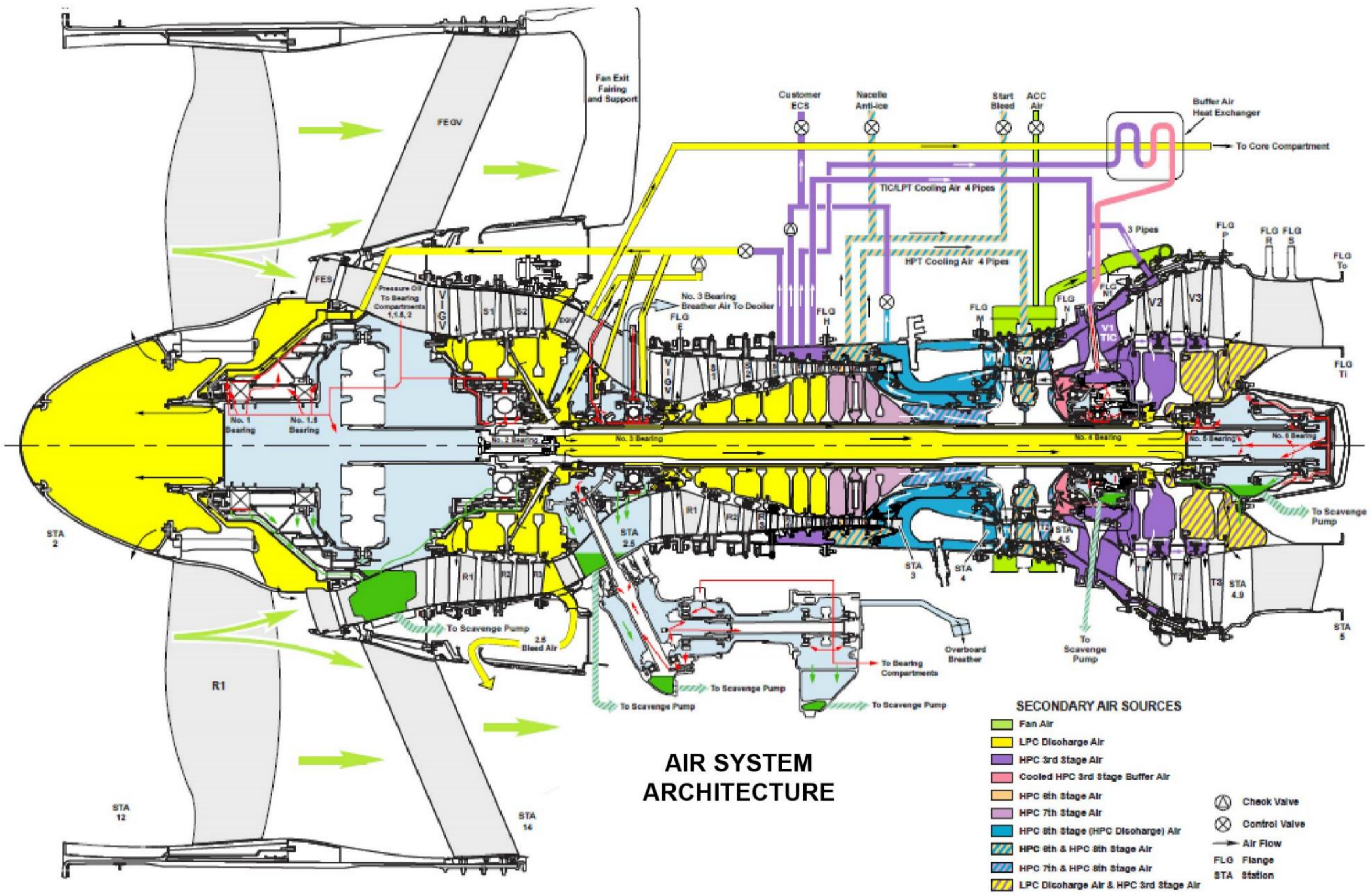
GENERAL

The engine air system makes sure that the compressor airflow and turbine clearances are controlled.

The system also deals with the cooling, pressurizing and ventilation airflows.

External and internal tubing is used to achieve the various functions.

The main air sources are the fan discharge air, Low Pressure Compressor (LPC) discharge air, High Pressure Compressor (HPC) 3rd stage air and HPC 6th stage air.


AIR SYSTEM ARCHITECTURE
Fan Exit Fairing and Support
FEGV
FES
Customer ECS
Nacelle Anti-ice
Start Bleed
ACC Air
Buffer Air Heat Exchanger
To Core Compartment
TIC/LPT Cooling Air 4 Pipes
HPT Cooling Air 4 Pipes
3 Pipes
No. 3 Bearing Breather Air To Deoiler
Pressure Oil To Bearing Compartments 1,1.5, 2
No. 1 Bearing
No. 1.5 Bearing
No. 2 Bearing
No. 3 Bearing
No. 4 Bearing
No. 5 Bearing
No. 6 Bearing
To Scavenge Pump
2.5 Bleed Air
To Bearing Compartments
Overboard Breather
SECONDARY AIR SOURCES
Fan Air
LPC Discharge Air
HPC 3rd Stage Air
Cooled HPC 3rd Stage Buffer Air
HPC 6th Stage Air
HPC 7th Stage Air
HPC 8th Stage (HPC Discharge) Air
HPC 6th & HPC 8th Stage Air
HPC 7th & HPC 8th Stage Air
LPC Discharge Air & HPC 3rd Stage Air
Check Valve
Control Valve
Air Flow
FLG Flange
STA Station

COMPRESSOR AIRFLOW CONTROL

The compressor control system optimizes the compressor performance and its stability during engine start, transient and reverse thrust operations.

The two subsystems that comprise the compressor control system are the:

Compressor Stator Vane Control System,

Compressor Bleed Control System.

STATOR VANE CONTROL SYSTEM

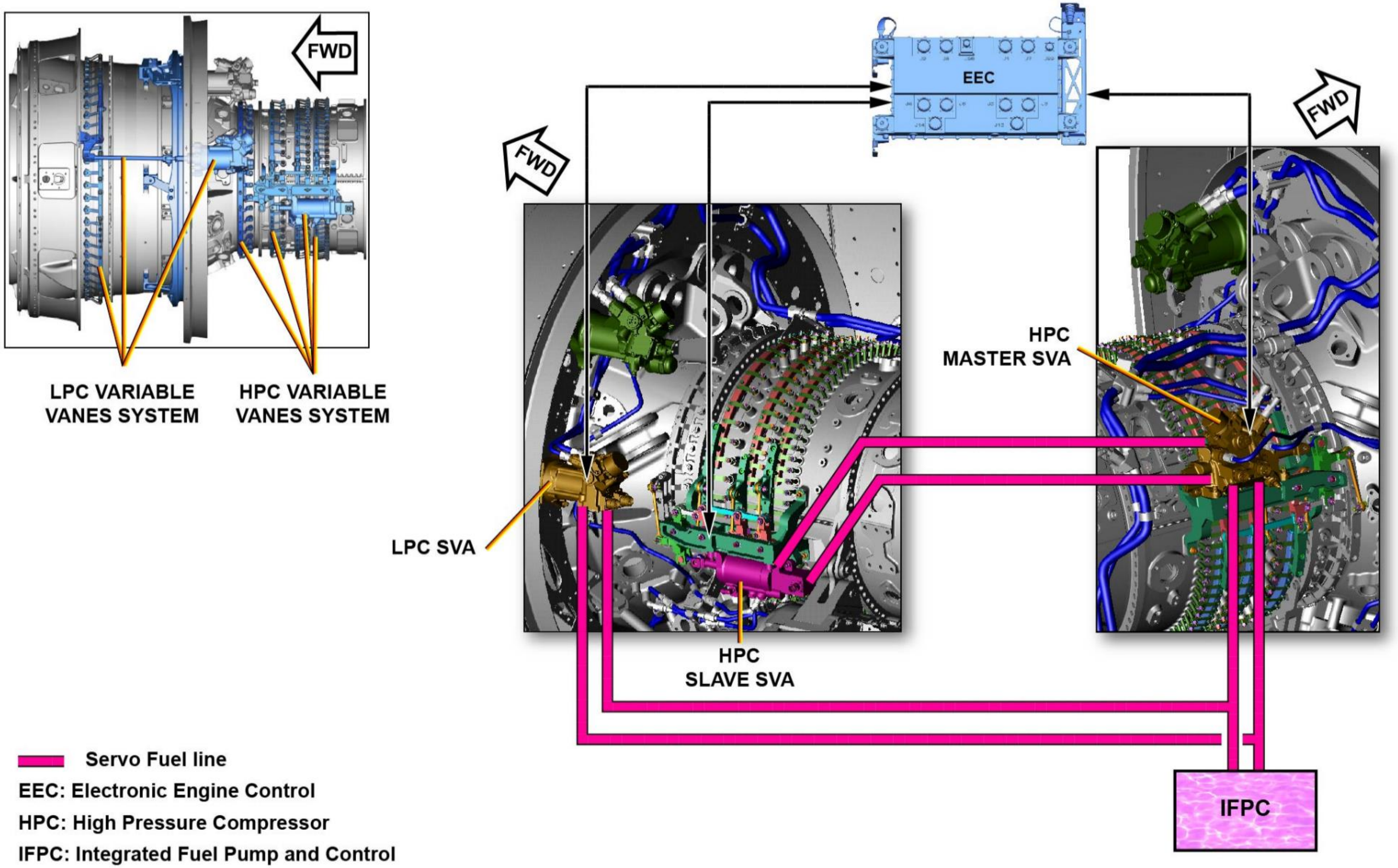
The first stage LPC stator vanes and the HPC Inlet Guide Vanes (IGV) and the 1st, 2nd and 3rd HPC stages have variable stator vanes.

The Electronic Engine Control (EEC) controls the vanes positioning to adjust the compressor airflow via three Stator Vane Actuators (SVAs) and mechanical linkages.

Each of the LPC SVA and the primary HPC SVA comprises an electrically controlled dual coil torque motor and a fuel operated Electro-Hydraulic Servo Valve (EHSV).

The secondary HPC SVA is a slave of the primary.

The three SVA Linear Variable Differential Transformers (LVDTs) transmit the piston position to each EEC channel individually.



Servo Fuel line
EEC: Electronic Engine Control
HPC: High Pressure Compressor
IFPC: Integrated Fuel Pump and Control
LPC: Low Pressure Compressor
SVA: Stator Vane Actuator

COMPRESSOR AIRFLOW CONTROL SYSTEM

COMPRESSOR VARIABLE VANE CONTROL

The Compressor Variable Vane Control System uses actuators to move the HPC and LPC Variable Inlet Guide Vanes (VIGVs), adjusting the angle of airflow required for optimal engine operation.

The actuators receive commands from the EEC and are positioned hydraulically using pressure fuel (PF) from the Integrated Fuel Pump and Control.

Sub-systems include:

- Low Pressure Compressor Variable Inlet Guide Vane Control
- High Pressure Compressor Variable Vanes System.

Both the LPC and HPC Variable Inlet Guide Vanes use actuators to change vane positioning via a bellcrank and linkages.

The vanes in the LPC and HPC are commanded by the EEC and use fuel pressure to maintain engine stability.

The EEC controls the vanes using schedules based on rotor speeds.

It also receives vane position feedback from Linear Variable Differential Transducers (LVDTs) mounted to the actuators.

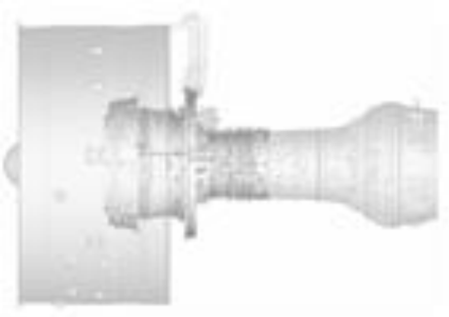
VIGVs for the LPC are positioned by a schedule based on N1 (LPC) speed. VIGVs for the HPC are positioned by a schedule based on N2 (HPC) speed.

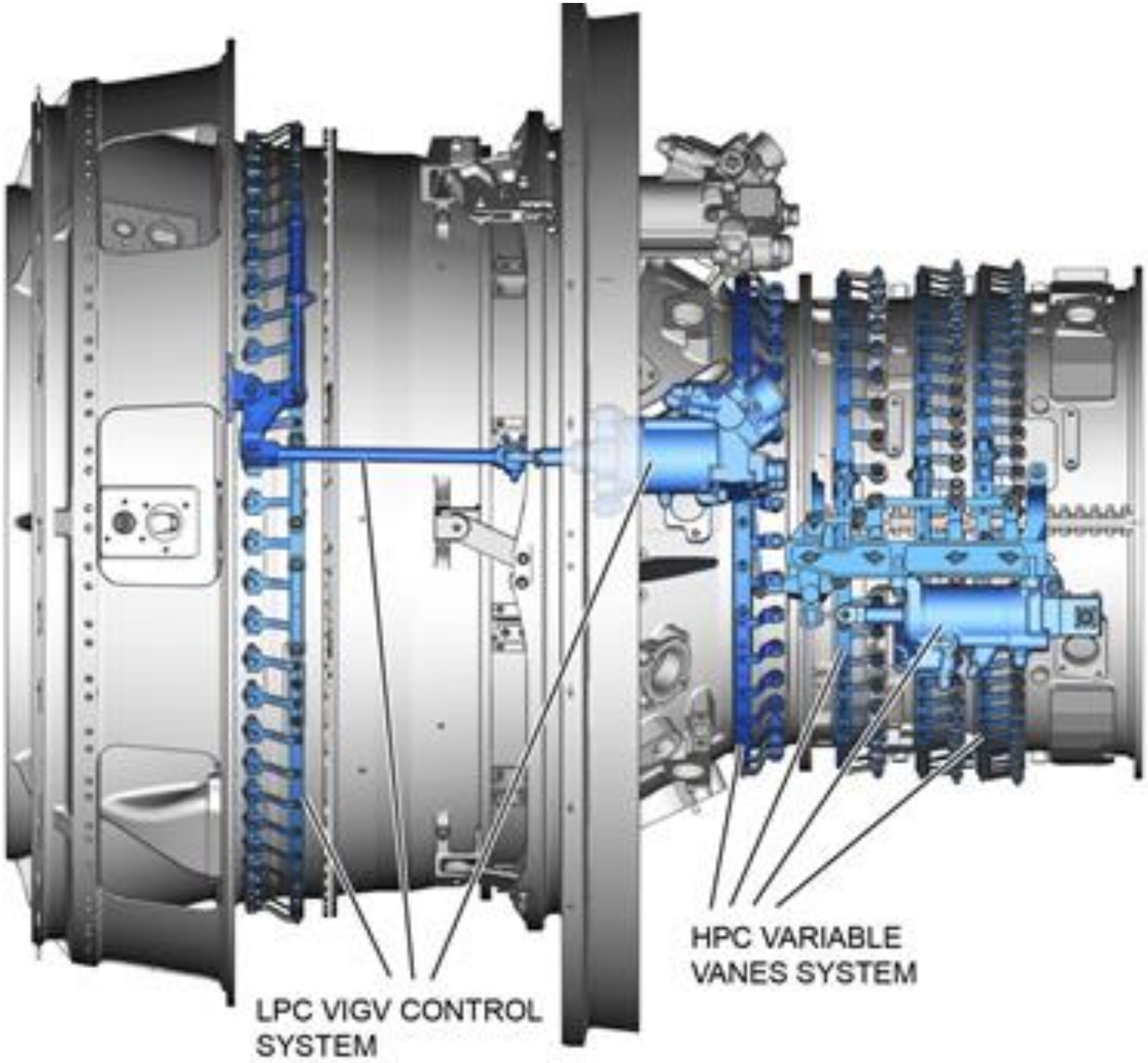
Components for the LPC Variable Inlet Guide Vane Control system include:

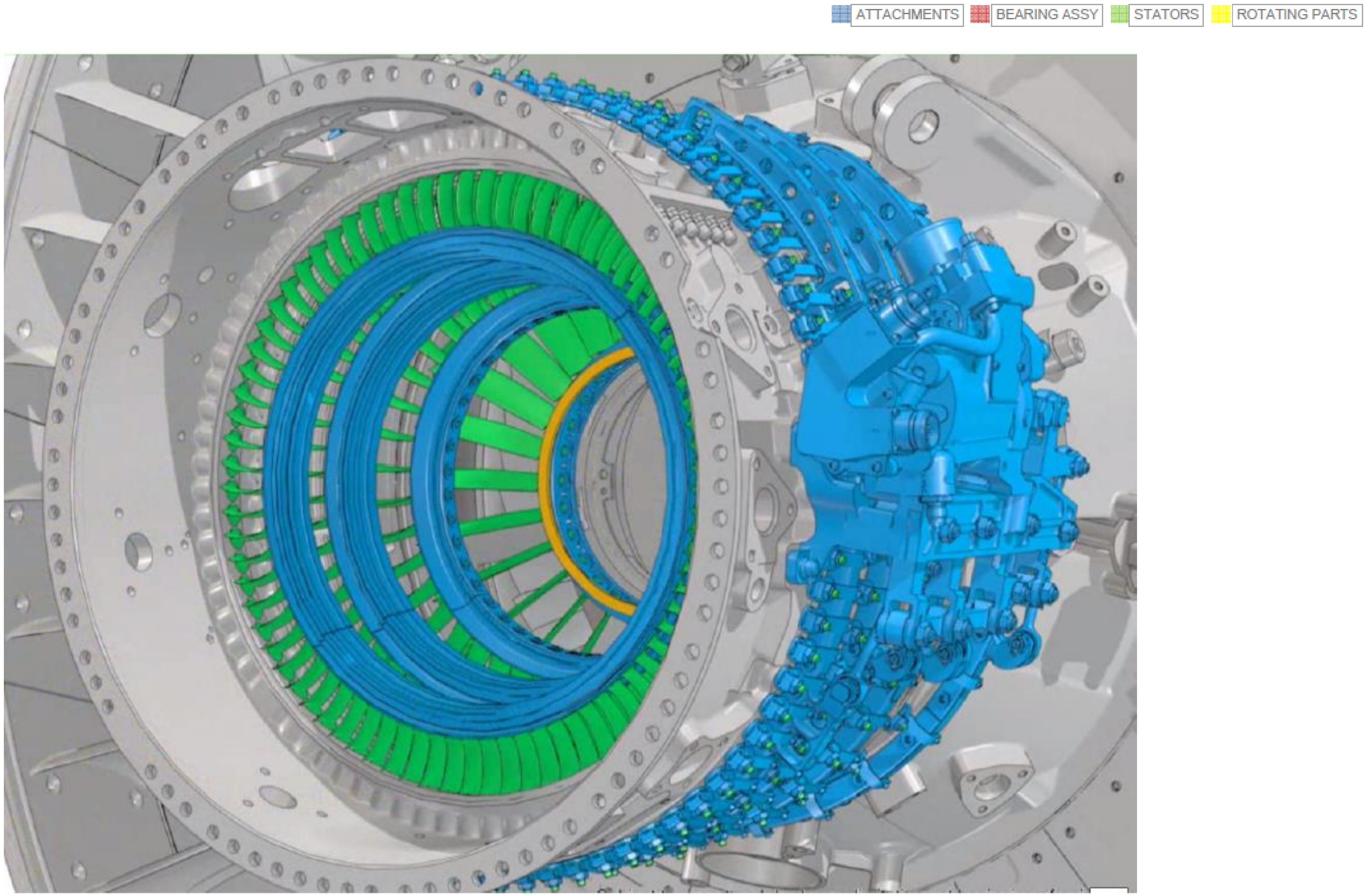
- stator vane actuator
- bellcrank
- linkage
- connecting rod.

Components for the HPC Variable Vanes System include:

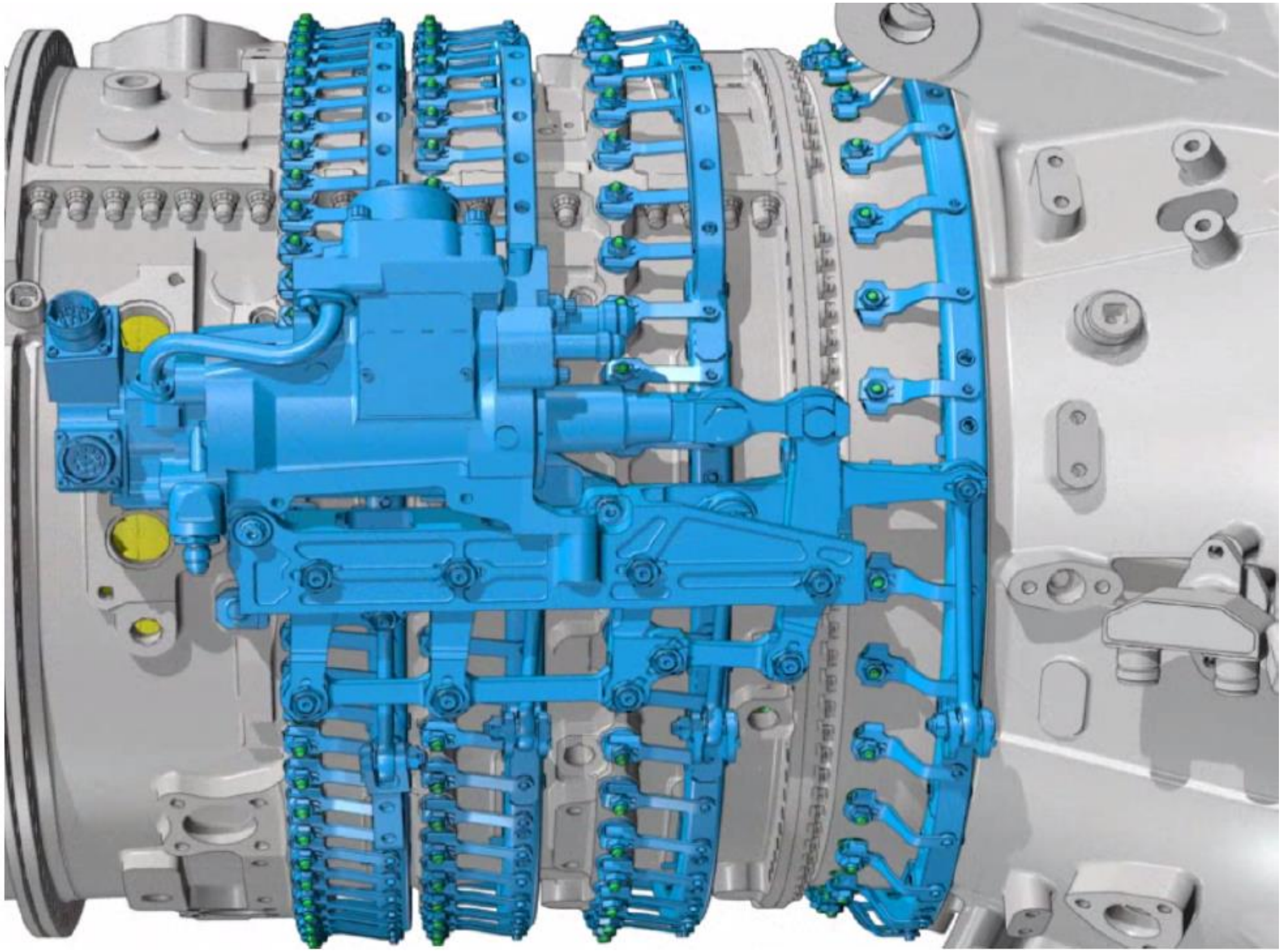
- stator vane actuators (2)
  - primary
  - secondary
- bellcrank linkages (4).




LPC VIGV CONTROL
SYSTEM
HPC VARIABLE
VANES SYSTEM



COMPRESSOR VARIABLE VANE CONTROL



COMPRESSOR VARIABLE VANE CONTROL

LPC Stator Vane Actuator (LPC SVA)

Purpose:

The LPC SVA positions LPC variable inlet guide vanes through the LPC SVA linkage when commanded by the EEC.

Location:

The LPC SVA is mounted in the Compressor Intermediate Case fire containment ring on the left side of the engine at approximately 9:30.

Description:

A dual-channel Linear Variable Differential Transducer (LVDT) is mechanically coupled to the actuator piston to provide electrically isolated position feedback signals to each channel of the EEC.

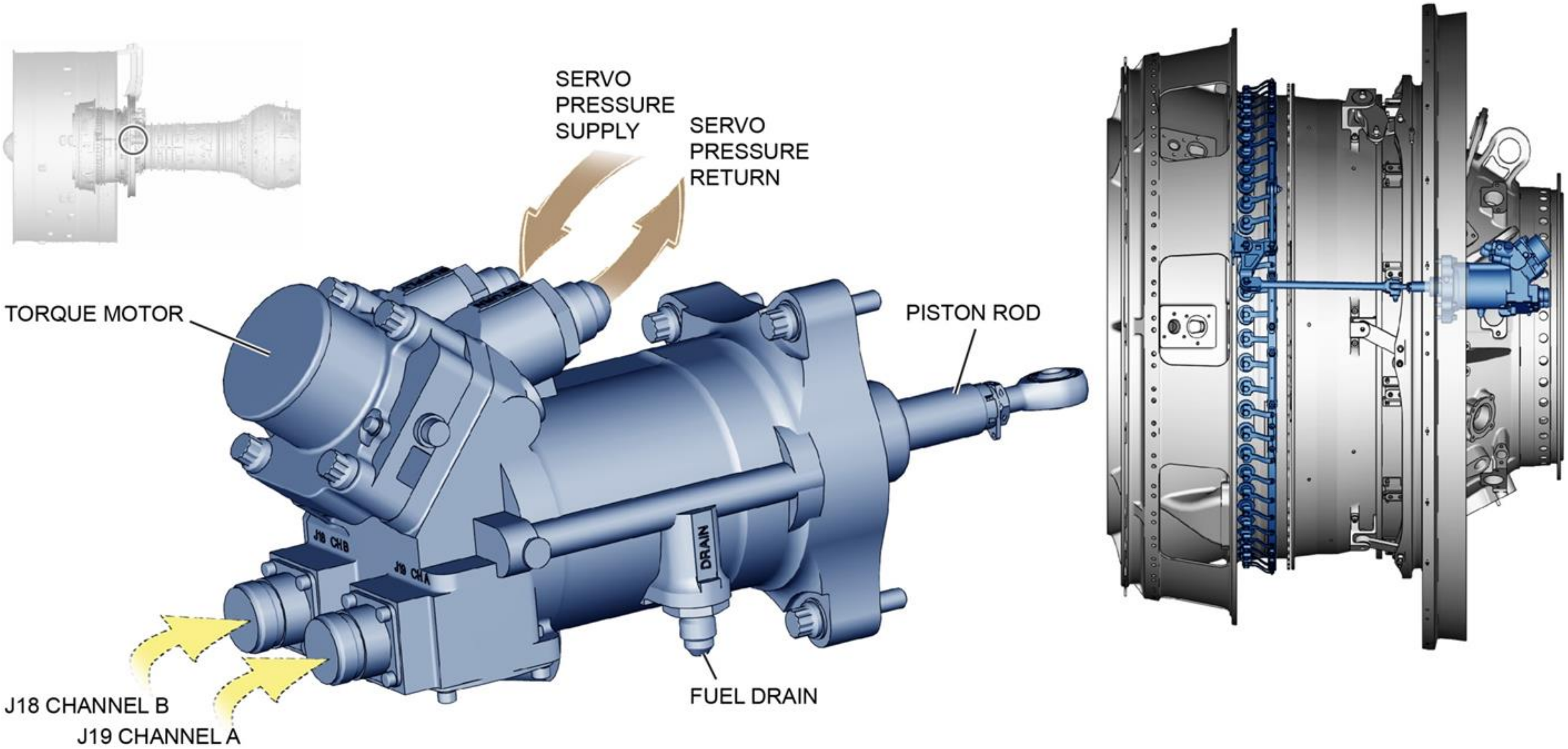
Operation:

During engine operation, the EEC sends electrically isolated drive signals to the dual channel torque motor that is part of the LPC SVA.

The drive signals direct pressurized fuel to either side of the actuator piston to achieve the commanded position.

If there is a loss of electrical power to the torque motor, the actuator positions the vanes in the full open fail safe position for maximum airflow through the LPC.

The actuator has a fuel drain for internal component leakage.



SERVO PRESSURE SUPPLY
SERVO PRESSURE RETURN
TORQUE MOTOR
PISTON ROD
DRAIN
FUEL DRAIN
J18 CHANNEL B
J19 CHANNEL A

LPC Variable Inlet Guide Vane (VIGV) Linkage

Purpose:

The LPC VIGV linkage translates the axial position movement of the LPC Stator Vane Actuator into circumferential synchronizing ring movement to position the guide vanes.

Location:

The linkage is located on the LPC case at 9:30.

Description:

The LPC SVA piston is attached the LPC connecting rod by a bolt through a clevis end. The forward end of the LPC connecting rod is bolted to the LPC bellcrank assembly.

The LPC bellcrank assembly is bolted to the bellcrank bracket.

The bracket is attached to the Fan Intermediate Case by four bolts.

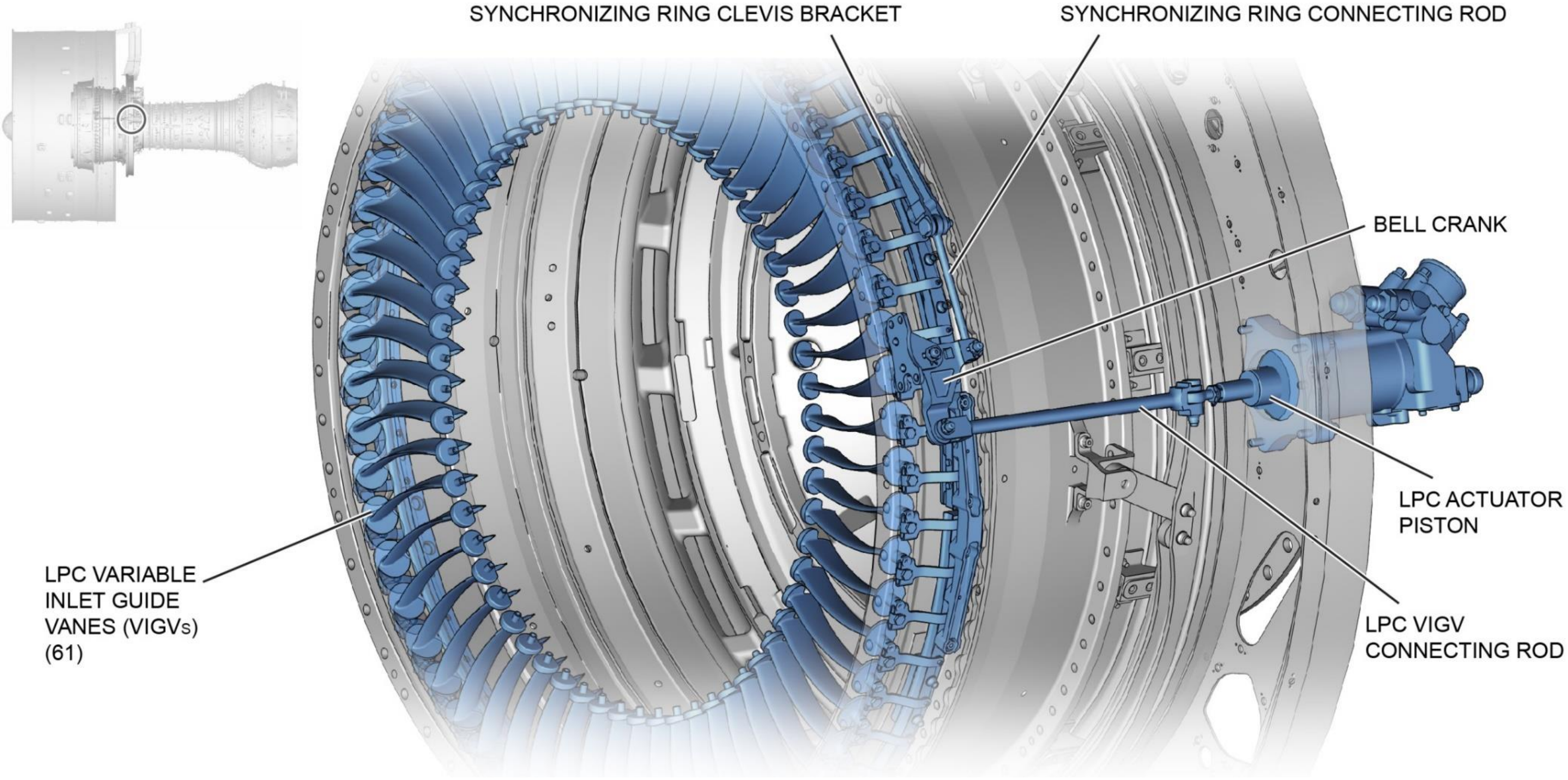
Operation:

1. Upon receiving a command from the EEC, the LPC Stator Vane Actuator directs pressurized fuel to the appropriate side of the piston to move the LPC connecting rod.

2. The forward end of the LPC connecting rod moves the LPC bellcrank assembly, which pivots about the bellcrank bracket.

This translates the axial movement of the LPC SVA into circumferential movement of the synchronizing rings.

The rings move the 61 VIGVs in unison to the correct position.



SYNCHRONIZING RING CLEVIS BRACKET
SYNCHRONIZING RING CONNECTING ROD
BELL CRANK
LPC ACTUATOR PISTON
LPC VIGV CONNECTING ROD
LPC VARIABLE INLET GUIDE VANES (VIGVs) (61)

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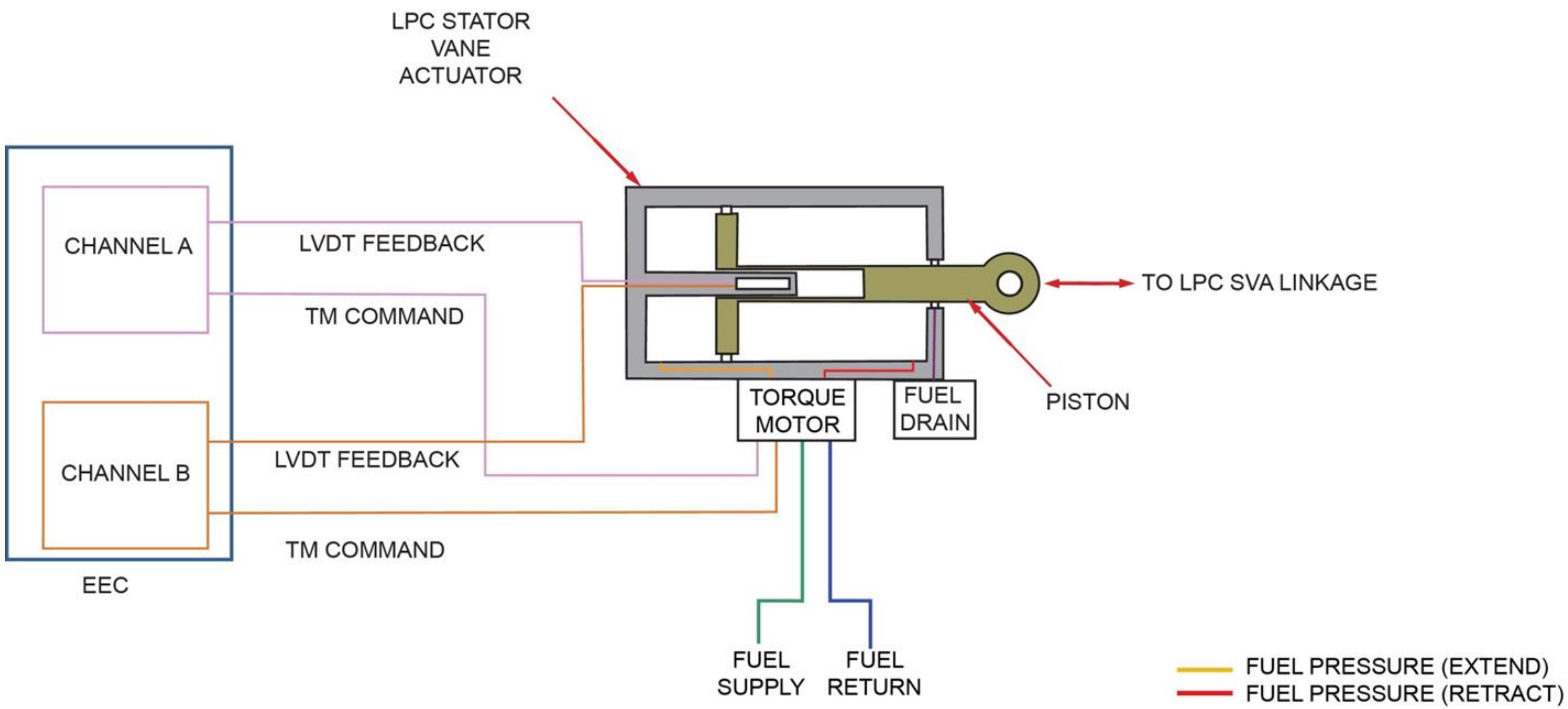


LPC VARIABLE INLET GUIDE VANE CONTROL SCHEMATIC

High Pressure Compressor Variable Vanes

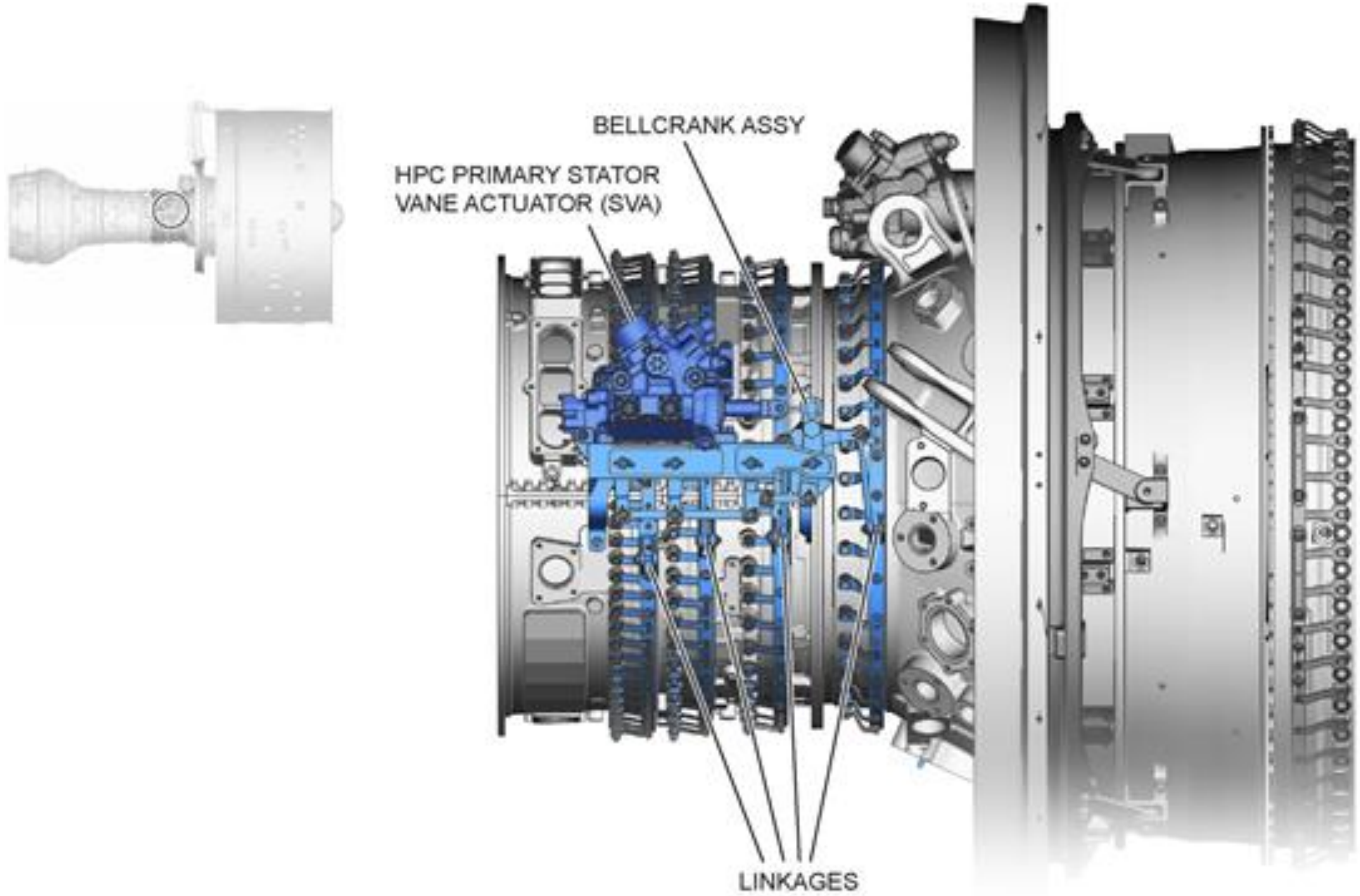
HPC Variable Stator Vane Actuators work in unison to position HPC Variable Inlet Guide Vanes and Variable Stator Vanes in response to EEC commands that optimize engine performance.

The system has primary and secondary stator vane actuators and adjusts the vanes using the HPC VIGV and VSV linkage.

Safety Conditions

CAUTION

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.


BELLCRANK ASSY
HPC PRIMARY STATOR
VANE ACTUATOR (SVA)
LINKAGES

HPC Primary Stator Vane Actuator

Purpose:

The HPC primary Stator Vane Actuator positions the inlet guide vanes of the Compressor Intermediate Case and the 1ST, 2ND and 3RD variable vanes of the HPC.

Location:

The primary actuator is mounted on the HPC case on the right side at 2:00.

Description:

The primary SVA is a dual-channel, EEC-controlled valve with a fuel actuated piston that moves the HPC bellcrank assemblies.

Piston position feedback is provided to Channel A of the EEC.

Operation:

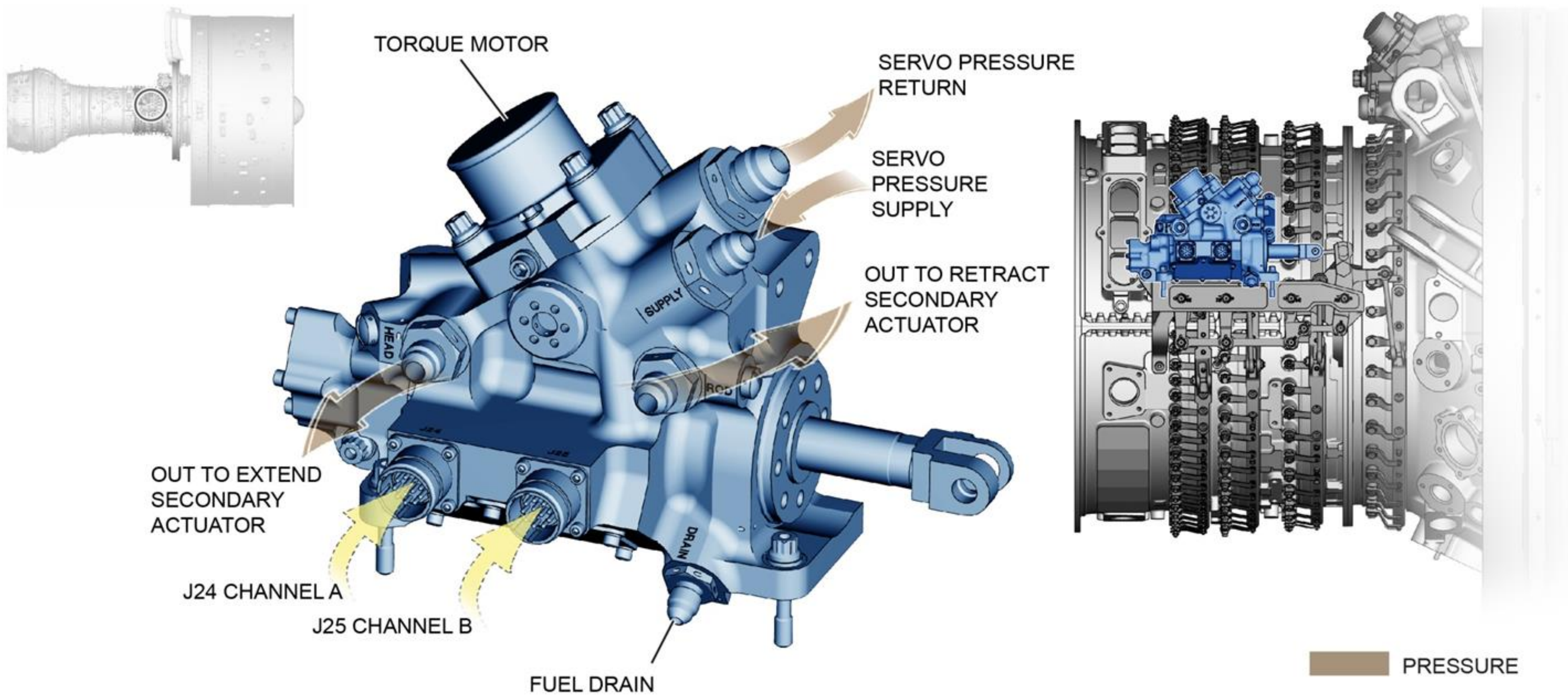
During engine operation, the EEC sends electrically isolated drive signals to the dual-channel torque motor that is part of the primary SVA.

The torque motor uses the electrical signals to direct pressurized fuel to either side of the actuator piston to achieve the commanded actuator position.

A single channel Linear Variable Differential Transducer (LVDT) is mechanically coupled to each actuator piston to provide a positional feedback signal to the EEC.

If there is a loss of electrical power to the torque motor, the actuator positions the vanes to the full open fail-safe position for maximum airflow through the HPC.

The EEC can use either the primary or secondary actuator LVDT feedback signals to control the system.



TORQUE MOTOR
SERVO PRESSURE RETURN
SERVO PRESSURE SUPPLY
OUT TO RETRACT SECONDARY ACTUATOR
OUT TO EXTEND SECONDARY ACTUATOR
J24 CHANNEL A
J25 CHANNEL B
FUEL DRAIN
SUPPLY
HEAD
ROD
DRAIN
PRESSURE

HPC Secondary Stator Vane Actuator

Purpose:

The HPC secondary Stator Vane Actuator positions the inlet guide vanes of the Compressor Intermediate Case and the 1st, 2nd and 3rd variable vanes of the HPC.

Location:

The secondary actuator is on the left side of the HPC at 9:00.

Description:

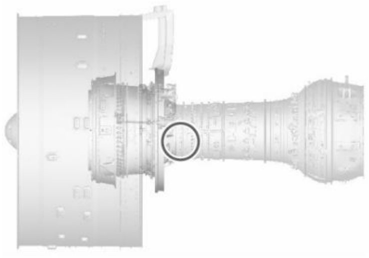
The secondary SVA is a dual-channel, EEC-controlled valve with a fuel actuated piston that moves the HPC bellcrank assemblies.

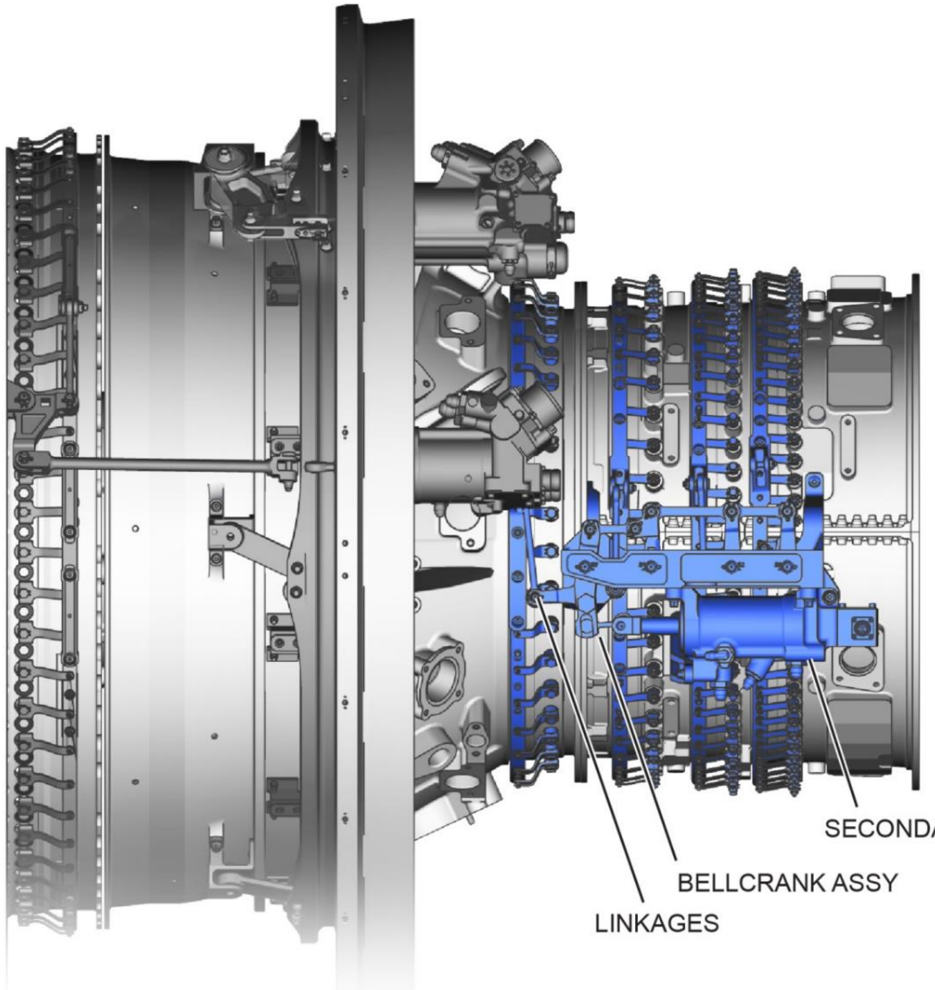
Piston position feedback is provided to Channel B of the EEC through the secondary SVA’s Linear Variable Differential Transducer (LVDT).

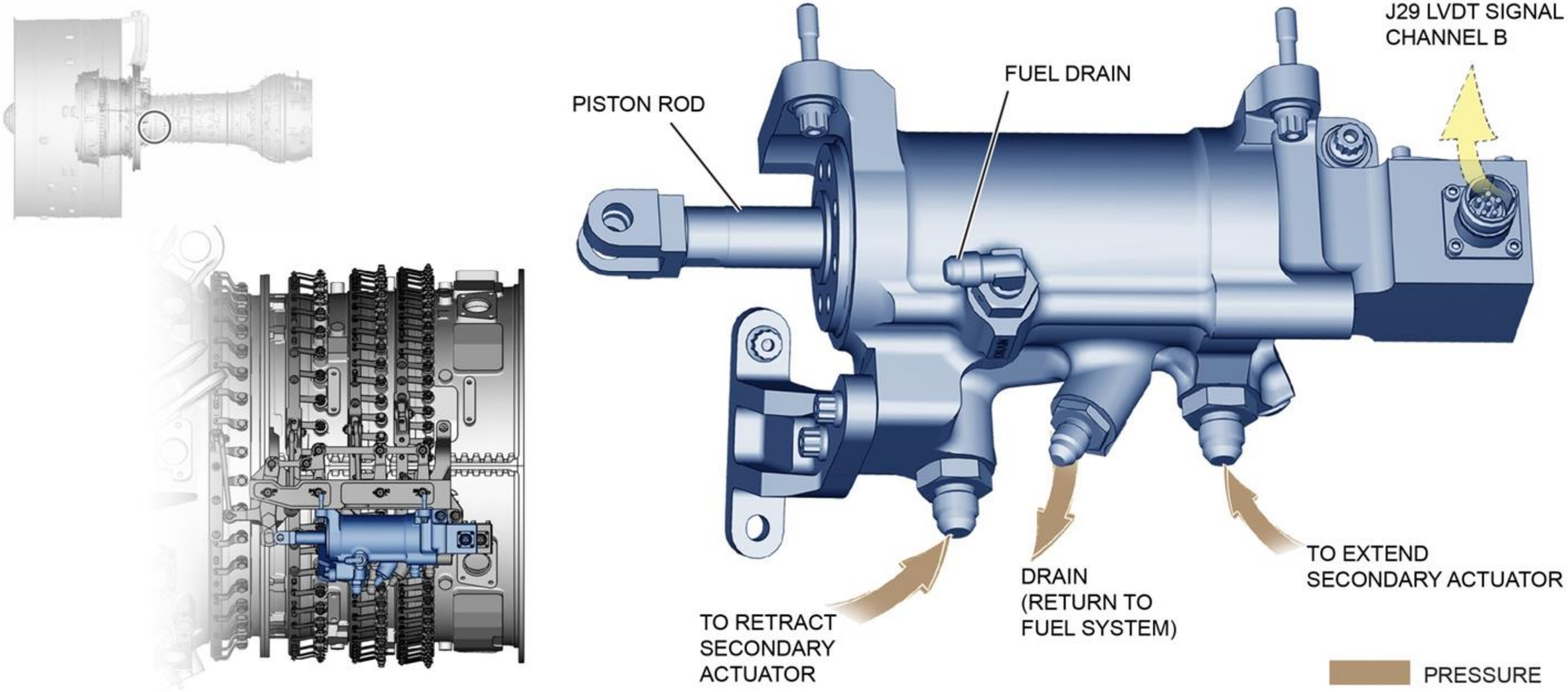
Operation:

Pressurized fuel from the primary SVA is routed via a fuel supply and fuel return tubes to the HPC secondary SVA, positioning the HPC secondary actuator piston.

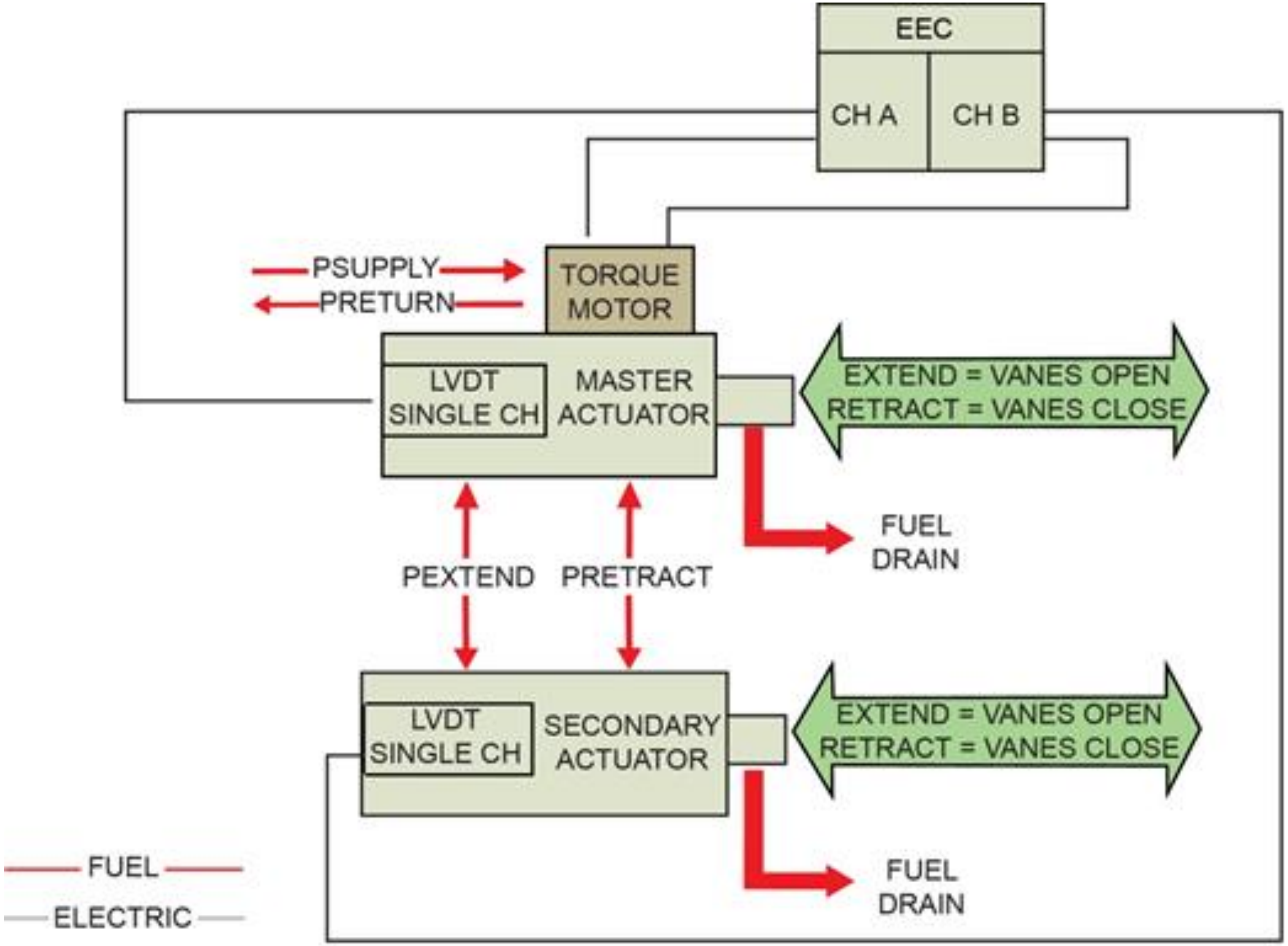
The EEC uses primary and secondary actuator LVDT feedback signals to control the system.




SECONDARY STATOR VANE ACTUATOR
BELLCRANK ASSY
LINKAGES



PISTON ROD
FUEL DRAIN
J29 LVDT SIGNAL
CHANNEL B
TO RETRACT
SECONDARY
ACTUATOR
DRAIN
(RETURN TO
FUEL SYSTEM)
TO EXTEND
SECONDARY ACTUATOR
PRESSURE


EEC
CH A
CH B
PSUPPLY
PRETURN
TORQUE MOTOR
LVDT SINGLE CH
MASTER ACTUATOR
EXTEND = VANES OPEN
RETRACT = VANES CLOSE
FUEL DRAIN
PEXTEND
PRETRACT
LVDT SINGLE CH
SECONDARY ACTUATOR
EXTEND = VANES OPEN
RETRACT = VANES CLOSE
FUEL DRAIN
FUEL
ELECTRIC

BLEED CONTROL SYSTEM

The compressor bleed control system comprises one LPC Bleed Valve Actuator (BVA) and two HPC bleed valves.

The LPC bleed system is used to control the LPC discharge 3rd stage airflow into the fan discharge.

The EEC modulates the LPC BVA and mechanical linkages accordingly.

The LPC BVA comprises an electrically controlled dual coil torque motor and a fuel operated EHSV.

The actuator LVDT transmits the piston position to each EEC channel individually.

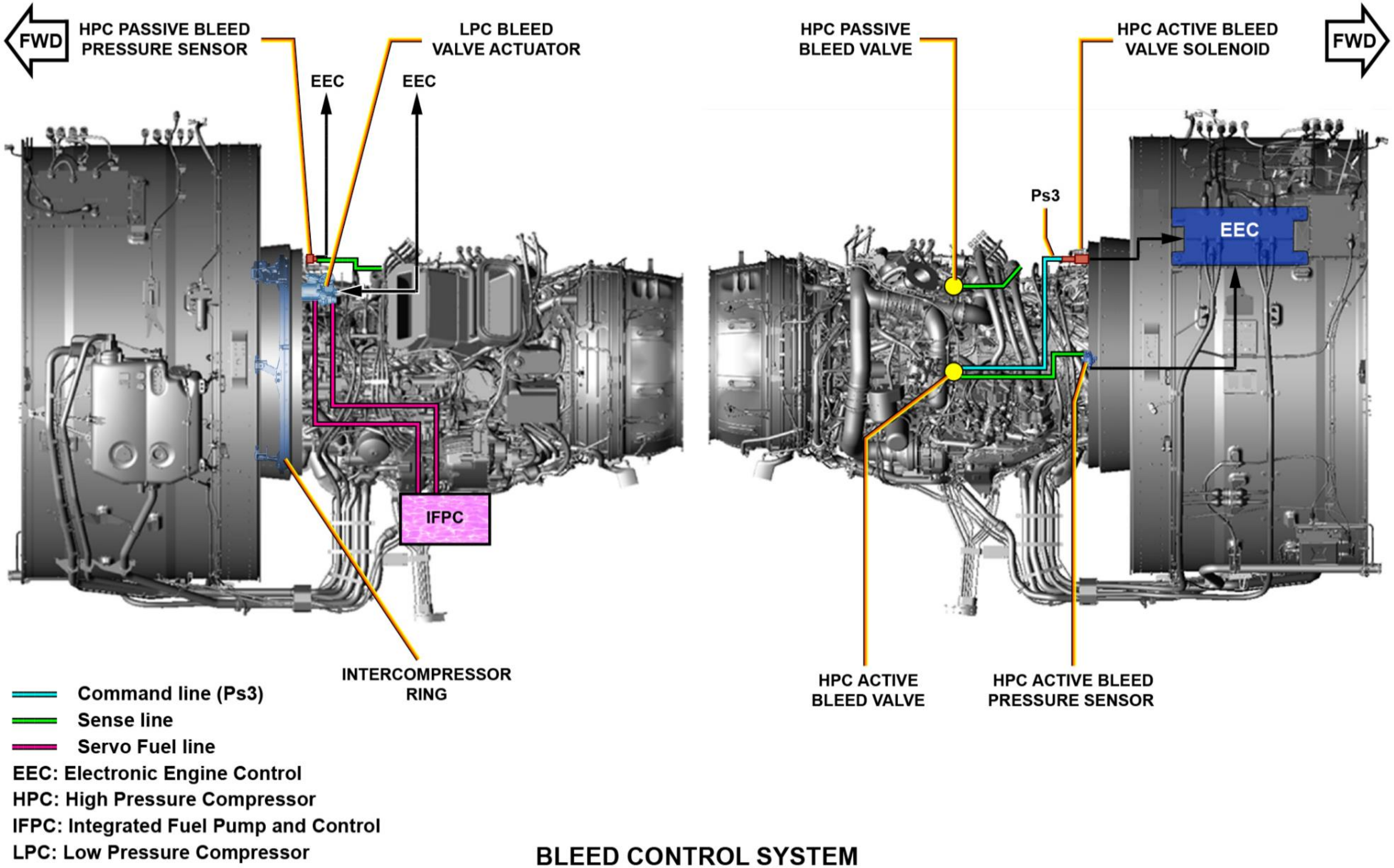
The HPC bleed system is used to control the HPC 6th stage airflow into the core area.

The system has two ON-OFF HPC bleed valves; one is active, the other passive, and both spring-loaded open and pneumatically closed at certain engine operating conditions.

The active valve is EEC controlled closed through the HPC bleed valve solenoid thanks to Ps3 pressure.

The passive valve closes when the pressure inside the HPC is high enough to force the spring-loaded valve closed.

Both are monitored by the EEC thanks to two dedicated pressure sensors.



BLEED CONTROL SYSTEM

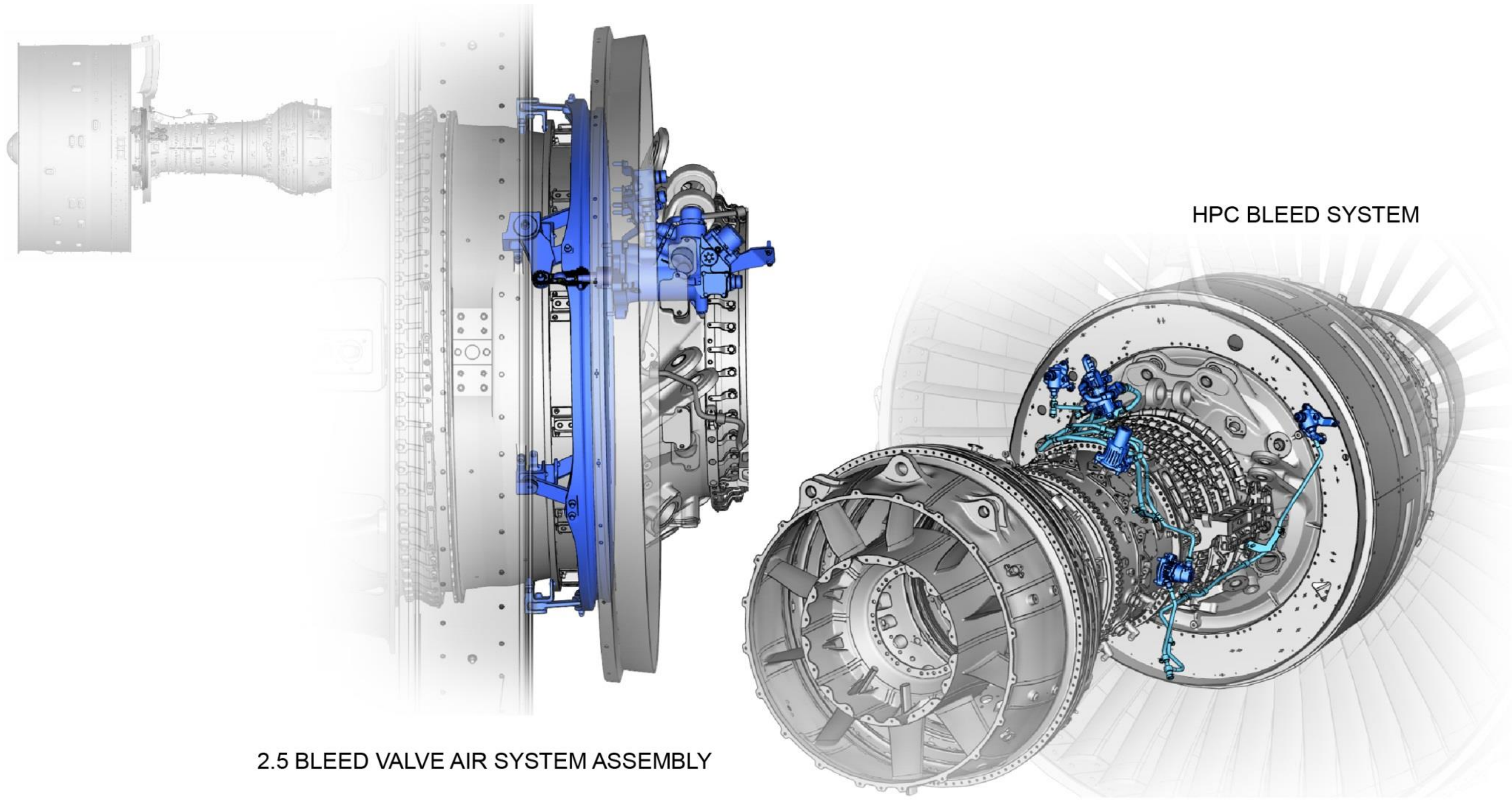
COMPRESSOR BLEED AIR SYSTEM

The Compressor Bleed Air System improves engine operability and stability by bleeding air from the Low-Pressure Compressor.

The system also removes debris from the LPC air stream.

The Compressor Bleed Air System consists of the following:

- 2.5 Bleed Valve Air System Assembly
- HPC Bleed Air System.

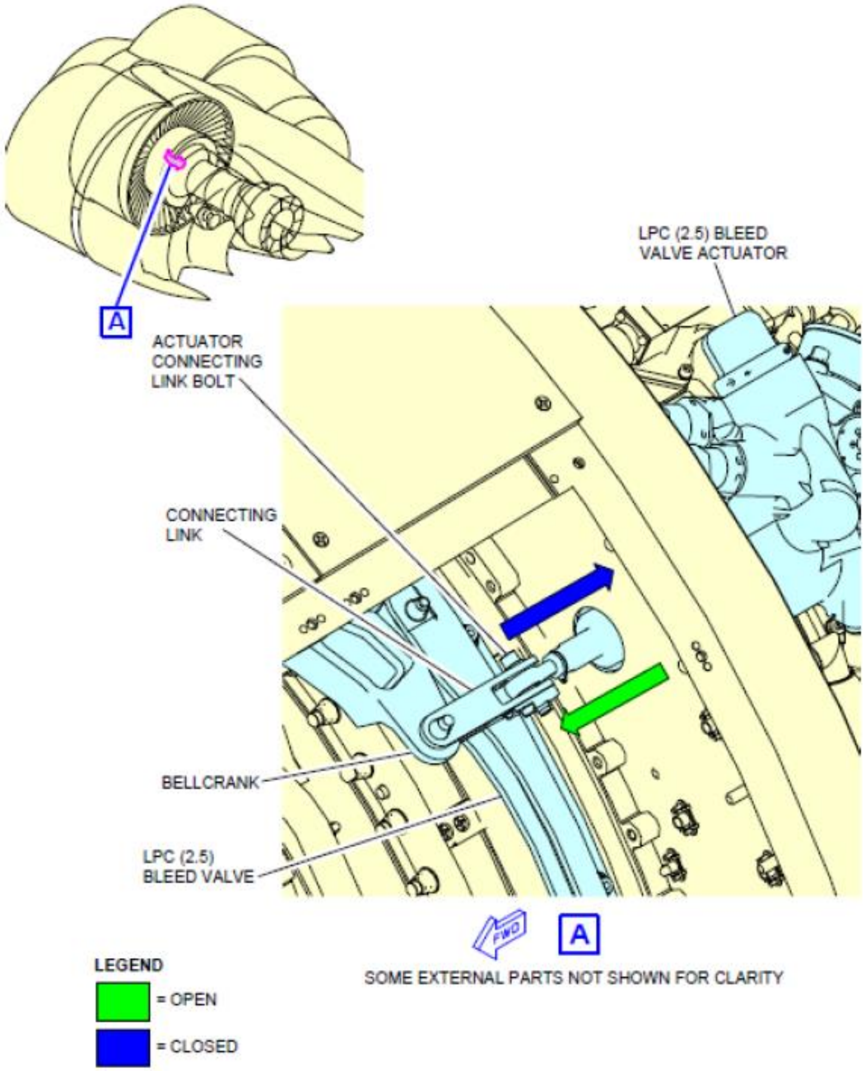

HPC BLEED SYSTEM
2.5 BLEED VALVE AIR SYSTEM ASSEMBLY

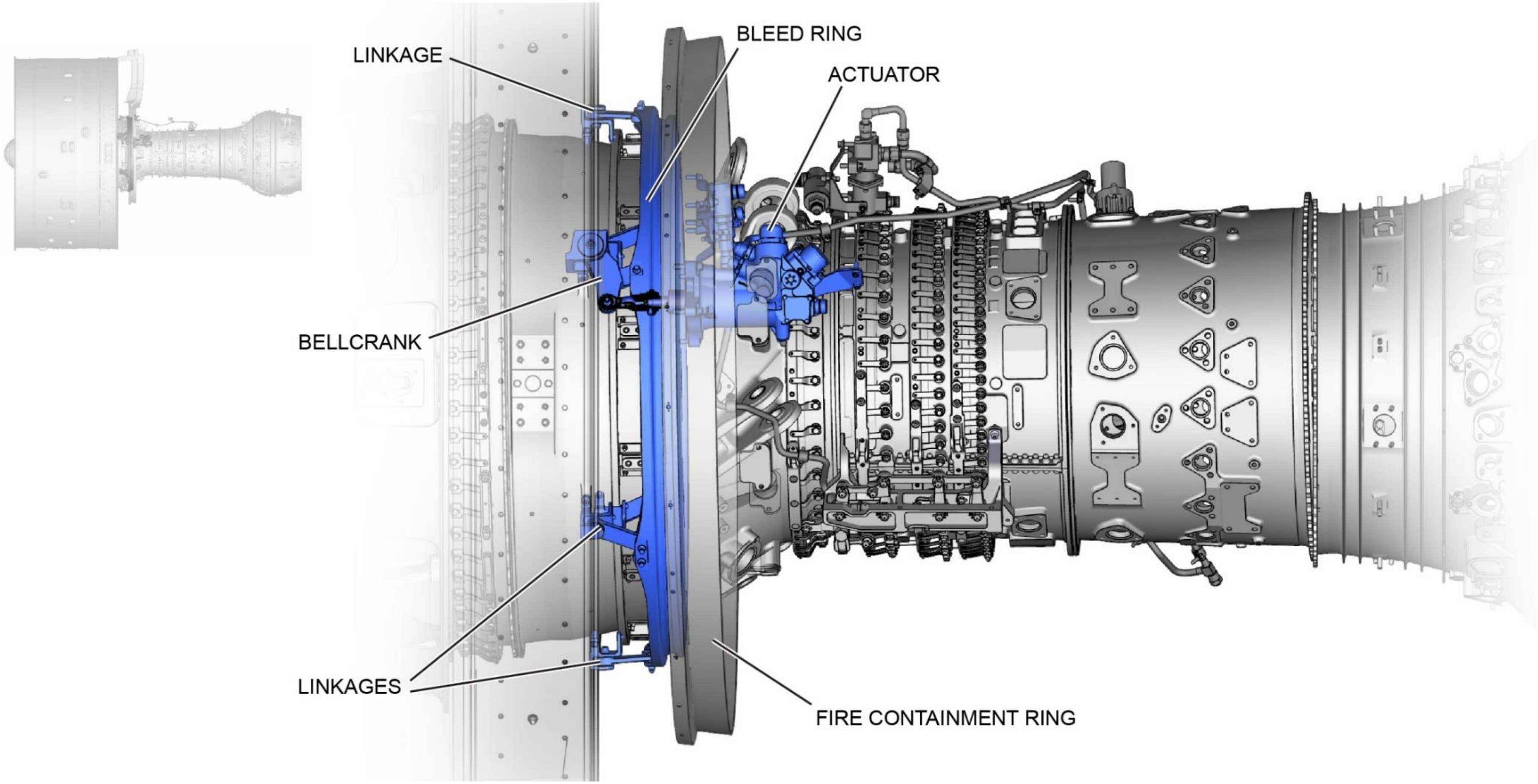
2.5 Bleed Valve Air System Assembly

The 2.5 Bleed Valve Air System Assembly discharges LPC exit airflow into the fan bypass airstream.

Assembly components are shown below.

- Bleed ring
- Actuator
- Bellcrank
- Linkages




LINKAGE
BLEED RING
ACTUATOR
BELLCRANK
LINKAGES
FIRE CONTAINMENT RING

2.5 Bleed Valve Actuator

Purpose:

The 2.5 bleed valve actuator controls the LPC bleed valve through the 2.5 bleed valve linkage when commanded by the EEC.

Location:

The actuator is mounted at the rear of the CIC fire containment ring at approximately 9:30.

Description:

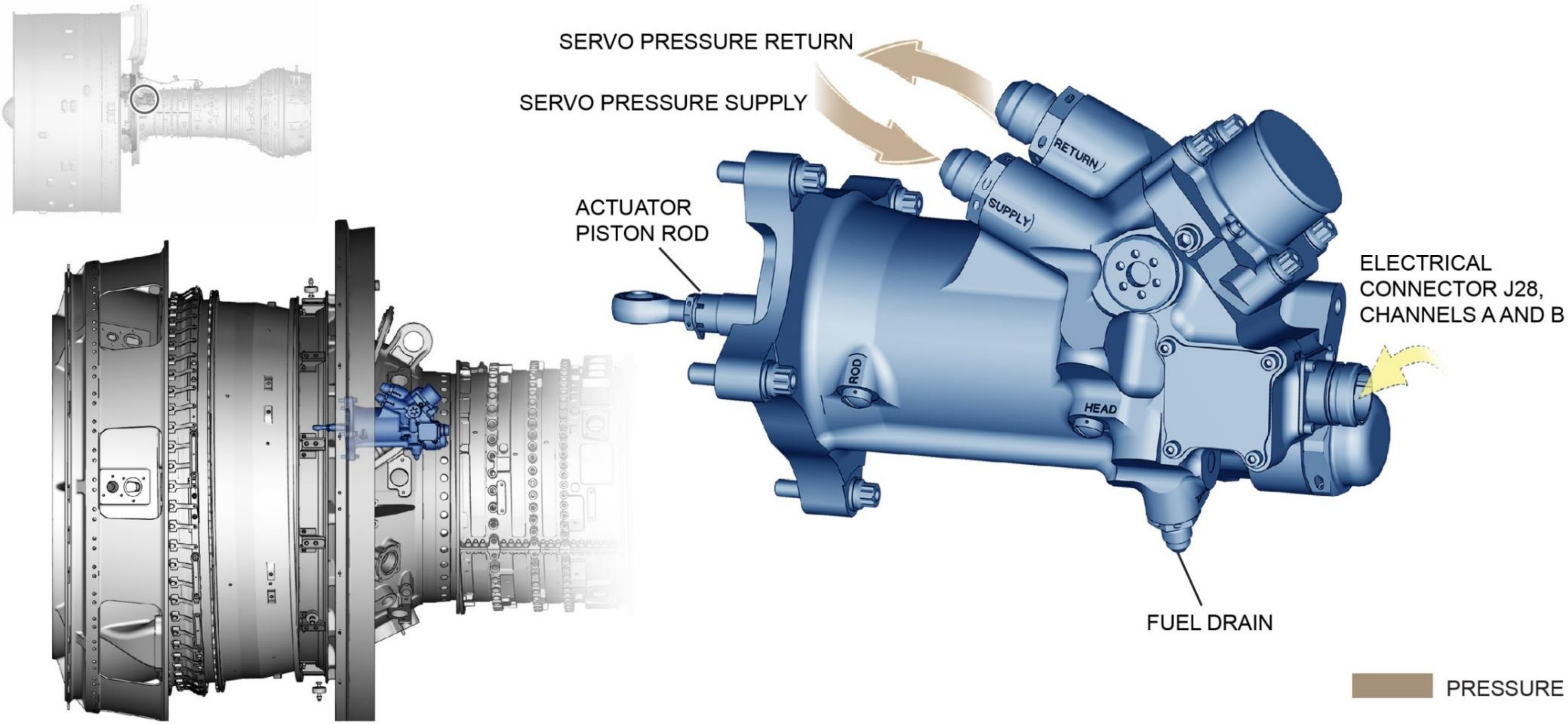
A dual channel Linear Variable Differential Transformer (LVDT) is mechanically coupled to the actuator piston to provide position feedback signals to each channel of the EEC.

Operation:

During engine operation, the EEC sends electrical signals to a dual channel torque motor that is part of the bleed valve actuator.

The torque motor uses the electrical signals to direct pressurized fuel to either side of the actuator piston to achieve the commanded position.

If there is a loss of power, the actuator positions the bleed valve closed.


SERVO PRESSURE RETURN
SERVO PRESSURE SUPPLY
RETURN
SUPPLY
ACTUATOR PISTON ROD
ROD
HEAD
ELECTRICAL CONNECTOR J28, CHANNELS A AND B
FUEL DRAIN
PRESSURE

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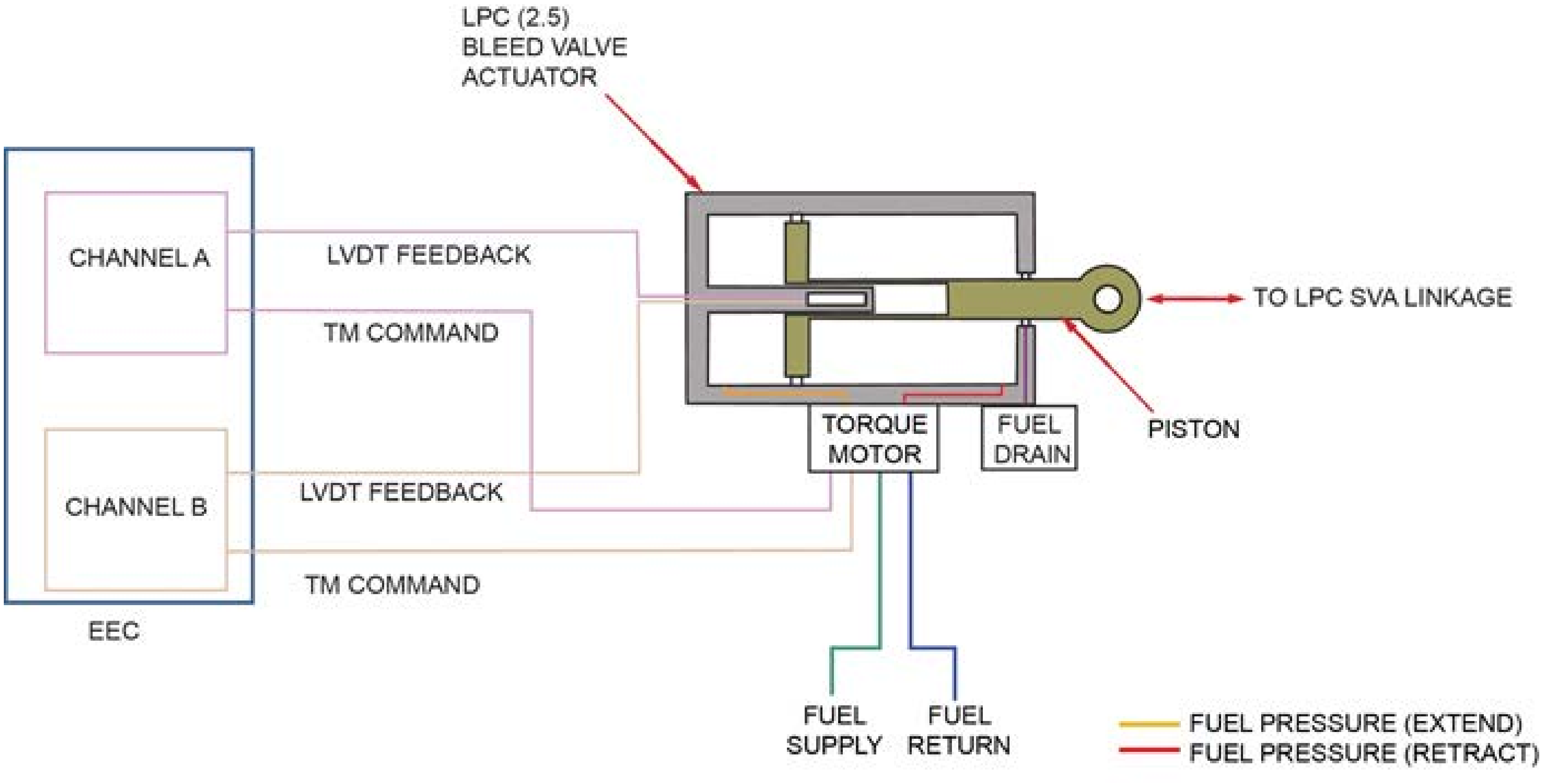


2.5 BLEED VALVE ACTUATOR SCHEMATIC

2.5 Bleed Valve Linkage

Purpose:

The 2.5 bleed valve linkage translates axial movement of the 2.5 bleed valve actuator piston to circumferential movement to open and close the bleed valve.

Location:

The linkage is located at 12:00 on the LPC case.

Description:

The bleed valve connecting link is bolted to the 2.5 bleed valve actuator piston at one end and to the bleed valve bellcrank at the other end.

The bleed valve bellcrank is also attached to the bleed valve by one bolt and is fastened to the bellcrank support bracket with one bolt and washer.

The bellcrank support bracket is mounted to the LPC outer case by two bolts.

Two fabric coated, silicone seal rings are installed on the bleed valve to provide sealing when the bleed valve is in the closed position.

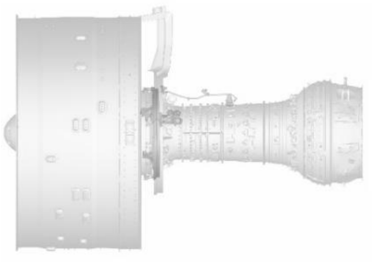
Idler links support the bleed valve around the circumference of the CIC.

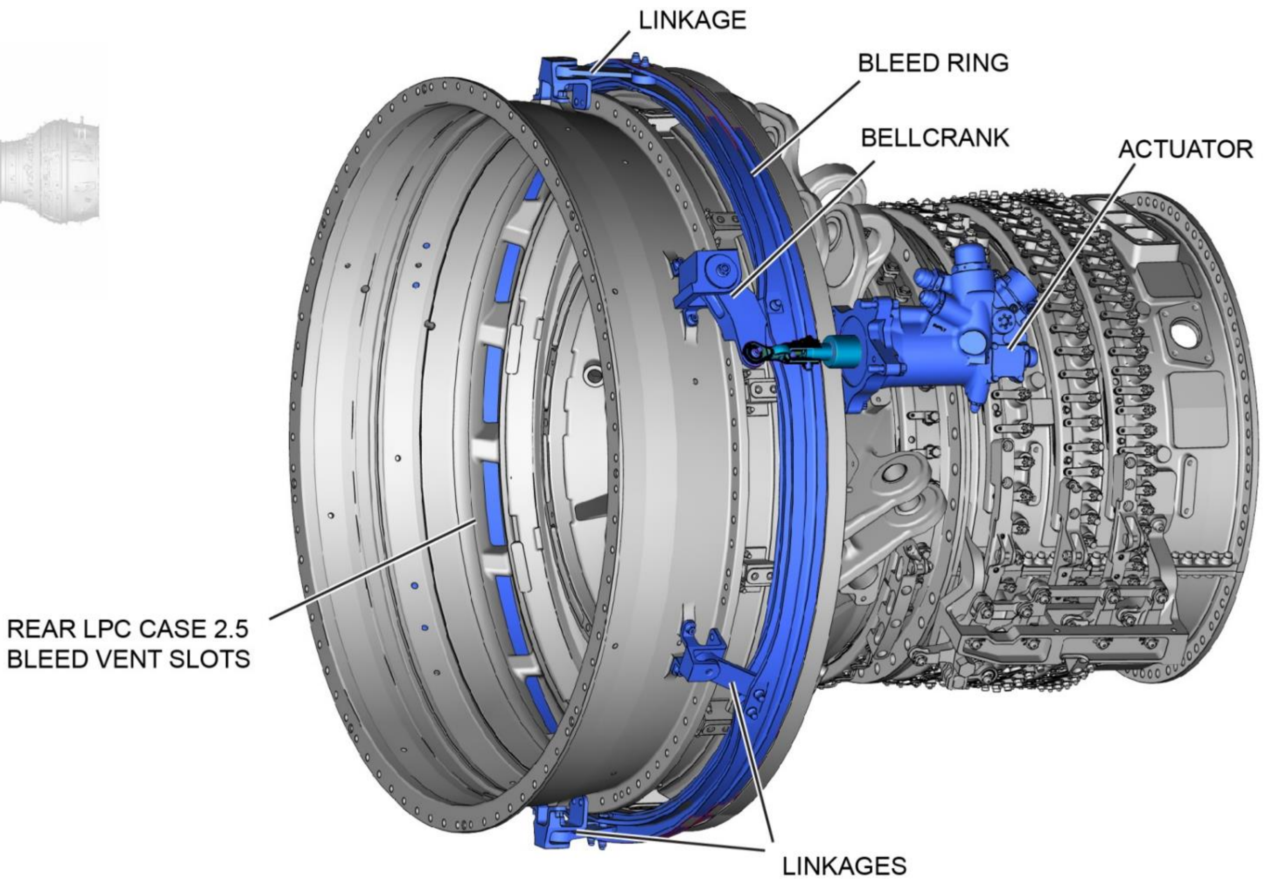
Operation:

Forward and aft movement of the actuator piston is transmitted by way of the bleed valve bellcrank to the bleed valve.

This force moves the bleed valve in a spiral motion between an open or closed position, regulating LPC bleed air out the 2.5 bleed ducts in the Compressor Intermediate Case.

The LPC bleed air is discharged into the fan bypass airstream.




LINKAGE
BLEED RING
BELLCRANK
ACTUATOR
REAR LPC CASE 2.5
BLEED VENT SLOTS
LINKAGES

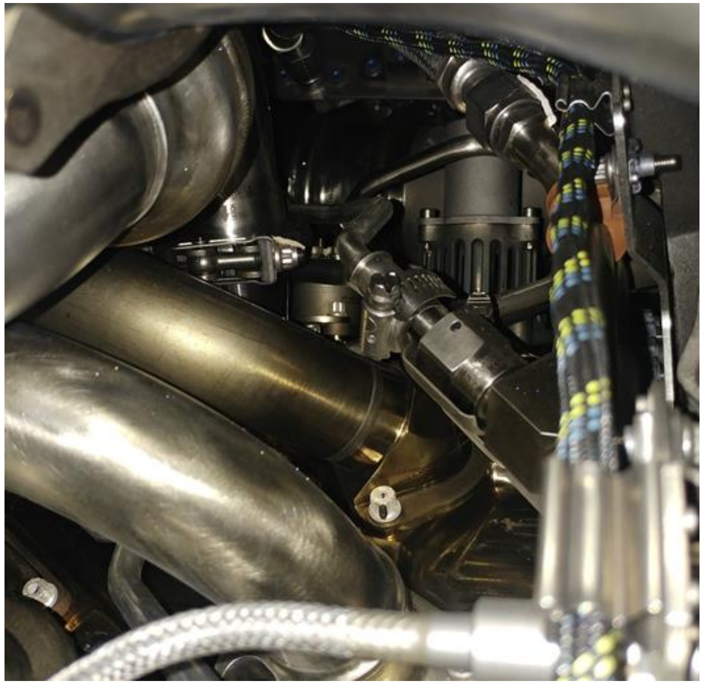
HPC Bleed Air System

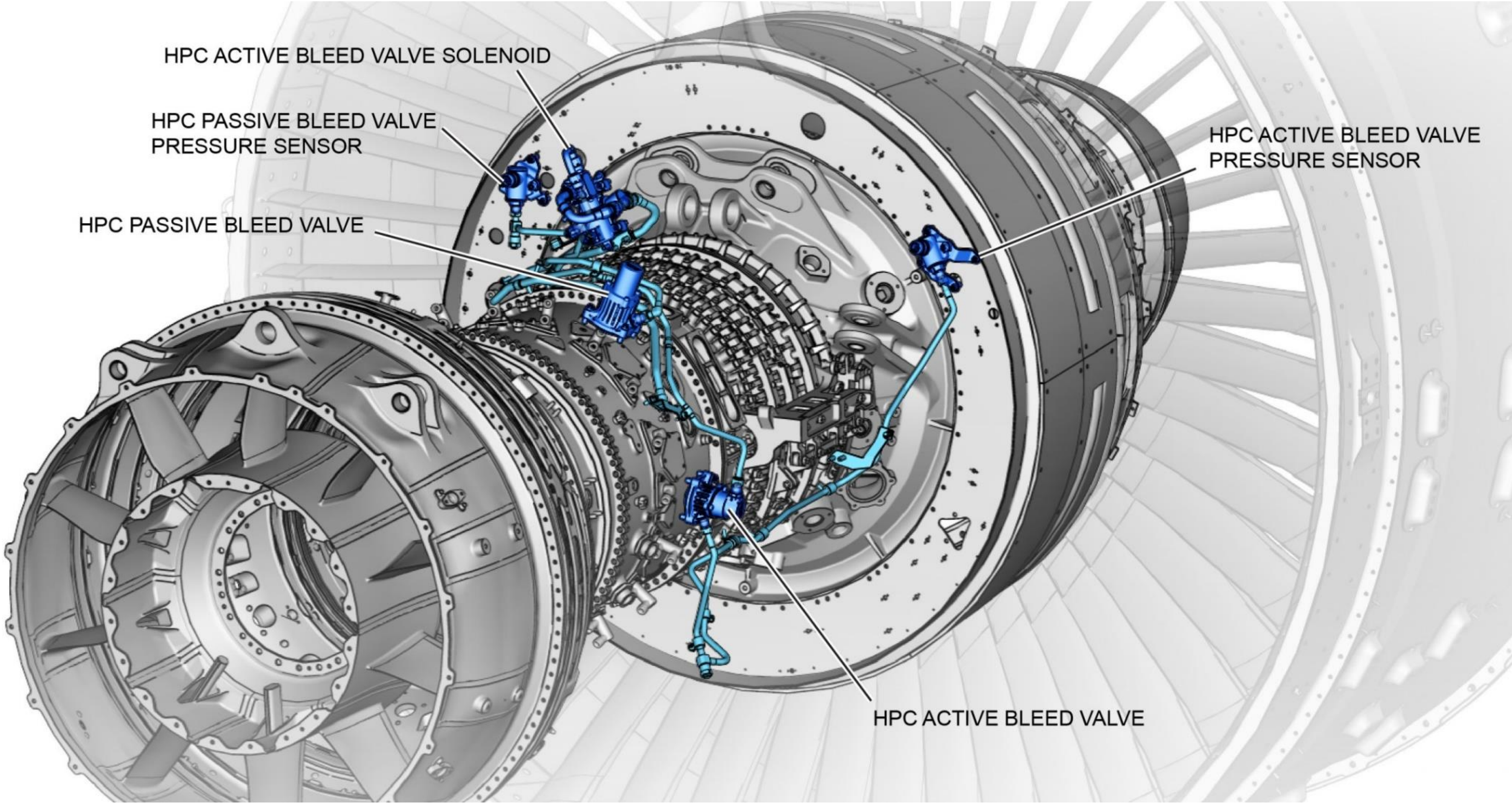
The HPC Bleed Air System bleeds 6th Stage HPC air to improve engine start up performance.

The system has both active and passive components as shown in the chart.

The valves are located under many components and vent the air to the core; not into bypass air as most engines do.

Component	Active	Passive
Bleed valve	✓	✓
Bleed valve pressure sensor	✓	✓
Bleed valve solenoid	✓	




HPC ACTIVE BLEED VALVE SOLENOID
HPC PASSIVE BLEED VALVE
PRESSURE SENSOR
HPC PASSIVE BLEED VALVE
HPC ACTIVE BLEED VALVE
PRESSURE SENSOR
HPC ACTIVE BLEED VALVE

HPC Passive Bleed Valve

Purpose:

The HPC passive bleed valve is a spring-loaded valve that allows HPC 6th Stage air to bleed directly into the core compartment during engine start to help with initial compression of upstream core air flow.

Location:

The passive bleed air valve is located on the HPC case at 1:00.

Description:

The HPC passive bleed air valve is attached to the outer diffuser case boss by four bolts. A gasket is installed between the HPC bleed valve and the diffuser case to prevent air leakage.

Operation:

The spring forces the bleed valve open when the pressure within the High-Pressure Compressor is low.

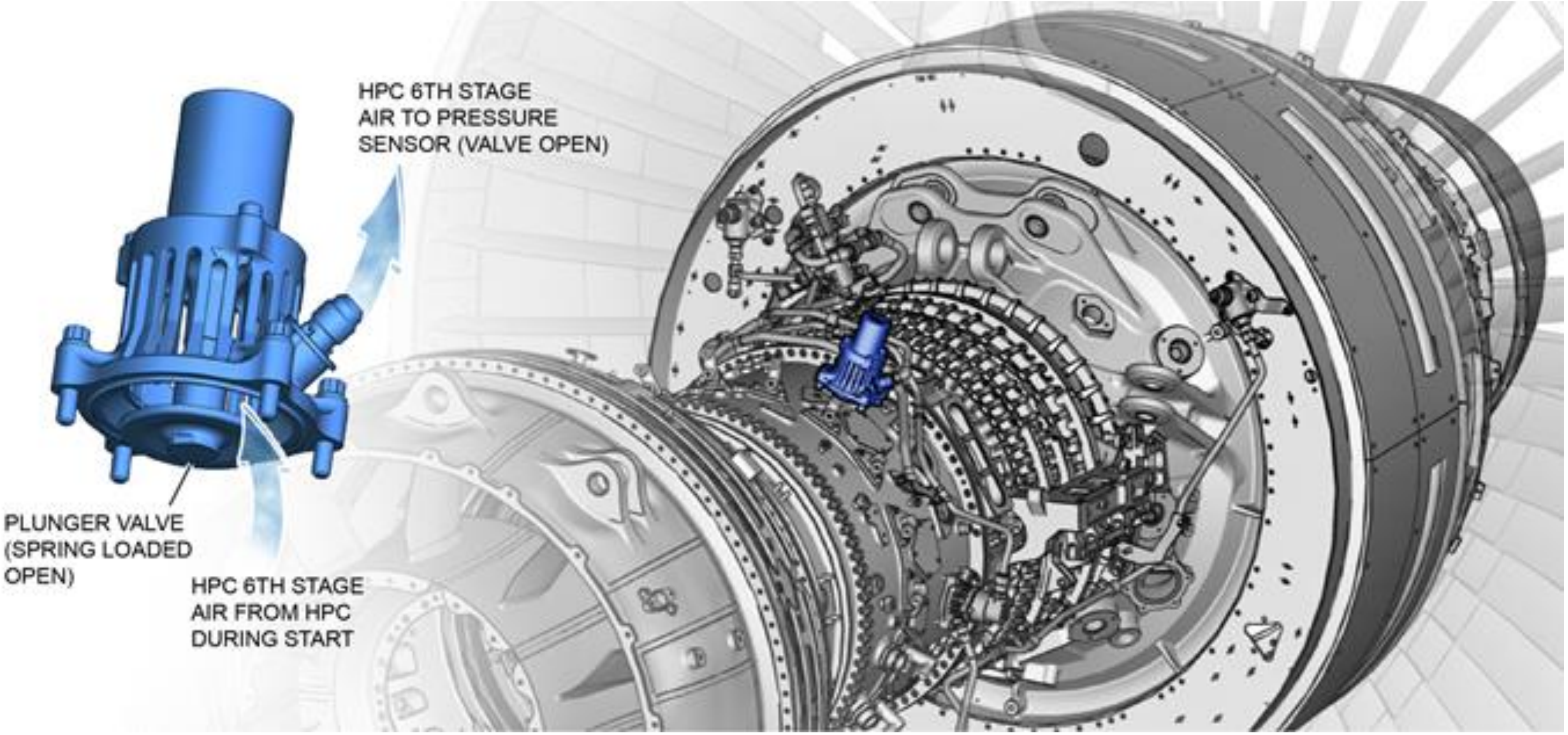
When sufficient pressure is developed in the High-Pressure Compressor the valve is forced closed.

Safety Conditions

CAUTION

BEFORE YOU REMOVE THE VALVE FROM THE CASE, MAKE SURE THE AREA IS CLEAN AND FREE OF DEBRIS.

THIS WILL PREVENT CONTAMINATION AND FOREIGN OBJECT DAMAGE TO THE ENGINE.


HPC 6TH STAGE
AIR TO PRESSURE
SENSOR (VALVE OPEN)
PLUNGER VALVE
(SPRING LOADED
OPEN)
HPC 6TH STAGE
AIR FROM HPC
DURING START

HPC Active Bleed Valve

Purpose:

The HPC active bleed valve is a spring-loaded valve that allows HPC 6th Stage air to bleed directly into the core compartment during engine start to help with initial compression of upstream core air flow.

Location:

The active bleed air valve is located on the HPC case at 3:30.

Description:

The HPC active bleed valve is attached to the outer diffuser case boss by four bolts. A gasket is installed between the HPC active bleed valve and the diffuser case to prevent air leakage.

Operation:

The passive HPC bleed valve closes at sub-idle and the active HPC bleed valve is opened with PS3 air supplied by the HPC active solenoid valve.

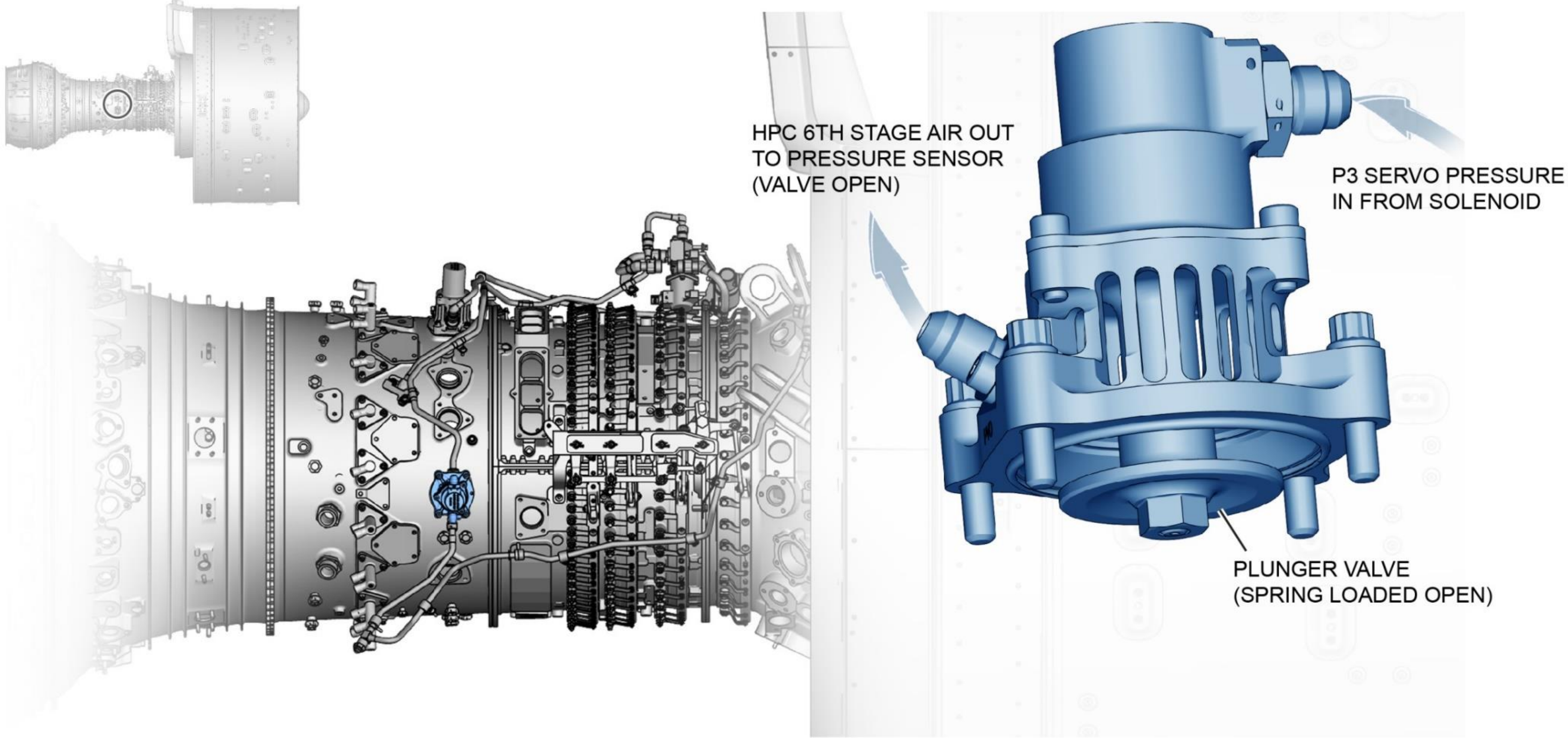
At observed idle, the EEC will command the solenoid closed, shutting off PS3 air.

The active HPC bleed valve closes with Stage 6 HPC air.

Safety Conditions

CAUTION

BEFORE YOU REMOVE THE VALVE FROM THE CASE, MAKE SURE THE
AREA IS CLEAN AND FREE OF DEBRIS. THIS WILL PREVENT CONTAMINATION AND FOREIGN OBJECT DAMAGE TO THE ENGINE.


HPC 6TH STAGE AIR OUT
TO PRESSURE SENSOR
(VALVE OPEN)
P3 SERVO PRESSURE
IN FROM SOLENOID
PLUNGER VALVE
(SPRING LOADED OPEN)

HPC Passive and Active Bleed Valve Air Pressure Sensors

Purpose:

The dual-channel HPC passive bleed valve air pressure sensors measure the outlet air pressure on the HPC bleed valves.

Location:

Both sensors are located on the CIC.

The passive sensor is located at approximately 10:00 and the active sensor is at approximately 2:00.

Description:

The pressure sensors consist of two independent, electrically isolated sensing elements, a stainless-steel body, and an electrical connector.

The components are assembled as a hermitically sealed unit.

The stainless-steel body has a mounting flange and houses the sensing elements.

Operation:

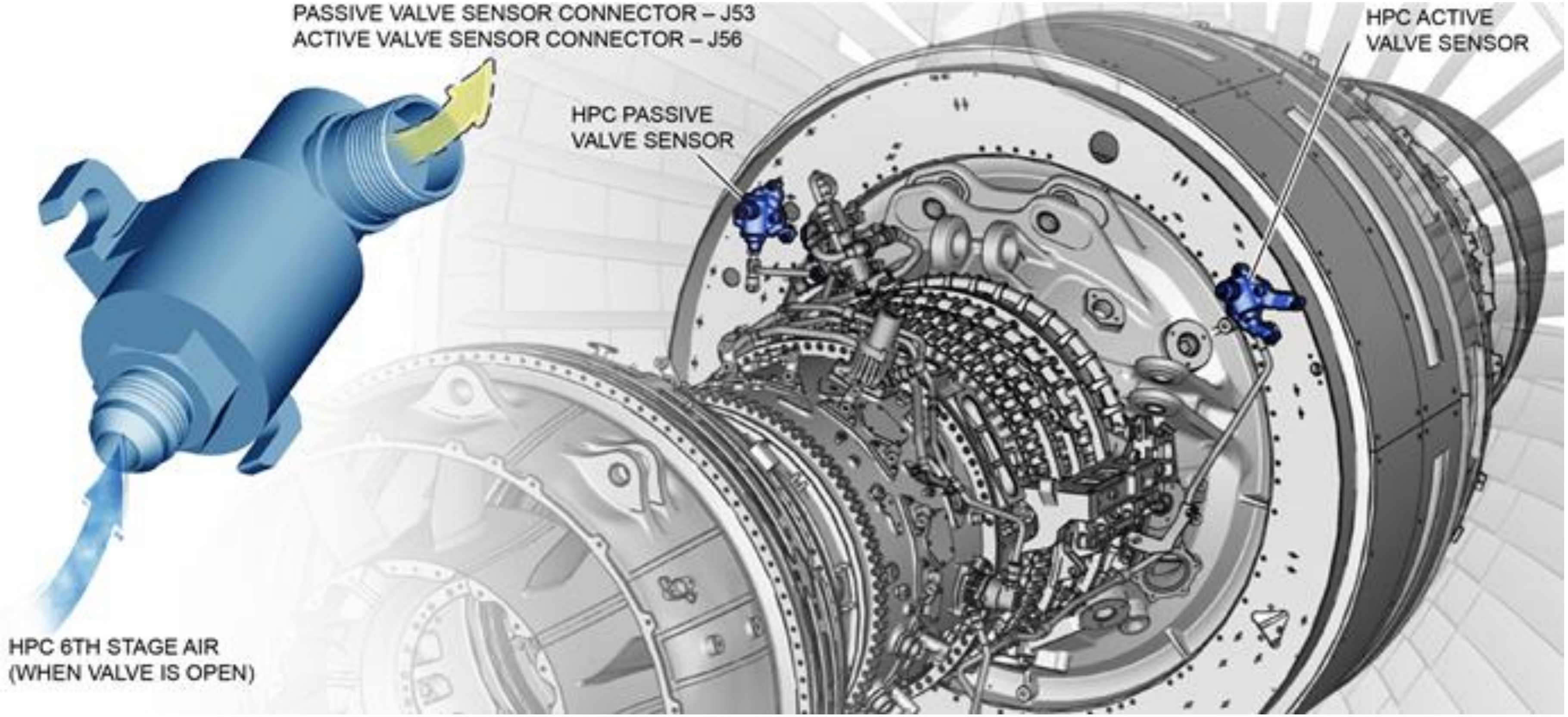
HPC bleed valve sense lines direct pressurized air from the HPC bleed valves to the HPC bleed valve pressure sensors' sensing elements.

Each sensing element consists of a diaphragm with strain gages.

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

This output voltage correlates directly to air pressure.

Each sensing element is connected to the electrical connector and sends the air pressure signal to the EEC over separate channels.


PASSIVE VALVE SENSOR CONNECTOR – J53
ACTIVE VALVE SENSOR CONNECTOR – J56
HPC PASSIVE
VALVE SENSOR
HPC ACTIVE
VALVE SENSOR
HPC 6TH STAGE AIR
(WHEN VALVE IS OPEN)

HPC Active Solenoid Valve

Purpose:

The HPC Active Solenoid Valve provides discrete (on/off) control of HPC PS3 servo pressure sent to the HPC active bleed air valve.

Location:

The active solenoid valve is located at 2:30 on the combustor case.

Description:

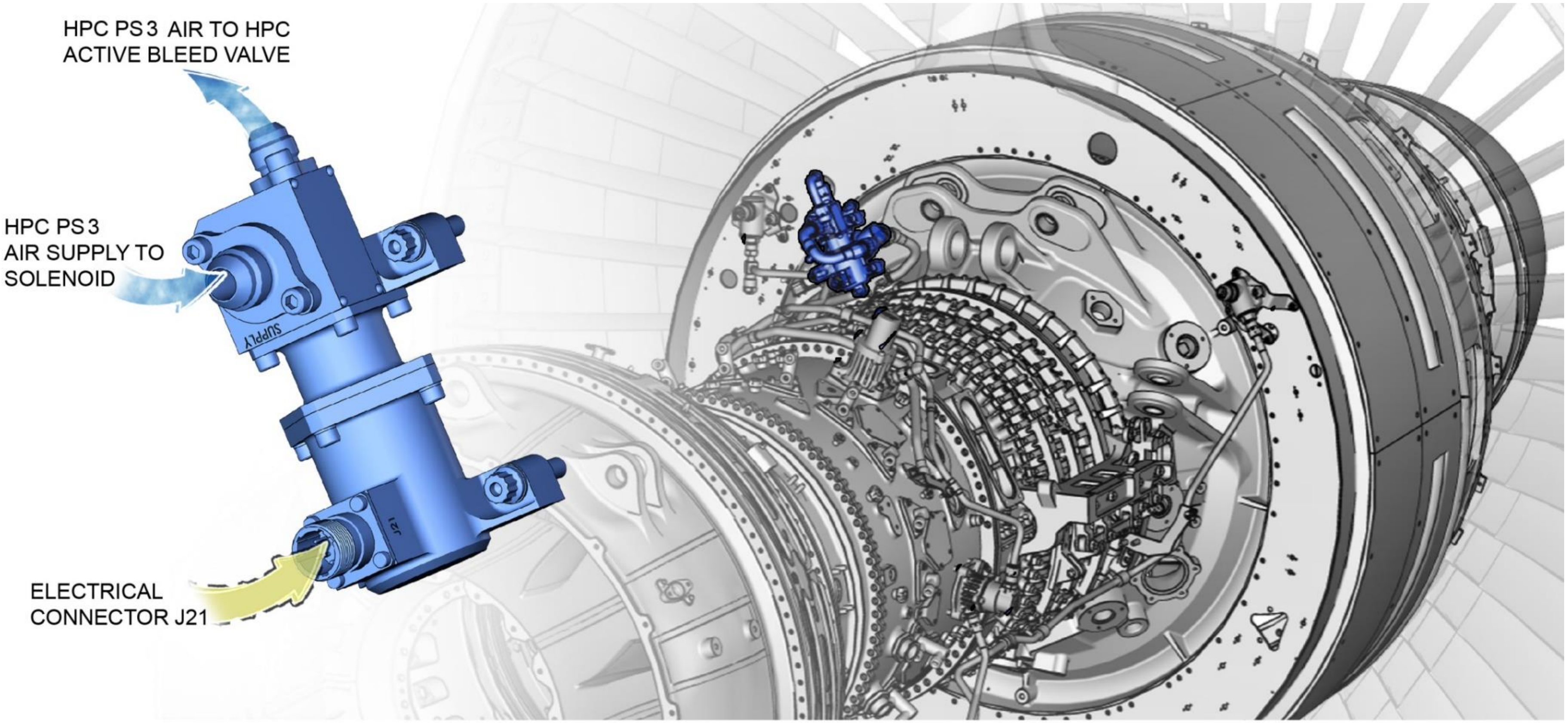
The dual-channel HPC active solenoid valve controls the flow of HPC PS3 servo pressure to the HPC active bleed valve.

The active solenoid valve is controlled by the EEC.

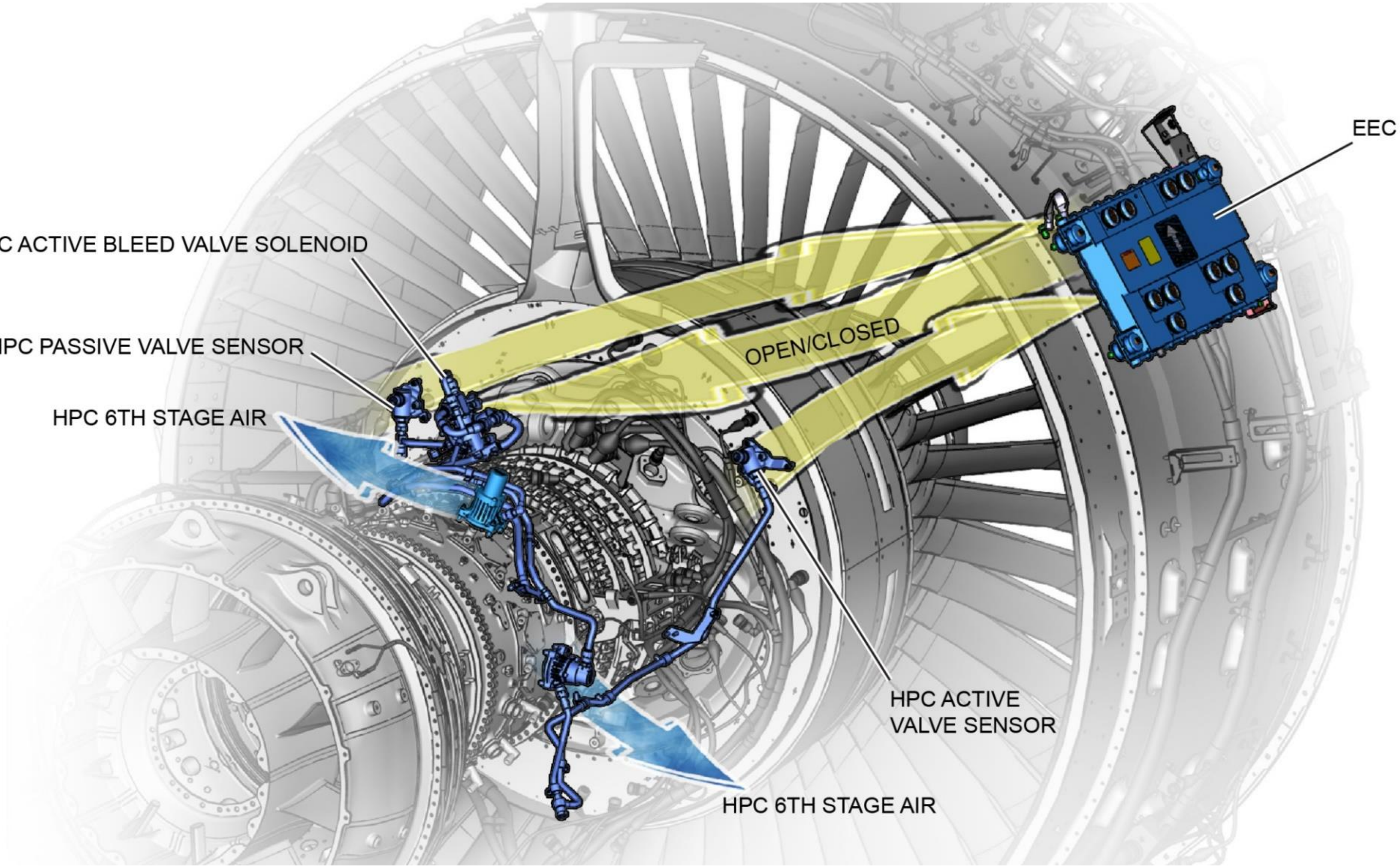
Operation:

When the solenoid is de-energized, the valve is closed, shutting off the flow of HPC PS3 servo pressure.

The valve is open when energized, allowing HPC PS3 servo pressure to flow to the HPC active bleed valve and open it.


HPC PS3 AIR TO HPC
ACTIVE BLEED VALVE
HPC PS3
AIR SUPPLY TO
SOLENOID
SUPPLY
J21
ELECTRICAL
CONNECTOR J21

INTENTIONALLY BLANK


EEC
HPC ACTIVE BLEED VALVE SOLENOID
HPC PASSIVE VALVE SENSOR
OPEN/CLOSED
HPC 6TH STAGE AIR
HPC ACTIVE
VALVE SENSOR
HPC 6TH STAGE AIR

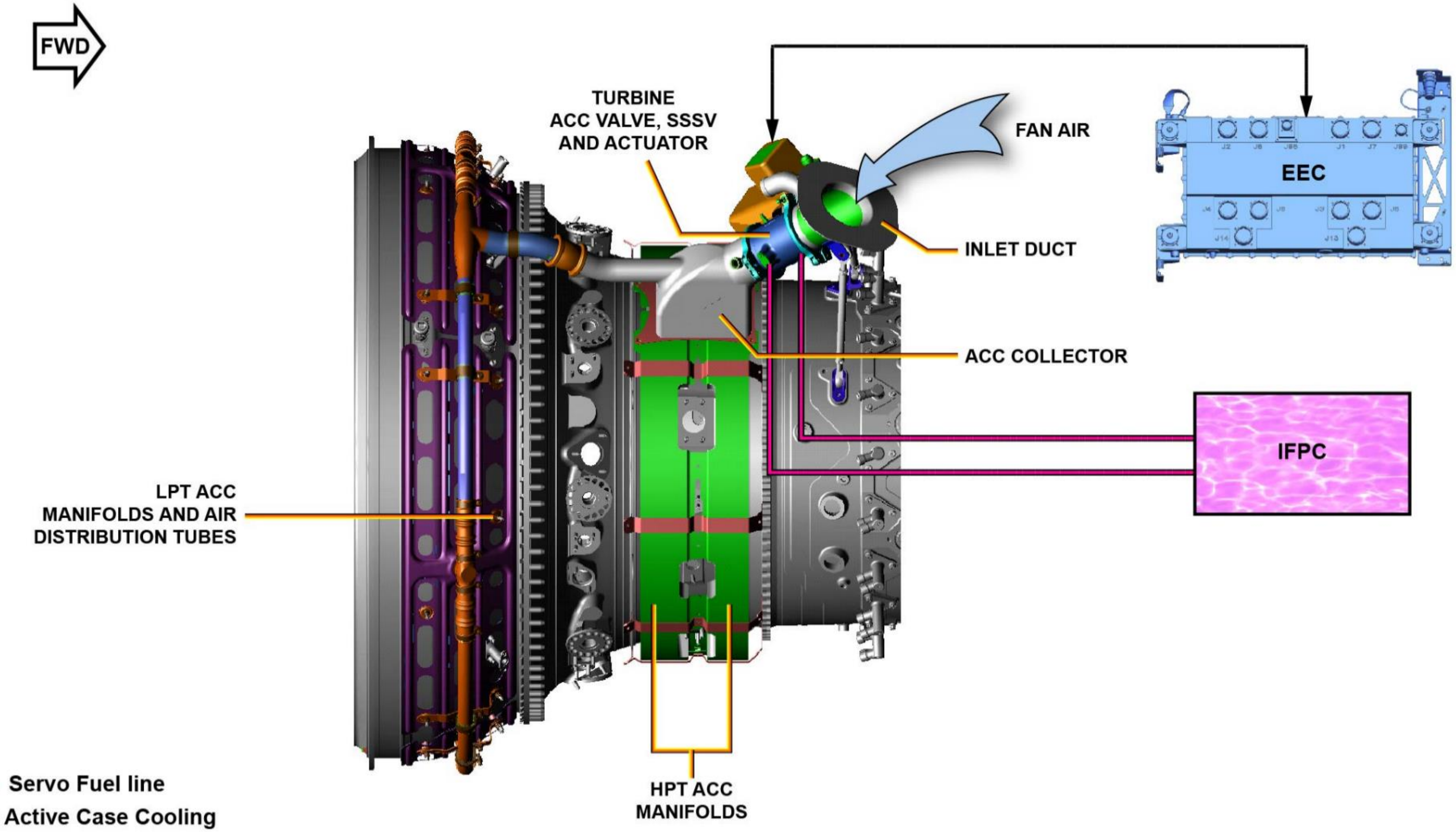
TURBINE ACTIVE CASE COOLING SYSTEM

The Turbine Active Case Cooling (ACC) system cools and controls the expansion of the turbine case to match the radial expansion of the rotary parts; this improves the fuel efficiency and extends the turbine case life.

The EEC modulates the turbine ACC air valve to let some fan air flow be discharged via manifolds and tubes around the LP and HP turbine cases.

The turbine ACC air valve comprises an electrically controlled Single Stage Servo Valve (SSSV) and a fuel operated actuator that operates the butterfly.

An LVDT transmits the piston position to the EEC channel A.



Servo Fuel line
ACC: Active Case Cooling
EEC: Engine Electronic Control
HPT: High Pressure Turbine
IFPC: Integrated Fuel Pump and Control
LPT: Low Pressure Turbine
SSSV: Single Stage Servo Valve

TURBINE ACTIVE CASE COOLING SYSTEM

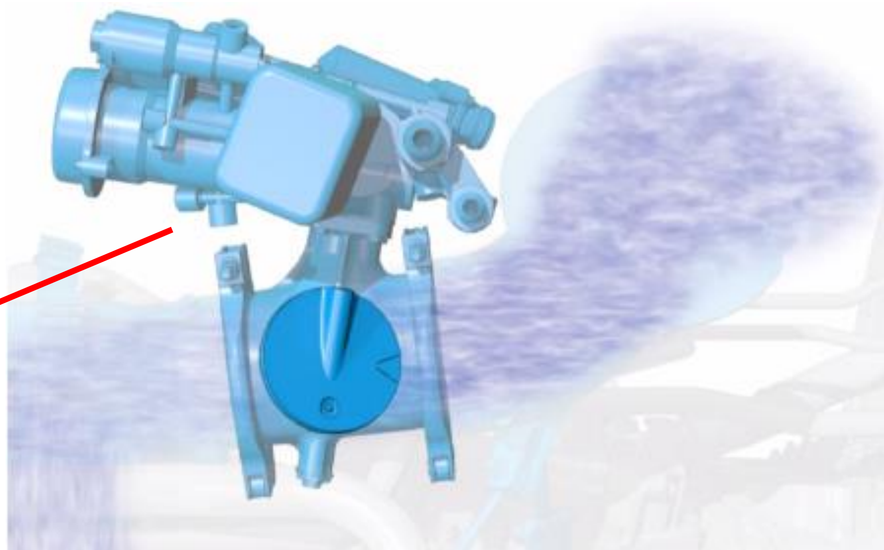
ACTIVE CLEARANCE CONTROL (ACC) SYSTEM

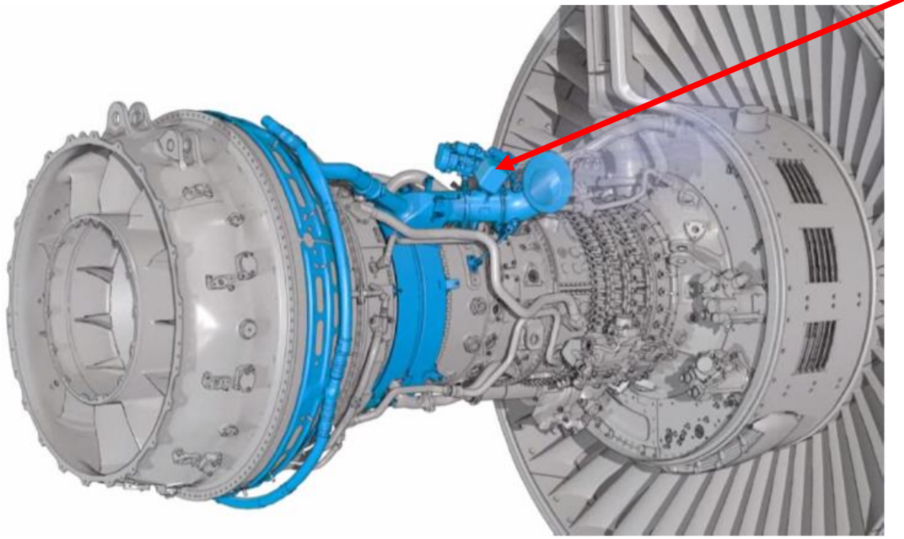
The Active Clearance Control System meters' fan cooling air that is ducted from the nacelle thrust reverser door and sent to the turbine cases.

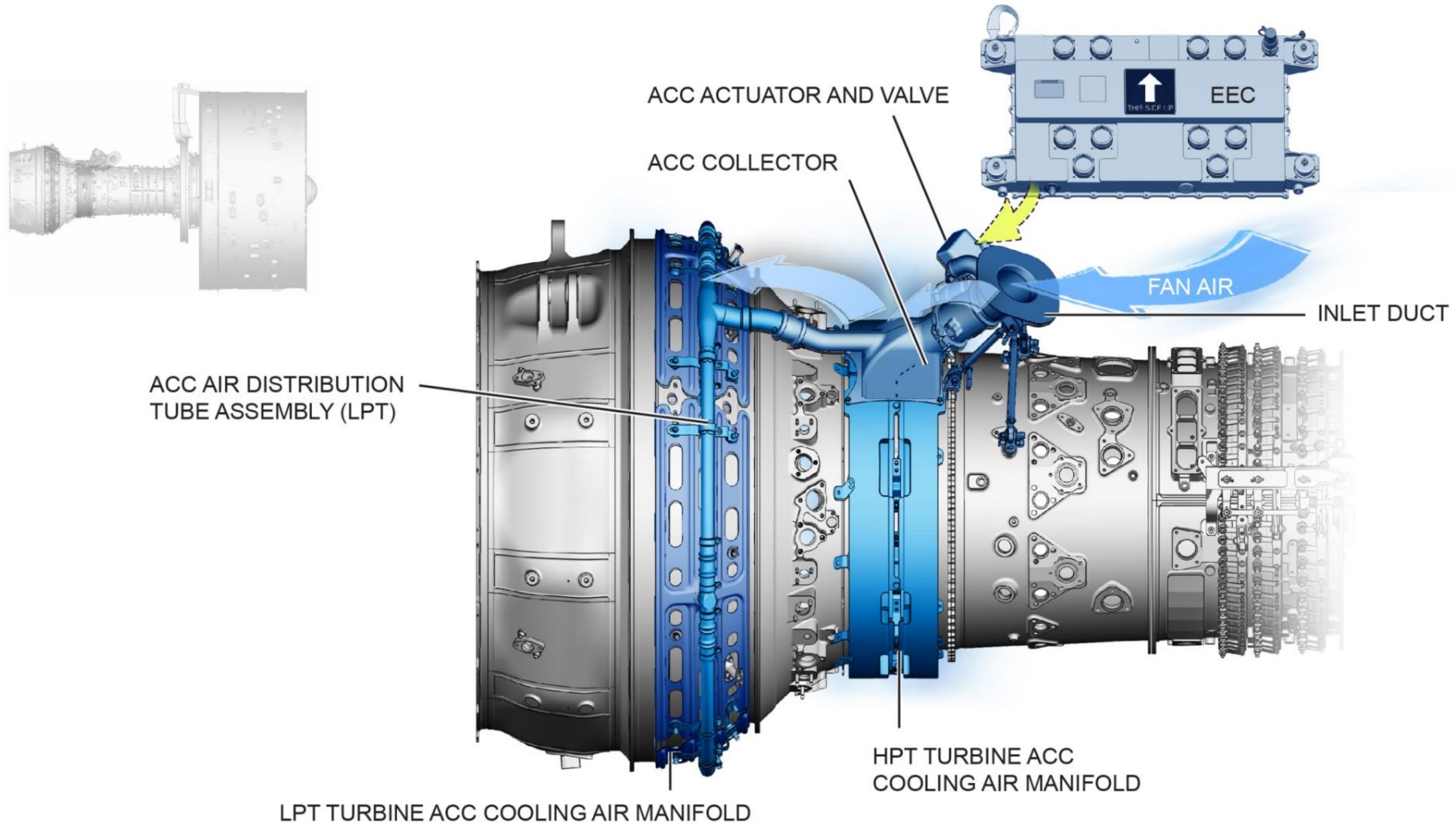
The cooling air limits turbine case growth during thermal expansion, reducing HPT and LPT blade tip clearance and improving fuel efficiency.

The ACC System includes the components shown below.

- Inlet duct
- ACC valve and actuator
- ACC collector
- ACC manifolds for HPT and LPT
- ACC air distribution tube assembly for LPT






ACC ACTUATOR AND VALVE
EEC
ACC COLLECTOR
FAN AIR
INLET DUCT
ACC AIR DISTRIBUTION
TUBE ASSEMBLY (LPT)
HPT TURBINE ACC
COOLING AIR MANIFOLD
LPT TURBINE ACC COOLING AIR MANIFOLD

Inlet Duct

Purpose:

The inlet duct receives and directs fan bypass cooling air to the ACC valve and actuator.

Location:

The inlet duct is located on the diffuser case at 1:00.

Description:

The inlet duct is made of stainless steel.

To prevent cooling air leakage, the outboard side of the duct has a seal land that contacts a bellow seal attached to the nacelle door.

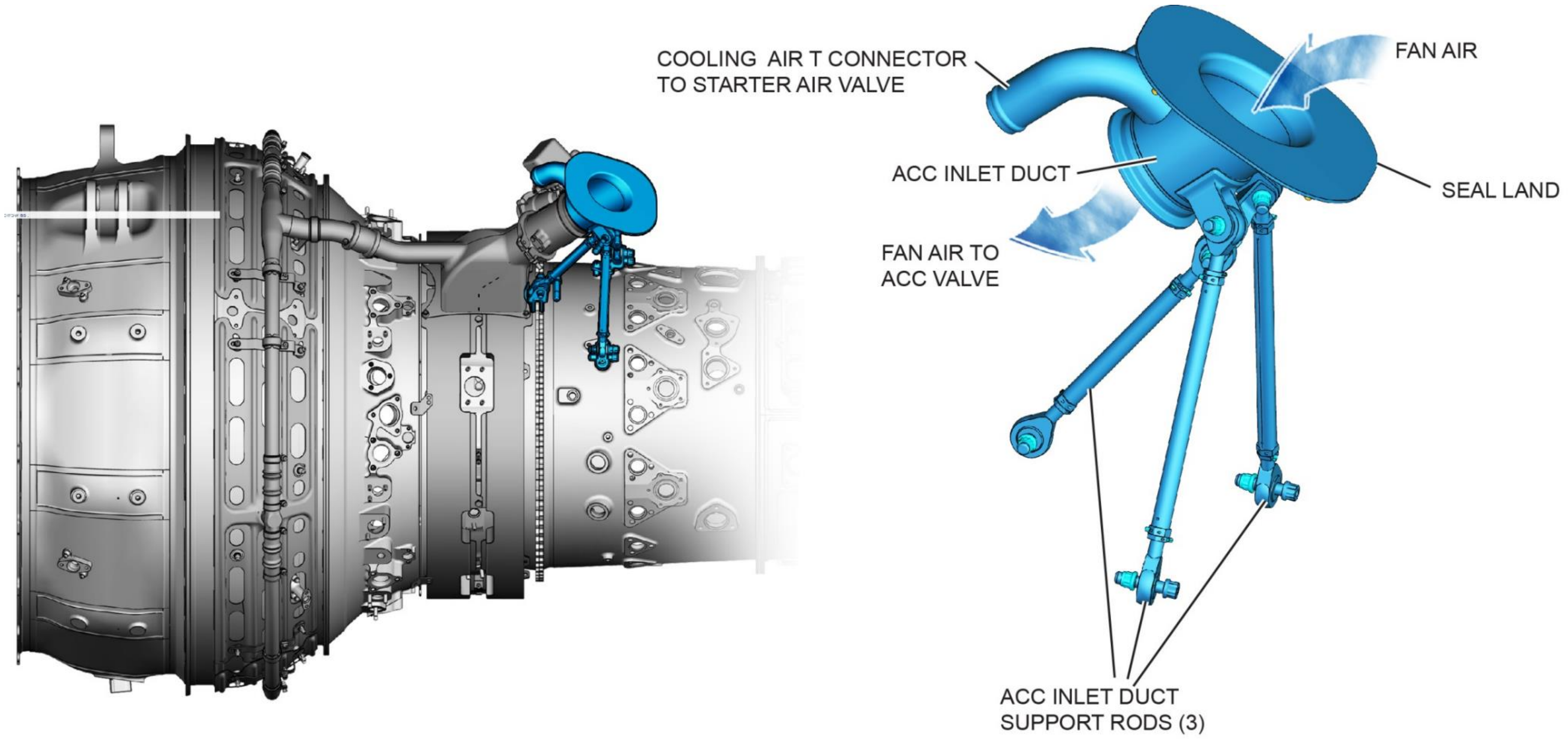
The inboard end of the
duct is attached with a clamp to the ACC valve and actuator.

Three connecting rods bolted to three brackets provide axial support for the inlet duct.

The rods are bolted to the diffuser case at the inboard end and to the inlet duct at the outboard end.

Operation:

Fan bypass air enters the inlet duct via the Inner Fixed Structure of the nacelle.


COOLING AIR T CONNECTOR
TO STARTER AIR VALVE
FAN AIR
ACC INLET DUCT
SEAL LAND
FAN AIR TO
ACC VALVE
ACC INLET DUCT
SUPPORT RODS (3)

ACC Valve and Actuator

Purpose:

The ACC air valve is a fuel-actuated butterfly valve that regulates the flow of cooling air to the turbine cases.

Location:

The air valve and actuator are located on the diffuser case at 1:00.

Description:

The dual-channel valve and actuator are controlled by the EEC based on N2 speed and altitude.

A fuel-actuated piston opens and closes the butterfly valve. The piston is attached via a link to the butterfly valve shaft.

The valve is held in position relative to the shaft by a tapered pin that goes through a hole in the centre shaft.

The valve and actuator are attached to the ACC collector with a clamp and a seal that prevent leakage between the components.

A single-channel LVDT is mechanically coupled to the actuator piston to provide an electrical feedback signal to Channel A of the EEC.

Operation:

1. During engine operation, the EEC sends electrical command signals to a dual channel torque motor that is part of the valve and actuator.

2. The torque motor uses the signals to direct pressurized fuel to either side of the actuator piston to achieve the commanded position.

3. The piston opens and closes the butterfly valve, sending bypass airflow to the HPT and LPT case cooling manifolds.

The airflow cools and actively controls turbine case expansion to match the radial expansion of the rotor.

During normal engine operation, the valve is closed at start and idle, partially open at take-off and climb, and fully open at cruise.

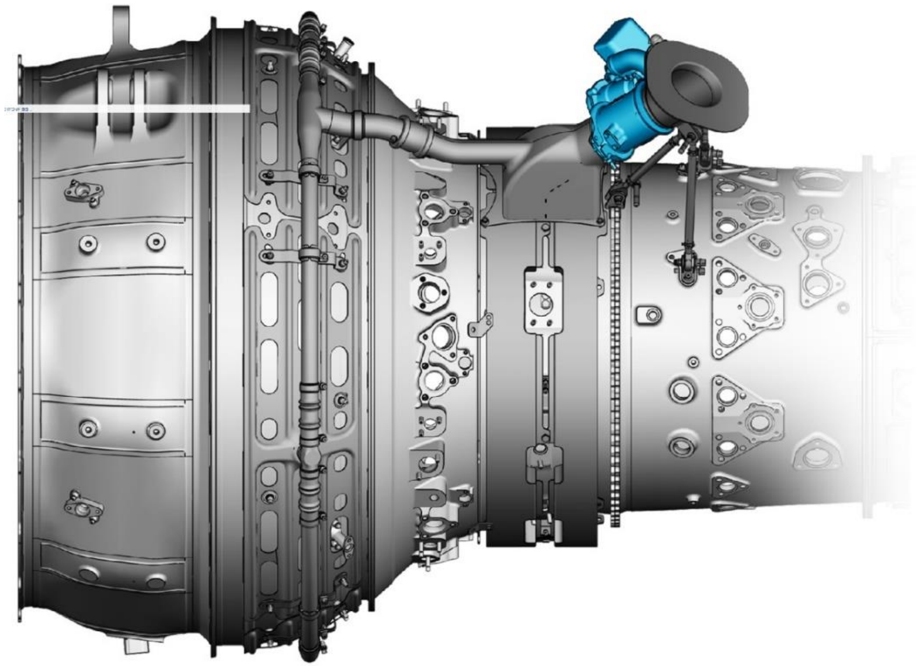
In the event of electrical power loss, the fail-safe mode of the valve and actuator is closed.

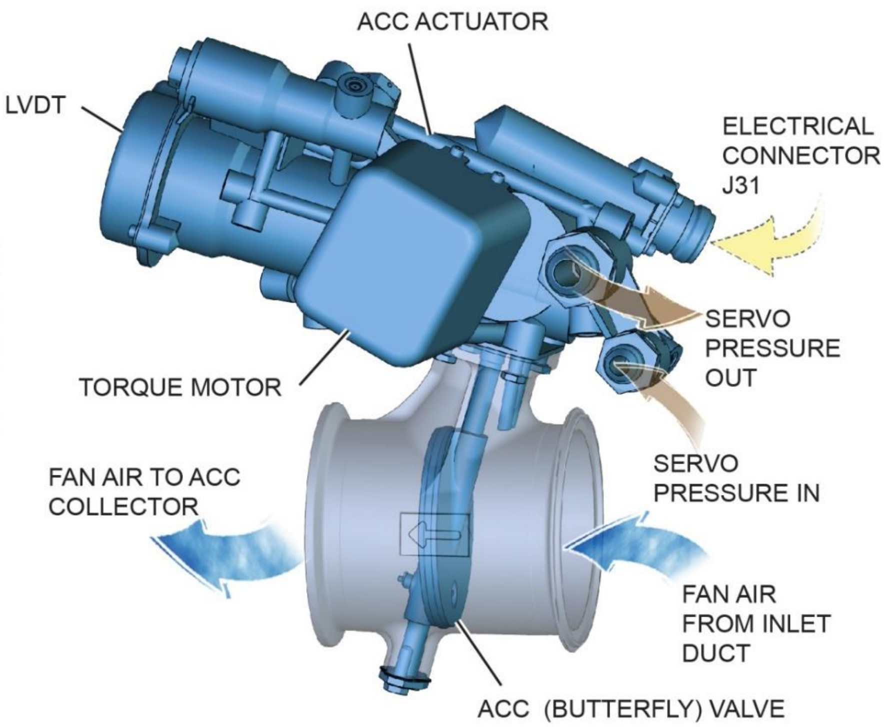
Safety Conditions

CAUTION

DO NOT BEND THE FUEL TUBES WHEN YOU DISCONNECT THEM FROM THE VALVE.

DAMAGE TO THE FUEL TUBES WILL OCCUR IF TOO MUCH FORCE IS APPLIED TO THE TUBES.




ACC ACTUATOR
LVDT
ELECTRICAL
CONNECTOR
J31
SERVO
PRESSURE
OUT
TORQUE MOTOR
SERVO
PRESSURE IN
FAN AIR TO ACC
COLLECTOR
FAN AIR
FROM INLET
DUCT
ACC (BUTTERFLY) VALVE

ACC Collector

Purpose:

The ACC Collector distributes fan cooling air to the ACC HPT and LPT manifolds.

Location:

The collector is located at 2:00 on the HPT case.

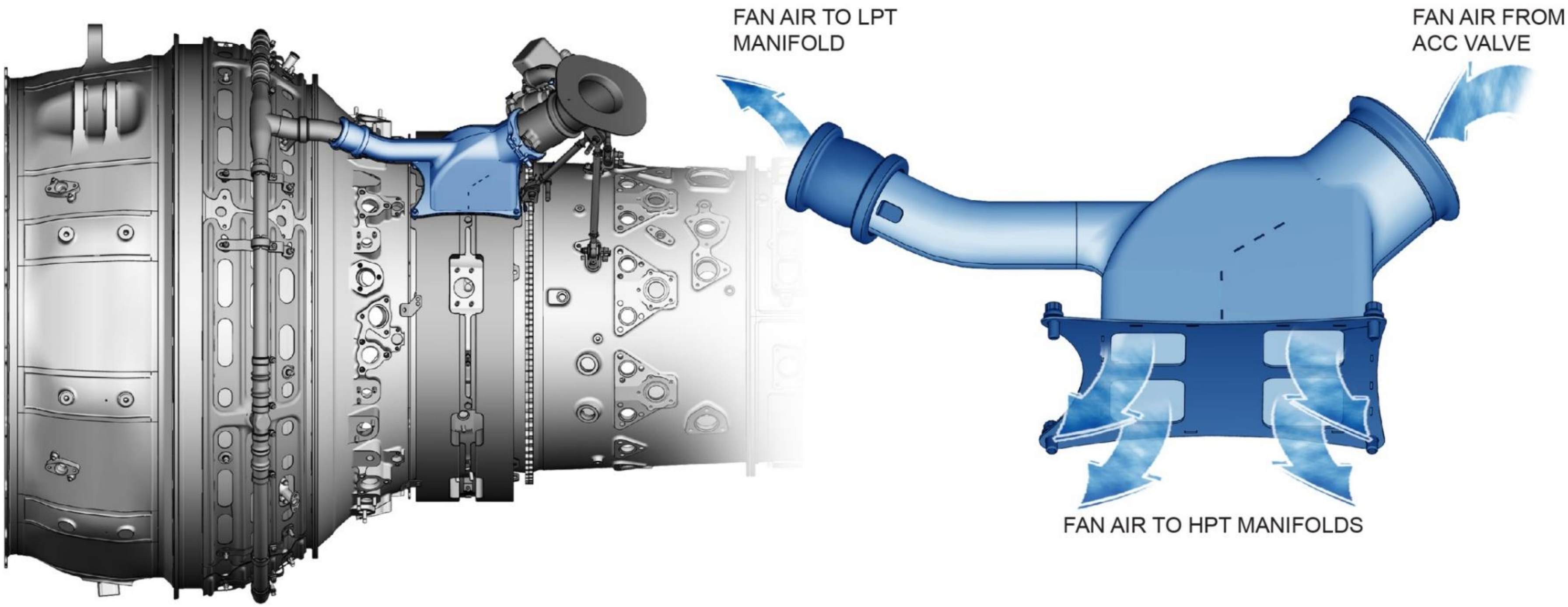
Description:

The stainless-steel collector is attached to the HPT ACC manifolds with four bolts, and attached to the LPT ACC tube using a coupling and two packings.

The packings prevent cooling air leakage.

Operation:

Fan air is routed from the ACC valve into the collector and directed separately to the HPT and LPT manifolds.


FAN AIR TO LPT
MANIFOLD
FAN AIR FROM
ACC VALVE
FAN AIR TO HPT MANIFOLDS

HPT ACC Manifolds

Purpose:

HPT ACC manifolds receive cooling air from the ACC collector and distribute it around the inside of the manifolds.

Location:

The manifolds are located around the diameter of the HPT case.

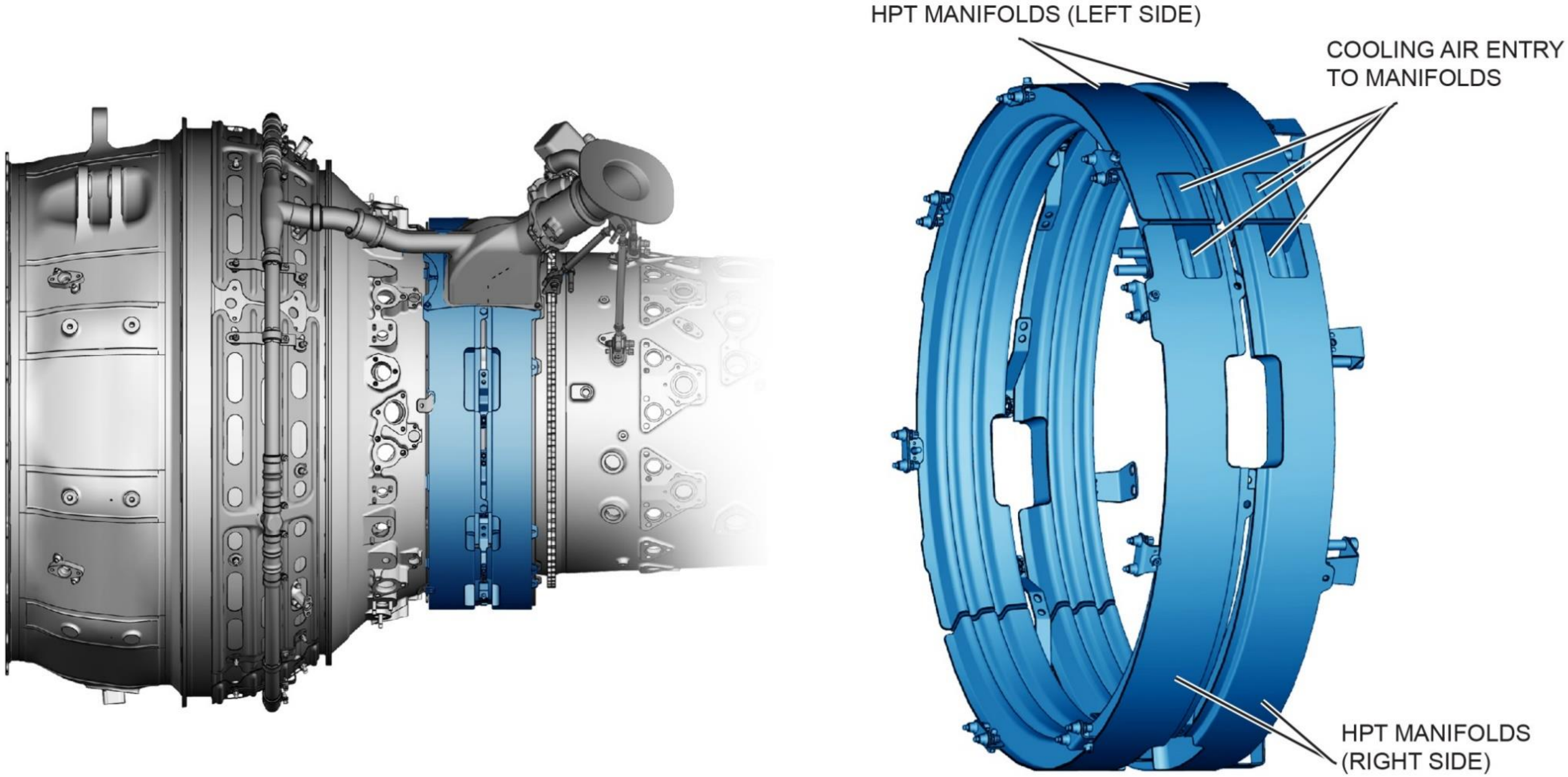
Description:

Two sets of stainless steel manifolds (left and right) are installed on the outside of the HPT case in the same radial plane as the 1st and 2nd stage HPT blades.

They are attached with brackets and bolts to the M and N flanges of the HPT case.

Operation:

Cooling air exits the HPT ACC manifolds through small holes on the inner diameter, cooling the HPT case.


HPT MANIFOLDS (LEFT SIDE)
COOLING AIR ENTRY
TO MANIFOLDS
HPT MANIFOLDS
(RIGHT SIDE)

LPT ACC Manifolds

Purpose:

LPT ACC manifolds supply cooling air from the ACC collector to the outside of the LPT case.

Location:

The manifolds are located around the diameter of the LPT case.

Description:

The stainless-steel manifolds are installed onto 24 studs in the LPT outer case and secured with 24 nuts.

Each manifold has an integral tube stand-off that mates with a manifold connector on the LPT Air Distribution Tube Assembly.

LPT Air Distribution Tube Assembly

Purpose:

The LPT Air Distribution Tube Assembly receives cooling air from the ACC collector and distributes the air onto the LPT case.

Location:

The assembly is attached to the LPT case.

Description:

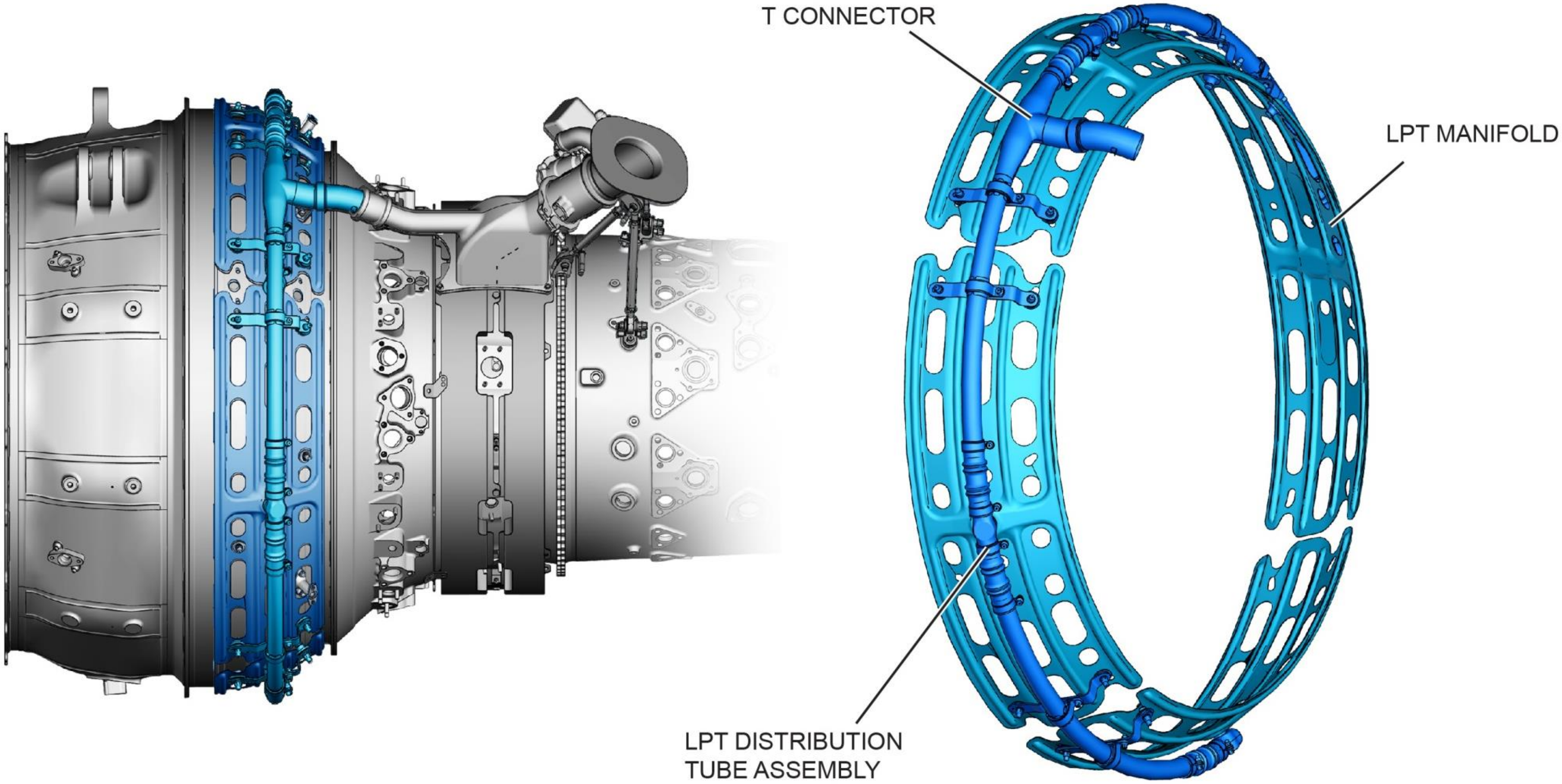
The assembly consists of three separate sections, six tube couplings and four manifold connectors.

One of the three tube sections have an integral T connector that receives air from the ACC collector.

Tube couplings connect the tube sections to the manifold connectors.

The couplings fit over the outside diameter of the tube sections and manifold connectors, and are secured with 12 clamps.

The tube sections are attached to the LPT case with seven clamps installed on seven brackets attached to the case studs.


T CONNECTOR
LPT MANIFOLD
LPT DISTRIBUTION
TUBE ASSEMBLY

TURBINE COOLING AIR SYSTEM

The Turbine Cooling Air (TCA) System is a passive system that provides a continuous flow of cooling air inside the turbine cases.

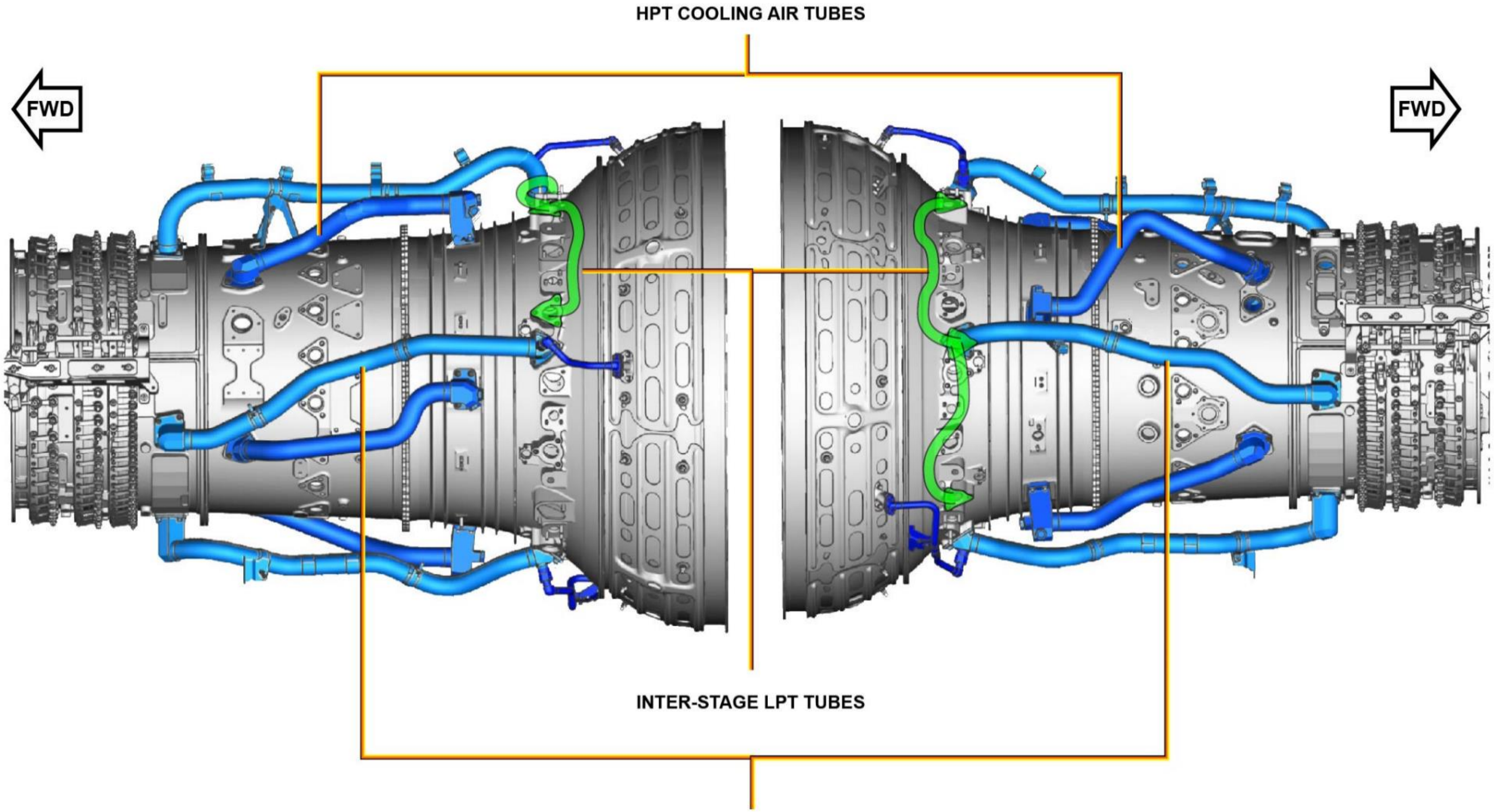
The system consists of 19 external tubes or jumpers that direct calibrated HPC bleed air (3rd and 6th stages) to the followings:

High Pressure Turbine (HPT) 2nd stage vanes,

Inter-stage HPT cavity,

Turbine Intermediate Case (TIC) Stator Vanes, including the inner and outer diameter cavities,

Low Pressure Turbine (LPT) case outer cavity and LPT rotor inter-stage cavities.



HPT: High Pressure Turbine

LPT: Low Pressure Turbine

TIC: Turbine Intermediate Case

TURBINE COOLING AIR SYSTEM

TURBINE COOLING AIR (TCA) SYSTEM

The Turbine Cooling Air System provides continuous cooling air to the High-Pressure Turbine (HPT 2nd stage vanes, the inter-stage HPT cavity) Turbine Intermediate Case (The TIC stator vanes (which include Outside Diameter (OD) and Inside Diameter (ID) cavities) Low Pressure Turbine. (the LPT case outer cavity, and the LPT rotor inter-stage cavities).

Engine parts cooled by the system are shown below.

High Pressure Turbine 2nd Stage vanes between the 1st and 2nd stage rotors

HPT 2nd Stage blade attachment

Turbine Intermediate Case (TIC) fairings

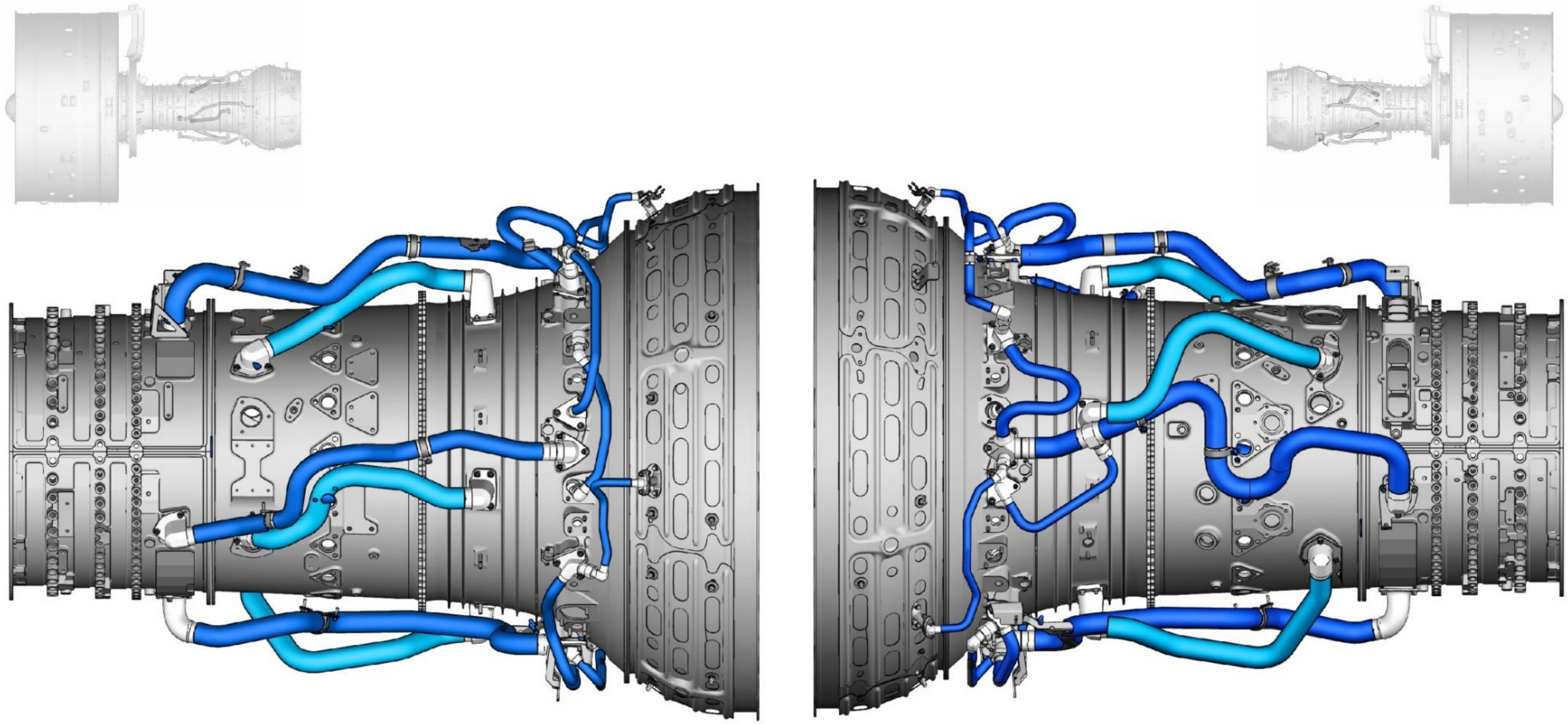
LPT case

LPT rotor and blade attachments

Jumper and cooling air tubes for each component are shown in the table.

The TCA system has four HPT cooling air tubes. The TIC/LPT has four main TCA tubes, eight TIC jumper air tubes and three jumper air tubes that supply air to the LPT case

<table>
<tr><th>Component</th><th>Jumper Air Tubes</th><th>Cooling Air Tubes</th></tr>
<tr><td>HPT</td><td>N/A</td><td rowspan="3">4</td></tr>
<tr><td>TIC</td><td rowspan="2">8</td></tr>
<tr><td>LPT rotor</td></tr>
<tr><td>LPT case</td><td>3</td><td>N/A</td></tr>
</table>



High Pressure Turbine Cooling Air Tubes

Purpose:

HPT cooling air provides continuous airflow of 6th Stage bleed air to the HPT 2nd Stage vanes.

Location:

The airflow tubes are located approximately 90° apart at these positions: 1:00, 5:00, 7:00, 10:00.

Description:

The system consists of four TCA air tubes that provide cooling airflows into the hollow vanes, and through passages that exit out of the trailing edges of vanes and vane platforms.

The air is metered by plates located between the HPT case and tubes.

Cooling Air

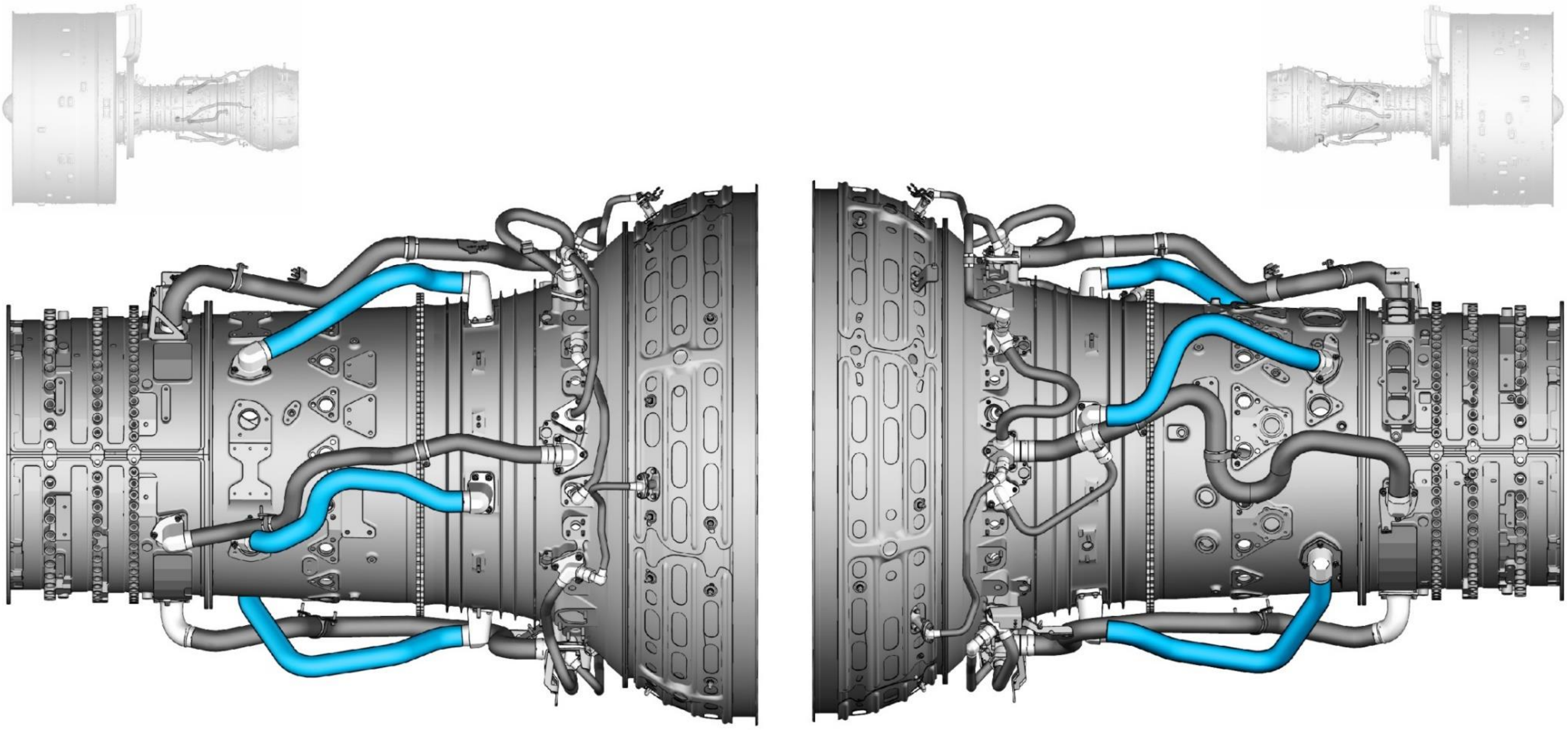
1 The HPT TCA system supplies continuous flow of 6th stage bleed air to the HPT 2nd stage vanes for cooling.

2 The HPT TCA system has four TCA air tubes that are installed approximately 90 degrees apart on the engine core.

3 This air is controlled by plates which are located between the HPT case and the TCA tubes.

4 The cooling air flows into the hollow vanes and through passages that go out of the trailing edge of the vanes and on the inner and outer platforms.

5 Cooling air is also supplied through the vanes to the interstage HPT cavity.



HPT COOLING AIR TUBES (HPT 6th STAGE AIR)

Turbine Intermediate Case/ Low Pressure Turbine Cooling Air Tubes

Purpose:

TIC/LPT cooling air provides continuous flow of HPC 3rd Stage bleed air to the Turbine Intermediate Case and LPT case and rotor.

Location:

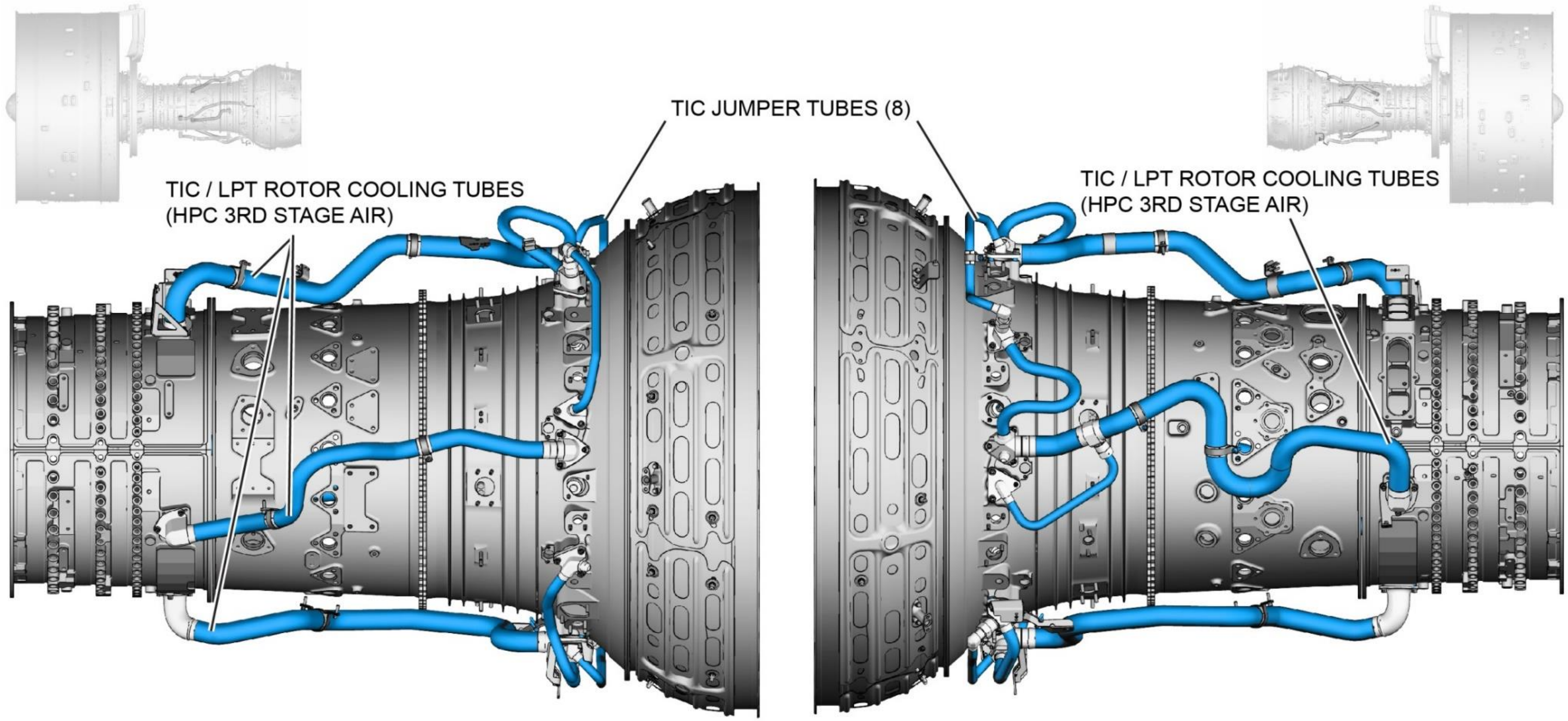
Four TIC cooling air tubes cool the TIC fairings, as well as the inner and outer TIC walls known as transition ducts.

The tubes are positioned at 3:30, 6:00, 8:00 and 11:00.

Eight jumper tubes are installed around the radius of the TIC fairing and three more are located on the LPT case at 12:00, 4:30 and 9:00.

Description:

The eight additional jumper tubes that feed off the four cooling tubes send air through the TIC connecting rods to the Low-Pressure Turbine rotors and blade attachments.



TIC/LPT FRONT ROTOR COOLING AIR TUBES (HPC 3rd STAGE AIR)

Low Pressure Turbine Cooling Air Tubes

Purpose:

The LPT TCA jumper tubes direct cooling air between the LPT outer case and Second Stage vanes.

Location:

The three jumper tubes are located on the LPT case at 12:00, 4:30 and 9:00.

Cooling Air

1 The TIC/LPT TCA tubes supply continuous flow of HPC 3rd stage bleed air to the TIC and LPT case for cooling.

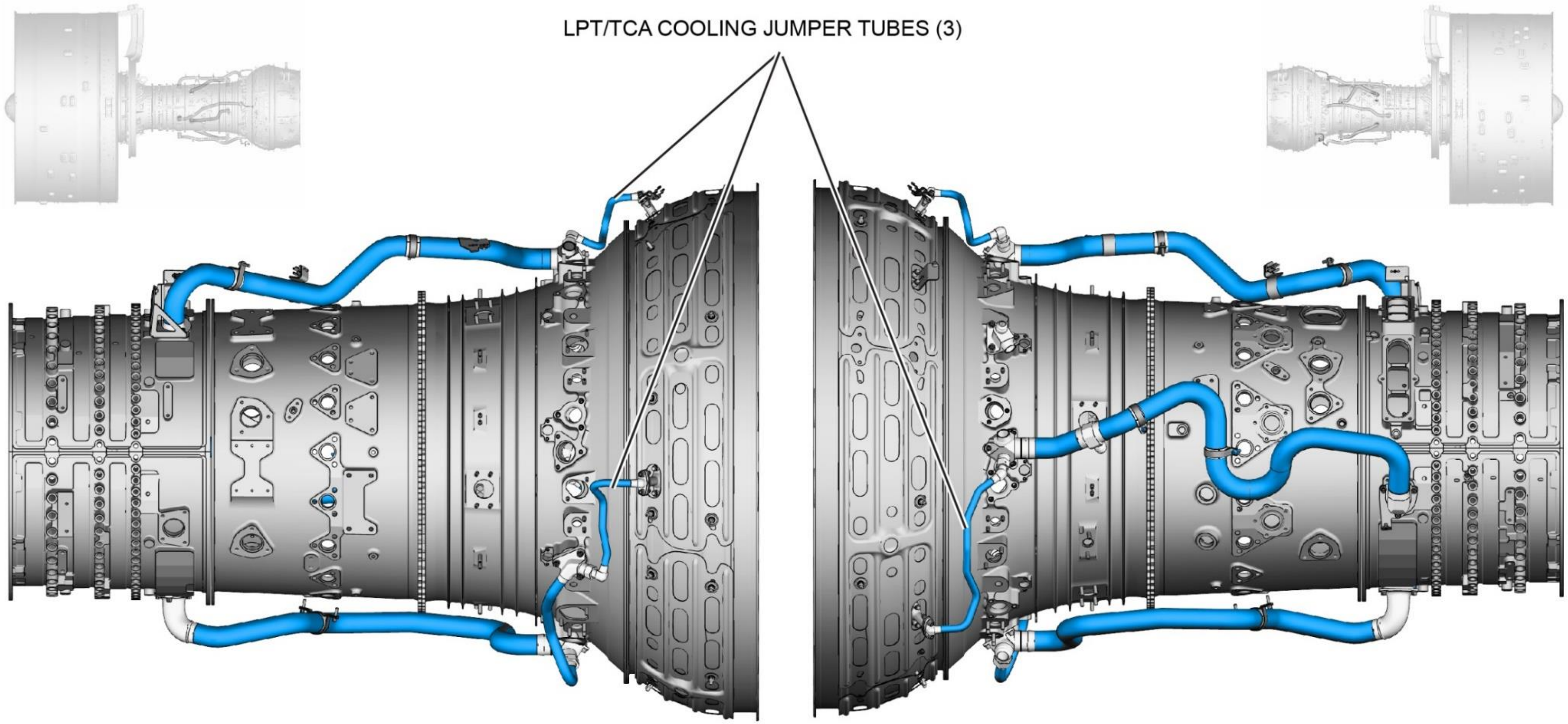
2 This air cools the TIC fairings and the inner and outer TIC walls.

3 Cooling air flows to the TIC through TIC jumper tubes (eight each) located on the HPT case.

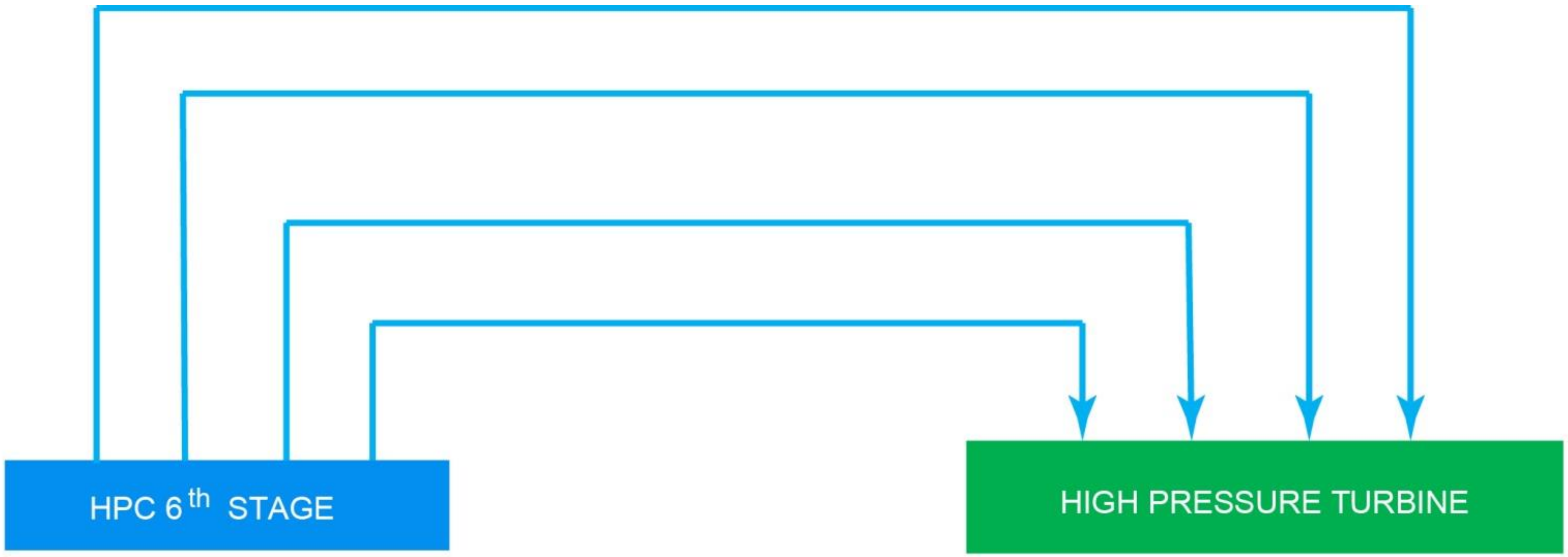
4 This air is controlled by plates located between the TIC and the jumper tubes.

5 There are an additional three jumper tubes connected to the TIC/LPT TCA tubes. These tubes supply cooling air to the LPT outer case.

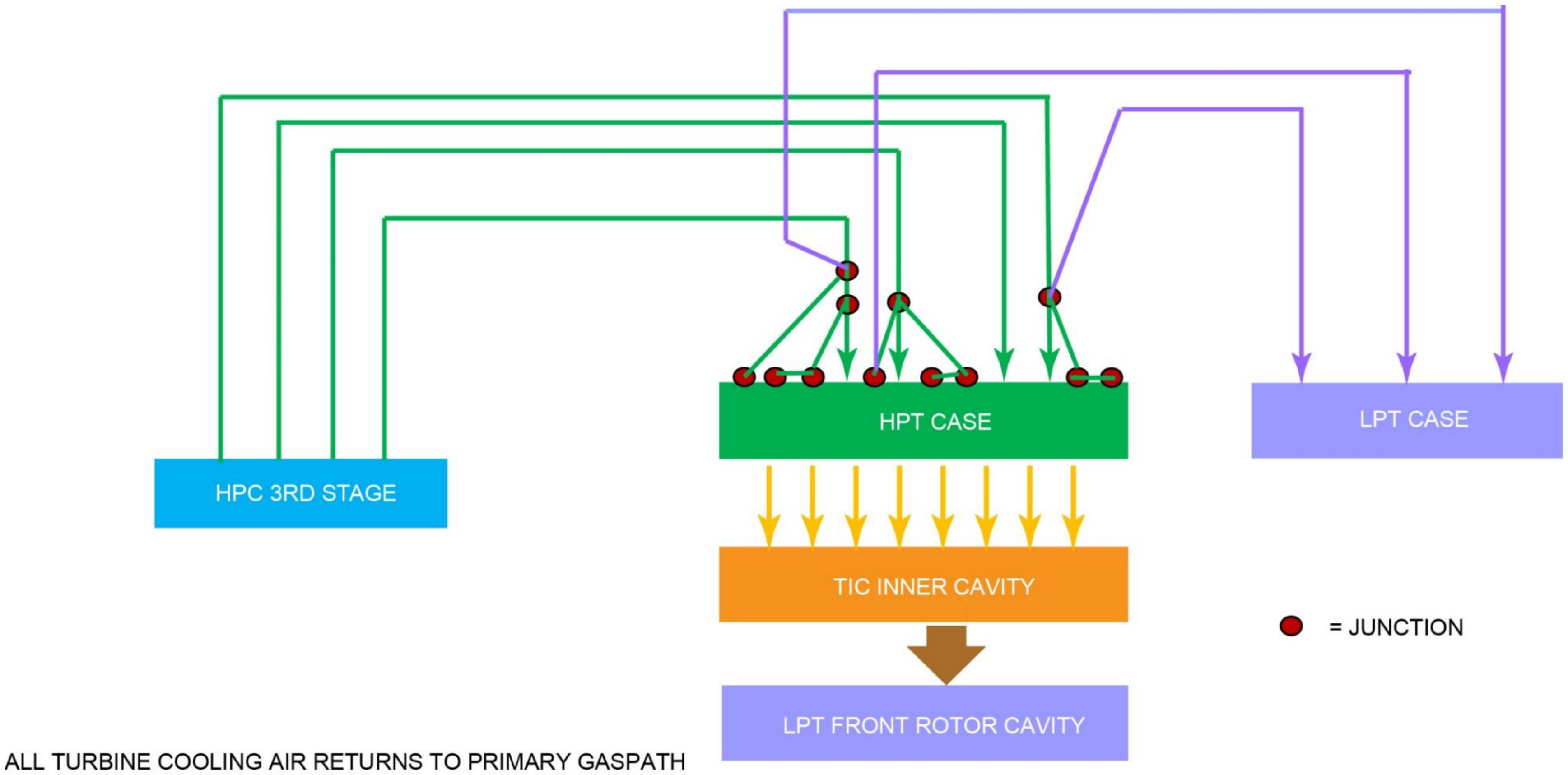
6 This air is also controlled by plates located between the LPT case and the LPT TCA jumper tubes.



LPT/ TCA COOLING (HPC 3RD STAGE AIR)



HPT AIR SYSTEM SCHEMATIC



TIC/LPT TCA AIR SYSTEM SCHEMATIC

ENGINE BEARING COOLING SYSTEM

The engine bearing cooling system provides cooling buffer air to the engine main bearing compartments and supplies sealing air to prevent oil leakage.

It consists of:

- the buffer/ventilation system for bearing numbers 1, 1.5, 2, 3, 5 and 6,
- the engine bearing cooling system for bearing number 4.

BUFFER / VENTILATION SYSTEM

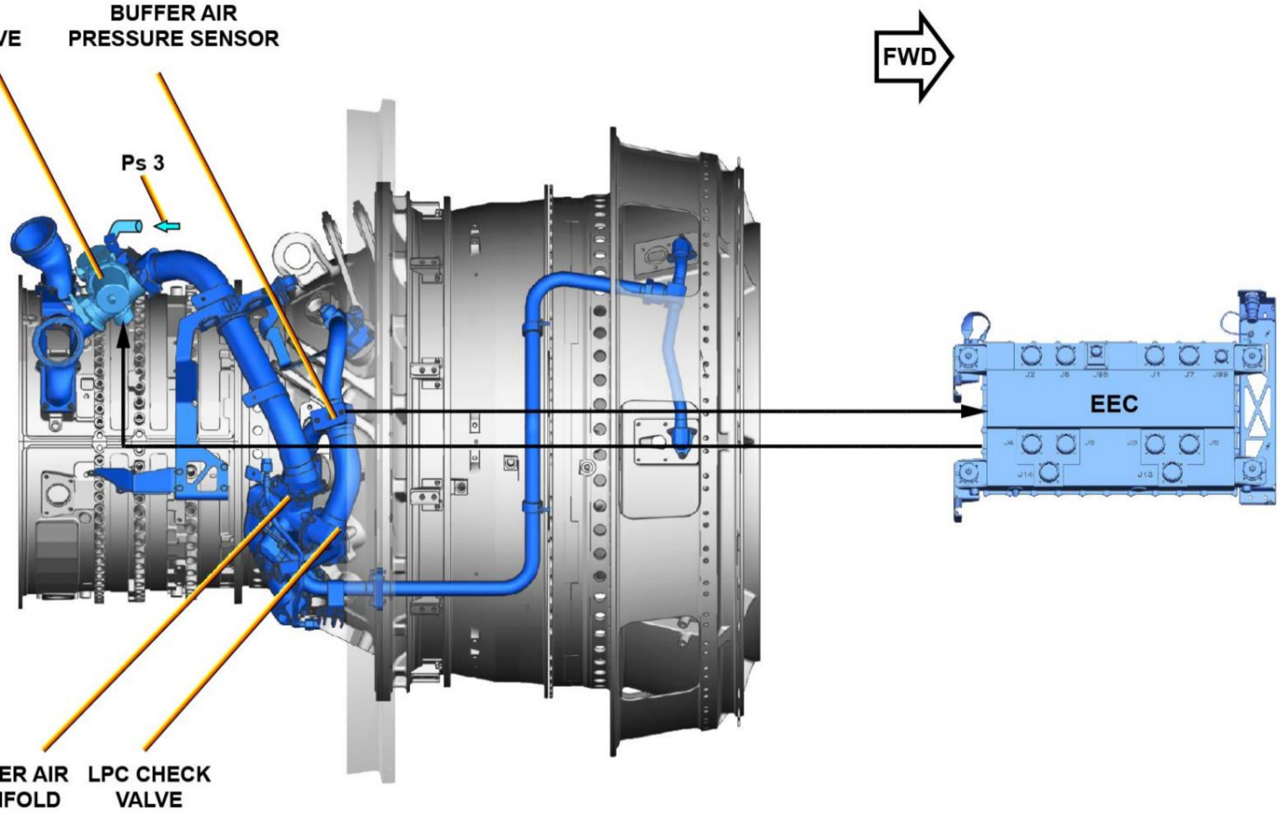
The bearing compartments numbers 1, 1.5, 2, 3, 5 and 6 are cooled and pressurized by the HPC 3rd stage through the LP buffer shutoff valve at low power or by the 2.5 bleed air valve at high power through the LPC check valve.

The LPC check valve is a passive device that is open until the HPC 3rd stage pressure delivered by the LP buffer shutoff valve is higher than the 2.5 pressure, to prevent a reverse flow.

The LP buffer shutoff valve is open through the integrated EEC controlled HPC buffer shutoff valve solenoid thanks to Ps3 pressure.

The cooling buffer air is distributed to the bearing compartments via external and internal tubing, including LP shaft.

For monitoring, the Buffer Air Pressure Sensor (BAPS) provides a buffer air pressure signal to both EEC channels.



Command line (Ps3)

EEC: Electronic Engine Control

LPC: Low Pressure Compressor

BUFFER / VENTILATION SYSTEM

ENGINE BEARING COOLING SYSTEM

The Engine Bearing Cooling System provides cooling buffer air to the engine main bearing compartments.

It also supplies sealing air to prevent oil leakage.

The system consists of the Buffer Cooling and Bearing Ventilation subsystems.

Buffer Cooling System Components are listed below.

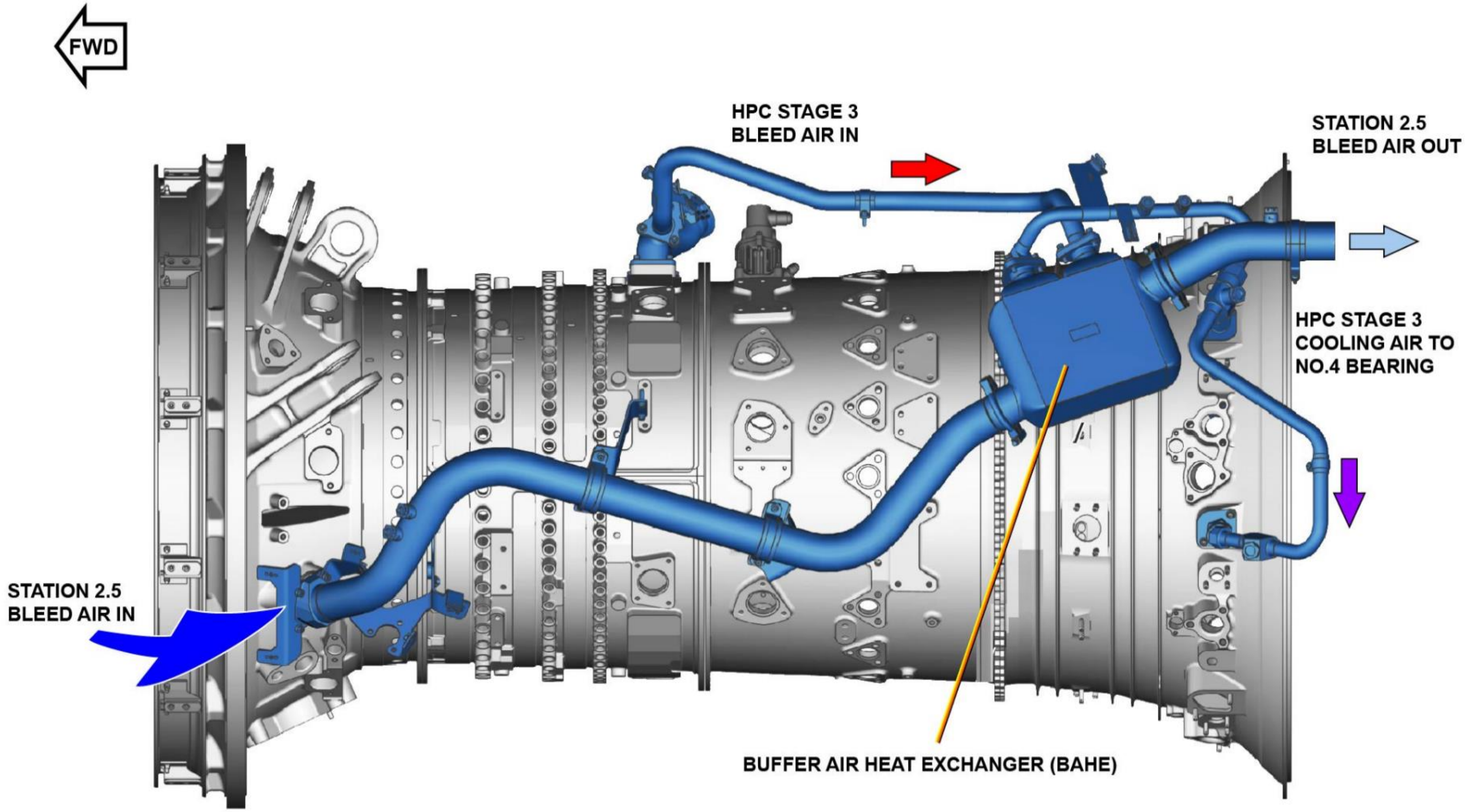
Buffer Air Heat Exchanger BAHE

External cooling tubes

NUMBER 4 BEARING COOLING SYSTEM

The Buffer Air Heat Exchanger (BAHE) uses station 2.5 bleed air to cool HPC 3rd stage air before it is delivered to the number 4 bearing housing.

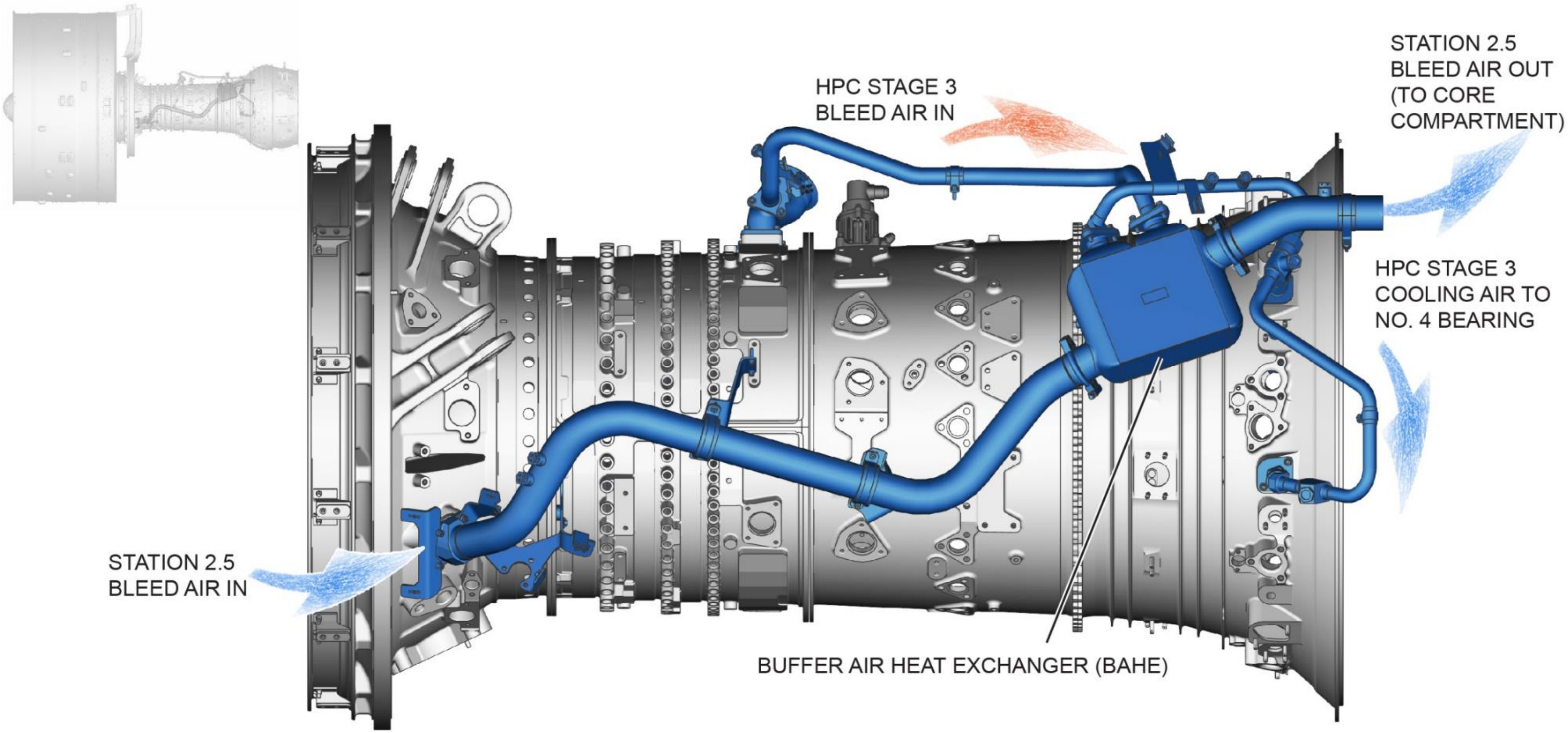
The station 2.5 air exits the BAHE and is routed into the core area.



HPC: High Pressure Compressor

ENGINE BEARING COOLING SYSTEM

The Buffer Cooling System cools the No. 4 Bearing compartment by sending 3rd Stage high compressor bleed air through the Buffer Air Heat Exchanger.


HPC STAGE 3
BLEED AIR IN
STATION 2.5
BLEED AIR OUT
(TO CORE
COMPARTMENT)
HPC STAGE 3
COOLING AIR TO
NO. 4 BEARING
STATION 2.5
BLEED AIR IN
BUFFER AIR HEAT EXCHANGER (BAHE)

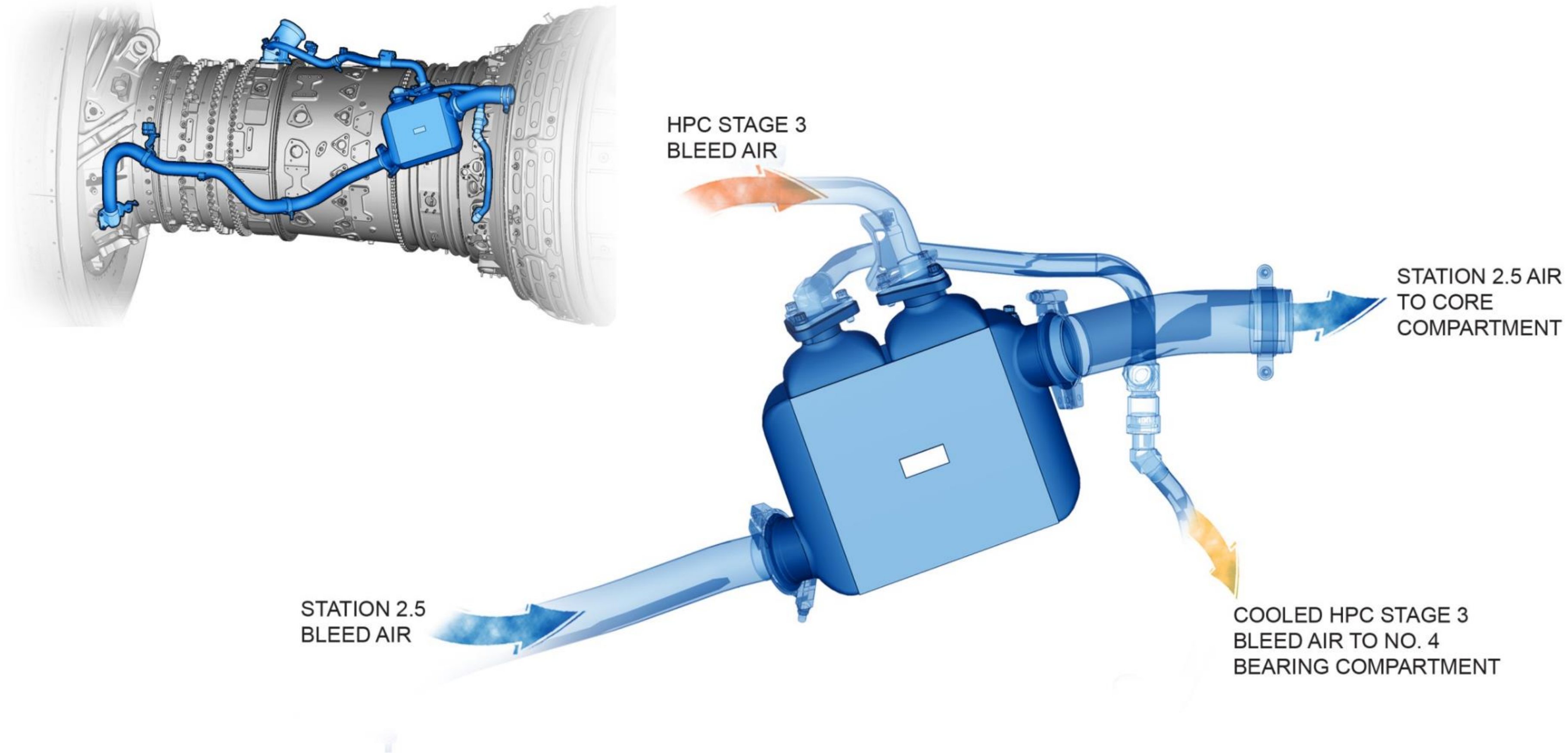
Buffer Air Heat Exchanger (BAHE)

Purpose:

The Buffer Air Heat Exchanger uses Station 2.5 bleed air to cool HPC 3rd Stage Air before its delivery to the No. 4 Bearing housing.

Location:

The BAHE is attached to the diffuser case at 11:00.


HPC STAGE 3
BLEED AIR
STATION 2.5 AIR
TO CORE
COMPARTMENT
STATION 2.5
BLEED AIR
COOLED HPC STAGE 3
BLEED AIR TO NO. 4
BEARING COMPARTMENT

Engine Bearing Cooling

The main components of the cooling system are the buffer air heat exchanger, the external cooling air tubes and the internal buffer air tubes.

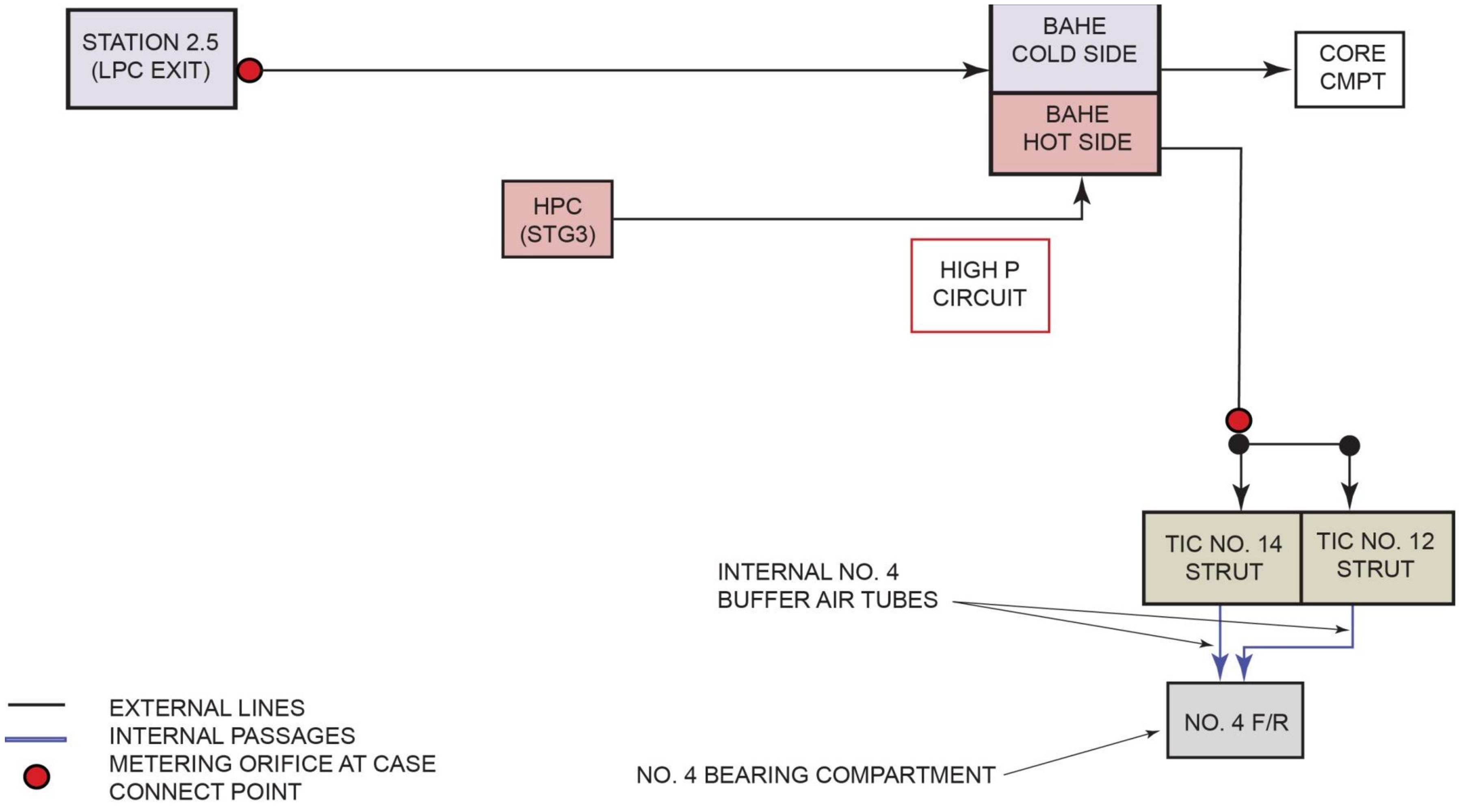
1 The No. 4 bearing compartment buffer air is supplied from the 3rd stage high compressor bleed plenum by the pneumatically controlled LP buffer shutoff valve.

2 The high compressor supply air enters the buffer air heat exchanger through external plumbing. It then flows through the two-pass plate fin, air-to-air heat exchanger.

3 Cooling air is supplied to the heat exchanger from the LPC discharge air (station 2.5 air). The station 2.5 air exits the heat exchanger and dischargers into the core area.

4 The cooled high compressor discharge air is then routed to the No. 4 bearing compartment by internal and external plumbing.

5 At the bearing compartment, the cooled air flows around the compartment wall of the bearing housing to cool the bearing compartment.


STATION 2.5
(LPC EXIT)
BAHE
COLD SIDE
CORE
CMPT
BAHE
HOT SIDE
HPC
(STG3)
HIGH P
CIRCUIT
TIC NO. 14
STRUT
TIC NO. 12
STRUT
INTERNAL NO. 4
BUFFER AIR TUBES
NO. 4 F/R
NO. 4 BEARING COMPARTMENT
EXTERNAL LINES
INTERNAL PASSAGES
METERING ORIFICE AT CASE
CONNECT POINT

Bearing Ventilation System

The Bearing Ventilation System controls the flow of HPC Stage 3 air to maintain the proper air pressure at bearing compartment nos. 1, 2, 3, and 5/6, ensuring proper functioning of the carbon seals.

During engine start and at high power settings, pressurized air is provided from LPC exit stage 2.5 bleed air.

At low engine power settings, pressurized air is provided from the HPC 3rd Stage.

See the components below.

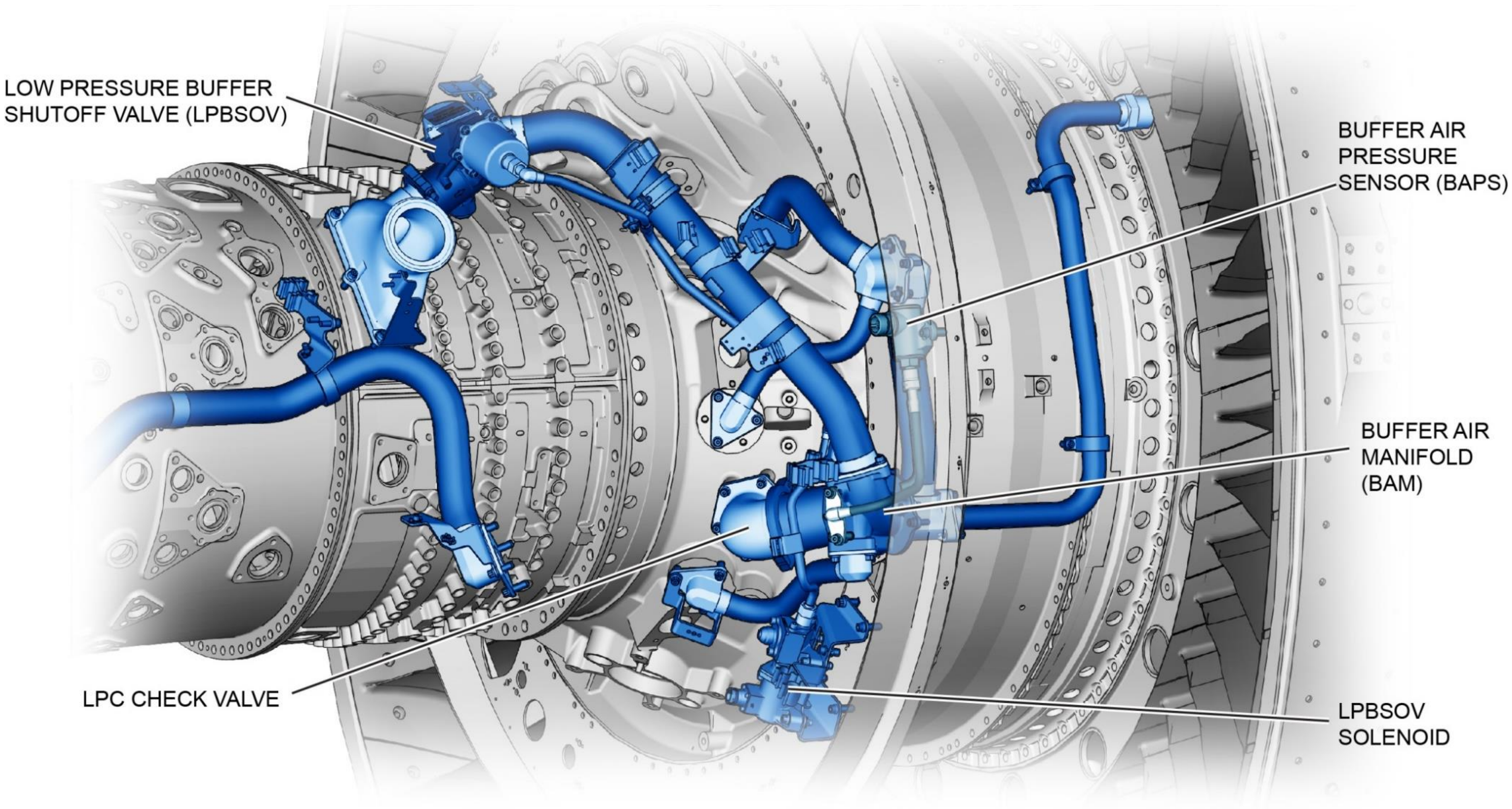
Low Pressure Buffer Shutoff Valve LPBSOV

Low Pressure Buffer Shutoff Valve solenoid

Low Pressure Compressor check valve

Buffer Air Pressure Sensor BAPS

Buffer Air Manifold BAM


LOW PRESSURE BUFFER
SHUTOFF VALVE (LPBSOV)
BUFFER AIR
PRESSURE
SENSOR (BAPS)
BUFFER AIR
MANIFOLD
(BAM)
LPC CHECK VALVE
LPBSOV
SOLENOID

(a) The main components of the buffer/ventilation system are the Low Pressure (LP) buffer shutoff valve, the LP buffer shutoff valve solenoid, the Low-Pressure Compressor (LPC) check valve, the Buffer Air Temperature Sensor (BATS), the buffer air pressure sensor, the buffer air manifold, the external buffer air tubes and the internal buffer air tubes.

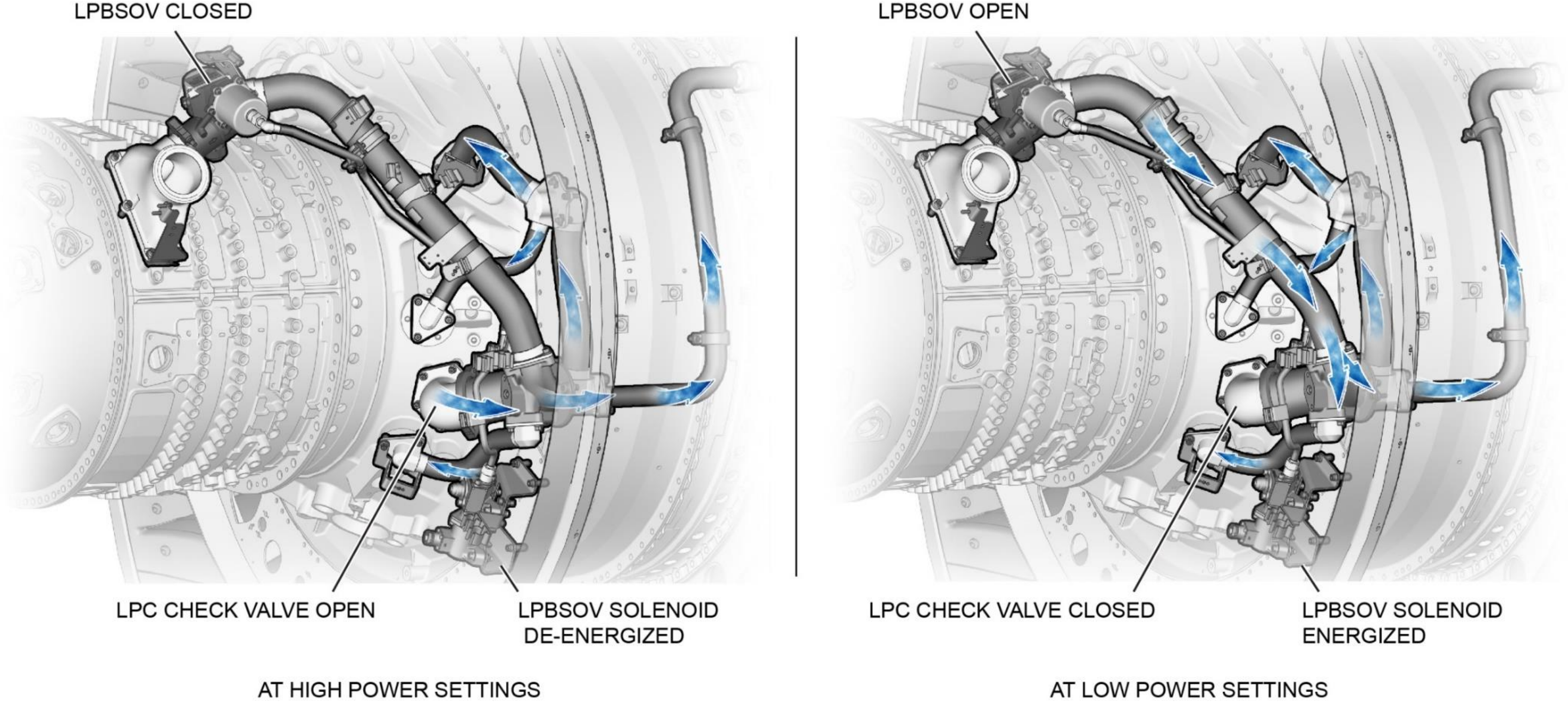
(b) Buffer air for the No. 1, 2, 3, 5 and 6 bearing compartments is supplied from the 3rd stage HPC and the LPC by the LP buffer shutoff valve which is controlled by the LP buffer shutoff valve solenoid.

(c) The LP buffer shutoff valve solenoid is operated by the buffer air pressure sensor.

(d) The BATS is installed on external tubing and a C-seal is used to provide a seal and prevent air leaks.

The BATS provides a buffer air temperature signal to the Electronic Engine Control (EEC).

(e) Buffer air goes out of the No. 3 bearing forward seal area then flows through the Low-Pressure Turbine (LPT) shaft inner diameter to the No. 5 and 6 bearing compartment.


LPBSOV CLOSED
LPC CHECK VALVE OPEN
LPBSOV SOLENOID DE-ENERGIZED
AT HIGH POWER SETTINGS
LPBSOV OPEN
LPC CHECK VALVE CLOSED
LPBSOV SOLENOID ENERGIZED
AT LOW POWER SETTINGS

Low Pressure Buffer Shutoff Valve (LPBSOV)

Purpose:

The Low-Pressure Buffer Shutoff Valve provides discrete (on/off) control of HPC 3rd Stage bleed air supply to the Bearing Ventilation System.

Location:

The valve is located on the HPC split case at 1:00.

Description:

Bearing compartments that house bearing nos. 1, 1.5, 2, 3, and 5/6 are cooled using the EEC-controlled Low Pressure Buffer Shutoff Valve.

The LPBSOV consists of an actuator cover and housing that contains a spring and piston assembly.

The valve is spring-loaded closed. It is actuated by HPC 3rd Stage servo pressure that is controlled by the Low-Pressure Buffer Shutoff Valve solenoid.

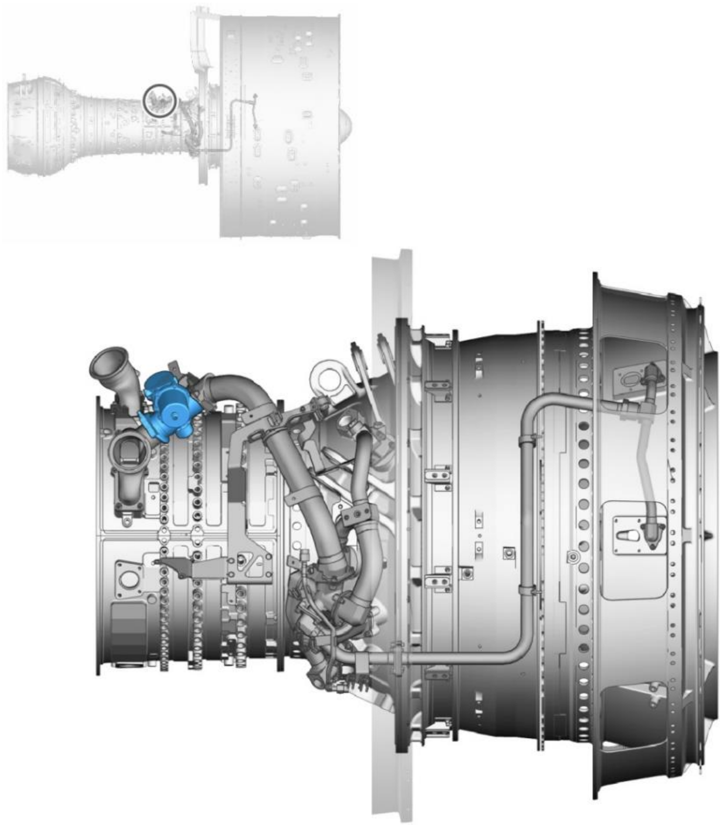
If the valve is removed on-wing or during a shop visit, the gasket and C-seal are replaced.

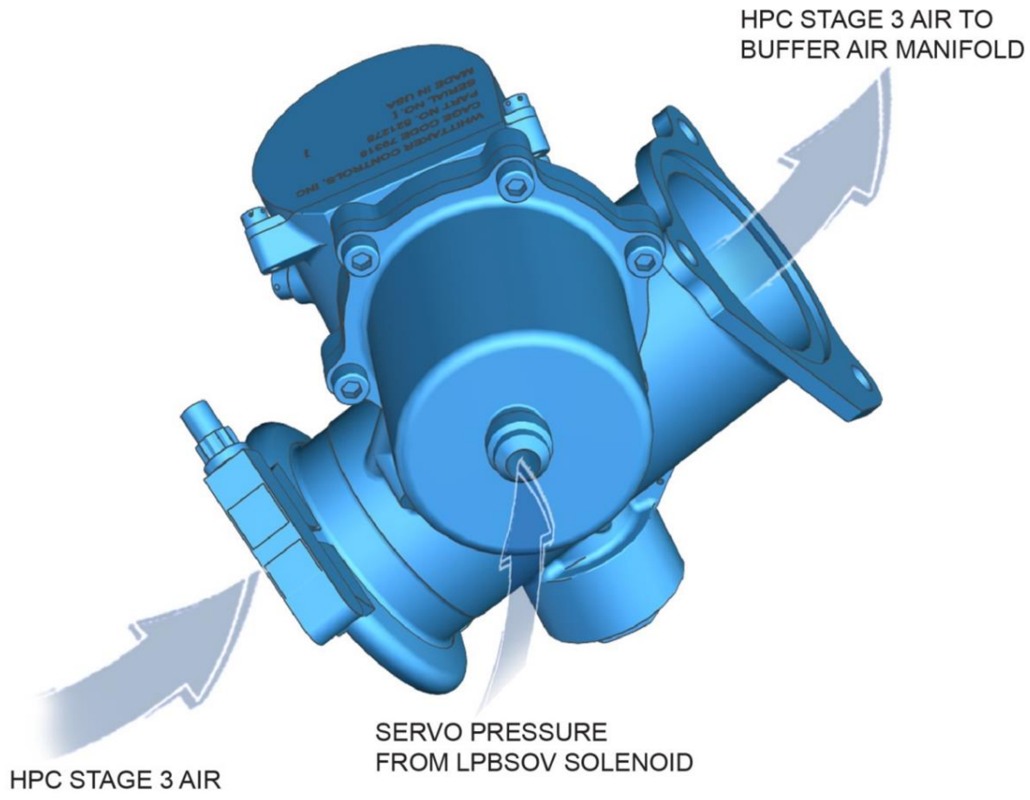
Operation:

When HPC 3rd Stage servo pressure is applied, it pushes the spring-loaded piston forward.

In the actuator housing, the piston is connected to a shaft through an internal linkage that rotates the shaft when the piston moves forward or aft.

A butterfly valve in the valve body is connected to the shaft, allowing it to open or close based on the piston position.




HPC STAGE 3 AIR TO
BUFFER AIR MANIFOLD
SERVO PRESSURE
FROM LPBSOV SOLENOID
HPC STAGE 3 AIR

Low Pressure Buffer Shutoff Valve (LPBSOV) Solenoid

Purpose:

The Low-Pressure Buffer Shutoff Valve solenoid provides discrete (on/off) control of the HPC 3rd Stage servo pressure sent to the Low Pressure Buffer Shutoff Valve.

Location:

The solenoid is located on the CIC firewall at 5:00.

Description:

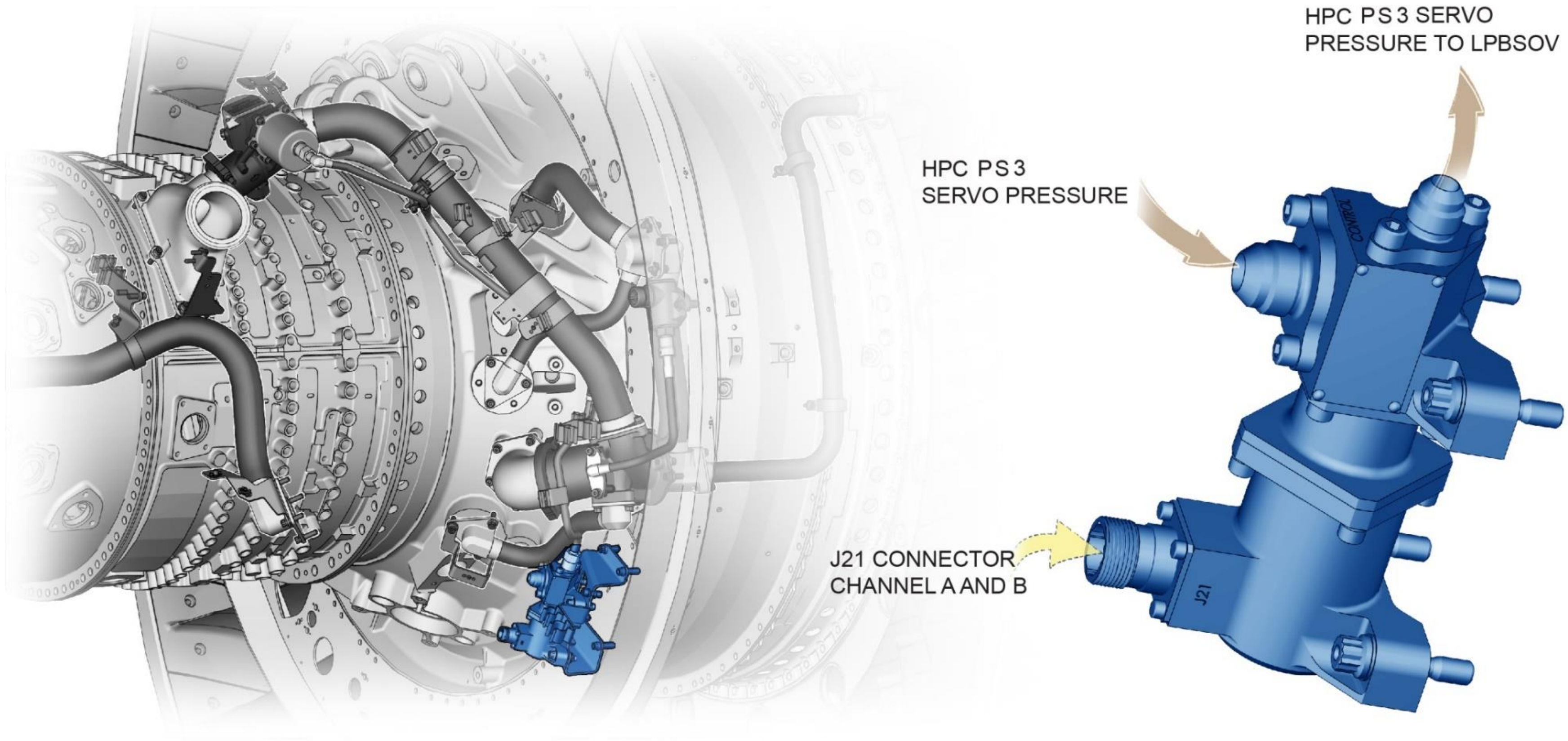
The solenoid is dual channel and controlled by the EEC.

Operation:

When the solenoid is de-energized, the valve is closed, shutting off the flow of HPC PS3 servo pressure.

When the solenoid is energized, the valve is open, allowing HPC PS 3 servo pressure to flow to the LPBSOV.

HPC PS 3 servo pressure lines direct air from the HPC 8^{TH} Stage to the shutoff valve solenoid, and from the solenoid to the Low-Pressure Buffer Shutoff Valve.


HPC PS3 SERVO
PRESSURE TO LPBSOV
HPC PS3
SERVO PRESSURE
J21 CONNECTOR
CHANNEL A AND B
J21

Low Pressure Compressor Check Valve

Purpose:

The Low-Pressure Compressor check valve prevents HPC 3rd Stage air from flowing into the LPC flow path while being used by the Bearing Ventilation System.

Location:

Located inside the Buffer Air Manifold at 4:30, the check valve is not visible.

Description:

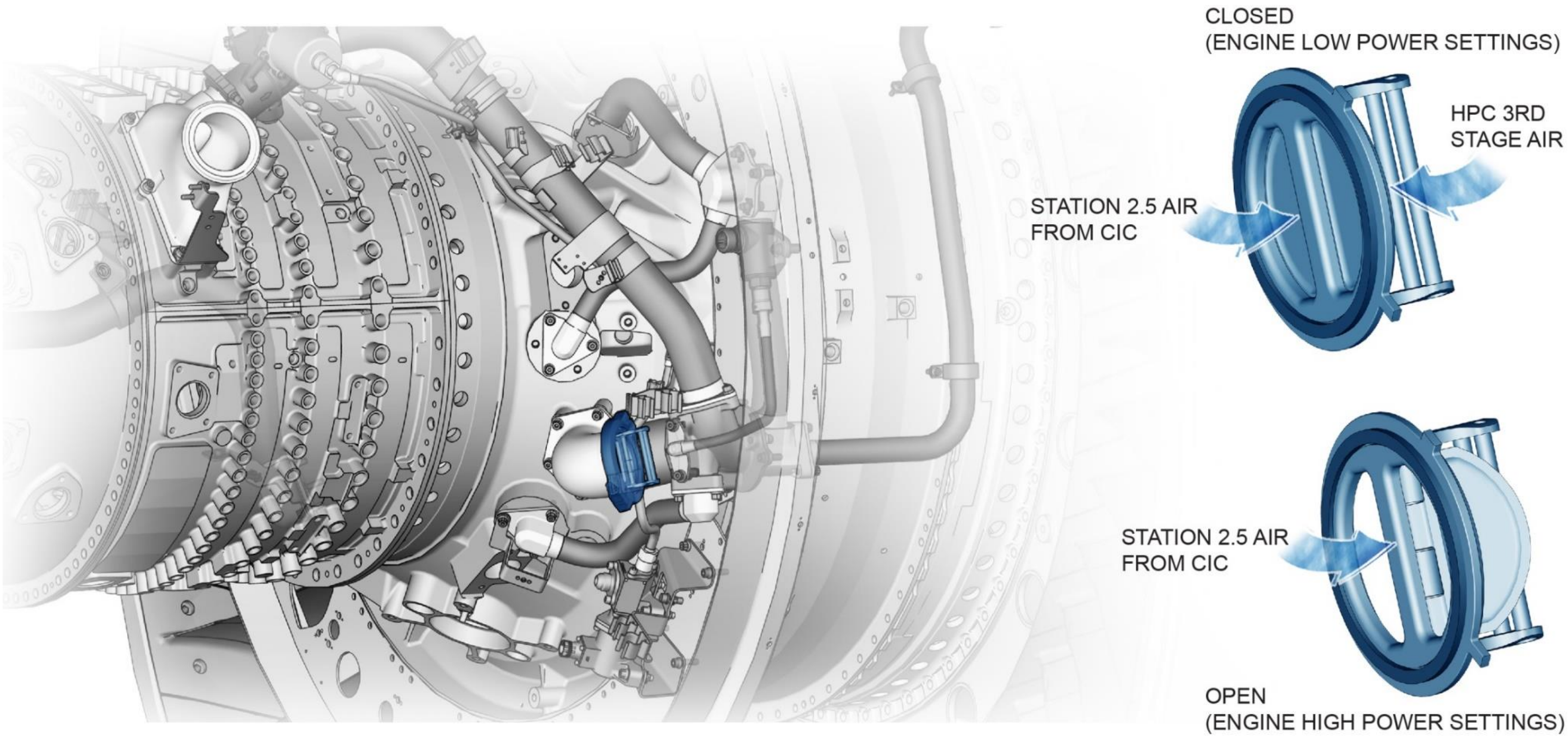
The check valve is a passive device with two flappers that hang from the flapper shaft in the open position at engine start.

Operation:

LPC buffer air flows past the valve at low power settings.

When the EEC commands the Low-Pressure Buffer Shutoff Valve to open, the HPC 3rd Stage air forces the flappers to close, preventing backflow into the LPC.

The flappers pivot on the flapper shaft due to gravity and air pressure.


CLOSED
(ENGINE LOW POWER SETTINGS)
HPC 3RD
STAGE AIR
STATION 2.5 AIR
FROM CIC
STATION 2.5 AIR
FROM CIC
OPEN
(ENGINE HIGH POWER SETTINGS)

Buffer Air Manifold (BAM)

Purpose:

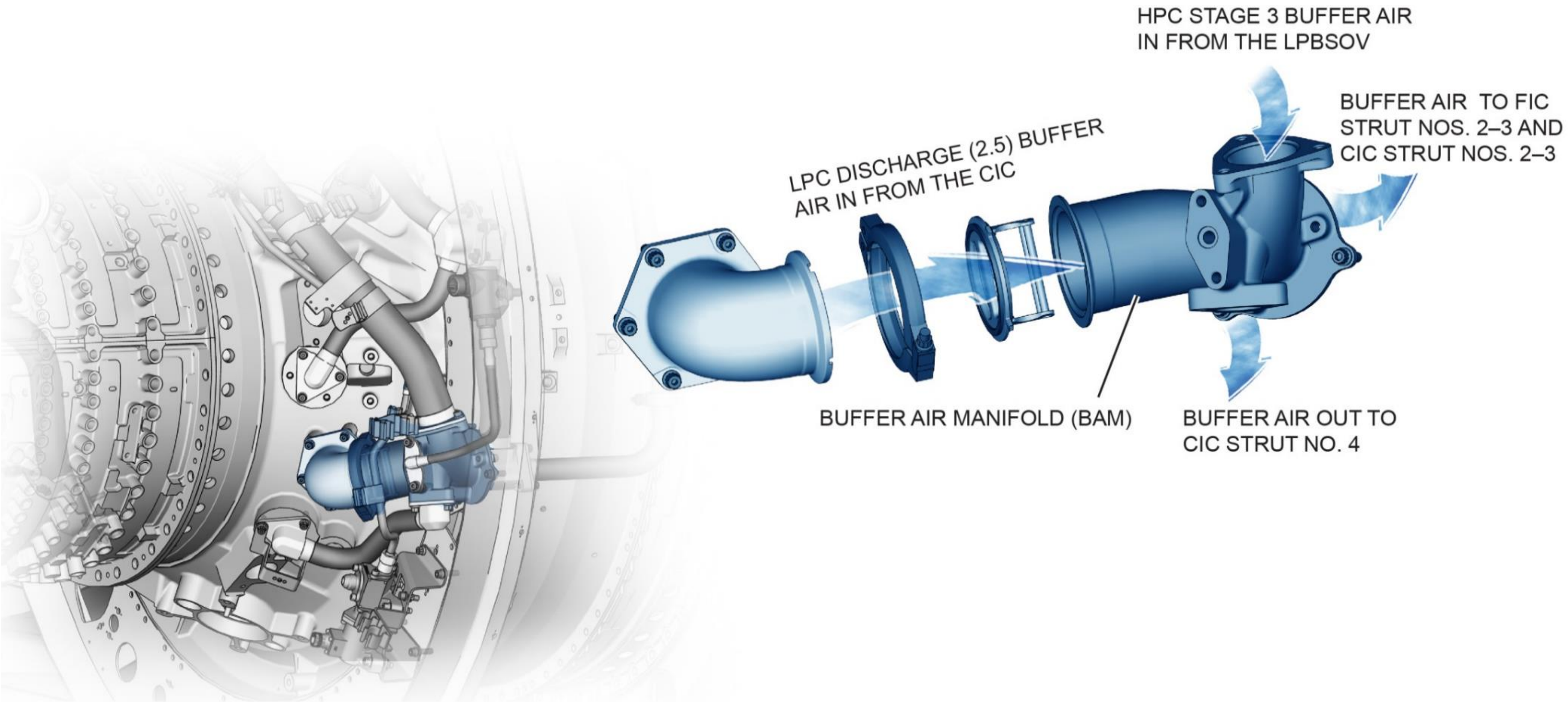
The manifold directs buffer air to the Bearing Ventilation System, including bearing compartment nos. 1, 2, 3, and 5/6.

Location:

The Buffer Air Manifold is attached to the Compressor Intermediate Case at 4:00.

Description:

The Buffer Air Manifold receives air directly from the LPC and from the 3rd Stage HPC from tubes attached to the Low-Pressure Buffer Shutoff Valve and the CIC.


HPC STAGE 3 BUFFER AIR
IN FROM THE LPBSOV
BUFFER AIR TO FIC
STRUT NOS. 2–3 AND
CIC STRUT NOS. 2–3
LPC DISCHARGE (2.5) BUFFER
AIR IN FROM THE CIC
BUFFER AIR MANIFOLD (BAM)
BUFFER AIR OUT TO
CIC STRUT NO. 4

Buffer Air Pressure Sensor (BAPS)

Purpose:

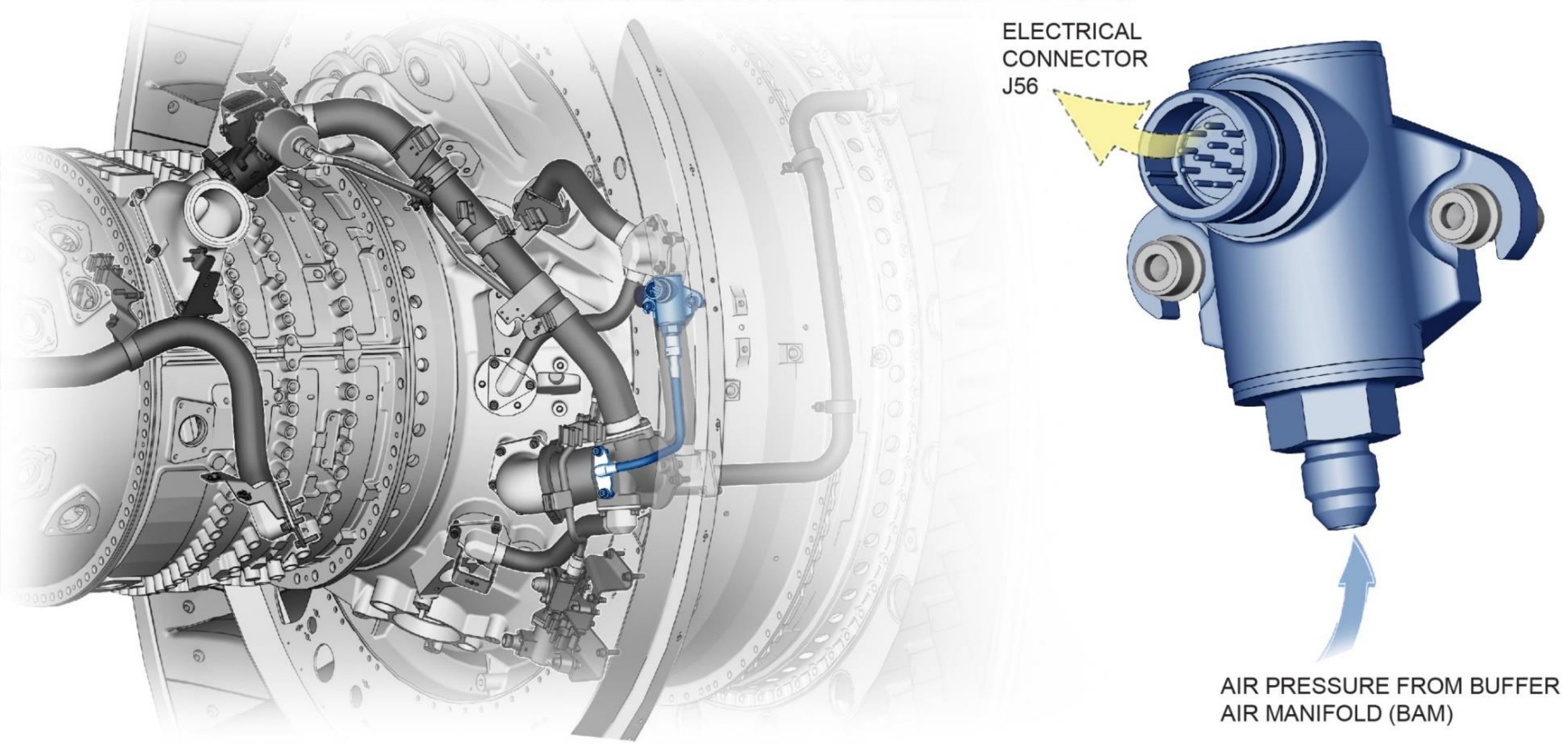
The Buffer Air Pressure Sensor provides feedback to the EEC to validate the position of the Low-Pressure Buffer Shut-off Valve (LPBSOV).

Location:

The dual channel sensor is located downstream of the Buffer Air Manifold on the Compressor Intermediate Case at 3:00.

Description:

The signal provided to the EEC confirms the position (open or closed) of the LPC check valve and Low-Pressure Buffer Shutoff Valve.


ELECTRICAL
CONNECTOR
J56
AIR PRESSURE FROM BUFFER
AIR MANIFOLD (BAM)

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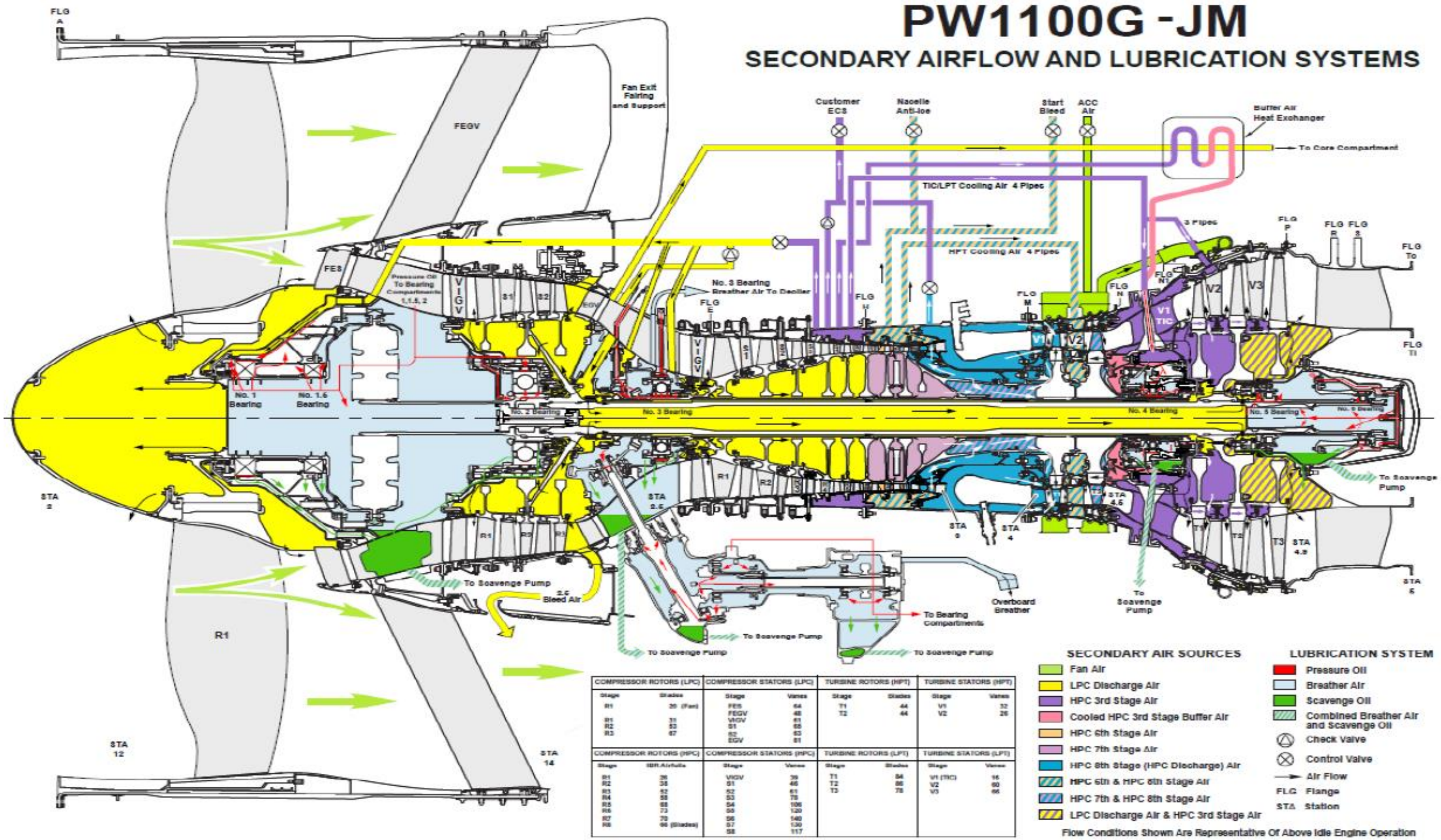


COMPRESSOR ROTORS (LPC)		COMPRESSOR STATORS (LPC)		TURBINE ROTORS (HPT)		TURBINE STATORS (HPT)	
Stage	Blades	Stage	Vanes	Stage	Blades	Stage	Vanes
R1	20 (Fan)	FES	64	T1	44	V1	32
		FEGV	48	T2	44	V2	26
R1	31	VIGV	61				
R2	53	S1	65				
R3	67	S2	63				
		EGV	81				

COMPRESSOR ROTORS (HPC)		COMPRESSOR STATORS (HPC)		TURBINE ROTORS (LPT)		TURBINE STATORS (LPT)	
Stage	IBR Airfoils	Stage	Vanes	Stage	Blades	Stage	Vanes
R1	26	VIGV	39	T1	84	V1 (TIC)	16
R2	38	S1	46	T2	86	V2	60
R3	52	S2	61	T3	78	V3	66
R4	58	S3	78				
R5	68	S4	106				
R6	73	S5	120				
R7	70	S6	140				
R8	96 (Blades)	S7	130				
		S8	117				

COMPARTMENT COOLING

The compartment cooling system ensures the ventilation of the fan compartment, the core compartment and dedicated components inside the core compartment.

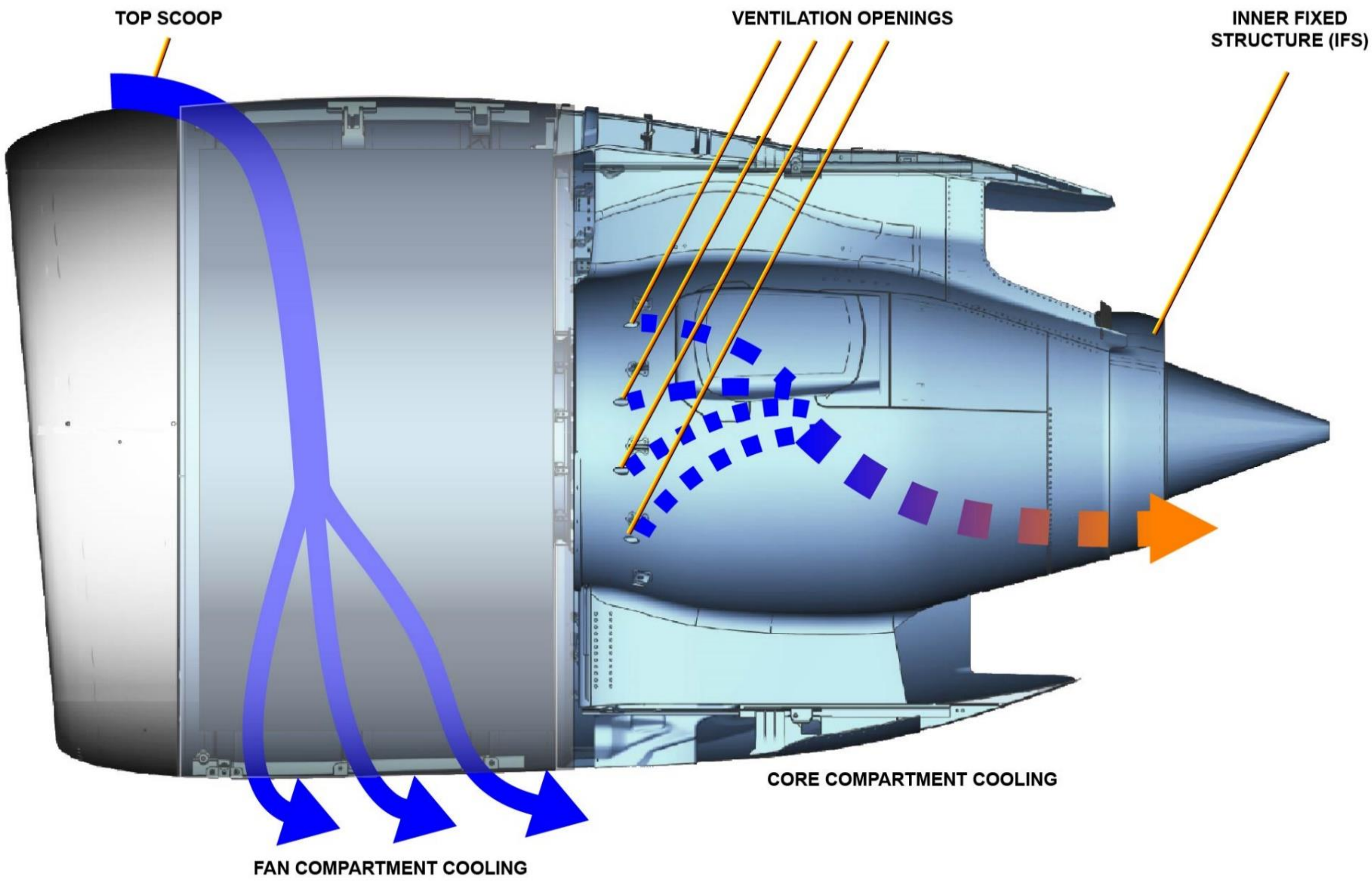
The cooling of the fan compartment is achieved through a passive ventilation system.

Outside airflow circulates from the top scoop around the fan case and exhausts through bottom holes and gabs of the fan cowls.

The cooling of the core compartment is achieved through a passive ventilation system.

Fan bypass airstream is directed to the nacelle core, ignition leads, igniter plugs and Environmental Control System (ECS) bleed valves through openings on the inner contour of the thrust reverser cowl doors and exhausts through bottom holes and gabs of the Inner Fixed Structure (IFS) trailing edge.

Additional tubes are dedicated for the cooling of the ACC Valve, Starter Air Valve (SAV) and the Flow Divider Valve (FDV).



COMPARTMENT COOLING SYSTEM

An Example of an update concerning the Engine Air system

This FOT is issued to inform Operators of A320neo and A321neo aircraft equipped with PW engines about the publication of white OEB No.53 in the FCOM and the QRH. 2.

DESCRIPTION

In service experience indicates several ENG 1(2) AIR SYS FAULT ECAM alert triggering in flight.

The ENG 1(2) AIR SYS FAULT ECAM alert monitors the buffer air system.

The buffer air system (Buffer Air Shut Off Valve (BASOV) or Buffer Air Check Valve (BACV)) ensures engine bearing cooling, sealing, and pressurization.

The ENG 1(2) AIR SYS FAULT ECAM alert triggers in either of the following situations:

When the BASOV is detected failed open or failed closed,

When the BACV is detected failed closed.

These in-service occurrences of the ENG 1(2) AIR SYS FAULT that have been recently experienced in flight are mostly due to sensor quality issues, or to BASOV that are slow to close.

When the BASOV is detected failed open, the ENG 1(2) AIR SYS FAULT ECAM alert requests that the flight crew reduces the thrust of the affected engine to IDLE.

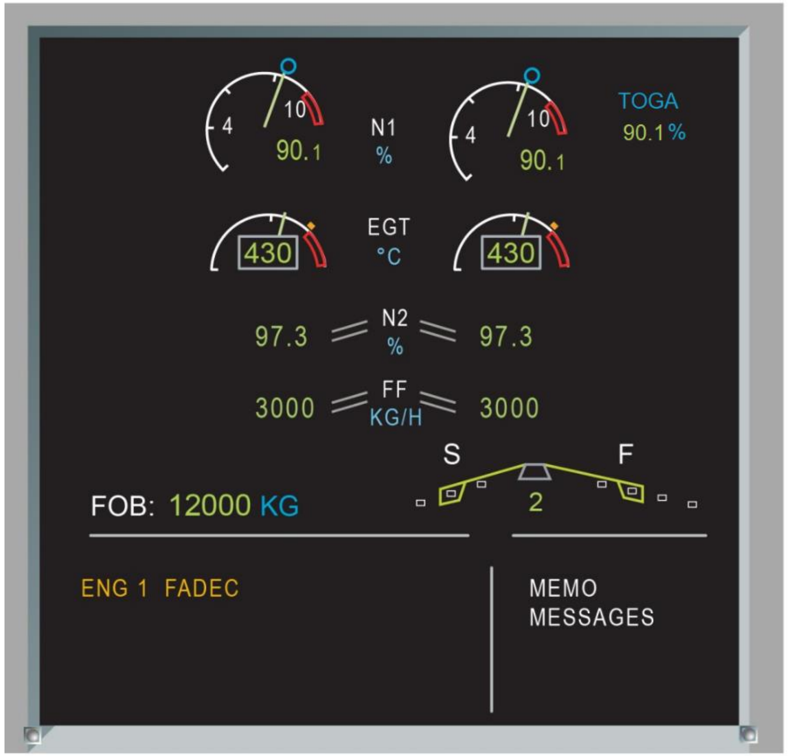
The purpose of white OEB No.53 is to avoid systematic thrust reduction of the affected engine to IDLE, and thus, to avoid potential operational consequences such as diversion, or in-flight turn back.

CONSEQUENCES

White OEB No.53 indicates that the flight crew should wait 5 minutes before they perform any actions.

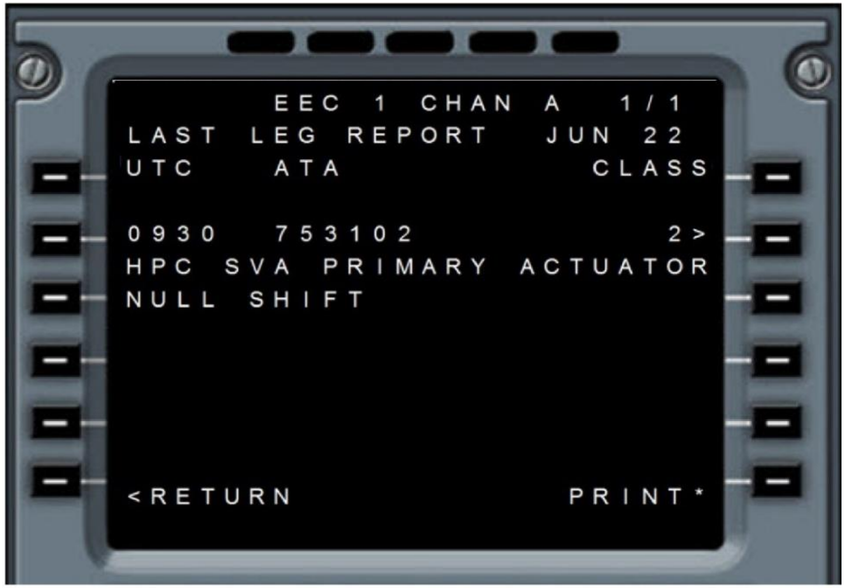
This is because during this 5-minute period, the BASOV may cycle with engine thrust variations, and the ECAM alert may disappear.

FLIGHT CREW INITIAL WARNING



ENGINE/WARNING DISPLAY

INTERACTIVE MODE FOR MAINTENANCE ACTION



MULTIPURPOSE CENTRALIZED DISPLAY UNIT (MCDU)

SAMPLE ECAM MESSAGES FOR ATA 75

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