

CHAPTER

72

Engine GE 115

(GE90-100 SERIES ENGINES)

CHAPTER 72
ENGINE GE 115

Subject/Page	Date	COC	Subject/Page	Date	COC
72-EFFECTIVE PAGES			72-00-00 (cont.)		
1	Sep 05/2018		19	May 05/2015	
2	BLANK		20	May 05/2015	
72-CONTENTS			21	May 05/2015	
1	May 05/2015		22	BLANK	
2	BLANK				
72-00-00					
1	Sep 05/2016				
2	Sep 05/2016				
3	May 05/2015				
4	May 05/2015				
5	May 05/2015				
6	May 05/2016				
7	May 05/2015				
8	May 05/2015				
9	May 05/2015				
10	Sep 05/2017				
11	May 05/2015				
12	May 05/2015				
13	May 05/2015				
14	May 05/2015				
15	May 05/2015				
16	May 05/2015				
17	May 05/2015				
18	May 05/2015				

A = Added, R = Revised, D = Deleted, O = Overflow, C = Customer Originated Change

72-EFFECTIVE PAGES

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**CHAPTER 72
ENGINE GE 115**

<u>CH-SC-SU</u>	<u>SUBJECT</u>	<u>PAGE</u>	<u>EFFECT</u>
72-00-00	ENGINE - INTRODUCTION	1	ARO ALL
72-00-00	ENGINE - GENERAL DESCRIPTION - 1	4	ARO ALL
72-00-00	ENGINE - GENERAL DESCRIPTION - 2	6	ARO ALL
72-00-00	ENGINE - COMPONENT LOCATIONS	8	ARO ALL
72-00-00	ENGINE - SPINNERS AND FAN BLADES	10	ARO ALL
72-00-00	ENGINE - ENGINE SEPARATION	12	ARO ALL
72-00-00	ENGINE - BALANCE WEIGHTS	14	ARO ALL
72-00-00	ENGINE - ACCESSORY DRIVES - COMPONENT LOCATIONS - FORWARD	16	ARO ALL
72-00-00	ENGINE - ACCESSORY DRIVES - COMPONENT LOCATIONS - AFT	18	ARO ALL
72-00-00	ENGINE - BORESCOPE ACCESS PORTS	20	ARO ALL

72-CONTENTS

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ENGINE - INTRODUCTION

General

This chapter gives general information about the modules and internal components of the GE90-115B engine.

The bypass ratio is a ratio of the mass of air going through the fan duct to the mass of air going through the engine core.

The engine weight includes the engine build up (EBU) equipment that Boeing installs. The engine driven hydraulic pump (EDP), the integrated drive generator (IDG), and the inlet cowl are examples of EBU equipment.

Data Plate

The engine data plate is on the aft face of the fan hub frame at the 9:00 position. It is below the configuration box. The data plate shows this information about the engine.

- Type certificate number
- Model number
- Serial number
- Engine configuration
- Take off (TO) thrust
- Maximum continuous thrust
- Service bulletin number that sets engine configuration
- Date of manufacture
- Emissions compliance
- Manufacturing location.

Type certificate is issued by the applicable regulatory agency. The certificate shows that the agency approves the engine as airworthy.

The production certificate number is issued by the applicable regulatory agency. The space shows the current Production Certificate number, PC - 108.

The CONFIG field shows engine rating and configuration information. TO THRUST is the takeoff thrust (in pounds) at the specified rating. The TO thrust is the approved maximum thrust level at which the engine can operate. The TO thrust on the data plate is different than the TO thrust that Boeing uses, called Boeing equivalent thrust (BET). The thrust on the data plate is measured on a test stand and is equivalent to the static thrust at sea level. Boeing equivalent thrust (BET) is a calculated number. It is equivalent to the thrust at 165 knots at sea level. BET is defined so that engines with the same BET will have approximately the same TO performance at sea level.

MAX CONT is the maximum continuous thrust (in pounds) at specified rating. Maximum continuous thrust is measured on a test stand. It is the approved maximum thrust level at which the engine can operate with no time limit.

The SERV BUL field shows the service bulletin number that goes with a change in the engine configuration. You install different EEC rating and configuration plugs to change the engine configuration.

The emissions field shows that the engine complies with emissions standards.

Abbreviations and Acronyms

- AGB - accessory gearbox
- BET - Boeing equivalent thrust
- cont - continuous
- EEC - electronic engine control
- GE - General Electric
- HPC - high pressure compressor
- HPT - high pressure turbine
- IDG - integrated drive generator
- IGV - inlet guide vane
- LPC - low pressure compressor
- LPT - low pressure turbine
- max - maximum

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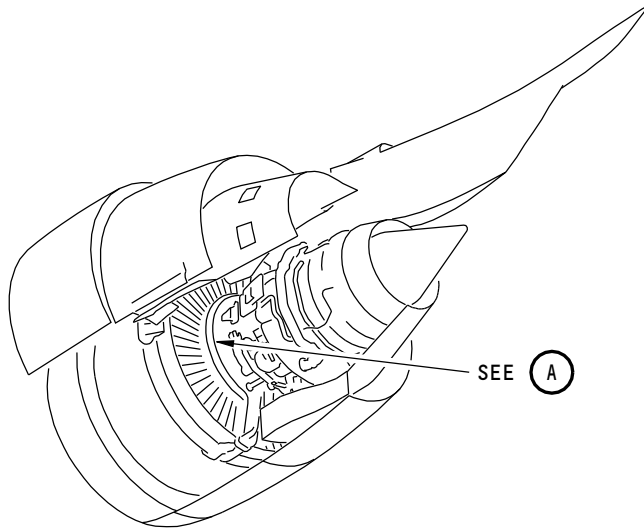
ENGINE - INTRODUCTION

- OGV - outlet guide vane
- TCF - turbine center frame
- TO - takeoff
- TRF - turbine rear frame



GE90-100 SERIES ENGINES

777-200/300 AIRCRAFT MAINTENANCE MANUAL



ENGINE DATA:

TO THRUST (BET): 110,760 LB
BYPASS RATIO: 9:1
WEIGHT (APPROXIMATE): 18,982 LB (8610 KG)
FAN CASE DIAMETER: 166.46 INCHES (4.23 METERS)
FAN DIAMETER: 128 INCHES (3.25 METERS)
LENGTH: 323.24 INCHES (8.21 METERS)

GE Aircraft Engines			
TYPE CERTIFICATE	PROD CERTIFICATE		
E00049EN	PC - 108		
MODEL NO.	SERIAL NO.		
GE90	906-XXX		
PROPULSOR IDENT. 2115M11G01			
RATED TO MODEL CONFIGURATION IDENTIFIED BELOW			
CONFIG	TO THRUST	MAX CONT	SERV BUL
115BG01	115,300	110,000	72-XXX
DATE OF MFG		EMISSIONS	
8/2004		COMPLY	
102A543P01		MADE IN USA	
CINCINNATI, OHIO			

ENGINE DATA PLATE

(A)

ENGINE - INTRODUCTION

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ENGINE - GENERAL DESCRIPTION - 1

General

The GE90 is a high-bypass, two shaft, turbofan engine.

- It has a low pressure (LP) rotor system (N1) and a high pressure (HP) rotor system (N2).
- The engine has station numbers to identify locations along its axis.

Airflow

The engine has primary (core) airflow and secondary (bypass) airflow.

- The bypass ratio of this engine is 9:1.
- This means that 9 times more secondary air goes through the engine than primary air.
- The primary airflow goes through the compressors, combustion section, and turbines.
- The combustion section also gets fuel from the fuel nozzles.
- This mixture of air and fuel burns to make high pressure exhaust gas.
- The exhaust gas goes out of the combustion section to turn the turbines.
- The exhaust gas from the primary airflow makes approximately 17 percent of the forward thrust.
- The secondary airflow goes around (bypasses) the core of the engine.
- The secondary airflow makes approximately 83 percent of the forward thrust.
- The thrust reverser system also uses secondary airflow for reverse thrust.

Low Pressure Rotor System (N1)

The LP rotor system includes the fan and a four-stage low pressure compressor (LPC) connected to a six-stage low pressure turbine (LPT).

- A coupling connects the LPT drive shaft to the LPC.

High Pressure System

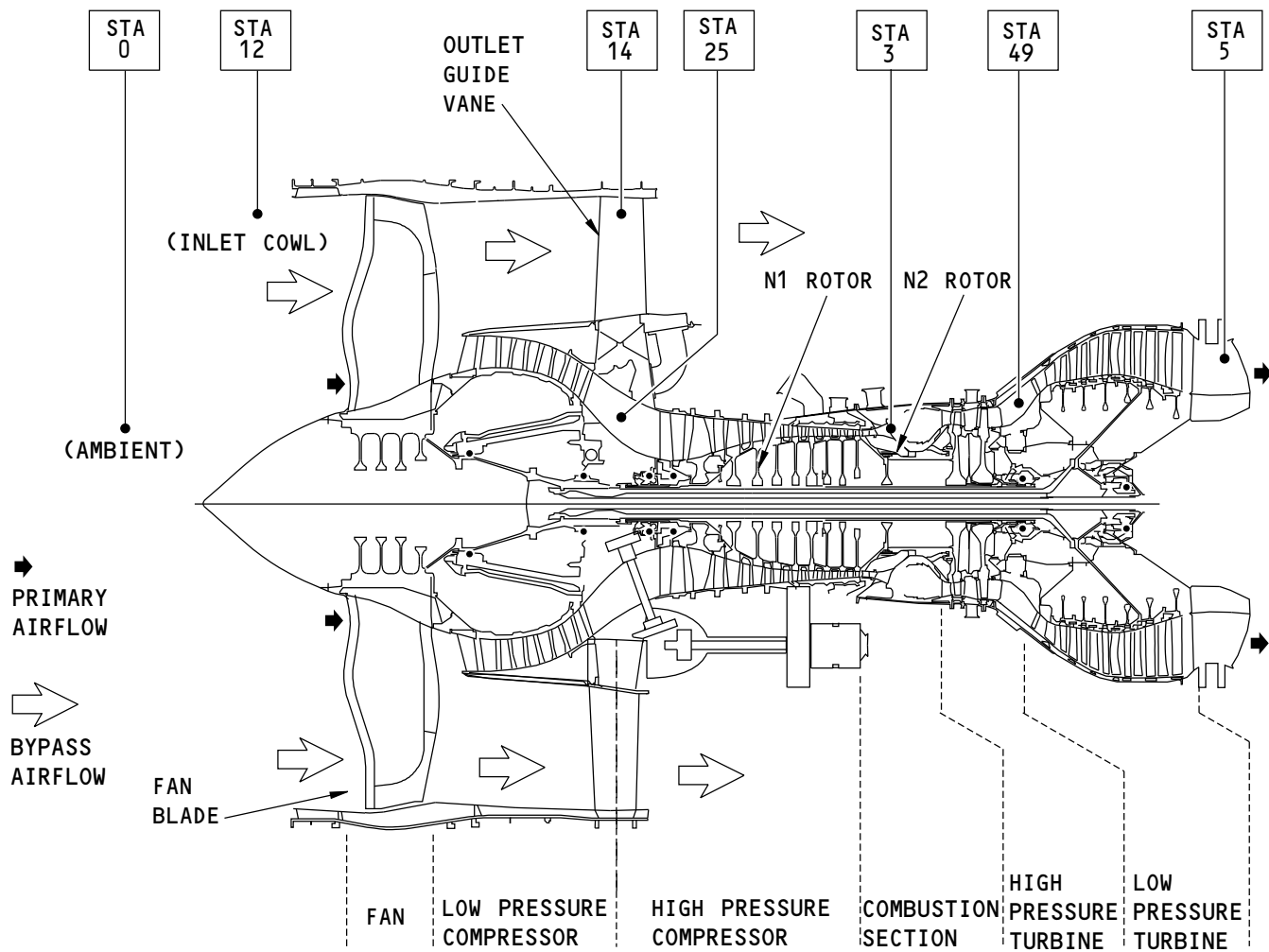
The HP rotor system is an nine-stage high pressure compressor (HPC) connected to a two-stage high pressure turbine (HPT).

- A coupling connects the HPT drive shaft to the HPC.
- The HPC has variable stator vanes in the first four stages.

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ENGINE - GENERAL DESCRIPTION - 1

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ENGINE - GENERAL DESCRIPTION - 2

Main Engine Bearings

Six main engine bearings hold the N1 shaft and the N2 shaft.

- Numbers identify the engine bearings.
- The main engine bearings are in three dry-sump cavities.
- The letters A, B, and C identify the sumps.
- The lube and scavenge pump supplies lubricating oil to the bearings and draws oil out of the bearing sumps.
- The number 1 and number 2 bearings hold the front of the N1 shaft.
- The number 1 bearing is a roller bearing and holds only radial loads.
- The number 2 bearing is a ball bearing and is the thrust bearing for the N1 shaft.
- There are two number 3 bearings:
One is a ball bearing and one is a roller bearing
The two of them hold the front of the N2 shaft.
- The ball bearing is the thrust bearing for N2 shaft.
- The roller bearing holds only radial loads.
- The number 1, 2, and 3 bearings are in the A sump:
The number 4 roller bearing holds the rear of the N2 shaft
The number 4 roller bearing is in the B sump
The number 5 roller bearing holds the rear of the N1 shaft
The number 5 roller bearing is in the C sump.

The accessory gearbox holds and turns the engine accessories.

- The N2 shaft turns the radial drive shaft through the inlet gearbox:
The radial drive shaft turns the horizontal drive shaft through the transfer gearbox
The horizontal drive shaft turns the accessory gearbox.

Accessory Drives

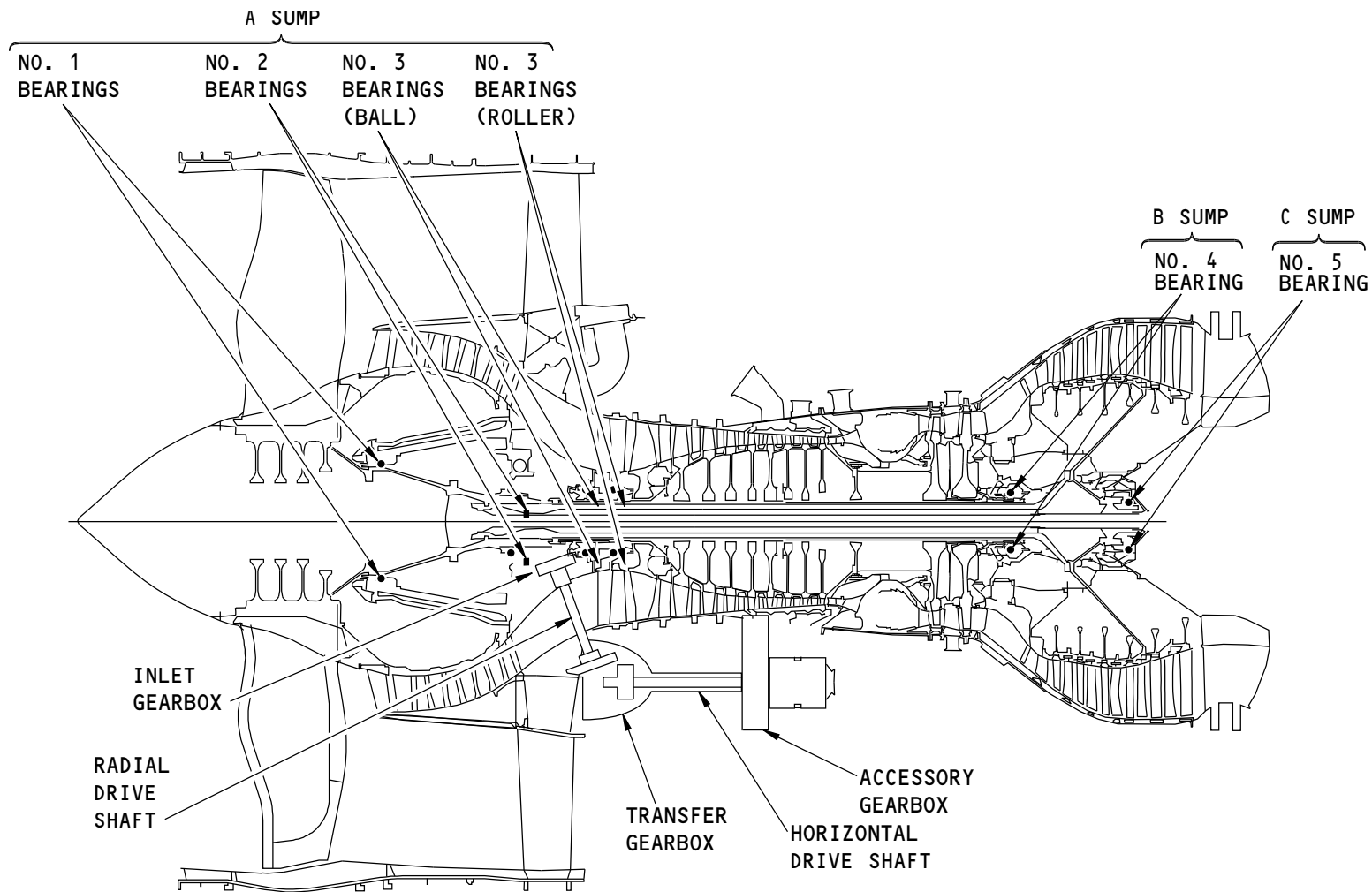
There are three gearboxes on the engine:

- Inlet gearbox
- Transfer gearbox
- Accessory gearbox.
- The inlet and transfer gearboxes transfer energy from the N2 shaft to the accessory gearbox.

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ENGINE - GENERAL DESCRIPTION - 2

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ENGINE - COMPONENT LOCATIONS

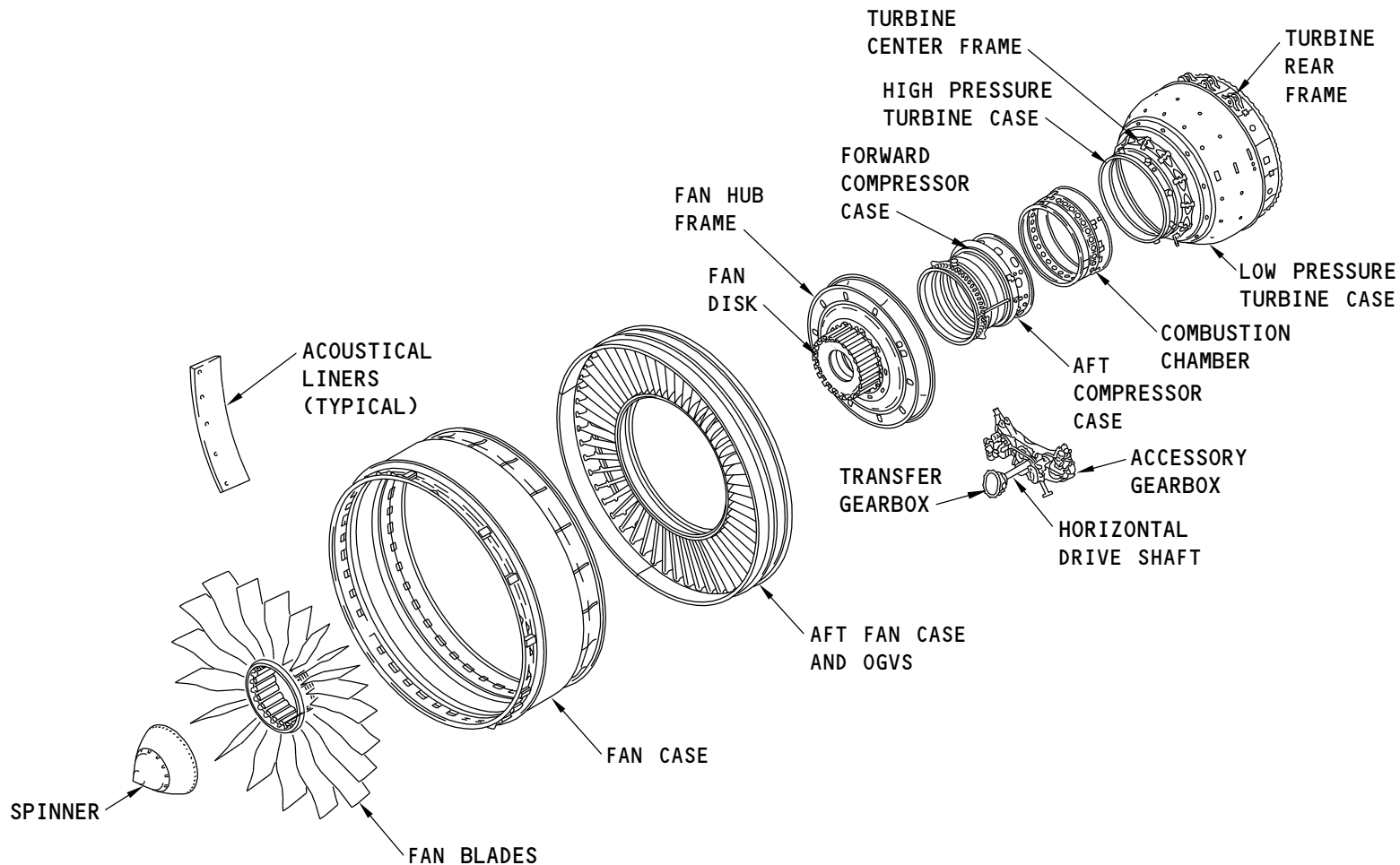
General

The GE90 engine has these primary engine modules and components:

- Spinners
- Fan blades
- Fan disk
- Fan case
- Fan frame
- Fan hub frame
- Forward compressor case
- Aft compressor case
- Combustion chamber
- HPT case
- Turbine center frame
- LPT case
- Turbine rear frame
- Accessory drives.

Acoustical liners attach to the inside of the fan case to absorb the sound of the fan blades. There are eight forward and eight aft acoustical liners.

The accessory drives are below the HPC at the 6:00 position.



ENGINE - COMPONENT LOCATIONS

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ENGINE - SPINNERS AND FAN BLADES

Spinners

The one piece spinner is an aerodynamic fairing that directs inlet airflow. The spinner attaches to the support ring with 22 attach bolts. The support ring attaches to the fan disk with 22 attach bolts.

Fan Blades

There are 22 wide-chord fan blades on the engine. The fan blades are carbon fiber and resin with a titanium leading and trailing edge. The fan blades are line replaceable units.

The fan blades fit into dovetail slots in the fan disk. The dovetail slots hold the fan blades in place radially. There are fan blade platforms between the fan blades. They make an aerodynamic surface for the air flow. The spinner, fan disk, and forward face of the fan hub frame hold the fan blade platforms in place.

Fan blade spacers and dovetail keys fit at the base of the fan blade in the dovetail slot. These help the fan blade fit tight in the dovetail slot.

Fan Blade Removal

You remove each fan blade independently. To prepare for fan blade removal, first put the fan blade you will remove in the 6:00 position. Turn the fan blades counterclockwise to move the fan blades. To remove a fan blade, remove the components in this order:

- Spinner
- Fan blade platform
- Retainer bolt
- Fan blade spacer
- Dovetail key
- Retainer
- Fan blade
- Support ring.

You use a slide hammer to remove the fan blade spacers. You use a plastic hammer to install the fan blade spacers.

Training Information Point

The dovetail slots for fan blade numbers 1 and 5 are marked. The numbers are on the fan disk.

You must apply dry teflon spray lubricant to the dovetail end of the fan blade and to the fan blade spacer before you install them.


CAUTION

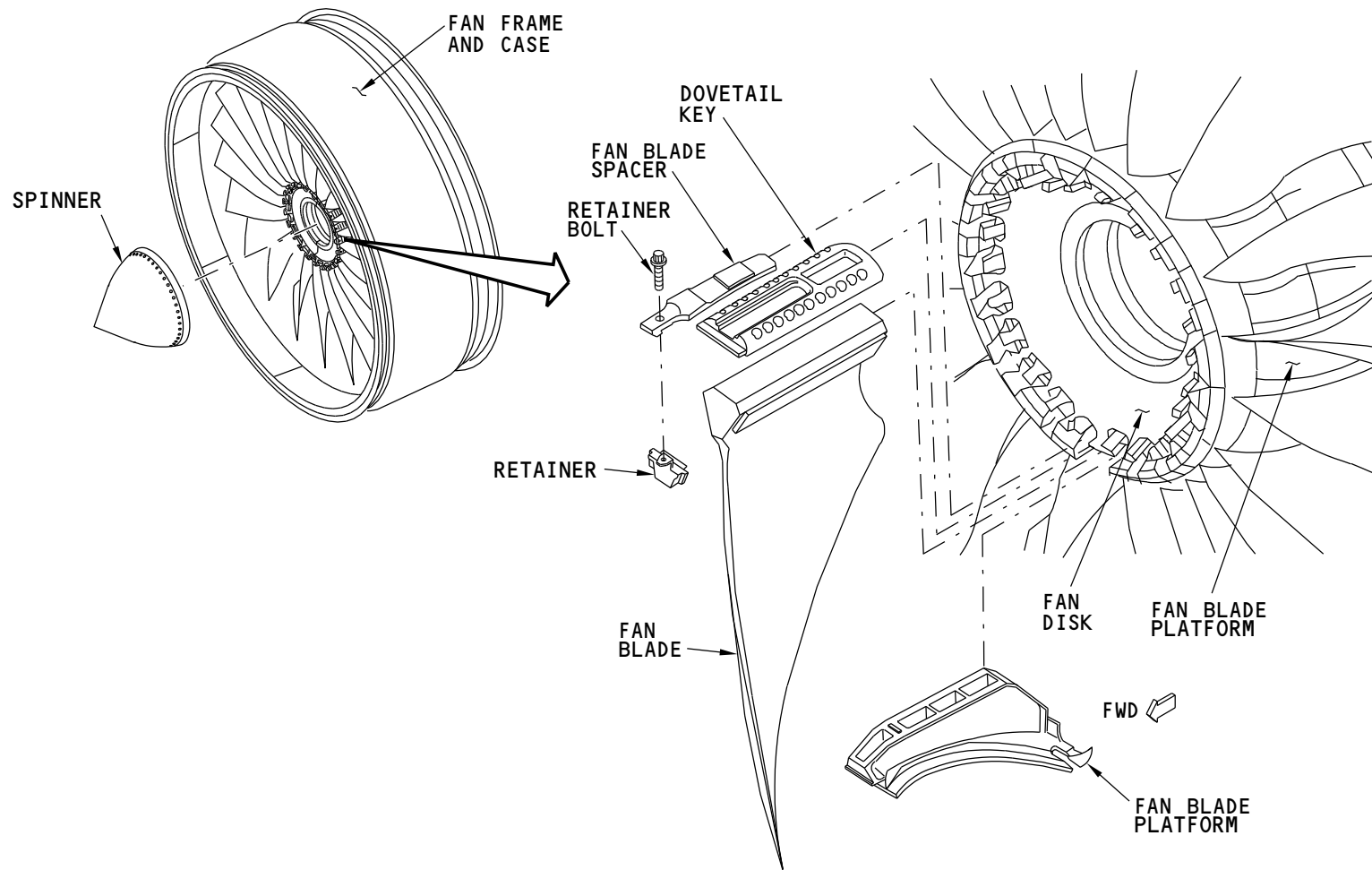
PUT THE PROTECTIVE MAT IN THE INLET COWL. THIS WILL PREVENT DAMAGE TO THE INLET COWL OR ENGINE BY TOOLS, PARTS, OR UNWANTED MATERIALS THAT FALL ON THE INLET COWL SURFACE.

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ENGINE - SPINNERS AND FAN BLADES

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**ENGINE - ENGINE SEPARATION****General**

You can remove the fan case and frame from the core engine. This divides the engine into two parts. There are two advantages to this:

- The engine is easier to move
- When you replace the engine, you only need to replace the engine core.

When you move the engine over long distances, it is necessary to divide it into two parts because it is so big.

Most engine work is done on the core engine. Very little work is done on the fan case and frame. Since you can remove the fan case and frame from the core engine, you do not have to include those parts with a spare engine. You can install the same fan case and frame on the new engine.

The spare engine attaches to the rear of the fan case and frame. The forward flange of the fan hub frame attaches to the inner diameter of the outlet guide vanes (OGVs) on the aft fan case.

Training Information Point

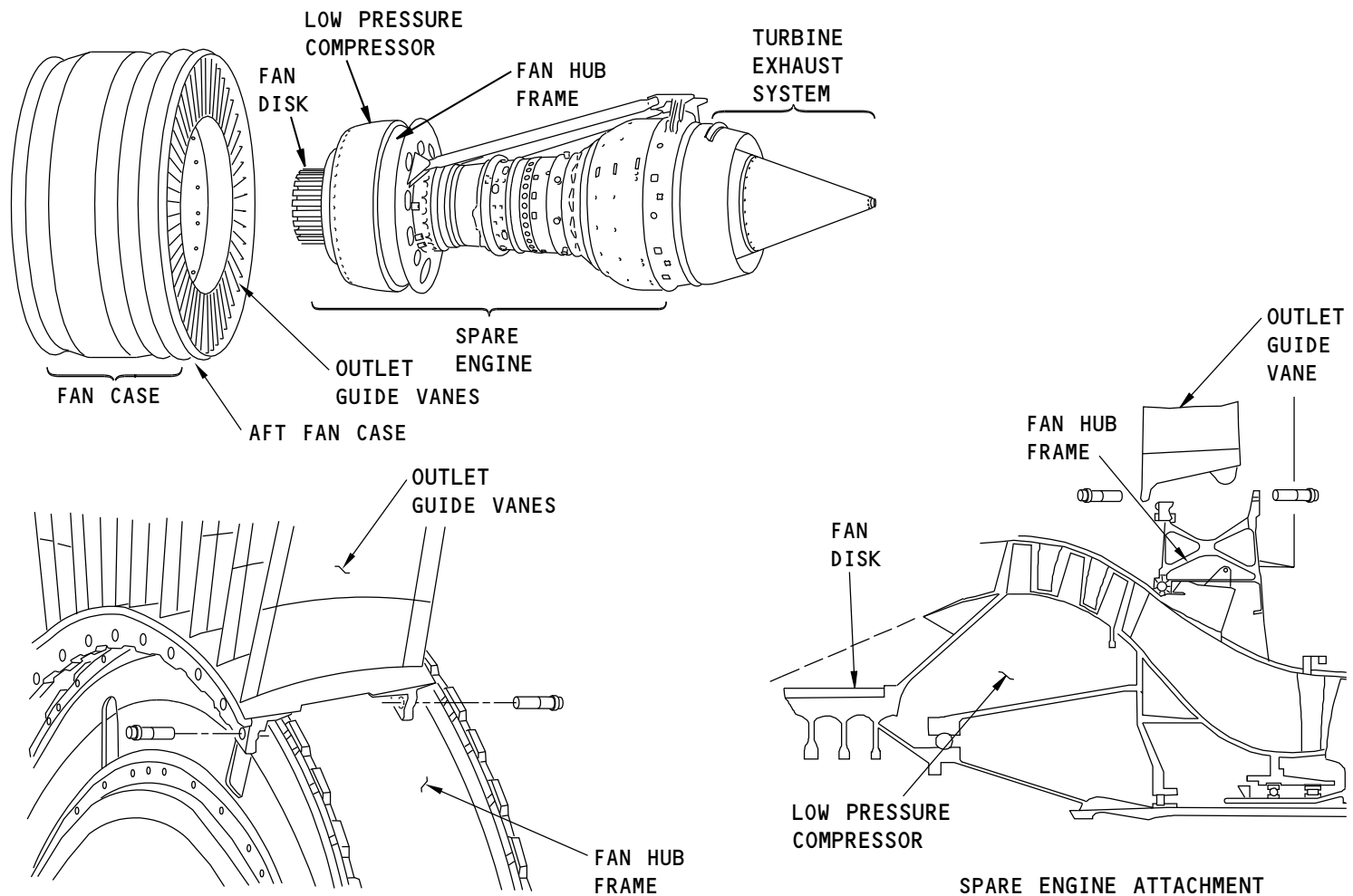
You remove the turbine exhaust system and put a cover on the fan disk when you move the engine.

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ENGINE - ENGINE SEPARATION

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**ENGINE - BALANCE WEIGHTS****General**

You can balance the fan section and the low pressure turbine on the GE90 engine.

See the airborne vibration monitoring section for more information on the engine balance procedure (SECTION 77-31).

Fan Balance

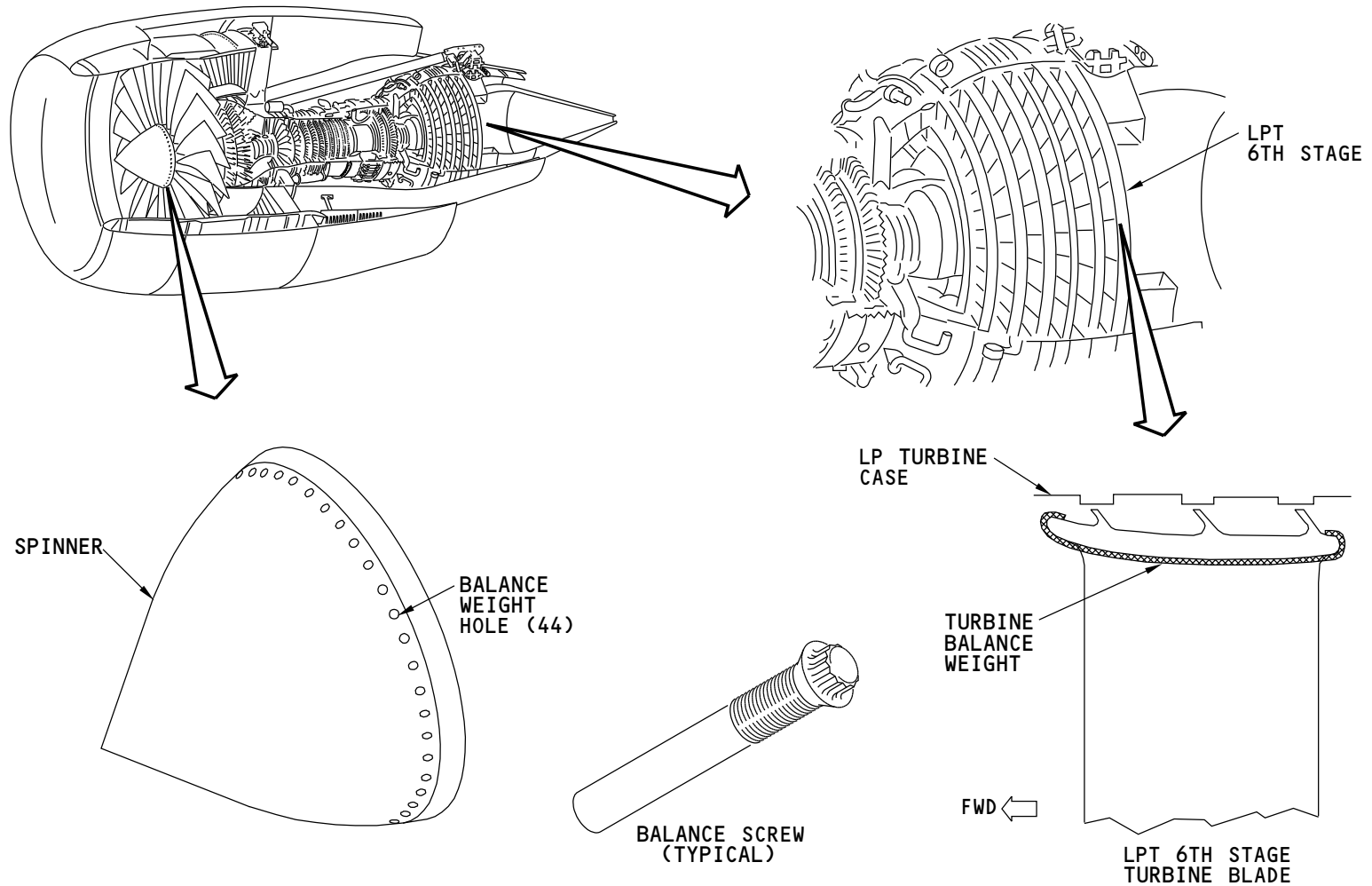
To balance the fan, you change balance screws in the spinner. There are 44 balance weights on the aft edge of the spinner between the spinner attach screws.

LP Turbine Balance

You balance the LPT with sheet metal clip-on weights. The weights attach at the tip shroud of the LPT stage 6 blades.

You use a special tool to attach the LPT clip-on balance weights. The tool bends (crimps) the aft end of the balance weight to hold it in place.

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ENGINE - BALANCE WEIGHTS
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**ENGINE - ACCESSORY DRIVES - COMPONENT LOCATIONS - FORWARD****Accessory Gearbox**

The accessory gear box (AGB) turns the engine accessories. The AGB gets torque from the N2 shaft through the horizontal drive shaft. It sends the torque through spur gears to turn the components on the gearbox. You get access to the accessory gearbox (AGB) with the thrust reverser halves open. The AGB is below the high pressure compressor.

Heat Shield

A titanium heatshield is between the core engine and the AGB. The heatshield protects the components on the gearbox from engine heat. It also prevents the spray of combustible fluids from the components on the hot engine case.

Accessory Gearbox Components

These components are on the front of the accessory gearbox:

- IDG fuel/oil heat exchanger
- Hydraulic pump
- Backup generator
- Borescope cranking pad
- Horizontal drive shaft
- Control alternator
- Lube and scavenge pump.

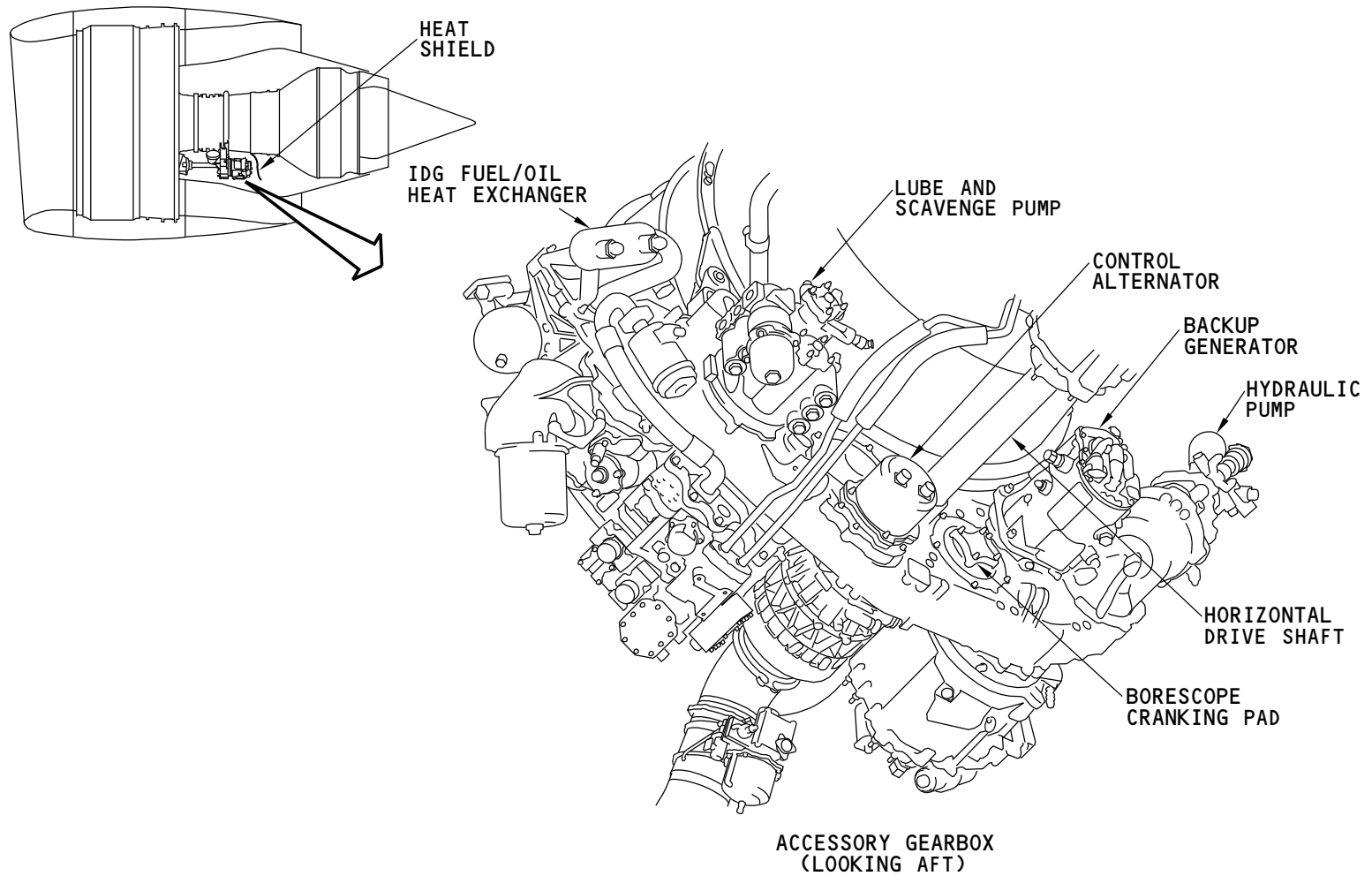
Training Information Point

The borescope cranking pad is on the front of the AGB on the left side. Engine components do not cause a blockage of access to the borescope cranking pad. Use a CF6-80C2 core motoring device to turn the borescope cranking pad.

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ENGINE - ACCESSORY DRIVES - COMPONENT LOCATIONS - FORWARD

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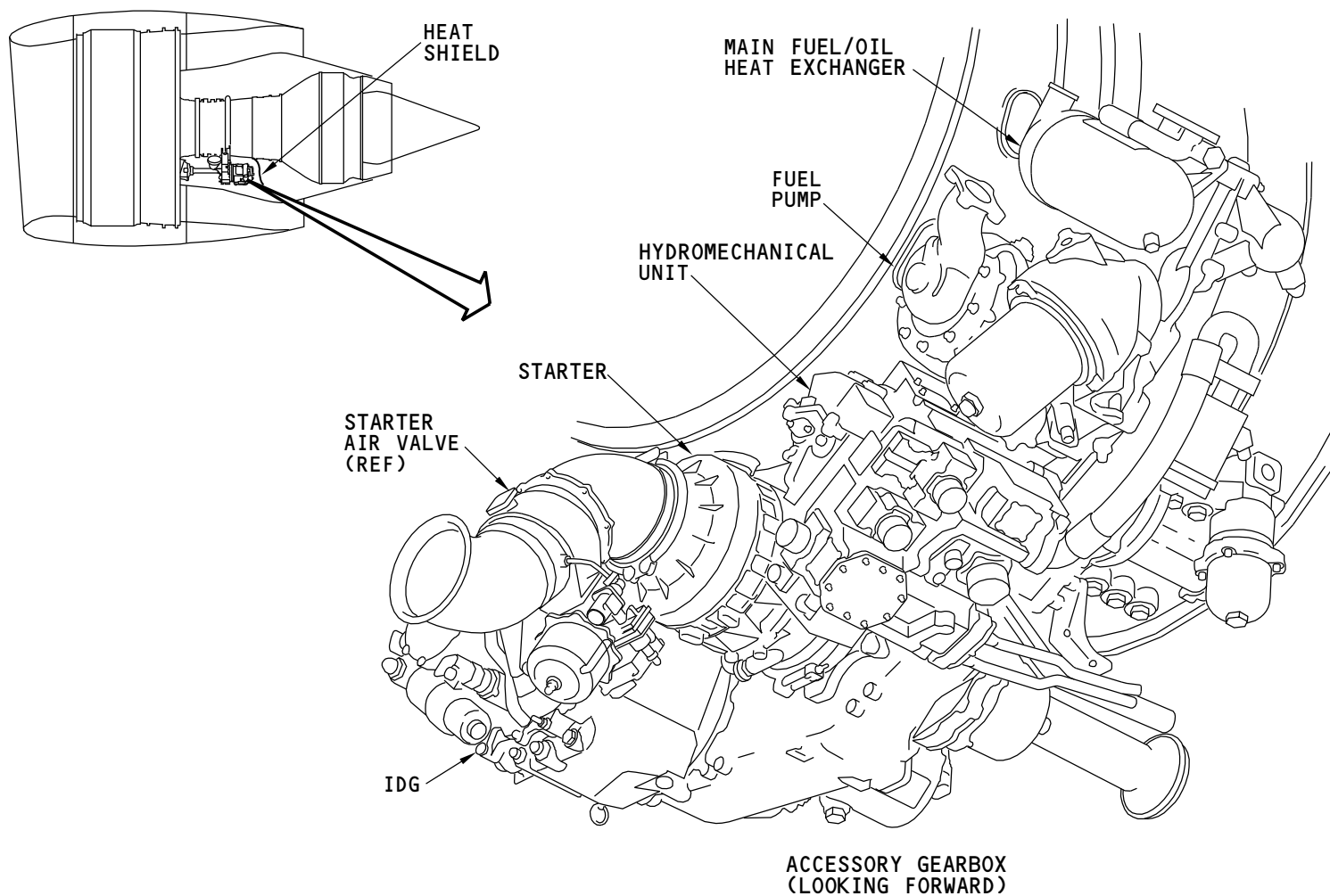


ENGINE - ACCESSORY DRIVES - COMPONENT LOCATIONS - AFT

Accessory Gearbox Components

These components are on the aft face of the accessory gearbox:

- Main fuel/oil heat exchanger
- Fuel pump
- Hydromechanical unit (HMU)
- Starter
- IDG.



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ENGINE - ACCESSORY DRIVES - COMPONENT LOCATIONS - AFT

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**ENGINE - BORESCOPE ACCESS PORTS****General**

There are 16 borescope ports on the GE100 engine series. There are 14 ports on the left side of the engine. Four borescope ports are spaced around the combustion chamber case.

You use the borescope cranking pad to turn the N2 rotor when you make borescope inspections.

Borescope Access Port Identification

These are the borescope access ports on the engine:

- Fan hub frame - IGV
- Forward HPC case - HPC stages 1-4
- Aft HPC case - HPC stages 5-7
- Combustion chamber - 2 ports on the left side and 2 on the right side (not shown)
- HPT case - HPT stages 1 and 2
- LPT case - LPT stages 2 and 4.

Training Information Point

The GE100series borescope plugs are self-locking and do not use seals. You remove the plugs with a standard 3/8 inch square drive.

The aft HPC has an inner and outer case which cover the four aft stages of the HPC. For this reason, the borescope plugs in the HPC ports at stator stages 5 and 6 have double plugs which seal in the inner case and the outer case. You remove and install each double plug as a single assembly. NOTE: The S1, S2, S3 and S4 BSI ports are blocked by the VSVs. You can use the VSV special function or hydraulic pumping to move the VSVs.

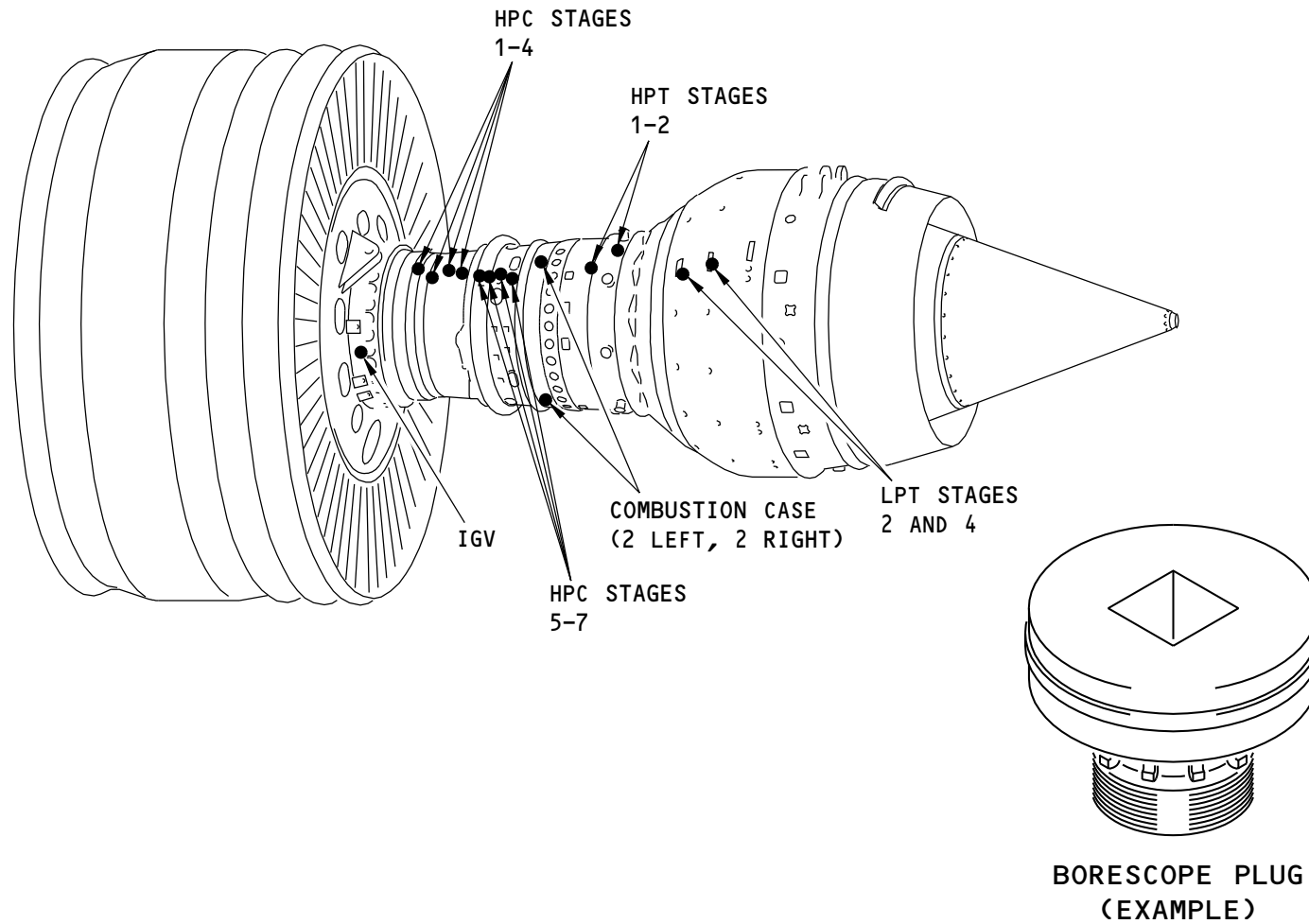
When you do a borescope inspection, use a 30 inch probe for the HPC inlet guide vanes (IGVs) borescope port. Use a 20 inch probe for all other borescope ports.

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ENGINE - BORESCOPE ACCESS PORTS

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