CHAPTER

72

Engine

(LEAP-1B ENGINES)

CHAPTER 72
ENGINE

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

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72-CONTENTS

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ENGINE - INTRODUCTION

Purpose

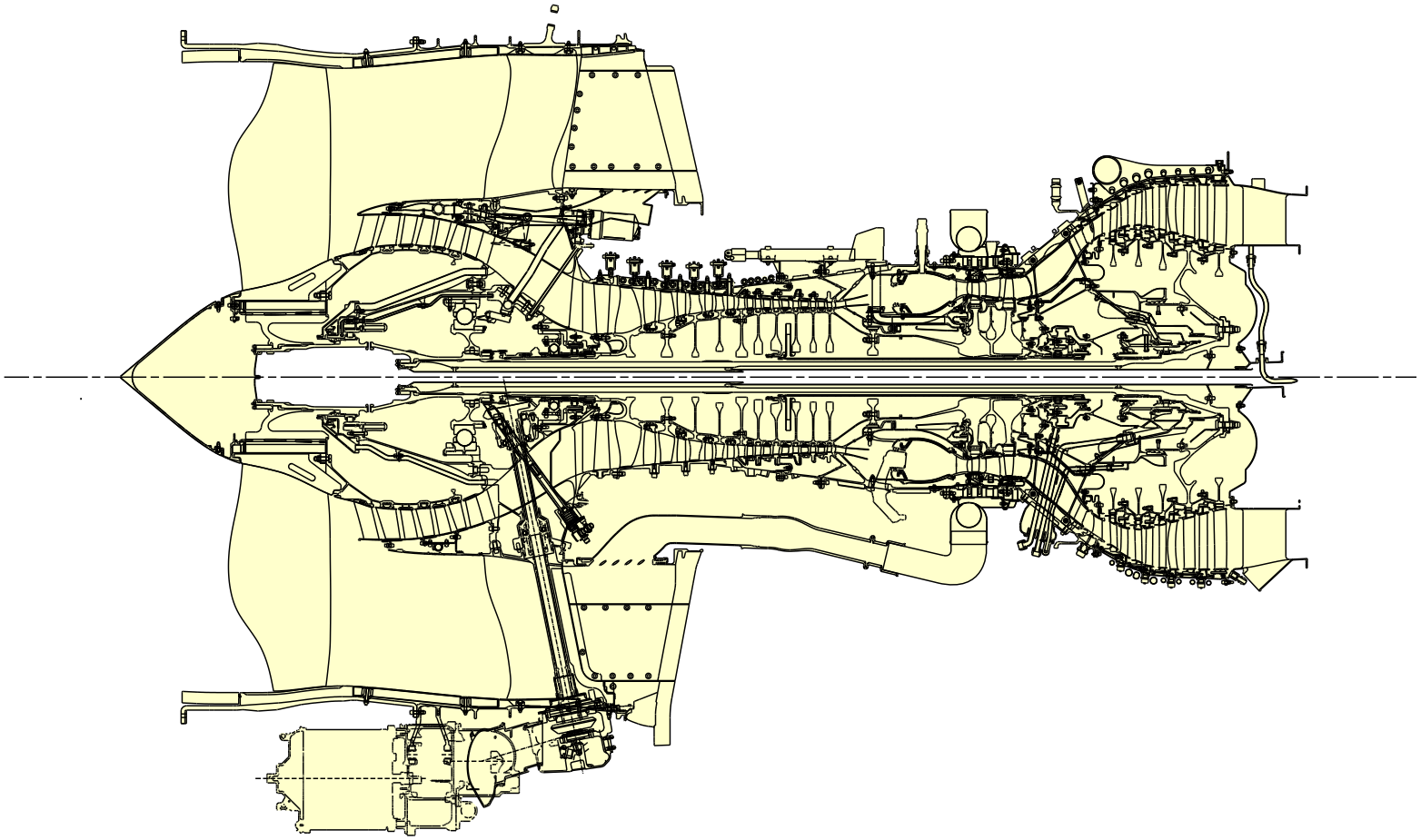
The engines supply thrust to the airplane. The engines also supply power to these airplane systems:

- Electrical
- Hydraulic
- Pneumatic.

Abbreviations and Acronyms

- AGB - accessory gearbox
- ALF - aft looking forward
- BLISK - bladed disk (single component)
- CDP - compressor discharge pressure
- EDP - engine driven pump
- EEC - electronic engine control
- EGT - exhaust gas temperature
- HP - high pressure
- HPC - high pressure compressor
- HPT - high pressure turbine
- IDG - integrated drive generator
- IGB - inlet gear box
- LEAP - leading edge aviation propulsion
- LPC - low pressure compressor
- LPT - low pressure turbine
- MFP - main fuel pump
- OPT - oil pressure and temperature
- P - pressure
- PAS - pneumatic air starter
- PMA - permanent magnet alternator
- RDS - radial drive shaft
- SFD - squeeze film damper
- T - temperature
- TGB - transfer gear box
- TS - transfer shaft.

ENGINE - INTRODUCTION



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ENGINE - INTRODUCTION

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ENGINE - GENERAL DESCRIPTION

General

The LEAP-1B is a high bypass, dual rotor, axial flow turbofan engine. The engine has three major modules; 20 minor modules and an accessory drive module. The engine fan diameter is 69.4 in. (176.3 cm). The bare engine weight is 5830 lb (2644 kg).

The engine has these three major modules:

- The fan major module
- The core major module
- The low pressure turbine major module.

These are some of the minor engine modules:

- Low pressure compressor (LPC)
- High pressure compressor (HPC)
- Combustion section
- High pressure turbine (HPT)
- Low pressure turbine (LPT)
- Accessory drive (The accessory drive section is three minor modules, an inlet gearbox, a transfer gearbox and an accessory gearbox).
- Thrust reverser and exhaust system

The LPC rotor and the LPT rotor are on the same low pressure shaft (N1).

The HPC rotor and the HPT rotor are on the same high pressure shaft (N2).

Low Pressure Compressor (Fan and Booster)

The LPC is a four-stage compressor. The fan is the first stage of compression. The fan increases the speed of the air. The booster is a three-stage compressor. The booster increases the pressure of this air and sends it to the HPC.

The splitter fairing divides the air into these two air flows:

- Primary
- Secondary.

The primary airflow passes through the inner portion of the fan blades and is directed to the booster. Then it enters the HPC and goes to the combustion chamber. Mixed with fuel and ignited, the gas flow produced provides energy to the HPT and to the LPT. The HPT drives the HPC, and the LPT drives the LPC. This airflow produces about 20 percent of the thrust.

The secondary airflow passes through the outer portion of the fan blades and exits through the fan duct. On the ground at take-off, the secondary airflow makes 80 percent of the engine thrust. The secondary airflow is also used by the thrust reverser system.

High Pressure Compressor (HPC)

The HPC is a ten-stage compressor. It increases the pressure of the air from the LPC and sends it to the combustor. The HPC also supplies bleed air for the aircraft pneumatic system and the engine air system.

Combustion Section

The combustion section mixes air from the compressors and fuel from the fuel nozzles. This mixture of air and fuel burns in the combustion chamber to make hot gases. The hot gases go to the HPT.

High Pressure Turbine (HPT)

The HPT is a two-stage turbine. It changes the energy of the hot gases into mechanical energy. The HPT uses the energy from the hot gases to turn the HPC rotor and the accessory drive.

Low Pressure Turbine (LPT)

The LPT is a five-stage turbine. It also changes the energy of the hot gases into mechanical energy. The LPT uses the energy from the hot gases to turn the fan and booster (LPC).

Accessory Drive

The N2 shaft turns the AGB through the accessory drive. The accessory drive has these minor modules and assemblies:

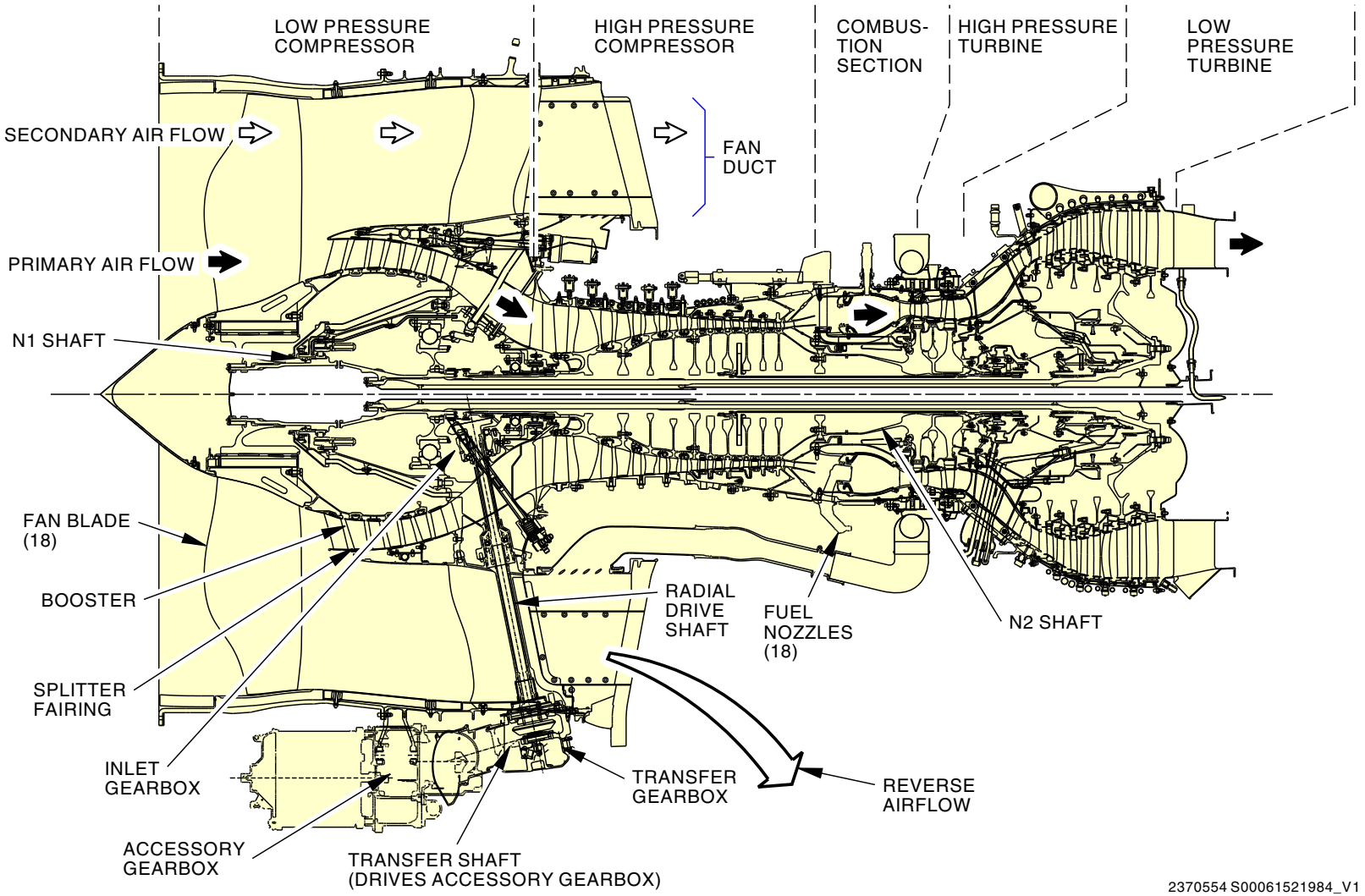
- Inlet gear box (IGB)

- Transfer gear box (TGB)
- Accessory gear box (AGB)
- Number 3 bearing assembly
- Radial drive shaft (RDS)
- Transfer shaft (TS).

Thrust Reverser and Exhaust System

The thrust reverser uses translating sleeves, blocker doors and cascade vanes to change the direction of the fan air exhaust. The exhaust system uses a nozzle and a plug to direct the exhaust gases.

ENGINE - GENERAL DESCRIPTION



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ENGINE - GENERAL DESCRIPTION

ENGINE - MAIN ENGINE BEARINGS

General

Five main engine bearings hold the N1 shaft and the N2 shaft. The bearings are numbered from 1 to 5. The ball bearings absorb the axial (thrust) and radial loads from the shafts. Roller bearings absorb only radial loads.

The main engine bearings are in three oil sumps. The oil sumps are A, B and C from front to rear.

Main Engine Bearings

The A sump has two ball bearings (number 2B and 3B) and two roller bearings (number 1R and 3R).

The B sump has 1 roller bearing (number 4).

The C sump has 1 roller bearing (number 5).

The number 1, 2 and 5 bearings hold the low pressure rotor (N1) .

The number 3 and 4 bearings hold the high pressure rotor (N2).

The number 3 bearing assembly has two bearings, the forward bearing is a ball bearing and the aft bearing is a roller bearing.

Sump Seals

Sump seals prevent oil leaks from the engine sumps.

The front of the A sump is sealed with a segmented radial (carbon) seal (SRS) and a labyrinth seal. An abradable seal upstream of the number 3 bearing seals the middle of the A sump. An SRS seal downstream of the number 3 bearing seals the aft end of the A sump. The A sump is vented to the engine center shaft.

An labyrinth seal upstream and an SRS seal downstream of the number 4 bearing seals the B sump.

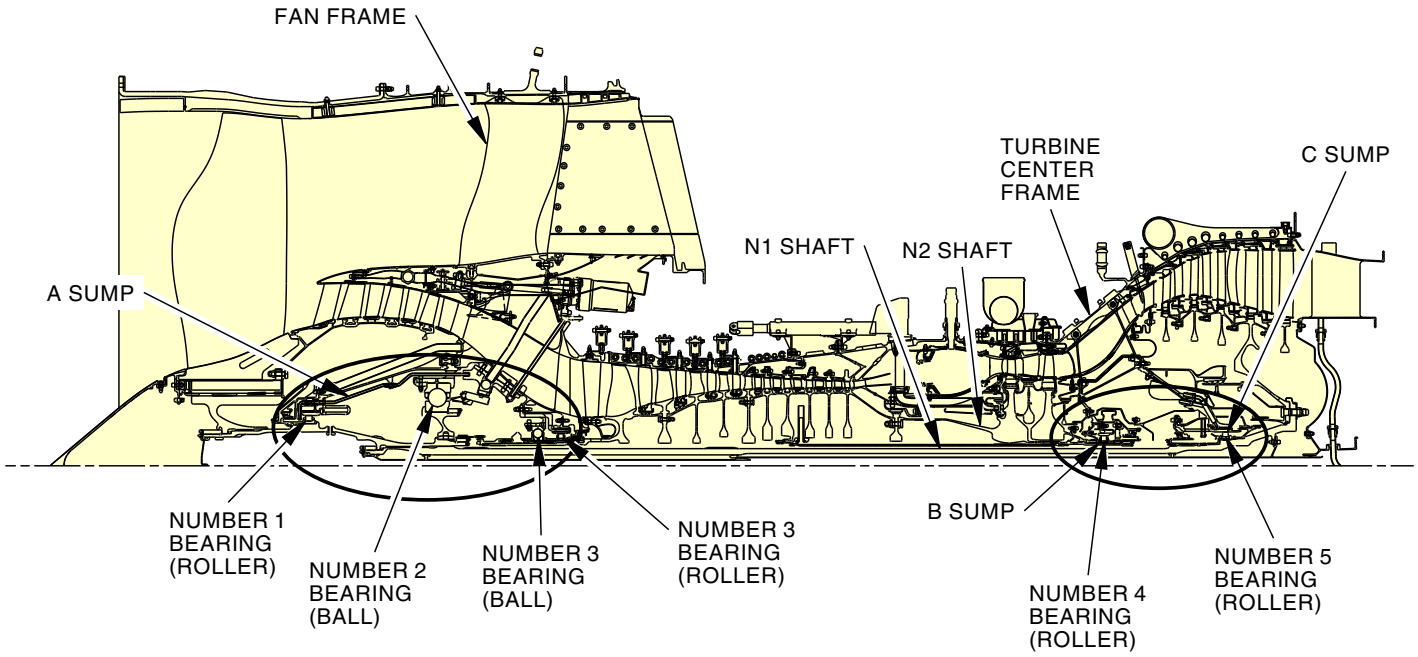
An SRS seal upstream and an labyrinth seal downstream of the number 5 bearing seals the C sump.

The B and C sumps are not vented.

Frames

The fan frame gives support for the number 1, 2 and 3 bearings. The turbine center frame gives support for the number 4 and 5 bearings.

ENGINE - MAIN ENGINE BEARINGS



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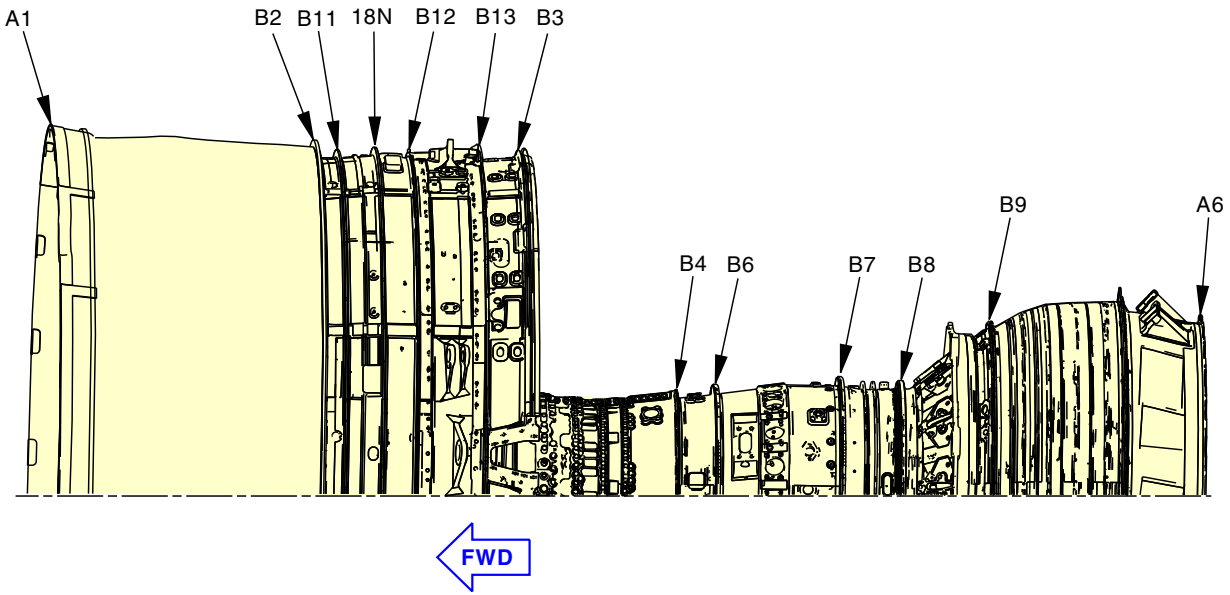
ENGINE - MAIN ENGINE BEARINGS

ENGINE - ENGINE FLANGE LOCATION

General

The engine has 13 flanges. The flanges are identified with an alphanumeric designation. The flanges hold various accessories and components. The alphanumeric designations are used to find the position of components on the engine.

ENGINE - ENGINE FLANGE LOCATION



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ENGINE - ENGINE FLANGE LOCATION

ENGINE - ENGINE AERODYNAMIC STATIONS

General

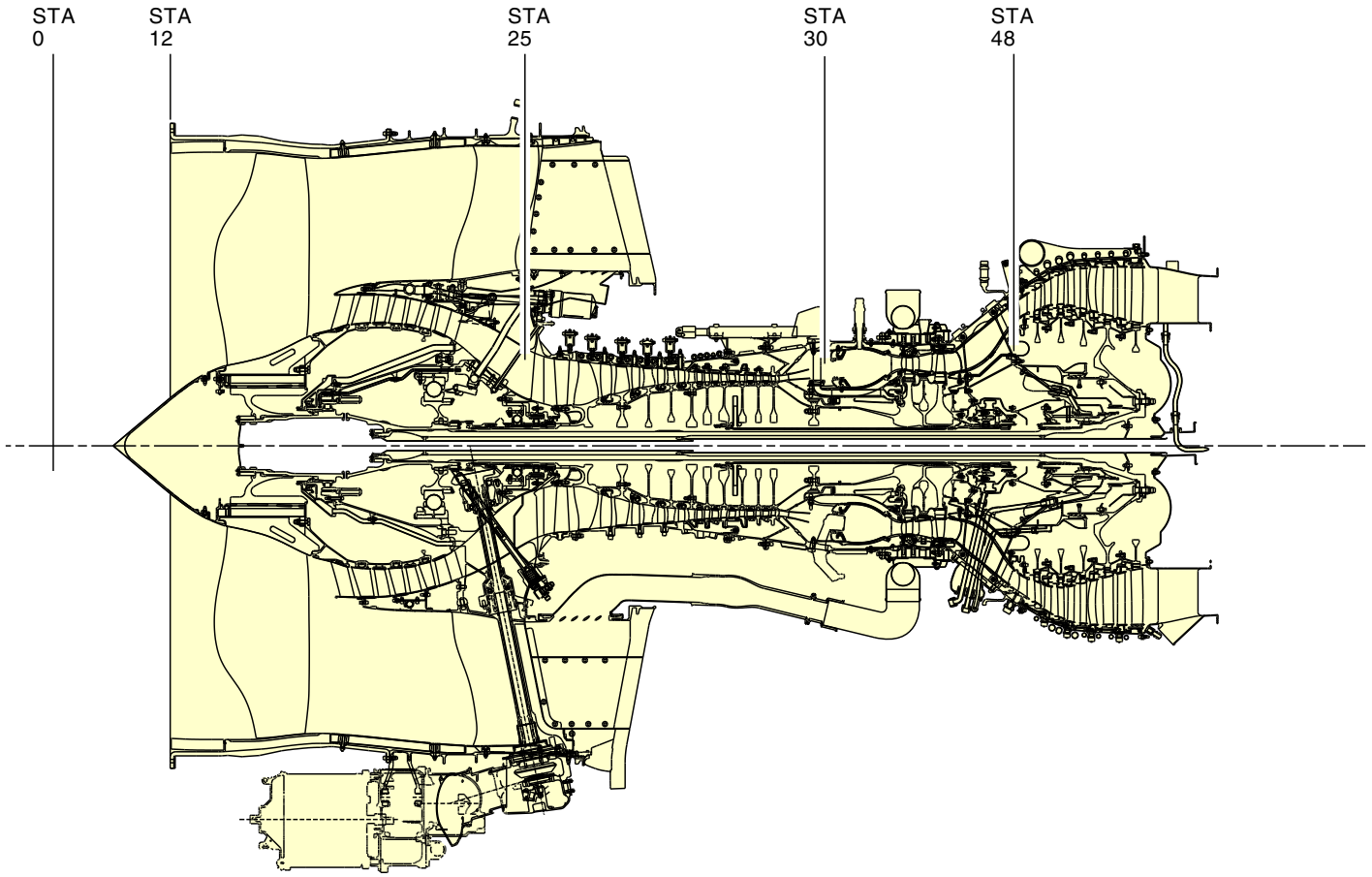
There are probes or sensors at these 5 engine aerodynamic stations:

- Station 0. The P0 sensor on the pressure subsystem (PSS) box measures ambient air pressure
- Station 12. The T12 sensor in the engine inlet measures fan inlet temperature
- Station 25. The T25 sensor measures high pressure compressor inlet temperature
- Station 30. The PS3 and T3 sensors measure high pressure compressor outlet pressure and temperature
- Station 48. The eight T48 (EGT) probes measure temperature at the inlet of the low pressure turbine.

See the engine fuel and control chapter for more information on engine fuel and control. (SECTION 73-00)

See the engine indicating chapter for more information on the probes and sensors. (SECTION 73-21)

ENGINE - ENGINE AERODYNAMIC STATIONS



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ENGINE - ENGINE AERODYNAMIC STATIONS

ENGINE - ACCESSORY DRIVE - COMPONENT LOCATIONS

General

The accessory gearbox (AGB) is on the left side of the engine, on the fan inlet case. The AGB sends torque from the N2 rotor through spur gears to turn the engine and airplane accessories. They are line replaceable units. You get access to the AGB and the accessories when you open the left fan cowl.

Accessories Locations

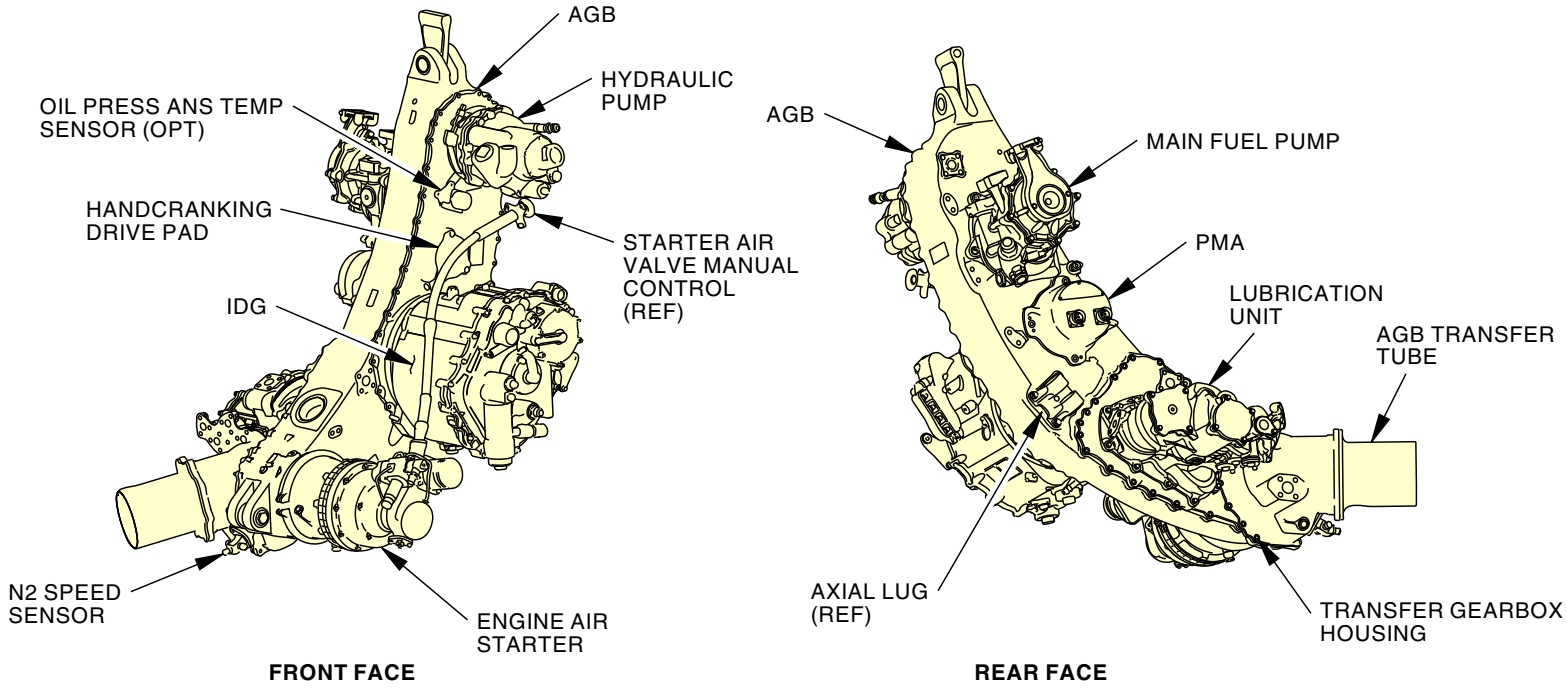
These engine and airplane accessories are on the front face of the AGB:

- Hydraulic pump.
- Oil pressure/temperature sensor (OPT)
- Handcranking drive pad
- Integrated drive generator (IDG)
- Engine air starter
- N2 speed sensor (bottom end of AGB housing next to starter).

These engine accessories are on the rear face of the AGB:

- Main fuel pump
- Permanent magnet alternator (PMA)
- Lubrication unit (includes scavenge screen plugs and oil filter cartridge element)

ENGINE - ACCESSORY DRIVE - COMPONENT LOCATIONS



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ENGINE - ACCESSORY DRIVE - COMPONENT LOCATIONS

ENGINE - FAN BLADES AND FRONT SPINNER CONE

Front Spinner Cone

The front spinner cone is an aerodynamic fairing that gives a smooth surface for airflow to the fan stage. The spinner cone keeps ice build-up to a minimum and decreases noise level. It is an anodized aluminum alloy. The front spinner cone attaches to the platform front shroud with 9 screws.

Fan Blades

There are 18 wide chord composite blades with titanium leading edges. Each blade has a dovetail that goes into a recess on the fan disk. Composite wear strips interface between the fan blade and the fan disk. It is not necessary to lubricate the fan blade root.

Spacers hold each fan blade in the correct radial position. The spacers are made of composite material. They hold the fan blades in the static position. Titanium and honeycomb fan blade locks hold the blades axially. The fan blade locks are at the front of the fan blade root. Platforms are between each fan blade. The removal of the front spinner cone and the platform front shroud is necessary when you remove one or more fan blades.

From the engine inlet, the engine fan blades are numbered in a counterclockwise direction.

This information is engraved on each fan blade:

- Manufacturing S.N. (Bottom of metal leading edge close to fan blade platform - convex suction side)
- Blade Serial number (Top of metal leading edge and on the side of the blade shank - concave pressure side)
- Moment weight (Blade shank - not visible when fan blade platform is installed - concave pressure side).

When you remove or replace fan blades, record the position and the serial number of the blades. That lets you do these tasks:

- Install the blades you removed in the same position to keep the engine in balance
- Calculate the spare blades position and the momentum weight correction when you replace blades.

Balance Weight Screws

Balance procedures for the fan blades use different weight balancing screws installed in the platform front shroud under the spinner.

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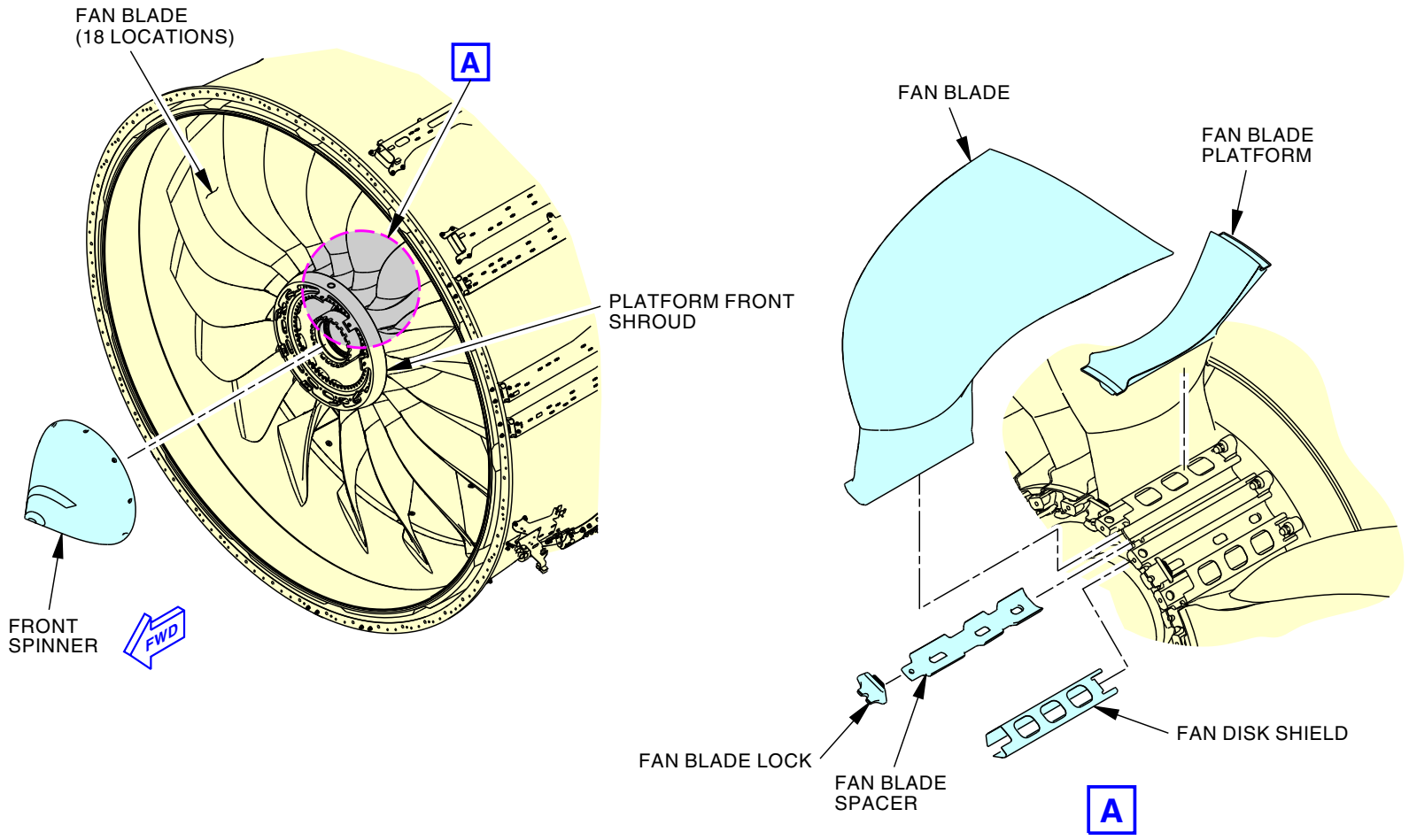
ENGINE - FAN BLADES AND FRONT SPINNER CONE



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ENGINE - FAN BLADES AND FRONT SPINNER CONE