G 550
POWERPLANT

* Permanent Magnet Alternator (PMA)
* * Right Engine = L ESS DC

Diagram showing connections and components of the G 550 powerplant system, including PITOT STATIC, SAT AIRSPEED, ADM, THROTTLE RESOLVER, ELECTRONIC ENGINE CONTROL, CHANNEL A and B, FMU, FUEL, and BR710C4-1I dedicated generator.
Two (2) Rolls-Royce **BR700-710C4-11**

15,385 Lbs Thrust @ Sea Level @ ISA + 15°C

High bypass engines **4.18:1**

**FADEC-controlled**

**Titanium inlet cowling**

**Critical engine:** R engine

AFM - Performance, Section 5.01.10

HP and LP compressor sections are driven by their own coaxial shafts (shaft within a shaft)

High thrust-to-weight ratio | Fuel efficiency | Noise reduction
FADEC SYSTEM

Full Authority Digital Engine Control (FADEC)

The sum of various systems

Data Entry Plug (DEP)

EEC

PMA

Controls and responds to EPR requirements

Pitot Static SAT
Airspeed

ADM

Throttle Resolver

Electronic Engine Control

Channel A Channel B

FMU

Fuel

>35% HP

<35% HP

ESS DC

Dedicated Generator

BR710C4-11

* Permanent Magnet Alternator (PMA)

** Right Engine = ESS DC
Each FADEC is powered by:

1. Initially by respective bus
2. > 35% HP RPM by its own generator

Each engine

controlled by

FADEC

The heart of FADEC

EEC

Powered by

< 35% HP

L ESS DC or R ESS DC

> 35% HP

PMA

Channel A  Channel B

* One active/controlling one back up

FMU

* Fuel control switch: changes channels
FADEC SYSTEM

- Rotor bow avoidance procedure during start if engine has been shutdown:
  > 20 MINUTES < 5 hours

- FADEC provides engine start protection:
  1. On the ground only
  2. ON switch only

- If a FADEC were to fail the engine would flame out

- Controls idle speed (Low Idle x High Idle)

\[ \text{FL}_510 \quad \text{Low Idle (flaps < 22°)} \]

\[ \text{High Idle (flaps > 22°)} \quad \text{FAF} \]

\[ \text{Allows full spool up within 8 seconds} \]

\[ \text{Ground idle} \]

\[ \text{Landing remains high idle after wow + 5 seconds} \]
ELECTRONIC ENGINE CONTROL

A COMPONENT OF THE FADEC SYSTEM AND ITS BRAIN

L ENGINE

R ENGINE

POWERED BY

① ESS DC

② OWN PMA ≥ 35% HP RPM

① ESS DC

② OWN PMA ≥ 35% HP RPM

MAU 1

MAU 2

MAU 3

ADM 1

ADM 2

ADM 3

INPUT

EEC

OUTPUT

MAU 1

MAU 2

MAU 3

FWC 1

FWC 2

CMC
ELECTRONIC ENGINE CONTROL

EEC

Control Modes

Primary Control Mode

Alternate Control Mode

Reverse Thrust Control Mode

Primary Control Mode

EPR

HP RPM (@ idle)

Alternate Control Mode

LP RPM

Reverse Thrust Control Mode

LP RPM

- Independent Overspeed Protection (IOP)

EEC

IOP

1 2

Overspeed?

Yes

No Shutdown

No

No Shutdown

Yes

Yes

Yes

Shut Down

* Both IOP 1 2 channels must agree for EEC to command FMU to shut off fuel to the engine
ENGINE PRESSURE RATIO (EPR)

**RATIO OF THE PRESSURE SENSED AT THE REAR OF THE LOW PRESSURE (LP) TURBINE TO THE PRESSURE OF THE AMBIENT ATMOSPHERE**

\[ EPR = \frac{\text{output}}{\text{input}} \quad \text{FORMULA DOES NOT APPLY TO THE BR710C4-11} \]

**ROTOR BOW**

**ROTOR BOW:** UNEven HEATING of the Rotor due to UNBALANCED ROTOR BAR CURRENT DISTRIBUTION which CAUSES the ROTOR to WARP

**ROTOR BOW:** UNEven COOLING inside the ENGINE

> 20 MINUTES < 5 HOURS =

PEAK HP RPM + 30 SECONDS before FUEL is INTRODUCED via the ENGINE RUN SWITCHES
Engine Ignition

- Two (2) Ignition plugs (3,000V each) per engine
- Normal ground start uses one (1) igniter
- In flight start uses two (2) igniters
- Manual ignition uses two (2) igniters

- Igniters are turned off automatically during an engine start at 42% HP RPM

- The EEC alternates channels and igniters as follows:
  1. EEC Channel A / Igniter 1
  2. EEC Channel B / Igniter 1
  3. EEC Channel A / Igniter 2
  4. EEC Channel B / Igniter 2

Right engine start / Igniter 1 failed

1st Attempt
EEC Channel
Ignition plug
EEC A

2nd Attempt
EEC Channel
Ignition plug
EEC B

3rd Attempt
EEC Channel
Ignition plug
EEC A

- No time limit on the use of continuous ignition
**Engine Ignition**

**Ignition Modes**

1. **Auto Start**
   - Start Master
   - Select Start
   - L ENG R ENG
   - One igniter only
   - EEC: Alternates Channels
   - Fuel Control Switch: Changes igniter plugs

2. **Alternate Start**
   - Crank Master
   - Select Start
   - L ENG R ENG
   - Manually Select CONT IGN

3. **Inclement Weather Mode**
   - T30 probe senses moisture

4. **Auto-Relight Mode**
   - HP, LP or TGT Abnormality

5. **Quick-Restart Mode**
   - Inadvertent Engine Shutdown in Flight
   - Return fuel control to run within 30 seconds
Engine Fuel System

Metered fuel from tanks' boost pumps to fuel spray nozzles. Introduction of fuel is controlled by FADEC.

Low (LP) pressure pump> driven by engines' accessory gearbox.

FCOC extracts heat from HOT oil.

LP pump can suction feed the engine < 20,000'.
Engine Fuel System

- Fuel control switches shut off fuel at the pylon
- Fire handles shut off fuel at the fuel tanks

- Fire handles valve position indicator:

  ![Diagram of valve position indicators]

  - Open
  - Closed

  Wheelwell (Aft Wall)

  Wheelwell

  Crossflow valve
  Inter tank valve
Total Capacity: 21 pints
One (1) Pressure Pump
Four (4) Scavenge Pumps
Max Consumption allowed: 0.42 pints/hour
Normal consumption is 0.1 pints/hour

Engine Oil System

Located and driven by engine's accessory gearbox

Fuel Cooled Oil Cooler

Magnetic Chip Detector

Oil Tank

Oil Pump

Oil Filter

FCOC

Accessory Gearbox

Front Bearing Chamber

Rear Bearing Chamber

(1) Pressure (4) Scavenge Pumps

Engine Oil Servicing

Conventional Gravity

Pressure Filling

Remote Replenishment System
**Engine Limitations**

**Engine Oil Temperature**
- Start: -30°C
- Taxi/Takeoff: +20°C
- Maximum: +160°C

**Engine Fuel Temperature**
- -40°C
- +140°C
- +165°C (15 minutes)

**Engine Start Cycles**
- 3 minutes / 15 seconds
- 3 minutes / 15 seconds
- 3 minutes / 15 minutes

**Engine TGT Temperature**
- 150°C: Introduce fuel
- 700°C: Start (ground)
- 850°C: Start (inflight)
- 900°C: Takeoff (5 minutes)
- 885°C: MCT

**Engine Oil Check**
- 75 < 30 minutes from shutdown
- Last flight of the day
- 24 cumulative hours
Engine Limitations - Start

- Minimum oil temperature: -30°C
- Minimum bleed air pressure: 40Psi
- Maximum TGT < Fuel: +150°C
- Maximum TGT: +700°C

Engine Start Cycle:
- 3 minutes/15 seconds
- 3 minutes/15 seconds
- 3 minutes/15 minutes

Engine Rotor Bow:
- > 20 minutes < 5 hours

Engine - Static Keep Out Zone:
- > 10 seconds
- > 66-80% LP

Automatic Protection:
- Parking brake set
- When in reverse thrust
Engine Limitations - Takeoff

Takeoff in ALT mode (LP) is prohibited

Minimum Oil Temperature for Takeoff: +20°C

Maximum TGT 900°C

5 Minutes ← TO/EA → 10 Minutes

OEI > V1
ENGINE BLEEDS OFF - TAKEOFF

- QRH - ALTERNATE NORMALS
  BLEED OFF TAKEOFF PROCEDURE
  NG-11

- APU BLEED AIR \(1500\) AGL
  1.4 \% gross weight increase
  PERFORMANCE HANDBOOK
  PA-47, NOTE 3

ENGINE LIMITATIONS - TAKEOFF

ENGINE X-WIND TAKEOFF LIMITATION

1. \(\leq 66\%\) LP RPM
2. \(\geq 20\) KTS X-wind
3. Forward speed \(\geq 20\) KTS
4. Slam acceleration to EPR (Rated or Flex) \((\leq 5\) seconds)
   Auto Throttle OK
   \(\times\) Add 600\° to Required Field Length
Engine Limitations - Inflight

Maximum Continuous Thrust (MCT) 885°C TGT

Start Envelope

≤ 25,000'

Starter Assist Windmill Start
≤ 250 KCAS ≥ 251 KCAS

Maximum TGT 850°C

Note: No FADEC Protection

Engine Limitations - Landing

Thrust Reversers

70% LP - 30 Seconds
Idle Reverse by 60 KCAS

Note: It is recommended to operate engines at idle for 8 minutes before shutdown
Do not attempt restart if:
- Fire
- FOD
- Frozen

Restart or not?

Yes:
- Airstart - Automatic
- Airstart - Windmilling
- No FADEC available during start
- Icing conditions

No: Engine shutdown in flight

Engine failure:

1. Open crossflow valve
2. Re-arm E-Batts
BR710C4-11 turns counter clockwise when seen from the front.
Questions, comments or errors?
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Thank you!