2A-71-10: General Arrangement

1. General Description:

(See Figure 1.)

The Gulfstream IV is powered by two Rolls-Royce Tay Mk611-8 engines, each of which is a twin-spool, axial-flow turbofan. The Tay is a high bypass ratio turbofan, designed to achieve optimum fuel efficiency and component reliability, while complying with noise requirements per FAR Part 36 Stage 3, which reflects the same requirements of ICAO Annex 16 Chapter 3.

The Low Pressure (LP) spool consists of a single stage fan and a three stage Intermediate Pressure (IP) compressor driven by a three stage LP turbine. The High Pressure (HP) spool consists of a twelve stage HP compressor driven by a two stage HP turbine.

The combustion section has ten liners that connect together in an annular chamber. In each liner is a fuel spray nozzle that injects a fine spray of fuel into the liner for ignition.

The fan bypass air stream and LP turbine exhaust are mixed in a twelve lobed forced mixer before discharge to atmosphere through a common propelling nozzle.

The engine is started by an air starter motor which rotates the HP compressor shaft.

A. Engine Data:

(1) Ratings (Takeoff At ISA Sea Level, Static):

- Takeoff Thrust — 13,850 lbs.
- Pressure Ratio — 16.0:1
- Bypass Ratio — 3.10:1

(2) Compressors:

- LP compressor — 1 stage (fan)
- IP — 3 stages
- HP — 12 stages with variable inlet guide vanes and a bleed valve

(3) Dimensions:

- Length — 94.7 inches
- Fan Tip Diameter — 44.0 inches
- Basic Weight (Dry) — 3255 lb

(4) 100% Shaft Speeds:

- LP — 8393 RPM
- HP — 12,484 RPM

B. Subsections Within This Section:

This section is divided into the following subsections:

- 2A-71-20: Nacelle Arrangement
- 2A-71-30: Mechanical Accessories

2. Limitations:

A. Primary Parameter Operating Limits:

The following limitations exist for the Tay Mk611-8 engines installed on the Gulfstream IV:

Condition	LP % RPM	HP % RPM	TGT C°	Time Limit
Maximum Ground Starting TGT	—	—	700	Momentary
Maximum Relighting (Airstart) TGT	—	—	780	Momentary
Maximum Takeoff	95.5	99.7	716 - 800	5 Minutes **(1)**
Maximum Go-Around	95.5	99.7	716 - 800	5 Minutes **(1)**
Maximum Continuous **(2)**	95.5	97.5	715	Unrestricted
Minimum Idle Approach	—	67.0	—	Unrestricted
Minimum Ground Idle	—	46.6	—	Unrestricted
Maximum Reverse	—	88.0	695	**(3)**
Maximum Overspeed	98.3	102.6	—	20 Seconds
Maximum Overtemperature	—	—	801 - 820	20 Seconds

NOTE(S):

(1) The use of takeoff thrust on Go-Around rating is limited to five (5) minutes all engines operating or ten (10) minutes in the event of an engine failure.

(2) Maximum continuous power is not recommended for normal flight operations. Continued use of this power setting may result in reduced engine life.

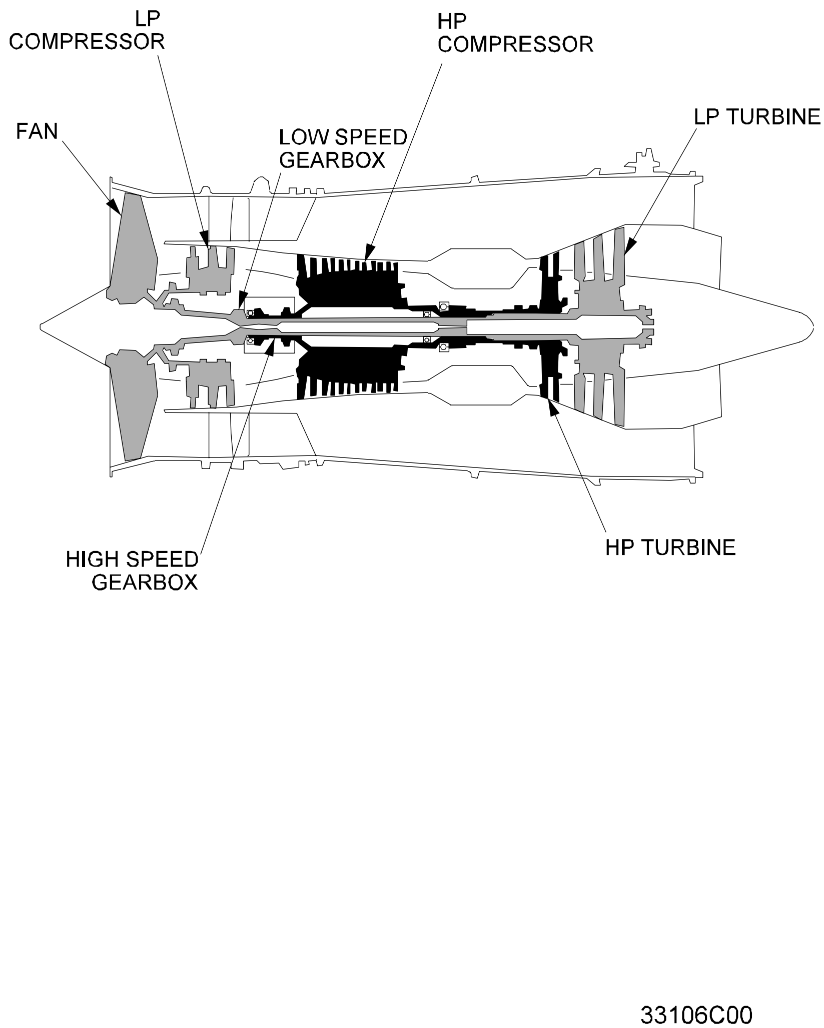
(3) For airplanes SN 1000 thru 1143 without ASC 166: use of thrust reversers is limited to one (1) minute every thirty (30) minutes.

B. Takeoff Power:

For minimum acceptable power settings for takeoff, refer to RATED EPR SETTINGS FOR TAKEOFF THRUST charts in Section 5 of the Airplane Flight Manual. Takeoff EPR must not exceed rated value by more than 0.01.

C. Tailwind Takeoff:

Maximum tailwind component approved for takeoff and landing is 10 knots.



Powerplant General Arrangement
Figure 1

2A-71-20: Nacelle Arrangement

1. **General Description:**

(See Figure 2.)

The nacelle is designed to:

- House the engine in an aerodynamic casing
- Ventilate the interior of the nacelle
- Provide access to engine components for inspection or servicing
- Collect fluids and deliver them overboard
- Collect core and fan air exhaust gases and propel them rearward
- Assist aircraft speed reduction on the ground
- Provide fire detection and protection within the nacelle

Each nacelle incorporates the following subsystems, units and components:

- Nose Cowl Structure
- Upper and Lower Hinged Cowl Doors
- Fixed Cowl Structure
- Aft Cowl Structure
- Engine Fire Protection System

The nacelle assemblies are dedicated to the left-hand (LH) or right-hand (RH) engine installations and are not interchangeable. The principal material of construction in the fixed and hinged cowling is honeycomb light alloy, except for a steel section of panel assembly outer skin adjacent to the pylon. The nose cowl structure is basically aluminum alloy, with an aft steel bulkhead forming engine forward of the fireshield. The thrust reverser doors and aft cap (aft portion of fairing) are steel construction with the rest of the thrust reverser fairing being of aluminum alloy.

2. **Description of Subsystems, Units and Components:**

A. **Nose Cowl Structure:**

(See Figure 3.)

The nose cowl assembly is mounted to the engine air intake casing and forms an annular duct where air is admitted to engine compressors. The structure consists of an inner and outer skin supported by frames. The nose cowl has a piccolo tube mounted inside where hot air is admitted through a series of holes directly from a tap off the engine bleed air manifold for anti-icing purposes. This air is exhausted through holes on the inside of the cowl leading edge to engine air intake. An air inlet scoop is located on the underside of the inlet cowl for alternator cooling purposes. See Section 2A-30-30, Cowl Anti-Ice System, for nose cowl anti-icing.

B. **Upper and Lower Hinged Cowl Doors:**

(See Figure 4.)

(1) General:

The hinged cowlings consist of upper and lower main access doors, hinged at the upper and lower edges of the fixed cowl respectively. When closed, the doors are secured together with tension latches at the outboard horizontal centerline of the nacelle. Adjustable jury strut rods stowed inside the doors are used to secure the doors in the open position for engine accessibility.

(a) Opening of upper and lower cowl doors:

NOTE:

Do not attempt to open the engine cowling if wind speed is 60 mph or greater. Use extreme care when opening the cowling above 30 mph.

Due to the mechanical arrangement of the upper and lower cowl doors, the lower cowl door is to be opened first. There are five tension latches securing the lower door to the upper door and are numbered 1 (forward) thru 5 (aft). In addition to these latches, there are also two safety latches; which are both located at 6 o'clock positions at the forward and aft ends of the lower door.

Any time cowl doors are open, ensure doors are secured with front and rear hold open struts. This will allow for utilization of the lower door as a maintenance platform as well as prevent damage to the door and/or fuselage due to high winds or jet blast.

If opening the lower cowl door outside of the hangar and upper cowl door is not to be opened, use a suitable tying device with at least 650 lb tensile strength (no bungee or other stretchable cord) to secure upper door in the closed position. High winds can cause damage to upper door and surrounding structures if it is not properly secured in this manner.

- Ensure area immediately surrounding the upper and lower cowl doors is clear to allow opening of upper and lower cowl doors.
- Position a maintenance platform (adjustable preferred) adjacent to cowl doors. Allow enough vertical and horizontal spacing to prevent the door from contacting the platform.
- Using a flat blade screwdriver or another suitable device, unlatch forward and aft safety latches.
- Depress button on each tension latch and pull firmly to unlock the latches. Do so in the following sequence: No. 1, 2, 4 and 5.
- Lift each of these four latches and secure the safety hooks in theirlocking clips.
- Supporting the weight of lower cowl door, unlatch the remaining No. 3 tension latch and secure its safety hook in holding clip.
- Carefully lower cowl door to the open position.
- Insert the forward and aft jury struts and lock them to

the full open position.

- Raise maintenance platform to the approximate vicinity to bottom of the upper cowl door.
- Raise the upper door, insert the forward and aft jury struts and lock them to the full open position.

(b) Closing of upper and lower cowl doors:

NOTE:

If upper cowl door was not opened and is secured to the closed position, remove the securing device at this time.

- Inspect the area inside and outside of the cowl doors to ensure area is clear of tools, maintenance equipment and other objects.
- Manually support upper cowl door. Release and stow front and rear jury struts.
- Lower upper cowl door to the closed position.
- Lower adjustable platform to a suitable height to allow access and clearance of lower cowl door.
- Manually support lower cowl door. Release and stow front and rear jury struts.
- Raise and support lower cowl door in the closed position and push button on each tension latch to disengage safety hooks in the locking clips.
- Engage and lock lower cowl door to upper cowl door with the No. 3 tension lock by applying firm overcenter pressure.
- Engage and lock the remaining four tension latches in the following order: No. 4, 5, 2 and 1 in a similar manner.
- Verify each of the five latches (and button within that latch) is flush and locked.
- Latch forward and aft safety latches at under side of lower cowl.
- Remove maintenance platform from adjacent area.

(2) Access Doors:

Three access doors are located in lower main door:

- One for engine oil sight gage and oil refill
- One for starter manual shutoff valve
- One for fire access (push to open)

Exhaust ports on lower door include an alternate cooling outlet, a nacelle vent and an LP exhaust air outlet.

C. Fixed Cowl Structure:

(See Figure 5.)

The fixed cowl is attached to the nose cowl and thrust reverser housing. It provides for attachment of upper and lower hinged cowlings. Openings and fluid fittings are also provided for services to and from power plant (such as bleed air duct openings, hydraulic fluid and fuel fittings, etc.).

The engine fire extinguishing distribution nozzles and two of the three engine fire detection elements are fitted at lower portion of fixed cowl.

An access panel is located in the upper forward portion of right hand fixed cowl for anti-ice manual override access.

D. Aft Cowl Structure:

(See Figure 6.)

The aft cowl structure includes the exhaust nozzle and thrust reverser actuator and linkage. It consists of a forward fairing (fixed), an outboard stang beam fairing, an inboard scoop fairing and upper and lower thrust reverser doors.

E. Engine Fire Protection System:

See Section 2A-26-00, Fire Protection, for details on engine fire protection components.

3. Limitations:

A. Flight Manual Limitations:

There are no Flight Manual limitations established for the nacelle at the time of this revision.

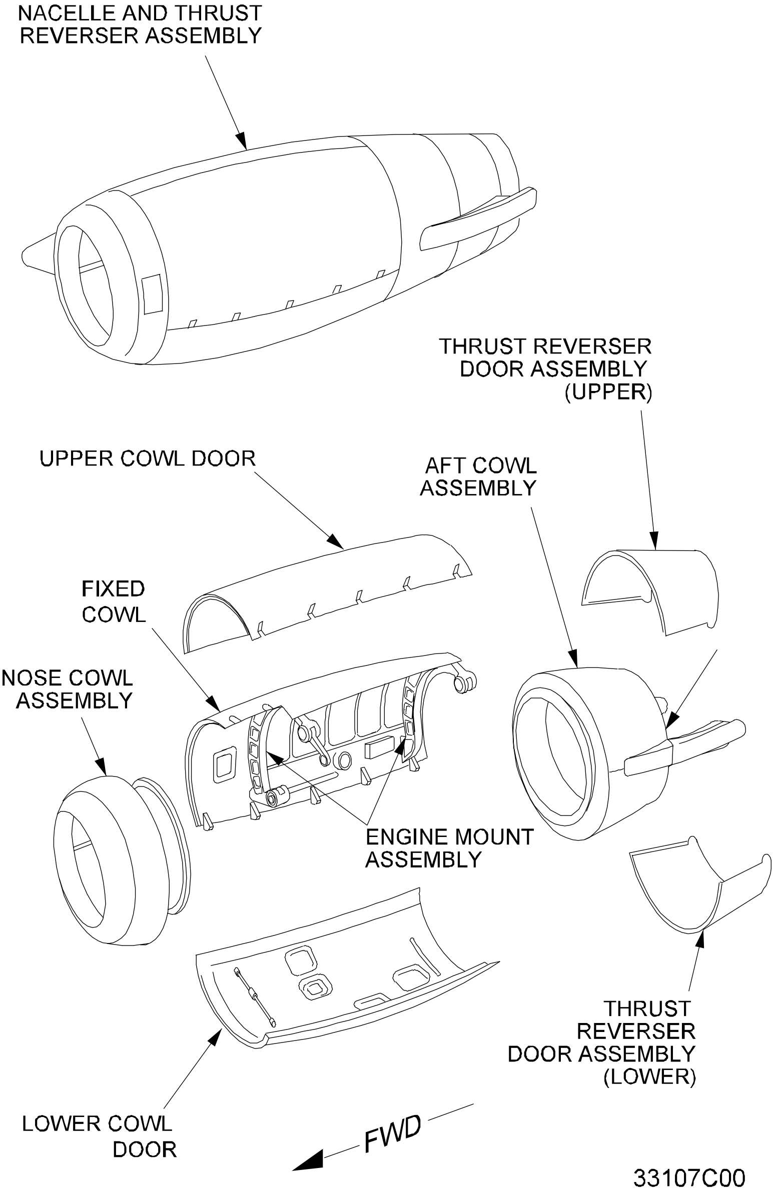
B. Other Limitations:

(1) **Lower Cowl Door Weight Limit:**

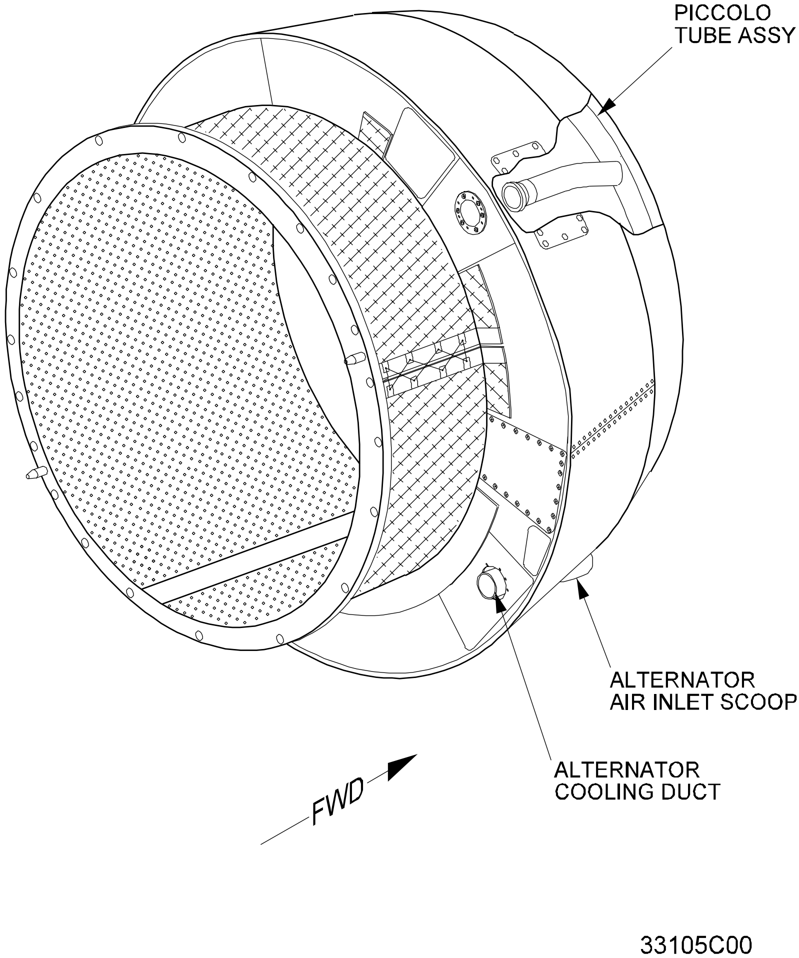
The lower cowl door is designed to support the weight of up to two persons of average weight and a small tool box.

(2) **Maximum Wind Velocity With Cowl Doors Open:**

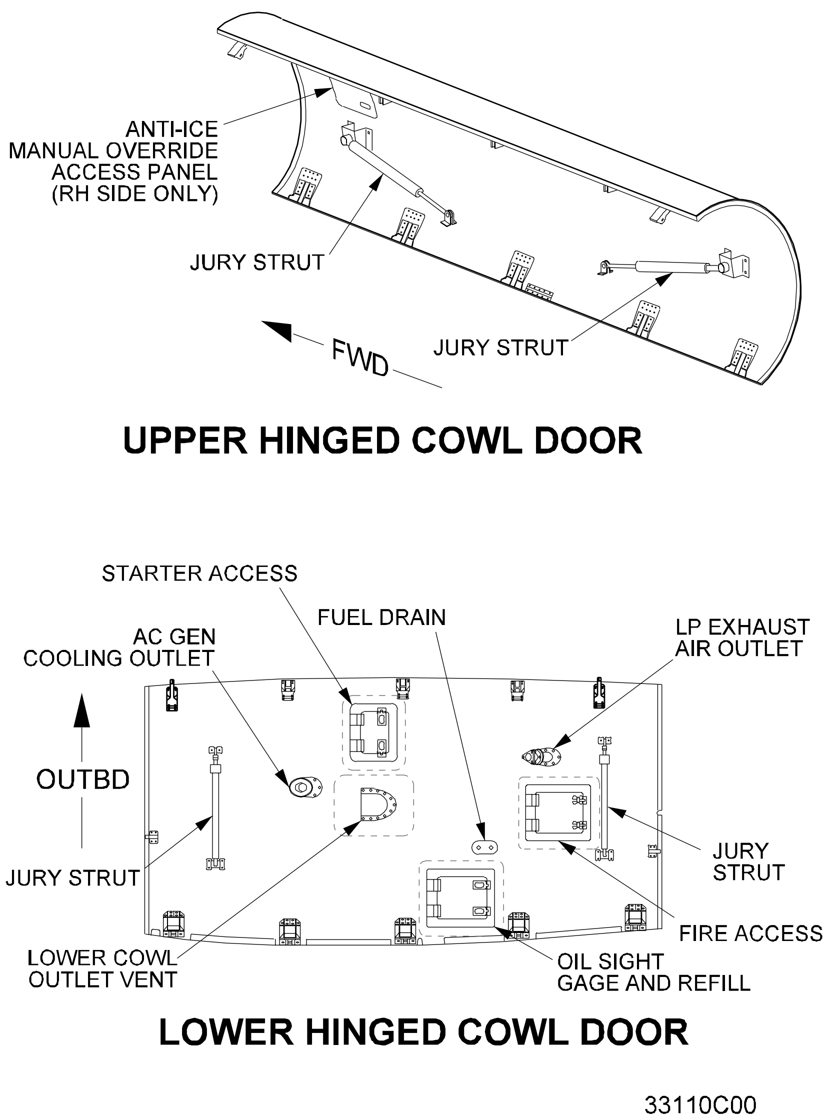
Open cowl doors are designed to withstand wind speeds of up to sixty (60) knots when properly secured with front and rear jury struts in the extended and locked position.



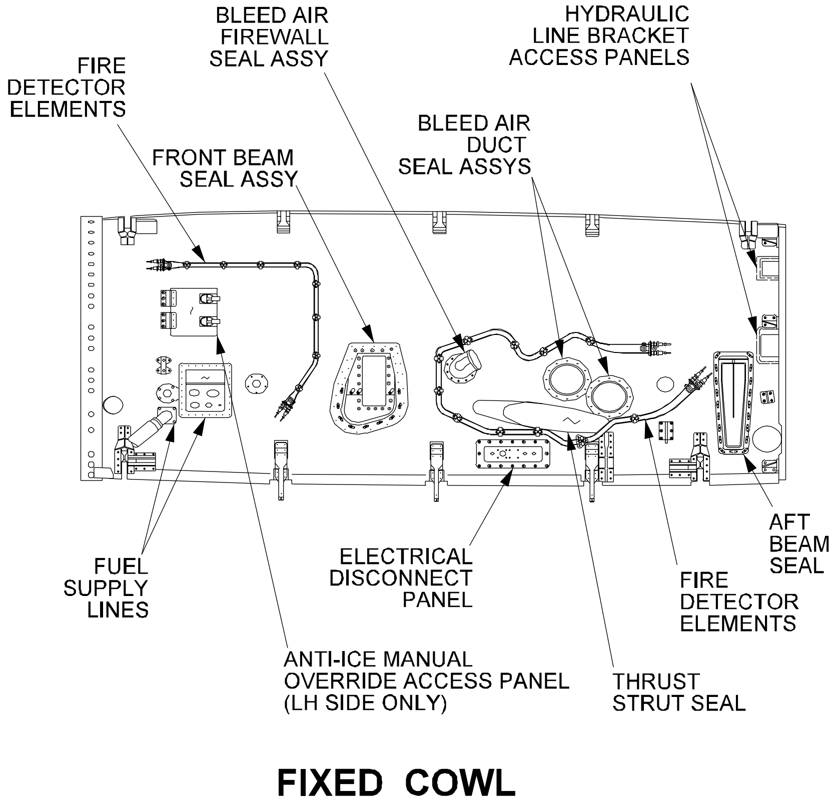
Nacelle Components
Figure 2



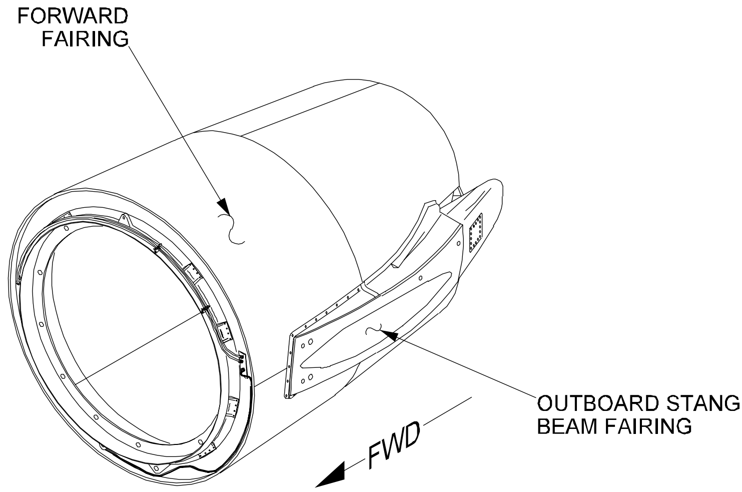
Nose Cowl Structure
Figure 3



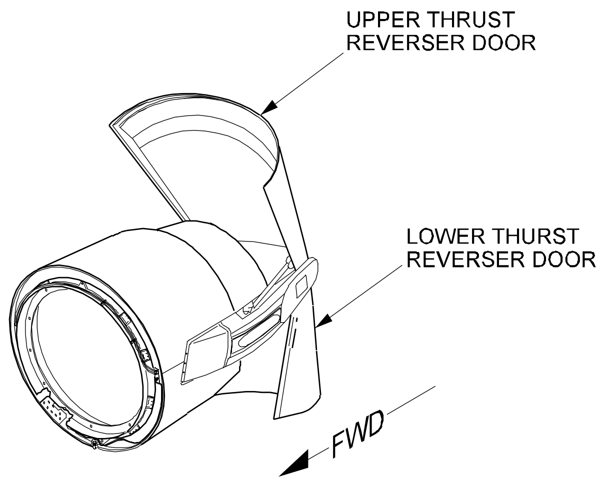
Upper and Lower Hinged Cowl Doors
Figure 4



Fixed Cowl Structure
Figure 5



AFT COWL (THRUST REVERSERS STOWED)



AFT COWL (THRUST REVERSERS DEPLOYED)

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Aft Cowl Structure
Figure 6

2A-71-30: Mechanical Accessories

1. General Description:

The purpose of the Mechanical Accessories system is to provide services for the engine and aircraft not directly related to thrust production. An internal gearbox between the LP and HP compressors acts as a power takeoff to drive the external low-speed (LP) and high-speed (HP) gearboxes. The gearbox drive housing contains the front and rear LP compressor shaft bearings and the HP compressor shaft front bearing.

A series of gears within the gearbox transmit LP and HP compressor shaft torque to a pair of driveshafts. These driveshafts extend through the engine's immediate compressor case to drive their respective external gearbox. The LP compressor drives the low-speed gearbox and the HP compressor drives the high-speed gearbox.

A. Aircraft Service Bleeds:

- Environmental Control System (ECS)
- Wing Anti-Icing
- Crossbleed Starting
- Precooling of Air for Aircraft Systems

B. Engine Handling Bleeds:

- Cowl Anti-Icing
- Engine Stability, Surge Recovery and Flameout Protection

C. Accessory Gearbox:

- Power for Gearbox-Mounted Accessories
- Power for Starting and Cranking

2. Description of Subsystems, Units and Components:

A. Aircraft Service Bleeds:

(1) General:

During normal operations, engine compressor bleed air entering each system (left or right engine) is primarily extracted through the mid-stage (7th stage) check valve. When required (mid-stage pressures too low), mid-stage bleed air is assisted by high-stage (12th stage) bleed air by either augmenting (adding to) mid-stage airflow or by complete mid-stage to high-stage switching (12th stage taking over all pneumatic functions).

(2) Environmental Control System (ECS):

The environmental control system provides for pressurization, heating, cooling, ventilation and the means for reduction of humidity in flight or on the ground. True air conditioning is classified as heating or cooling as necessary to maintain a specific level of temperature within the occupied areas of the aircraft, regardless of the ambient temperatures or the operating conditions. Pressurization is the control over the pressure within the occupied areas.

(3) Wing Anti-Icing:

The wing anti-ice system consists of a leading edge which is fed by a perforated duct called a piccolo tube. An open air space in the leading edge forms a passage for hot bleed air. The bleed air prevents formation of ice on the wing leading edges. Bleed air tapped from the bleed air manifold flows to the wing leading edges, via anti-ice valves, wing anti-ice ducts and piccolo tubes when the system is in operation.

(4) Crossbleed Starting:

After starting one engine from either APU or an external air supply, the other engine may be started by crossbleeding air from the running engine. Power is advanced on the running engine to achieve a minimum of 25 to 30 PSIG on the bleed air pressure indicator or ENGINE START synoptic page and the remaining normal start procedures are used. Upon completion of crossbleed starting, the engine is returned to idle.

(5) Precooling of Air for Aircraft Systems:

From the bleed air pressure regulator and shutoff valve outlet, regulated bleed air passes through the bleed air precooler heat exchanger located in the pylon of the aircraft, where it is cooled by fan air from the engine. Precooler bleed discharge temperature is controlled to a nominal 400° F by a transfer of heat to the cooler and lower pressure engine fan air that flows through the cooling air passages of the precooler heat exchanger. The cooling air is ducted overboard through the louvers in the lower surface of the engine pylon.

Bleed air from the bleed air precooler heat exchanger outlet enters the crossover manifold ducting in the tail compartment with its temperature and pressure controlled to 400° F and 40 PSIG (for most conditions). The crossover manifold is tapped to distribute bleed air to the various systems.

B. Engine Handling Bleeds:

(1) Cowl Anti-Icing:

The nose cowl assembly mounted on the engine air intake consists of a piccolo tube mounted inside where air is admitted directly from a tap off of the engine bleed air manifold. For anti-icing purposes, hot air is supplied to the nose cowl leading edge duct (top of cowl) and piccolo tube by a feed pipe coming from the bleed air manifold. A series of holes in the piccolo assembly allows hot air to flow around the insides of the nose cowl. This air is exhausted through holes on the inside of the cowl leading edge to the engine air intake.

The anti-icing air supply is controlled by a shutoff and pressure regulating valve, mounted on each engine. The valve in turn, is controlled by an ON-OFF switch, one for each side, located on the cockpit overhead panel and labeled L COWL and R COWL.

NOTE:

Ice accumulation on the front of the engine fan and spinner can disrupt and restrict airflow into the engine. Large build ups of ice could increase the risk of structural and impact damage. The fan spinner uses a soft rubber point that distorts during engine operation to ensure ice accretion is shed centrifugally before it builds up. The fan blades use centrifugal force to shed ice and prevent accumulation during operation. This use of centrifugal force is known as the passive form of ice protection.

(2) Engine Stability, Surge Recovery and Flameout Protection:

The HP compressor control system allows for the stability of airflow in all ranges of RPM through the use of Variable Inlet Guide Vanes (VIGV's), a 7th stage bleed air valve and the Airflow Control Regulator (AFCR). The VIGV's and the 7th stage bleed air valve are operated together by the AFCR, which operates in response to input based on HP compressor inlet temperature and HP rpm.

At a low RPM, the VIGV's are at their maximum or "closed" angle (relative to engine airflow). The bleed valve, which is in the open position at this time, allows the bleed air to escape into the bypass duct and exit the engine through the fan air exhaust.

As engine RPM increases (approximately 70 to 80% HP RPM), the AFCR initiates movement of the VIGV's toward their "open" position, creating a minimized airflow angle of attack and closes the bleed air valve. Closing the valve channels 7th stage bleed air into the manifold the surrounds the HP compressor case. The VIGV's increase the angle of incidence (with decreased airflow) on the front stage of the HP compressor as engine RPM decreases. This prevents the flow of air back towards the front of the compressor which can create blade stall and compressor surge, as a result of the unstable airflow.

C. Accessory Gearbox:

(See Figure 8.)

(1) Low-Speed Gearbox:

Also referred to as the left gearbox, it is not considered a module and is mounted on the left side of the Intermediate Pressure Compressor (IPC) case. The gearbox is driven by the LP spool through the intermediate gearbox and has mounting provisions for the following:

- LP Shaft Governor
- LP Tach Generator

(2) High-Speed Gearbox:

Also referred to as the right gearbox, it is mounted on the lower right side of the IPC case. The gearbox is driven by a shaft from the internal gearbox located between the IP and HP compressors and transfers power from the HP spool to the gearbox. It has mounting provisions for the following:

- Engine Alternator
- Centrifugal Breather Outlet
- Hydraulic Pumps
- LP Fuel Pump
- HP Fuel Pump
- HP RPM Tach Generator
- Fuel Flow Regulator
- Starter Motor
- Airflow Control Signal Transmitter

(3) Power For Starting And Cranking:

The high-speed gearbox transmits power from the starter motor to the engine during normal start/crank procedures.

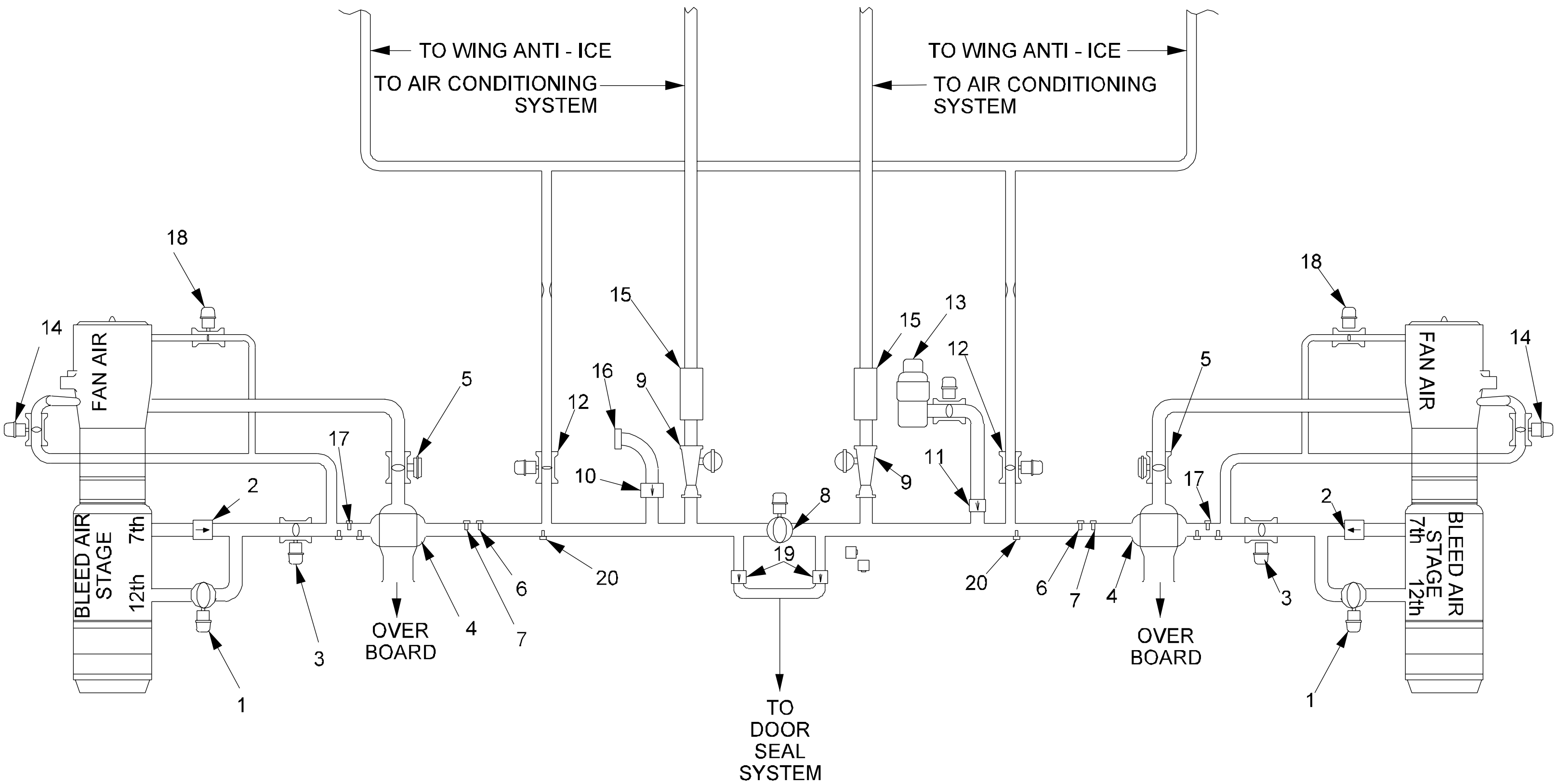
3. Controls and Indications:

The Mechanical Accessories system has no controls and indications as a stand-alone system. See the following sections for specific controls and indications:

- Section 2A-21-00, Air Conditioning
- Section 2A-30-00, Ice and Rain Protection
- Section 2A-36-00, Pneumatics
- Section 2A-80-00, Engine Starting

4. Limitations:

There are no limitations established for the Mechanical Accessories system at the time of this revision.



ITEM NO	DESCRIPTION	ITEM NO	DESCRIPTION
1	HP BLEED AIR PRESSURE REG & S/O VALVE	11	AUX POWER UNIT AIR CHECK VALVE
2	LP BLEED AIR CHECK VALVE	12	WING ANTI-ICE PRESSURE REG S/O & TEMPERATURE CONTROL VALVE
3	BLEED AIR PRESSURE REG & S/O VALVE	13	AUXILIARY POWER UNIT (APU)
4	BLEED AIR PRECOOLER HEAT EXCHANGER	14	AIR TURBINE STARTER & BLEED CONTROL VALVE
5	AIR MODULATING PRECOOLER FAN VALVE	15	CABIN/COCKPIT OZONE FILTER
6	PRECOOLER OUTLET TEMPERATURE SENSOR	16	EXTERNAL AIR FILTER
7	PRECOOLER TEMPERATURE CONTROL ANTICIPATOR SENSOR	17	COWL ANTI-ICE DUCT OVERHEAT (675 F) SWITCH
8	BLEED AIR ISOLATION S/O VALVE	18	COWL ANTI-ICE PRESSURE REGULATOR & SHUTOFF VALVE
9	AIR CONDITIONING SYSTEM SHUTOFF & FLOW CONTROL VALVE	19	CHECK BLEED AIR DOOR SEAL SYSTEM VALVE
10	EXTERNAL AIR CHECK VALVE	20	BLEED AIR OVERTEMP°(550 F) SWITCH

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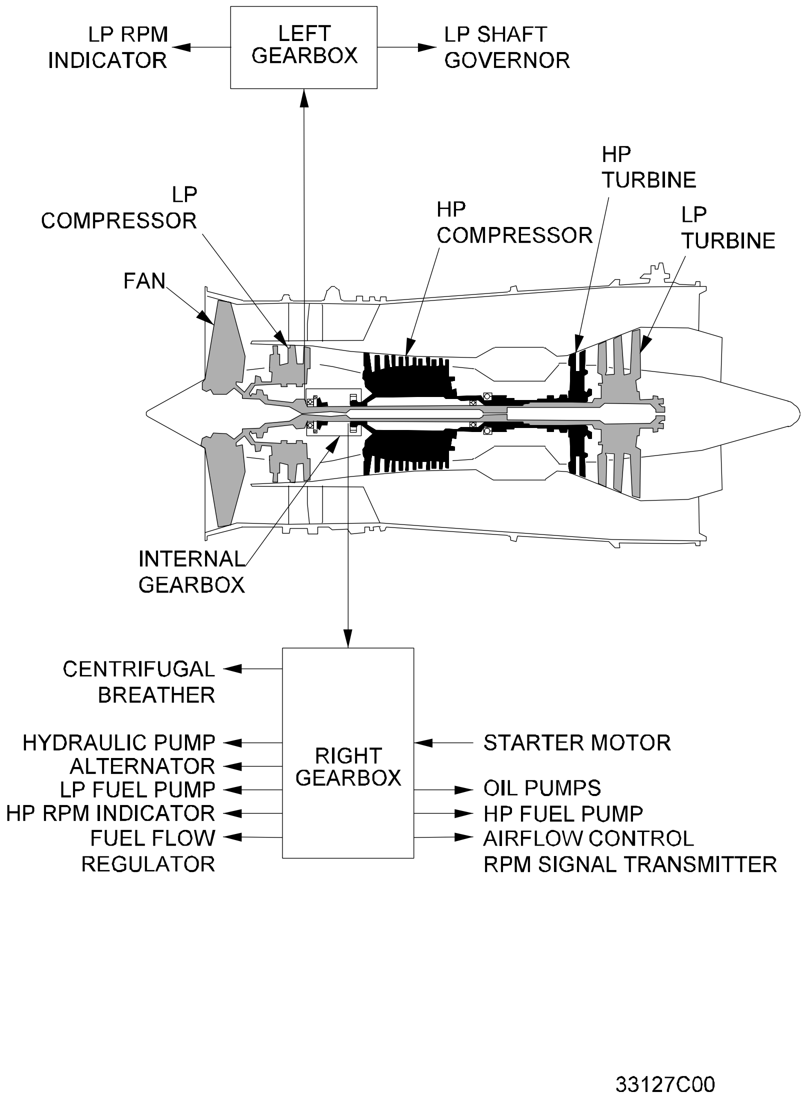
Bleeds System Simplified
Block Diagram
Figure 7



Accessory Gearbox Layout
Figure 8

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